
18th HELLENIC FORESTRY CONGRESS
Hellenic Forestry facing major challenges
& International Workshop
Information Technology, Sustainable Development, Scientific Network & Nature Protection
100 YEARS OF FORESTRY (1917-2017)
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Department of Forestry Pella
FORESTRY OF EDESSA - FORESTRY OF PELLA
REGION OF CENTRAL MACEDONIA
ΠΕΡΙΦΕΡΕΙΑΚΗ ΕΝΟΤΗΤΑ ΠΕΛΑΑΣ
Δήμος Έδεσσας
ARISTOTLE UNIVERSITY OF THESSALONIKI
FACULTY OF AGRICULTURE, FORESTRY AND NATURAL ENVIRONMENT
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PROCEEDINGS

18th Hellenic Forestry Congress

«Hellenic Forestry facing major challenges: sustainable forest management, forest cadaster, environmental technologies-networking and nature protection»

&

International Workshop

"Information Technology, Sustainable Development, Scientific Network & Nature Protection"

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Varosi

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Welcomings

Dr Nikolaos S. Grigoriadis

President of Hellenic Forestry Society (HFS) & Organizing Committee, Senior Researcher at Hellenic Agricultural Organization – Demeter/Forest Research Institute Thessaloniki

Dear members of HFS, dear colleagues, honorable invited participants,

on behalf of the Greek Forestry Society and the Organizing Committee of the 18th Pan-Hellenic Forestry Conference & the International Conference I welcome you to the beautiful Edessa! I welcome you to Pella, the home of Alexander the Great, to the "balcony of God" according to our writer Lountemis!

I also wish to express our pleasure that you are with us today and of course you a warm welcome for our foreign delegates and I wish them a good stay!

The 18th Hellenic Forestry Congress has as title: **"Greek Forestry facing major challenges: sustainable forest management, forest cadaster, environmental technologies-networking and protection of the natural environment"**, while at the same time it hosts the International Workshop titled: **"Information Technology, Sustainable Development , Networks & Nature Protection "** in collaboration with the Department of Forestry and Natural Environment (AUTH), which this year celebrates its 100 years of operation.

As we know, forest ecosystems are the backbone of the natural terrestrial ecosystems of the planet and hence of our country. They constitute an important part of the landscape and at the same time a "home" for man and many other living beings. They also perform many interconnected social, economic and environmental functions - offering jobs, income and raw materials, and a number of important productive activities can be developed. But they also offer other invaluable services related to soil protection, infrastructure, freshwater diet, forest recreation, education, conservation of forest biodiversity, and a positive contribution to the upcoming climate change. However, today the forests and modern Greek Forestry face many challenges, many of which are discussed by the two invited speakers and the participants (Greeks and foreigners).

At this Hellenic Congress & International Workshop as Forester and Nature Scientists, we aim to better understand the importance of forest ecosystems, especially the modern

challenges our industry and science knows. This is a double celebration, where we will happily enjoy a journey into knowledge and experience together with the opportunities for acquaintance with each other and with the place that this time hosts the Congress, the beautiful city of Edessa (Pella). I point out in advance the importance of the area as a cross-border area with the emphasis on the protection of forest biodiversity (Natura 2000 network etc) in the north part and sustainable primary production in the south, always focusing on the use of natural resources, proof for that the available water resources, the sustainable rural development and the permanent historical presence of man!

Honorary presenters of this congress, apart from its meaning full choices, such as synergies with other environmental actors, for example with the Educational Center of Edessa-Giannitsa, to restrict the plastic bag, are to address important issues of forest science through two thematic round tables (one in Greek / HFS sessions and one in English / workshop session). Also, this year we celebrate the 100th anniversary of the Department of Forestry of the Aristotle University of Thessaloniki (1917-2017) with the first invited speaker, the President of the Department of Forestry and Natural Environment of the Aristotle University of Thessaloniki, Professor Theochari Zaga and second guest speaker of the professor of the University of Freiburg, Mr Juergen Huss. Finally, we wish to commend two people who were distinguished for their significant contribution to the case of the Forest and Natural Environment in our country, Mr. Apatsidis Lazaros from the forestry area and Mr. Decleris Michael from the field of justice.

Organizationally, it is worth mentioning that the 18th Hellenic Forestry Congress & International Workshop have the honor of being under the auspices of three of our top institutions, the Hellenic Parliament, Ministry of Environment and Energy and the Ministry of Rural Development & Food. Finally, on behalf of O.C. I wish to express my warm thanks to the co-organizers, supporters, sponsors and all the partners of this event.

Again I thank you very much for your presence.

Sokratis Famellos

Assistant Minister of Environment and Energy

Dear friends,

It is a great honor for me to open the 18th Pan-Hellenic Forestry Conference and International Workshop. The year 2017 has undoubtedly been a year in which the issue of the "Forest Maps" (Greek forest survey) has highlighted the value of forest policy and science, and provides us the opportunity to share thoughts and concerns with foresters.

It is our common goal to complete successfully the forest surveying process; it is a bet that we set together and together we are running it all these months. The forest survey is a very powerful tool of the State for the sustainable use of Greece's resources, but also for addressing social, environmental and climate challenges and environmental protection/conservation.

Especially for the future challenges, Greece should be ready so to respond dynamically. Forests and wooded lands should have a crucial role in the next period in order to address the national productive reconstruction goal and we should equip ourselves for this purpose. We should learn from examples deriving from past or from traditional uses in order to reinforce old practices with new technological and scientific resources aiming at sustainability. The first step to this direction was the Common Ministerial Decision on the grazing management plan standards, in which the roles of each manager and competent authority were clearly clarified for the benefit of the environment and the society.

Moreover, for many years our country has been functioning in a fragmented way at the environmental sector, and mainly operated when there was a need to bring a crisis under control; it never acted preventively. For sure, the sustainable development and future planning are an issue. We spend multiple resources to guard public wealth and national biodiversity and we witness that effort each summer during forest fires. At the same time, we degraded as a country our GDP, the primary sector and the forest production. Our scope is to fight to change this mindset. We want the Public Sector in general and the Forest Service specifically to be a forerunner. Our recent decisions and legal circulars on forest fires are on the axis of protection - prevention - planning - control.

Our goal is to co-develop a National Forest Strategy in which forest management will serve multifunctional forestry. A basic operational tool for this purpose is also the standards of the forest management studies. These standards are currently developed by the Ministry of Environment and Energy.

We believe that the Conference Proceedings volume will be a useful handbook for future actions, both for the Ministry and the decentralized agencies, since the future forestry practice has no longer to deal with demands concerning land designation acts, and there is time and space for science and research results to be included in the daily life of forest services and forest-related societies.

Dr. Theocharis D. Zagas

SCHOOL OF FORESTRY AND NATURAL ENVIRONMENT
OF ARISTOTLE UNIVERSITY OF THESSALONIKI

Dear Mr president of Hellenic Forestry Society, dear guests, dear colleagues, dear students, Ladies and Gentlemen.

The 18th Pan-Hellenic Forestry Congress with subject: "Hellenic Forestry facing major challenges" and the International Workshop "Information Technology, Sustainable Development, Scientific Network and Nature protection" is now a reality.

The preparations of so many months in a scientific and organization level have eventually given their fruits. Despite the socioeconomic crisis, our sector, united is challenging to take safe steps ahead with proven facts. So we continue a tradition that has been established by the Hellenic Forestry Society , with every conference being better that the last. The present Congress has all the required characteristics to be better than the last one, and what lies ahead is the confirmation.

The School of Forestry and Natural Environment A.U.Th. contributes in the organization of the conference in terms of organization, science and arts and celebrates 100 years of operation and contribution to the country. I am really happy that I represent this historical department of the Aristotle University of Thessaloniki at this important moment and I wish to send a message to all the colleagues that serve our sector from every position, to the new colleagues that straggle for a position in the general workspace, to our students that will succeed us: To support with all our forces Forestry and The Natural Environment as a scientific community. To be united, with solidarity. To reclaim the advantages that have to do with our scientific field and the times. We ought to be optimistic but also active.

Many thanks to the Organizing and Scientific Committee and especially to the local coordinators, the Municipality of Edessa, the Environmental Education Centre, the Forest Services and the sponsors that contributed with effort and economical sources for the best possible organisation of the Conference. I hope we will fulfil your expectations.

With these thoughts and encouragements, I wish a great outcome and luck to our Conference and hope to be unforgettable to every participant from every point of view.

Thank you!

Editorial Preface
International Workshop
Information Technology, Sustainable Development, Scientific Network & Nature Protection

Dr. Zacharoula S. Andreopoulou
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Environmental Information Technology Systems can serve the needs of the society, citizens, communities and enterprises and provide well appreciated innovative smart services, applications, devices and methods while Sustainability has been the key issue recently in local, national, international and trans-national environmental policies globally, global entrepreneurship., etc, especially in the context of the economic crisis. New technologies have emerged with smart tools and services inspiring sustainability and green growth, quality of life, green entrepreneurship etc. The International Workshop focus on these contemporary issues and it was held at 9th and 10th October, in the Old School Room, in Varossi, Edessa within the 18th Panhellenic Forestry Congress.

Papers included in the proceedings of the Workshop provide a multi-discipline approach because this workshop aims to bring together and to present innovative emerging Information Systems applications in Forestry, Environment and Sustainable Development and has provided a forum for presentation of emerging methodologies, theories and applications aiming to bring together professional, experts and researchers working on Information and Communication Technologies in Forestry, Environment and Sustainable Development. Also, there are papers from the Round Table concerning the role of scientific networks in the protection of natural environment.

The Workshop has received 74 papers by authors coming from 14 countries. All papers were submitted to a double blind review process.

The applications described in the papers include sustainable ecosystems management, ICT uptake for environment and energy, ecosystem management with spatial information systems, the role of Scientific Networks in Nature Protection, green technologies, sustainable development and quality of life, internet and entrepreneurship, adoption of technologies for the agro-environment.

We are confident that these proceedings will stimulate further discussion between research and environmental stakeholders and will provide new perspectives that will result both theoretical and practical advance.

Invited Speeches

Milan Mesić

Prof. Dr. Milan Mesić (1962, Zagreb), agricultural engineer, Dr.Sc., University of Zagreb Faculty of Agriculture, Department of General Agronomy, Full Professor, Scientific Coordinator of the BSc Study Program "Agroecology", Head of Department.
Education: General and applied crop production, Agroecology, Fertilization, Liming, Soil protection and monitoring.
Research: Assessment of soil quality through improved soil sampling schemes, precise information about soil properties, new possibilities for determination of soil properties including spectroradiometry and remote sensing, influence of nitrogen fertilization on water quality, soil properties and crop yields and quality, relations between nitrogen and carbon cycles in soils.
Most important results: Sustainable use of acid soils, Nitrogen fertilization acceptable for the environment, Prevention of anthropogenic soil degradation in intensive agricultural production, Method for soil sampling based on circular soil probe (Patent pending: international application No. PCT/HR2011/000021).
Technical skills and competences: Participation in the preparation of a large number of papers, studies, expert opinions, annual reports, lectures and public appearances on radio and television. Participation in the projects of LIFE III and the preparation of documents to meet the needs of the Ministry of Agriculture, Fisheries and Rural Development; the Ministry of Environmental Protection, Physical Planning and Construction; and the Environmental Protection Agency. Member of the board of supervisors of the Croatian Association for the Organization of Ploughing Contests, and has judged several county competitions as well as the 53rd World Ploughing Contest in Ireland in 2006. Author or co-author of more than 200 professional studies.
Lectures: Agroclimatology, Basics of Agriculture, Agriculture and Environment.
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Environmental Role of Soil Carbon under Mediterranean and Continental Climate Conditions

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Total carbon (C) in soils is the sum of both organic and inorganic carbon. Organic carbon is present in the soil organic matter (SOM) fraction, whereas inorganic carbon is largely found in carbonate minerals. In agro ecosystem there are numerous factors that affect the balance between gains and losses of SOM. The content of soil organic carbon (SOC) is a universal soil quality indicator with significant influence on soil properties. Different soil forming factors that influence soil development under Continental and Mediterranean climate are closely connected with temperature and precipitation regime. Because of complex influence of SOC on chemical, physical and biological soil properties it is important to predict the trends of possible SOC level changes under actual scenarios for Climate change. Agricultural land use very often influence reduction of SOC levels in comparison with soils under forest vegetation. Interesting comparison between same soil type under agricultural use and forests for Croatian conditions is given by Martinovic (2000). In Croatian parts of Pannonian plain in

surface soil horizons of Luvisols under agricultural use, decrease of SOC is near to 58%, in Stagnosols around 51%, and in Eutric Cambisols near 60 %, compared with SOC content in same soil type under forests. In addition to that, for soils with predominant influence of Mediterranean climate SOM content in Red Mediterranean Soils (Terra rossa) used for annual crops decreased in average 32%, and under vineyards in average 37%, both compared with SOC content in forest soils of same type.

Mihalic (1973) locates the beginnings of agriculture on Croatian territory to the Mediterranean part of the country during the Roman Empire from where it was spread to the continental part of the country. At some Croatian islands there are agricultural fields cultivated longer than 2500 years. Beside orchards, vineyards and vegetables, crop sequence on arable fields was old Mediterranean two field crop rotation – fallow land and wheat or barley. Later agriculture was spread to the continental parts where agricultural land was either developed from grasslands of forests, after clear cutting. Crop rotation was intensified after discovery of America when new crops were introduced. If we analyze the history of agriculture, changes in SOC content under forests and under agricultural usage can be more easily understood. According to Meersmans J. et al. (2009), intensified land management practices seriously affect the SOC status of the soil. The increase in plough depth and a change in crop rotation result in a significant decrease of C near the surface for dry silt loam cropland soils. According to Álvaro-Fuentes, J. et al. (2011) there is little information about soil organic carbon (SOC) stocks and changes in Mediterranean areas at a regional scale. Rodeghiero et al. (2011) stated that most of the natural or semi-natural environments in Mediterranean areas are coincident with areas of **low to medium** SOC content, while some cultivated areas are almost identically traced to extensions of **low or very low** SOC content.

Soil structure, nutrient availability, water holding capacity and microbiological activity are the most important factors of soil fertility that are closely related with SOC content of soil. Compared to the Continental Climate conditions, SOC content of soils under Mediterranean Climate is even more important, because of much longer dry and warm period over summertime, more shallow soils, and longer period of cultivation.

Management of agricultural fields, grasslands, meadows, orchards and forests has a significant influence on soil carbon content. Depletion of SOC is not an option for sustainable land use neither under Continental, neither under Mediterranean climate conditions. Therefore, it is very important to protect soils and to apply sustainable land management in terms of tillage, fertilization and crop rotation.

Key words: *Soil organic carbon, Continental Climate, Mediterranean Climate*

Mariana Golumbeanu

Senior researcher Mariana Golumbeanu - holds a MSc in Sustainable development in coastal zone and a PhD in Geography and Environmental Protection by the University of Bucharest, Romania. She started her career as research assistant at NIMRD (1996) in the Oceanography Department. In the next years, she was involved in different research themes related to integrated coastal zone management, Marine planning applications of Use-Marine Planning, anthropogenic pressures in the coastal area. She was nominated in 2012 by the Ministry of Environment as National Focal Point for *Advisory Group on the Development of Common Methodologies for Integrated Coastal Zone Management at the Black Sea Commission* (Istanbul, Turkey); ICZM representant to the NRCs European Environmental Agency (EEA/EIONET Denmark), Member of the Permanent Technical Secretariat of National Committee for Coastal Zone. She coordinated the national project of the Ministry of Education on New Methods for the Improvement of the Integrated Coastal Zone Management (ICZM) and Maritime Spatial Planning (MSP) in the Romanian Coastal Zone/2016-2017, Study on Integrated Coastal Zone Management, under the Project "Improvement of the Integrated Coastal Zone Management in the Black Sea Region, ICZM" (JOP Black Sea Cross Border) /2014-2015, PEGASO-BSCPS-IC-10 Permanent Secretariat to the Commission for the Protection of the Black Sea Against Pollution: "Elaboration of ICZM Indicators and ICZM Guidelines, Romania", 2013-2014 and has participated in several EU multidisciplinary projects like: FP7 MareFrame „Co-creating Ecosystem-based Fisheries Management Solutions" /2014- 2018, FP7 PERSEUS (Policy-oriented marine Environmental Research in the Southern European Seas/ 2011 – 2015, FP7 COCONET- „Towards COast to COast NETworks of marine protected areas (from the shore to the high and deep sea), coupled with sea-based wind energy potential"/ 2012-2016, DG ENV - IRIS-SES "Integrated Regional Monitoring Implementation Strategy in the South European Seas" (2014-2015), DG MARE/EC – ANPA/RO: National program for data fisheries collection for 2015-2018, INTERREG III B CADSES Coastal and Maritime Planning ICZM PLANCOAST (2006-2008)(Assistant manager).

At the present, she is the Head of the Technological Transfer and Dissemination Department. Besides, she is Associated Professor at Ovidius University of Constanta, Faculty of Natural Sciences and Agricultural sciences, Department of Geography and Faculty of Civil engineering.

In 2000, PhD M. Golumbeanu was nominated co-chair of the International Secretariat for Southeastern Europe of Balkan Environmental Association (ISSE-BENA), organization who aims to encourage the research in the current state of science in pollution and environmental sustainability in the Southern Europe and Black Sea area.

The main activities focused on the Regional coordination of Balkan Environmental Association Program for Research projects and Scholarships for Young Scientists in Romania, Bulgaria, Serbia and Croatia (147 research projects and 263 scholarships) and Training courses on Environmental Professions – 32 training courses (862 graduates), accreditation of two professional curriculum in basic and advance knowledge, according to the Romanian legislation by the Ministry of Labour and the Ministry of Education.

In addition, she is Member of the Editorial Management Board of the Journal of Environmental Protection and Ecology (JEPE) - indexed and abstracted in the Science Citation Index Expanded

(SciSearch*), Member Editorial Board of International Journal of Ecosystems, Member of Editorial Team – Oradea Journal of Business and Economics OJBE and Member of the Editorial Board of Ovidius University Annals, Series: Civil Engineering.

STRENGTHENING THE CAPACITY BUILDING IN BALKAN AND BLACK SEA REGION

Mariana Golumbeanu

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Abstract

The ability of people, organizations and society to perform functions, to solve problems and to set and achieve objectives in a sustainable manner and to manage their affairs successfully, is realized by bringing together experts and stakeholders in the fields of environmental, industrial and socio-economic sciences. **Balkan Environmental Association (BENA)** is strengthening the capacity building in Balkan and Black Sea region by organizational structures, trainings, programs and organizations to enhance the understanding of the value of environmental sciences, experiences, research and related data and products.

Keywords: *environmental sciences, Balkan Environmental Association, capacity building, regional and international cooperation*

Introduction

BENA has at its disposal a secure and satisfactory communication network within Europe and Black Sea region aimed at developing the cooperation and the exchange of environmental information among its members, as well as identifying and appraising the current problems of environmental protection on a national, regional and international basis.

Organizational capacity building is used by NGOs & Governments to guide their internal development and activities. It refers to the process of enhancing an organization's abilities to perform specific activities. An Organizational capacity building approach is used by NGOs to develop internally so they can better fulfill their defined mission (*Kaplan, 1999*).

Depending on the organization and objectives, for capacity exist several definitions:

United Nations Development Program (UNDP): Capacity is the ability of people (P), organizations (O) and society (S) to perform functions, solve problems, and set and achieve objectives in a sustainable manner.

United Nations Conference on Environment and Development (UNCED): Capacity building includes country human, scientific, technological and institutional resources and capabilities. The goal of capacity building is to enlarge abilities of (environmental and socio-economic) stakeholders to evaluate and address crucial questions related to policy choices. These choices should be based on understanding of environmental and socio-economic potential and limits and needs of the country.

The general aims of BENA is to bring together experts and stakeholders in the fields of environmental, medical, industrial and socio-economic sciences from the Balkan and Black Sea region: Universities, NGOs (non-governmental organizations), governmental structures, administrative authorities, local stakeholders and private business in order to increase mutual knowledge of their communities and to explore the mechanisms of synergy (see BENA infrastructure) (*Golumbeanu and Vosniakos, 2010*).

It is considered and planned to use components of this network for the tasks of creating public awareness, undertaking outreach, and making promotion:

- analyze interactions between environmental, economic and community trends;
- establish scientific ways for environmental protection, and ultimately;
- promote strategies and institutional changes to improve environmental and natural resources support environmental decision making processes through objective and independent scientific research, studies and professional training.

Capacity building approach can be based on three complementary elements: *infrastructure*: hardware and software and other technology required to develop, access and use of scientific knowledge, experience and observation techniques; *individual* (human): education and training of individuals to be aware of, access, use and develop of scientific knowledge, research, experience and hereto-related techniques and data observation; *institutional*: building policies, programs and organizational structures in governments and organizations to enhance the understanding of the value of environmental sciences, experiences, research and hereto-related data and products

Elements of the BENA Capacity Building:

Capacity building has typically been defined as the development and strengthening of human and institutional resources (*Teohareva 2011*).

The elements of capacity building are based on an integrated approach:

1. Infrastructure capacity building: Access to knowledge, expertise and data and information (BENA participation in the frame of *7th European Commission Project* Upgrade Black Sea Scientific Network Black Sea SCENE *(Golumbeanu et al., 2010),* participation of BENA members in the projects/studies in the frame of ***Black Sea Cross Border Cooperation Program/Joint Operational Programme „Black Sea basin 2007-2013"*** *e.g.* Creation of a Black Sea Network for Sustainable Tourism Development in Bulgaria, Romania, Ukraine, Moldova And Georgia (BS – TOURISM NET) (*Golumbeanu et al., 2014*), A Scientific Network for Earthquake, Landslide and Flood Hazard Prevention (SciNetNatHazPrev), *The European territorial Cooperation Programme Greece-Bulgaria 2007-2013*: Chemical and Radiological Risk in the Indoor Environment (CHeRRIE)", *EU Project TR0703.01-03/35* – BENA and Urban and Public Health Association, Adnan Menderez University, Turkey.

Since 2001, the organization developed in the Balkan region the ***BENA Program for research projects and scholarships***. As results were funded **147 research projects and 263 scholarships** for young scientists in Romania, Bulgaria, Croatia and Serbia. The Calls were developed in the environmental topics: pollution control in environmental media for hot points identification, new methods/techniques development in relation with international requirements; environmental impact/risk assessment for identification of areas, where pollution abatement, clean production or ecological reconstruction are required; environmental technologies (drinking water, waste water, wastes); training and consulting for EMS (ISO 14001) and QMS (EN 45001) development and implementation for certification/accreditation etc.

Scientific publications: BENA has its own official ***Journal of Environmental Protection and Ecology (JEPE)***, which is starting to serve as a digital library for environmental issues. The journal has the task to lead among the worldwide academia and provide the concrete establishment of effective dialogue. The Journal of Environmental Protection and Ecology (JEPE) is indexed and abstracted in the Science Citation Index Expanded (SciSearch*) and Journal Citation Reports/Science edition, Thomson Scientific, and in Elsevier Bibliographic Databases (Geobase and EMBiology), Ulrich Database etc.

But, also the periodical **BENA conferences** might be considered as infrastructural capacity building by creating scientific network for exchange of knowledge, expertise and experience (BENA organized and co-organized almost 90 scientific events on different environmental issues *e.g.* conferences, workshops, stakeholders meeting etc.)

2. Individual (human) capacity building: Education and training (for example the training workshops and summer schools organized by BENA).

B.EN.A. organized **Training Centers on Environmental Professions** for specialists and unemployed people, in order to improve their professional status and to update their knowledge on modern environment management, in order to face the job market demands.

The Training Centers were funded by the *Ministry of Foreign Affairs of Hellenic Republic (Department of International Development and Co-operation-HELLENIC AID)* in 2002 and were running for two years program, having the great impact and success in the region.

BENA continues its efforts for the sustaining training activity on environmental professions with the support of private companies like: Titan S.A., Tomini Trading SRL, Carpatcement Heidelberg Cement Group, Bancpost Romania, Procter & Gamble, ANCDPI, Balkan Mineral and Mining.

During 2002-2014 more than **1,400 persons graduated the courses on environmental professions** in Constanta, Bucharest, Plovdiv, Varna, Skopje and Belgrade (*Golumbeanu et al., 2012)*. The structure of the Training Centers is listed below:

1. Training Center on „Environmental management" specialization in the National Institute for Marine Research and Development "Grigore Antipa" Constanta, Romania.

2. Training Center on "Eco-agro-tourism and organic agriculture", in the Agricultural University of Plovdiv, Bulgaria.

3. Training Center on "Public Health Impact" specialization, in the Faculty of Medicine, Skopje, Former Yugoslav Republic of Macedonia.

4. Training Courses in "Sustainable Fishery" specialization running in the in National Institute of Fishery and Aquaculture (IFA) in Varna, Bulgaria.

5. Training Courses on "Sustainable Development in the frame of EU Legislation Harmonization", in the Faculty of Chemistry, University of Belgrade, Serbia.

BENA is member of the International SKILLSnet of CEDEFOP - *European Union Center for the Development of Vocational Education and Training.*

3. Institutional capacity building: Development of policies, programs and organizational infrastructures of research institutes, governmental organizations (governmental agencies, departments, municipalities, administrative authorities, etc.).

BENA's infrastructure is based in Academic Institutions and forms an environmental scientific network being a very good example of institutional capacity building: **BENA National Bureaus in 10 countries:** Headquarter in Greece (*ATEI of Thessaloniki*), Albania (*University of Tirana*), Bulgaria (*Agricultural University of Plovdiv*), Bosnia and Herzegovina (*University of Sarajevo*), Croatia (*University of Zagreb*), Former Yugoslav Republic of Macedonia (*Institute of Public Health*), Moldova (*Institute of Electronic Engineering and Industrial Technologies of Academy of Sciences of Moldova, Kishinev*), Montenegro (*University of Podgorica*), Romania (*ECOIND and Polytechnic of Bucharest*), Serbia (*VINCA Institute and University of Belgrade*) and Turkey (*Istanbul Technical University*) and its International Research Secretariat for Southeastern Europe (ISSE-BENA) *National Institute for Marine Research and Development "Grigore Antipa", Constanta, Romania*.

BENA Liaison Offices in 9 countries: Albania (*University of Shkodra*), Armenia (*Centre for Ecological - Nonosphere Studies of National Academy of Science, Yerevan*), Croatia (*University Osijek*), Georgia, Italy (*University of Tuscia*), Portugal (*University of Algarve, Faro*), Russian Federation, (*National Research Institute of the Azov Sea Fishery Problems (NRIASF), Rostov on Don*), Ukraine (*Ukrainian Scientific Center of the Ecology of Seas (UkrCES) in Odessa*) and Turkey (*Namik Kemal University, Bosporus University*).

The fast growing network of universities, research centers, municipalities and organizations through the promotion and dissemination the activities and objectives, data information infrastructure in several meetings concerning the networking, transnational and Joint Research activities; planning mutual meeting in the frame of scientific community in Europe and Black Sea region.

General Objectives of BENA Capacity Building

- Bring together experts and stakeholders in the fields of environmental, medical, industrial and socio-economic sciences from for example the Balkan and Black Sea region: Universities, NGOs (non-governmental organizations), governmental structures, administrative authorities, local stakeholders and private business in order to increase mutual knowledge of their communities and to explore the mechanisms of synergy.
- Identify and analyze the gaps in capacity and technical and non-technical obstacles to the access and exploitation of knowledge, know-how, experience, data and information and products.
- Build capacity at infrastructure, individual (training) and institutional (community of practices) level and to develop user test cases with reference to problems common to regions in Europe, like the Balkans and the Black Sea.
- Promote and increase the general awareness of the benefits of exchange of knowledge and expertise, data and information, especially among present and future users, beneficiaries and sponsors of relevant national and regional systems.
- Build the observational capacity and infrastructure through establishment of National and Transnational Networks of scientists, scientific and governmental organizations, private industries, NGOs and universities.
- Carry out comprehensive review of existing and planned local, national and regional initiatives aimed at capacity building goals.
- Identify and analyze the gaps in societal benefit areas and awareness in the European environmental threatened regions and recommend solutions for their filling.

Conclusions

Capacity building is matter of all stakeholders – scientists, governments, municipalities, administrative authorities, universities, institutions, NGOs, public awareness organizations, national and transnational organizations involved in the sustainable development of specific regions. Hereby the "magic" words are coordination and tuning, respect and the willingness to cooperation, exchange of knowledge, expertise, experience, data and information. The Balkan Environmental Association (BENA) can be considered as an excellent example of capacity building including 3 elements: infrastructure, individual and institutional.

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SIMILARITIES IN TREE SPECIES COMPOSITION ACROSS FRAGMENTED FOREST PATCHES: THE CASE OF SACRED GROVES IN NORTHERN GREECE

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Abstract

Sacred groves in northern Greece are dynamic systems and an essential component of socio-ecological landscapes. Their woody vegetation is hypothesized to be the result of both environmental and management practices that acted as constrains on the forests' development suppressing understorey growth, while prohibitions on wood cutting preserve large-sized trees. In this paper, we carried out a systematic tree inventory of six sacred groves, in order to determine the similarity and variation in woody species composition. Five main tree species' communities were identified, subdivided into two main groups, potentially related to local management history. Our findings are crucial for local conservation planning, providing evidence of the extent to which the vegetation community is linked to site environment and historical management in such complex cultural landscapes.

Keywords: *Cultural landscapes, Sacred Natural Sites, site classification, species composition*

Introduction

Sacred forests are significant components of anthropogenic landscapes and are amongst the best-known types of Sacred Natural Sites (SNS: areas 'set aside' for spiritual or religious purposes; Oviedo and Jeanrenaud 2007, Verschuurenn et al. 2010). They exist within a variety of cultural landscapes across the world and not restricted to any particular religion. Bhagwat and Rutte, (2006) in their extensive review of SNS, reported 33 examples from all continents covering about 10 different types of biomes. In Europe, sacred forests exist in several forms; both as vestiges of ancient spiritual traditions which have often been absorbed into local cultural practices and secured by existing religious groups, or as monastic and/or church managed landscapes where nature conservation and productive management practices are often mutually combined (Mallarach 2012).

Sacred forests are frequently community-driven. It is the local community that acts as the custodian of the site, managing and protecting its cultural, spiritual and environmental value (Wild and McLeod, 2008). Custodial groups define specific management rules, regulating governance and prescribing duties and prohibitions on forest use. Such rules vary from site to site reflecting the specific nature of communities and the way they wish to manage local resources and their environment (e.g. strict protection, prohibition to fell trees, controlled grazing; Stara et al. 2016, Frosch et al. 2016). Governing rules, in combination with different socio-economic settings and environmental and climatic variables all contribute to inter and intra site diversity. Comparison of sacred forests are hence difficult to undertake and requires grouping at habitat level as different vegetation communities might be present within a single site (Frosch et al. 2016).

Sacred forests are believed nonetheless to share some common features. Bhagwat and Rutte (2006) describe how such sites are often situated in the proximity of agricultural landscapes and local communities. Jäckle et al. (2013) found that sacred groves in Northern Morocco are mainly located on elevated and prominent areas. In addition, Wild and McLeod (2008), and Dudley et al. (2009) reported that many sacred sites contain higher biodiversity levels than similar neighboring habitats or managed habitats, as further supported by field evidence in some of the world's sacred forests (e.g. Gao et al. 2013). However, contrasting results might be obtained, especially when the sacred forest is small in size (Garcia et al. 2006). In such cases, the condition of the surrounding landscape matrix may be crucially important for the biodiversity of single groves (Daye and Healey 2015).

In Greece, and especially in the mountainous Epirus region, sacred forests provide regulatory services as protective wooded buffers above villages or as reserves that define and protect important resources held in common for usage in times of need (Stara et al. 2016). Confirming existing evidence on SNS, recent research has revealed that sacred forests in Epirus differ greatly from one another in terms of size, forest type, and management practices (Tsiakiris et al. 2013, Stara et al. 2016). However, their social function is gradually fading as a consequence of the depopulation of rural areas. This partial cultural abandonment is assumed to have direct effects on the forest layer similarly to the vegetation encroachment of abandoned fields and pastureland occurring throughout Greece. Assessing their tree species composition and how it reacted to different management practices become therefore crucial from a local conservation planning perspective. Sacred forests' dynamism can indeed challenge the simple concept of preservation as a basis for forest protection.

In this paper, we present the results of an analysis of woody vegetation for six sacred forests. This was undertaken via an indicator species approach based on dissimilarity of basal area frequencies, considering both the stand structure and the density of tree species. We also explore how community composition is linked to site environment and historical management, in particular with regard to the role of site rules and taboos. This indication of causation would help others to predict which sites, sharing a similar environment/management history, would be expected to have similar habitat composition. Such findings would be especially valuable in a management abandonment scenario, as it has occurred broadly in Epirus (Northern Pindos) sacred forests.

Materials and Methods

Study areas

The study area of this research is located in north-western Greece, within the Epirus Region and specifically in local administrative units of Zagori and Konitsa. This is a mountainous zone scattered with small villages that suffered from rural abandonment in the 20th century becoming one of the most sparsely populated areas of Greece. The mountains host a rich flora and fauna including several endemic species. In addition, most of the region is comprised in the Natura 2000 network, while part of it is protected as National forest (1966, 1973) and recently as National Park (2005) (EEA 2016).

Sixteen sacred forests have been recently studied in detail (Stara et al. 2016), encompassing a variety of existing local forest ecosystems. Six of these were selected for the present study to represent overall forest variation (altitudinal gradient, species composition and local management type). These are: (i) *Agios Nikolaos* in Livadakia, belonging to the village of Vitsa; (ii) *Kouri*, village of Mazi; (iii)

Mirauae, village of Palioseli; (iv) *Agia Paraskevi* the sacred grove of the village of Vovoussa; (v) the excommunicated forest of the village of Greveniti; and (vi) *Graditsa*, village of Kapesovo (Fig.1).

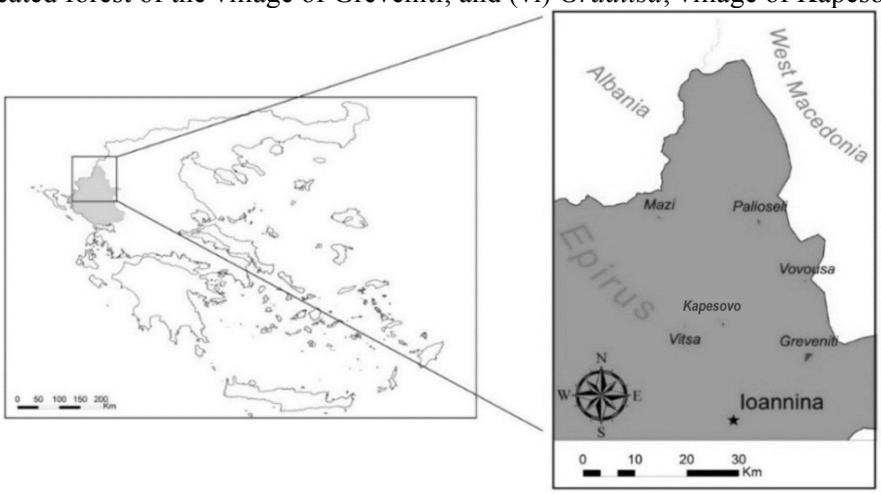

Figure 1. *Location of the six sacred groves in the Epirus Region, northwestern Greece.*

Data collection

During the summers of 2014 and 2015 a tree inventory was undertaken in each study site. A systematic sampling design was used by fitting a square grid (cell size 15 x 15 m) with a north/south and east/west orientation to the forest area. Notional forest boundaries were defined by Tsiakiris et al. (2013) using former forest extent on aerial photographs from 1945.

Grid spacing was computed with the following formula:

$$Spacing(m) = 100\sqrt{\frac{A_f + A_b}{n}} \quad (1)$$

Where *n* (the number of grid intersections) was set at 30, and the forest area, in ha, (A_f) was taken to include a 50 m outer buffer (A_b). Plots laying partially outside the sample area were dropped. At each grid intersection, three NW oriented nested plots were laid out:

- A 15 x 15 m plot, where all trees with a diameter at breast height $d_{1.3} \geq 5$ cm were identified and diameter measured;
- A 5 x 5 m sub-plot, where all saplings and/or shrubs (with diameter at ground level ($d_0 \geq 1$ cm and $d_{1.3} < 5$cm) were recorded;
- A 1 x 1 m sub-plot, where all seedlings (individuals with diameter at ground level $d_0 < 1$ cm) were recorded.

Additional variables sampled at plot level included: aspect, slope, altitude, geology, soil composition, ground cover vegetation, grazing intensity, amount of deadwood in the plot, and highest tree in the plot.

Data analysis

In order to understand intra and inter site variation in woody composition across study sites, the overall frequency of all recorded species by diameter at breast height for each plot was computed. Tree species recorded in the subplot were not aggregated to 15×15 plot level as done in Aerts et al. (2006), due to the strong heterogeneity of saplings and shrub density within each plot. Tree basal area per species (BA_s), rather than presence-absence data was used to assess dissimilarity in woody composition both in term of species abundance and species size structure. Equation 2 describes this index:

$$BA_s = 7.85 \cdot 10^{-5} \sum_{t=1}^{T_s} (d_{1.3t})^2 \quad (2)$$

where T_s is the total number of trees *t* per specie *s* and $d_{1.3t}$ is the diameter of tree-*t* at breast-height.

Plots that had no tree cover (6 plots) were removed from the analysis, resulting in a final matrix of 40 species over 154 plots. Bray-Curtis measure of dissimilarity was used to compute composition difference between plots based on species basal area frequencies. The resulting distance matrix was then repeatedly clustered into 2 to 10 groups using a k-means clustering protocol with 25 random starts. A measure of cluster homogeneity (silhouette) was used to identify the most explanatory number of clusters to select. Indicator species analysis was applied as to determine which group of tree species best represent the obtained cluster. The analysis was run following the prescriptions of Dufrene and Legendre (1997), applying 1000 permutations. In order to select meaningful indicator species, only those that emerged to be significant and with an indicator value >25% were considered for the final assessment.

In order to investigate existing environmental gradients behind the plot distribution across clusters, nonmetric multidimensional scaling (NMDS) was run on the species basal area frequencies. NMDS was performed with three dimensions, a Bray-Curtis measure of distance, and a maximum number of 500 iterations. NMDS resulting axes and sampled environmental variables were then tested for relationship, to investigate how far spatial and environmental gradients contributed to cluster reordering. Explanatory variables were tested for multicollinearity, using a Generalized Variance Inflation Factor (GVIF) analysis. Variables showing a GVIF higher than 2 were removed. Subsequently a backward stepwise regression analysis based on model Akaike Information Criterion (AIC) was used to select the most parsimonious model achievable. Additional tests were run to test multiple regression assumptions of all models. In order to achieve normality of residuals, Box-Cox transformations were applied as required.

Lastly, habitat and stands variables were tested for difference within clusters using Kruskal–Wallis non-parametric test and its relative post-hoc pair-wise comparison due to lack of normality and homogeneity of variance across variables. Because of the presence of ties in data, Nemenyi-test with Chi-squared approximation was used (Pohlert 2014). Statistical analysis was performed using the computing environment R.

Results

The forest inventory recorded 160 plots across six sites (including six plots with no tree cover). Each sampled sacred forest was found to have a distinctive canopy layer: with Vitsa, Mazi, Kapesovo, characterized by broadleaved oaks (*Q. frainetto, Q. cerris, Q. pubescens* and only in Mazi*, Q. trojana),* Greveniti by beech (*F. sylvatica*), while Vovoussa, and Palioseli by pine trees (*P. nigra*). Nevertheless the Bray-Curtis index computed, revealed a large intra-site dissimilarity (Vitsa: 0.75; Kapesovo: 0.76; Mazi: 0.78; Vovoussa: 0.66; Palioseli: 0.57; Greveniti: 0.71), suggesting a significant variation of species within sites despite the dominant cast of trees. Such dissimilarity is significantly reduced when computed at cluster level (for a five-cluster configuration an average of 0.59). A configuration of five clusters was then selected as a meaningful repartition of the sample, as the average cluster silhouette, used as validation of clusters consistency, gradually reduced as expected when the sample partition gets higher. The clusters selected had 38, 25, 47, 17 and 27 elements respectively.

Figure 2 illustrates the results of the indicator species analysis performed. For four out of five clusters it was possible to identify significant indicator species. The cluster analysis first split coniferous (*P. nigra*) (cluster 1) and deciduous tree communities. This group was then further partitioned into beech forest fragments (*F. sylvatica*) (cluster 4), and then into different oak communities (*Q. coccifera - Q. frainetto*; Cluster 2; *Q. pubescens*, *Q. trojana* and *Carpinus spp*, Cluster 5). No significant indicator species were found for Cluster 3, which considering its high dissimilarity index (0.90), combine several species of sclerophyllous habitats (*e.g. A. monspessulanum, Q. coccifera, J. oxycedrus)*.

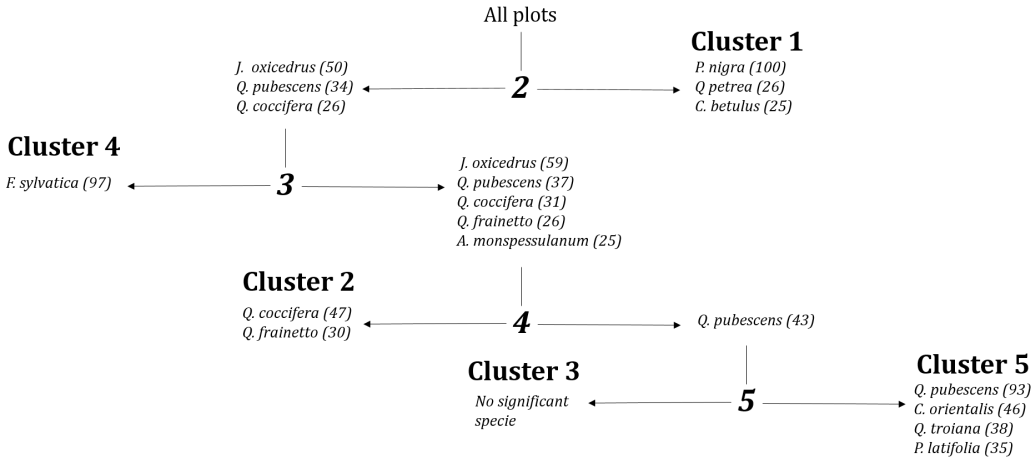

Figure 2. *Clusters obtained with the k-means clustering technique and their associated indicator species. Each indicator value is shown in parenthesis. Only species that are significant with an indicator value ≥ 25% are presented.*

The NMDS performed well partitioning the five communities into three dimensions, obtaining an average stress of 10.8. The first axis separates plots with more compact and rocky soils from the others (as presented in Table 1). Figure 3 shows how this ordination unambiguously divides the beech and the pine community (cluster 1 and 4) from the rests. On the opposite side, the third axis further partitions plots with a higher content of leaf litter on the ground and characterized by steep slopes, separating additionally cluster 3.

Table 1. Result of the regression models between the three NMDS axes scores and local environmental variables. Only significant variables are shown.

Explanatory variables	NMDS 1[a]	NMDS 2[b]	NMDS 3
	Model coefficient; t value; p value		
Intercept	9.00; 15.4; <0.001	1.22;3.61;0.000	0.58; 3.18; 0.002
Compact soil	0.47; 1.96; 0.052	-	-
Stoniness	0.28; 2.10; 0.037	-0.14;-2.18;0.031	-
Northness	-0.72; -5.24; <0.001	-0.16; -2.54;0.012 <0.012	-0.156; -2.85; 0.005
Altitude	-0.00; -8.21; <0.001	0.00; -2.83; 0.005	-0.000; -2.52; 0.01
Slope	-0.06;-6.30; <0.001	-	0.011; 3.20; 0.002
Deadwood	-0.39; -3.05; 0.003	-	-
Leaflitter	-	-0.21;-2.60;0.010	0.160; 2.55; 0.002
R^2	0.67	0.19	0.16

a A Cox-Box transformation was applied to the response variable augmented by 3 in order to achieve normality of the residuals (λ=1.7).
b Cox-Box transformation on the response variable augmented by 2 (λ=1.15).

Significant differences across clusters were also found when comparing stand characteristics both at tree and saplings/seedlings level (Figure 4). In particular, plots belonging to beech and pine communities were the ones with the tallest canopy trees and largest basal areas. The highest density of saplings and shrubs was found in cluster 3 and 5 with the latter also showing a significantly higher density of trees at plot level and a larger variation of species.

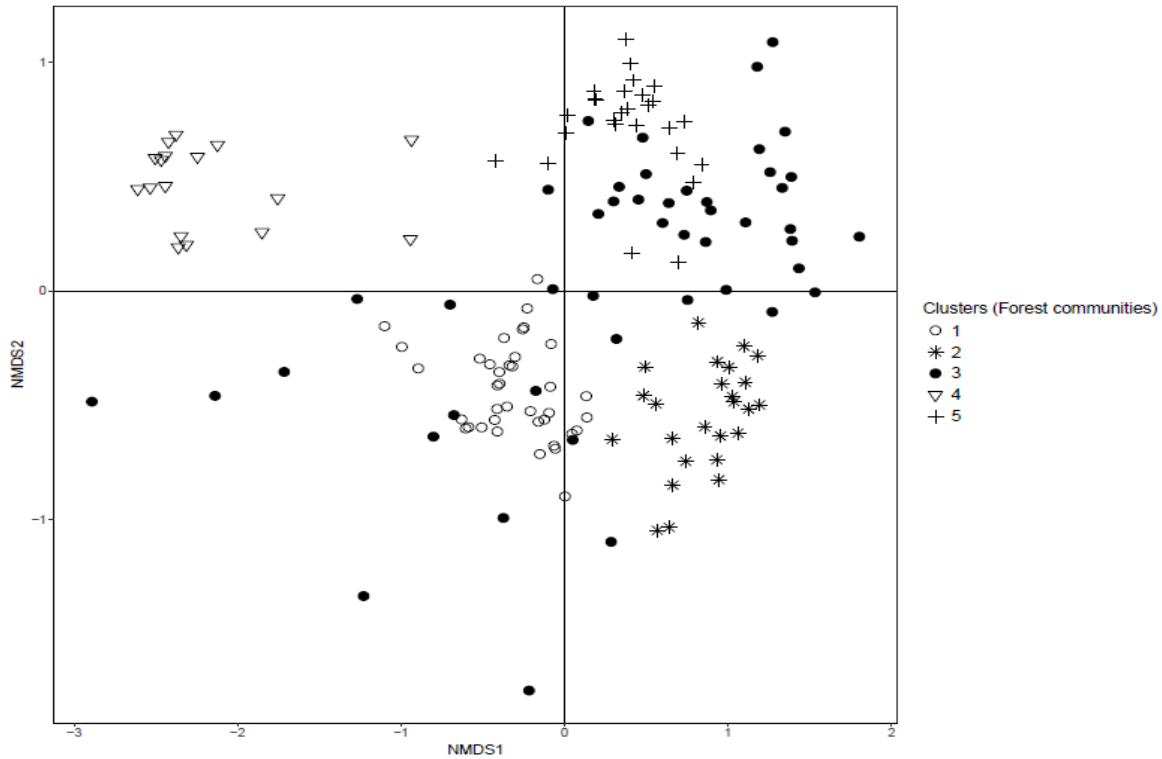

Figure 3 *NMDS ordination of 154 plots across six sacred groves. Plots are labelled according to the five communities produced by the cluster analysis.*

Discussion-Conclusions

The purpose of this study was to untangle the representation of forest ecological communities within sacred groves in NW Greece, in terms of tree diversity and stand structural characteristics. The five groups determined in the cluster analysis summarize well the existing woody communities that populate the sampled sacred groves. In particular, the NMDS ordination subdivides the forests into two main groups:

1. Beech (cluster 4) and pine forests communities (cluster 1) located in sites with a high altitude and steep slopes. Such sites are dominated by large and tall trees, not older than 200 years in age, due the fast growth characteristics of beech and pine. Their understorey, shaded by the canopy layer, is much sparser than in the other forest habitats. In addition, they are characterized by a soil with a deep organic layer rich in deadwood.

2. Oak and mixed broadleaved forest communities (2, 3 and 5), characterized by lower altitudes and gentler slopes. In cluster 2 and 3, in particular the soil is much more compact than the previous communities, which could be due to the higher grazing intensity there observed. The trees that make up these forest patches are significantly shorter (average of 12 m height), much narrower and present at a lower density (average basal area of 20.4 m^2/ha). Abundant are understorey saplings, often showing a shrubby form.

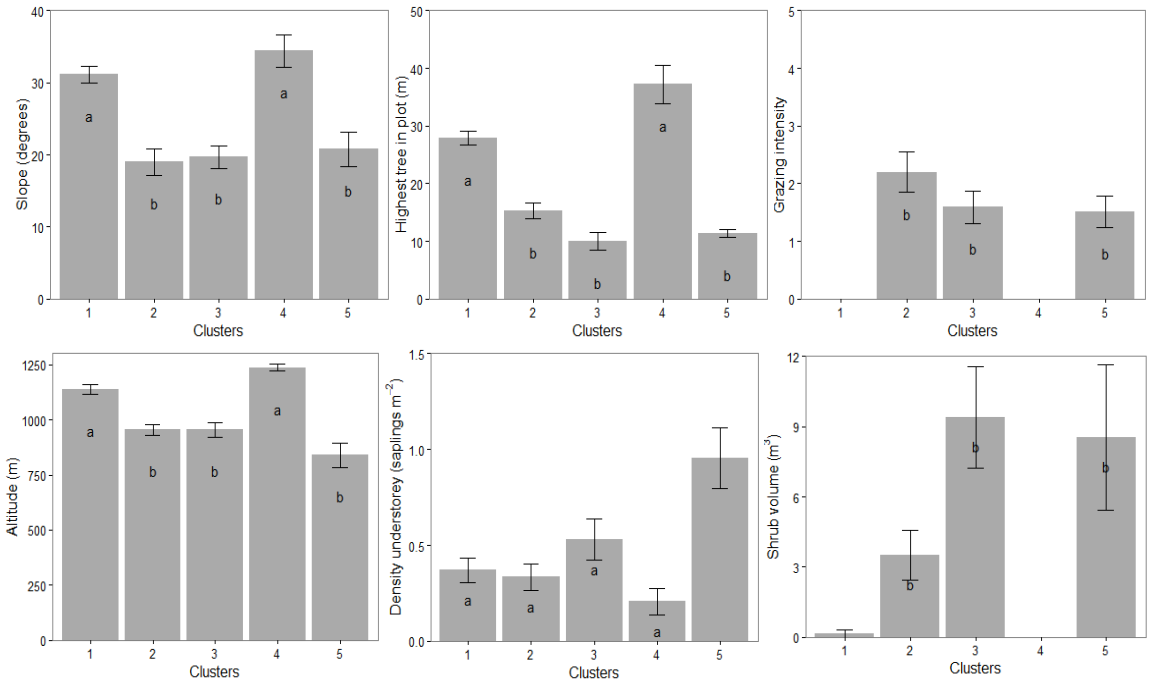

Figure 4. Selected forest stand and environmental variables averaged for the five habitat clusters. Letters indicates groups that do not significantly differ (Kruskal-Wallis non parametric test, p value > 0.05). Error bars are ±SE.

The distinction between these two macro-groups relate directly to environmental conditions (e.g. altitudinal gradient), but can in addition be linked to differences in management practices and protection status existing in the diverse habitats of the studied sacred groves. The former group is related to the high priority placed on these forests to protect downslope valley settlements from landslide and rockfall events (Volkwein et al. 2011). This strict protection regime could partly explain the abundance of organic soil material that was found in such communities, and the limited grazing intensity. In addition, those forests (e.g. as in Palioseli and Greveniti), were governed through a threat of excommunication used as an abstract menace to potential forest trespassers, entailing stronger prohibitions (e.g. grazing was not allowed; Stara et al. 2016).

The situation for oak and mixed broadleaved communities (e.g. Mazi and Vitsa) is quite different, as they were often used as shaded rest areas (in Greek *"stálos")* by shepherds and goatherds for communities' animal flocks, and hence they are subject to grazing, although currently occurring at minor intensity (Pion, 2014). Their high density of shrubs and understorey saplings is an indication, respectively, of current (browsed shrubs) and former (released understorey once management practices ceased) grazing patterns. Such dynamic reaction of forests in response to former management practice should be strongly taken into account for future conservation planning of those sacred groves.

What also appears, is that clusters are not site-specific but rather spread across sites. Table 2 presents the results of the cluster grouping in relation to the six studied groves, their main historical hypothesized functions, and the historical landscape structure. What it emerges is that all sites share a mix of habitats from all clusters. In particular, if only the two macro-groups formerly introduced are considered, it is possible to observe how also excommunicated forests (Greveniti and Palioseli) have plots attributable to former grazing areas (e.g. released understorey and dense shrubs layer). On the contrary, agropastorialists sites such as Vitsa and Mazi only shows plot belonging to the second macro-group.

This grouping at intra-site level might suggest that the forest proximity to the communities, and their blurring boundaries (often determined by perceptual factors rather than topographical marks; Marini Govigli et al. 2015) make sacred forests contributing to a much larger set of ecosystem services. These are spatially dependent on the location of the forests (higher restriction in the proximity of the forest core, larger interference in its fringes). This supposition, supports first field visits in Greveniti and Vovoussa, which hypothesized that that both forests were partially dominated by deciduous oaks, in the form of open wood pasture, currently present as decaying trunks throughout

areas of the forests. Further work concerning spatial and temporal patterns of these vegetation communities is currently under development, and it will contribute to test such hypothesis.

Table 2. Table with the repartitions of plots between the six sacred forests and the five clusters of forest communities obtained.

			Macro-group 1 Beech and pine forests communities located in sites with a high altitude and steep slopes. Large amount of deadwood.		**Macro-group 2** Oak and mixed broadleaved forests, characterized by lower altitudes and gentler slopes. Compact soil and observed grazing intensity. Abundant and dense understorey.		
Forest name	**Main ES entailed to forest**	**Hypothesized landscape structure when rule was stronger**	Cluster 1	Cluster 4	Cluster 2	Cluster 5	Cluster 3
Greveniti	Slope landslide protection	Forest on slope; lim. deadwood removal	3	17		2	6
Palioseli	Slope landslide protection	Forest on slope with limited deadwood removal	15		4		
Vitsa	Grazing shaded area	Former open area			16	1	9
Kapesovo	Grazing shaded area	Former open areas				9	14
Mazi	Grazing shaded area	Former open areas			1	15	12
Vovoussa	Aesthetic purposes, strict protection	Forested hill with no deadwood removal	20		4		6

Conclusion

Via an analysis of vegetation patterns, this study recognize how Northern Greece sacred groves are constituted of a combination of different habitats driven both by environmental and social constrains. Linking habitat types to former management practices become thus an essential tool to develop effective conservation management strategies for the governance of sacred forests and the ecosystem services these entail. This is especially true when boundaries are not statics, but rather dependent on local management, traditional knowledge and social norms; currently fading due to persistent demographical shifts. In order to preserve the cultural and biodiversity values of such sites, forest managers should focus on the key role of traditional management practices (e.g. low intensity grazing) in shaping the structural and biodiversity characteristics of these habitats, and their capacity to deliver multiple ecosystem services within the forest landscape. Such findings can assist the management of other natural sacred sites facing similar scenarios of abandonment management practices.

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FORESTS IN LITHUANIA: CURRENT SITUATION AND FUTURE PERSPECTIVES

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Abstract

A review of Lithuanian forests is focused on different aspects: forest area changes, short history of Lithuanian forestry, changes of main tree species health due to environmental factors. All studies mentioned in the paper were carried out in Lithuania. Relevant literature sources and information about forest health and tree condition parameters (mean defoliation, tree distribution in defoliation classes and number of damaged trees) of the main forest tree species (Scots pine, Norway spruce, hairy-twigged silver birch, silver birch, European aspen, black alder, gray alder, European ash and common oak) were briefly summarized.

Keywords: *Lithuanian forests, historical data, coverage, forest health*

Introduction

According to the geographical location, Lithuania is attributed to the Northern countries. However, according to the vegetation zones range projections, the country's territory belongs to the temperate mixed forest zone. There is a prediction that country's territory will remain in this zone over the next century because the composition of dominated tree species will not significantly change in the nearest future (Gonzalez et al. 2010).

Official history of forestry in Lithuania is documented from 1529. Then, the Law books of Lithuania with the first Forestry law were published. There were simple legislations about forest ownership, cuttings, hunting and financial fines for such activities in other person's property. In these books, foresters were also mentioned, and high rank forester was called "urėdas" ("head of forest enterprise") in Lithuanian. This fact is historically important for foresters because this rank is still active in Lithuanian forestry system.

In Lithuania, the total forest land area was almost 2.2 million ha, covering 33.5% of the country's territory in 2016. About 50% of forest land by ownership belongs to the state and 40% are private. About 10% of forests are reserved for the restitution (State Forest Service 2016). Thirty percent of forests in Lithuania are under protection status, where management activities are limited or even prohibited.

Forestry sector in Lithuania is very important: it provides about 59,000 job places (2010–2015) mainly in the manufacture of furniture and manufacture of wood products; forestry alone contributes to about 10,000 job places.

Historical forest area changes in Lithuania

Over the last 10 thousand years Lithuanian forest composition often changed. These changes depended on the ongoing post-glacial climatic fluctuations. After pollen data of lakes and mire deposits analysis was restored the composition of vegetation in six different regions of Lithuania. Also Kabailienė (2006) analysed development of climate and soils during the Late Glacial and Holocene. The author stated that historically birch together with pine forests became dominant in the Alleröd (10900–11900 BP) stage when the considerable warming took place in Lithuania. Later, during the Younger Dryas (10900–11900 BP) the dwarf birches (*Betula nana* and *B. humilis*) were dominated. Analysing the changes of composition of vegetation at different stages during the Holocene, it was found that in Preboreal and Early Boreal (8100–10000 BP) birches comprised 50-80% of all forests in Lithuania. Next increase of birch species was noticed in the Early Subatlantic stage (1000–2500 BP) when*Betula* and

Alnus wasspread in all Lithuania, also *Pinus* wasgrowing. Similarly, the pollen of *Betula* and *Pinus* prevailed among trees during the last 1000 years (the Late Subatlantic).

During 1944–1991 year period (Soviet regime time) the annual harvest in Lithuania was significantly lower (on average only 3.2 million m^3)than nowadays. For comparison the average annual harvest of roundwood for the period 2010–2015 was 7.3 million m^3. This was mainly because roundwood was imported from the other Soviet Union countries (Morkevičius 2001). The significant expanded of forest resources in Lithuania started after the Second World War. During the period 1951–1991 only 37% of the annual increment was felled (Brukas and Kairiūkštis 2003). After the collapse of the Soviet Union in 1991, use of forest resources has intensified. The growing stock volume in mature stands in forests available for wood supply has increased significantly.

Nowadays, the coniferous stands in Lithuania occupy about 1.2 million ha and cover 55.8% of the forest area. They are followed by softwood deciduous forests (835,900 ha, 40.6%). Hardwood deciduous forests occupy 74,000 ha (3.6%). The total area of softwood deciduous forest land increased by 137,400 ha over the last thirteen years. The area of hardwood deciduous has decreased by 18,600 ha (mainly due to dieback of ash stands) and coniferous forest by 11,500 ha (AM/VMT, 2016). There are eight most dominated tree species in Lithuanian forests: Scots pine *(Pinus sylvestris* L.), Norway spruce (*Picea abies* (L.) H. Karst.), Common oak (*Quercus robur* L.), European ash (*Fraxinus excelsior* L.), birch species (*Betula pubescens* Ehrh. and *Betula pendula* Roth), Black alder (*Alnus glutinosa* (L.) Gaertn.), European aspen (*Populus tremula* L.) and Grey alder (*Alnus incana* (L.) Moench). The stands of the mentioned tree species occupy almost 99% of all Lithuanian forests (Lithuanian Forest statistics 2012).

The data of forest area in Lithuania is available from XI century (Fig. 1). In the period from the XI century to 1948 year, forest coverage significantly decreased from 56% to 19.7%. However, from 1956 year the forest coverage area of Lithuanian forests is continuously increasing. There was only three-year period, from 2012 to 2014 year, when forest area was stable.

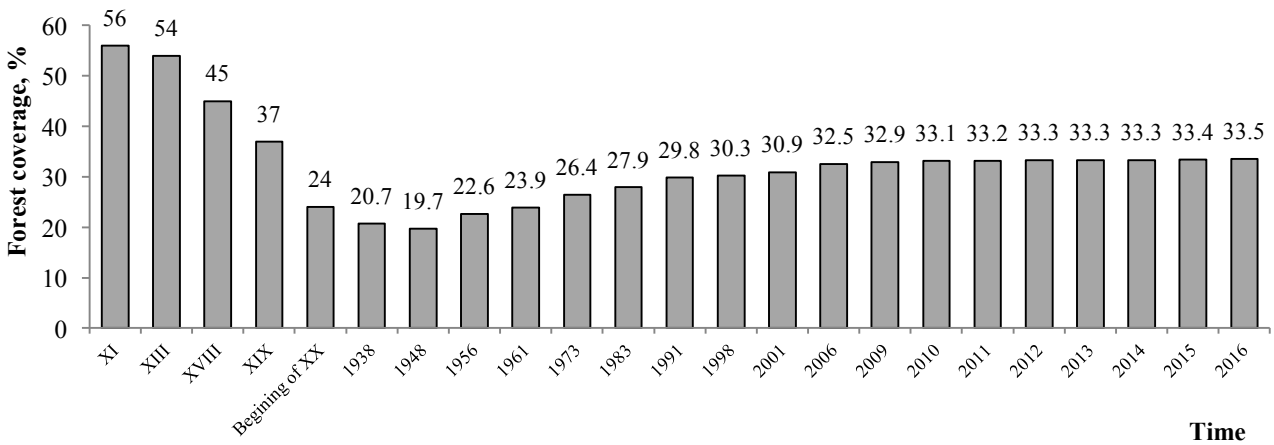

Fig. 1. *Historical changes of forest coverage in Lithuania (Source: State Forest Service 2016)*

The newest study of Jasinevičius et al. (2017) analysed the impacts of alternative domestic wood utilisation scenarios for a Lithuanian bioeconomy and climate change mitigation. One of the main reasons to start this research was a large volume of wood in mature and over-mature forest stands (Fig. 2). This is because of relatively low harvest in Lithuanian forests.

According to Kupstaitis (2016), there are few reasons which not let the increase of harvest: (1) over 10% of forests are still reserved for restitution and forest management in these areas is prohibited; (2) strict environmental protection policies; and (3) negative public opinion about forest harvest.

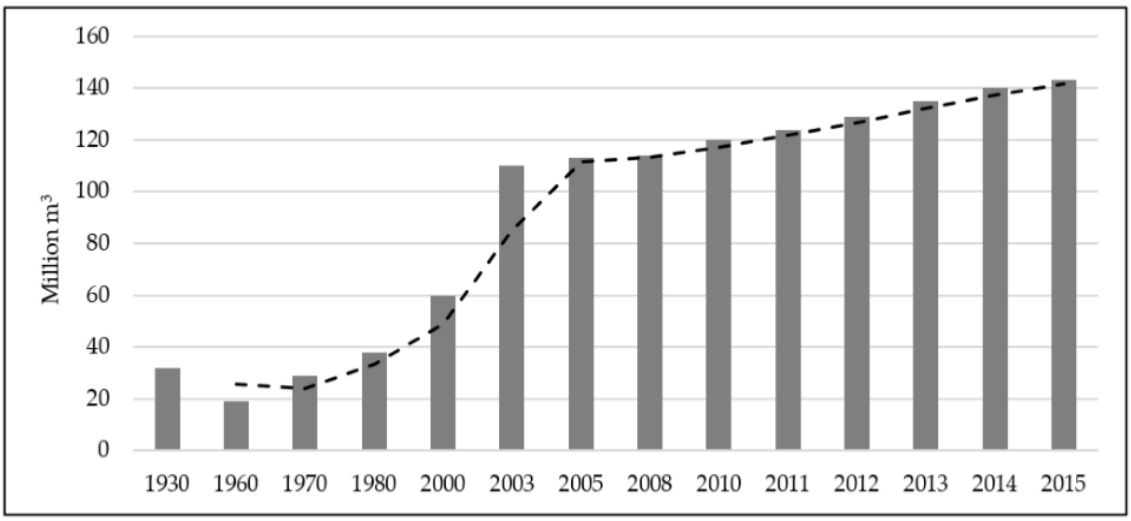

Fig. 2. *Growing stock volume in the mature forest stands during 1930–2015-year period. (State Forest Service 2016)*

The data of various tree compositions in Lithuanian is available from 1922 and are given as irregularly observed time series (Table 1). According to data of last 90-years period it was registered big changes of proportion in forest tree species composition. There was significant decreasing of both dominant coniferous species (*Pinus sylvestris* and *Picea abies*) during this period. Comparing nowadays stands plots with data from 1922, Norway spruce area decreased about 1.7-1.8 respective from 35.4% to 20.9%. Scots pine stands area decreased not so significant compared with data from 1922 year.

Table 1. *Forest stands area (%) by dominant tree species*

	Accounting year													
	1922*	**1931**	**1941**	**1953**	**1961**	**1972**	**1983**	**1988**	**2002**	**2012**	**2013**	**2014**	**2015**	**2016**
Scots pine	37.0	36.3	41.5	42.9	45.9	45.2	43.3	43.0	36.7	35.1	35.1	35.0	35.0	34.8
Norway spruce	35.4	36.5	30.3	27.3	20.2	17.9	20.7	23.0	23.1	20.8	20.9	20.9	20.9	20.9
Silver birch	12.2	12.1	11.2	13.5	16.6	19.6	21.3	20.1	19.9	22.3	22.4	22.4	22.3	22.2
Black alder	5.2	5.5	5.9	5.5	5.9	5.5	5.1	5.0	6.0	6.9	7.0	7.1	7.3	7.4
Grey alder	1.4	1.5	1.4	1.8	2.3	3.1	2.4	1.9	6.2	6.3	6.2	6.2	6.1	6.0
European ash	6.7	5.9	7.8	7.0	6.6	6.0	3.9	3.1	2.8	3.8	4.0	4.0	4.1	4.4
Common oak	1.3	1.4	0.9	1.1	1.4	1.2	1.2	1.3	1.8	2.0	2.0	2.1	2.1	2.2
European aspen	0.8	0.8	0.9	0.9	1.1	1.3	1.9	2.5	2.7	1.7	1.4	1.3	1.2	1.0

*-data without Vilnius county

The areas of the deciduous trees in Lithuania over the 90-year period increased, except for European ash.The area of the latter tree species in 2012 was only 3.8%, while in the period from 1922 to 1977 it was 6-7% (Table 1). Our forecasts for the next twenty years are not very poor for this tree species, i.e. according to the former and current trend of the change, the area of European ash should not decrease significantly and stabilize by about 3.7-3.8%.

Environmental impacts on Lithuanian forests

The changes of European forest condition have been attracting the attention of society, scientists and politicians from the end of last century when massive decreasing of trees health started. The main reason causing these changes was high air pollution (Shutt and Cowling

1985). In Lithuania, massive deterioration of tree health was fixed in the territory near the nitrogen fertilizer plant JV "Achema" in 1979.

Generally, one of the most important tree health condition parameter is crown defoliation. Annual assessment of tree crown defoliation in Lithuania was started from 1987. It was one of the aims of the Regional forest health monitoring program. This program is important for Lithuania and it is a part of European Forest Monitoring program (ICP Forest).

Throughout the forest monitoring process, the data sequence of many years of tree species, both in Europe and in Lithuania, provided opportunities for comprehensive data analysis and research.The trends of the condition change of all forests and major tree species in Europe (Fischer and Lorenz2011) and Lithuania (Ozolinčius and Stakėnas 1999, Ozolinčius et al. 2005) have been determined, and the influence of various environmental factors on the condition of trees was recorded (Percy and Ferretti 2004, Seidling and Mues 2005 et al.). The influence of hydrothermal conditions and air pollution on the condition of trees was analyzed in Lithuania (Ozolinčius and Stakėnas 2001, Ozolinčius et al. 2005, Augustaitis 2005, Augustaitis et al. 2007). However, these surveys covered the monitoring of forests until 2002 (Ozolinčius et al. 2005) or were intended for one tree species (Augustaitis 2005, Stakėnas et al. 2012). A comprehensive analysis of forest monitoring data, using the data of 23 years of regional forest monitoring, provides opportunities for more detailed analysis of the most important forest tree species in Lithuania and changes in the forest condition.

The analysis of tree crown defoliation in Lithuania in 1989-2012 showed that the mean defoliation changed from 18.8% to 24.2% in different years (Fig. 3). Also it was found that the trees of weak defoliation (defoliation up to 25%) were dominated (41.4–74.5%) in Lithuanian forests (Stakėnas et al. 2013).

Although the condition of the most dominated tree species in Lithuania changed much during this period, according to the mean defoliation the following trends were determined: the condition of pine and aspen has insignificantly improved, insignificant worsening was found for birch and spruce trees, while the condition of ash significantly deteriorated. Even after the reduction of air pollution in Europe in 2001–2010, the trends of tree condition in the hemiborealandborealforest zones(where Norway spruceandScots pine dominate in the forests) remain similar to those which were obtained in 1989–1997. This means that the mean crown defoliation decreased in a direction of the emission gradient which was set from the Czech Republic to Finland.

In terms of long-range air transport, Lithuania's geographical situation is particularly unfavourable as the prevailing southwest winds come from the most polluted regions of Western and Central Europe (Juknys et al. 2002). Other equally important reasons for determining the forest ecosystem condition are anthropogenic impacts (atmospheric pollution, direct human activities - technical damage during felling, etc.), abiotic (wind, snow, etc.) and biotic damage (insects, beasts, plant diseases, etc.) and, in recent years, climate change, such as higher vegetation period air temperatures, more frequent summer droughts become more important (Bredemeier et al. 1998,Ozolinčius and Stakėnas 2001,Hu et al. 2008,Hüttl 2009, Ozolinčius et al. 2009, Johnson and Jacob 2010, Fabiánek et al. 2012, Stakėnas et al. 2012).

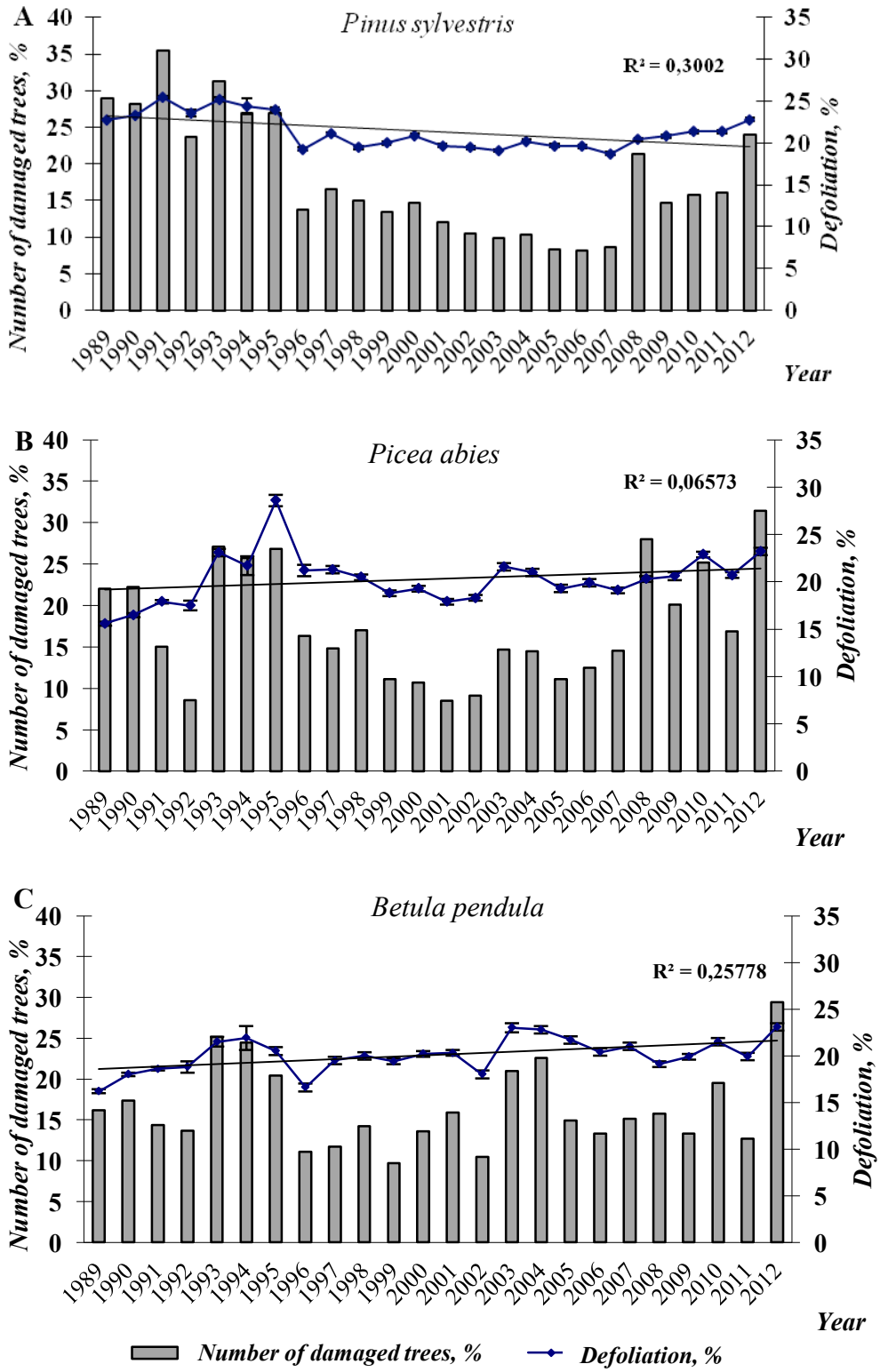

Fig 3. *Mean defoliation (%) and number of damaged (%) of main tree species ((A) Scot pine; (B) Norway spruce; (C) Silver birch) in Lithuania during 1989-2012 year period (Source: Stakėnas et al., 2013)*

Čapkauskas (2016) analysed frequency of trees damaging agents that affected main tree species during 1991-2013-year period in Lithuania. The author found that 28% of damaged trees were determined during the monitoring period. The higher vulnerability has been observed for coniferous (14.4%) than deciduous (32.5%) tree species (Table 2). The higher frequency of all damages was observed in the deciduous stands (average 32.5%), comparing

to coniferous (average 14.4%).Also, the higher frequency of damages caused by forest animals was observed in young pine stands.

Table 2. *Average number of damaged trees (% from all assessed trees) by different cause during 1991-2013 year period (Source: Čapkauskas, 2016)*

	Animal damage, %	**Insects, %**	**Fungi, diseases, %**	**Abiotic factors, %**	**Human impacts, %**	**Other, %**	**All damages, %**
Scots pine	0.26±0.10	1.30±0.38	1.64±0.26	3.96±0.65	1.87±0.32	3.31±0.40	10.07±1.11
Norway spruce	3.41±0.38	2.40±0.63	1.78±0.31	6.33±1.34	3.43±0.55	5.09±0.67	18.77±1.77
Birch	0.42±0.15	6.21±1.62	1.50±0.19	3.47±0.49	1.65±0.24	4.81±0.49	14.70±1.63
Coniferous	1.83±0.31	1.85±0.37	1.71±0.20	5.14±0.76	2.65±0.33	4.20±0.40	14.42±1.22
Deciduous	1.79±0.23	15.75±1.89	7.69±0.77	3.45±0.32	1.98±0.21	7.91±0.62	32.45±1.92
All species	**1.80±0.19**	**12.24±1.49**	**6.20±0.61**	**3.87±0.31**	**2.15±0.18**	**6.99±0.49**	**27.94±1.58**

It was found that insects usually damage about 12% of trees in Lithuanian territory, mostly of deciduous tree species (16%).The frequency of insect damages significantly increased in the stands of *Betula* spp. during the period from 1991 till 2013.Fungi and disease damages annually were fixed in 6% of all accounting trees. The higher frequency of fungi and disease was observed for the deciduous (8%) species.

Lithuanian forest future perspectives

In Lithuania, moving from the north to the south, the proportion of conifer species in the forest stands decreases because of deciduous tree species increase. The most important question is to realise how changing climate would affect Lithuanian forests in the future. Obvious changes should be fixed on forest stands species composition. According to the Lithuanian climate change models, created by specialists from Lithuanian Hydrometeorology service (Galvonaitė and Valiukas 2005), two types of prognosis exist. The first prognosis is based on Climate change scenario B1. According to this scenario, the mean annual air temperature will be by 1°C higher during 2031-2060-year period and by 2°C during 2061-2090 year period compared with 1981-2010 year period. The temperature changes would not affect the amount of mean annual precipitations. The second scenario A2 was predict that mean annual temperature in Lithuania will increase by 2-2.5°C during 2031-2060 year period and by 4°C during 2061-2090 year period compared with 1981-2010-year period. The amount of mean annual precipitations will increase by 15%.

If climate would change according the B1 scenario in the future, Lithuanian climate would become similar to the current climate in Denmark, western part of Germany, Netherlands and northern part of France. If climate would become as predicted in the A2 scenario, Lithuanian climate would be similar to Belgium, northern and southern part of France. Therefore, Lithuanian climate would become more favourable to deciduous species, including silver and downy birches by 2090 (Ozolinčius et al., 2014). However, the part of Norway spruce in Lithuanian forests composition should decrease until 2036. According to the National forest inventory data, the number of *Tilia cordata*, *Ulmus glabra*, *Acer platanoides*, *Ulmus minor* and *Carpinus betulus* in Lithuanian forest growth during 1998-2002-year period. There is a prediction that non-native tree species such as *Quercus pubescens, Abies alba, Fagus sylvatica, Pinus cembra, Pinus mugo, Tilia platyphyllos, Acer pseudoplatanus, Acer* campestre, also*Larix decidua, Taxus baccata, Quercus petraea* will grow naturally in Lithuanian forests until the end of XXI century.

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PRELIMINARY RESULTS OF IMPLEMENTATION OF CLOSE TO NATURE SILVICULTURE IN GREEK OAK FORESTS UNDER THE ASPECT OF THE STAND-LEVEL MANAGEMENT APPROACH

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Abstract

In the present study the first results of the application of the close to nature forestry and of the Prosilva Europe principles in the oak forests under conversion in Northern Greece are presented. Oak forests comprise the most extensive forest ecosystem and are a significant ecological and socio-economic parameter over time. This is why the Greek state, half a century ago, set the strategic goal of the conversion of coppice oak forests into high forests. Technological advances, scientific knowledge and accumulated experience in forest management have led to a revision of the interventions applied in the conversion system. The present management proposal suggests a more detailed forest division from the one that is currently used and at the same time it adapts and implements the concepts of close to nature forestry in two demonstration areas of oak forest under conversion. Finally, it proposes silvicultural and management measures that lead to high oak forests with better ecological characteristics.

Keywords: *Close to nature forestry, oak forests, conversion into high forests, ecological and socioeconomic parameter.*

Introduction

Forest ecosystems form the backbone of the natural terrestrial ecosystems of the planet and of our country, and because of the large extent they occupy today, they consist a site of development of multiple, often "opposing" activities and functions. In modern societies multifunctional forest and "multipurpose forestry" follow the obsolete concept of "woodland" and new needs and priorities are put into the forest management.

The forests in our country perform interconnected functions such as social (recreation, environmental education), economic (primary production, income generation) and environmental (ground-water-atmosphere protection, water cycle, habitat, biodiversity, regulatory role in climate with positive contribution in the "upcoming" climate change) making its management combined and complex.

The forests, as open systems, are subjected to continuous impact by humans and consequently interventions that degrade them. The Greek forest soils due to their mineral composition, the dominant mountainous relief, where more than 50% of the area has slopes

above 10%, and the prevailing Mediterranean climate which characterized by rapid rains, along with the, for centuries, Anthropogenic interventions, resulted severe erosion phenomena, the degradation and limitation of the area the natural forests occupy. It is well known that much of the country's soil, in the order of 30-35% (E.E.S.D.E. 2001), is seriously threatened by degradation due to intense erosion, while the risk of desertification is also serious.

The productive reconstruction of the forests with an emphasis on the sustainable management has long been a challenge to integrate modern requirements (e.g. to enhance biodiversity), to maximize their contribution to the economy, employment and the environment (Strategic Study 1986-2010). In particular, the oak forests - the most extensive and of great socio-economic importance ecosystems - their conversion management and the natural regeneration by seeds afterwards, are still a challenge for Greek forestry. This, of course, must be done through the application of a sustainable and multifunctional forestry based on the known three-fold of sustainable development: society-economy-environment (Zagas 2013).

The Country's oak forests are of high priority given the long term pressure they have suffered through the coppice management (clear cuts with small rotation times). For half a century now, in a large proportion of their area, conversion into high forests is a good forestry practice, but new ideas of forestry science should be incorporated. In this case, Close to nature forestry comes as an assistant and complements the forest practice of conversion by giving answers to important issues such as:

• Description and forest inventory on the basis of the silvicultural stand approach, as a prerequisite for an ecological forest management.

• Change of management and silvicultural systems from coppice to seedlings and from even aged to uneven aged group selection systems.

• Improving the stand structure through interventions in the species composition favoring the mixing of the species,

• Silvicultural measures and volume calculation of allowable cut that have to be applied in each case i.e. stand type and age class of the oak forest.

It is widely known that for many years forests in Europe, particularly private ones, were managed by clear cuts and by the favoring of conifers, especially spruce, at the expense of broadleaf trees (Smaltschinski 1990, Schieller and Schadauer 1993, Schadauer 1994). This has led to monocultures, to the lessening of biodiversity and, more generally, forest health problems. This has resulted in organizations supporting natural forestry such as Pro Silva. Pro Silva strengthens those management strategies that optimize the preservation, conservation and utilization of forest ecosystems in such a manner that their ecological and socio-economic functions are sustainable and profitable. The general approach to management includes marketable and non-marketable objectives taking into account the entire ecosystem. The general goals and objectives of Natural Forestry (PRO SILVA 2012) are the creation of uneven aged, mixed forest with multi-layer structures where they harmoniously combine the productive role of forests (wood production) with the services (habitat, biodiversity , aesthetics, soil protection, water regulation, etc.).

A basic prerequisite for the implementation of natural forestry in the forest management plans is the forest division to reach the detail of forest stand. According to Panagiotidis (1979), the division of the forest should follow the shape: section, subsection, stand type, where the first two categories are identified with geographical-administrative characteristics, while the latter, which comprises the smallest area of temporal dynamic planning, with silvicultural and short term management characteristics.

The aim of this study was to: (a) highlight the importance of creating demonstration areas in oak forests under conversion into high forests for their scientifically sound management;

and (b) highlight the importance of the more detailed division of the management subsection into forest stand types and their importance in Sustainable management of these forests.

Materials and methods

The research was initially based on a review of relevant published articles in Greece and abroad, as well as on approved plans and studies of the country and on the local forest authorities.

The main criterion for choosing the oak species in which the experimental areas would be installed was that of the greatest ecological and socio-economic importance for the country. Thus, the study of the Hungarian oak (*Quercusfrainetto*) stands was chosen.

During the first stage of the project, concerning its experimental documentation, two experimental areas were selected - one in Edessa, Pella and one in Arnaia, Chalkidiki–the dominant species was the Hungarian oak, with the following characteristics:

Table 1: Description of the two demonstration plots

Experimental area 1: Public forest compartment of Sotira, Edessa, Pella	Experimentalarea2: Public forest compartment of Olympiada, Arnaia, Chalkidiki
Section: 4	section: 62 / stand: 62α
Area: 43,8 ha	Area: 60,0 ha
Silvicultural from:even aged	Silviculturalfrom:even aged
Management class: oak under conversion into high forest	Management class: oak under conversion into high forest
$Age_{(2015)}$: 60 years	$Age_{(2015)}$: 90 years
Intervention stage: thinning	Intervention stage: regeneration

The second stage included the preparation and collection of data for the two demonstration areas in order to set up a single monitoring system compatible with that of the Prosilva Europe network so that it can be integrated into the above network. During this stage, the following data were collected for each experimental area:

i. Site characteristics (data set A), using thematic maps such as altitude, slopes, aspects, geological and soil maps).

ii. Biometrical characteristics (group B) using the existing forest maps, vegetation maps.

iii. Other data for the study areas, such as meteorological data, specific studies or surveys such as phytosociological, site classification.

The synthesis of the above data resulted in a series of important decisions that should be taken for the uniform monitoring of the demonstrative plots of the network, such as:

- Determination of the existing variability/diversity of the demonstration plots.
- Selection the sampling method (degree of intensity).
- Selection of the sampling grid (eg 200X200m or 100X100m).
- The choice of the forest management unit (stand type = stand in silvicultural sense).

Then the collected data, georeferenced in the Greek reference system EGSA ’87, were uploaded into a GPS device in order to be available for field work and thus allowing for the control of spatial applicability of the principles of the natural forestry on the selected demonstration plots.

In each experimental plot, control and division of the section into subsections and stand types according to Panagiotidis (1979) classification.

The challenge that had to be addressed was the more detailed and better description of the studied plots at the level of stand type. This also gave the first result of forest management at

stand type level. The distinction of the stand types in the two sites was based on three criteria: the forest species, the site quality and the age class.

In particular, for the experimental area of Chalkidiki, which has been already divided into stand types based on the above criteria, it was verified the accuracy of the stand boundaries. For the experimental area of Edessa, where there was no corresponding information, there has been new division of the experimental area into forest stand types

It is well known in Greece that, the to date, system of inventory - management planning – silvicultural prescriptions, both at the level of Management Plans and at the level of practiced forestry, is far from a modern and holistic forestry.

The stand management method based on Natural Forestry (Prosilva principles) was chosen as management method, aiming at the creation of a mixed uneven aged group forest.

Results

*I.Demonstration plot 1:*Public forest compartment of SOTIRA, Edessa, section 4 & suggested management measures

Ia. Demonstration plot 1 – standtypes division

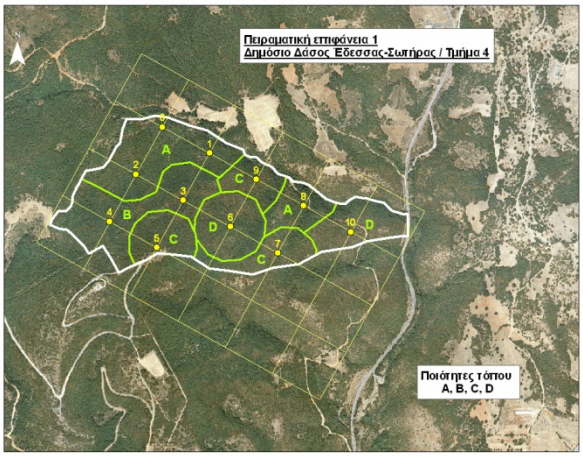

Figure 1: Part of Ortho-foto from the demonstration plot 1 (section 4 – Sotira, Edessa) Basemap EKXA S.A. 2007-2008

Figure 2:Photograph from demonstration plot 1(section 4 – Sotira, Edessa)

Table 2:Data from subsection and stand types of the demonstration plot 1

Sample plots	X	Ψ	Main species	Dbh&Height (cm & m)	Stocking volume (m^3/ha)	Annual increment (m^3/yr/ha)	Site quality *	Stand type	Area m^2 (ha)	Species composition
0	336671,83	4521457,18	Qco	D=11,9 H=9	64,5	3,69	V (IV)	A		Pure hungarian oak & middle site quality
1	336846,65	4521360,01	Qco	D=14 H=12			V (III)	A	92,972	Pure hungarian oak & middle site quality
2	336574,55	4521281,82	Qco	D=16 H=14			IV (III)	A		Pure hungarian oak % middle site quality
3	336749,34	4521184,81	Qpu/Qco/Cor	D=12 H=14	130,6	5,9	IV (III)	B	10,027	Mixed hungarian oak & middle site quality
4	336477,47	4521106,96	Qco/Qpu/Cor	D=13,2 H=14	62,7	3,79	IV (III)	B		Mixed hungarian oak & middle site quality
5	336652,19	4521106,9	Qco/Cor	D=7, H=6			VI (V)	C	46,152	Mixed hungarian oak & poor site quality
6	336924,14	4521087,65	Qpu/Qco	D=12, H=12			V (III)	D	35,507	Mixed/pure hungarian oak & middle/poor site quality
7	337098,96	4520990,48	Qco/Qpu	D=10 H=7	45,3	2,48	VI (V)	C	45,286	Mixedhungarianoak&poorsitequality
8	337195,91	4521165,49	Qco	D=15 H=11			V (IV)	A	40,635	Purehungarianoak&middlesitequality
9	337021,19	4521262,37	Cor/Qco/For	D=9,5 H=7	58,2	3,04	VI (V)	C	25,814	Mixedhungarianoak&poorsitequality
10	337371,17	4521068,15	Qpu	D=13,9 H=7,5	30,4	1,83	VI (V)	D	51,669	Mixed/purehungarianoak&middle/poorsitequality
				Average	65,3	3,5			43,830 (5)	

Sitequality * According to site index of Gatzojiannis & Grigoriadis (2000) and Matis (2000)
Qco: *Quercus conferta*, Qpu: *Quercus pubescens*, Cor: *Carpinus orientalis*, For: *Fagus sylvaticas.l*

Ib.Suggested silvicultural – management prescriptions & results from the test treemarking

In the demonstration plot 1 where the A (Pure Hungarian oak & middle site quality) and C (Mixed Hungarian oak & poor site quality) stand types were chosen the suggested prescriptions were as follows:

- High positive selection. Detection of 40-50 future crop trees per ha and removal of 1 to 2 stronger competitors.
- Favoring of the mixture with noble broadleaved species such as ash, service and wild service tree, maple, wild cherry, elm by removing all the competitors.
- Maintenance and creation of the secondary stand with oriental hornbeam, dogwood and other available species of the understory.

The creation of vertical multi-layer group structure is not possible today because of the young age and the coppice origin of the stand. More specifically, in the area of the demonstration plot it is anticipated to be some regeneration in the near future in a few small existed opening groups.
The test treemarking was carried out in an area of one tenth of a haf or the determination of the intensity and type of thinning (see table 3). In the stand types A & C detected and chosen 9 and 6 future crop trees respectively and marked for thinning 1 to 2 strongest competitors per crop tree. So in the poor site quality a light thinning was carried out by removing 10.3% of the stocking volume and in the better site quality light thinning removing 15.4% of the volume

Table 3: Results from a test tree marking in the demonstration plot 1

Stand type	Future crop tree (FCT) selection	Competitors	Production (Cut)	as % of the stocking volume
A Pure Hungarian oak & middle site quality	1. FCT1 Oak (20cm) 2. FCT2 Oak (20cm) 3. FCT3 Oak (21cm) 4. FCT4 Oak (20cm) 5. FCT5 Oak (16cm) 6. FCT6 Oak (15cm) 7. FCT7 Oak (18cm) 8. FCT8 Oak (14cm) 9. FCT9 Oak (18cm)	1. Oak (13cm) 2. Oak (10cm) 3. Oak (20cm) 4. Oak (14cm) 5. Oak (14cm) 6. Oak (14cm) 7. Oak (14cm) 8. - 9. Oak (14cm)	Σ=0.9m^3/ha	15.4 %
C Mixed Hungarian oak & poor site quality	1. FCT1 Oak (16cm) 2. FCT2 Oak (15cm) 3. FCT3 Ash (12cm) 4. FCT4 Oak (18cm) 5. FCT5 Oak (16cm) 6. FCT6 Ash (10cm)	1. - 2. Oak (20cm) 3. Oak (20cm) 4. Oak (12cm) 5. oak sticks 6.2 Ash (6cm)	Σ=0.4m^3/ha +1200 sticks	10.3 %

The forest labor for the above mentioned work is estimated in 1 ha/ 8 hours per person. Because it is a pre-commercial thinning does not produce any notable commercial wood products.

II. Demonstration plot 2: Public forest compartment of Olympiada, Arnaia, Chalkidiki suggested management measures.

IIa. Demonstration plot 2 – stand types division

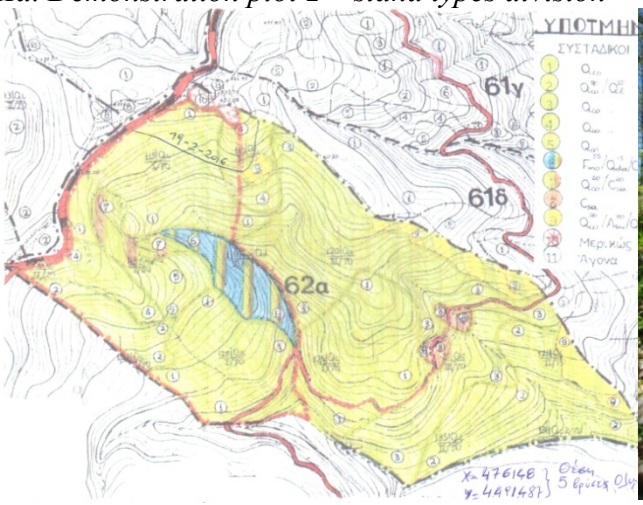

Figure 3: Partof forest species map from the demonstration plot 2 (subsection 62a – Olympiada, Chalkidiki). Map source: Arnaia Forest service

Figure 4: Photograph from demonstration plot 2 (subsection 62a – Olympiada, Chalkidiki)

IIb. Suggested silvicultural – management prescriptions and results from test tree marking

In the case of demonstration plot 2 Olympiada, Chalkidiki, the stand is ending the conversion stage and approaching the regeneration stage. The A (pure Hungarian oak and good site quality 90 years old) and the C (pure Hungarian oak and middle site quality 90 years old) stand type were chosen and the prescribed measures were:

- High thinning and positive selection. Detection of about 40-50 future crop trees per ha (seeds trees) and removal of 1-3 competitors.
- Favoring of the mixture with noble broadleaved species by removing all of their competitors so as to feed the forest floor with lots of seeds.
- Treatment of the understory (in small spots). In the case of stand type 2 removal of the Greek strawberry tree and the heath to facilitate the regeneration of the acorns
- Establishment of new opening groups and expansion of existed, the groups should have approximately twice the height of mature trees, with small openings providing micro-environments suitable for tolerant regeneration and the larger openings providing conditions suitable for more intolerant regeneration.

Table 4:Results from a test tree marking in the demonstration plot 2 Olympiada, Chalkidiki

Stand type	Future crop tree (FCT) (species/dbh / group opening size)		Competitors / peripheral treesδένδρα (species/dbh)		Stocking volume(cut) m^3/ha	As % of the stocking volume
A. PureHungarian oak &good site quality	Selection of (FCT (species/dbh)	1. FCT1 Oak (35,5cm) 2. FCT2 Oak (37,0cm) 3. FCT3 Oak (31,5cm) 4. FCT4 Oak (24,5cm)	Competitors (species/dbh)	1. Oak (37,5cm) 2. Oak (37,5cm) 3. Oak (33,0cm) 1. Oak (32,0cm) 2. Oak (29,0cm) 3. Oak (29,5cm) 1. Oak (20,5cm) 2. Oak (30,5cm) 1. Oak (23,5cm) 2. Oak (28,0cm) 3. Oak (21,0cm)	Σ=74,1	44,60%
	Group opening (shape&size/m^2)	ellipse A-D (1000 m^2)	Peripheral trees (species/dbh)	1. Oak (32,0cm) 2. Oak (29,0cm) 3. Oak (29,5cm) 4. Oak (31,5cm) 5. Oak (35,0cm) 6. Oak (32,0cm) 7. Oak (30,5cm) 8. Oak (24,0cm) 9. Oak (27,5cm) 10. Oak (38cm) 11. Oak (33cm) 12. Oak (30cm) 13. Oak (30cm)	Σ=95.4m^3/ha	57,40%

Stand type	Future crop tree (FCT) (species/dbh / group opening size)		Competitors / Peripheral trees (species/dbh)		Stocking volume(cut) m^3/ha	as % of the stocking volume
C. Pure Hungarian oak &middle site quality	Peripheral trees (species/dbh)	1. FCT1 Oak (30,5cm) 2. FCT2 Oak (24,0cm) 3. FCT3 Oak (27,0cm) 4. FCT4 Oak (25,5cm)	Ανταγωνιστές (είδος/BHD)	1. Oak (23,5cm) 2. Oak (31,0cm) 3. Oak (29,0cm) 1. Oak (26,0cm) 1. Oak (21,5cm) 2. Oak (25,0cm) 3. Oak (26,0cm) 1. Oak (15,0cm) 2. Oak (16,0cm)	Σ=38.2m^3/ha	23.9 %
	Group opening (shape&size/m^2)	Ellipse A-D	Περιφερειακά δένδρα (είδος/BHD)	1. Oak (32,0cm) 2. Oak (22,0cm) 3. Oak (20,5cm) 4. Oak (19,0cm) 5. Oak (26,0cm) 6. Oak (27,0cm) 7. Oak (21,0cm) 8. Oak (27,5cm) 9. Oak (24,0cm) 10. Oak (30,0cm) 11. Oak (21,0cm) 12. Oak (21,0cm) 13. Oak (27,5cm) 14. Oak (27,0cm) 15. Oak (26,0cm)	Σ=70.9m^3/ha	42.7 %

Discussion - conclusions

Nowadays, the country is experiencing a deep environmental and economic crisis and is in the face of critical reforms (and) on forestry issues. Therefore, inevitably, it needs to make a review of its forest resources in relation to their situation and prospects. There should also be an evaluation of their management system so that firstly significant gaps in Greek forestry, such as the silviculture of the conversion into high oak forests, and secondly the incorporation of new knowledge and experience, should be addressed.

In the present study, the first results of the application of the principles of close to nature forestry in two oak forests under conversion into high forests were presented, the first in the phase of conversion thinning and the second in the regeneration phase. Paying attention on the forest management at stand level, the two demonstration plots were divided into stand types determined by three criteria. The stand type boundaries were marked on the ground. New silvicultural prescriptions were discussed and determined for each demonstration plot

(conversion thinning in Edessa and regeneration in Arnea). Generally, the conversion thinning at the first plot ranges between 10-15% applying the high thinning and positive selection as silvicultural prescription, and in the second case the thinning intensity ranges between 30-60% applying seed tree thinning on group openings.

The transition from coppice to the seed tree management and especially in uneven aged silvicultural forms such as group selection as it is suggested also by the Prosilva, demand great experience in silvicultural treatments from the managers and forest practicians both in tenting of young stands and in subsequent thinnings.

Thechangeofthemanagementandthesilviculturalformofouroakforestsitisconsideredadvisable because through these irregular forest forms the forest biodiversity will be increased and to a certain extent the people's life quality who live close to forests will also be increased. Additionally, the application of the principles of close-to-nature forestry will help the forest ecosystems to adapt to the already occurring climate change.

From the present study we can draw the following conclusions:

1. The division of the managed forests in the detailed level of stand types it is considered advisable for the proper application of the principles of close to nature forestry.
2. The light thinning of the order to 12-15% of the stocking volume are considered satisfactory for the conversion thinning in oaf forests.
3. The aim of natural regeneration of the oak forests under conversion into high by creating group selection and where ever it is possible mixed group selection seed tree forests it is considered feasible. The natural regeneration process should be initiated for all forest stands that are already 90-100 years old so as up to the age of 130-140 years to have been regenerated in group selection forms of three age classes.
4. We can support that adapting the principles of Prosilva Europe in our forest practice, our natural forests as basic green infrastructure can support the economy, safeguard the habitats, provide services and contributes to sustainable and resilient natural forest ecosystems.

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STEM TAPERS OF *Fagus sylvatica* IN MUNICIPAL FORESTOF NAOUSA.

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Abstract

This paper examines the statistical behavior of fifteenstem tapers and which distribution each of them follows. Two categories of taper rates were examined, having diameters in relatives or absolutes heights of a tree. Analysis showed that most of the stems have taper values more than 1centimeter per meter. Some tapers fit to the Normal distribution while others fit Gamma, or Lognormal. Also, analysis showed that there is not a taper that gives best results for all the examined criteria but different tapers give best results for different criteria. The data were collected in the Municipal Forest of Naousa from 300 trees of *Fagus sylvatica* using random sampling.

Key words: *stem taper, stem volume, Naousa, descriptive statistics.*

Introduction

The form of a tree is related to the diameter of the tree stem which generally narrows from the base to the tip. Taper is the rate of change in diameter in relation to the increase in height along the tree stem (Grey, 1956). Taper equations are used to predict the diameter of a tree stem at any height of interest (Larsen, 2017). Numerous taper functions of various forms have been developed over the past 100 years, from simple taper functions to more complex forms (Muhairwe et al., 1993). Relatively simple taper functions can effectively describe the general taper of trees (Brooks, 2008). The knowledge of taper is important to the forest industry (Goodwin, 2009; Ikonen et al., 2006). Research has been attempting to develop taper functions from a more theoretical basis, but this work still has far to go (West 2009; Ikonen et al. 2006).

Trees tend to be more cylindrical with increasing stand density(Grey, 1956). A heavily thinned stand exhibits more taper than an unthinned stand over time. Also, a tree in a windy area is more tapered than a tree in a non-windy area. Taper varies in different portions of the stem, being fairly large near the butt on account of the root swelling, diminishing toward the middle and increasing again toward the top (Anuchin, 1970). Species, genotype, age, competition site, and silviculture treatments determine the tapering rates of trees. Larson (1963) pointed out that the most variations in stem form are attributed to changes in the size of the live crown, the distribution of the live crown along the stem, and the length of the branch free bole.

Absolute taper is the difference between the diameters of two cross sections separated by a distance of 1 meter along the stem. For evaluating the taper variations, it is common practice to establish the mean taper. The mean taper is equal to the difference between the large diameter d_1 and small diameter d_2 divided by their distance$L$ (Equation 1).

$d1-d2L$ (1)

In this study the mean taper was used in all taper calculations.

Anuchin (1970) made detailed measurements of over 4,000 logs and established a direct relationship between the mean taper and the log diameter. Prodan (1965) calculated mean

taper to estimate the total stem volume. Georgopoulos (1973) estimated taper for the whole stem using the function:

$d0.1h - d0.9h0.8\,h$(2)

where $d_{0.1h}$ is the stem diameter at 0.1 of the total high of the tree, $d_{0.9h}$ is the stem diameter at 0.9 of the total high and h is the total height of the tree.

According to Maraseni et al. (2007), the knowledge of taper will improve the understanding of species in several ways. It will help to improve estimation of log volume, which could be used for estimation of stem volume. Secondly, it will help to estimate the amount of sawn timber, as for a given volume severely tapered logs will provide less sawn timber than less tapered logs. Also, by knowing the taper, the forest managers can have better information about the growing condition of the trees. By knowing tapers, taper functions can be used. Kozak (1988) mentions that taper functions are known to provide estimates of over and under bark diameter in every high along the stem, to estimate the total stem volume, to estimate a part of the stem volume, and to estimate the high where is a specific diameter.

The purpose of this research is to calculate and compare many of tapers and examine their statistical behavior and if they fit to the Normal distribution, a very common continuous distribution, providing information to forest managers to control and review the effectiveness of management and silvicultural treatments.According to Podlaski (2008), the knowledge of theoretical distributions describing data from mixed forests of abies and fagus would be advantageous in dendrometry, silviculture, forest management, and ecology.

Material and methods

The data used in this study were collected from Municipal Forest of Naousaand for the species of *Fagus sylvatica*. The forest is in north and northeast slopes of Vermio Mountain from height 380 meters to 2,027 meters having main species trees of *Fagus sylvatica*, *Castanea sativa*, and *Pinus nigra*. The species of *Fagus sylvatica*was selected because it is among the major commercial species in the area.

A program in platform Rstudio produced randomly pairs of numbers representing easting and northing, i.e. points in the forest. By using a handheld GPS of Garmin, we reached the points having the coordinates the program produced and we measured the nearest trees of *Fagus sylvatica*. For this study, several measurements were taken on each tree at different heights along the stem. By using caliper,measures of the diameter of stem at 0.3 and 1.3 meter were taken and by using a Spiegel relascop - a sophisticated, compact, and robust instrument for measuring height, diameter, basal area, and range; measures of the diameter were taken along the stem at the 0.1, 0.3, 0.5, 0.7, and 0.9 of the total height. By this way, a pre-sample of 66 trees were randomly selected and measured. The mean taper (cm/m) was calculated using equation 1 that Anuchin (1970)used. To calculate the appropriate sample size of each taper, the following equation was used (Levy et al 1991):

$$n = \frac{t^2\, cv^2}{d^2} \qquad n = \frac{t^2\, cv^2}{d^2} \qquad (3)$$

where *n* is the sample size of each taper, *t* is the value of student's distribution (*t*-distribution) for probability 95%, *cv* is the coefficient of variance, and *d* is the maximum acceptable error expressed as a percent of the mean.For practical reasons the maximum acceptable error is 6%.

The tapers are divided in two groups. The first group includes five tapers having large end diameter the diameter at 0.3 meters from the ground and small diameter the 0.1, 0.3, 0.5, 0.7, and 0.9 of the total tree height. The tapers of the group are symbolized as $\alpha_{0.3\text{-}0.1h}$, $\alpha_{0.3\text{-}0.3h}$, $\alpha_{0.3\text{-}0.5h}$, $\alpha_{0.3\text{-}0.7h}$, and $\alpha_{0.3\text{-}0.9h}$,respectively. The second group includes total ten tapers. Four tapers having large diameters at 0.1 of total height and small diameters at 0.3, 0.5, 0.7, and 0.9 of

total height respectively and are symbolized as $\alpha_{0.1h-0.3h}$, $\alpha_{0.1h-0.5h}$, $\alpha_{0.1h-0.7h}$, and $\alpha_{0.1h-0.9h}$, three tapers having large diameters at 0.3 of total height and small diameters at 0.5, 0.7, and 0.9 of total height are symbolized as $\alpha_{0.3h-0.5h}$, $\alpha_{0.3h-0.7h}$, and $\alpha_{0.3h-0.9h}$, two tapers having large diameters at 0.5 of total height and small diameters at 0.7 and 0.9 of total height are symbolized as $\alpha_{0.5h-0.7h}$, and $\alpha_{0.5h-0.9h}$, and one taper having large diameter at 0.7 of total height and small diameter at 0.9 of total height is symbolized as $\alpha_{0.7h-0.9h}$.

After finishing the collection of data, SPSS ver. 22 was used to analyze them.By using boxplots, data were examined to see if there are any outliers or extreme values and to see if the range in which the central 50% of the observation falls. Descriptive statistics were used to calculate from the data the mean, the standard error of the mean, the upper and lower bound of 95% confidence interval for the mean, the 5% trimmed mean, the median, the coefficient of variance, the minimum and maximum values, the range, the interquartile range, the skewness, and the kurtosis. Because skewness and kurtosis statistics are sensitive to anomalies in the distribution were studied in conjunction with a histogram and boxplot. By using Q-Q plots data were checked if they follow or not the Normal distribution. It is just a visual check, not an air-tight proof, so it is somewhat subjective. Having examined all the above statistics, a conclusion that a taper fits or not the Normal distribution can be extracted.

To see which distribution each taper fits, an R package for fitting distributionswas used. The package is the "fitdistrplus", created by Delignette-Muller et al. (2015) and Delignette-Muller and Dutang (2015),provides functions for fitting univariate distributions to different types of data and also provides various functions to compare the fit of several distributions to the same data set and can handle to bootstrap parameter estimates.Data were tested if they fit Lognormal distribution, Gamma distribution, and Weibull distribution. The parameters of the distribution were estimated by the maximum likelihood function. The goodness of fit to the distributions was evaluated using Kolmogorov- Smirnov (KS), Cramer-von Mises (CvM), and Anderson–Darling (AD). Aikake's Information Criterion (Akaike, 1973) and Bayesian Information Criterion (BIC) (Schwarz, 1978) were also evaluated. The smallest value to the test shows the distribution that fits to the data.

Results - Discussion

Sample sizefor each taperwas calculated by using equation (3). The sample size ranges from 92 trees for taper $\alpha_{0.3-0.9h}$ to 297 trees for taper $\alpha_{0.5h-0.7h}$. In order to have an appropriate accuracy of the estimates, 300 trees were measured. Data analysis results showed that the minimum diameter of sample trees is 12.3 centimeters, the maximum diameter of samples trees is 52.1 centimeters, the minimum total height of the sample trees is 10.1 meters and the maximum total height is 29 meters.As it can be seen from the Figure 1, all the examined tapers have outliers ("x") but no extremes values ("+"). The outlier values come from open grown trees or from trees with good growth and are not removed from the dataset. The outlier values are not from the same trees for all tapers.

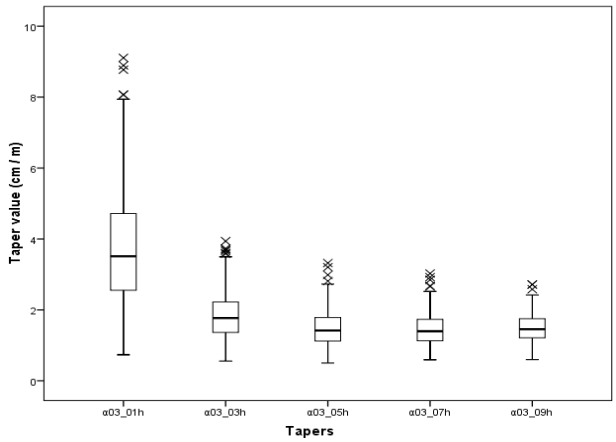

Figure 1. Boxplots for tapers of the first group

The results of descriptive statistics of the first group of tapers are showed in Table 1 and it can be seen that the taper $\alpha_{0.3\text{-}0.1h}$ has the largest mean, almost the double of the $\alpha_{0.3\text{-}0.3h}$ because of root swelling. Comparing the mean values of each taper by the corresponding 5% trimmed mean it is evident that the 5% lower and higher values do not affect the mean. The coefficient of variance shows that the taper $\alpha_{0.3\text{-}0.9h}$ has less variability than the other tapers of the group. As the distance between the two measured diameters of a taper is getting larger, the values of standard deviation, the range, the minimum, and the maximum values and the interquartile range are getting smaller. By examining the skewness and kurtosis of the tapers the conclusion is that the distribution of the taper $\alpha_{0.3\text{-}0.9h}$ is fairly symmetric and it can be said that fits to the Normal distribution.

Table 1. Descriptive statistics for the first group of tapers.

Statistic	$\alpha_{0.3\text{-}0.1h}$	$\alpha_{0.3\text{-}0.3h}$	$\alpha_{0.3\text{-}0.5h}$	$\alpha_{0.3\text{-}0.7h}$	$\alpha_{0.3\text{-}0.9h}$
Mean	3.7137	1.8487	1.5027	1.4638	1.5022
5% Trimmed Mean	3.6372	1.8223	1.4774	1.4431	1.4918
Median	3.5115	1.7703	1.4206	1.3995	1.4557
Coefficient of variance	43.55%	35.66%	32.54%	29.77%	26.15%
Std. Deviation	1.6176	0.6590	0.4891	0.4358	0.3929
Minimum value	0.7352	0.5568	0.5045	0.5937	0.5997
Maximum value	9.1069	3.9394	3.3213	3.0278	2.7163
Skewness	0.6934	0.6152	0.7950	0.7290	0.4257
Kurtosis	0.4079	0.1948	0.6542	0.5842	0.0042

In the next step of the analysis, frequency histograms for each taper were examined and the distributions were also found fairly symmetric. However, histograms could be misleading since the look of a histogram is largely dependent on the "bin" size; the space between the tick marks. By using Q–Q plots it can be seen if the data fits to the Normal distribution or not. Viewing in Figure 2 the Q-Q plots, it can be said that all the tapers approach fairly the Normal distribution. In the extremes of the lower left and upper right the points, representing taper values, fall a little bit of the line; in a Q–Q plot that is not uncommon. Those few points of the line are not enough to say that the distribution of the data is not Normal. However, this is a visual check, not an air-tight proof, so it is somewhat subjective.

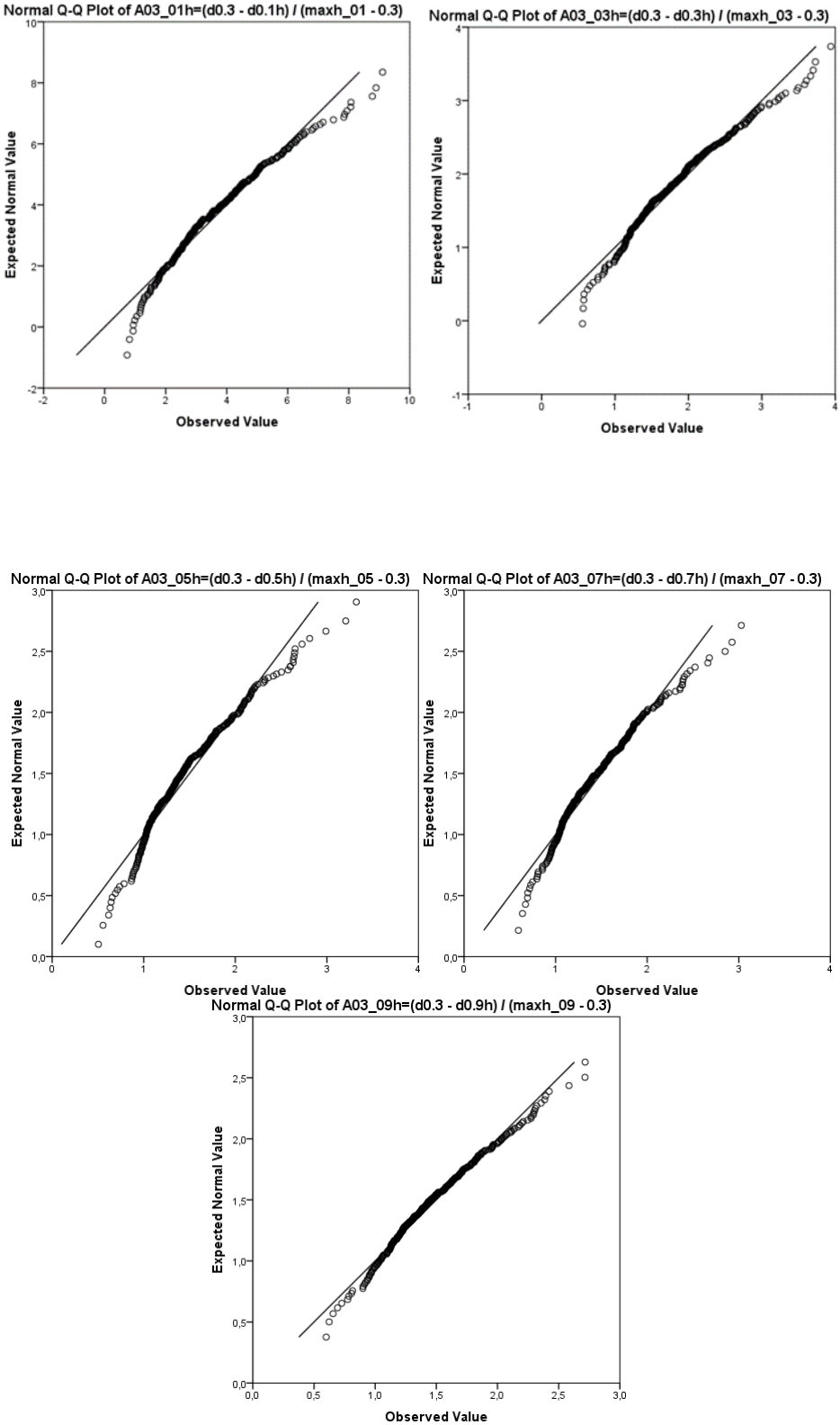

Figure 2 Q - Q plots of tapers $\alpha_{0.3\text{-}0.1h}$, $\alpha_{0.3\text{-}0.3h}$ $\alpha_{0.3\text{-}0.5h}$, $\alpha_{0.3\text{-}0.7h}$ *and* $\alpha_{0.3\text{-}0.9h}$

For that reason, the examination of data using strictly statistical tools is the next step of the analysis. A Kolmogorov-Smirnov statistical test is taking place and shows that only taper $\alpha_{0.3\text{-}0.9h}$ fits to the Normal distribution. For the other tapers by using the "fitdistrplus" package, the results shows that taper $\alpha_{0.3\text{-}0.1h}$ and $\alpha_{0.3\text{-}0.3h}$ fits to Gamma distribution while $\alpha_{0.3\text{-}0.5h}$ and $\alpha_{0.3\text{-}0.7h}$ fit to Lognormal distribution.

For the second group of tapers the boxplots are presented in Figure 3. All tapers have outliers ("x") and extreme values ("+"),in conjunction to the first group tapers where there are no extreme values.

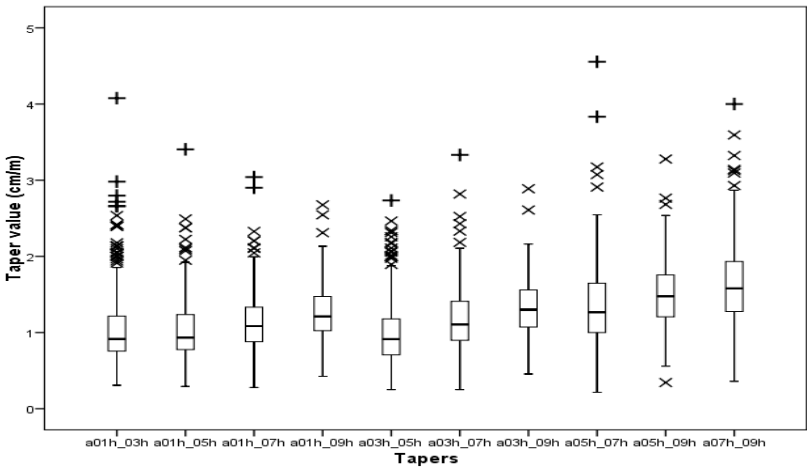

Figure 3 Boxplots for tapers of the second group.

Extreme values can occur because of faulty adjustments of the measurement instruments or by not applying appropriately the correct methodological measurement process. In our cases the extreme values come, mainly, from open grown trees and outliers are coming from good growth trees. The taper values are ranging from 1.03 cm/m to 1.63 cm/m when the taper values of the first group are ranging from 1.46 cm/m to 3.71 cm/m. In taper $\alpha_{0.5h\text{-}0.9h}$ an outlier from the bottom side exists. This taper comes from a very cylindrical stem. The median in many cases is not in the middle of the rectangular box. In Table 2 the descriptive statistics of tapers are presented. In all tapers the difference between the mean and the 5% trimmed mean is small, less than 4%. The coefficient of variance ranges from 27.39% for taper $\alpha_{0.1h\text{-}0.9h}$ to 49% for taper $\alpha_{0.3h\text{-}0.5h}$. Large values of the CV coefficient make the mean value a "bad" index of central tendency.Taper $\alpha_{0.3h\text{-}0.5h}$ has the largest value of kurtosis and skewness. Small values of skewness and kurtosis are observed for the tapers $\alpha_{0.5h\text{-}0.9h}$, $\alpha_{0.3h\text{-}0.9h}$, and $\alpha_{0.1h\text{-}0.9h}$.

Table 2. Descriptive statistics for the second group of tapers.

Statistic	$\alpha_{0.1h\text{-}0.3h}$	$\alpha_{0.1h\text{-}0.5h}$	$\alpha_{0.1h\text{-}0.7h}$	$\alpha_{0.1h\text{-}0.9h}$	$\alpha_{0.3h\text{-}0.5h}$	$\alpha_{0.3h\text{-}0.7h}$
Mean	1.0626	1.0370	1.1480	1.2694	1.0114	1.1907
5% Trimmed Mean	1.0150	1.0017	1.1210	1.2550	.9704	1.1625
Median	0.9212	0.9370	1.0843	1.2138	.9135	1.1061
Coefficient of variance	48.78%	40.97%	34.14%	27.39%	49.02%	37.31%
Std. Deviation	0.5184	0.4249	0.3920	0.3477	0.4958	0.4443
Minimum value	0.3075	0.2918	0.2779	0.4252	0.2500	0.2500
Maximum value	4.0770	3.4052	3.0409	2.6755	4.7937	3.3645
Skewness	1.8019	1.8339	1.3715	0.7784	2.2556	1.3253
Kurtosis	4.8477	5.9402	3.5247	1.2410	11.2418	3.4577

	$\alpha_{0.3h\text{-}0.9h}$	$\alpha_{0.5h\text{-}0.7h}$	$\alpha_{0.5h\text{-}0.9h}$	$\alpha_{0.7h\text{-}0.9h}$
Mean	1.3383	1.3701	1.5018	1.6335
Std Error of Mean	0.0215	0.032	0.0248	0.0317
5% Trimmed Mean	1.3279	1.3409	1.4925	1.6115
Median	1.3009	1.2679	1.4765	1.5783
Coefficient of variance	27.87%	40.51%	28.65%	33.57%
Std. Deviation	0.3730	0.5550	0.4303	0.5485
Minimum value	0.4557	0.2143	0.3429	0.3590
Maximum value	2.8878	4.5547	3.2774	4.0000
Skewness	0.6616	1.3169	0.4119	0.7402
Kurtosis	1.0401	4.3551	0.6561	1.4890

By examining the histograms, the Q-Q plots, the boxplots, and the descriptive statistics of tapers$\alpha_{0.5h\text{-}0.9h}$, $\alpha_{0.3h\text{-}0.9h}$, and$\alpha_{0.1h\text{-}0.9h}$it seems that the distributions of these tapers are fairy symmetric and it can be said that these tapers fit to the Normal distribution. Since there is no

conclusion about which distribution fits to other seven tapers, the use of "fitdistrplus" package took place. By performing the fitting, results showed that tapers $\alpha_{0.1h\text{-}0.3h}$, $\alpha_{0.1h\text{-}0.5h}$,$\alpha_{0.1h\text{-}0.7h}$, $\alpha_{0.3h\text{-}0.5h}$,and$\alpha_{0.3h\text{-}0.7h}$ fit to the Lognormal distribution while $\alpha_{0.5h\text{-}0.7h}$,and$\alpha_{0.7h\text{-}0.9h}$ fit to the Gamma distribution (Table 3).

AIC values	Weibull	Gamma	Lognormal	Normal
Taper $\alpha_{0.1h\text{-}0.3h}$	407,6738	355,1488	**333,0730**	460,1480
Taper $\alpha_{0.1h\text{-}0.5h}$	318,1139	255,6504	**238,1246**	340,7512
Taper $\alpha_{0.1h\text{-}0.7h}$	293,9783	237,6054	**228,9321**	292,46
Taper $\alpha_{0.1h\text{-}0.9h}$	236,0383	197,0024	197,6496	**192,50**
Taper $\alpha_{0.3h\text{-}0.5h}$	380,9053	328,6538	**312,0938**	433,4112
Taper $\alpha_{0.3h\text{-}0.5h}$	359,0191	313,7427	**309,9577**	367,5955
Taper $\alpha_{0.3h\text{-}0.9h}$	275,0364	244,8722	248,9141	**242,6898**
Taper $\alpha_{0.5h\text{-}0.7h}$	486,0048	**457,1433**	468,4496	501,12
Taper $\alpha_{0.5h\text{-}0.9h}$	355,8444	350,5943	361,7957	**348,4197**
Taper $\alpha_{0.7h\text{-}0.9h}$	495,8682	**478,5830**	493,6704	494,06

Table3. AIC values for tapers of the second group.

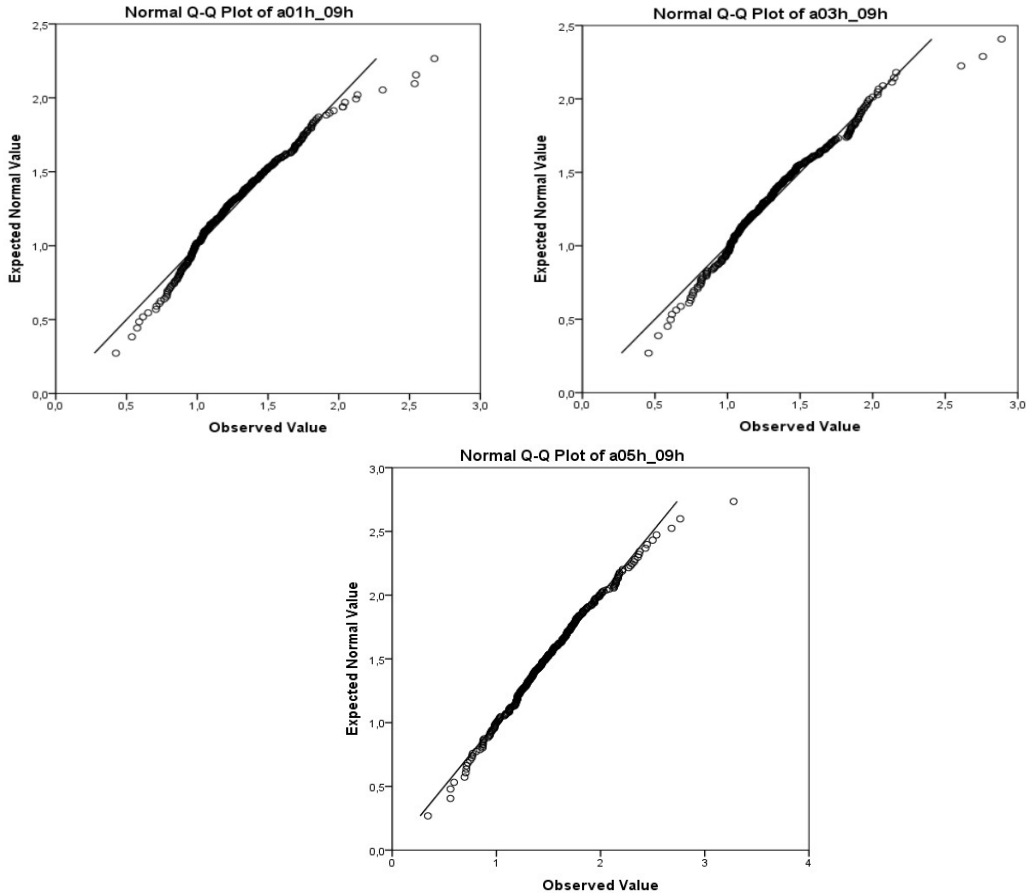

Figure 4. Q - Q plots of tapers $\alpha_{0.1h\text{-}0.9h}$, $\alpha_{0.3h\text{-}0.9h}$, *and* $\alpha_{0.5h\text{-}0.9h}$.

Conclusion

The examination of the fifteen stem tapers of *Fagus sylvatica* shows that all the tapers have values greater than 1 cm/m. Trees with a high degree of taper (greater than 1cm/m) are said to have poor form, while those with low taper (less than 1cm/m) have good form. From practical view, the taper whose large diameter is at 0.3 meters from the ground, is easiest to calculate its value once the large diameter is easy to be measured with calliper and the small diameter will be estimated by using spiegel relaskop. However, the values of stem taper are affected by the root swelling. May be a better choice is taper from 0.8 meters where the influence of root swelling is not big. Having in mind the results of the graphic techniques (boxplots, histograms, Q-Q plots) and descriptive statistics, it is fair enough to say that all tapers of that group follow the Normal distribution, but from strictly statistical view only taper $\alpha_{0.3\text{-}0.9h}$ follows the Normal distribution. Taper $\alpha_{0.3\text{-}0.9h}$ has the lowest coefficient of variance which means smaller sample size for exporting results comparing to other tapers of the group. Furthermore, this taper takes into account diameters with distance between them almost 90% of the total length of the tree.

The second group gives taper values mostly near 1 cm/m. Both measured diameters are estimations using spiegel relaskop. The advantage of this category of taper is that there is no root swelling in their values. The tapers $\alpha_{0.1h\text{-}0.9h}$, $\alpha_{0.3h\text{-}0.9h}$ and $\alpha_{0.5h\text{-}0.9h}$ fit to the Normal distribution, tapers $\alpha_{0.1h\text{-}0.3h}$, $\alpha_{0.1h\text{-}0.5h}$,$\alpha_{0.1h\text{-}0.7h}$, $\alpha_{0.3h\text{-}0.5h}$,and$\alpha_{0.3h\text{-}0.7h}$ fit to the Lognormal distribution and tapers $\alpha_{0.5h\text{-}0.7h}and\alpha_{0.7h\text{-}0.9h}$ fit to the Gamma distribution. Tapers of the upper part of the tree fit different distribution of tapers of the other part of a tree.

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INTEGRATING GLOBAL FOREST FOOTPRINTS INTO FOREST MANAGEMENT SCENARIOS FOR TEN EU COUNTRIES

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Abstract

This research serves to integrate the concept of "ecological footprint" into future-oriented forest management scenarios. Ecological footprints measure human appropriation of ecosystem products and services in terms of the area of bioproductive land and sea needed to supply these services. Scenarios are commonly used to explore stakeholder perceptions of possible forest futures, and are typically focused on the local impacts of different management choices. This paper illustrates how global footprint analysis can be incorporated into scenarios to enable local forest stakeholders to consider the impacts of their local decisions at national and global levels. The scenarios used in this research were drawn from the EU-funded project 'INTEGRAL where ten European countries were included as case studies. It finds that different future forest management scenarios involving a potential increase or decrease of the harvested timber, or potential increase or decrease of subsidies for forest protection, combined with various possible changes in local consumption patterns, might have impact on both "internal" (local) and "external" (non-local) forest or either carbon footprints. Conclusively, crucial decisions to reduce local production, without a concurrent decrease in local consumption, could contribute to an increase in reliance on high risk imports with a net negative impact on sustainability.

Key words: *Forest footprint, forest management scenarios, INTEGRAL project, sustainability*

Introduction

It has been estimated that by the year 2007 humanity was consuming 1.5 times the resources that the earth had produced in a single year (Ewing et al. 2010:18). Moderate UN scenarios, involving low population growth and small improvements in diet, suggest that by 2050 we will require two Earths to support us over the long term (Ibid). International trade is playing an increasing role in the rise of global consumption. In general, as countries gain in wealth they decrease their relative reliance on domestic resource extraction, while increasing their overall consumption and reliance on foreign imports. The concept of a global "footprint" has helped to measure and quantify this shift, by translating all consumption into standardized global units. For example, Wiedmann et al. (2013) define "material footprints" (MF) in terms of the global allocation of raw materials extracted to produce end products. The material footprint of nations calculated by multiplying the final demand of a country for goods and services with multipliers representing all upstream global material requirements associated with one unit (dollar) of product.They find that with every 10% increase in gross domestic product, the average national MF increases by 6% (Wiedmann et al. 2013). Given the global nature of production and consumption, "sustainable" land use planning requires consideration of global footprints, since decisions to produce or consume locally serve to reduce, replace or

displace impacts elsewhere. Area-based measures of global footprint provide perhaps the most intuitive method to link the footprint concept with local land use. These include concepts such as "ecological footprints" and "forest footprints" that translate consumption into standardized units known as "global hectares". The "ecological footprint" measures human appropriation of ecosystem products and services in terms of the amount of bioproductive land and sea area needed to supply these services (Wackernagel and Rees 1996). Six land use types are considered in this calculation: cropland, grazing land, fishing ground, forest land, built-up land, and carbon uptake land (Ewing et al. 2010). The uptake land to accommodate the carbon Footprint is the only land use type included in the Ecological Footprint that is exclusively dedicated to tracking a waste product: carbon dioxide" (Buonocore et al 2014).Box 1 outlines the Wackernagel and Rees formula for calculating footprints (Wackernagel and Rees 1996, Wackernagel et al. 2004, Nie et al. 2010). The degree to which footprints are sustainable depends, in part, on the overall capacity of the land to support them. Wackernagel and Rees (1996) have coined the term "biocapacity" to refer to the biosphere's ability to meet the human demand for material consumption and waste disposal.

Box 1: *The Footprint equation*

Footprint (gha)=consumption (tonnes)/ Global Yield $_{annual}$ (tonnes/ha) * Equivalence Factor $_{annual}$ (gha/ha)

or

$$EF=\Sigma R_j\,(P_i+I_i-E_i)\,/\,Y_i$$

Where

- **EF** (Ecological Footprint): A measure of how much area of biologically productive land and water an individual, population or activity requires to produce all the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management practices (measured in global hectares) (global hectare: a productivity weighted area used to report both the biocapacity of the earth, and the demand on biocapacity (the Ecological Footprint).
- $\mathbf{Y_i}$ (Yield Factor): A factor that accounts for differences between countries in productivity of a given land type.
- $\mathbf{P_i+I_i-E_i}$ (Consumption of the wood products (i) category): For this study it used the apparent consumption witch calculated as "production plus imports (It includes imports for re-export) minus exports (It includes re-exports) as FAO defines (FAO 2010).
- $\mathbf{\Sigma R_j}$ (Equivalence Factor): A productivity- based scaling factor that converts a specific land type (such as cropland or forest) into a universal unit of biologically productive area. j is one of the six specified categories of ecological productive land. e.g. For forest land and for the year 2005 is 1.33 (WWF 2008).

The main focus of this study is to analyze the forest footprints and biocapacities often European countries that were included as case studies in the EU-funded project 'INTEGRAL', a project exploring future-oriented integrated management of European forest landscapes. This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grand agreement No 282887 (Hinterseer et al 2014). The majority of the INTEGRAL project was focused on the development of future-oriented scenarios and policy back-casting for sustainable forest management within select forest areas in each of the case study countries. The footprint analysis included in this paper serves to situate these locally-oriented INTEGRAL case studies into global context. In particular, it examines how a global perspective might influence the definition of what is sustainable local forest practice. Since the forestry contexts in the INTEGRAL case studies were highly diverse as well as highly interdependent, this analysis also draws on the INTEGRAL case study scenarios to explore ways to address this interdependence.

Material and methods

The main aim of the INTEGRAL project was to provide a better understanding of the challenges and opportunities presented by integrated forest management in Europe. The project is especially innovative in linking developments at the management and programme levels with policy change. The project addressed two questions: what forest-related future scenarios ('forest futures') might unfold during the next 25-30 years, and, what might be their impacts as regards ecological, socio-economic, and policy aspects (Sotirov et al. 2015).Previous project results reveal that the key factors 'Policies, laws and regulations', 'Forest ownership structure', 'Timber markets', 'Bioenergy markets' and 'Subsidies', and to some extent 'Non-wood ecosystem goods and services', are likely to be the most influential factors shaping future forest management in Europe (Sotirov et al. 2014). Based on the above questions and on these key factors, forest stakeholders in twenty landscape case study areas in ten EU countries (Bulgaria (Teteven and Yundola), France (Pontenx), Germany (Munich South and Upper Palatinate), Lithuania (Suvalkija and Zemaitija), Portugal (Chamusca, leiria and Vale de Souza), Slovakia (Kysuce and Podpolanie), Sweden (Helge a and Vihelmina)), Italia (Asiago, Etna, Molise), The Netherlands (South-East Veluwe) and Ireland (Newmarket and Western Peatland).) developed a range of future scenarios to explore the implications of different management priorities. One common perception between the case studies, for example, is the tension between growing public interest in forests for recreation and conservation on the one hand and timber production and /or profit maximization on the other. Scenarios supporting the former goals are presented as "Green values" in Sweden, "Romantic nature" in the Netherlands" and "Ecology" in Lithuania. The latter scenarios are presented as "Production++" in Sweden, "liberal future" in the Netherlands and "Maximum potential benefit" in Bulgaria. This paper examines the implications of ecological versus production oriented scenarios for "internal" and "external" forest footprints using quantitative methods to collect, organize, interpret and present data. The data about consumption of wood products were received from FAOSTAT (2014) database and the primary data for the footprint figures were received from the Global Footprint Network (2013). We then present a case study from the Netherlands (South-East Veluwe) to diagrammatically and quantitatively illustrate the relationship between different stakeholder scenarios and global forest footprints.

Results

The above introduction to global ecological footprints highlights the current excess and inequality of global consumption, as well as the increasing reliance on international trade. The relationship between these overall patterns and forests, however, is quite complex. Currently, the leading global driver of forest loss is the expansion of commercial agriculture in tropical countries, and EU consumption plays a significant role in supporting this expansion (Cuypers et al 2013). In this regard, it is the EU's production and consumption of agricultural products, and to a lesser extent biofuels, that exerts the greatest impact on global forests. We suggest that participatory forest land use planning can serve as one venue for generating discussion among forest stakeholders about these cross-sectoral linkages and how EU countries and communities might best address it. However, since the focus of the INTEGRAL project was on the integrated management of forestlands, we will concentrate the remainder of our analysis on the role of the forest sector. Wackernagel and Rees (1996) have defined forest footprints and forest biocapacity in terms of timber production, consumption and trade. From this perspective, the world's total forest footprint is less than half of the biocapacity of its forestlands (Global Footprint Network 2013). However, all this tells us is that the total quantity of forest products harvested does not exceed the mean annual increment, i.e. the growth, of the world's wood supply. It tells us nothing about the quality of this footprint. That

is, it doesn't tell us how the wood was harvested, who benefited from it, and what the impacts were on local communities, biodiversity and other ecosystem services. Forests are clearly valued for more than timber, so we make no claims as to the "sustainability" of current levels of forest product consumption. Rather, we view the assessment of footprint size or quantity as an important first step in considering consumption within the context of planetary, national or ecosystem-level boundaries.

i) The Quantity of EU production, trade and consumption

Europe is a major producer and trader of forest products. Over half of Europe's forests are designated for production – a much higher percentage than the global average of 32 percent (FAO 2006). The region accounted for almost one-third of global production in 2006 and nearly half of the world's trade in forest products with imports of US$158 billion and exports of US$184 billion (FAO 2006). Figure 1 and Figure 2 present EU (28) forest products production, exports and imports within the category Forest + (FAOSTAT 2014). The graphs highlight how the EU as a whole is currently producing a large percentage of the wood products it consumes, but is also an important trading partner with non-EU countries.

In total, EU production of products that measured in cubic meters (cum) (Figure 1), including roundwood, sawnwood, veneer and fiberboard, fluctuated from 423 million cum in 2009 to 528 million cum in 2007. In contrast, the imports and exports fluctuated at lower levels. The imports ranged from 128 million in 2009 to 159 million in 2006, and the exports from 113 million in 2001 to 151 million in 2007. Production measured in tonnes (Figure 2), including pulp and paper products, increased during the examined period. The production began to increase from 170 million to almost 200 million in 2007, followed by a short decrease in 2009 (174 million) and finally reached the amount of 193 million in 2012. Parallel increases were observed in imports and exports with a small dip around 2009, 2008. However, the rise in exports of pulp and paper products has been greater than the rise in imports. In regards to future projections, the EFSOS (European Forest Sector Outlook Study) model highlights a general tapering off of growth in wood products consumption in Western Europe combined with ongoing dynamic growth in Eastern European markets through 2020, as these markets continue to mature (Kangas and Baudin 2003). In terms of net EU/ EFTAconsumption, the greatest increase will be in paper and paper board, rising to nearly 122 million metric tonnes in 2020 from almost 77 million metric tonnes in 2000. EU/EFTA countries refer to 15 European Union member countries and Iceland, Norway and Switzerland (Kangas and Baudin 2003). They reported that in 2000 the consumption of sawn wood was approximately 90 million cum and will be over 106 million cum in 2020. The consumption per capita of wood-based panels will follow the same trend, from 44 million cum approximately in 2000 to over 63 million cum in 2020. Jonsson (2012) mentioned that according to EFSOS II (UNECE, FAO 2012) the average annual growth rate of consumption in EU/EFTA countries using A1 scenario (a future world of very rapid economic growth) for the period 2020-2030 would be 1 % for sawnwood, 2% for panels and 1,9 % for paper and paperboard. Additionally, using the B2 scenario (more emphasis is on local solutions to economic, social, and environmental sustainability) the above percentages are 0,5 %, 0,9 % and 0,9 % respectively.

Buongiorno et al. (2012) made one more long range study with projections obtained with the Global Forest Products Model GFPM (Buongiorno et al. 2003, updated in Buongiorno and Zhu 2011) giving an outlook for 2030 and 2060 for the world forest and forest industries under different scenarios. Those scenarios concerned the future of population, the GDP growth, the energy use, the land use changes and finally the resource availability. According to the Scenario B2 (medium future changes of the above) it could be calculated that the sawnwood consumption of EU (25) will remain at the levels of 100 million cum in 2030 and a decrease at approximately 95 million cum will take place in 2060. In addition, the estimation

of the sum of consumption of newsprint, printing and writing paper, and other paper + paperboard (same as the paper and paperboard reported by Kangas and Baudin 2003) as a total will reach the amount of approximately 100 million metric tonnes in 2030 and 114 million tonnes in 2060. The EU (25) also expected to keep the levels of wood based panels (plywood, particle board and fibreboard) consumption at almost 62 million cum in 2030 and approximately 60 million cum in 2060. Similar trends are reported in other studies with long term projections for the forest sector, such as the successor EFSOS II (UNECE, FAO 2012), FAO Global Forest Products Outlook Study (Zhu et al. 1998) and ETTS V (Baudin and Brooks 1995). The EU/EFTA is also expected to increase its production and exports across these product groups. In other words, emerging economies will play an increasing role in both forest product production and consumption. In sum, from the perspective of global footprints, sustainable forest production and consumption has become an increasingly international question.

ii) The total footprint calculation for forest products

According to the Global Footprint Network (2013) the EU's per capita forest ecological footprint (FEF) is more than twice that of developing countries, and equals the equivalent of roughly 64% of its per capita forest biocapacity. However, as illustrated by our case study countries, there is considerable variation within the EU both in terms of footprint and forest biocapacity (Figure 3). Figure 3 highlights major variation in the internal surplus or overshoot in the forest footprint of EU countries, ranging from the Netherlands whose forest footprint is over 700% of its forest biocapacity, to countries like Finland and Sweden who consumer only a small fraction of their forest biocapacity. If, on the other hand, one compares countries' forest footprints per capita with global average biocapacity per capita, then the results look quite different. Figure 4 presents these results for the INTEGRAL case study countries. In this case, Lithuania and Sweden lead with the highest per capita forest footprints in absolute terms. Perhaps the most important message to take from Figure 3 and 4 together is the need to consider both local and global contexts when assessing forest sector impacts. The sustainability of a country's consumption levels depends on many factors, including the environmental and social costs and benefits of local wood production versus other substitutable products. For example, it may be relatively sustainable for a country like Sweden that is richly endowed with forest resources to consume more wood per capita than Portugal.

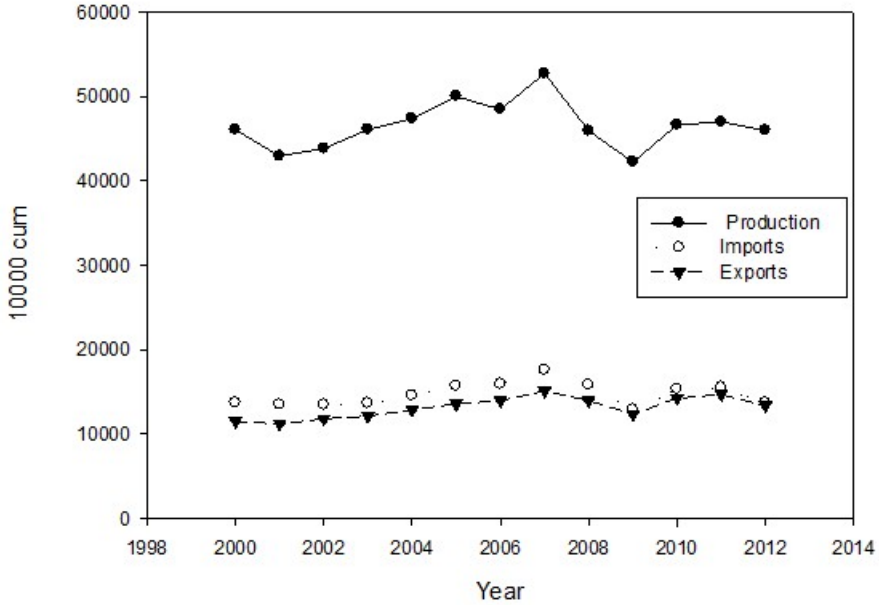

Figure 1. EU(28) forest products trade in cum. (Chips and particles, Hardboard, Insulating Board, MDF, Other Indust Roundwd(C), Other Indust Roundwd(NC), Particle Board, Plywood, Sawlogs+Veneer Logs (C), Sawlogs+Veneer Logs (NC), Sawnwood (C), Sawnwood (NC), Veneer Sheets, Wood Residues).

As highlighted in Figure 3 bellow, the INTEGRAL case study countries vary considerably in the balance of their per capita forest footprints and biocapacity. In general, those countries with the greatest domestic overshoot are those with low per capita forest area—including most notably the Netherlands and Ireland. These differing forest endowments in turn have stimulated high levels of internal EU trade reflecting the interdependence of EU forest footprints. For example, Sweden reportedly exports 69% of its sawnwood production, with top importers including Great Britain and Germany (Edwards et al 2013). Likewise, 26% of Swedish pulp and 88% of Swedish paper production is exported and the leading markets are Germany, Great Britain, Italy and France (Ibid). Intra-EU trade was also identified as important to the emerging economies of Bulgaria, Lithuania and Slovakia. However, in these latter case study countries, EU and Asian markets for unprocessed wood combined with relatively low technical capacities at the forest and mill levels are reportedly reducing their ability to maximize the value of this trade as well as develop their own internal processing capacities (e.g. Paligorov et al. 2013).

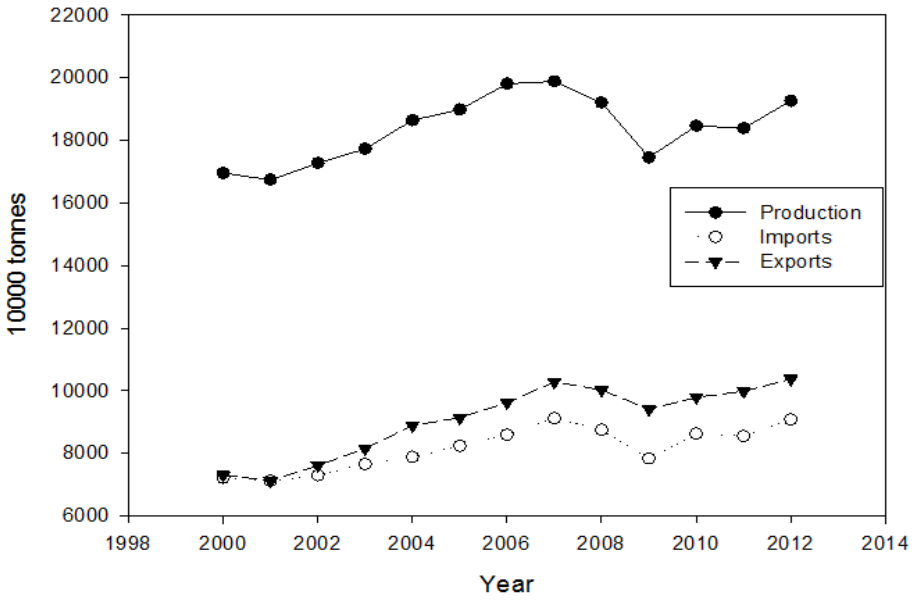

Figure 2. *EU (28) forest products trade in tonnes. (Dissolving Wood Pulp, Mechanical Wood Pulp, Newsprint, Other Fibre Pulp, Other Paper+Paperboard, Printing+Writing Paper, Recovered Paper, Wood Pellets, Wood Charcoal, Semi-Chemical, Wood Pulp).*

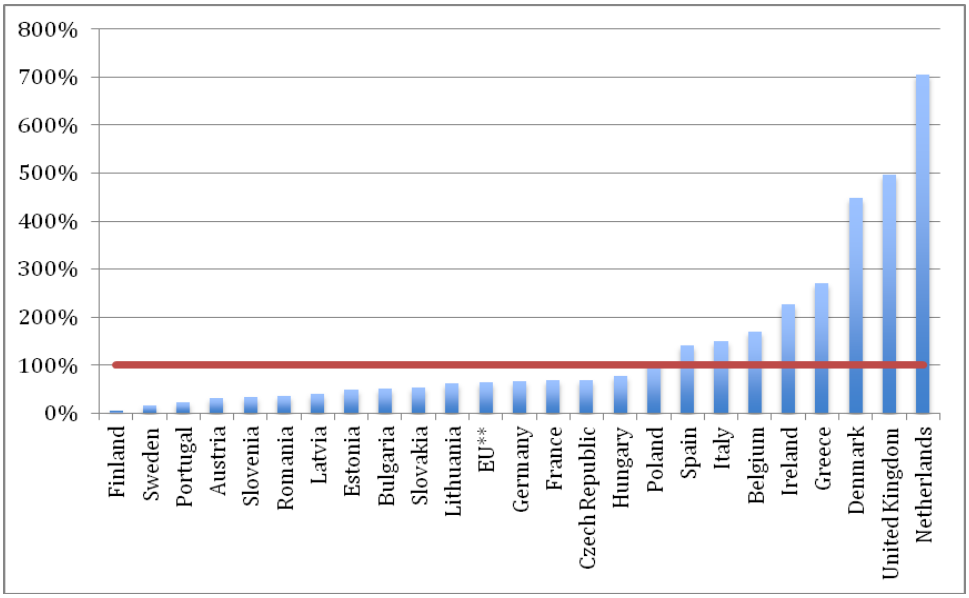

Figure 3. *Forest footprint per capita as percent of a country's per capita forest biocapacity (red line highlights the 100% threshold).*Source: Global Footprint Network, 2013. National Footprint Accounts, 2011 Edition.

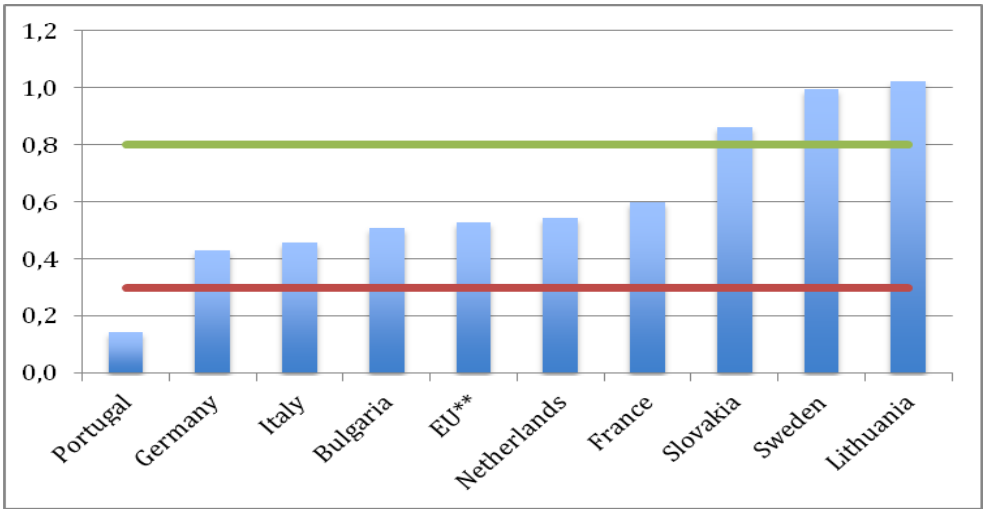

Figure 4. *Forest footprint per capita for INTEGRAL case study countries compared to global average (red line) and global biocapacity (green line).*Source: Global Footprint Network, 2013. National Footprint Accounts, 2011 Edition

iii) Case study contexts

The Irish case study, in contrast, reports positive impacts from EU trade. In this case, EU demand for wood from the growing plantation base has helped compensate for the drop in domestic demand that resulted from the crash in building construction brought on by global recession (Bonsu and Dhubháin 2013). Intra-EU wood trade is not only impacting forest economies, but their ecologies as well. The Eastern European case studies in particular note problems with excessive, destructive and/or illegal forest harvest practices driven in part by growing international demand for timber (Brukas et al. 2013, Paligorov et al. 2013). Meanwhile, in France and Portugal the international competitiveness of eucalypt and Northern spruce and fir, combined with recent hurricane damages and fires, are contributing to the loss or conversion of once-profitable maritime pine forests (Sergent et al. 2013, Sottomayor et al. 2013). The growing international market for biofuels is also seen as impacting forest practices in many case study countries, although there is no clear consensus on how it will do so. For example, stakeholders in Italy variably view growth in demand for biofuels as a potential environmental threat that will drive intensified forest production, or as an incentive to "clean" the forest through thinning and the removal of deadwood which will help prevent forest fires (Pettenella et al. 2013). In sum, the forestry contexts in the INTEGRAL case studies are not only highly diverse, but also highly interdependent. The following subsection explores ways to address this interdependence in the process of future-oriented scenario building.

iv) Case study scenarios

The following Figure 5 and Figure 6 draw on the Southeast Veluwe (Netherlands case study) as an example to explore how one might examine the implications of ecological versus production oriented scenarios for "internal" and "external" forest footprints. "Internal footprint" in this context refers to the extent of their local impacts on forest biocapacity, while "external footprint" refers to the displacement of this impact elsewhere to other watersheds, regions and/or countries. As illustrated in Figure 5, the "Romantic nature future" scenario involves subsidizing forest protection, strong public interest in protecting non-timber forest values and matching public policies along with little development of the timber sector. This would likely lead, in turn, to decline in timber production and a decrease in the internal forest footprint. The impact of different scenarios on external footprints would depend on whether there were any corresponding changes in local demand for timber products. If demand remains at current levels, then reliance on imports would increase to accommodate the shortfall leading to an increase in external footprints. If, however, local demand for wood

products decreased an amount equivalent to the drop in local production, then the external footprint would remain stable. The above "Liberal future" scenario (Figure 6) contrasts with the "Romantic nature future" scenario. Here subsidies for forest protection decrease which increases pressure on forest owners to generate income from forestlands. At the same time, an increasingly urbanized public loses interest in recreation and nature protection and the profitability of timber harvest is enhanced by lower management costs and higher timber prices. All of these factors contribute to an increase in timber harvest resulting in a larger internal (local) forest footprint. As with the Romantic nature future scenario, the impact this has on external footprints depends on changes in consumer demand. If demand is stable, then it could lead to a decrease in imports which would reduce the external footprint. If local demand increased equally with increases in production than reliance on imports would remain stable.

The issue of energy impacts is also relevant to the INTEGRAL case study scenarios in regards to their treatment of biofuel production. In fact, a number of different European case study scenarios include trends in fuelwood and biofuels as a major defining element. Biomass production in these scenarios is often associated with more intensive management and shorter rotation forestry. In some scenarios an increase in intensive biofuel production is associated with "utilitarian" or production-oriented futures (e.g. in the "Utilitarian future" scenario in Southeast Veluwe, Netherlands) while in others biofuel product is combined with strict set-asides for nature conservation and/or carbon storage. (e.g. in the Climate change mitigation scenario in Suvalkija, Lithuania). Assessing the footprint effects of these different biofuel scenarios is a complex and controversial endeavour which requires evaluating tradeoffs for biodiversity and other forest values as well as calculating global forest and carbon footprints. This again highlights the need for further research.

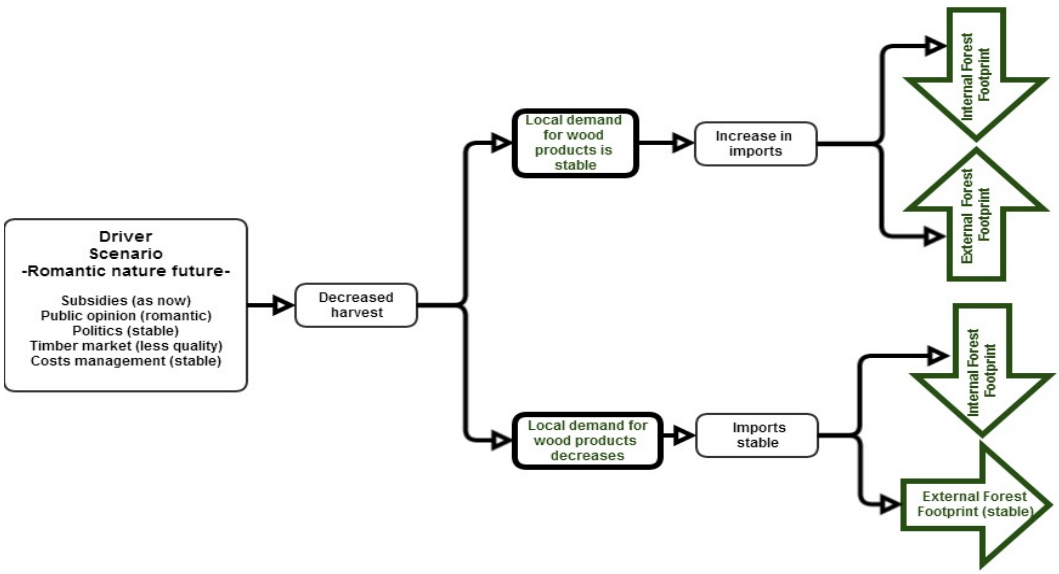

Figure 5. *Driver Scenario - Romantic nature future (Southeast Veluwe, Netherlands)*

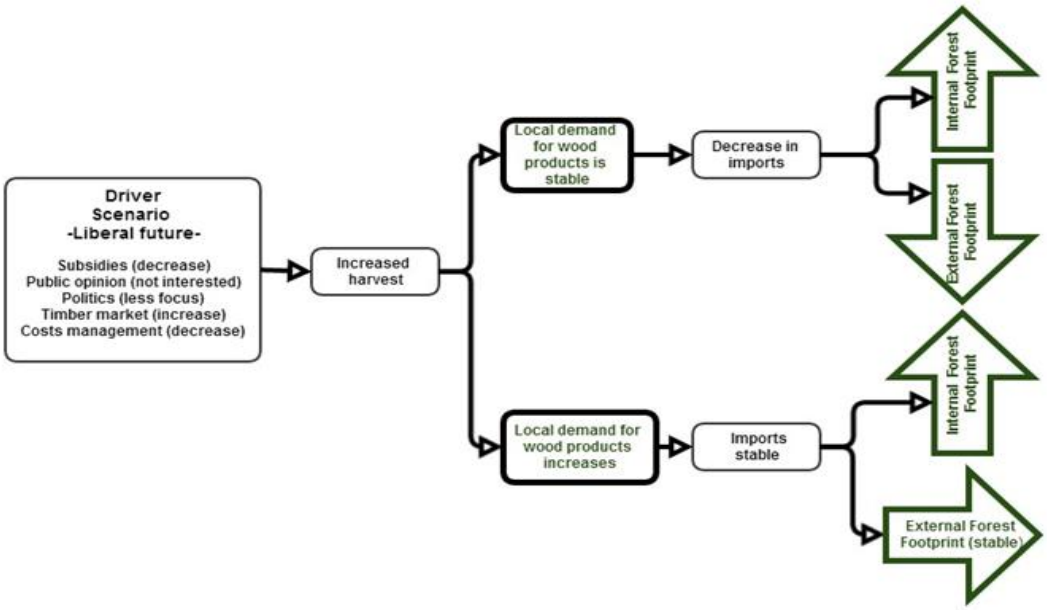

Figure 6. *Driver Scenario-Liberal future (Southeast Veluwe, Netherlands)*

Discussion and Conclusion

As our world becomes increasingly globalized, decisions about forest and land use in one part of the world have increasingly greater impacts elsewhere. The concept of global footprints provides one tool for local forest stakeholders to begin to think about the impacts of their local decisions across scales. This includes quantitative calculations which can be applied at various scales to compare apparent consumption of forest products to the earth's "biocapacity" to supply those products. Likewise, similar calculations can be made to assess "carbon footprints" based on the amount of "uptake land" required to supply the energy consumed in producing, transporting and trading products. As we illustrated in the previous section, it is then a relatively straightforward matter to link these quantitative footprint concepts to the scenarios created by INTEGRAL case study stakeholders. Figure 5 and Figure 6 provide a graphic illustration of how scenarios involving an increase or decrease timber in harvest, combined with various possible changes in local consumption patterns, might together affect both "internal" (local) and "external" (non-local) forest or carbon footprints. The concept of "footprint", however, can also be interpreted more broadly to extend beyond biocapacity and carbon to encompass all of the forest values identified by forestry stakeholders. For this purpose, the concept of "footprint quality" for the identification of the sources of EU forest products is really important in terms of consumption and sustainable forest management. Fully "integrated" forest planning and scenario processes would involve not only identifying what values are locally important but considering how those values might be coherently promoted at national, EU and global scales.

The analysis of the international wood trade highlights how significant quantities of wood products traded and consumed within the EU originate from countries where the risks of illegal or unsustainable logging are high. Thus the ecological and social impacts of buying a cubic meter of wood from these sources, i.e. the "quality" of the footprint this generates, may be quite different from a cubic meter of wood produced locally. For example, eastern Russia is a region with relatively high rates of illegal and/or unsustainable logging and is also a major source of primary processed wood for the EU. Likewise, Secondary Processed Wood Products (SPWP) are increasingly sourced from China, and much of the wood used to produce these products originates in eastern Russian and high risk tropical countries. Thus decisions to reduce local production, without a concurrent decrease in local consumption,

could contribute to an increase in reliance on high risk imports with a net negative impact on sustainability. While the concept of "footprint quality" thus helps call attention to the global significance of local actions, there is need for further research to inform local stakeholders about the precise nature of their external impacts. For example, researchers such as Lindner et al. (2010) are exploring methodologies that integrate a wide range of social, environmental, and economic variables and energy use to assess the relative impacts of different wood supply chains. On-going research is also needed to inform consumers and consuming countries how they might transform their consumption policies and practices in ways that support improved forest governance worldwide (e.g. Lesniewska and McDermott 2014). Given predictions of ever-increasing globalization and rising global consumption, the need for further research of this kind is likely to grow ever-larger and more urgent over time.

Acknowledgements

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BLOCKCHAIN AND RFID POWERED MODEL TO COMBAT CURRENT AGRICULTURAL PROBLEMS

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Abstract

Technological advancements have offered a wide range of solutions to several agricultural challenges. Numerous tech innovations have been developed and tested around the world, with diverse degrees of success, to assist the agricultural sector increase productivity and incomes, and reduce risks. However, those very advancements that have automated hard and time consuming labor, have also created a series of challenges that are hard to solve. Excessively long supply chains, release of unsafe foods into the market, e-commerce difficulties, and consumer behavior patterns are just a few of the problems to overcome. A new technology, blockchain, has come with the promise of a fourth industrial revolution. This paper addresses a number of challenges in the agricultural sector and presents a tentative solution via a blockchain and RFID powered model.

Keywords:*Blockchain, RFID, Supply Chain, Agriculture*

Introduction

Blockchains represent one of the most disruptive technological innovation of the last twenty years. They can pave the way to groundbreaking research, technology development and disruptive innovation, igniting the creation of revolutionary business models and markets in a wide number of fields, including financial services, commerce, smart contracts, the Internet of Things (IoT), cyber-security, machine-to-machine transactions and many others.

The ability of blockchains to track transactions in an atomic manner makes their deployment desirable when an asset is transferred as they can keep track of the asset's movements. While the asset is transferred from point A to point B there might be several intermediate points in between. It is of ultimate importance that the asset is not tampered with, diverted or modified in any way without prior permission. Blockchains can be used to track sensor measurements and avert any kind of duplication with another malicious value in the same timestamp and thus securing sensor data from malicious attacks (Shanmugasundaram 2016).

In the agricultural sector, blockchain technologies can influence three key areas. First, consumers demand for quality fresh food but producers and manufacturers are having a hard time to verify the accuracy of data from farm to table. The ability of blockchain to make the supply chain entirely transparent and rich with immutable provenance data from farm to table assists in providing solutions to this problem. Second, blockchains have the potential to create and improve access to finance in the developing world through mobile payments, credits, and decreased transaction fees. Over a billion people worldwide dealing with agriculture, many of whom are smallholder farmers in developing countries are enabled affordable access to capital. Third, blockchains enable trustworthy, efficient supply chains in the developing world as they can improve they can improve the settlement process for farmers, buyers, and financiers like banks. Adding transparency, trust, and efficiency to settlements can decrease risk and unlock new financing mechanisms for banks (Weston et al. 2016).

This paper addresses several of the challenges in the agricultural sector and presents a tentative solution via a blockchain and RFID powered model.

Section2 presents the currentstatus of e-commerce growth, consumer preferences in regards to price and product question, green supply chains, and green marketing respectively along with its challenges.Section 3 describes blockchain and RFID technologies while Section 4 presents the proposed solution based on a synergy between blockchain and RFID. Section 5 describeshow the proposed model actually may solve the challenges presented in 2 through the blockchain and RFID powered model and Section 6 presents the conclusions along with our future work and plans.

Basics of the Agricultural Industry and its Challenges

In this Section, we present an overview of the agricultural industry in relation to online sales of products, e-commerce growth, customer behavior alongwith several of the challenges that the industry is faced with.

E-commerce Creep towards Market Dominance

E-commerce, online transactions between clients, existed since the 70's but was strictly limited between participating organizations linked with telephone cables and infrastructure of that time (Kay 2000). High costs, the absence of personal computers, and lack of user friendly applications that the general public could use to conduct transactions obstructed e-commerce from emerging as the concept we know today. It was not until 1994, when the first navigation browser was released by Netscape that B2C transactions were made possible and the first secure retail transaction took place (Wai 2016). The opportunity to increase gains through online sales was embraced by many which was reflected by the excitement and investments that were poured into it stock-wise (Geier 2015). Nearly two decades after the dot-com bubble that followed, permanently closing down several e-commerce firms, online sales seem to be steadily rising against brick-and-mortars sales. Whereas both brick-and-mortars and purely e-commerce firms have seen growth in sales, e-commerce has secured more of the pie, accounting to 8.4% of sales in the 3rd quarter of 2016 in the US (Business Intelligence 2016).Nonetheless, the road to success is not all silky as e-commerce firms that offer perishables have to deal with a range of issues that act as barriers to grocery shopping from the end consumers' point of view. Individuals, who value freshness of their food over the time and effort saved by ordering online, are unlikely to let others pick out their greens (Kestenbaun 2017). Long queues, unpleasant in-store environment, time spent into pushing a cart around, are all reasons why shoppers would choose online than in-store shopping (Looney 2015) except that the *distrust* associated with letting a clerk choose their products for them is a major drawback.

Non-secure payments

E-commerce websites place a lot of importance on the security of payment transactions and account details of their customers for obvious reasons. Sensible consumers would turn their back to websites that do not guarantee safety of their money. Numerous attempts to strengthen secure transactions include the deployment of https websites, transactions through middlemen such as PayPal, pin codes, and the list goes on.

Nonetheless, hackers are always a step ahead in finding ways to bridge security measures as it has been proven through history. Personal information of approximately 70 million Target (discount store) customers was stolen in 2015 (Summe 2014). In 2013, roughly 10 million MasterCard and Visa card holder accounts were stolen leaving many vulnerable (Bickle 2012). The security bridge of colossal organizations that are involved in astounding volumes of transactions only goes to show that no individual claims immunity from fraud and

theft. Guaranteed online security and protection of customer funds would be expected to boost e-commerce sales as it would eliminate barriers to it as perceived by customers themselves (Deepak 2016).

Freshness of Produce

Online grocery shops should ultimately rid customers of all the drawbacks of the traditional shop visit. Avoidance of long queues, noise, shelves not stocked with the produce they intended to buy, and the list of in-store shopping burdens grows larger than the actual shopping list.

On the other hand, online shopping of perishables as it is currently imposes drawbacks of different nature. Shoppers do not entrust their shopping to the store clerks for a variety of reasonable considerations. They might feel that the produce that has been selected is not the freshest in stock and it is rather the produce that the store wants to get rid of before it spoils (Poulter 2011). Clerks might also be less careful with their order, treating their items harshly to the extent that it is damaged. Incomplete order deliveries, late dispatch, odd substitutes, are a few of the reasons why shoppers return to brick and mortars (Ramus and Nielsen 2006).
It is clear that the main obstacle to increased online sales of perishable goods is the severed trust between the end-consumer and the store.

Supply Chains, Price and Quality of Products

Consumers sensibly keep a vigilant eye for supermarket deals. Price, nonetheless, has a direct effect in purchase decisions as when food is too expensive, price sensitive consumers are repelled, while if it is deemed too cheap, one may find himself/herself wondering about the quality of the food that he/she is about to put in the basket (Heeraman 2015). Certainly, perception of value for money is affected by the socioeconomic environment that the consumers live in. Supposing a once flourishing economy becomes stagnated and struggling, purchasers are most likely to turn to discounters for their weekly shopping and place less importance on food quality and safety as they simply cannot afford it (Felsted 2014). On the other hand, buying cheaper products does not necessarily imply lower quality, or at least not much lower than those highly priced. Discounters such as ALDI and Lidl in the UK are investing their profits into boosting sales rather than piling it up and it has proven to be effective as ALDI has seen an increase of 4 billion pounds from 2010 to 2014 and Lidl has seen an increase of 1 billion pounds for the same period (Felsted 2014).

The exact opposite is happening in China which suffers from severe pollution. The five-day red pollution alert declared by Beijing authorities in December 2016 has made it clear that pollution is a matter that has to be immediately dealt with (Philips2016). The smog that grounded many flights trapping locals and barring entrance to inbound flights is also contaminating the region's and country's produce in general. A survey report released by the Hong Kong Trade Development Council (HKTDC) shows that more than half of the respondents prefer to buy imported food at a much higher price over fears of health hazards they are prone to when consuming local produce (HKTDC 2014). Placing importance on origins is a great way to avoid putting contaminated food on the dinner table.

Consumers' concerns over food safety and quality are constantly increasing and retailers demand for more for large volumes of consistent and reliable product. As a result the role of production and supply chain management is becoming more significant. More effective and efficient food supply chain management systems are required for the food production planning, collection, processing and storage at various levels, handling, packaging, and distribution of final product to the consumer. This process involves many stakeholders such as farmers, vendors/agents, wholesalers, rural retailers and suppliers and transporters. For maintaining the food quality throughout the supply chain, it is essential that information flow

and management of produce is preserved at all levels (Gebresenbet et al. 2012). One of the main challenges faced with is the lack of transparency which may have several forms and result to the consumers being deceived. Moreover, it is often the case that consumers are not well educated about their rights, laws that do not affect them directly, or about the processes of the firm (RealWire 2015).

Traceability has become of utter importance as public health safety and potentially imposed laws (i.e. EU, USA, Japan, etc.) are pushing entities in any supply chain to keep records of product conditions (Kelepouris et al. 2007). However, the conventional means of produce movement which involves lots and a numbering system is rather prone to inaccuracies, uncertainty, and inability to truly trace a product. It is due to that exact tracing inability that once a contaminated product has been identified, it requires the recall of nearly all stock – if not entirely – based on plain suspicion and fear of contamination (Paterson 2017). Reverse logistics alone is a costly procedure. Add product disposal costs, refunds, severely damaged brand value as the recall is likely to make the headlines on the next day's newspapers, and you have yourself a recipe for financial catastrophe.

Lack of traceability also sets the ground for fraud to prosper. Origin of produce is now an important factor into shaping consumer purchase decisions as seen with the Chinese market in early sections of this paper. As both tracking and tracing in a supply chain are hard to follow, swindling entities within the supply chain do not face enough deterrents to proceed to fraudulent actions that could harm the reputation of all the actors that were involved in the movement of the product. For instance, a farmer who grows or imports two varieties of rice, exactly the same in appearance, but differ in price and quality, might mix the two varieties in order to maximize profit.

Moreover, longer and global supply chains have become complex to the extent that maintaining transparency throughout its entirety is a strenuous task if not ambitious (Source Intelligence 2016). It could be the case where the entity right before the end consumer does not know everyone who partook in the movement, transformation, or mixture of the products that they received. This prevents actors in the supply chain to revise the role of their counterparts which makes assessments and restructure of the supply chain to eliminate vulnerabilities and unnecessary services nearly impossible.

Green marketing, many times associated with green supply chains is a selling tool for many companies. It is imperative for firms to follow lawful trends that might bring some extra profit and so they did with green marketingexcept products were labeled as green without being subjected to changes that would justify the new label. Some products would be labeled as green just because their production did not break the nation's legislations and policies regarding the environment. Consumers would pay a *premium price* for "green products" that were no different than others that simply did not break any law (Peattie and Crane 2005).Surface of the truth would only harm the trust and brand loyalty of the consumers, resulting in backlashes for the organizations that engaged in activities described above. For instance, the UK based seafood marketing company "John West" has been scrutinized by Greenpeace in 2015 for its fishing practices. More specifically, Greenpeace claims that only 2% of its tuna is caught using fishing methods that are harmless to other species and, thus, it would fail to meet its pledge that 100% would be caught through sustainable fishing by 2016 (BBC 2015).

The complications of such incidents, just as unsafe food circulation through supply chain mismanagement, are the opaqueness and the lack of truly verifiable information. John West responded to the accusations coming from Greenpeace with denial and said thatthey were very well on their way to meeting their goal (BBC 2015), but who can prove it? Just as Greenpeace cannot prove that John West sources its fish through unsustainable fishing practices, John West cannot substantiate the opposite. A study by Delafrooz et al. (2013)

indicates that advertisements with the purpose of informing consumers about a firm's environmental friendly activities and products has the greatest effect on consumer behavior resulting into more sales. However, it also indicates that failure of advertisement campaigns to bring in more moneyis largely due to the low credibility of the particular green advertisements.

Blockchain Technology and RFID

Blockchains

Blockchain represents one of the most disruptive technological innovations to have happened in the last twenty years: it can pave the way to ground-breaking research, technology development and disruptive innovation, igniting the creation of revolutionary business models and markets in a wide number of fields, including financial services, commerce, smart contracts, the Internet of Things (IoT), cyber-security, machine-to-machine transactions and many others. Agriculture is one of the industries that can immensely benefit from the efficiency and effectives that blockchain promises.

Whether private or public, distributed ledgers based on blockchain offer trust as the records are immutable. Provided that participants in the network are good-willed, only data that has been deemed as reliable and true are accepted and added to the chain in the form of blocks. Once added to the rest of the chain, the records are impossible to alter producing records whose content is undisputable and allows for complete transparency (Leibowitz 2016). As the contribution towards the final product for each actor in the supply chain would be clear, the share of revenue is only a minor computational matter that could be automated as well.

Smart contracts have been a great addition to blockchain technology as non-complex contracts can be self-enforced, if the promisor and promisee agree, allowing for automated transactions (Schatsky 2016). Thanks to the immutability of records and trust that blockchain offers, smart contracts can be more secure than conventional contracts where actions of the parties might be hard to prove (Christidis et al. 2016). Although smart contracts have yet to be developed to enable enforcement of complicated contracts, they are still capable of enabling day-to-day transactions and minor processes in industries that could still be a game changer for the business processes as a whole.

RFID Tags

Radio-Frequency Identification (RFID) has been around for a few decades considering that it was introduced in the early 70's and was later on used to enable automatic toll payments (Roberti 2005). Mass production resulting in lower acquisition costs has led to the wide adoption of the technology; from doors unlocking with RFID cards to wireless payments.

For RFID enabled applications, there have to be two components that make the transmission of the radio-waves possible; the RFID reader and transporter, commonly known as RFID tag. RFID tags can then be broken into two main categories: *passive* and *active*. Passive tags with extended memory can store up to 2KB of data where as active tags can store up to 128KB (Pais and Symonds 2011). The difference between the two is that active tags come with a battery that will provide the tag with sufficient energy to transmit all the information stored on it. In order to store and transfer more data, size is sacrificed as active tags are larger than passive which is a major drawback for installation on small and inexpensive objects (Pais and Symonds 2011). Passive tags on the other hand are smaller and cheaper but they come short of the storage space that the active tags offer.

The current function of the RFID reader isto detect the presence of a tag (within approximately 30 feet) and read the data that is stored on it. In the case of passive tags, just enough energy is transmitted to it to transmit the data stored on it to the reader (Vogt 2002).

As active tags would need more energy to transmit the data that are stored on it, the battery they are integrated with comes to the rescue (Pais and Symonds 2011). The data that have been read are usually stored on a central database via middleware. That central database is accessible by nodes that have been authorized, but, the weakness of a central database being cybersecurity, the database is also accessible to unwelcomed parties.

Blockchain and RFID synergy

RFID technology is ideal for tracking the movement of goods and even for storing trivial information about the product itself. Except for a small detail: whether the data is stored on the tag itself or on a network, data security cannot be completely enforced as anyone who receives access to the middleware that can add, view, and modify the data, can intentionally alter the content.

Data-on-tag storage which is the process of storing data on an RFID tag provides a somewhat decentralized system as information of products that flow within the same supply chain are stored on each products tag separately instead of a centralized database (Diekmann et al. 2007). Data-on-tag storage bears a lot of risks and limitations. Should the tag itself be damaged because of any external factors, all data stored on it is lost as there is no backup to restore it. Storage itself is very limited as previously mentioned, especially when it comes to passive tags (Diekmann et al. 2007). Even if a database is set up to store the content of the tag, data captured and stored in real time on the tag would take some time to be transferred to the database leaving them vulnerable. Furthermore, reliance on a central database to any extent would take away from the decentralization someone would hope to achieve using data-on-tag methods.

Data-on-network storage on the other hand does not have considerable capacity limitations as capacity can be scaled to the needs of the organization (Diekmann et al. 2007). It also provides security from hardware malfunction or damage as there is usually a backup, whether the organization maintains its own servers or it chooses to outsource them to a cloud service provider. On the other hand, having all data accumulated through the RFID tags and readers concentrated at a centralized server makes it vulnerable to malicious intent. In the extreme, but not impossible, scenario where an employee unintentionally mishandles a batch (e.g. products left out of freezers for longer period than acceptable, products transported to the wrong destination), provided he has authorization to access the central database, he could arrange the appropriate changes to cover up the incident. Of course, when referring to alteration of data from internal entities, the same could happen with data-on-tag storage, but data-on-network storage is prone to alteration from external entities as well.

Blockchain is a technological advancement that solves the security issues that RFID based systems are challenged by. Wherever the data is stored, it is protected from both malicious acts and catastrophic events (Iansiti and Lakhani 2017). If the data captured by an RFID system is transmitted onto the blockchain via middleware, then it can never be altered. Moreover, each node (e.g. computer, cell phone, etc.) connected to the network works as storage for the data as they maintain the records stored in the blockchain.Let's examine the example of the employee attempting to change data regarding the delivery of the product to the wrong destination. Without blockchain technology, he could easily delete or alter the data provided he had access to the middleware that can perform such actions. With blockchain technology and the automated insertion of RFID captured data into a block, no single entity in the entire of the network could alter or delete the record.

The combination of blockchain and RFID based systems have the power to optimize supply chains, turn them green(er), and solve issues that plague e-commerce and marketing that derive from supply chain inefficiency.

Concept of Blockchain Backed Logistics

A study by Kelepouris et al. published in 2007, presents a system architecture of a supply chain empowered by RFID technology (Figure 1). The architecture is developed around a central information system which stores the data captured by the RFID tags. This section aims to analyze their model, suggest means of decentralization, integration of DLT with RFID, and extend its scope.

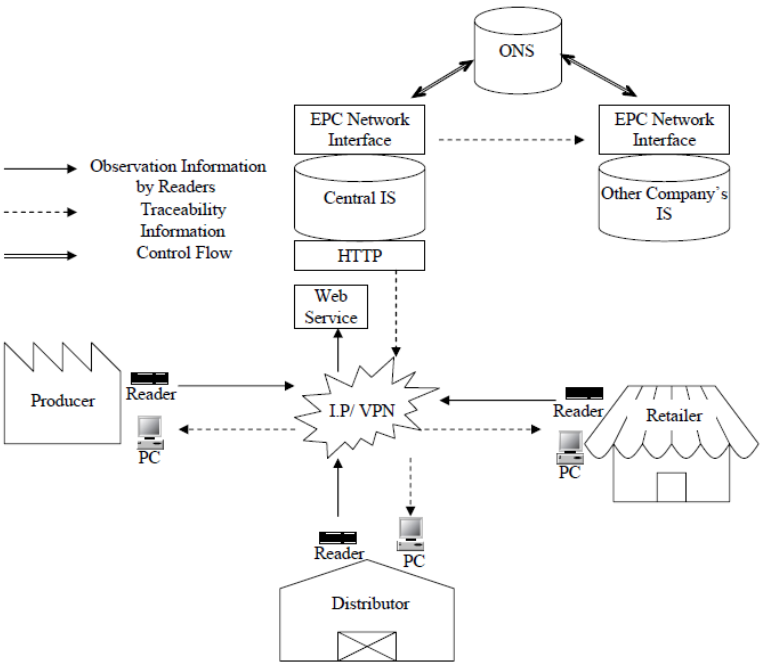

Figure 1. Kelepouris et al. RFID based system

Requirements of a distributed system and security

If the above system was to be converted in a decentralized one, based on blockchain, then a lot of the entities shown in the diagram would become obsolete. Blockchain by default is a distributed database with no central host. As soon as a block is added to the chain, then every node in the network receives a copy of the blockchain that was verified. Each node having a copy of the distributed database alleviates problems linked to central points of storage. In case a node is damaged, the records do not vanish as they can be retrieved from the other nodes that participate in the network whereas in the case of a central information system, all records would be lost along with the damaged infrastructure.

Figure 2 visualizes a distributed network of nodes that blockchain technology forms along with the infrastructure requirements to record information in the block. The device can be anything that can connect to the internet and perform the computational work necessary to be a part of the blockchain network. It could be a PC, a smartphone, a tablet, or any device that satisfies the needs of the implementing supply chain entity. With that being said, every circle representing a node can be considered as an entity in the supply chain.

In a distributed environment as the one visualized in Figure 2, the infrastructure requirements are extensively minimalized. Each node or entity needs to have the RFID readers that will transfer the data on the tag to the device of choice which will later be forever stored in a block, should the device be connected to the internet.

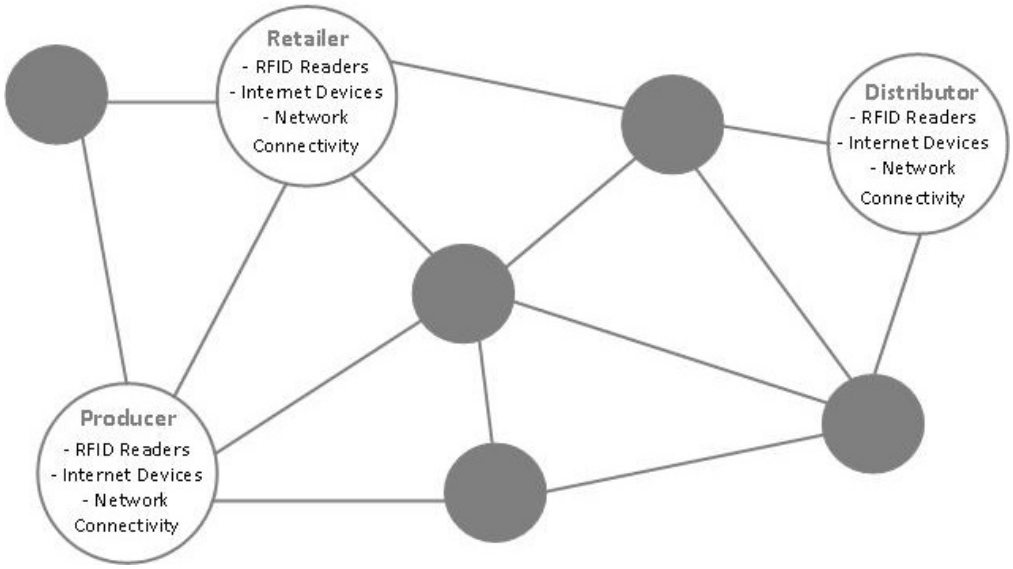

Figure 2 Blockchain and RFID powered model structure

The central database is eliminated ridding entities along the supply chain of the any unwelcome security breaches and malicious data alteration. The risk of a malicious activity is increasingly becoming an issue to be concerned with as ransomware attacks increased by 300% from 2015 to 2016, counting 4,000 attacks a day (CCIPS 2016). Maintaining files that can be accessed by third parties puts the firm in risk of being locked out of them, similar to the NHS case in May, 2017 after the WannaCry ransomware attack (Graham 2017). Alteration, or encryption in the case of ransomware, is infeasible as the records on the blockchain cannot be modified and are shared among participants. New records dismissing the validity of previous ones are indeed possible and could be used to misguide and misinform, but for anything to be recorded, consent and validation from all network participants needs to be granted.

Once the central database becomes obsolete, so does the EPC Network interface and any software used to transmit data between the partnering organizations. In conclusion, as seen in Figure 2, the Kelepouris et al. requirements for running a RFID based transparent supply chain are halved, making anything from the central database onwards unnecessary.

Produce Traceability

As blockchain solves trust problems that other technologies cannot, it only remains to develop a tentative model for achieving true traceability in the agricultural supply chain. RFID tags and means of handling them are the protagonists of this section as we assume that there is an uninterrupted connection to an IP network for data transmission and record creation purposes.

To draft a traceability model, the container of the product must be decided. It would not be a wise idea to attach RFID tag to agricultural products directly as that would deteriorate the overall appeal of the product to the consumer, undermine its monetary value, and raise question over the safety of the tag itself as it could easily be removed by having a piece of the product cut out. Nonetheless, a lot of products are already packaged and sold in batches, which makes it easy to attach the RFID tag where the barcode, for instance, would be. Oranges are put into nets, spinach in plastic bags, broccoli in plastic wrap, and so forth. Attaching RFID tag on small quantities of produce does help keep track of the produce once it reaches a distribution center or the retailer before they are purchased by the consumers.

On the other hand, movement of the product from the point of harvest cannot be done with the aforementioned method as they are not even packed yet. Instead large lots, that could be potentially customized to fit the delivery vehicles employed by the agricultural firm, should also carry an RFID tag containing origin information. Once the lots have arrived at the packing center, the information on the lot tags can then be replicated onto the tags that will be placed on the package itself.

Origin information cannot be automated with existing, mainstream technology which mandates human intervention to create that first entry. What happens when the individual assigned with that task intentionally or accidentally places RFID tag containing deceitful data on the wrong lot?

Product surveillance from sprout to harvest

Blockchain technology can be utilized beyond produce tracking. After all, country of origin does not necessarily guarantee high quality and safety.

Site-specific crop management (SSCM), analysis of soil and crop condition to apply only what is needed in order to save resources, is made possible with variable-rate application (VRA) methods and their tools (Grisso et al. 2011). VRA sensors can perform a remarkable range of measurements such as soil microbial populations, disease occurrence, crop growth, harvestable yield, soil and water pollution, etc. (Bongiovanni & Lowenberg-Deboer 2004). Such data is invaluable when it comes to classifying produce as safe-to-consume or as hazardous. As these sensors can be wireless to transmit collected data to a device for services such as dashboard provisions, they could be twitched to send data for blockchain records. Once this is achieved, the farmers, distributers, and all interested parties in the supply chain, can find out at any time whether the crops were subjected to external factors that could deteriorate the quality of the final product.

Sensors that measure quality of the environment the crops grow are not the only ones that could constitute an essential actor in the process of ensuring produce quality. Yield monitors measure the yield and moisture levels at the time of harvest (Franzen 2008). Measuring moisture at the time of harvest might not significantly change the quality classification shown by VRA data but measuring the yield can be used as a lead to ensure one important matter; that no irrelevant produce outside the slot that is being worked on has been mixed with the rest into the lot. For instance, assuming that the slot is being worked on is expected to yield approximately 300KG of X product, but the total quantity found in the lots amounts to 400kg, then the deviation is large enough to cause suspicion of compromise.

Damaged Cargo

High or low temperatures can damage the products being transported. Damage could be in the form of appearance alteration, flavor distortion, growth of hazardous bacteria, etc. In cases where there is no visible damage to the product, such as that of bacteria development, the end consumers' health could be in risk and the retailers' reputation under scrutiny.

Temperature sensors embedded on the lots carrying the produce could record the temperatures at all time while transmitting the highest and lowest temperatures onto a device(s) that will later create the record on the blockchain. All involved parties which have an interest in the conditions the produce was transported in (i.e. distributors, retailers, consumers) may know at any time whether the produce could be possibly damaged.

Customer Platform

All of the proposed actions would not be of much value if data collected during the growth of the crops, their harvest, and the movement of the product, did not become available to the consumer.

When buying online, retailers could accommodate the provision of the data collected at the time of the check-out. Consumers could then be informed about the quality of the product, the origin, condition they were in while being carried, and the harvest and packaging date. As an extra layer of reassurance, once the consumer received their order from the retailer, a code provided to them could be used to verify the displayed information through a platform maintained either by a union of retailers, or a governmental agency dedicated to consumer satisfaction and protection.

In the case of visiting an actual branch of the store to purchase groceries, verification of all the aforementioned information could be done through devices equipped with either barcode scanners or close-range RFID readers that will automatically retrieve data from the platform and then display them on the screen. Similar devices exist today but their function is to display the price of the product as sometimes, due to human error and neglect, products are shelved without a price tag.

Proposed Solutions

This section describes how the blockchain based practices developed in Section 4 can solve the problems associated with e-commerce, supply chain, and customers themselves as presented in Section 2.

Non secure payments become history

Bitcoin was brought into the world by Satoshi Nakamoto in late 2008 as the first cryptocurrency underlain by blockchain (The Economist 2015). A medium of exchange that is fungible, highly divisible, durable, transportable, and un-counterfeit-able. Cryptocurrencies such as Bitcoin, Ethereum, and Litecoin, to name a few, are the obvious way to enable safe transactions over the internet. Consumers who choose not to purchase their groceries online, or individuals who do not even own a card in fear of becoming victims to fraud, could engage into fraud-proof e-commerce activities once cryptocurrency payments are widely embraced by merchants.

It will not be long until cryptocurrencies are recognized as a valid medium of exchange for both online and in-store purchases. AEON, the largest retailer in Asia, has partnered up with IBM to build a blockchain-powered payment platform with their primary aim being to financially include underprivileged areas in Asia where financial exclusion is at its highest (Samburaj 2017). The platform will also be designed to facilitate allocation and redemption of loyalty points while in the meantime offering better data management.

Freshness of produce

Yield sensors, which measure yield and moisture at the time of harvest, could be twitched to timestamp the harvest. Consumers may check the date of harvest of the products they are purchasing through the platform described in Section 4.5 to avoid paying a premium for products labeled as fresh but, in fact, are not.

Traceability

At every stage of the practices mentioned in Section 4, there is an RFID tag attached to the product in handling. RFID readers could be placed at all units that the product will be subjected to any sort of handling in order to record the arrival of the product to the unit. The true origin of the product can then be available to the consumer, once again, through the platform provided by a union of retailers or governmental agency.

This practice can be extended to products that use agricultural produce as raw material. A firm might claim that their fruit pie is a produce of the nation that is being sold in, but that

would not be entirely true if the pie was baked in that specific nation but the fruit themselves were sourced from abroad.

On a different note, any entity within the supply chain could benefit from the provision of tracking information. In cases of contaminated products making it into the market, retailers may recall only the products from the source-to-blame. Through blockchain, you can pinpoint in detail, not only the brand that has been contaminated, but also which unit of the brand spread the unsafe products. Recall costs could be reduced by millions of dollars if all reverse logistics costs are accounted for.

Transparency

Complete transparency of all the entities partaking in the supply chain can be achieved through the use of blockchain. Entities that are involved with procuring, packaging, and processing the product are automatically identifiable as their physical units are equipped with RFID tags reporting to the blockchain

Other entities such as sales representatives, accountants, and distributors, who are outsourced can also be identified through the blockchain through either the settled of transactions with existing cryptocurrencies or their own invented tokens that do not necessarily maintain their own value, but rather maintain a fixed value in correspondence to the fiat currency used in transactions (i.e. 1 token = 1 dollar). Participation of all entities in the blockchain network regardless of their involvement, will enable stakeholders to review and optimize their supply chain at any moment, riding it of unnecessary entities that cause longer lead times and unjustified costs.

Conclusions

Maintaining food quality and safety in the agricultural and food supply chain is of ultimate importance for the welfare of humans. The supply chain however is complex and retaining transparency, immutability, and safety of the food and the information associated with it from the point in time it is produced till it reaches the consumer is a compound process. Blockchain technologies appear to provide us with potential solutions to several challenges that the agricultural industry is faced with. In this paper, we propose a solution powered by blockchain technology and RFID. Sensors placed at the field where production is underway, monitor, capture and send information to the blockchain that are essential to supply chain stakeholders and consumers, such as possible contamination, soil properties, and insecticides used. On harvesting, RFID tags embedded on transport lots and units' facilities keep track of every station the product was transported to before it reached the shelves. In the meantime, entities that provide off-the-field services and mostly have to do with the finances behind the products, exchange tokens (cryptocurrency) to justify their presence and purpose in the supply chain. Eventually, when the customers purchase the products, they can confirm that the products are safe to consume, and that they paying for what they are, through the digital platforms/portals that would need to be designed to disseminate the information captured by the sensors and RFID and placed on the blockchain.Future work entails further investigation and implementation of such systems powered with reverse logistics for green supply chains.

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ENERGY AND OTHER PROPERTIES OF FIR AND BEECH LOGGING RESIDUES

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Abstract

In the light of the increasing energy needs, the growing concern of climate change and of unemployment, particularly in rural areas, utilization of forest residues for energy is becoming increasingly important. Exploring the possibilities of utilizing the biomass of logging residues for energy requires analysis and knowledge of its properties. In this study the properties (ash, volatiles, fixed carbon, carbon, hydrogen, oxygen, nitrogen and calorific value) of the various constituents of the biomass of fir (*Abies borisii - regis*) and beech (*Fagus silvatica*) logging residues were determined. The results showed: Ash and nitrogen content was several times higher in bark and in foliage than in wood and as a result branches as a whole mass (wood and bark) had higher ash and nitrogen content than stem. Bark had higher content of volatiles and lower caloric content than wood. With the exception of twigs which had lower volatile and caloric content, there were no significant differences between stem and branches as a whole mass. Fixed carbon, carbon and hydrogen content differed significantly between stem and various constituents of logging residues.

Keywords: *forest biomass, logging residues, fir, beech, energy properties*

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Introduction

The projected depletion of fossil fuels and the growing concern for the impact of CO_2 emissions on climate change have focused global attention on biomass, especially on forest biomass, for energy production (European Commission 2005, Smeets and Faaij 2007, Becker et al. 2011). In recent years, the use of residues that remain in the forests after logging has attracted great interest as an energy source (Lehtikangas 2001, Gan and Smith 2007, Nurmi 2007, Malinen et al. 2010, Bouriaud et al. 2013, Jarvinen and Agar 2014. Their biomass consist of tops, branches, bark, foliage or needles and stumps. Forest residues may also include small trees that break during logging, dead trees and low-value trees or trees of non-market forest species (Roser et al. 2008, Philippou 2014).

Logging residues from final harvest are expected to play a pivotal role in meeting renewable energy goals in many countries (Aguilar 2014). In addition, utilization of logging residues as a forest biomass could create business opportunities and employments in local populations, generate profit from residual material and provide energy self-sufficiency for rural communities (Eker et al. 2005, Philippou 2014). Leaving logging residues in the forest, fuel material density and risk of fire in the forest base increase and the problem of bark beetle damage and rejuvenation obstacles can emerge (Spinelli et al. 2007). On the other hand, the literature on removal of logging residues from the forest and their exploitation also addresses various environmental and ecological issues and puts some constrains (Hesselink 2010, Abbas et al. 2011, Wall and Hytönen 2011). In the past, logging residues were not exploited mainly because their harvest and transport was technically difficult and uneconomic. Currently new harvesting technologies and transportation systems have been developed and in conjunction with the increase in petroleum prices enable their extraction from the forest (Kauriinoja 2010, Svanaes and Jungmeier 2010, Filippou and Philippou 2014). Also, new and more

efficient technologies enable conversion of biomass into energy in small units (mainly gasification) or conversion into compressed forms (wood pellets) that can be installed in or near the forests (Kauriinoja 2010). These further limit transportation costs and give opportunities for local employment and rural development.

Compared with the usual stem wood, logging residues biomass differs in chemical composition % of cellulose, hemicelluloses, lignin, extracts and inorganic elements (Nordin 1994, Nurmi 1997, Zeng et al. 2014). There also exists a variability in chemical composition between the various constituents of forest biomass (Obernberger et al. 2006, Werkelin et al. 2007, Vassilev et al. 2010, Wang and Dibdiakova 2014). Moisture content, ash content, volatile content, elemental composition and calorific value are the main material properties that affect the material behavior during conversion into energy as well the overall energy outcome (Obernberger et al. 2006, Vassilev et al. 2010).

Calorific value of biomass is a function of its chemical composition (Shafizadeh et al. 1977, Kendry 2002).Various researchers have determined the calorific value of various types of biomass from their elemental composition using proximity regression analysis models (Demirbas 2003, Friedlet all. 2005, Telmo et al. 2010, Singh et al. 2015). Several researchers (Philippou1982, Harris 1984, Howard 1988, Nurmi 1997, Obernberger et al. 2006, Barboutis and Lykidis 2014, Zeng et al. 2014, Singh et al. 2015) have measured the heating value of various tree species and found significant differences both between species and between tree biomass components. Ash percentage and its composition affect the proper functioning of the burners and gassifiers (Bryers 1996, Nielsen et al. 2000). The ash adheres to the heat transfer surfaces and cause corrosion. When burning the elements, mainly K, Na, S and Ca can melt, form sticky particles, adhere to the surfaces of the walls and create a burner malfunction (Filbak et al. 2011). The biofuel content of nitrogen N is responsible for the formation of nitrogen oxides (NOx) which have an environmental impact (Van Loo and Koppejan 2002).

Exploring the rational opportunities of utilizing the biomass of logging residues requires analysis and good knowledge of their properties. The aim of this work was to determine the energy properties (moisture, ash, volatiles, fixed carbon, carbon, hydrogen, oxygen, nitrogen and calorific value) of the various constituents of fir and beech logging residues.

Material and methods

Representative samples of fir (*Abies boriisi regis*) and beech (*Fagus silvatica*) logging residues were taken from tops and branches with bark and foliage of five trees of each species. Samples of stems with a diameter of 25 cm were also taken for comparative measures. The above sampling was done during a parallel study aiming at estimating the dry amount of logging residues remaining after logging in a fir (Figure 1) and a beech forests in the northwest part of Greece (Filippou et al. 2015).

For the determination of the material properties, the branches were cut into three parts: thick branches (diameter> 5 cm), thin branches (diameter of 2 - ≤5cm) and twigs (branches with a diameter <2 cm including the needles or leaves). Samples of stem, thick and thin branches were also debarked in order wood and bark to be tested separately. The samples were air-dried and milled first in a common hammer mill and then in a Willey mill to obtain particles having a size <0,420mm (40 mesh). The proximate analysis (ash content, volatiles and the fixed carbon content, VC and FC, respectively), and the ultimate analysis (C, H, N percent) were determined for three samples of each material in accordance with CE/TS 14775, CEN / TS 15148 and CEN / TS 15104 standards, respectively (CEN/TS 14775, 15148, 15104, 2005). The higher heating value (MJ/Kg dry) was determined in accordance with CEN / TS 14918 standard (CEN / TS 14918,2005). The free ash higher heating value was determined by reference to ash free weight of the materials.

Figure 1. *Logging residues of fir trees: a. branches of <2cm in diameter with the needles, b. branches of >2- <5 cm in diameter, c. branches of >5 cm in diameter. d. tops, e. stump and f. stembark.*

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Results and discussion

The results of the paper are presented in the Tables 1-3. Tables 1 and 2 give the proximate and ultimate analysis and Table 3 give the higher heating values of the various parts of fir and beech logging residues, respectively.

Table 1. *Chemical properties of fir logging residues*

Sample	Proximate analysis			Ultimate analysis			
	Ash	VC (%)	F C (%)	C (%)	H (%)	O* (%)	N (%)
Stem	0.62	76.59^{c} ** ±0.447	22.99^{d} ±0.423	49.93^{d} ±0.640	6.63^{b} ±0.105	43.26	0.175^{b} ±0.012
--wood	0.5	76.63^{c} ±0.271	22.95^{d} ±0.187	50.08^{e} ±0.162	6.73^{c} ±0.078	43.11	0.081^{a} ±0.010
--bark	3.2	74.94^{b} ±0.153	21.86^{c} ±0.122	49.02^{b} ±0.165	6.46^{b} ±0.268	44.25	0.275^{c} ±0.005
Tops	1	78.91^{d} ±0.113	20.09^{a} ±0.359	49.07^{b} ±0.216	6.59^{b} ±0.153	44.14	0.195^{b} ±0.152
--wood	0.6	79.19^{e} ±0.205	20.21^{b} ±0.302	49.82^{d} ±0.582	6.66^{b} ±0.124	43.45	0.075^{a} ±0.005
--bark	4.5	75.04^{b} ±0.216	20.46^{b} ±0.253	49.63^{c} ±0.070	6.63^{b} ±0.043	43.48	0.265^{c} ±0.005
Thick branches	0.76	78.75^{d} ±0.205	20.41^{b} ±0.142	49.44^{c} ±0.705	6.45^{b} ±0.146	44.01	0.099^{a} ±0.015
--wood	0.52	79.44^{f} ±0.482	20.58^{b} ±0.088	49.84^{d} ±1.397	6.61^{b} ±0.131	43.45	0.095^{a} ±0.005
--bark	4.5	75.24^{b} ±0.178	20.26^{b} ±0.294	48.69^{b} ±0.428	6.14^{a} ±0.030	44.14	1.035^{f} ±0.185
Thin branches	0.86	78.76^{d} ±0.220	20.38^{b} ±0.106	48.96^{b} ±0.262	6.44^{b} ±0.158	44.42	0.18^{b} ±0.001
--wood	0.5	79.12^{e} ±0.376	20.4^{b} ±0.446	48.26^{b} ±0.266	6.45^{b} ±0.135	45.2	0.095^{a} ±0.001
--bark	5	74.16^{a} ±0.045	20.84^{b} ±0.177	47.87^{a} ±0.269	6.39^{b} ±0.227	44.8	0.855^{e} ±0.028
Twigs	3	76.84^{c} ±0.050	20.16^{a} ±0.170	49.02^{b} ±0.160	6.58^{b} ±0.036	43.89	0.505^{d} ±0.045

*Calculated. **In each column, figures followed by different letter (s) indicate significant difference by Duncan's multiple range test (P<0.05).

Table 2. *Chemical analysis of beech logging residues.*

Sample	Proximate analysis			Ultimate analysis			
	Ash	VC (%)	F C (%)	C (%)	H (%)	O* (%)	N (%)
Stem	0.69	81.58^{e}** ±0.350	17.73^{c} ±0.335	47.09^{c} ±1.045	6.27^{b} ±0.122	46.4	0.235^{b} ±0.005
--wood	0.6	81.37^{d} ±0.436	18.04^{d} ±0.251	47.47^{c} ±0.281	6.29^{b} ±0.282	46.07	0.165^{a} ±0.040
--bark	5.2	78.41^{b} ±0.355	16.40^{b} ±0.227	46.61^{b} ±0.266	6.06^{a} ±0.252	46.73	0.595^{d} ±0.058
Thick branches	0.98	80.73^{c} ±0.050	18.29^{d} ±0.263	46.85^{b} ±0.177	6.25^{b} ±0.058	46.65	0.25^{b} ±0.010
--wood	0.8	79.51^{c} ±0.190	19.69^{f} ±0.194	47.02 ±0.794	6.40^{c} ±0.015	46.4	0.175^{a} ±0.005
--bark	6	76.09^{b} ±0.156	17.87^{c} ±0.155	45.88^{a} ±0.551	5.95^{a} ±0.152	47.59	0.58^{d} ±0.061
Thin branches	1.14	80.56^{c} ±0.390	18.94^{e} ±0.407	47.62^{d} ±0.276	6.27^{b} ±0.148	45.59	0.26^{b} ±0.032
--wood	0.9	81.13^{d} ±0.320	18.02^{d} ±0.185	49.73^{e} ±0.211	6.47^{c} ±0.035	43.64	0.16^{a} ±0.001
--bark	6.5	77.01^{b} ±0.230	15.8^{a} ±0.113	46.75^{b} ±0.529	5.97^{a} ±0.079	46.89	0.39^{c} ±0.017
Twigs	5.5	75.07^{a} ±0.190	18.73^{e} ±0.140	49.09^{d} ±0.265	6.67^{d} ±0.055	42.66	1.57^{e} ±0.030

.*Calculated. ** In each column, figures followed by different letter (s) indicate significant difference by Duncan's multiple range test (P<0.05).

Ash content

As we can see from Tables 1 and 2, the ash content was multiple times (up to 12) higher in bark than in wood of the branches. The ash content was different in the two forest species and was found higher in the thin than in the thick branches. It ranged from 0,5% to 0,9% in wood and from 5% to 6,5% in the bark of thin branches and from 0,52% to 0,8% and from 4,5% to 6% in wood and bark of thick branches, respectively. Beech had higher ash content than fir in all tree components. For comparison purposes, Table 1 also shows the ash content of wood and bark of fir and beech stem taken from transverse disks having diameter of 25cm. In fir, the ash content of stem wood did not differ from the ash content of branch wood, while in beech it was much lower than in branches. In both species, the ash content of sembark was several times higher than that of stemwood. Werkelin et al. (2007) also found significant differences in ash content between wood and bark in stem and in branches of fir, poplar and pine. Zeng et al. (2014) found significant differences in ash content between different parts of the tree biomass.

Volatile and Fixed Carbon content

In fir, the volatile matter (VC) was in the range of 74,16 % in the bark of thin branches and 79,49% in the wood of thick branches. In beech, VC was in the range 75,77 % in twigs and 81,73 % in stem wood. The VC of wood and bark was higher in beech in all tree parts. In both species, the VC of wood was higher than that of bark. The fixed carbon (FC) in fir ranged between 20,16 % in twigs and 22,65% in stemwood and in beech between 17,37% in stem wood and 19,87% in the wood of thick branches. FC in all parts of beech was higher in bark than in wood while in fir there was no essential difference. In a study of ultimate analysis of 13 wood species (Telmo et al. 2010) VC varied among the species between 74,7% and 86,3% and FC between 12,4% and 22,5%. In the same study VC and FC of beech wood was 85,7% and 13,9%, respectively. Demirbas (1997) gives for beech wood 74% VC and 24, 6% FC.

Ultimate analysis

In fir, the carbon content varied between 47,87% in twigs and 50,08% in stemwood. In beech, carbon content varied between 45,88% in bark of thick branches and 49,73% in wood of thin branches. In fir, the hydrogen content varied between 6,14% in the bark of thin branches and 6,73% in the wood of stem. In beech, the hydrogen content varied between 5,95% in the bark of thin branches and 6,68%, in twigs. Wood in all parts of both species had higher carbon and hydrogen percent than bark. On the average, fir parts had higher carbon and hydrogen content than those of beech.

Oxygen content varied in fir from 43,12% in stemwood to 44, 90% in the bark of thin branches and in beech from 42,67% in twigs to 46,89% in the bark of thin branches. Oxygen content in all biomass components of both species was higher in the bark than in the wood. Also, oxygen content was lower than carbon content in all fir biomass components, but in beech was higher than carbon content in the bark and lower in wood. Telmo et al. (2010) found higher oxygen than carbon content in beech stemwood.

Nitrogen content was higher in beech. It varied in beech from 0,16% in the wood of thin branches to 1,17% in twigs and in fir from 0,015% in the wood of thin branches to 0.275% in the bark of stem. In all cases, bark had 3-4 times higher nitrogen content than wood.

Heating values

Table 3 shows the heating value of the various components of fir and beech respectively. Heating value is given in two types, as higher heating value (HHV) and as higher heating value of ash free material (HHVf). The later was calculated after subtraction of ash from the weight of the HHV determination biomass samples.

Table 3. *Heating values of fir and beech logging residues*

Sample	Fir		Beech	
	HHV (MJ/kg)	HHVF*(MJ/kg)	HHV(MJ/kg)	HHVF*(MJ/kg)
Stem	20.80[c]** ±0.02	20.94	19,56[b] ±0.01	19,69
--wood	20.84[c] ±0.03	20,97	19.58[b] ±0.02	19.70
--bark	20.52[c] ±0.015	21.54	19.47[b] ±0.015	20.54
Tops	20.49[b] ±0.02	20.49	-	-
--wood	20.53[c] ±0.04	20.65	-	-
--bark	20.45[b] ±0.02	21.41	-	-
Thick branches	20.57[d] ±0.04	20.73	19,58[b] ±0.02	19,79
--wood	20.61[d] ±0.03	20.71	19.67[b] ±0.04	19.83
--bark	20.48[b] ±0.01	21.44	19.41[a] ±0.02	20.65
Thin branches	20.79[e] ±0.02	20.97	19.63[b] ±0.025	19,85
--wood	20.80[e] ±0.02	20.90	19.70[b] ±0.015	19.88
--bark	20.32[b] ±0.025	21.38	19.31[a] ±0.04	20.65
Twigs	19.57[a] ±0.015	20.17	19.42[a] ±0.02	20,55

*HHVf= higher ash free heating value. ** In each column, figures followed by different letter (s) indicate significant difference by Duncan's multiple range test (P<0.05).

The higher heating value (HHV) of fir biomass ranged from 19,57 MJ / kg in twigs to 20,80 MJ/kg in the wood of thin branches and in beech biomass from 19,31 MJ/kg in the bark of thin branches to 19,70 MJ/kg in the wood of thin branches. On the average, fir biomass had higher HHV than beech biomass. Jarvinen and Agar (2014) while experimenting on making pellets from pine and logging residues found that the average caloric content for the whole pine tree was 20,80 MJ/kg and for residues 21,60 MJ/kg. Telmo et al. (2010) found an average heating value (HHV) of pellets from beech wood 19,14 MJ/kg. Phyllis2- Database (ECN. 2012) gives a calorific value for beech bark of 21,67 MJ/kg and an average calorific value of beech wood measured by 12 researchers of 19,08 MJ/kg with a respective range of 16,48-20,51 MJ/kg. Shafizadeh et al. (1997), Demirbas (1997), Gillespie et al. (2013) and Miranda (2015) found a correlation between carbon content and calorific value. Biomass with higher carbon content had higher heating value. The data of Table 1, 2 and 3 do not show this relationship for the materials used. The ash free higher heating value (HHVf) ranged in fir from 20,17 MJ/kg in twigs to 21,54 MJ/kg in the bark of stem and in beech from 19,70 MJ/kg to 20,65 MJ/kg and increased proportionally with the removal of ash. HHVf was significantly higher in the bark than in the wood in all tree parts, but no significant differences between stem and branches in both species were found.

Conclusions

This study has shown that fir and beech logging residues differ from stem wood in some properties that are important for energy use. Tops and branches had a high content of bark, while (branches with diameter <2 cm) also included needles or leaves. Bark and foliage differed substantially in composition from stem wood. Ash and nitrogen content was several times higher in the bark and foliage than in the wood and as result branches as a whole mass (wood and bark) had a higher ash and nitrogen content than that of the stem. Bark had also a higher content of volatiles compared to wood but with the exception of twigs there were no significant difference between stem and branches as a whole mass. Bark and foliage had also a lower heating value than wood. Fixed

carbon, carbon and hydrogen content differed significantly between stem and the various constituents of logging residues. The relatively higher values of ash and nitrogen content found in the biomass of logging residues, are not as high as in the biomass of other lignocellulosic materials such as agricultural residues and annual plants which are being used for energy production. From the results of this study we could conclude that logging residues of fir and beech could be used as an energy raw material. However, during their processing to energy, attention should be given to the proper servicing of the burners or gassifiers for avoiding accumulation or melting of the ashes.

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RENEWABLE ENERGY SOURCES PROMOTION IN THE AREAS OF PELOPONNESE AND CRETE: THE INTERNET CHALLENGE

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Abstract

One of the major characteristics of our time and of technological boom in general is the Internet. One of the key elements contained in it are the search engines. They are used for information, keyword searching on the Internet, with the user entering keywords by himself in order to accurately detect material relevant to the subject of his/her interest.This survey raises the element of Internet searching and exploitation of the RES enterprises that operate in Crete and Peloponnese. This way, data is recorded for every company and useful statistic conclusions are stated for this particular area of interest.

Keywords: *Internet, renewable energy sources, websites, search engines*

Introduction

TheInternetisaglobalcomputernetworksystem connected with each other that offers its services to millions of users around the world daily. Messages/packets are exchanged between computers, based on communication protocols for both hardware and software. Each computer or device in general connected to the Internet is able to exchange data directly and bidirectionally as well. The technique of network connection based on communication protocols and packet exchange is called Networking. Web applications are related to many sections, such as education, politics, newsfeed, health, relaxation, entertainment and communication (Jones 2001).

Interaction of information between computers on the Internet is effective thanks to its service, the World Wide Web (WWW). The basic unit of this service is the web page, which is a special computer file that contains information linked to other sections of web-organized content. A set of web pages is called a website. Web users can follow their own way of reading the information by choosing the websites they want to visit themselves. Thisway, understandingofthegathered information is easier (Jones 2001).

The Internet creates a new business environment, offering plenty of applications and services and making a significant contribution to increase their flexibility. It is an excellent opportunity for entrepreneurs who want to promote their business and their products, significantly reducing all costs. Thus, in the Internet a business may be displayed for commercial advertising purposes or have more choices related to it, such as buying products (Bambury 1998, Andreopoulou 2012). More and more companies are now using the Web for their promotion, as it allows great flexibility at low cost. Also, thanks to the Internet, communication is comfortable between enterprises and partners/clients (Jones 2001).

Renewable energy sources (RES) are forms of exploitable energy derived from various physical processes, such as the wind, the geothermal, the sun, the water circulation and others (Liserre et al. 2010, Panwar et al. 2011) . In particular, energy forms coming from renewable, non-mineral sources are wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gases, sewage treatment plant gases and biogases (Kalkanis 1997, Herzog et al. 2001, Liserre et al. 2010). Generally, RES is considered to be the alternative of the traditional. They have been studied as a solution to the depletion of non-renewable energy sources, such as fossil fuels. In recent years, the green growth model, which is based on the application of renewable energy sources to be as a motion power of the transition from non-renewable sources to the new ones, is being promoted (Adams 2003, Andreopoulou 2009).

TheaimofthispaperistoregistereachoftheRESenterprisesinCreteandPeloponneseandtoanalyzethe offered services through the Internet. In a few words, the researcher is able:

- to find information for each region in these areas
- tocollectdatarelatedtotheconnectionabilityoffered by the enterprises
- to gather statistical data for all data range offered by the enterprises on their website

Materials and Methods

TheRESenterpriseswereresearchedandfoundbyusingtheInternetsearchengines.Next step was to register all data in a Microsoft Excel worksheet, where we had a general view of it. Finally, the enterprises were classified by area of interest and then all results were presented with tables and statistical graphs.

Search progress was based mainly on Google search engine but also on less known search engines such as Xo.gr and Vres.gr, which filled up the empty blanks with more information.

During searching, some suitable keywords were used, related with the desired search objects. These are presented below in Table 1:

Table1. *Keywords for data search*

Keywords for data search	
energy	pellets
internet	geothermal energy
search engines	geothermal
renewable energy source enterprises	Corinthia
Peloponnese	Argolis
Crete	Achaea
renewable energy sources	Elis
renewable energy sources in Crete	Arcadia
renewable energy sources in Peloponnese	Messenia
wind energy	Laconia
solar energy	Chania
water-powered energy	Rethymno
hydropower energy	Heraklion
biomass	Lasithi

Results

In this chapter, the search results on the Internet about RES enterprises for each region are presented. Specifically, 24 enterprises were found in Crete, while in Peloponnese a total of 81 were located. There were plenty of data about displayed information. These results were categorized depending on:

- the area of interest
- how frequently Internet is used (how many enterprises use it or not)
- the foreign languages on website
- the offered ways of contact between clients and enterprises
- the RES forms

These are the conclusions about RES enterprises in Peloponnese:

- After searching in Achaea,sixteen RES enterprises were found. Five of them possess a website (31,3% of total number) and three of them use foreign language. All enterprises possess phone number,, 60% of total also have an e-mail and 20% of them maintain accounts on Facebook and Twitter. Intotal, 56,3% usewindenergy, while 25% usesolarenergyand 18,7% hydropower.
- InCorinthia tenRESenterpriseswerefound.Fourofthem possess a website (40% of total number) and three of them use a foreign language.All enterprises have a phone number, 50% of them a Facebook account, and also 50% have e-mails and 25% a Twitter account. Half of them usesolar energy and the rest use wind energy.

- In Argolis, eleven RES enterprises were found. Three of them possess a website (27% of total number), while only one uses foreign languages. All enterprises have a phone number and e-mail as well. About 82% of them use solar energy and the rest 18% use wind energy.
- In Arcadia, eight RES enterprises were found. Two of them possess a website (25% of total number) and only one uses foreign languages. All of them have phone numbers and e-mails. About 63% of them use wind energy, 25% solar energy and the rest 12% hydropower.
- In Elis, four RES enterprises were found. Two of them possess a website (50% of total) and use foreign languagesas well. All of them have phone numbers and e-mails, while 50% use Facebook as well. About 75% of them use solar energy, while 25% use wind energy.
- InMessenia, twelveenterpriseswerefound. Only two possess a website (17% of total) and only one uses foreign languages.All of them have phone numbers and e-mails, while 50% use Facebook and Twitter. About 58% of them use solar energy, 33% wind energy and the rest 9% hydropower.
- In Laconia, twenty RES enterprises were found. Eight of them possess websites (40% of total number) and four of them use foreign languages. About 88% ofthemhave phone numbers and e-mail as well. Furthermore, 12% of them use Facebook and Twitter. About 65% of them use solar energy and the rest 35% use wind energy.

Then results for RES enterprises in Crete follow:

- In Chania, a total number of eight RES enterprises was found. Four of them have websites (50% of total) and two of them use foreign languages. All enterprises have phone numbers and 75% use e-mail. About 88% of them use wind energy and only 12% use solar energy.
- In Rethymno there are several projects to be started, mainly wind farms and a project for hydropower that are going to be built in the near future. Atthemoment, thereisawindfarmintheareaofthevillageAkoumiawithapowerof 7,2 MW that belongs to the Country. Other significant progress in the area was not found at all. As a result, it is impossible to show statistic results in our paper for this region of Crete. Someeffortsareinprogresstoachieveuse of the wind as a main target, meaning that it will enroll great energy push in the area.
- In Heraklion, eight RES enterprises were found. Three of them possess a website (38% of total number) and two of them use foreign languages. About 67% ofthemhavephonenumbersand e-mails, while 33% use Facebook and Twitter. About 88% of them use wind energy and only 12% use solar energy.
- In Lasithi, eight RES enterprises were found. Three of them have websites (38% of total number) and all of them use foreign languages. Furthermore, all of them have phone numbers and e-mails. About 25% of them use solar energy, while 75% of them concentrates on wind energy.

Forbettervisualresultsandeffectsoftheaboveconclusions, it is thought to be necessary to use suitable tables and graphs.Accordinglytothis, some general statistics are provided for further use by future researchers.

Table 2. *Number of enterprises and contact details*

Search results for RES by each region				
Prefecture	Enterprises	Wind	Solar	Hydropower
Achaea	16	9	4	3
Corinthia	10	5	5	0
Argolis	11	2	9	0
Arcadia	8	5	2	1
Elis	4	3	1	0
Messenia	12	7	4	1
Laconia	20	7	13	0
Chania	8	7	1	0
Rethymno	0	0	0	0
Heraklion	8	7	1	0
Lasithi	8	6	2	0

Table 2 showsarithmeticcontentsrelatedtotheRESenterprises and how they communicate through the Internet. The dependent factor is the region for each enterprise.

Percentage results are shown in the next Graphs 1 and 2. ItisstatedthatenterprisesinPeloponneseincomparisonwiththosein Crete are less organized on the Internet (32% of them compared with 42%).

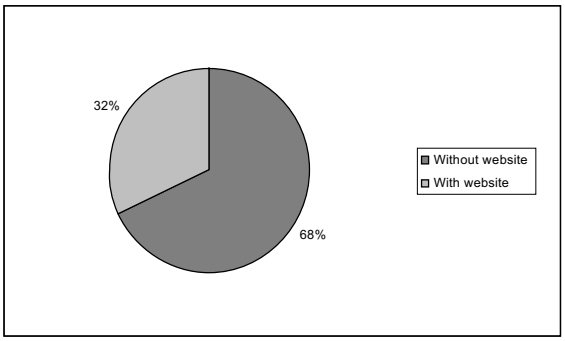

Figure 1. *Percentage of enterprises in Peloponnese with websites*

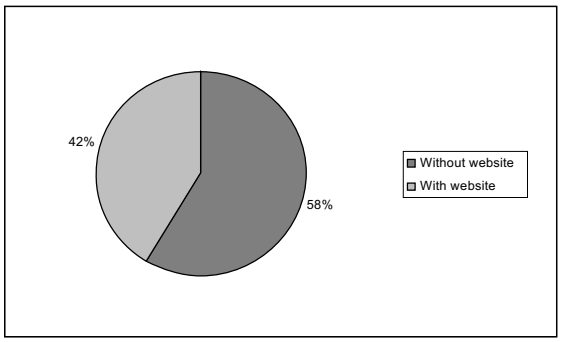

Figure 2. *Percentage of enterprises in Crete with websites*

Table 3.*Exploitation of RES by each department*

Search results for RES by each region				
Prefecture	Enterprises	Wind	Solar	Hydropower
Achaea	16	9	4	3
Corinthia	10	5	5	0
Argolis	11	2	9	0
Arcadia	8	5	2	1
Elis	4	3	1	0
Messenia	12	7	4	1
Laconia	20	7	13	0
Chania	8	7	1	0
Rethymno	0	0	0	0
Heraklion	8	7	1	0
Lasithi	8	6	2	0

InTable 3 allresultsrelatedtouseofRESforeachregionarepresented. Thegreatdifferencebetweenwindandsolarenergyinthetworegionsisquiteinteresting.Thisisvisibleinthenex tGraphs 3 and 4. MorethanhalfoftheenterprisesinPeloponneseusesolarenergy, whilethemajorityofenterprisesinCrete (about 83%) concentratesonwindenergy.

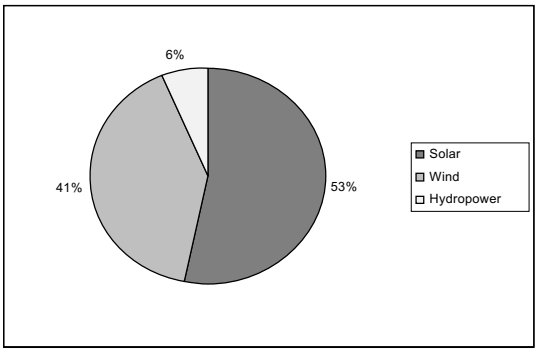

Figure 3. *TypesofRESinPeloponnese*

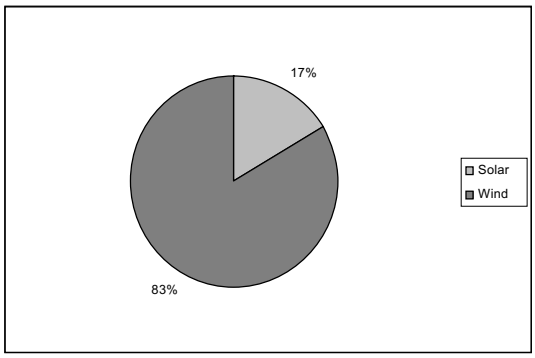

Figure 4. *Types of RES in Crete*

Discussion - Conclusions

ItiscertainandundeniablefactthattheInternetisdominatingintheinformationsection, withavarietyofapplicationsandtoolsofferedtothepublic.The easy way it is used establishes it as necessary and, having in mind how easy is to access it as well, it has been used by people regardless of age.

One of the major tools of the Internet is known as the Search Engines. Their main use is to find information through the Internet with the aid of keywords.All information gathered for the RES enterprises in Crete and Peloponnese and presented in this paper was collected with these Search Engines.

Therenewableenergysources (RES) and, mainly, windandsolarenergy, are used to a greater extent during our time as alternative energy sources. Theyarestillbehindthough, comparedwiththenon-renewableenergysources, likeoil and natural gas. Perspectivesarequitehigh, with many countries supporting electricity production from the sun and the wind.

These conclusions are calculated if we summarize our search results through the Internet in the regions of Crete and Peloponnese. Specifically, 24 enterprises were found in Crete and 81 in Peloponnese. Moreover, a second conclusion is that wind energy is more developed in Crete than solar energy. Thiscouldbeexplainedaftertaking into consideration the position of the island, the land shape, the available land, the mountains etc.

Tosummarize, webelievethattheresultsofourpaperinthese areas of southern Greece could be used for further research, or even to encourage new enterprises to use RES.

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SUSTAINABLE TOURISM LOCAL CLUSTER DEVELOPMENT IN PROTECTED AREAS: THE CASE OF PARNASSOS

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Abstract

Protected areas are widely considered as most suitable for sustainable tourism development of a region, aiming to stimulate the local economy and community. The formulation of integrated sustainable tourism development programs, is to be based on the cooperation among local and regional authorities, using as tools: the systematic promotion, publicity and advertising activities for the region, constantly searching for new tourism markets and target groups, and finally the cooperation among local authorities, local enterprises and residents. Parnassos National Park in Central Greece is an ideal protected area for sustainable tourism development, thanks to its rich natural environment, cultural heritage, local traditions, gastronomy and hospitality. This article investigates the need for the coordination of local tourism stakeholders within a local sustainable tourism cluster, to contribute in raising public awareness in environmental protection.

Keywords: sustainable development, Parnassos National Park, local tourism cluster

1. Introduction

Worldwide, protected areas are considered to be institutions of great socio-educational impact that could be linked to the process of education for sustainable tourism development. Protected areas contain some of the planet's most important ecosystems and many also 'serve as important cultural places where people contemplate and understand the natural world through visitation and tourism' (Eagles et al., 2013:60). The term 'protected area' is used to describe a variety of unique and very diverse habitats and natural areas (Murphy, 2014). The IUCN (2008:8) defines a protected area as a "clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values" (Dudley 2008).

There is a significant variation in the location and size of protected areas, as well as in the purpose of the site and the management and conservation strategies adopted, leading to a distinct lack of universal understanding over their purpose, intended use and management systems (Murphy, 2014). As a result, efforts were made to establish protected area categories that could be used worldwide to help define the purpose of protected areas and develop universal management and conservation standards (IUCN, 2008).

National parks (Category II) fall, with wilderness areas, nature reserves, sanctuaries, national monuments, World Heritage sites, and protected landscapes and seascapes and variants on these forms, along the IUCN continuum according to the level of human activity permitted (Dudley 2008). National parks are" large natural or near natural areas set aside to protect largescale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally

compatible spiritual, scientific, educational, recreational and visitor opportunities" (Dudley 2008: 16, Miller et al. 2014: 257). National Parks can vary significantly in size, environmental and cultural amenities, management structure and lead management authority (e.g., state, federal, provincial entity), research priority and effort, operational and enforcement emphasis, educational programs, and goal priorities. (Miller et al. 2014: 258), since there is no single approach adopted as to their management.

According to the United Nations Environment Program (2013), National Parks 'provide protection for functioning ecosystems, but tend to be more relaxed with human visitation and the supporting infrastructure' and can contribute to local economies through educational and recreational tourism. Different protection is afforded to these protected natural areas and thus, activities such as tourism development are managed in varying ways, influenced by the area's categorization by national and international organizations.

However, tourism activities and facilities can create major threats to ecological integrity (Rollins and Robinson, 2002) since many national parks are under increasing pressure to provide more visitor facilities, accommodate more visitors, increase the supply of overnight accommodation and provide different types of visitor activities (Huang et al. 2008). The implication for sustainable tourism in protected areas is particularly challenging as it involves different stakeholders with contrasting obligations and interests (McCool, 2009) at the national, regional and local level. The formulation of integrated sustainable tourism development programs, is to be based on the cooperation among local and regional authorities, using as tools: the systematic promotion, publicity and advertising activities for the region, constantly searching for new tourism markets and target groups, and finally the cooperation among local authorities, local enterprises and residents (Kostopoulou 2012). As Boyd (2000:162) points out '…attention must shift towards how tourism, in line with sustainability principles, is planned, developed and managed to suit National Park environments'. Therefore, the institutional framework, within which activities are conceived, planned, funded, implemented, and managed is of major importance (Brinkerhoff and Goldsmith, 1990:4) for sustainable tourism development in National Parks. Smith et al. (2003) indicate that better quality governance of National Parks leads to higher quality–biodiversity conservation, while Eagles (2009) suggests that more research is needed in this area.

This article presents a conceptual framework for examining how an iconic National Park with rich natural and cultural components can be influenced by the internal dynamics of a local sustainable tourism development cluster. Parnassos National Park in Central Greece is an ideal protected area for sustainable tourism development, thanks to its rich natural environment, cultural heritage, local traditions, mountain shelters, hiking trails and climbing routes, mountain bike, horseback riding, a unique flora and fauna, local gastronomy and hospitality. The article presents the results of a secondary research conducted on Parnassos National Park broader area on its commitment to the process of environmental education promoting sustainable and responsible tourism, and indicates the still unused potential of National Park activities which can contribute to raising public awareness in this regard.

2. Study area: Parnassos National Park

2.1 Environmental characteristics

Parnassos is a National Park with rich natural and cultural heritage that can be considered to be a living ecological laboratory of nature and ecology with important and sensitive ecosyetems. The area could act as a model for the development of alternative forms of tourism in mountainous areas. Local natural and cultural resources can be regarded as a

development keystone where Parnassos National Park Management Body aims to guarantee environmental protection and sustainable development (Tsitsoni 2015).

The study area constitutes an ideal tourism destination, endowed with a unique natural environment and landscape, flora and fauna, rich cultural heritage and lively traditions, warm local hospitality and gastronomy, mountain shelters, hiking trails and climbing routes, mountain bike, horseback riding (Region of Central Greece). The most attractive tourism resources of Parnassos territory include mountainous areas, caves, canyons, archaeological sites, byzantine/ medieval monuments, traditional settlements, wetlands as well as congress centers in many hotels.

The basic advantage of the area is the existence of a rich variety of environmental resources, however unexploited to a significant extent. Natural resources and an attractive landscape with picturesque villages, hiking trails and mountaineering routes, as well as important ski centers namely Parnassos and Timfristos, constitute a dynamic potential for the development of alternative forms of tourism in the area e.g. mountainous, winter tourism. The rich variety of the natural environment covers all the types of alternative forms of tourism. However, considerable natural resources have not yet been properly exploited, for example hiking trails in protected areas etc. For the tourism potential development of the area there is need for regional planning that reassures the rational use of the landscape e.g. mountains, caves, wetlands, lakes, rivers, as well as cultural resources.

The importance of local agricultural products for attracting gastronomy tourism should be also underlined. Moreover the local agricultural products like olives, olive oil, a variety of wines, honey, cheese, all form a unique combination of natural resources (climate, soil, local varieties and animal breeding) and cultural heritage of the region (traditional production equipment, skills and practices).

The mild climate of the area allows for both summer holidays period as well as for winter holidays. Excessively high temperatures or high degree of moisture are not recorded during the summer period, therefore the area offers a friendly environment for Northern European tourists. The climate also favors the winter tourism development on mountainous areas, especially in the ski centers locations.

The study area has a rich historical and cultural heritage, with significant monuments and archaeological sites that can contribute to the cultural tourism development of the region. The worldwide famous archaeological site of Delphi (the Delphie Oracle, the Ancient Theater, the Stadium and the Museum) is the second most visited destination in Greece. The archaeological and folklore museums, religious monuments, historical bridges, together with local cultural events and folklore festivals based on local traditions and products form an attractive tourism destination. Finally, the geographic location of the study area, at the centre of Greece, neighboring major transport nodes e.g. Athens International Airport "Eleftherios Venizelos" and urban centers e.g. the capital city of Athens constitutes a significant accessibility advantage.

2.2 Tourism characteristics

The study area is characterized by a dual tourism development pattern that includes: a) destinations with high touristic performance indicators e.g. Delphi, a premium cultural tourism destination, Arachova, a major ski tourism destination, that attract an intense demand growth of international tourists and weekend urban visitors, b) destinations with considerably low touristic performance indicators e.g. Parnassos mountainous area, that presents considerable potentials for further tourism development, and could form a model of

alternative forms of tourism (mountainous, winter, etc.) for sustainable tourism development and the protection of natural environment.

The study area, due to a unique spatial concentration of natural and cultural resources and climate conditions offers opportunities for sustainable tourism development and activities for all year around (Tioka 2007, Tsitsoni 2015). These activities include mountainous and winter tourism, such as winter sport activities, as well as opportunities for walking and hiking activities covering:

- Outdoor activities, mountain- climbing, hiking, riding, sports camps operating during the summer (Kostopoulou and Aivatzidou 2007).
- Cultural events and traditional local products festivals (Kostopoulou et al. 2015), environmental educational and scientific activities in protected areas, visits to archaeological sites, monuments, museums.

The study area is considered to be a rather low budget destination for summer holidays. According to the Hellenic Chamber of Hotels Institute's study "Regional analysis of Greek Hotels", the Region of Central Greece is a fair prices or a good "value for money" destination, regarding accommodation and food. However, winter resorts may come with quite high price levels due to high demand for ski infrastructure and associated facilities.

The percentage of repeating visitors in the study area is satisfactory e.g. nature tourism in Parnassos National Park, or sport activities at Arachova ski center. Residents from the capital city and other urban centers, whose origin is from the area, are regularly repeating their visits, bringing with them relatives and friends, so they all have the opportunity to discover the natural and cultural heritage of the region (Tioka 2007).

3. Materials and Methods: Results

The surveys' results of research that have been carried out during the last two decades at the broader area of Parnassos (Kostopoulou 2012, Fousteri 2012, Martinis 2001, Tioka 2007, Papageorgiou 2005), provided useful considerations for the tourism flows, as well as the possibilities for tourism development of the region.

Survey results show that the vast majority of visitors come from Athens and other urban crnters (Martinis 2001). Visitors are mainly approaching the area by their own car (80%), where the most popular destinations are Parnassos Ski Centre in the winter and the archaeological site of Delphi. There is an intense spatial concentration of tourist resorts in Arachova, as a result the benefits from tourism activities are not spatially equally distributed, while the number of visitors in the mountainous areas during the summer period are quite low.

The study area, due to the size, variety and spatial distribution of tourism resources, can build up opportunities for tourism development all over the year by offering alternative forms of tourism. As a result, the tourism activity that is mainly being focused on ski tourism during the winter season, could be reoriented towards alternative forms of tourism offering: a) outdoor activities (climbing, mountain bike, hiking etc), b) cultural, informative, educational, scientific events (visiting monuments, museums, festivals, conferences).

The study area has not yet fully exploited its tourism development potential based upon unique natural and cultural characteristics. The area has not a characteristic tourism profile that would promote the comparative advantages in the tourism market, while a considerable lack of tourism infrastructure has been detected (Papageorgiou 2005). Furthermore, the lack of co-ordination -among all stakeholders involved in the production of the local tourism

product is considered to be one of the major problems for the sustainable tourism development of the region (Fousteri 2012).

Within this framework the contribution of Parnassos National Park to the tourism development of the region, and its overall impact on the local economy is rather limited, in spite of a large spectrum of development opportunities. Most of the visitors have restricted information about the National Park and the facilities offered. Nevertheless, the visitors of the National Park strongly agree with its significant role for the protection of nature and the opportunity provided for the sustainable development of the area. According to a survey (Martinis 2001) 80% of respondents were positive to the idea of introducing an entrance ticket to the National Park, provided that the money would be allocated for environmental protection. According to the survey (Martinis 2001) the vast majority of respondents (90%) strongly believe that the area is the appropriate natural environment for environmental education and sustainable tourism development programs. Parnassos National Park Management Body has developed the necessary infrastructure for the promotion and implementation of awareness programs for students and residents, where participants can be taught and experienced the role of natural and cultural environment protection in sustainable development (Tsitsoni 2014, 2015).

The general conclusion out of the secondary research undertaken for the study area is that there is considerable unexploited potential for sustainable tourism development to be based upon the appropriate planning strategies and measures, as well as cooperation among all stakeholders involved to create a local sustainable tourism development cluster. The Greek state in a recent law for the establishment of National Parks Management Bodies, gives the opportunity to local stakeholders to promote, support and organize ecotourism tourism programs ("Nature 2000" Commission 2011, Tsitsoni 2012). Protected areas' management bodies could also provide quality labels to local enterprises in protected areas, operating according to the terms of environmental protection, for the area.

4. Discussion-Conclusions

Based on the results of our research on secondary sources, we can come with some conclusions and proposals for the improvement of tourism development of the region and the local tourism product. The wider region of Parnassos has considerable opportunities for the development of special and alternative forms of tourism since the area has rich natural and ultural resources.

The best practices and knowledge of relevant know – how of European touristically developed protected areas, and the cooperation with other mountainous tourist communities around the world, are valuable assets and could create considerable advantages through international cooperation programs. A list of proposals, yet not exhaustive, aiming at motivating tourism demand and increasing the number of tourists in the area includes the following: (Martinis 2001, Papageorgiou 2005, Tioka 2007, Kostopoulou 2012, Fousteri 2012, Tsitsoni 2015).

- Formulation of an informative- educational program for local enterprises, about alternative forms or tourism in the region, especially ecotourism and nature tourism.
- Founding of a local agency, with the main objective to promote sustainable tourism development in protected areas, the resources development, financial and human capital of Parnassos National Parks Management Body in order to undertake more initiatives.
- Promotion of the specific characteristics of the tourism product of the region

- Laying out a friendly touristic behavior framework for all stakeholders involved in tourism (friendly prices, high quality service for customers etc.)
- The tourism product should be adapted and harmonized with the local culture and lifestyle, aiming at preserving authenticity and avoiding commercialization
- Modernization of hotel units and restauration of traditional buildings, archaeological sites, churches and monasteries in the area;
- Improvement of transport infrastructure and access to remote mountainous settlements of the region , adaptation of transport infrastructure to the natural environment of the area, construction of green infrastructure and implementation of projects for environmental protection
- Support for public and private investments in tourism infrastructure e.g. hiking, climbing, mountain – climbing and agri-tourism
- Installation of the necessary signs and info kiosks at nodal poles of tourism attractions of the region
- Consultancy support to tour operators , Municipal tourist offices,
- Organizing cultural events such as festivals, concerts, theatrical performances, revival of local traditions and customs during the year
- Route and networks trails for the promotion e.g. of archaeological heritage monuments and museums, aiming at a wider diffusion of tourist attendance
- The development of alternative forms of tourism in order to attract a variety of target groups all over the year.
- Interventions and improvements on local technical and social infrastructure e.g. pavements, lighting, sufficient parking places, security in local municipalities. in order to improve tourists' and residents' quality of life
- The creation of an integrated tourist promotion program with a definite management project and political approach
- The training of employees being involved in tourism, through subsidized programs, seminars, workshops on issues related in tourism at protected areas
- The local population should chance the way of thinking, through environmental education and information of the benefits from sustainable touristic development
- Adopting touristic code of behavior and vision to the success of area as a high quality tourism destination
- Special educational programs in schools, so for students to become environmentally aware.

In reference to Parnassos National Park and its contribution to the touristic development of the region, a number of actions are being proposed that can contribute to the improvement of its operation and support to the local economy (Kostopoulou 2012, Fousteri 2012, Tsitsoni 2015).

- The creation of an integrated tourist package, combining visits to the National Park and other activities (accommodation, entertainment, sport activities, ski, etc.), for attracting visitors with different motivations and interests.

- Support to the participation of locals in sustainable tourism development synergies, through volunteering, enriching their associations and groups, organization of conducted tours, educational programs etc.,
- Systematic and co-ordinated cooperation synergies among Parnassos National Park Management Body and the authorities involved with tourism (local authorities, local enterprises, etc.),
- Organizing and/or participating in awareness' seminars/workshops/conferences on issues related to the environment protection and the combination between nature tourism and its protection,
- Increasing and improving educational and recreational activities (exhibitions, cultural events, educational programs for children and adults, research activities etc.)
- Elaboration of specific visitors' management plans, focusing on issues on defining the area's tourism carrying capacity (Kostopoulou and Kyritsis 2006).

The operation of Parnassos National Park Management Body is expected to have a direct positive impact on the promotion and implementation of information awareness of local authorities and residents, as on the social, economic and cultural development of the region. Moreover, it will contribute significantly to the protection and conservation of the environment, as well as the implementation of environmental legislation and protection of the Park.

Recognizing the great value of biodiversity and sensitivity of mountainous ecosystems, imposes the need for integrated sustainable tourism development planning. Tourism development in protected areas can have multiple benefits for the local societies and economies, such as increasing employment and income of residents, while preserving and protecting the natural environment. In order to achieve sustainable tourism development goals, there is need for the study and planning design at the national, regional and local level, as well as a consensus among all stakeholders involved in local sustainable tourism development (government entities – local authorities – local community).

For the success of this planning approach, there is need for the coordination of the active involvement of residents and the cooperation among all tourism stakeholders, within a local sustainable tourism cluster to include: local authorities, local tourism operators, Parnassos National Park Management Body, local tourism enterprises associations, local environmental and tourism initiatives, residents. A factor of major importance for the proper sustainable development of the protected area under study is the education and training programs for tourists and residents, so as for them to understand the need for the creation of a local sustainable tourism cluster in the area.

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DESIGN AND LAYING OUT OF PATHS IN SEMI MOUNTAINOUS FOREST AREA FOR BETTER MANAGEMENT AND DEVELOPMENT OF THE AREA

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Abstract.

The production of accurate cartographic material is essential because it constitutes an important tool of management. In order to surveying and layout of the paths and the production of accurate maps can be used several devices and instruments such as the Meridian compass in combination with clinometer and the electronic compass - finder (i.e. TruePulse 360° B). The aim of this paper is to highlight the significance of the accurate display procedure of path with the aid of the above mentioned instruments and to investigate the range of the usefulness of the measurements. The results of the measurements are presented in a CAD program on PC, where the final shape of a part of the network paths of the study area is appeared, and the points of measurement are given in figure. The mapping can be extended and the results of the surveying can be included in a printed or electronic map data in order to be used by stakeholders.

Key words: path, surveying, layout, compass, cartographic.

Introduction

The forest covers many everyday human needs (e.g. recreation, walking, hiking, mountaineering, trekking, training, sports, etc.). These activities are achieved through the use of paths, which are now well developed and have taken the form of a network. During the past they constituted shaped ways by pedestrians and animals in order to join places that have for man any particular interest. Today, with technology development, in their mapping out and surveying was given to them great importance, because they serve as mentioned above many activities and at the same time constitute an ecological form of road, friendlier to the environment than other classic routes. In consequence, depending on the regions we want to approach, potential users, the length, the degree of difficulty and their shape, we distinguish the paths in various categories (paths of big corridors, mountaineering paths hiking trails, peripatetic paths, educational paths and in combinations of paths). Greece except from the national trails contains also parts of two international paths (E4, E6). Paths are cultural elements associated with human presence and activity. Also they are passed through areas with natural beauty and great biodiversity and along or to their final destinations. There are a wealth of cultural elements associated with the daily activities and services of residents (floors, water mills, terraces, inns, bridges) but also with religious and other traditions (churches, monasteries). In Greece, in recent years, there have been attempts to explore these pathways in order to develop the areas where they cross, while preserving the historical and cultural elements. For example, the paths to Amorgos (Kouroupaki, 2001), footpaths on Andros (Vretou & Kouroupaki, 2001), the paths in Mani (Saitas, 1995), the paths to Skopelos (Vlami & Zogkaris, 1997) the paths of Nafpaktos (Pountzas, 1998).

Apart from Greece and various countries of Europe, as in Cyprus (the nature trails in the Akamas) (Cyprus Tourism Organization, 2009), UK (National Park Midlands, English) (Nicholls, 1996), the Isle of Gomera in Canary Islands (Gomez et al., 1987) and elsewhere were opened old paths and were drawn new ones to the ecotourism development in the region. The aim of this paper is to highlight the significance of the accurate display procedure of path with the aid of the Meridian compass in combination with clinometer and the electronic compass - finder (i.e. TruePulse 360° B). Also the

present paper goals to the exploitation of the around area Mesoropi, as the path crosses in parallel the settlement and its end is close to the beginning of the path to "Voskovrisi". Still, the highlighting and improvement of the path and the construction of some complementary works make the route accessible to visitors who want to enjoy the unique natural environment and also voluntarily contribute to its protection. Thus, alongside the increased interest that is shown in recent years for forest recreation, the aim of voluntary protection of this area will also be served.

Materials and Methods

Research area

The study area is particularly worthwhile from the viewpoint of vegetation and is located on the southeastern side of Mount Pangaion. The area is suitable for recreational activities as it offers plane trees that cause awe and offer a shadow of shade while in some parts *Quercus Coccifera* is appeared. Still in parts the presence of fern is intense. The area that will develop the route both due to location and due to elements of the natural environment that attract visitors, such as vegetation in combination with the wet element, as well as elements for better service such as easy access and the presence of settlements in nearby. The composition of vegetation along the path, due to the water element, consists mainly of largethe nature of the forest vegetation and topographical formation is an important green lung of the area. It is also an interesting forest route, as it accumulates a lot of experience on a short walk (Figure 1).

Fig. 1. Study area

Materials and methodology

The instrument that was used in order to survey part of the paths was the electronic compass - finder True Palse Laser Technology 360° B and the Meridian compass/clinometer (Figures 2 and 3). The electronic compass – finder on a tripod always shots to the reflector that is mounted on the height of the observer's eye. The target height is remaining fixed until the end of the measurements. The 360 laser rangefinder has an integrated compass that allows us to measure azimuth and provides an extra onboard solution called missing line. This is a simple 2-shot routine that instantly calculates the distance, inclination and azimuth direction value between any two remote points. For downloading data into any compatible data collector, we can use the standard RS232 serial port or Bluetooth®. The Meridian compass/clinometer is a small hand-held instrument of amazing accuracy of 1^g from the outer cycle while we can evaluate the $(1/6)^g$ due to a prism of magnification 16x. It concludes a

clinometer with different scales (100%, ±45°, ±50^g). It can be used economically wherever precision requirements do not require a theodolite or leveling instrument.

Fig. 2. TruPulse Laser Technology 360° B

Fig. 3. Meridian compass/clinometer

The surveying of the path started from Klothori and ended to Nivro in a natural swimming pool. The points were surveyed with Meridian compass/clinometer and the electronic compass - finder then entered in a CAD program (AutoCAD 2005). With the command POLYLINE all these points get together and gave us the route of the path as shown in the next chapter.

Results

Based on the measurements, come to light the data in table 1. Also the differences between the electronic compass - finder True Palse Laser Technology 360° B and the Meridian compass/clinometer are concluded.

Table 1. Measurements with the electronic compass - finder True Palse Laser Technology 360° B and the Meridian compass/clinometer

ID Point	Electronic compass - finder True Palse Laser Technology 360° B				Meridian compass/clinometer		
	Distance between points (metre)	Distance from the beginning (metre)	Azimuth (degree)	Azimuth (grand)	Distance between points (metre)	Distance from the beginning (metre)	Azimuth (grand)
A		0,00				0,00	
	45,10		11,1	12,3	46,00		19
1		45,10				46,00	
	19,60		4,7	5,2	19,00		13
2		64,70				65,00	
	4,40		349,7	388,6	5,00		396
3		69,10				70,00	
	19,90		3,2	3,6	28,00		10

These devices provide us with enough information about the two routes of the path as it appears in figure 4.

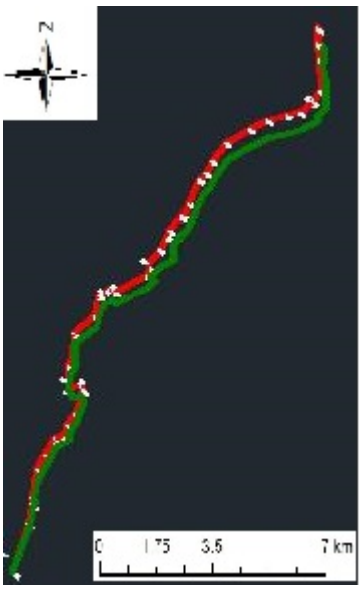

Fig. 4. The points of the path in AutoCAD

Discussion-Conclusions

The elevation and improvement of the path automatically helps to highlight the natural environment of the study area. The course has been carefully traced so that the visitor can walk through secure places and not to disturb the surrounding environment (old terraces etc.). The study does not foresee cutting and pruning of trees, while there are signs for paving, aiming to improve the Aesthetics, the view, but above all the sense of security that the visitor must feel while walking along the path. In general, the course of the path and the selection of the positions of the complementary works were based on:

- Safe passage
- Continuous and uninterrupted visual contact with the aquatic element and the wider natural environment, as well as the protection of the entire area
- The emergence of the natural beauty of the area with works and constructions that will not alter the natural environment and will be adapted to the whole aesthetics of the landscape

- The pleasant and comfortable stay of the visitors in the area.

Provide Facilities for Recreation

The elevation and improvement of the forest path from Klothori to Nivrio in the MC Mesoropi will be designed to serve activities such as walking, relaxation, enjoyment and observation of nature. The course of the path has been carefully designed so that the visitor can walk through secure places and not to disturb the surrounding environment (old terraces, etc.). Interventions in the existing vegetation will not occur. The deck will be constructed with a width of 1.20 m, while points are provided with paving. Two wooden footbridges will be built at the crossing points. The above interventions are made both for constructional reasons and for reasons related to the sense of security the visitor must feel while walking through the path. Specifically will take place:

- Opening, shaping and marking of decks on the deck
- Marking
- Construction of wooden pedestrian bridges and stone stairs
- Providing facilities for rest and recreation for visitors.

These devices provide us with enough information about the terrain and they contribute to the creation of topographical activities as it appears in this paper. The suburban forests are usually categorized as high fire risk zones or are declared as an environmentally protected forest. The subcategories of the environmentally protected forests include both cases of absolute protection, to a semi protection one, defining a limited permission of technical works, such as access paths. The real expectations from the environmentally protected forests are pleasure, environmental education, and environmental tourism. Path is a friendly form of road on the forest environment. Therefore it would be good to map the entire route network in Greece. So it would be easier to manage but also to highlight areas of the country. The proposed mapping of paths can start from the national network of paths and continue with other routes of interest, aiming the maximum flow of information (e.g. for the development of eco-tourism, development and management of recreation, skidding with animals) and generally serve the various needs of users of trails. The results of these mapping can be included in a printed or electronic material for use by stakeholders. The lists of points' coordinates of each route will be available so that they are used as waypoints to a GPS receiver and guide a walking tour, etc. While the accurate digital mapping of the paths can be the basis for the production of multimedia products for the acquaintance of future visitors to the area's natural, historical and tourist features. Recreation paths are for people. They allow us to go back to our roots. Paths help humans make sense of a world increasingly dominated by automobiles and pavement. They allow us to come more closely in touch with our natural surroundings, to soothe our psyches, to challenge our bodies, and to practice ancient skills. Keep this in mind when designing, constructing, and maintaining paths. Although many paths have some purely utilitarian value, their esthetic and recreational qualities are important to most people. A well-crafted path is unobtrusive, environmentally sensitive, and fun. Human psychology also plays a role. A useful path must be easy, obvious, and convenient. Paths exist simply because they are an easier way of getting someplace. Of course, many paths, such as wilderness trails, dirt bike routes, or climbing routes, are deliberately challenging with a relatively high degree of risk. All paths are not created equal. Each is ideally designed, constructed, and maintained to meet specific requirements. These specifications relate to the recreational activities the path is intended to provide, the planned level of difficulty, the amount of use expected, and physical characteristics of the land. Ecological and esthetic considerations are also important.For example, a narrow winding path might be the right choice for foot traffic in wilderness, while one with broad, sweeping turns would be appropriate for an all-terrain vehicle route. A smooth path with a gentle grade is more appropriate for an interpretive path or a path designed for disabled persons No discussion of paths is complete without talking straight to the topic of esthetics. We're talking for scenic beauty here. It is pleasing to the eye. The task is simple. An esthetically functional path is one that fits the setting. It lays light on the land. Good planning also includes monitoring path condition. It's hard to do good planning unless you have some idea of the current situation and trend. The thematic routes and hiking paths are two good cases to "invest" the state. Many visitors find it interesting to spend some of their holiday time in a "healthy walk" in an interesting path. It is certain, too, that if we care to give an "ecotourism reputation" to

every place we should create as soon as possible (among other things) a dense network of hiking paths that will allow highlighting these areas as a valuable destination for eco-tourists. The cost for the "creation" of a path is actually relatively small (from 18 to 60,000 euros) and a gain from its existence is discernible. The funding of many pathways in Greek territory came from various development programs (e.g. LEADER II, LEADER +, etc.).The bodies that provide trekking services can be, except by private companies, national agencies or private collections, mainly mountaineering. All of them in the performance of their tasks they use maps and sometimes produce maps adapted to their specific requirements. The maps of this category are always marked the hiking-trails. The maps that are used are usually derived from basic cartographical infrastructure of each country are in different scales and in different ways illustrate the specific geographical features such as glaciers and slopes with steep gradients which are compatible only with climbing. Generally on these maps someone can meet a wide variety of cartographic symbols, and a great variety of ways to display the lines of paths. Taken together, the maps offered in the market, in Greece or internationally, from small-scale maps showing the mountain trails with varying degrees of accuracy, but is not suitable for use by individual or groups of walkers inexperienced on how to use these maps. These walkers should be able to understand where they are in the real world and on the map, but also to recognize and follow the path on the ground with the help of the map. Obviously, to make this possible, the issue of movement over mountain paths and the corresponding cartographic material production ought to be based on a new basis, where the exact knowledge and the surveying of such paths will have an important role in principle, which is not the case today.

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FUZZY MULTIPLE CRITERIA ANALYSIS FOR SELECTING THE OPTIMUM TREE SPECIES FOR TRUFFLE CULTIVATION IN GREECE

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Abstract

Truffle cultivation may be very profitable for farmers; however, the selection of an appropriate site and a host tree species is very difficult, truffles being a very sensitive cultivation with very specific requirements in terms of soil pH, climatic conditions, orientation, altitude etc. The aim of this paper is to facilitate the selection of the optimum tree species for truffle cultivation in Greece, using fuzzy multiple criteria analysis, namely the VIKOR method. Some of the most common tree species suitable for truffle cultivation in Greece were examined: *Quercus sp., Pinus sp., Corylus avelana, Ulmus campestris, Fagus sylvatica, Carpinus betulus*, taking into consideration five basic criteria: soil pH, temperature, rain, altitude and orientation. The research resulted to a ranking of the six tree species in terms of their suitability for truffle cultivation, according to these criteria. The findings are of great interest under the scope of Forest Policy, since afforestation of abandoned and degraded agricultural land is a key priority for the European Union. Moreover, the multiple criteria analysis model developed contributes to the minimization of investment risk in truffle cultivation, allowing farmers to select the optimum tree species or achieve a compromised solution. The final ranking of the alternative tree species was produced by using fuzzy VIKOR and the optimum tree species in both scenarios examined was *Quercus sp.* (*Quercus coccifera, Quercus ilex and Quercus pubescens)*.

Keywords: *fuzzy multiple criteria analysis, truffle cultivation, tree species, Forest Policy, sustainable development*

Introduction

Truffles are non wood products that gained increased popularity in the past years because of their unique taste and their extensive use in high gastronomy. Truffle cultivation has spread worldwide in the last few years (García-Montero et al. 2008). It is considered to be very profitable for farmers (Reyna and Garcia-Barreda 2014) but is also a very demanding cultivation with uncertain yield (Lefevre 2012). According to Chevalier and Pargney (2014) the main reason for failure in truffle cultivation is the absence of modern cultivation techniques; the farmers tend to adopt more empirical methods and they seem to ignore the rational methods.

The selection of an appropriate site and a host tree species is very difficult, because truffles are very sensitive and have specific requirements in terms of soil pH, climatic conditions, orientation, altitude etc. Serrano-Notivoli et al. (2016) examined the potential sites for black truffle cultivation in Northeast Spain (Zaragoza province) with the use of Geographic Information Systems and their model included edaphic, climatic and topographic parameters. Soil factors are considered to have the greatest impact on truffle cultivation (García-Montero et al. 2006, García-Montero et al. 2008). A large study conducted in Germany between 2008 and 2011 indicated that climate change affects the truffle distribution (Stobbe et al. 2012). The same study pointed out that the best host tree species for truffles are *Quercus sp.*, *Corylus sp.*, and *Fagus sp*. The suitability of *Quercus sp. and Corylus sp.*

for truffle cultivation has been also verified by a study in Sweden (Wedén et al. 2009) and a study in Spain (García-Montero et al. 2007).

Truffle cultivation is also linked with sustainable development. Reyna and Garcia-Barreda (2014) pointed out that truffle cultivation has benefits that affect all three pillars of sustainability: society, environment and economy. Regarding the environmental pillar, in particular, it has been proven that truffle cultivation promotes reforestation and land use stability (Bonet et al. 2006). Truffle cultivation could be combined with tree crops cultivation, offering a sustainable solution for the rural development in Greece, especially in less favoured areas (Tsiaras and Spanos 2017).

A recent study highlighted the great potential for truffle market in Greece; among its findings was an indication that the development of the truffle market will contribute to the Agricultural Policy of Greece with the cultivation of arid lands (Tsitsipati and Christodoulou 2014).

The aim of this paper is to facilitate the selection of the optimum tree species for truffle cultivation in Greece, using fuzzy multiple criteria analysis, specifically the VIKOR method. Multiple Criteria Decision Analysis (MCDA) is a method broadly used for problems of optimization especially in the sectors of Forestry, Agriculture and Environment (e.g. Kiker et al. 2005, Huang et al. 2011, Mendas and Delali 2012, Reiff et al. 2016).

Materials and Methods

In this study six of the most common tree species for truffle cultivation were examined in correlation with five criteria that affect truffles productivity: 1) soil pH, 2) temperature, 3) rain, 4) altitude and 5) orientation. Two different scenarios were examined. In the first scenario all criteria were weighted equally, while in the second scenario emphasis was given to the soil pH criterion, since soil is the most crucial factor for truffle cultivation (García-Montero et al. 2006, García-Montero et al. 2008). The data were based on the existing bibliography on truffles (e.g. Hall and Haslam 2012) and the analysis was made with the VIKOR method.

VIKOR proposed by S. Opricovic in 1990 as a multicriteria analysis method for solving complex decision problems with several potential alternative solutions which can be evaluated by conflicting quantitative and qualitative criteria. The outcome of VIKOR is a rankingof the possible solutions and the suggestion of the subset of solution that is “closest” to the “ideal” solution. (Yazdani and Graeml 2014). However, in some situations the decision maker is unable to express a perception or judgment without uncertainty or vagueness (Zadeh 1965). FVIKOR can resolve the imprecision or vagueness of human judgment, modeling both criteria and weights as TNFfuzzy numbers and execute using the fuzzy operations and ranking procedure (Sanayei et al. 2010). Measure of the “closeness” for the compromise ranking is the aggregating function (Yu 1973, Zeleny 1982, San Cristobal 2011):

$$L_{p,j} = \left\{ \sum_{i=1}^{n} \left[w_i \cdot \left(f_i^* - f_{ij} \right) \Big/ \left(f_i^* - f_i^- \right) \right]^p \right\}^{1/p} \quad ,1 \le p \le \infty \text{ και } j = 1,2,\ldots,m$$

where n is the number of criteria, m is the number of the alternative solutions, $w_i = [1_i^w, m_i^w, r_i^w]$ is the weight of the criterion i, $f_i^* = [l_i^*, m_i^*, r_i^*]$ is the best and $f_i^o = [l_i^o, m_i^o, r_i^o]$ is the worst value of criterion i for all alternatives and $f_{ij} = [l_{ij}, m_{ij}, r_{ij}]$ is the evaluation of the alternative j in regard to criterion i. FVIKOR the values:

$$L_{1,j} = S_j = \sum_{i=1}^{n} w_i \otimes d_{ij}, \quad j = 1,2,\ldots,m,$$

$$L_{\infty,j} = R_j = \underset{i}{MAX} \left[w_i \otimes d_{ij} \right] \ , \quad j = 1,2,\ldots,m,$$

$$Q_j = v\left(S_j \,!\ \ S^* \right) \Big/ \left(S^{or} - S^{*l} \right) \oplus \left(1 - v \right) \left(R_j \,!\ \ R^* \right) \Big/ \left(R^{or} - R^{*l} \right), \ j = 1,2,..,m$$

as measures for the ranking. The alternative with the minimum S-value is the one with the maximum group utility (the rule of “majority”) and the alternative with the minimum R-value is the one with the minimum individual regret of the “opponent” (Opricovic and Tzeng

2004).The parameter v is used for the adjustment of the strategies of maximum group utility and individual regret (Opricovic and Tzeng 2007) and takes values in the interval [0, 1]. Finally, FVIKOR constructs the ranking lists S, R and Q in descending order and propose the compromise solution according to the following rules (Opricovic 2011, Kim and Chung 2013):

a) The alternative $A^{(1)}$with the minimum Q value if:
   C1. "Acceptable advantage": Q ($A^{(2)}$) - Q ($A^{(1)}$) >= DQ, where $A^{(2)}$is the second alternative in Q list and DQ = 1/(1-m).
   C2. "Acceptable stability in decision making": The alternative $A^{(1)}$is also first in list S and/or R.
b) The alternatives $A^{(1)}$and $A^{(2)}$ of Q list if only the condition C2 is not satisfied.

The alternatives $A^{(1)}$, $A^{(2)}$,..., $A^{(M)}$ of Q list, for maximum M determined by the inequality Q ($A^{(M)}$) - Q ($A^{(1)}$) < DQ if the condition C1 is not satisfied.

An important problem in multicriteria analysis is that the vagueness of a concept might obstructs its reasonable description by conventional quantitative arithmetic expressions or relations. Linguistic variables, which are variables whose values are words or sentences in a natural language, provide the means for the approximate quantitative characterization of fuzzy concepts. In our study, we utilize the linguistic values {Very Bad (VB), Bad(B), Average(A), Good(G), Very Good(VG)} and the corresponding triangular fuzzy numbers {(0, 0, 2), (0, 2, 4), (3, 5, 7), (6, 8, 10), (8, 10, 10)} to convey the evaluations of the alternative solutions and the weights of the criteria.

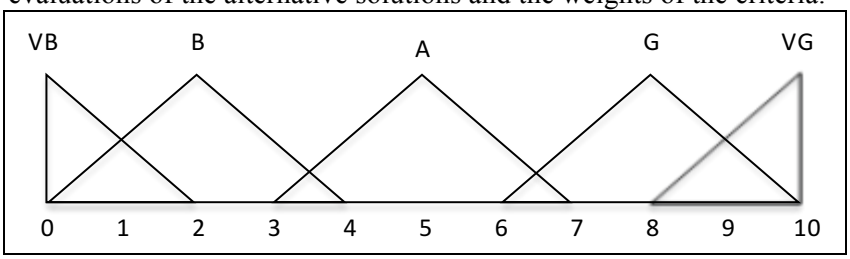

Figure 1. Linguistic values and triangular fuzzy numbers

Results

In the first scenario, all criteria that affect the selection of tree species (soil, temperature, rain, altitude and orientation) were weighted equally; the results are shown in Table 1.

Table 1. Scenario 1, equal weights

Equal weights *			
S ranking	R ranking	Q ranking	Compromise solution
Quercus	*Ulmus*	*Quercus*	*Quercus*
[-0.020,0.300,0.500]	[0.080,0.160,0.200]	[-0.771,0.000,0.771]	*Caprinus*
0.270	0.150	0.000	*Ulmus*
Caprinus	*Caprinus*	*Caprinus*	
[0.040,0.440,0.640]	[0.080,0.160,0.200]	[-0.729,0.100,0.872]	
0.390	0.150	0.086	
Fagus	*Corylus*	*Ulmus*	
[0.180,0.500,0.620]->0.450	[0.080,0.160,0.200]	[-0.643,0.186,0.957]	
	0.150	0.171	
Ulmus	*Quercus*	*Corylus*	
[0.160,0.560,0.760]	[0.080,0.160,0.200]	[-0.600,0.229,1.000]	
0.510	0.150	0.215	
Corylus	*Pinus*	*Fagus*	
[0.220,0.620,0.820]	[0.120,0.200,0.200]	[-0.496,0.276,0.857]	
0.570	0.180	0.228	
Pinus	*Fagus*	*Pinus*	
[0.280,0.640,0.720]	[0.120,0.200,0.200]	[-0.424,0.376,0.929]	
0.570	0.180	0.314	

The best three choices according to the first scenario are: 1) *Quercus sp*., 2) *Carpinus sp*. and 3) *Ulmus sp*.

In the second scenario the criteria were given different weights and the most important criterion was the soil pH. The weights assigned to each criterion are shown in Table 2.

Table 2. Weights of the criteria in scenario 2 (realistic)

Criterion	**Weight**
Soil pH	0,5
Temperature	0,1
Rain	0,1
Altitude	0,1
Orientation	0,2

For the second scenario the best alternative is *Quercus sp*., same as in the first scenario, however *Pinus sp*. is the second best alternative (Table 3).

Table 3. Scenario 2, different weights

Different weights *			
S ranking	Rranking	Qranking	Compromise solution
Quercus	*Quercus*	*Quercus*	*Quercus*
[-0.110,0.170,0.370]	[0.040,0.080,0.100]	[-0.343,0.000,0.343]	*Pinus*
0.150	0.075	0.000	
Pinus	*Pinus*	*Pinus*	
[0.040,0.400,0.540	[0.060,0.100,0.200]	[-0.235,0.156,0.533]	
0.345	0.115	0.153	
Caprinus	*Caprinus*	*Caprinus*	
[0.070,0.470,0.670]	[0.050,0.250,0.350]	[-0.226,0.330,0.743]	
0.420	0.225	0.294	
Ulmus	*Ulmus*	*Ulmus*	
[0.280,0.680,0.880]	[0.200,0.400,0.500]	[0.032,0.587,1.000]	
0.630	0.375	0.552	
Corylus	*Corylus*	*Corylus*	
[0.280,0.680,0.880]	[0.200,0.400,0.500]	[0.032,0.587,1.000]	
0.630	0.375	0.552	
Fagus	*Fagus*	*Fagus*	
[0.390,0.750,0.810]	[0.300,0.500,0.500]	[0.186,0.717,0.957]	
0.675	0.450	0.644	

* In each cell : Alternative
fuzzy evaluation
crisp evaluation

Discussion-Conclusions

Both scenarios resulted in *Quercus sp.* as the best alternative among the examined tree species. In Greece the most suitable tree species for truffle cultivation of the genus *Quercus* are: *Quercus coccifera, Quercus ilex and Quercus pubescens*. *Quercus ilex* is also proposed by Bonet et al. (2006) as a suitable tree species especially for the cultivation of black truffle (*Tuber melanosporum*). In the more realistic scenario, where the most important factor was considered to be the soil, the second best choice was *Pinus sp.* In Greece the most suitable tree species for truffle cultivation of the genus *Pinus* are: *Pinus halepensis* and *Pinus sylvestris*. In the less realistic scenario in which all criteria were of the same weight, *Carpinus* and *Ulmus* were the other tree species that were pointed as good alternatives.

The results of the study could be useful to the planning of Forest Policy in Greece, by the provision of subsidies for oak reforestation in less favoured areas, a practice used in Spain since the late '80s with impressive results in socioeconomic level (Samils et al. 2008). The same practice regarding the conversion of marginal or abandoned agricultural land, mostly found in less favoured areas, to woodlands with dominant tree species the *Quercus sp*. is also used in Italy and France with good results (Olivera et al. 2011).

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MANAGEMENT AND PROTECTION OF PERI-URBAN FORESTS OF THREE TOWNS IN GREECE

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Abstract

a) The satisfaction of continuous leisure demand in suburban forest requires management of space properly so in the one hand to provide better services to visitors and in the other hand to protect against excessive and improper use of by guests. In the present study we investigated and analyzed the current situation of the suburban forests of Drama, Limni and Elassona and proposed the appropriate future management. The views of residents are reflected in primary research using a questionnaire (personal interview). The results focus, regardless of the region, to the multiple roles played by suburban forests for urban and suburban areas. The integration of suburban forests and above all the urban green as key elements of spatial planning and urban reconstruction of large and small urban centers are the means that will create favorable conditions for future upgrading of suburban forests in order to sufficiently accomplished modern triple productive, ecological and social role.

Keywords: *Suburban forestmanagement, peri-urban forest, Drama, Limni,Elassona*

Introduction

Features of the urban areas are the continuing increase of the density of population, the steadily increasing surfaces covered with asphalt and other hard building materials. Furthermore, the proximity of some of the modern cities to industrial areas and excessive traffic volume weigh heavily on environmental conditions, increasing air pollution and temperature and decreasing the speed of the wind in the urban environment (Miller 1997, Jim and Chen 2006, Georgi and Tzesouri 2008, Dafis 2010). However, it is considered that the urban and suburban green spaces are of crucial importance for the environmental conditions (Samara and Tsitsoni 2007). Green spaces may, under certain conditions, contribute to the improvement of the city's environmental conditions. Predominant role play the extent of green surface, the shape and composition of the vegetation and the combination with the water surfaces. Moreover, the rapid development of technology, the human intervention in nature and the exploitation of natural resources have resulted in the degradation of the natural environment and disrupting the ecological balance of forest ecosystems with unpleasant consequences even for human survival itself. Modern man believed that he may be unreasonably imposed in nature and to exploit in order to satisfy their needs. Despite the continuing disruption of one relationship "Forest - Man", the second always felt the need to return even for a moment to the natural environment from which it began, to experience some from the unique pleasures.

Suburban forests seem to form a perfect way, since they are accessible to the majority of the urban population. Suburban forests are not simply a set of trees and shrubs covering a surface. It is an ecosystem that performs a number of functions, which are felt by the services and goods offered. The sectors that can contribute is to improve the microclimate (solar radiation, temperature, relative humidity, ionization, etc.), production of oxygen, carbon dioxide absorption in clean air (Dafis 2010, Cartalis and Varotsos 1992, Willis 2003, Nowak et al 2006 , Georgi and Tzesouri 2008, Haase et al. 2012). In table 1In flood protection and enrichment of aquifers in recreational providing urbanites in noise reduction, protection from winds, protect against radiation, in the regulation of lighting conditions and glare protection, aesthetic improvement of suburban space in preserving biodiversity and the overall maintenance of the ecological balance, energy saving, environmental education and familiarity with the surroundings (botanical gardens, nature study trails, environmental education centers, sight positions etc.), in social problems (unsociability, crime, etc.) (Ftika 2008, Grau et al.

2008). The most important problems are the fires, the community and military installations find reception in the mountains lack of space on the urbanspace, overgrazing and rubbish (Zigkiris 2008, Konstantinidou 2014). The characteristics and benefits of the greenspaces are presented in the following table (Ftika 2008, Zigkiris 2009, Dafis 2010, Konstantinidou 2014).

Table 1. The characteristics and benefits of three green area typologies.

	Urban parks	**Peri-urbanforests**	**Forests**
Definition	Greenspaces in urbanspace	Forest in the interface between urban and rural space.	The total forest and woodland.
Location	In the urbanfabric.	On the outskirts of the city	Long distance from the cities.
Origin	Usuallyplanted, sometimesnatural.	Often natural forests. When they are planted the ecological condition are similar to natural.	Usuallynaturalforestecosystems.
Size	Usually they occupy small areas	Bigger than the parks and the groves in plan.	Extendedareas.
Delimitation-legislation	It is delimitated in the urban fabric.	It is defined as forest. Usually it is not delimitated as peri-urban.	Delimitated according to the forest management projects and protected by the forest and environmental legislation.
Growing conditions	Adverse conditions due to pollution. Higherairtemperature.	Favorable conditions. Undisturbed soil. Possible pollution because of industry proximity.	Naturalgrowingconditions.
Management	By the Municipality. According to Arboriculture. Planting, pruning operations, fertilization, control of insects and disease.	It is depended on the ownership regime. Principles of sustainability, forest and soil conservation and improvement. Pruning and disease control. Sometimes removal and replacement. Also natural regeneration.	From the Forest Services to the public forests. Principles of sustainability, forest and soil conservation and improvement. Rarelydisease and insectcontrol. Naturalregeneration.
Soil protection, protection from floods.	Protects the soil.	Main protection of the floods.	Permanent protection of the soil in extended areas.
Products	Limited.	Possible.	Production of remarkableproducts.
Climatologicaluses	Improvement of microclimate depending on the size and characteristics the park.	Significant improvement of the microclimate and air pollution reduction.	Significant contribution to the global carbon balance.
Duration of visit	Short and often.	For a few hours or for a day	Onedayorlonger.
Recreationactivities	Extensive use of the area	It is offered mostly for sports and recreation. Extensive use of the area for several activities.	Multiple activities spread in large areas.
Dangers-Threatens	Arbitraryconstructions, illegalinterference	Strong residential pressures, illegal interference, forest fires, infestations by insects.	Less residential pressures, healthier, they reserve the ecologic balance

The Minister of Agriculture (Fountas2002) states: "it is necessary to define the legal concept of"per-urban forest "and to institutionalize the system of protection and management of peri-urban forests. We also need to review and upgrade the way and peri-urban forest management techniques in order to highlight the protective and cultural role and to meet more effectively the social needs. The development of a new institutional framework for planning and preparing management plans for these forests is imperative. The integration of suburban forests and above all the urban green as a key planning data and urban reconstruction of large urban centers are the means that will create favorable

conditions for future upgrade and expansion of suburban forests and quality of life of megacities. The perceptions of the public and scientists ever expanding need for change in the orientation management of peri-urban forests in order to sufficiently accomplished modern triple productive, protective and social role.

The purpose of the study is to investigate and analyze the existing problems of suburban forests Drama, Limni and Elassona and appropriate future management methodology. Also, the aim is to draw conclusions on the following issues:

• Demand for forest recreation in the peri-urban forests of Drama, Limni and Elassona (active and future). The investigation of the demand or need for recreation is vital, because ultimately leads to even an approximate estimate of the number of visitors, the type of activities, the visit time, residence time, etc., variables necessary for the proper planning of various projects. Active demand is the current demand and future demand is the demand that will be formed after the performance of space projects.

• Description of the management of peri-Drama, LimniandElassonaPeri-Urban forests.

• Preferences of residents, activities and recreation facilities in the peri-urban forests of Drama, Limni and Elassona.

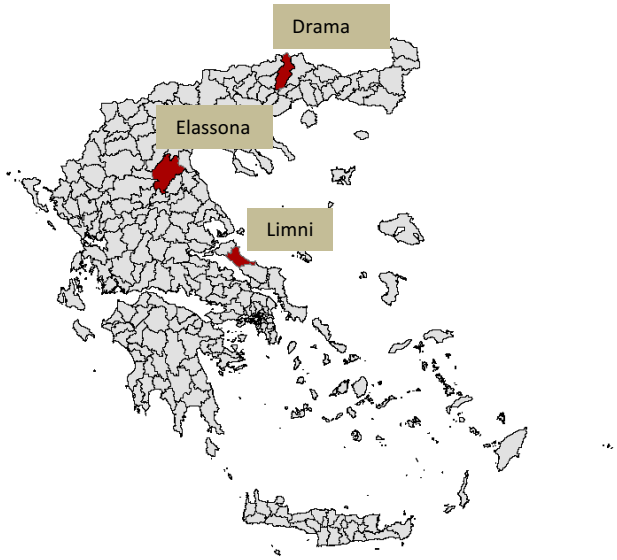
• Estimation of recreational value.

• Problems suburban forests and ways to address them.

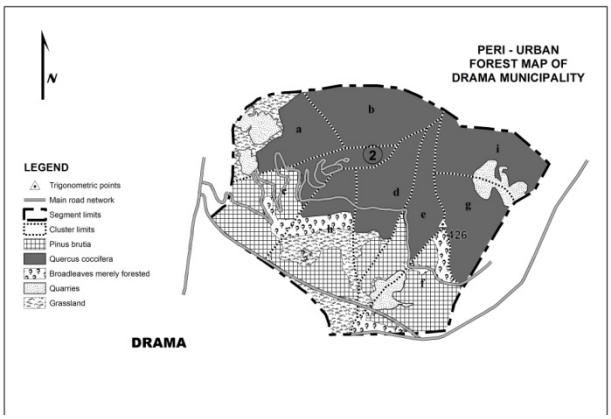
Materialsand methods

B. Case study area

The fieldwork concerns the peri-urban forests of Drama, Limni and Elassona, of north and central Greece (map 1). Drama is the capital of the Prefecture in Eastern Macedonia, Greece positioned at N 41° 09' 38.89'' E 24° 09' 32.09''. The Korilovos pine forest is the suburban forest of the city of Drama in the north of the city, with panoramic view at the plain of Drama. The hill of Korilovos, with a maximum altitude of 624 meters, is considered an extension of mount Falakro. The vegetation consists of Calabrian pine (*Pinusbrutia)* which comes from artificial reforestation in the south, but also from native vegetation with kermes oak (*Quercuscoccifera*), eastern hornbeam (*Carpinusorientalis*), Christ's horn (Pa*liurus spina-christi*), and common juniper (*Juniperuscommunis*) (map 2). The Korilovos pinewood originated from artificial reforestation launched by the Forest Service of Drama in the years 1945 to 1946 and was completed for the most part in 1950 (Forestry Service of Drama 1982, 2008).

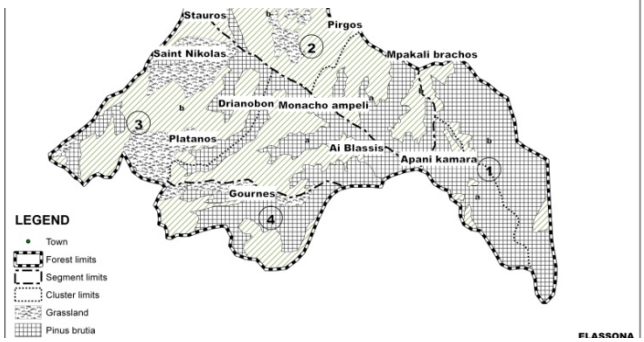


Map 2. Location of the peri-urban forests.



Map 1. Peri-urban forest of Drama.

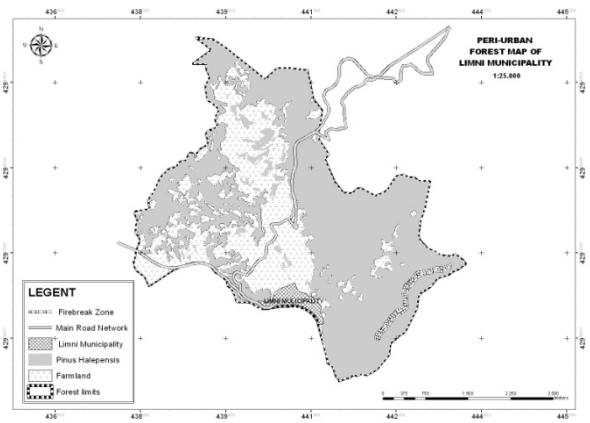
Elassona is the capital of the Municipality of Elassona, Thessaly,



Map 3. Peri-urban forest of Elassona.

Greece with coordinates N 39° 54’ 00.44’’ E 22° 10’ 54.26’’. It is built on the southern fringes of Olympus at the foot hills and the plain of Elassona was the capital of a wide geographic area with similar population for four thousand years called Perraivos and is known from ancient times as the capital of Perraivos called Olosson (also mentioned by Homer). The suburban spread of forest hills located north of Elassona and from an altitude of 300 meters to 700 meters (map 3). From 1937 to 1955 the then Forest Service proceeded with the reforestation of the area with Calabrian pine (*Pinusbrutia*) and cypress positions (*Cupressussempervirens*), false acacia (*Robiniapseudoacacia*) and Canadian poplar (*Populuscanadensis*) through streams. The vegetation that prevails in the greater region is the shrubby vegetation Kermes oak (*Quercuscoccifera*) and grasslands. Due to the strong slopes and existing favorable corrosion conditions, that existing forest cover carries serious protective effect on own pas s and pelvis generally torrent Elassonitis. A case ownership of the suburban forest of Elassona where a section of approximately 1100 acres are co-owners between government and T.ETH.A and found in it the premises of 364 PII Elassonas (outpost Ammunition Warehouse). The particular characteristics of the Monastery Olympiotissa in a top of the city of Elassona trademark and that the peaks seen most of the Thessaly plain and the peaks of Olympus, a view of infinite beauty. Its area occupies 360 hectares.

Limni, a town in northern Evia, StereaEllada, Greece, with coordinates N 38° 46’ 05.83’’ E 23° 19’ 34.54’’. It issituated near the ancient city Elymnion which is refered to Sophocles projects. Lays amphitheater within a geological panel clearly oriented towards the sea in a cove of the North Evian Gulf. According to the census of 2001 had 2.118 inhabitants. The suburban forest located northeast of the Limni(map 4) and is a sensitive ecosystem that presents important ecological interest. It is worth noting that the area presented 42 endemic species and subspecies. only mention Evia oak (*Quercustrojana ssp. euboica*) that grows in the region and has taken its name from the island of Evia and also the presence of top predators, such as birds of prey and otters that are notable indicator of the completeness of ecosystems. Creates local wind combined with the topography (canyons) improves the thermal comfort conditions. Local air, which is created by the topography of the area ('north wind' the locals call it) is northeast and blowing main evening hours 15:00 to 19:00.



Map 4. Peri-urban forest of Limni.

C. Sampling and survey methods

Apart from the literature search, data collection of services and data collection in situ, and conducted research questionnaires. Questionnaires and interviews are one of the research methods to investigate views, interests and attitudes. The results of the questionnaires after processing and interpretation, help to draw conclusions and decision making (Tu et al. 2015).The preparation and design of the questionnaire, the type of questions (open - closed type), measuring the attitudes and behavior of respondents and the choice of the population based on the literature (Chiesura 2004, Tyrvainen et al 2007, Zigkiris 2008, Anthopoulos and Georgi 2011).

The aim of the questionnaire consists of twenty-two questions closed and open-ended, is to identify the habits of the respondents for their visit to peri-urban forests respectively Drama, Limni, Elassona, respectively the reasons for the visit, their views on the current situation and their suggestions for improving the premises.The choice of "personal interview" method was based on the advantages of the method on the other like that answer most, possible explanations of questions from the Census respondent and use of a large questionnaire. Certainly the disadvantages of this method is quite laborious for the census, great time for the collection of responses, and sometimes lodged by the census ‘right’ answer.

The samples were determined to be 60 questionnaires to different age, gender, profession and habits of people. Held in each region at different times and from February 1st until March 15th, 2015.

The first two of the questions in the questionnaire are to do with the age and sex give i.e. respondents profile. The next six questions exploring the habits of the respondents in terms of their visits to the study area, such as visit frequency, the carrier transition facility in suburban area etc. The respondents were asked to give their views on the site, while the remaining questions have the opportunity to make their proposals for the management and the possible emergence of suburban forests. The questionnaire also investigates their intention to participate in environmental education events and their intention for voluntary tender storage space. For the convenience of the respondents preferring multiple choice questions in the largest part of the questionnaire. Finally, there were integrated control questions, which then interbred.

Results

The response to the questionnaire and interview was very high at 98 %. Up to 65 % of respondents visit the forest on foot, and secondly by using bicycle. A small percentage 5-15 % uses private car.The residents of the study areas use the peri-urban forests all over the year. In summer over 40 % of the responders visit the forest, while this percentage is 25-35 % during the spring. During the winter only 11-13 % of the responders visit the forest and in autumn the percentage rises to 16-24 % (fig.1).

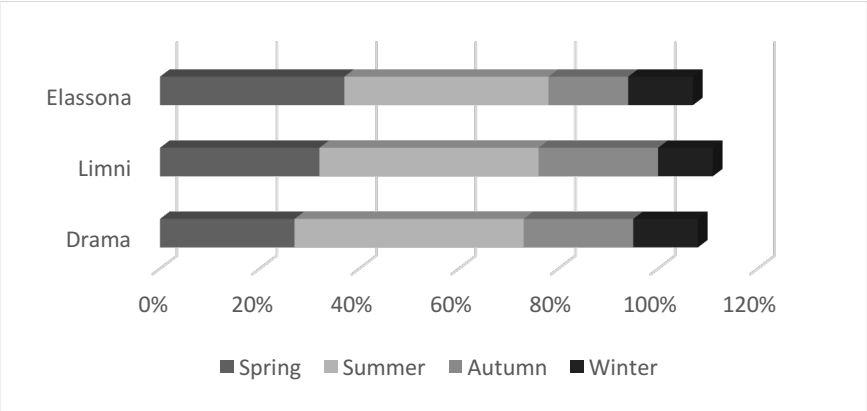


Fig 1. *The use of peri-urban forests through the seasons of the year.*

Although each area has its specific features, climate, geographical location, proximity to the sea, the visiting frequency of the respondents in the forest, ranges in percentages of 25%-35% for at least two times a month and varies in each region once the month by 24% -51% at least once a year 24% - 45%(fig. 2). Respondents aged over 40 years visit more often the peri-urban forest than those under 40 years old.

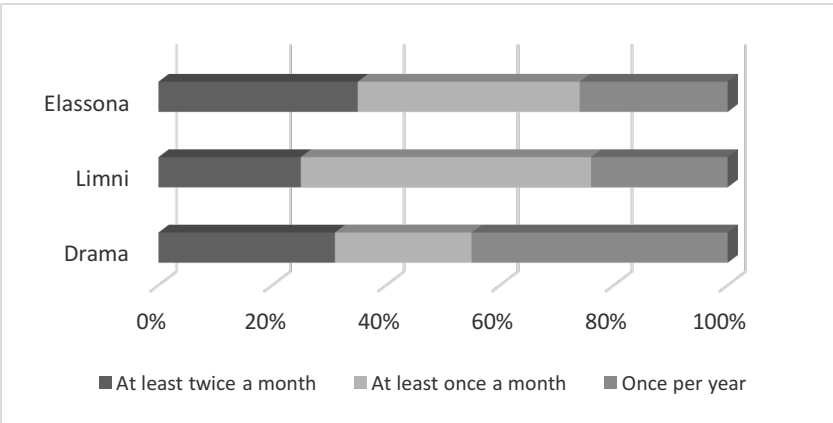


Fig 2. *Frequency of use of the peri-urban forests.*

The deficiencies found in peri-urban forests, according to the opinion of respondents, are children's playgrounds (50 %) and information centers (40 %). Infrastructure in sports playgrounds, trails, garbage bins and information centers are significant shortcomings for respondents in all regions and with the rates ranging from 33 % to 43 % (fig. 3).

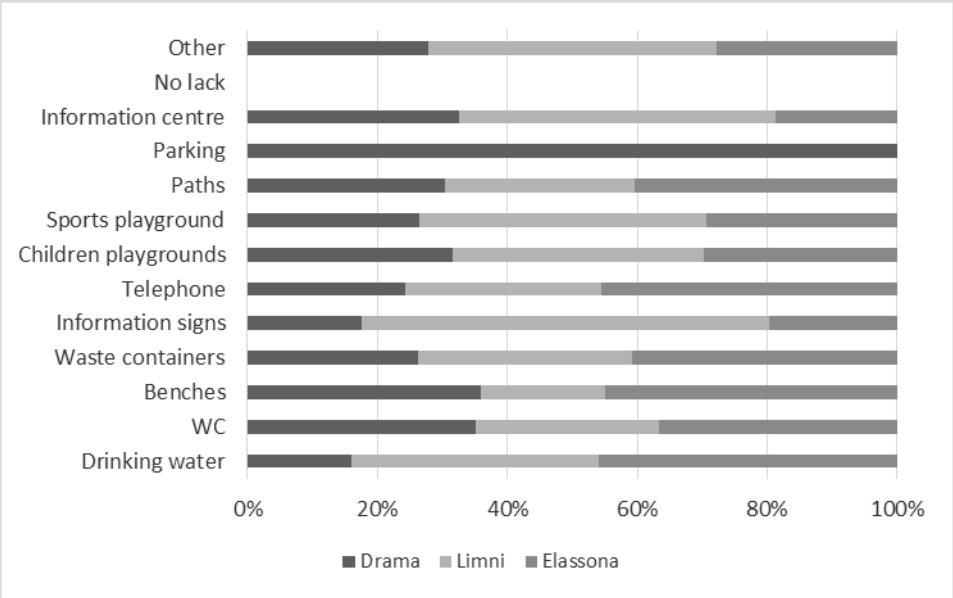


Fig. 3. *Lack of facilities in the peri-urban forests.*

The greatest threats to forest recreation areas in peri-urban forests according to the respondents are fires and garbage disposal (fig. 4). Also infestation of trees by pine processionary(*Thaumetopoeapityocampa*) affects the stay of respondents in the forest and the duration of the visit.

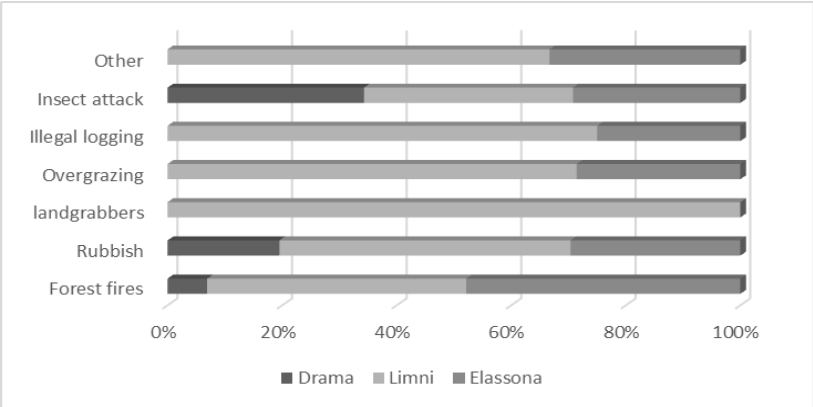


Fig. 4. *Main problems of the peri-urban forests.*

Most of the respondents in Elassona (60%) are willing to pay the ticket of 2 € for their visit to forest recreation areas to improve and maintain them while 15% say they do not intend to pay. On the contrary 60% of the responders of Drama are unwilling to pay a fee.In Limni the 15%-30% of the respondents are willing to pay a fee regardless of the amount, with a 5 % is not going to pay any fee.

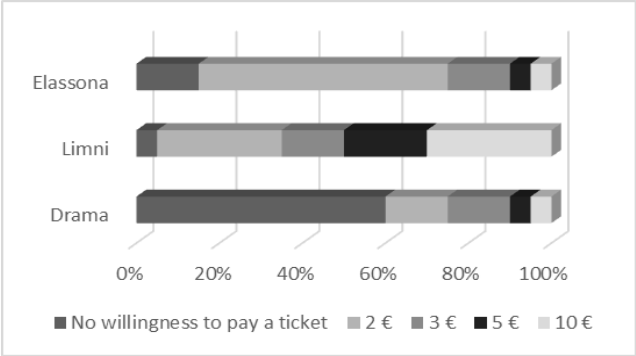


Fig. 5. *Willingness to pay a ticket*.

Drama. The surface suburban green attributable to residents of Drama (2011 census) is 85 sq.m. per capita (3802.0 acres to 44 823 inhabitants), surface comparable to that of other cities of Greek territory.

The proposals set out below are governed by the principle of sustainability, the principle of conservation of the forest as forest and soil protection. Furthermore, subject to the philosophy of the development of extensive use of suburban forest and recreation rather intensive.

The interventions proposed take account of the protective status of the area and taken special care to be in harmony with the forest ecosystem, such as the use of indigenous (native) forest species for reforestation and the use of recyclable materials with low ecological footprint as stone and wood.

The proposals are divided into the following sections:

• Demarcation, protection and management of suburban forest.
• Reforestation and rehabilitation of degraded vegetation.
• Pleasure Works.
• Connecting the suburban and urban green.
• Environmental education-familiarizing the local population with the natural environment.
• Formulation Procedure.

Elassona. The locals recognize the ecological significance of suburban forest and most of them often visit. Hovering course intense fear of a fire due to the fire in the PII Elassonas July 2013 for this proposed basic prevention and care measures of the peri-urban forest.The most new course state voluntary contribution for this storage. It is characteristic that almost all respondents visiting the forest often and often visited if there was a better infrastructure (paths, dustbins, toilets). Most of them declare that they would pay for better management and consider very important the fact of its existence in the city of Elassona.

Limni. The percentage of citizens who visits the suburban forest, the reasons for the visit, the shortcomings are, improvement of recreational facilities, improving the quality of life you want by increasing the green, and through the contributions of their own, problems who identify with dominant fires and trash, play a decisive role in the selection of another mode of suburban forest management (Zigkiris 2009). The overriding objective of the management should be the protection, improving the aesthetic and ecological enhancement not only attract people but to improve the microclimate of the area.

Discussion-Conclusions

Overall, respondents, regardless of group or the region, were particularly interested to the peri-urban forest, answered all the closed questions and largely open and expressed opinions and proposals for a possible management of the areas.

• Most visitors arrive in the forest on foot, which indicates that accessibility is easy. This also follows from the answers to the accessibility.

• It was found that the majority of respondents, although they have not been involved in environmental education events, they would like to participate in such programs. Especially students and teachers agreed in their entirety. Different age groups visit the areas for different activities . The decision makers therefore should take into account the different preferences (Roovers et al. 2002).

• Respondents who answered the open-ended question about the construction materials, indicated their preference in stone, wood and natural materials, indicating their environmental sensitivity.
• The reasons for the visit of the forest visitors is the walk, sports, rest and relaxation, contact with nature and escape from the city, as well as friendly meeting. Peri-urban forest fulfils many psychological and social needs of the citizens, which makes the green area a valuable resoyrce (Chiesura 2004).
• The main problems of the forests are considered the existence of garbage, infestation pineprocessionary and forest fires. Such disturbances decrease the values of the peri-urban forest (Tyrvainen 2007).
• Respondents agree with the emergence of the forest and said it should include gazebos, benches, restrooms and improvement of the existing infrastructure. However, most of them are not prepared to bear the cost for the improvement and maintenance of the site.
• Recognize the ecological value of suburban forest by citizens of surveyed areas and sought another way of management and protection.

In conclusion, the research revealed that specific properties are very important to the visitors of the peri-urban forest. In future survey the properties could be linked to the willingness of the visitors to pay a ticket.

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MULTI-TEMPORAL CHANGE ANALYSIS OF VEGETATION COVER USING REMOTE SENSING DATAAS A TOOL TO MONITORING ECOSYSTEM AND BIODIVERSITY INTEGRITY: THE CASE OF ILIA - GREECE

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Abstract

The use of satellite data has been widely applied to provide a cost-effective mean to analyzeland cover changes over large geographic regions. The aim of this study was the multi-temporal change analysis of vegetation overthe last 30 years, using freely available remote sensing data, in Ilia Prefecture, Greece. In the first step,four vegetation indices were adopted to analyzethe dynamic change of vegetation. At the second step, the investigation of the vegetation density changes was succeededthrough thematic change detection techniques, andat the third step, a Comprehensive Change Detection Method (CCDM) was applied for mapping biomass progress/regress. Finally, after the catastrophic mega-fire of 2007 in Ilia, a change analysis of four vegetation indices focused in this affectedregion was implemented to investigate the vegetation restoration. Althoughsome spatial changes of vegetation cover were observed during the study period, the state of vegetation cover either improved or remained constant through time,demonstrating the high potential of Mediterranean ecosystems to recover after disturbance events.

Keywords: Remote Sensing, Biomass, Multi-temporal Analysis, Vegetation Indices

Introduction

Land cover and its temporaldynamics, play a major role in global patterns of climate and biogeochemistry cycles of the Earth(Lambin and Strahlers 1994).Monitoring land cover and biomass changes is essential for planning and managing natural resources, modelling environmental variables, understandingthedistribution of habitats and assessing biodiversity(Nieto et al. 2015; Gómez et al. 2016,Hobia et al. 2017).Inforests, which are the most important terrestrial ecosystemsin terms of carbon flux between the atmosphere and the surface of the earth, biomass changesare predicted tohappen both to the current forested areas and also to areas that are currently not forested (Bollandsås et al. 2013), as a result of climate and land use changes (Höhneet al. 2007). Deforestationaffectsbiological diversity and results in soil degradation, mainly in the tropics (Matos et al. 2017; Sousa et al. 2017) but also in other areas (seeBurrascano et al.,2016).Wildfire occurrence and associated post-fire succession are the most importantdrivers of vegetation changes (Jinet al. 2017), especially in Mediterranean ecosystems. These ecosystems show high resilience to fire, although the increasing rate of wildfire frequency and severity could cause serious ecosystem degradation (Ruiz-Gallardoet al. 2004). Remote Sensing andGIS have been used

extensively in post-fire applications, not only to estimate the burn areas (Mitri and Gitas 2006)but also to evaluate post-fire recovery (Diaaz-Delgado et al. 2005; Poirazidis et al. 2012).

The use of satellite data provides a cost-effective mean to analyze land cover, over large geographic regions(Lu 2006; Lunetta et al. 2006). A fundamental advantage of remote sensing isfor the ability to collect and analyze time series images over large geographic areas easily and often at no cost (Hame et al. 1998). Digital change detection is a process of determining and quantifying change based on multi-temporal remotely sensed data (Jin et al. 2013), and it constitutes one of the most important applications of Earth orbiting satellite sensors for natural resource management (Kennedy et al. 2009), providingmulti-date digital imagery with consistent image quality, at short intervals, on any scale and during complete seasonal cycles (Rignot and van Zyl 1993).Various researchers have described methods for change detection usingremote sensing data, like transparency compositing, image differencing, imagerationing, classification comparisons and image enhancement techniques (Munyati 2000; Matsushita et al. 2007; Kennedy et al. 2009; Jin et al. 2013; Zhu and Woodcock 2014; Jin et al. 2017).

The main goal of the study was to evaluate a multi-approach methodology for long-term analysis of vegetation changes as a tool to monitoring ecosystem and biodiversity integrity, using the Ilia Region, Greece as acase study. The specific objectives of this study wereto: 1) quantify vegetation changes using relative indices, 2) investigate the changes of vegetation density classes, 3)mapping biomass progress/regress using composite vegetation indexand 4) detect the forest recovery after wildfire.

Materials and Methods

Study Area

The study was carried out in the Peripheral Unit of Ilia (21°26′25.84″E and 37°40′7.244″N), located in southwest Greece. It covers 220,678 ha, of which 1,479 ha have been included in the Natura 2000 network (GR233002- Oropedio Folois, GR2330004 – Olimpia, and GR2330005 – Thines and Paraliako DasosZacharos, Limni Kaifa, Strofilia, Kakovatos). The study area is characterized as a typical heterogeneous Mediterranean landscape, where forest stands (mainly by *P. halepensis*and *Quercus species)*of different sizes and ages are mixed with cultivations, primarily olives yards (Poirazidis et al., 2012).

Remote Sensing Data and Pre – Processing

In order to analyze the dynamic change of vegetation, we used 25 Landsat images acquired from 1984 to 2016 (Table 1). Twentyimages were Landsat TM5, while five were Landsat 8 OLI/TIRS. The selected imageswere aqcuiredbetweenJuly 15 and August 25 of each year, except for 2007 which was acquired in September.The image of 2016, due to problems,was not usedin the further analysis.

Table 1. *The remote sensing images used in the study.*

Year	Sensor	Year	Sensor	Year	Sensor	Year	Sensor
1984		1994		2006			
1986		1995		2007	Landsat 5 TM		
1987		1996		2008			
1988	Landsat 5 TM	1997	Landsat 5 TM	2011		2016	Landsat 8 OLI/TIRS
1989		2000		2012			
1991		2001		2013	Landsat 8 OLI/TIRS		
1992		2004		2014			
1993		2005		2015			

In certain circumstances, calibration of the image data is necessary prior to classification and change detection using multi-temporal images(Duggin and Robinove 1990). Depending on the nature of research, atmospheric/radiometric correction can either convert a digital number to surface reflectance (absolute) or correct the same digital number values in order to represent some reflectance (relative), regardlessof what the actual reflectance value may be on the ground (Song et al. 2001). In our case, we applied an absolute atmospheric correction using an ENVI 5.4 software routine.

Quantitative and multi-temporal analysis of biomass using vegetation indices

The first objective was to quantify the vegetation changes using vegetation indices. For this reason, four vegetation indiceswere calculated for each study year: (1) Enhanced Vegetation Index (EVI), (2) Modified Soil Adjusted Vegetation Index (MSAVI), (3) Normalized Difference Moisture Index (NDMI) and (4) Normalized Difference Vegetation Index (NDVI). Then, the mean values of thoseindiceswere calculated and evaluated in all the time-series (1984-2015)on two zone levels based on the LPIS-GIS:(1) Forest zone, Abandoned zone and Olive Grove zone and (2) Natural zone (the combination of the previous three zones).

Enhanced Vegetation Index

EVI (Eq.1) was developed to optimize the vegetation signal with improved sensitivity in high biomass areasand improved vegetation monitoring through a de–coupling of the canopy background signal and a reduction in atmospheric influence (Jiang et al. 2008):

$$\boldsymbol{EVI} = G\,\frac{N-R}{N+C_1\,R-\,C_2B+L} \quad (1)$$

where N, R and B are near – infrared, red and blue bands respectively, G is a gain factor, C1, C2 are the coefficient of the aerosol resistance term and L functions as the soil – adjustment factor. The coefficients adopted in the Landsat EVI algorithm are L= 1, C1= 6, C2= 7.5 and G = 2.5. EVI has been used in various studies including those on land cover change, estimation of vegetation biophysical parameters, phenology, evapotranspiration and other (Lo and Yang 2002; Matsushita et al. 2007; Sims et al. 2006; Wardlow and Egbert, 2010).

Modified Soil Adjusted Vegetation Index

MSAVI (Eq.2) is a modified version (Qi et al. 1994) of the Soil Adjusted Vegetation Index (SAVI) developed by Huete (1988). The basic idea of MSAVI is to provide a variable correction factor L. This adjustment factor depends on the observed level of vegetation cover and the product of other vegetation indices, such as NDVI and WDVI (Matricardi et al. 2010).

$$\boldsymbol{MSAVI} = N + 0.5 - \sqrt{(N + \ 0.5^2 - 2\ (N - R\ )}(2)$$

where N and R, are near-infrared and red band, respectively.

Normalized Difference Moisture Index

NDMI (Eq.3) is very useful for detecting vegetation water liquid (Xu, 2006). This index produces accurate results in the forest conditions and is more accurate than NDVI in detecting forest disturbance (Wilson and Sader, 2002).

$$\boldsymbol{NDMI} = \frac{(N - S1)}{(N + S1)} \quad (3)$$

where N is near – infrared band and S1isthe infrared band between 1.55-1.75μm.

Normalized Difference Vegetation Index

Whereas NDVI (Eq.4) correlates directly with the vegetation productivity, there are numerous possible applications of the index for ecological purposes(Pettorelli et al., 2005). The NDVI provides information about the spatial distribution of vegetation communities, vegetation biomass, CO_2 fluxes, vegetation quality and the extent of land degradation in various ecosystems (Ferrari 2010; Pettorelli et al. 2005; Reed et al. 1994; Thiam 2003).

$$\boldsymbol{NDVI} = \frac{(N - R)}{(N + R)} \quad (4)$$

where N is near – infrared band and R is the red band.

Dynamic change of vegetation density

By using unsupervised classification (ISO DATA algorithm) based on the Normalized Difference Bare Soil Index (NDBSI) (Eq.5)three thematic classes of vegetation density were estimatedfor all study years(1) High Density Vegetation - forest, shrubs, olive groves, (2) Low Density Vegetation - transitional ecosystems, sclerophyllous vegetation and (3) Open and Rocky areas. NDBSI aims at enhancing bare soil areas, fallow lands, and vegetation with marked background response (Baraldi et al. 2006)and it was found to separate well the above density classes (Poirazidis et al. unpublished data).

$$\boldsymbol{NDBSI} = \frac{(\boldsymbol{S1} - \boldsymbol{N})}{(\boldsymbol{S1} + \boldsymbol{N})} \quad (\mathbf{5})$$

where S1is the shortwave infrared band with wavelength from 1.55 to 1.75 μm and N is near infrared band of wavelength 0.76 to 0.90 μm.

By using thematic change detection technics, a map of changes and net change diagram was produced to evaluate the relative changesfor the whole period (1984 - 2015) (Figure 1).

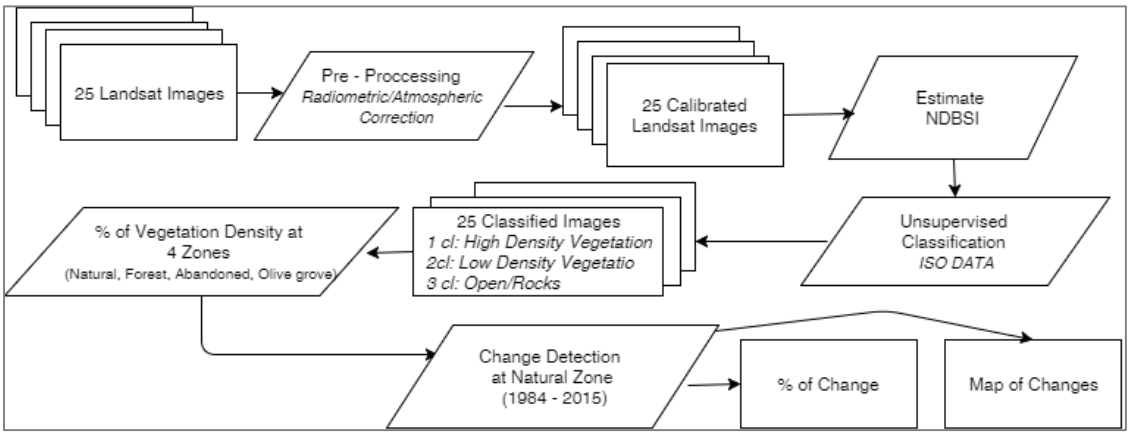


Figure 1. Flowchart of Dynamic change vegetation density

Change detection using composite vegetation index

The Comprehensive Change Detection Method (CCDM) using acomposite vegetation index was adopted to maptheprogress/regress (decrease / increase) of biomass.The CCD method was proposed by Jin et al. (2013) and includes three major components: (1) MICCA,a change detection method for a full range of land cover disturbance, (2) Zone, a change detection method that is specifically designed

to detect the changes related to forest, and (3) Combination, the knowledge – based combination of change map derived from the MIICA and Zone methods. The first two methods generate a map of changes with two classes: Biomass Increase and Biomass Decrease. To analyze the biomass changes in the Natural zone,the Zone method wasimplemented (Figure 2). Thismethodwasapplied by using two indices dNBR (Eq. 6) and dNDVI (Eq.7). These indices based on the difference between two time slots,are not only sensitive to the magnitude of the related forest change but also to the direction of the changes (Jin et al. 2013).

$$\boldsymbol{dNBR} = \left[\frac{(\boldsymbol{N_{t1}} - \boldsymbol{S_{t1}})}{(\boldsymbol{N_{t1}} + \boldsymbol{S_{t1}})}\right] - \left[\frac{(\boldsymbol{N_{t2}} - \boldsymbol{S_{t2}})}{(\boldsymbol{N_{t2}} + \boldsymbol{S_{t2}})}\right] \quad (6)$$

$$\boldsymbol{dNDVI} = \left[\frac{(\boldsymbol{N_{t1}} - \boldsymbol{R_{t1}})}{(\boldsymbol{N_{t1}} + \boldsymbol{R_{t1}})}\right] - \left[\frac{(\boldsymbol{N_{t2}} - \boldsymbol{R_{t2}})}{(\boldsymbol{N_{t2}} + \boldsymbol{R_{t2}})}\right] \quad (7)$$

where N_{t1} and N_{t2} are the near – infrared band of early and late date, respectively. S_{t1} is the shortwave infrared band of the early date, and $S_{t2}$is the shortwave infrared band of the late date. R_{t1} and R_{t2} are the red bands of the first and the second study year, respectively.

The input indices of each timewere the mean of two successive years (e.g.2006 is the average of2005 and 2006) to minimize the yearly variation of the estimated values. The estimation of biomass change direction was based on the reclassification of the differences of both indices using the mean value and standard deviation in four classes as: (1) pixels with no change [mean + 0.5*std], (2)pixels with no change [mean - 0.5 *std,], (3) pixels with biomass decrease[>= mean + 0.5*std] and(4) pixels with biomass increase [<= mean -0.5*std]. The reclassified indices were then combined to obtain an image with a total of 16 classes, whereclass 33 represents biomass decrease, and class 44 represents biomass increase.

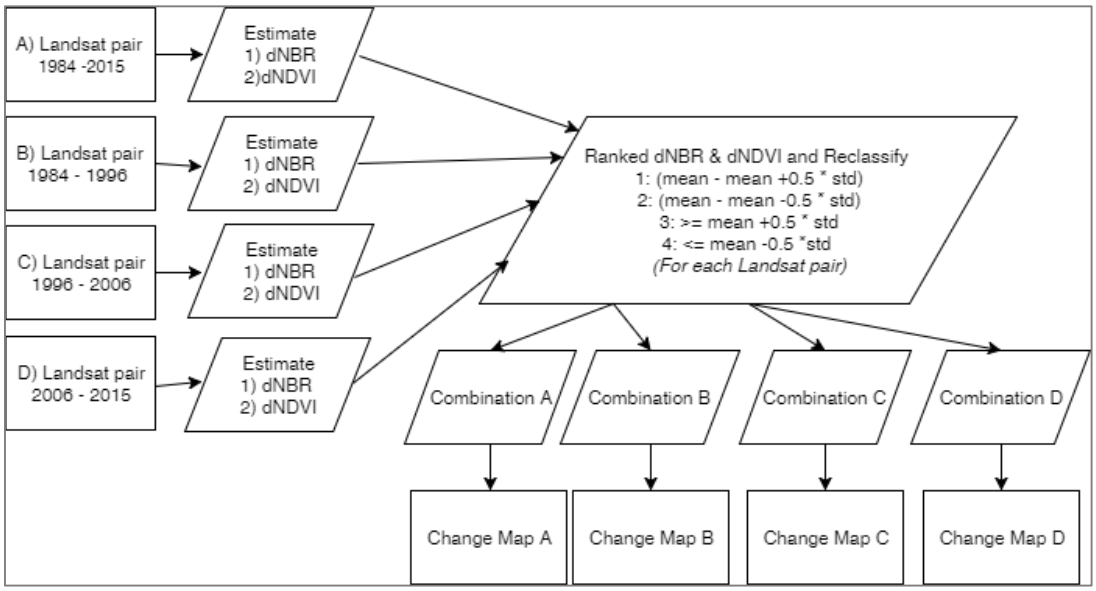


Figure 2. Flowchart of CCDM Zone Model

Analysis of post-fire vegetation restoration

Post-fire regeneration process differs among regions since different environmental factors play a critical role in regeneration patterns (Poirazidis et al. 2012). In Ilia's Peripheral Unit, at 2007, a catastrophic fire damaged 22,678 ha,mainly covered by*Pinus halepensis*forest. Through remote sensing techniques, we investigated the current vegetation status in this area to evaluate the level of recovery (Figure 3). The methodology approach followed by thisanalysis had two main components. The first onerefers to the comparison of the four vegetation indices, whichwere usedin section "*Quantitative and multi-temporal analysis of biomass using vegetation indices"*, for the years1986, 2006 (before thefire), 2007 (year of fire occurrence) and 2015(post-fire year). The second

componentcontains post-classification change detection techniques, using the NDBS index and ISO DATA unsupervised classification, as shown insection "*Dynamic change of vegetation density*". The change detection maps refer to thetime periods2006-2015, 2006-2007 and 2007-2015.

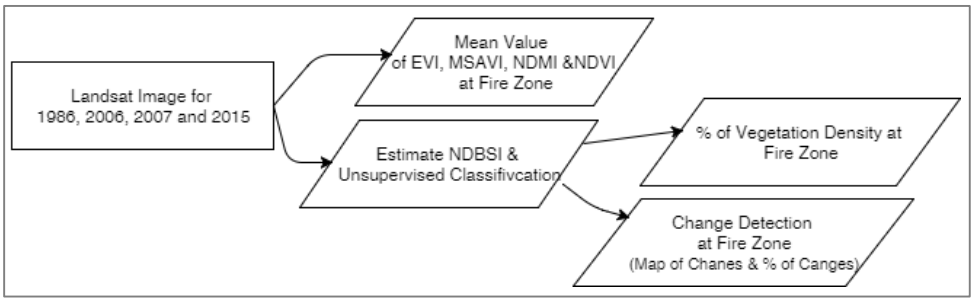


Figure 3. Flowchart of post – fire vegetation analysis

Results

Quantitative and multi-temporal analysis

The multi-temporal analysis of the vegetation indices (1984 - 2015) for thecombinedNatural zone of Ilia'sregion, showed small fluctuationsduring the study period, where EVI and MSAVI seem to be more stable over the years while NDMI and NDVI showedgreater fluctuations(Figure 4). A general small increasing trend was observed from 1984 to the recent times. The average values for EVI, MSAVI and NDMI werearound 0.4 and NDVI's mean value around 0.7. In 2007,all indicators due to the big fire in the Region were dropped down, but their values were returned close to the initial level (before fire) in 2015. Results from the three specific zones (Forest zone, Abandoned zone, Olive Grove zone) showed the same pattern as the Natural's zone (where the mean values are a bit higher, i.e. 0.5 for EVI, MSAVI and NDMI, and 0.75 for NDVI for the Forest and Abandoned zones).

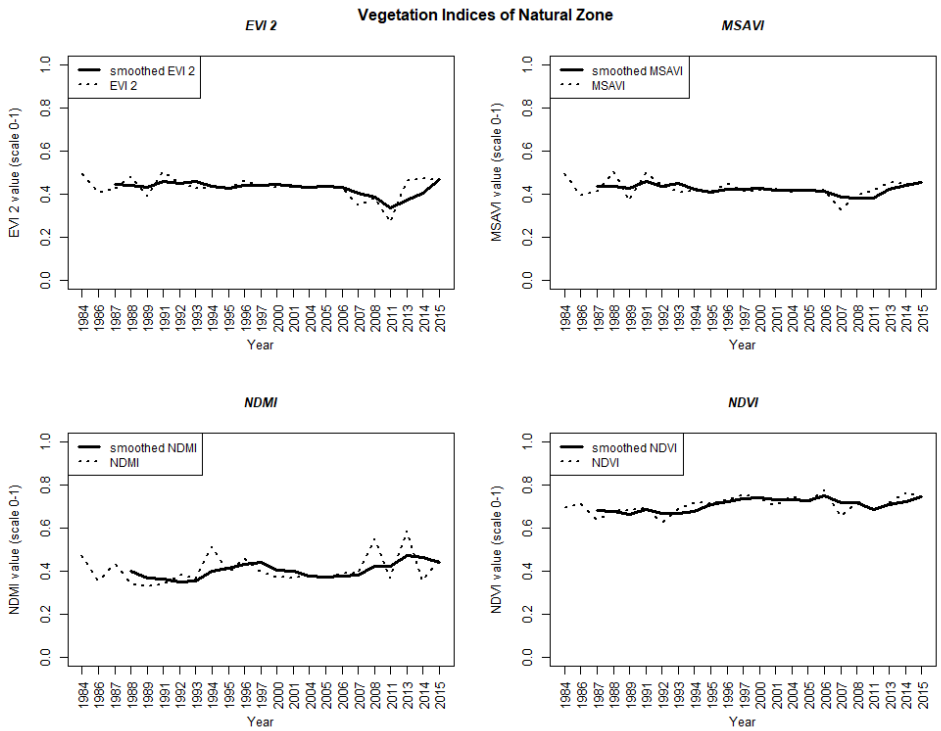
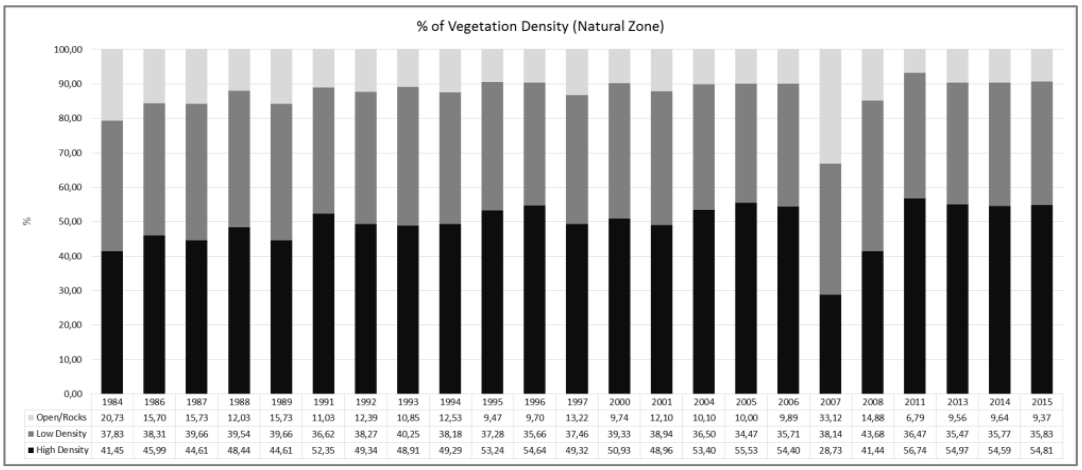


Figure 4. Vegetation Indices of Natural Zone (1984-2015)

Dynamic change of vegetation density

In the Natural zone, high density vegetationwas appeared to have the highest percentage of a mean value 49%, maximum value 57% in 2011 and a minimum value 29% in 2007 (Figure 5). Following high density vegetation, low density vegetationclasshas amean value 38%,maximum value 44% in 2008 and a minimum value 35%in several years. Lastly, open and rocky areas had the lowest coverage in all years with a mean value 13%,maximum 33% in 2007 and minimum 11% in 2011. Variations in rates per year were small as they didn't exceed 8% of net changes, with an exception in 2007 where the dense vegetation had lost 26%of its coverage, with a consequent increase by 25% of open and rocky areas. The dense areas recovered their ratesin 2011, after 2007's wildfire,as the period 2011-2015 highly vegetated areas covered approximately 55-57%.

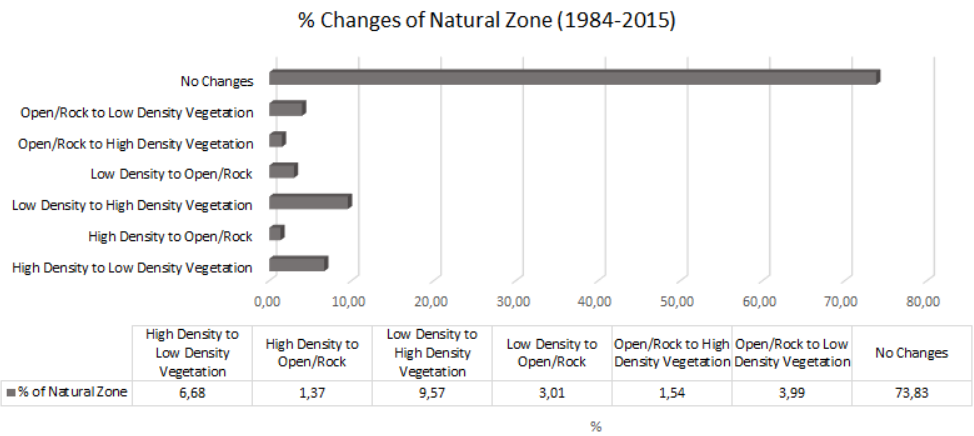
In Forest zone, as expected, the high density vegetation was the main class, with a mean value 74%and minimum value of 65%, while the remaining 26%,referred to the sparse vegetation category. At the Abandoned and Olive grove zones, the mainclass was thelow density Vegetation (28% to 47% and 48% to 52%, respectively) but they had the highest variation among density cover classes.



	1984	1986	1987	1988	1989	1991	1992	1993	1994	1995	1996	1997	2000	2001	2004	2005	2006	2007	2008	2011	2013	2014	2015
Open/Rocks	20,73	15,70	15,73	12,03	15,73	11,03	12,39	10,85	12,53	9,47	9,70	13,22	9,74	12,10	10,10	10,00	9,89	33,12	14,88	6,79	9,56	9,64	9,37
Low Density	37,83	38,31	39,66	39,54	39,66	36,62	38,27	40,25	38,18	37,28	35,66	37,46	39,33	38,94	36,50	34,47	35,71	38,14	43,68	36,47	35,47	35,77	35,83
High Density	41,45	45,99	44,61	48,44	44,61	52,35	49,34	48,91	49,29	53,24	54,64	49,32	50,93	48,96	53,40	55,53	54,40	28,73	41,44	56,74	54,97	54,59	54,81

Figure 5. Vegetation Density Classes at Natural Zone

The produced map of changes showed that for the period 1984-2015 (Figure 6 and 7) in the Natural Zone of Ilia,major changes wasn't observed, as 74% of the region was classified as "no change" areas, "low density" area was improved to"high density" vegetationat 10%,but at the same time 7% of "high density"areas were degraded to "low density" vegetation. Changes occurred mainly in the eastern – mountainous areasleading to improvedvegetation density and in the southern part of the region where a clear pattern (improvement or deterioration of the vegetation state) wasn't obvious.



	High Density to Low Density Vegetation	High Density to Open/Rock	Low Density to High Density Vegetation	Low Density to Open/Rock	Open/Rock to High Density Vegetation	Open/Rock to Low Density Vegetation	No Changes
% of Natural Zone	6,68	1,37	9,57	3,01	1,54	3,99	73,83

Figure 6. Changes of % in Natural Zone (1984-2015)

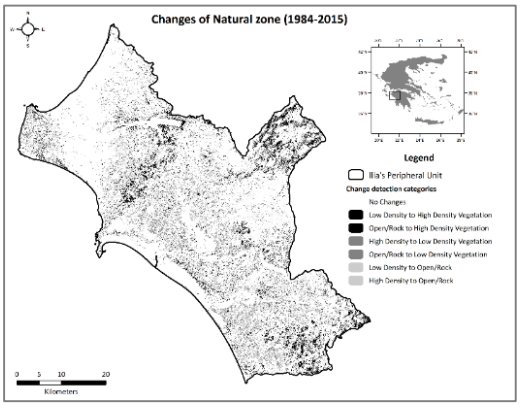


Figure 7. Spatial changes of Natural Zone (1984-2015)

Change detection of biomass using composite vegetation index

The Comprehensive Change Detection Method–Zone model was implemented in four time periods(A) totalperiod: 1984-2015, (B) 1984-1996, (C) 1996-2006 and (D) 2006-2015 to analyze spatial patterns within theoverall studied period (Figure 8).A similar pattern was observed in the periods B and C, where biomasshad atotal increase of60% and a relative decrease of 40%, resulting in a similar result for the overall period (A). This pattern was reversedin the last period (D), mainly by the effect of 2007's mega-fire. The mainreduction of biomass was observed in the southern section ofIlia's region while biomass growthappeared in the mountainous areas of the eastern partas well as in areas that belong to the Abandoned Zone.

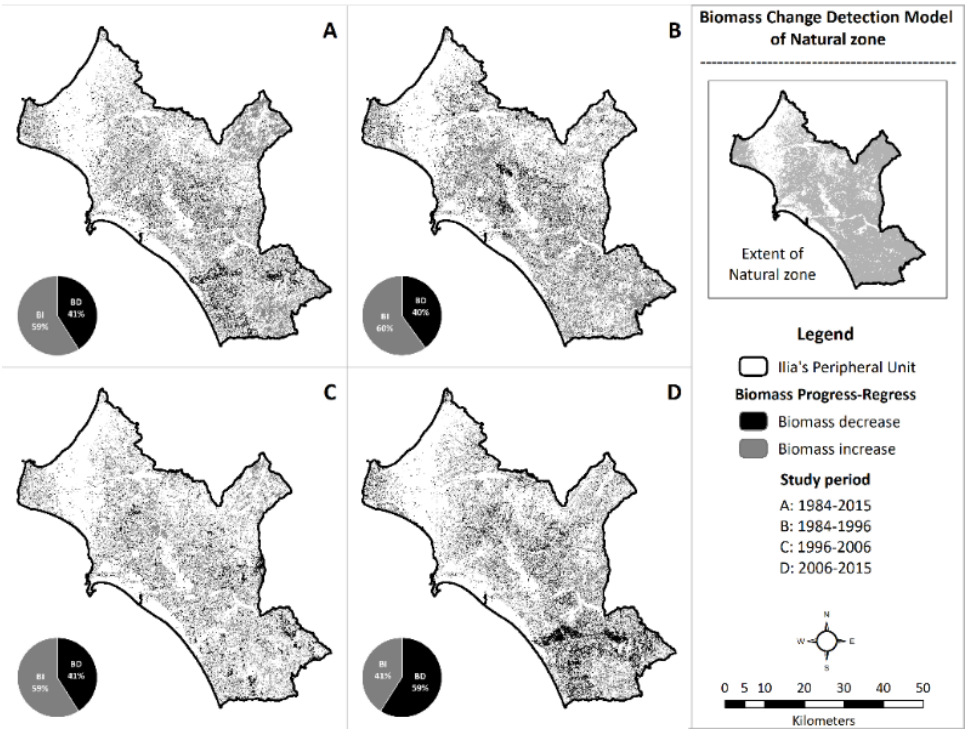


Figure 8. Biomass Change Detection Model of Natural Zone

Looking at the LPIS zones, the pattern at the Forest and Olive groves zones is similar witha differenceat their intensity. At the Forest Zone the relative rates of biomass were constantly increasing from 1984to 2006, which was estimated at 68% for the first period (B) to 73% for the second (C), but

a high decrease rate was found for the third period (D), whichreached 67%. Overall, in the studied period (A), a total increase of biomass (67%) appearedin the forest zone. In the Olive grove zone, results showed that biomass decreaseoutmatched biomass increase in almost all studied period. Specifically, in the period 1986-1996 (B) biomass decrease and increase had a value of 50%, and in the periods A,C and D biomass decrease had 52, 51 and 56% respectively.At all periods in the Abandoned zone, biomass had an increasing trend. Overall, in period A, the relative rates of biomass increased to 75%. The first periods (B and C) the increase rates were 69% and 60% respectively, and finally,at the period D,there was a biomass decrease of 49%.

Analysis of vegetation restoration after fire in 2007

The post-fire analysis of vegetation cover after the mega-fire of 2007, indicated the rapid recovery of the burnt forested area. Despite the almost complete disappearance of the forest vegetation in 2007, eight years later, most of the indices showed a better or similar picture compared to 2006 and better than 1986 (Figure 9a). Only the NDMI index did not fully recovered, possibly due to thesensitivity of this index in the more mature forest standswhich they burnt in 2015. Similar results were found in the analysis of density classes, where the presence of high density vegetation cover (from 86% in 1986 and 88% in 2006), was restored again in 2015 reaching 85% (Figure 9b).

From the classification of NDBS index for the pre-fire study years, it is evident that in this zone the presence of high density vegetation is very high, as in any year this percentage is not less than 85%. At the year of fire, the areas with high density vegetation cover only 9% of the study area. The Open/Rocky areas in the years before and after the fire do not exceed 3.5%, while in 2007 these areas amounted to 80%.

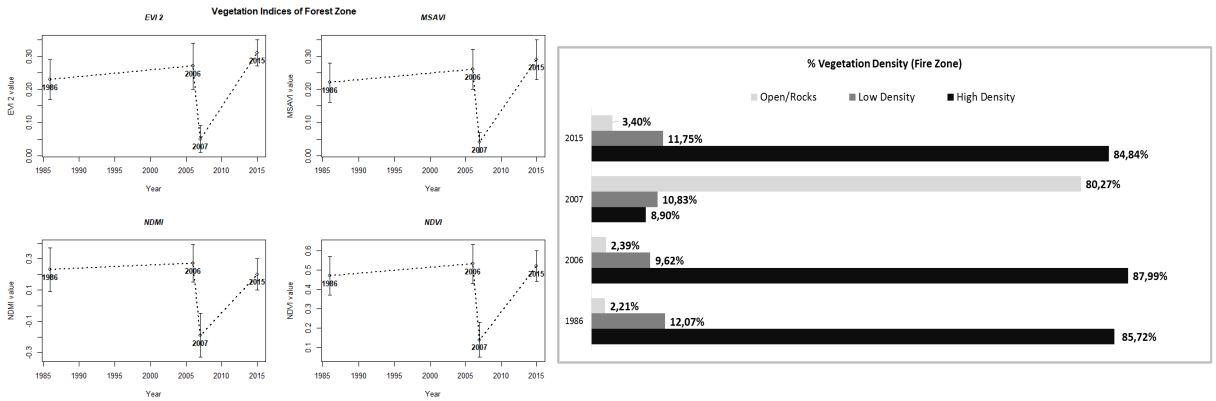


Figure 9. Changes of Vegetation Indices (left)and Density Class (right)at Burned Forest Zone in mega-fire of 2007, for the years 1986, 2006, 2007, 2015

Comparing the vegetation conditions between 2006 and 2015, one can see an excellent recovery rate since 92% of the area appears with no changes and only 8% of the burnt area has changed mainly in less vegetated areas. Specifically, 5.5% of “high density” vegetation in 2006 transformed into “low density” vegetation (4.5%)and “open and rocky” areas (1%) in 2015.Concerning open and rocky areas, no more than 0.3% changed into another type. Opposite, areas with “low density” vegetation in 2006 had changed to “high density” vegetation and “open and rocky” areas in 2015by approximately 1% in each density class (Figure 10).

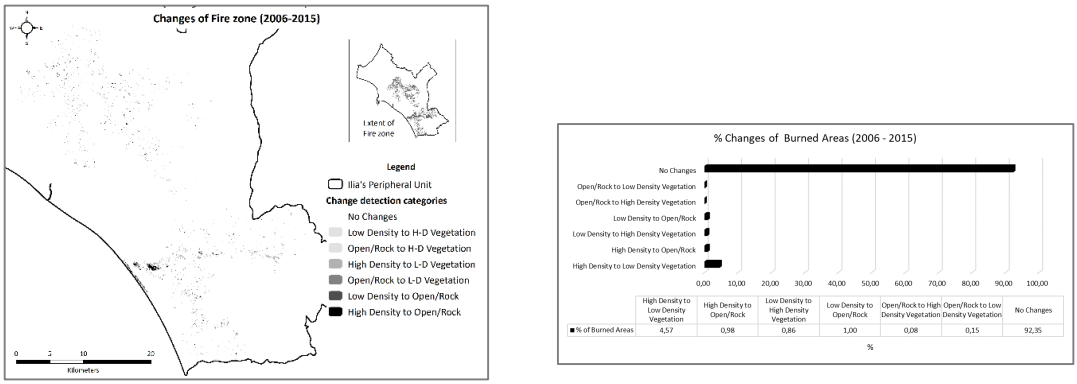


Figure 10. Change Detection Analysis at the Burnt Forest Zone for the period 2006-2015.

Discussion-Conclusions

Remote sensing is an appealing technology when estimating vegetation dynamics as it provides a vast range of data and tools (Galidaki et al. 2017). Many automated algorithms (Jin et al. 2013; Kennedy et al. 2009) have been successfully developed to detect land cover/use changes using mid-resolution images, such as Landsat images.The aim of this study was the development of a multi-level methodology of temporal analysis of vegetation changes using remote sensing data. This methodology could be used as a proxy for monitoring ecosystem and biodiversity integrity through a time scale.All of the vegetation indices showed stability, with small fluctuations but also aslightly increasing trend, with arelative similar pattern for all study zones. In 2007, asignificant reduction of biomass was counted, but most of the burnt forests consists of mature pine forest. The effective protection of natural regeneration both from Forest Service and locals allows the ecosystem to quickly recover and revegetate the burnt area within eight years since the fire event.

Concerning the study of vegetation densification, the results showed a rather stable condition. In all study years (except 2007)and all study zones, the areas with high density vegetation remained constant, which shows the high value of ecosystems in the Natural zone of Ilia's region (forest and olive groves parcels). In contrast, results from the implementation of CCDM – Zone Method, showed a spatial vegetation dynamic (progress or regress) in the Natural Zone, as the method captures a full range change, including all kind of disturbances (e.g. fire, deforestation). For the periods 1986-1996, 1996-2006 and 1986-2015 there was a significant increase of biomass in contrast to the biomass decrease at the period 2006-2015. Although the applied model shows an increase or decrease of biomass, it didn't clarify its origin, but additional data (e.g. polygons of the burnt areas, other pressures) could be overlaid to analyze cause–effect problems.

As the methodology produces spatial data, any scale of investigation could be used from Forest Services to monitor in a systematic way the integrity of local ecosystems and consequently the effectiveness of these ecosystems to support and maintain local biodiversity and ecosystem services. Newly available satellite sensors with better resolution (e.g. Sentinel 2 with 10m pixel size) could help ecosystems monitoring with better spatial accuracy, and these sensors have already been used for global monitoring of the environment (Drusch et al. 2012).

Finally, it is essential toemphasize the dynamic of Mediterranean ecosystems. This type of ecosystems has the ability to recover quickly, in case ofa disastrous intervention (e.g. fire) but not in the case of repeated events(Keesstra et al. 2017; Poirazidis et al. 2012), thusthe early recognition of urgent intervention is a cost-effective method for economic and ecological benefits. Monitoring, observation, and interpretation of historical changes in land cover will significantly help the understanding of spatial dynamics and lead to a sustainable management of those sensitive ecosystems.

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ECOMED EUROPEAN PROJECT: TOOLS AND APPROACHES TO ENHANCE THE ECOENGINEERING SECTOR IN THE MEDITERRANEAN ECOREGION

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Abstract

Soil loss and degradation are major threats worldwide with many scientists considering them as important as climate change. In the Mediterranean ecoregion soil loss and degradation are increasing because of anthropogenic activities, climate change and the region's susceptibility. The aim of this project is to promote the use of eco-friendly methods to mitigate such problems with the acceptance and increased utilization of ecoengineering through the generation of theoretical and practical material and tools suited for this ecoregion. To achieve its objectives, ECOMED is reinforcing the know-how transfer within the sector, evaluating existing ecoengineering works, generating new interactional schemes and dynamics within the sector and developing adapted design routines and protocols for the ecoregion. Specifically, current curricula and enterprise work practices of the Mediterranean ecoregion have been reviewed, stakeholders are participating in an online questionnaire on ecoengineering and three protocols specialized for the ecoregion have been developed. The previous activities will provide the basis for the development of sector specific theoretical-practical tools and the accreditation of the modular training syllabus. Overall, the goal is to greatly enhance the knowledge and specialization level of the ecoengineering sector in the Mediterranean.

Keywords: *soil conservation, climate change, sustainability, environmental management, eco-friendly methods*

Introduction

Soil loss and degradation are considered major threats worldwide because they have many negative implications on humans, their society and the environment (Yang et al. 2003, Zaimes et al. 2016). Specifically, soil loss affects the productivity of land and the ecosystem dynamics. While it is a natural phenomenon, anthropogenic activities such as agriculture, deforestation and urbanization have accelerated soil loss rates (Bakker et al. 2008, Montgomery 2007). Accelerated soil loss leads to decreased soil quality and significant land degradation and this is the reason why many scientists consider it a threat as important as climate change. Preventing soil loss and degradation is a worldwide priority thus numerous soil conservation efforts have and are being implemented to achieve soil sustainability (Ananda and Herath 2003, Baumhardt et al. 2015, Panagos et al. 2016).

The most common natural processes that lead to soil loss and land degradation are soil erosion, landslides and floods. Soil erosion occurs more frequently than landslides and floods. In contrast, landslides and floods are more episodic and typically substantially more catastrophic.

Soil erosion is the natural phenomenon of the removal and transportation of the soil particles by forces such as water and wind. It has been reported that approximately 75 billion tons of soil are eroded annually (Pimentel and Kounang 1998). In agricultural areas, soil erosion rates can range from 13 to 40 tons/ha/year that means that soil loss is 13-40 times faster than the soil renewal rate (soil forms slowly) (ibid). This clearly indicates that without mitigating soil erosion, soil sustainability cannot be achieved.

Landslide refers to the mass movement of rock debris and/or earth downwards along a slope (Easterbrook 1999). Landslides are also called landslips, slumps or slope failure. The main driver of this phenomenon is gravity (i.e., soil weight) but in order to occur, factors that affect the original slope stability are very influential (ibid). Natural and anthropogenic activities can trigger landslides and they can be local or regional. Anthropogenic activities, such as land-use changes along with urban populations and infrastructure that expand into landslide-prone areas, have led to increased losses and fatalities from landslides (Chen and Wang 2007, Baum and Godt 2010).

Another natural disaster that impacts severely soil loss is flooding. The European Union (EU) in the Floods Directive defines a flood as a covering by water land that is not normally covered by water. Typically, flooding overflows from water bodies, such as a river, lake or ocean, by escaping its typical boundaries. As with landslides, they are natural phenomena, but their appearance has been exacerbated because of anthropogenic activities such as agriculture, channelization and urbanization (Morelli et al. 2012, Zaimes et al. 2012, Braud et al. 2013). Compared to other natural disasters, floods are the most common natural disaster during this last decade, based on the report of the Emergency Event Database (EM-DAT 2011).

Climate change is expected to add additional pressures on soil loss because the variations in temperature, sea level rise, rainfall amounts and intensities, number of days of precipitation and ratio of rain to snow will impact plant biomass production, plant residue decomposition rates, soil microbial activity, evapotranspiration rates and cause land-uses shifts (Nearing et al. 2004). The many changes due to climate change make it difficult to predict the exact impacts but the expected increase in extreme weather events, particularly the increased rainfall intensity and extended drought periods compared to past conditions (Giupponi and Shechter 2003), should increase water runoff and consequently soil erosion, floods and landslides (Routshek et al. 2014).

The increased occurrence of soil erosion, landslides and floods along with potential impacts of climate change and the exponential increase in the human population and their needs will put more pressure on the soil resources making soil loss and degradation mitigation an even greater priority (Rosenzweig and Hillel 2000). The EU trough the Directive 2004/35/CE and the "Soil Thematic Strategy" ((COM(2006) 231); (COM(2006) 232) and (COM(2012) 46) as well as the 2012 report 'The State of Soil in Europe' (Report EUR 25186 EN from the EEA)) has been developing a strategic policy for soil protection and damage recovery, clearly stressing the importance of the preservation and the sustainable management of soil resources (Panagos et al. 2012). The growing perception among the scientific community is to move towards solutions that are more eco-friendly based on ecosystem approaches.

The ecoengineering sector is currently developing worldwide, regulatory frameworks (including the European Water Framework Directive or more recently the European Green Infrastructure Strategy) and introducing the need to implement "soft" techniques for natural hazard control instead of "hard" techniques (engineered concrete and steel structures such as check dams), in the pursuit of restoring degraded environments or preventing further degradation during new constructions. The International Union for the Conservation of Nature (IUCN) is proactively endorsing the use of ecological engineering for disaster risk reduction (EcoDRR), and includes ecoengineering as a technique for protecting against landslides (Furuta et al., 2016; Renaud et al., 2016). Finally, this method promotes more cost-effective and sustainable ways to reduce soil loss and land degradation.

The aim of this project is to generate sector-specific theoretical and practical material and tools for the specialization process and enhancement of the Mediterranean ecoengineering sector. In addition, it is jointly developing a long term interaction scheme among the stakeholders of the ecoengineering sector in order to deliver training courses to enhance "Soil and Fluvial Ecoengineering, Hazard Assessment and Techniques Selection in the Mediterranean Environment." This is needed because

there is no specialized training offered in ecoengineering in most of the Mediterranean countries, the dynamic of know-how transfer of accumulated experiences within the sector is missing and there is a serious shortage of staff specialized in the enhanced restoration of degraded lands in Spain, Greece, Portugal, Italy, Turkey and FYROM. The ECOMED project addresses these challenges and is led by the Technical University of Madrid, along with 13 more partners that include academic entities and enterprises from 8 different countries (Italy, France, Greece, FYROM, Portugal, Spain, Turkey and United Kingdom).

Study Area

One of the ecoregions in Europe that should be a priority in regards to soil and land degradation is the Mediterranean (Cerdan et al. 2011); the focal area of this project. This is due to the natural characteristics of the region, specifically the semi-arid climate, sparse vegetation and steep topography that makes it extremely prone to erosion, floods and landslides (Davidson 1991, Zaimes et al. 2012). It has also been inhabited by humans for thousands of years that have heavily impacted it and this is evident in the many unsustainable agricultural lands of the region and the few remaining patches of natural ecosystems (Pearce 1996, Tal 2010). Another major factor is the frequent wildfires in the region that are a natural part of the ecosystem (Spanos et al 2005, Shakesby 2011). Burnt areas have very high erosion rates, and if protective measures are not taken within a short period after a wildfire event, excessive erosion, landslides and flooding should be expected (Nearing et al. 2004, Ranis et al. 2015). In addition, the socio-economic changes during the past century in the ecoregion have led to the frequent abandonment of agricultural fields that have increased susceptibility to soil loss (Ries 2009). Finally, the forecasted changes in climate for the ecoregion should also be a major concern. Precipitation intensities are expected to increase and along with prolonged droughts that potentially reduce the vegetative cover and increase soil crusting, should cause higher surface runoff volumes and peaks and increase the sediment transport capacity (Giupponi and Shechter 2003). Overall, climate change will enhance soil erosion, floods and landslides in the Mediterranean ecoregion where they already are a serious threat (ibid).

Methodology

Ecoengineering is the use of living plants or cut plant material, either alone or in combination with inert structures, to control soil erosion and the mass movement of land in order to fulfill engineering functions (Schiechtl 1988). It matches technical (protection and stabilization), ecological (eco-systemic restoration), landscape (improve landscape integration) and socioeconomic (more efficient and source of employment) scientific aspects. Soil and fluvial ecoengineering are sustainable tools to improve resilience against soil loss and degradation (Figure 1). Ecoengineering is gaining significant presence into the riverbank and slope stabilization works worldwide. These techniques are widely used in Atlantic and Eurasian ecoregions but are gaining more acceptance within the Mediterranean ecoregion.

Figure 1. *Successful econgineering examples from the Mediterranean ecoregion: a) log crib wall in Spain (left) (source: Paola Sangalli) and b) mixed check dam in Spain (right) (source: Guillermo Tardío).*

In order to meet the objectives of the ECOMED project and develop material and tools essential for the specialization process of the Mediterranean ecoengineering sector the accumulated experiences within the sector need to be identified, analyzed and utilized. This is a cornerstone to achieve the sector's specialisation. These experiences are being tapped through different perspectives: a) from the know-how transfer within the sector, b) by analysing the existing ecoengineering works, c) by generating new interactional schemes and dynamics within the sector and d) by improving the existing or developing new design routines and protocols.

For the know-how transfer, a survey of the existing curricula at educational institutions in partner institutions was conducted and followed by a thorough analysis. In addition, a survey targeting specific enterprises related to the ecoengineering and geotechnical sector was conducted on the major current needs in order to improve the sector specialization level. Specifically, experts from big companies were asked questions in regards on how to best specialize ecoenginnering in the Mediterranean. In each Mediterranean participating country 2-3 experts were asked a set of questions.

When ecoengineering is implemented, typically plants and parts of plants are used as living building materials, in such a way that, through their development and in combination with inert materials (e.g. soil, rock, timber), to ensure a significant contribution to the long-term protection and mitigation against all forms of soil loss and erosion. The use of these living materials in Mediterranean environments involves many difficulties, notwithstanding the climate, since it differs significantly from the Atlantic and Continental ecoregions from where the current research and publications mainly originate from. Furthermore, given the semi-empirical nature of ecoengineering structures, it is crucial that successful engineering interventions but also "failure" are analyzed and transferred to different areas with similar problems (Tardio et al. 2017). This can be best accomplished by comparing between the original and the current state of the construction site in terms of biodiversity, soil evolution, plant anchorage, ecosystem resilience, etc. The latter idea is crucial within the ECOMED project strategy and exemplifies the need to study and analyze existing ecoengineering works. This is another major missing point in this ecoregion addressed in the ECOMED project, since the generated information are required to meet the needs for the professional specialization and to better understand its effective and efficient applicability in the ecoregion.

In order to generate new interactional schemes and dynamics within the sector, firstly all partners compiled a list of companies, enterprises, agencies and organization that work or deal with ecoengineering for each Mediterranean country of the partnership. This list was utilized in two different ways. Firstly, these are the key participants for the online questionnaire for the ECOMED project. Specifically, an expanded and extensive questionnaire that addressed what is lacking in the ecoengineering sector was developed. The sector needs and existing gaps based on the enterprises surveys were detected to be at the design, construction, and maintenance of works and in the educational and professional expertise. This led to the development of five different questionnaires that were for the: a) Design stage, b) Construction stage, c) Maintenance stage, d) Training stage and e) Enterprise/Company stage. The first three addressed ecoengineering at their different work stages

while the last two dealt with the education of experts and what expertise companies are looking for. These compiled lists are also used to invite the participants to the focus groups and workshops of the ECOMED project in the different countries. Both of these activities help fill the current scientific gaps and generate a knowledge transfer network involving the Mediterranean stakeholders essential for its success in specializing for the ecoregion. Furthermore, the comparisons of the analysis of the questionnaires answers obtained in each country will support the weaknesses and strengths analysis in each case and this information will be very valuable for defining the long term collaborative strategy within the sector in an efficient way (establishing a long term sector alliance). This is another essential outcome of the ECOMED project.

In ecoengineering works, as with any stabilization technique, there is a stress (or load) transfer between the soil and the structure but, in contrast to other solutions, this initial response is substituted by an evolving role of the living material used in the ecoengineering work as time progresses (Tardio and Mickovski, 2016). In these types of works, the nature of the materials used generates a natural evolving dynamic into the design life. One of the most important changes in the soil conditions takes place when plants, the live components, begin to grow and propagate new roots (Bischetti et al., 2009). In addition, the wood, one of the inert components used in ecoengineering techniques, in generally not treated and, as a consequence its mechanical properties deteriorate as time progresses (Leicester et al., 2003). Therefore, for an ecoengineering design, the time and elements durability must be considered more explicitly throughout the design life of the work (Tardio and Mickovski, 2016).

The above changes that occur in the lifespan of an ecoengineering work require a scheme that examines the entire work lifespan in order to verify the successes and errors of the intervention and justify potential corrective action. The particularities faced by this kind of works in a Mediterranean climate that are related to the aridity of the climate and the selection of both plant material and plantation techniques, demand a highly specialized and new knowledge triangle (new processes, methods and services) within the sector. In order to resolve these problems a monitoring program at each stage in the works needs to be developed. Currently, there is an absence of such preceding tools and therefore ECOMED is covering these gaps by developing protocols for the entire lifespan of ecoegineering works.

Preliminary Results and Future Activities

The survey of existing curricula at educational institutions in partner institutions, in regards to the know-how transfer, found that good practice examples and guidelines specific to the Mediterranean region in ecoenegineering are lacking in current training syllabus. Typically, institutions have one or two courses that are typically theoretical and should be updated and more practical. The targeted survey of the enterprises identified important aspects required to implement the specialization of ecoengineering in the Mediterranean region: a) educational practices need to change in order to embrace ecoengineering use in Mediterranean scenarios, b) gaps exist in the educational system based on employers and professionals perspectives, c) lack of communication between enterprises and Higher Educational centres, d) lack of systematic and accepted mechanisms of analysis, and e) improvements of the existing standards, routines and protocols of the sector. Activities are being implemented and tools are being developed within the ECOMED project in order to face the preceding challenges.

The criteria to select representative ecoengineering works within the Mediterranean ecoregion were determined. These criteria looked at characteristics such as the amount of available information associated to the work and the variety of the materials used. Furthermore, the final set of the selected works are representative of four scenarios: slope, fluvial, coastal and failed ecoenegineering works. Currently, existing works are being examined in Italy, France, Greece, FYROM, Portugal, Spain and Turkey. The final selected works will be analyzed and will provide new insights in regards to the applications of ecoengineeging in the Mediterranean ecoregion. The analysis of the selected ecoengineering works represent an essential source of information for developing more effective theoretical-practical tools and syllabus to support the specialisation process of the ecoengineering sector.

The online questionnaire is available for participants to complete (please see https://drive.google.com/drive/folders/0B4mC3IgGBMlFUkRYelZnTjJSZW8). More than 110

professionals in ecoengineering have answered the questionnaires from 11 different countries. The goal is to further increase the participation in the questionnaire to achieve a better participant distribution from the different countries and afterwards conduct an analysis for each country but also for the entire Euro-Mediterranean ecoregion. This analysis will provide insights in regards to the sector needs and existing gaps to improve the design, construction, maintenance stages of works, but also to enhance the educational and professional expertise. Finally, focus groups meeting have been arranged in August in all participating countries to discuss results from the online questionnaire that should also help develop new interactions and dynamics among the professionals of the sector.

Finally, the protocols for performing effective and efficient field ecoengineering works have been developed. These protocols are applicable and adopted for the entire Mediterranean region. The three protocols developed are: a) Protocol 1 - *Ecoengineering Work Selection Criteria*, b) Protocol 2 - *Ecoengineering Work Analysis Definition* and c) Protocol 3 - *Field Work Protocol*. Protocol 1 provides information about the criteria to be followed for selecting ecoengineering work examples in such a way that their analyses will effectively help develop the sector specific toolkit. Protocol 2 describes the structure, variables and stages that need to be included when analyzing each selected ecoengineering work. It provides guidelines on information required and the management plans that need to be developed before starting the work analysis for the different stages (such as design, construction and maintenance). Finally, protocol 3 defines all the procedures and methodologies for analyzing field work parameters and variables. In addition, different templates for analyzing the overall and particular work performance and effectiveness are also provided with the protocol.

The analysis of the: a) survey of the curricula and enterprises/companies, b) selected case studies of existing ecoengineering works in the Mediterranean, c) online questionnaires, focus group meetings and workshops and d) acceptance and adoption of the developed protocol will support the comprehensive impact/influence on the sector specialisation possibilities. Based on the above, a modular training syllabus will be developed, accredited and piloted by the Higher Education partners of the consortium. The intention is to offer ecoengineering in the Mediterranean environment within an interdisciplinary context with the endorsement and support of the enterprise partners. In addition, the training syllabus will provide employment opportunities, such as internships and other methods of applied learning as results of long-term feedback and interaction schemes between enterprises and Higher Education centres.

Conclusions

In order to improve the specialization level of the ecoengineering sector in Mediterranean ecoregion a set of sector specific tools are being generated (e.g. an enhanced syllabus offered in Higher Education centers, new monitoring protocols for construction sites and improved monitoring tools for assessing the overall work performance and effectiveness). Within this context, the consortium of this project will provide sound and practical knowledge based on the accumulated experience in order to offer to the next generation of practitioners and managers a solid and well suited training in ecoengineering restoration techniques in Mediterranean scenarios.

The strategy of the ECOMED project includes the following points: a) taking advantage of both the accumulated experience and the analysis of a set of case studies, b) generating new dynamics within the sector allowing for an enriched and effective know-how transfer between the stakeholders and c) offering a new set of sector specific tools to the Mediterranean ecoengineering sector for the practitioners and the Academia (e.g. protocols and training syllabus). Hence, the ECOMED project will be the basis for long term fine tuning tools that will allow the Mediterranean ecoengineering sector to improve its specialisation level and grow in reliability and acceptance. Finally, the preceding approach is readily transferable to other ecoregions and this shows the usefulness of the project from the circular economy point of view.

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SPATIAL ANALYSIS, HOT-SPOTS AND ORCHIDS DIVERSITY IN ZANTE ISLAND

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Abstract

The study aims at determining hotspots at sites of high species richness of the Orchidaceae family in Zante Island. The distribution of orchid species' abundance was estimated, mapped and correlated to environmental parameters. 967 recordings (220 track records in 2015-2016) were introduced in geographical analysis and models of biotope suitability were developed. 49 orchid species of 9 genera were identified among which rare species such as *Ophpys speculum*. Orchid species richness is remarkably high; presence of at least 10 species was indicated for the 53.2% of the island area. The altitude is a determining factor of species distribution differentiation for the majority of orchids, as well as geological substrate, slope and exposition. Species such as *Orchis papilionacea* show tolerance to altitude preferring granular deposits with fluctuating permeability. 12.5% of the island surface could be characterized as hotspots of high value for conservation of orchid diversity.

Keywords: *distribution, suitability map, altitude, hydro-lithography*

Introduction

Interactions between biotic organisms and environmental variables, such as the relation of heliophyte orchids with light intensity (Naveh, 1982), are of crucial importance for ecosystem evolution especially in the Mediterranean landscape. Selecting the proper environmental parameters and collecting field work data can result in the mapping of species distribution and their habitats suitability; such maps depict the predicted spatial distribution of species at wider areas. The combination of environmental parameters and taxa recordings can generate more robust modeling outcomes of species distribution (Elith & Leathwick, 2009). The aforementioned are basic tools for protecting species and preserving their diversity in regions with hot spots of high value (Rodríguez et al. 2007).

Orchidaceae

Orchidaceae is one of the prime and most diverse plant families (Tsiftsis et al. 2008) numbering more than 24.000 species of 800 genera worldwide. Despite its high species number, this family exhibits the highest percentage of extinction rate in the world. Hence the determination of the ecological niche is considered elementary for the conservation of *Orchidaceae* species (Tsiftsis et al. 2008). Related issues such as the reduction in the distribution range of orchid species have been investigated for instance in Northern Europe (Kulla and Hutchings 2006). Consequently ,studying the distribution of species' abundance

and also how it is affected by geographical and environmental factors, as well as determining their ecological niche, is essential for protecting the species of *Orchidaceae* family.

Hot Spots

Nowadays the number of threatened species exceeds well our available resources for the protection and conservation of these species, indicating a firm need for prioritizing biodiversity protection with a focus on regions where are detected the earnest protection requirements. A promising approach is to determine 'hotspots' in areas of high endemism threatened by habitat loss and in areas of high species richness or presence of rare taxa (Myers et al. 2000).

In the current study the distribution of species abundance was estimated and mapped aiming at determining hotspots at sites of high species richness belonging to *Orchidaceae*. Maps of species distribution and determination of areas with hotspots of high values will lead to protection and conservation of orchid, while the construction of models and the correlation of species with ecological factors determine the sites of high priority for species protection. Likewise, this study sets the basis to plan the scientific monitoring of *Orchidaceae* in the Ionian region.

Materials and Methods

The study area is distended across the island of Zante (covering a surface of 405 km^2). A high diversity of habitats is exhibited with a diverse mosaic of varied vegetation types (*Pinus halepensis* woods, shrubs, meadows, agricultural areas, olive groves, open burnt areas, sand dunes etc.).

A total of 967 recordings were completed between 2015 and 2016, following different tracks with a 2-4 km length and 2-meter belts of either side of each track. Specifically, 110 tracks were trailed in 2015 and 120 tracks were trailed in 2016. All these routes were homogeneously distributed across the habitats of Zante Island.

All recordings were introduced in a geographical database. For 29 species (with more than six recordings), out of the totally 49 species, individual models of habitat suitability were developed using the program Maxent. 13 environmental parameters, that affect the presence and distribution of *Orchidaceae* species, were used for modeling the individual distribution in three parameter units of topography, vegetation and geology:

- The first unit includes six parameters of topography: altitude, terrain gradient, effect of the relief exposure (quantitative northbound effect variable and eastbound quantitative variable) and relative topographic location (as a quantitative and qualitative variable).
- The second unit includes five parameters that characterize the area forestation: four vegetation indices (*Ndvi, Ndmi, Msavi, Evi*) and soil temperature as is recorded by the thermal band of satellite images.
- The third unit includes two qualitative geological parameters: lithological and hydro-lithological rock formations.

The selection of the most proper generalization grade for the individual models (at a scale from 0.5 to 3 in increments of 0.5) was conducted based on the criterion AICc, and when AICc was the same in 2+ models, then the most proper one was selected, namely the model with the lowest AUC.Diff. The environmental parameters were selected based on two criteria: a) percentage over a 5% participation in the interpretation of the species distribution, and b) degree of correlation between the selected variables less than 0.8. The suitability values were estimated using Maxent, based on a mean value of 10 replicates, with the method of crossvalidated. The suitability map, that its scale was firstly continuous between 0 and 1, was transformed into a binary file (presence – absence) according to the threshold “10th percentile training presence” to consider the environmental complexity of the region and thus

depict the species presence more conservatively. Considering this threshold in the prediction of species presence, we exclude a 10% of extreme observations, which potentially represent recording errors, ephemeral populations, or occurrence of unusual microclimatic conditions within an area. The synthetic map (synthesis of the species' individual presence) was formed by applying the SMD toolbox using the software ArcGIS (analysis at scale of 5000-meter squares). Then six spatial units based on species abundance were computed via the tool *Hot Spot Analysis (Getis-Ord Gi*)* and the Euclidean distance.

Results and Discussion

Totally 49 different orchid species of 9 genera (Ophrys, Orchis, Anacamptis, Serapias, Dactyloriza, Limodorum, Neotinea, Spiranthes, Hymantoglossum) were identified. Among them, the endemic *Serapias neglecta* subsp. *ionica*, *Dactylorhiza romana*, *Ophrys speculum*, and the rare *Spiranthes spiralis*, are indicative of the excessively high species richness of orchids in Zante.

Orchid species were recorded at all representative biotopes of the island, open and shadowed forest, macquis, phrygana, previously burnt, and wetland ecosystems, with the aim to cover a wide spectrum of environmental parameters so that the suitability models approximate the real species distribution. It is noted that Zante is a relatively small island (of 405 km^2 surface) having climate of Mediterranean type, with intense annual precipitation ranging from 800 to 900 mm and average of approximately 850 mm, showing a decreasing trend over time. The wet season starts in September and ends by May (Figure 1). The largest altitude is located at the top of the mount Vrachionas and reaches 792 m. Therefore, no explicitly distinct vegetation zones can be found on this island, hence in most cases, there is an overlap of vegetation zones and, consequently, of their species. As a result of these small environmental discrepancies, the modeling of generalist taxa may fail, while the modeling of specialist taxa is highly precise, as also shown by field data.

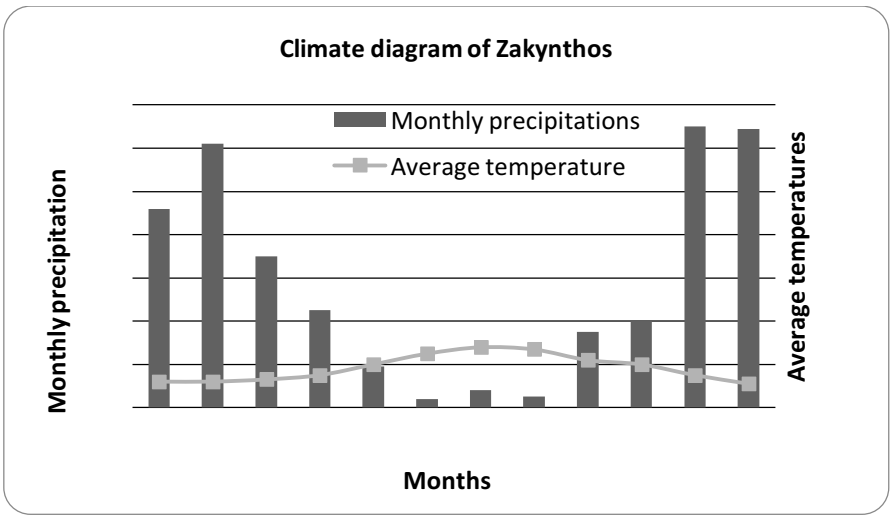
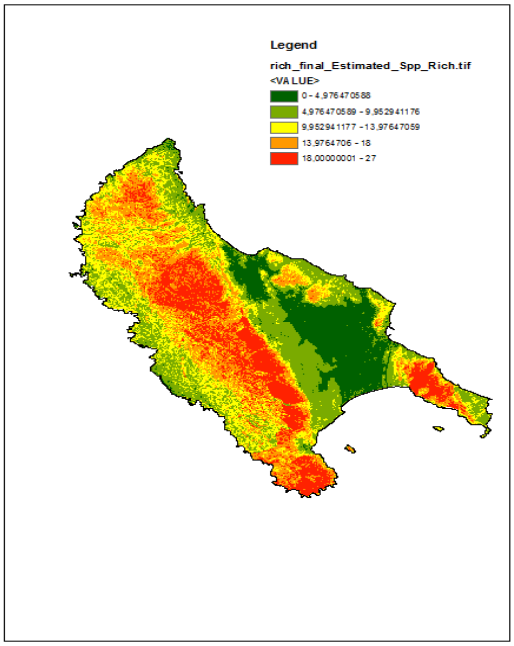


Figure 1. *Average monthly precipitation and temperature.*

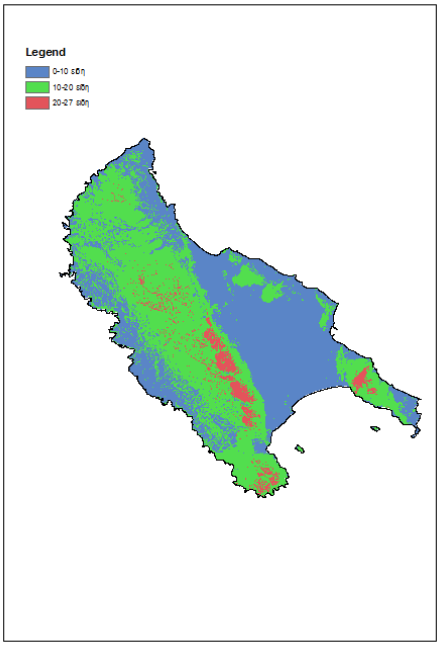
In parallel with the species recordings in the field, a specifically designed protocol was used to record the variations in environmental parameters, mainly for vegetation and rock, in the presence of *Orchidaceae* taxa. Combining the recordings data of species and environmental parameters, the maps of species distribution and their habitat suitability have been created. These maps are of particular value for designing and planning the conservation and protection of the *Orchidaceae* species.

We have examined and modeled the recordings data of 29 orchid species of 7 genera belonging to *Orchidaceae* family, since for these species the recordings were adequate enough to provide reliable models. We created a synthetic model (species and environmental parameters recordings) demonstrating that at a 53.2% of the island area, the presence of at least 10 orchid species is estimated (Map 1). In our case, the rare and specialist orchid species are most possibly overestimated, as is also reported in the results of Remm et al. (2008).

At particular sites (comprising the 4,7% of the island area) it is estimated that at least 20 orchid species are present, according to the synthetic model (Map 1,2).



Map 1.



Map 2.

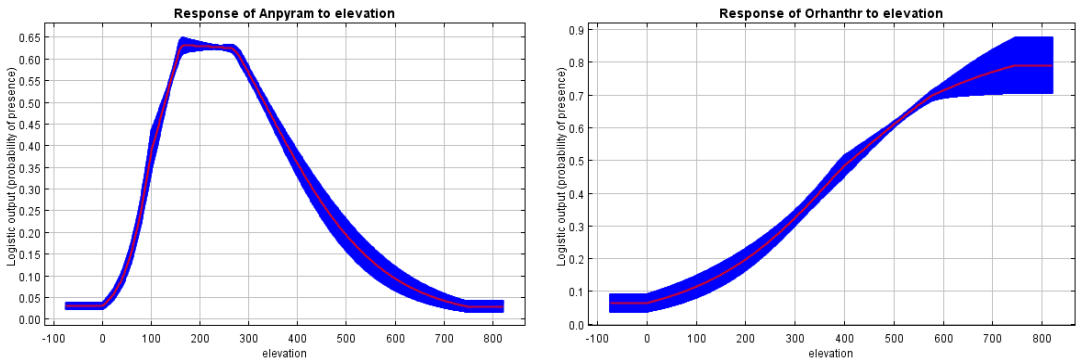
Map 1. Synthetic *map of species richness of Orchidaceae family in Zante Island*
Map 2. *Synthetic map of species richness of Orchidaceae family, at 3 classes based on species number, in Zante Island*

Environmental parameters in orchid distribution analyses (niche analyses)

The relation between species abundance and altitude is considered a key factor in floristic studies, as in relatively small geographical distances there are often significant climatic variations that largely determine the biodiversity of a region (Acharya et al. 2011, Grytnes et al. 2006), despite the fact that in many cases and for various taxa, altitude is not a defining factor of species abundance (Tsiftsis et al. 2008, Trigas et al. 2013). Apart from altitude, the range of species dispersion is also associated with other ecological and environmental parameters such as soil pH, exposition, slope, soil temperature, and climatic conditions, mainly precipitation and temperature. Taxa exhibit some degree of physiological tolerance to environmental pressures, while wide variations in species richness are strongly correlated with the climate (Lomolino 2001). Some researchers argue that species' morphology and abundance are mainly due to an environmental factor, which may be different for each species (Currie and Kerr 2008, McCain 2007). In any case, apart from the altitude, the most important factors seem to be water and energy for many species (Fu et al. 2006, Hawkins et al. 2003, O'Brien 1998).

In the case of Zante Island, despite the slight altitudinal differences, altitude is apparently the most determining factor of variation in species distribution, since it was selected as one of the most important variables in 27 individual suitability models out of a total of 29 models. In

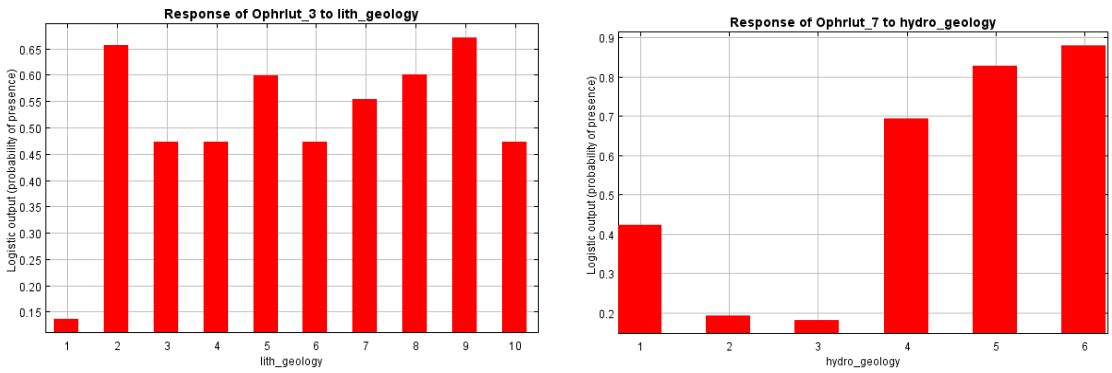
eleven species the altitude exhibited a bell-shaped adaptation (at 200 meters or at 600 meters as peaks) and in nine species showed an incremental linear adjustment, (Figures 2,3).



Figures 2,3: *The impact of altitude on Anacamptis pyramidalis and Orchis anthropophora*

Topography, geology and landscape openness are determining factors for orchids' diversity conservation. Hydro-lithology was the following most significant interpreting parameter (17 out of 29 models), with granular deposits dominating as suitable substrate, at south and east expositions of moderate inclination covered by less dense to sparse vegetation.

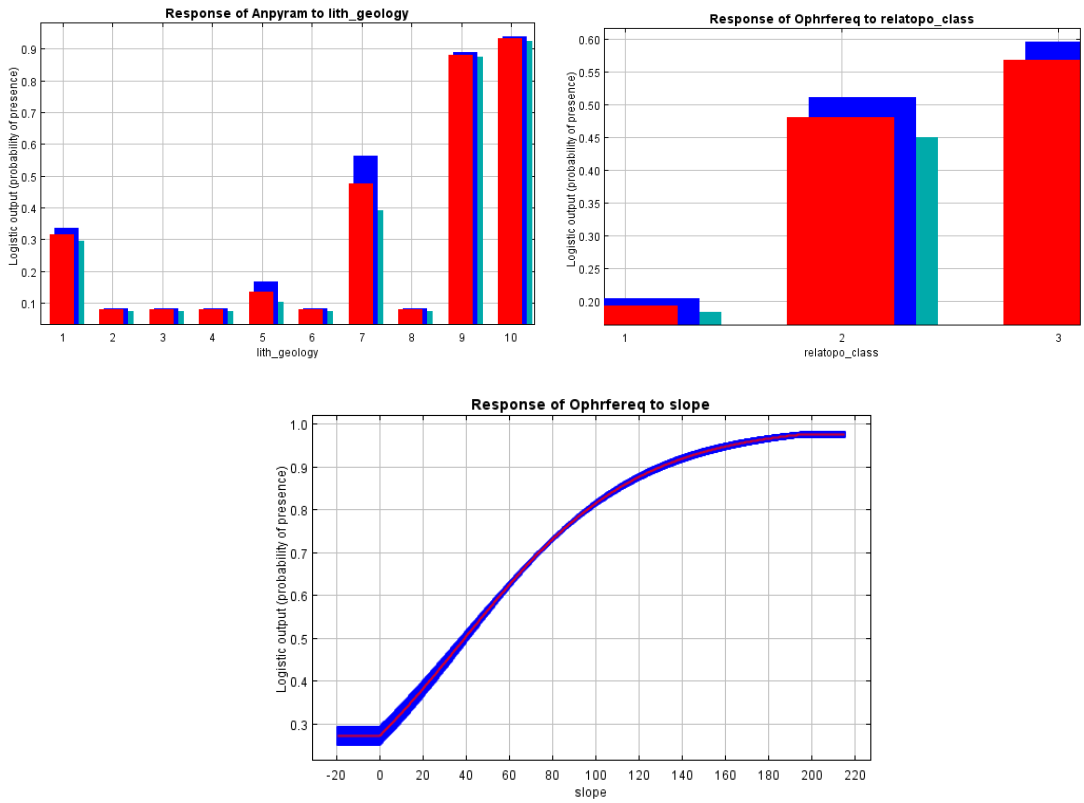
Ophrys lutea exhibits an incremental linear adaptation and the species presence was recorded throughout the altitudinal range of the island. According to recordings, the individuals of *O. lutea* are more robust and in complete flowering at medium altitudes, while at lower and higher altitudes their flowers are less and smaller. The species exhibits wide distribution also in relation to the geological substrate. Apart from the alluvial deposits, the species is recorded in all other types of geological substrates of the island, while in relation to water permeability, it prefers deposits with moderate, small and very low water permeability (Figures 4,5).



Figures 4,5: *Geological and hydrological preferences of Ophrys lutea*

Ophrys tenthredinifera was recorded on limestone rocks and marble limestones, while in relation to the altitude it is present along the whole range of the altitude in the island (10-790 m), with robust individuals in full flowering. *Orchis papilionacea* also shows the same tolerance to altitude, while it prefers granular deposits with fluctuating permeability. On the contrary, the distribution of *Orchis italica* appears to be strongly influenced by the altitude. *Orchis italica* has robust populations up to altitude of 580 m and beyond a decline is observed in the population and in the individuals' robustness. *Serapias linqua* is recorded at large populations in the island, at altitudes of 10-200 m, and besides alluvial deposits, it shows particular tolerance to all other types of rocks and water-permeability.

The erythrocyte deposits, mainly of carst cavities, as well as the limestones and dolomites, form the appropriate geological substrate for *Anacamptis pyramidalis*; the limestone, and also marl's limestone, gypsum substrates and mild slopes are appropriate for *Ophrys ferrum-equinum*, while *Barlia robertiana* shows preference to alluvial deposits of low water permeability and to granular deposits of fluctuating water permeability (Figures 6,7,8).

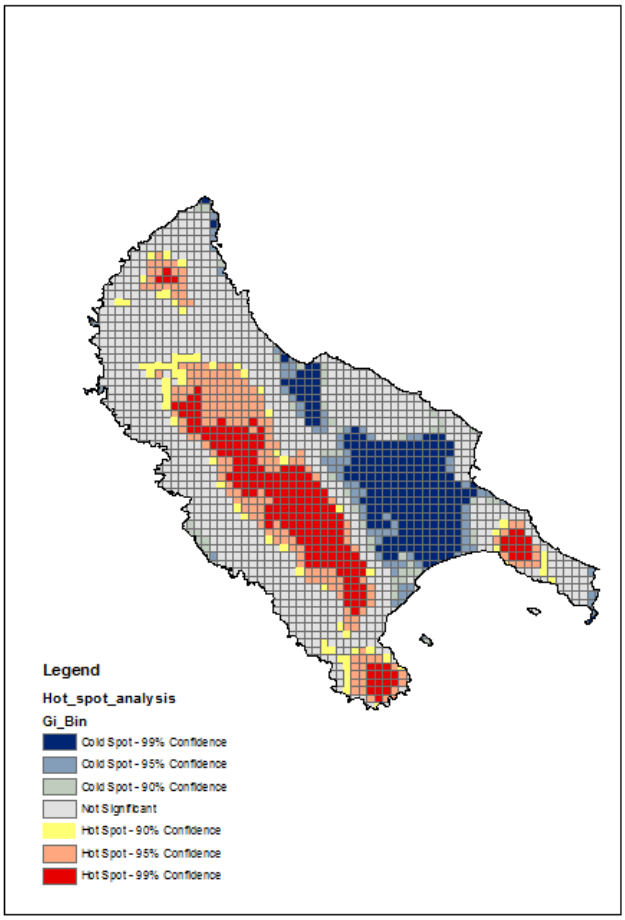


Figures 6,7,8: Individual models of the effect of abiotic parameters on *Anacamptis pyramidalis, Ophrys ferrum equinum,* and *Ophrys tenthredinifera*

In relation to the rest of parameters, the majority of species were recorded at southern and eastern expositions, mainly on medium - and upper - slopes of moderate inclinations with more or less sparse vegetation.

The significance of different ecological preferences of species which may be related to the high species richness, has already been identified for Zante Island (Poirazidis et al., 2015), suggesting that the landscape heterogeneity is a critical factor in preserving biodiversity. The present study confirmed the previous survey, since the research results of both studies are consistent.

Hot Spot analysis revealed that four areas of Zante, which account for a total of 12.5% of the island area, are of great importance for protecting species biodiversity and could be classified as hotspots of high value for the conservation of orchid diversity (Map 3). It is worth of noticing that in Zante Island have been recorded the rare *Ophpys speculum* (for the first time at only one site) as well as the rare *Dactyloriza romana, Limodorum abortivum* and *Spiranthes spiralis* the only one species with autumn flowering.



Map 3. *Synthetic map of Hot Spot analysis for orchid diversity conservation in Zante Island.*

Conclusions

The results of the present study, that it is the first time it is conducted in Zante Island, confirmed the richness of orchid species in the area and recorded the most significant environmental parameters influencing the species distribution; whereas the hot spots of the highest significance for orchid species conservation were detected and mapped. Rare species were also identified. For these species, it is indicated that apart from climatic conditions, the altitude is a determining factor for the majority of orchid species as well as the geological substrate, the slope and the exposition. It was also confirmed that the maps of species distribution which are derived from combining field work with geographical and spatial analysis have the potential to provide safe tools for decision making at spatial scales aiming at biodiversity conservation, through proper prioritization and development of strategies for conservation and protection of sensitive orchid species especially under climate change.

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SPATIAL ALLOCATION OF A SMALL HYDROPOWER PLANT WITHIN AN UNGAUGED WATERSHED USING G.I.S., HYDROLOGIC MODEL SWAT AND CFSR CLIMATE FORECAST MODEL.

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Abstract

In many countries, including Greece, the majority of mountainous watersheds are ungauged in respect to hydrologic and weather data. The lack of stream flow monitoring makes it very difficult and time consuming, in regards to the pre-processing development studies of hydropower projects that find possible locations for their construction. Field observations and in stream measurements may become too expensive due to the need for special instruments and labour costs. The present study focuses on the combination of a hydrologic simulation model and a climate reanalysis system for the estimation of a watershed's hydrologic characteristics, mainly stream flow, which will help in small hydropower plant's placement decision making. The foundation of the method is based on the ArcGIS system that is used for the introduction and display of spatial information. The SWAT semi distributed hydrologic model in the form of ArcSWAT extension for ArcMap, was used for running a series of hydraulic simulations of Ekaterini's stream watershed for extracting average monthly and annual streamflow data in each one delineated sub-watershed outlets by SWAT. Because of the lack of a weather station close to the study area with the adequate climatic data, weather parameter's time series generated by the global climate model Climate Forecast System Reanalysis (CFSR) were used as inputs for the SWAT model. The results of the simulation show a realistic prediction regarding the produced streamflow data in many predefined selection points within the whole watershed. The method developed here is promising especially regarding larger scale projects, like studying a group of watersheds within the boundaries of a municipality or even a prefecture.

Keywords: *G.I.S. SWAT, CFSR, Hydropower Plant, Watersheds*

Introduction

Hydroelectric power is one of the most promising solutions for sustainable energy production in the near future. As water is replenished through the hydrologic cycle, hydropower can be considered as a renewable technology (Frey and Linke, 2002). Another environmental advantage of hydro power is the fact that most dams constructed as hydroelectric plants are multi-purpose, meaning the dam is also used for irrigation, water supply and flood control, maximizing their positive social impact (Oud, 2002). The negative environmental consequences of hydro power are transforming a riverine environment into a lake environment upstream and changing water flow downstream of a dam (Klimpt et al., 2002). Small scale Hydro Power is a cost effective energy technology using renewable resources with minor environmental cost (Paish, 2002). There is not a global specific magnitude for defining "small hydropower plant." Many countries have established different upper power limits for their determination. Frey and Linke (2002), point out that definition of "small hydro" around the world varies widely from 1 MW capacity to 100 MW in some cases. The maximum allowed installed capacity for SHPs varies from 3 MW in Luxemburg, 5 MW in Germany, to 12 MW in France. Outside

Europe, in countries like Brazil, U.S.A., Russia, the capacity of SHPs is limited to 30 MW, while in China the upper limit for SHPs is 50 MW (Panic et al, 2013). An upper limit of 2.5 to 25 MW is used in most cases with the 10 MW value being the most accepted one worldwide (Paish, 2002). Additionally, less than 10 MW is the rated capacity for the definition of small hydropower plants proposed by ESHA (European Small Hydropower Association) (ESHA, 2012).

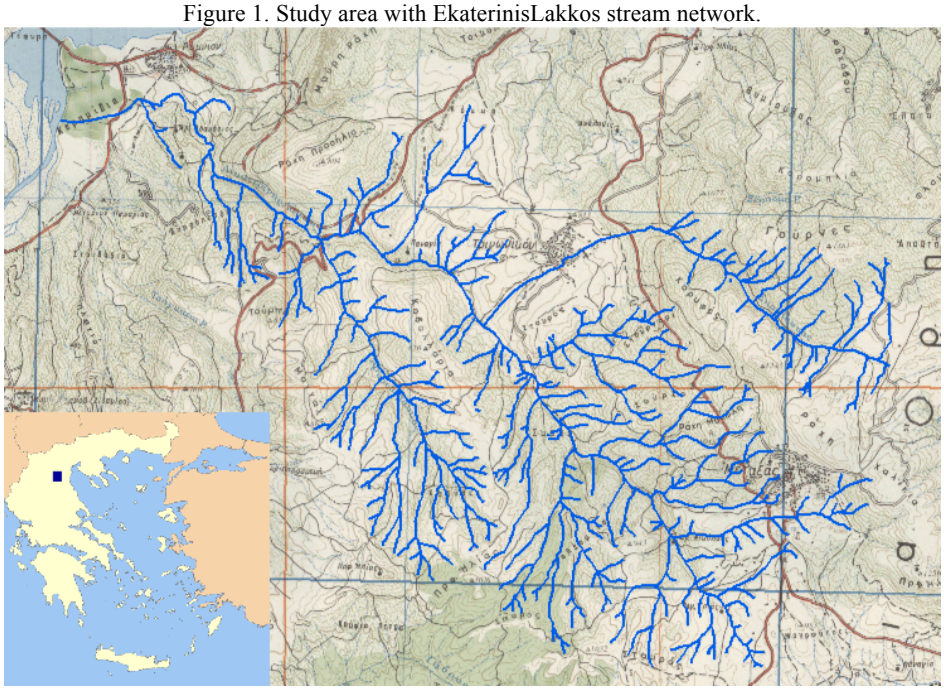
There are three major parts of the hydro power facilities: a) The impoundment facility uses a dam to store river water in a reservoir from where water is released towards the turbine according to energy needs. b)The diversion facility channels a portion of the river flow through a penstock to the turbine. This facility may require a small dam or even not at all. c) The run-of-river facility uses water within the natural flow range and does not require a reservoir. d) The pumped storage facility, a hybrid one that pumps water from a reservoir uphill to a second reservoir when there is little or no demand for electricity and acts vice versa like a normal hydropower facility on increased demands (US Department of Energy, 2015).

In Greece until 2006 there were approximately 50 SHPs operating and producing a rated power of 93.3 MW, most of them having a capacity of 1-10MW (Kaldelis, 2007). In 2010, Greece had 98 small hydropower plants and a total installed capacity of 196 MW, producing 753 GWh of electricity. That is a minor fraction of Greece's available small hydro potential which is 2000 MW according to United Nations Industrial Development Organization (UNIDO) and International Centre on Small Hydro Power (ICSHP) (Liu et al., 2013). The ground relief, especially in western Greece, legislation and governmental incentives give the opportunity for the development of a large number of small hydro projects in the future. Between 2001 and 2005, 230 new installations acquired permits for operation with a total rated power of 610MW. This paper focuses on the unexploited small hydro potential of a stream in Western Macedonia and the methods of citing one within a promising for hydro power generation watershed.

Materials and Methods

Ekaterinis Lakkos stream is located in North-Western Greece, in the prefecture of Kozani and the region of Western Macedonia (Figure 1). It springs in the Peaks of Kamvounia Mountains which are part of the Pieria mountain range. Kamvounia Mountain's ridge is the line that separates Western Macedonia and Thessaly regions. The stream flows from south-east to north-west and empties to the southern point of Polifitos artificial lake, near the recently constructed Ilariona's dam. It is one of the largest streams in the area that flows directly into the lake.

Figure 1. Study area with EkaterinisLakkos stream network.

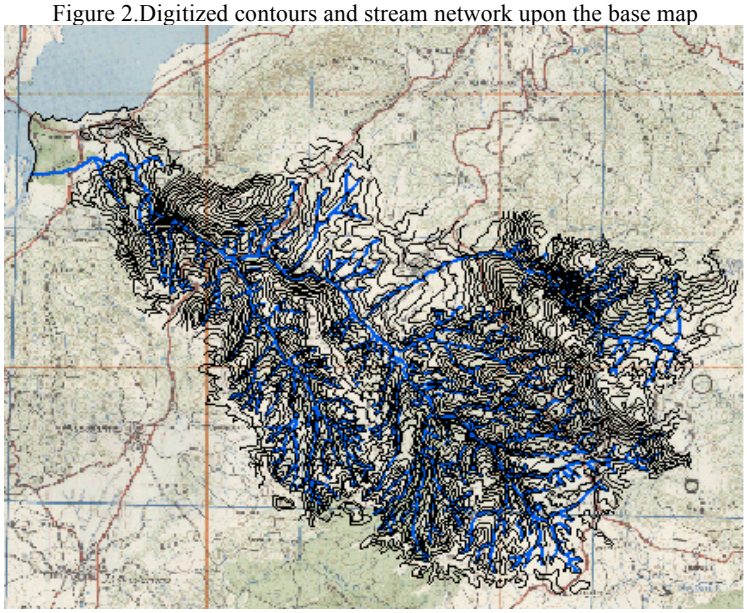


Ekaterinislakkos stream which is a perennial stream has two major ephemeral tributaries, Arkoudolakkas and Xirolakkas. The last two have torrential characteristics because of the steep slopes they flow through (Figures 1, 2).

The basis of this methodology is the GIS software, where all necessary data are imported into for processing and constitutes the graphical display of the framework. The GIS software used in this research is the ESRI's ArcGIS Desktop 9.3, the most popular one among all GIS software worldwide, because of its customization ability. ArcGIS processes and depicts two types of data, raster or grid data and vector data. Raster data are comprised of scanned maps, satellite pictures and aerial photos. Vector datasets are structures of common type feature classes which can be composed by points, lines or polygons.

For the purpose of this study the base layer for all other datasets is the topographic map 1:50000, labelled "LIVADERO" created and distributed by the Geographical Service of Greek Army (GSA). GSA's maps are very accurate and detailed and are used in the majority of projects regarding hydrology and land use spatial analysis.

Figure 2.Digitized contours and stream network upon the base map



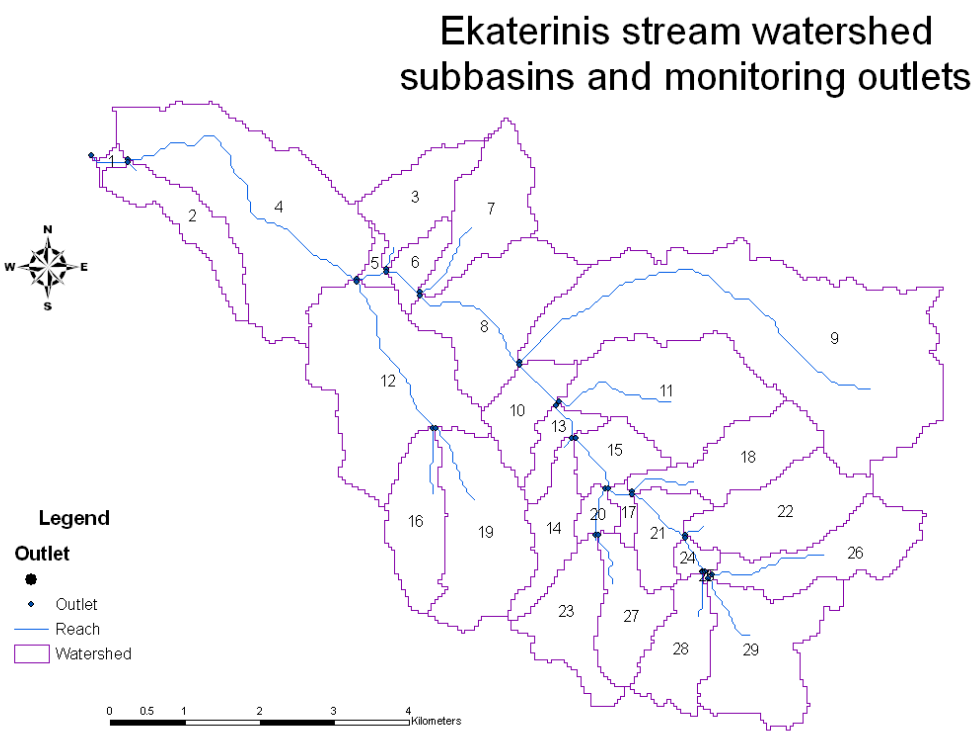
The next step for hydrologic processing is to create the DEM (Digital Elevation Model) of the study area. The DEM is created by the elevation feature (contours) and can become more accurate by "burning" the stream network into it. DEMs are the main datasets used by most spatial analysis tools and models and can also be created using LiDAR data, satellite images or field collected topographic survey data. The tool for DEM creation in ArcGIS is an extension embedded into the program named 3D Analyst. 3D Analyst is a specialized tool that can be added to ArcGIS and performs 3-dimensional display of GIS layers, in the present case the DEM which is a representation of the terrain elevation. The DEM is the groundwork for all the other analysis conducted in this study as it is the primary input dataset for the hydrological models.In this study SWAT is used mainly for the estimation of the stream flow in various points of the stream network. The model has been used for this purpose by many researchers and has always been proven to perform very well. In Greece there is a very small amount of rivers monitored regarding their water flow and most of these are large rivers. Most small catchment streams like the AikaterinisLakos stream studied here have never been monitored and until now their basins remain ungauged. The SWAT hydrological model is applied in order to perform a simulation of the hydrologic cycle in the basin. The model is able to simulate many other procedures, like instream point and non-point pollutants movement, underground water movement and many others but these are not used in present study. Finally, we used the Climate Forecast System

Reanalysis (C.F.S.R.) in order to generate weather data for the watershed area using data provided by the Hellenic National Meteorological Service.

Results

The digitization of the features of Ekaterini's stream watershed offers the possibility of spatial analysis and allows extracting many hydraulic and hydrologic characteristics that are necessary for further processing. The first significant feature that is exported by the ArcGIS processing is the DEM (Digital Elevation Model) of the studied basin which is the representation of the area's morphology. It is produced using the contours and the hydrographic network layers. The DEM incorporates information on elevation of every point within the basin constituting the base dataset for every further management in regards to spatial data. After the initial basic processing in ArcGIS, the DEM layer of the studied area was imported into the ArcSWAT program, which is the GIS interface of SWAT model. The first action of SWAT pre-processing routine is the delineation of the watershed. With the use of the DEM and the ArcHydro toolbox of ArcGIS software, ArcSWAT delineates the watershed of the studied stream and creates sub basins according to the stream network of the major basin. It also defines inlet and outlet points for every single sub basin which are used later as basin's monitoring points. The program gives the user the chance to define graphically as many monitoring points as he wants according to his simulation needs. In the current study, no extra monitoring points were added because the sub basin's outlet points are the only required to fulfil the purposes of this research. For Ekaterini's stream watershed, SWAT delineated 29 sub basins and the corresponding outlets. In Figure 3 is the layout of the delineated watershed with each sub basin labelled.

Figure 3.Sub basins labelled from 1 to 29 and the corresponding monitoring outlets of studied watershed



The watershed delineation tool also provides an output, on the topographic information about the main watershed and sub basins. According to the model, the area of Ekaterini's stream watershed is 49.35 km2 with a minimum elevation of 287m, a maximum elevation of 1389m and a mean elevation 810m. This information is also provided for every one of the sub basins (Table 1).

Table 1. Basic morphometric features of Ekaterini's stream basin and its delineated sub basins

Sub basin	Area (km2)	Min Elevation (m)	Mean Elevation (m)	Max Elevation (m)	Mean slope (%)
1	0.09	288	289.91	290	0.20
2	1.18	287	395.64	661	17.95
3	1.29	560	668.89	805	28.88
4	5.20	288	462.71	805	49.64
5	0.20	520	572.92	709	34.16
6	0.49	520	614.41	691	35.66
7	1.68	600	685.40	750	25.63
8	2.57	520	691.81	838	38.04
9	8.50	640	1030.51	1389	73.74
10	1.05	520	720.64	851	40.80
11	3.13	654	857.24	1228	57.88
12	3.99	536	694.80	872	56.90
13	0.53	520	711.89	855	77.82
14	1.01	569	805.45	1014	74.76
15	0.81	520	739.61	907	61.36
16	1.45	653	798.65	1007	58.37
17	0.21	520	790.49	882	58.00
18	1.61	740	973.13	1248	72.39
19	2.70	660	806.35	1010	50.96
20	0.31	520	758.85	846	86.97
21	0.86	741	838.61	956	48.66
22	2.04	796	1013.57	1271	45.42
23	1.47	520	893.45	1047	54.51
24	0.23	798	873.54	926	34.14
25	0.01	838	846.17	860	20.93
26	1.74	840	1035.48	1275	49.95
27	1.28	520	878.30	1048	80.71
28	1.25	837	959.40	1046	34.65
29	2.48	840	955.70	1042	17.37
Basintotal	49.35	287	809.95	1389	

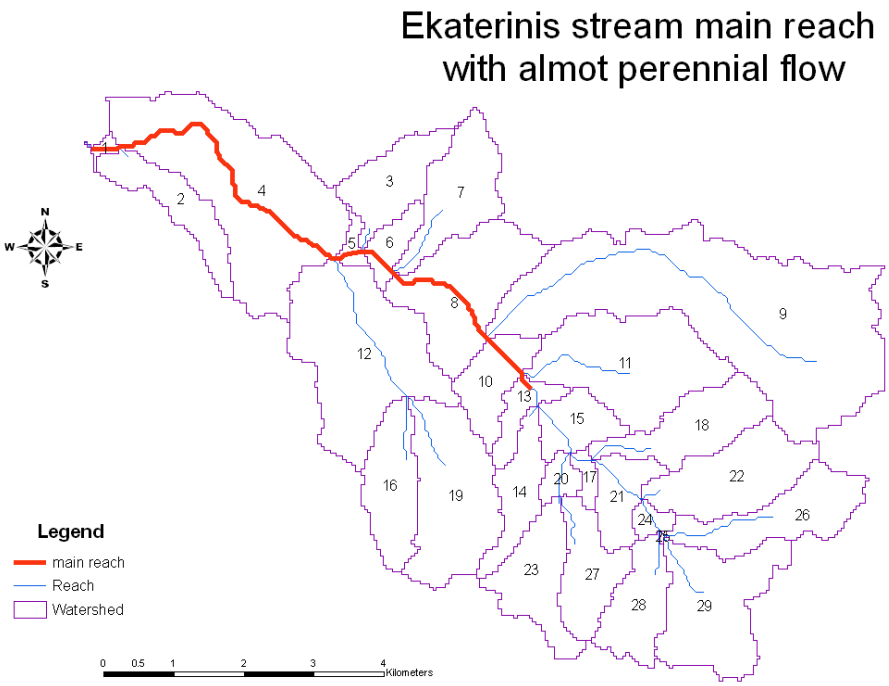
After the watershed delineation and input of the land-use, soil and slope data, the SWAT created 172 HRUs for the studied basin. Each HRU has a unique combination of land-use-soil-slope characteristics and is the smallest hydrologic unit that the model uses for analysis.

SWAT was set to run a simulation for 3 years, 2011-2013 as for those years' meteorological data were more reliable and are the closest ones to present time. Two simulations have been performed for the above simulated period. One for yearly outputs and one for monthly ones.

The results of the simulation show that many small sub basins have no flow year around or intermittent flow most of the time of the year. These catchments are the most mountainous one's low order and have only torrential streams, so they are also unsuitable for hydropower capability and are excluded as sites for small hydropower plant installation. The excluded sub basins No. are: 2, 3, 7, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28 and 29. Sub basin's 1 outlet is the outlet of the whole watershed and is located in the basin's mouth, where Ekaterini's stream meets Polyfytos Lake, so it also cannot be regarded as a possible location for hydropower generation.

The sub basin outlets, that this study focuses on, are those numbered 4, 5, 6, 8 and 10. The part of Ekaterini's stream that runs within these sub basins is shown in Figure 4 The length of the main stream reach has been calculated by ArcGIS and is 8,623 m.

Figure 4. The part of Ekaterini's stream with permanent streamflow, suitable for hydropower generation



Conclusions

The results of this study show that today, there are many tools which can help in decision making regarding spatial allocation of small hydropower units. We can overcome the lack of monitoring through the usage of simulation models, for both hydrologic and climatic ones. The SWAT produced stream flow data, show that reaches with adequate streamflow for hydropower production lie from the middle of Ekaterini's stream watershed, in the outlet of sub basin 10 and downstream through the mouth of the basin. This is absolutely compatible with empirical data and observations, as the more mountainous streams are torrential ones with ephemeral flow and thus inappropriate for hydropower exploitation. The great advantage of SWAT, over other models, is the ability to delineate the watershed into sub basins fast and easy, according to its user's needs and extract hydrologic information for them.

On the other hand, the advantage of CFSR is the compatibility with SWAT, as the user can retrieve ready for use weather data files formatted according to SWAT specifications, from the University of Texas webpage (www.utexas.edu). The use of observed data for the production of simulated time series gives the confidence that the later are highly valid for use in such researches.

The aim of the present study was to propose a methodology comprising of a GIS software, a hydrologic simulation model and a global climatic reanalysis system for estimating streamflow's within an ungauged watershed. With this methodology the need for field measurements is diminished and in the future could be eliminated at all.

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ASSESSMENT OF SPATIAL AND SEASONAL SOIL EROSIONWITHIN A MOUNTAINOUS WATERSHED OF STRYMONAS RIVER BASIN, GREECE

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Abstract

Soil erosion and the consequent sediment delivery into streams are among the most important environmental problems in the Mediterranean region threatening soil and water resources. In the current study, the Revised Universal Soil Loss Equation (RUSLE) was applied for the spatial and seasonal distribution of potential soil loss and sediment yield in the mountainous watershed of Lake Kerkini, in northern Greece. The RUSLE model has been implemented in aGIS framework using rainfall measurements, soil data and remote sensing derived products, such as a digital elevation model (DEM) and Normalized Difference Vegetation Index (NDVI). The predicted annual soil loss was 21.2 t $ha^{-1}$and the annual deposited sediment in Lake Kerkini was approximately 298,500 t. The results of this study further confirmed the seasonality of soil erosion under Mediterranean climate and vegetation conditions with autumn season having the biggest contribution (49.20%) to the annual soil erosion, closely followed by winter (43.35%). The annual spatial distribution of soil loss revealed that 11.36 % of the total study area suffers from severe and extreme severe erosion rates (>50 t ha^{-1} yr^{-1}), located in the steep hillslopes of the watershed.

Keywords:*Soil erosion, RUSLE, GIS, Remote Sensing, Mountainous watershed*

Introduction

Soil erosion is a physical process driven by the wind or water resulting in the removal of soil particles and their transport across a surface elsewhere. It is considered as one of the most important environmental problems across the earth as it threatens natural resources, agriculture and the natural environment (Rahman et al. 2009). The physical process of soil erosion is quite complex and involves several parameters, such as the climate regime, the vegetation cover, the soil type, the surface and landscape characteristics of an area. Human activities also influence the rate of erosion by reducing the vegetation cover and disturbing the soil. The semiarid Mediterranean regions are particularly vulnerable to erosion because they have long dry periods followed by intensive rainfalls, falling on steep slopes with fragile soils and sparse vegetation, resulting in considerable amounts of erosion (Benites et al. 2005). Monitoring soil erosion in situ is costly and usually limited to small experimental sites. The development of many empirical and physical soil erosion models coupled with remote sensing data andGeographic Information System (GIS) allowed the assessment of potential soil loss across a wide range of spatiotemporal scales (Millward and Mersey 1999, Wu and Wang 2007). Among these models, the most widely used are the empirical USLE-family models (USLE/RUSLE) because of their simplicity, robustness and efficiency (Xiaosong et al. 2011).

In the USLE/RUSLE models some factors are considered to be time-invariant, such as soil erodibility (K-factor) and the topography (LS-factor), while some others like the rainfall erosivity (R-factor) and the vegetation cover (C-factor) are highly time-variant and should be examined on a monthly or seasonal basis (Panagos et al. 2012, Ferreira and Panagopoulos 2014, Alexandridis et al. 2015). The objective of this study is to explore and map the seasonality of soil erosion in a mountainous watershed of the Strymonas River, considering the intra-annual temporal variability of vegetation and rainfall. The quantitative assessment of potential annual and seasonal soil loss is determined using the

Revised Universal Soil Loss Equation (RUSLE) model with gridded datasets integrated into a GIS framework. Furthermore, based on the estimated annual soil loss, the potential annual sediment yield transported to the outlet of the Lake Kerkini watershed is estimated with a spatially distributed sediment delivery ratio (SDR).

Materials and Methods

Study area

The mountainous Lake Kerkini watershed is located in Central Macedonia region, Greece, belongs to the Hellenic part of Strymonas River Basin and covers an area of 824 km^2 (Figure 1). The name of the watershed is due to Lake Kerkini, an artificial swallow lake protected by the International Ramsar Convention, which covers an area of approximately 75.51 km^2. Strymonas River is a transboundary river of approximately 393 km in the Balkan Peninsula. It forms a drainage basin of approximately 17,152 km^2 of which 6,400 km^2 are in the Greek territory. The water volume coming from Strymonas River inflows to the northeastern part of the lake, where the estuary-delta of Strymonas is located and through the years a unique wetland ecosystem has been formulated, considered among the most important in Europe. Apart from the Strymonas River, the lake is also supplied with a substantial amount of water and sediments from the Lake Kerkini watershed, which consists of torrents located at Mount Kerkini ("Belles"), north of the lake, and Mount Mavrovouni, south of the lake. Lake Kerkini as a reservoir and Strymonas River play an important role in the irrigated agricultural activities that take place in the Serres plain and cover an area of 1,000 km^2.

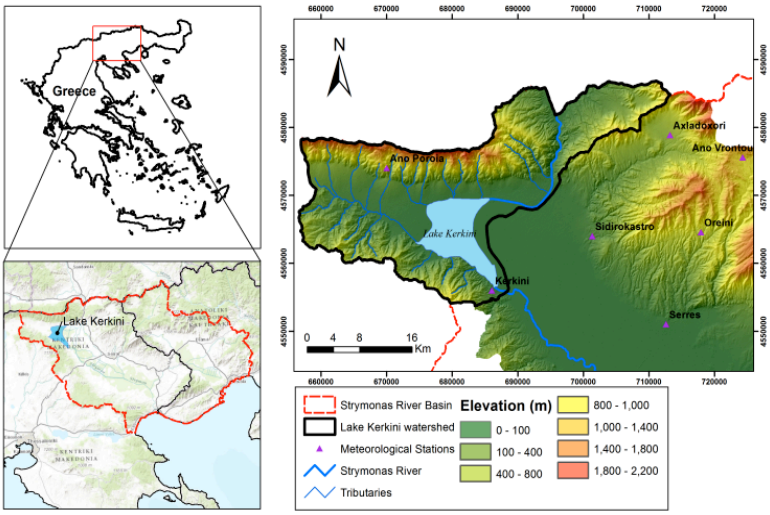

Figure 1.*Location of the Kerkini watershed and elevation map of the study area*

The topography of the Lake Kerkini watershed is mostly mountainous with elevations ranging from 20 to 2023 m. above the sea and a mean value of 413 m. Due to the steep topography, the watershed is prone to soil erosion. The study area can be divided into two climate zones; the mountainous areas located to the north and south of Lake Kerkini have humid continental climate and the plain area in the middle has humid subtropical climate. According to the CORINE Land Cover map 2006 (CLC2006) of the European Environment Agency (EEA, Copenhagen, 2006; http://www.eea.europa.eu), the Lake Kerkini watershed is covered mainly by forest (>51%), followed by agricultural areas which cover 30%, shrub vegetation cover 16%, urban areas cover1.4% and other land cover types comprise 1.6% of the total area. Finally, regarding the geological setting, the watershed area lies in the Servomacedonic geological mass (Psilovikos 1994).

Soil erosion prediction by RUSLE

The Revised Universal Soil Loss Equation (RUSLE) model was developed by Renard et al. (1997)as a revision and update on the Universal Soil Loss Equation (USLE) by Wischmeier and Smith (1978)and has been widely used for predicting the spatial distribution of annual soil loss by sheet and

rill/interill water erosion processes for both agricultural and forest watersheds (Kouli et al. 2009). The RUSLE function (Eq.1) incorporates five different factorsrelated with climatology, pedology, topography, land cover and land management for the calculation of soil loss:

$$A = R \times K \times LS \times C \times P \quad (1)$$

where A is the annual soil loss (t ha^{-1} yr^{-1}),R is the rainfall erosivity factor (MJ mm ha^{-1} h-^{1} yr^{-1}),K is the soil erodibility factor (t ha h ha^{-1} MJ^{-1} mm^{-1}),L is the slope length factor (dimensionless),S is the slope steepness factor (dimensionless),C is the vegetation cover factor (dimensionless),P is the conservation practice factor (dimensionless).

In the present work, RUSLE has been adopted in a Geographical Information System (GIS)framework to predict seasonal and annual potential soil erosion on a pixel-by-pixel basis. Two factors, the rainfall erosivity (R-factor) and the vegetation cover (C-factor) were calculated with different data for each season of the year, while soil erodibility (K-factor) and slope length and steepness (LS-factor) were assumed "stable" for the entire year.The conservation practice (P-factor) was assigned the value of 1 because there were no reliable data to define its value. The annual soil was calculated as the sum of each season's soil loss. The seasons are defined as follows: Winter (January, February, March), Spring (April, May, June), Summer (July, August, September) and Autumn (October, November, December). Each factor of the RUSLE model was calculated in raster format. Finally, to have consistent results all geo-database components and raster layers were projected to the Universal Transverse Mercator (UTM) Zone 34N projection system and were resampled to the same pixel size of 30 m x 30 m. The study was performed using ESRI ArcGIS 10.1, SAGA GIS 2.1.2 and R programming language.

RUSLE input data

The rainfall erosivity (R-factor) is a measure of the erosive force for a specific rainfall in a particular location (Morgan 2004). Many approaches have been introduced through the years for calculating the R-factor based on the available precipitation data. For this study, monthly and annual rainfall data were obtained from the Hellenic National Meteorological Agency ("HNMS") for seven meteorological stations (Table 1) over a period of 40 years (1967-2006). Only two meteorological stations are located inside the extent of the Lake Kerkini watershed., while the rest are selected for a better spatial distribution of rainfall, more representative for all altitudes in the watershed (Figure 1). Monthly R-factor values were calculated following the equations developed by Arnoldus (1980):

$$R_{annual} = \sum_{i=1}^{I=12} (R_{monthly}) i \quad (2)$$

$$R_{monthly} = 1.735 \times 10^{\left(1.5\, log_{10}\left(\frac{p_i^2}{P}\right) - 0.08188\right)} \quad (3)$$

where R_{annual} is the annual rainfall erosivity (MJ mm ha^{-1} h^{-1} yr^{-1}), $R_{monthly}$ is the monthly rainfall erosivity (MJ mm ha^{-1} h^{-1}), p_i is the monthly rainfall (mm) and P is the annual rainfall (mm).

Table 1. *Characteristics of the study area's meteorological stations*

Stations	**Easting (X)**	**Northing (Y)**	**Elevation (Z) (m)**	**Length of records (complete years)**	**Average annual rainfall (mm)**	**AnnualR-factor (MJ mm ha^{-1} h^{-1} yr^{-1})**
Serres	712627.80	4551038.39	34	1967-2006 (35)	470.27	283.52
Kato Oreini	717946.35	4564571.98	745	1967-2006 (38)	659.10	441.34

Ano Vrontou	724336.05	4575600.51	1040	1967-2006 (35)	688.14	560.69
Ahladohori	713256.29	4578872.73	500	1967-2006 (33)	543.57	378.23
Kerkini	686076.76	4556003.63	50	1967-2006 (38)	418.46	260.52
Ano Poroia	670041.28	4574040.80	395	1967-2006 (37)	716.09	500.95
Sidirokastro	701373.632	4564016.255	78	1967-2006 (37)	475.31	308.38

The K-factor in USLE/RUSLE methods is an empirical lumped parameter that accounts for the influence of soil properties and soil profile characteristics on soil loss (Renard et al. 1997). In the present study the soil erodibility (K-factor) was estimated with the help of a gridded soil dataset from the European Soil Data Centre (ESDAC) which has mapped soil physical properties at 500 m resolution for the geographical extent of Europe (Ballabio et al. 2016). The dataset named "Topsoil physical properties at European scale" includes among others three raster layers with the clay content (%), the silt content (%) and the sand content (%), respectively, of topsoil (0-20 cm) for the entire European Union. These three raster layers were produced at 500 m grid cell resolution with the LUCAS topsoil database as input and by applying the Multivariate Adaptive Regression Splines (MARS) model for the prediction of soil texture in the entire European Union (Ballabio et al. 2016). Combining the above three raster layers, the geometric mean particle size was derived for each grid cell (Eq. 5). Afterwards, the K-factor was estimated for each grid cell with the following formula (Eq. 4), which is based on the geometric mean particle size. The formula was developed by Renard et al. (1997) from global data of measured K values, obtained from 225 soil classes.

$$K = 0.0034 + 0.0405 \times exp\left[-0.5\left(\frac{log\, D_g + 1.659}{0.7101}\right)^2\right] \quad (4)$$

$$D_g = exp(0.01 \sum f_i \, ln\, m_i) \quad (5)$$

where K is the soil erodibility factor (t ha h ha^{-1} MJ^{-1} mm^{-1}), D_g is the geometric mean particle size for each particle size class (clay, silt, sand), f_i is the corresponding particle mass fraction for each particle class in percent andm_i is the arithmetic mean of the diameter limits for each particle size class (mm) based on the USDA classification. The m_i values for each soil particle class are the following: for clay 0.0010 mm, for silt 0.0026 mm and for sand 1.025 mm.

The slope length (L) and slope steepness (S) factors in RUSLE reflect the effect of terrain morphology and topography on the erosion process and they are generally lumped together as the topographic factor (LS). In this study, the LS-factor was computed in the System for Automated Geoscientific Analyses (SAGA) GIS software using the Module LS factor and following the algorithm developed by Desmet and Govers (1996). The LS-factor calculation required as input a digital elevation model (DEM) which was derived from the Shuttle Radar Topography Mission (SRTM) with cell size of 30 m.

The vegetation cover factor reflects the effect of cropping and management practices on soil erosion rates in agricultural areas and the effect of natural vegetation in non-agricultural areas (Wischmeier and Smith 1978, Renard et al. 1997). The C-factor gets values between 0 and 1; values closer to 0 indicate dense vegetation, while values closer to 1 are for bare soil. Several methodologies have been developed for estimating the C-factor at regional scale by incorporating vegetation indices from remote sensing data (De Jong 1994, Gitas et al. 2009, Kouli et al. 2009, Ferreira and Panagopoulos 2014). In the present study, Normalized Difference Vegetation Index (NDVI) values derived from Landsat TM/ETM+ imagery were used for the estimation of C-factor following Eq.8 proposed by Van Der Knijff et al. (1999):

$$C = exp\left[-a\frac{NDVI}{(b - NDVI)}\right] \quad (6)$$

where a and b are unitless parameters that determine the shape of the curve relating NDVI and C-factor values. Van Der Knijff et al. (1999) suggested that this scaling approach gives better results than

assuming linear relationship. Also, the values of 2 and 1 were selected for the parameters a and b, respectively (Van Der Knijff et al. 1999,Gitas et al. 2009, Kouli et al. 2009).

To achieve representative C-factor values for each season, four scenes of Landsat TM/ETM+ images were acquired in the period from 2001 to 2003. Each image is supposed to reproduce the "state" of vegetation at one season. The images have 30 m spatial resolution and cloud cover less than 2% to accurate estimate the NDVI values.

The RUSLE model provides only estimates of soil loss related to sheet and rill/interill erosion, not accounting for sediment deposition or gully/channel erosion. To determine the amount of sediment delivered to the stream channels and eventually the annual sediment yield of the watershed, the Sediment Delivery Ratio (SDR) is used. SDR is the fraction of soil erosion that is delivered to the watershed outlet and is affected by geomorphological factors specific to each watershed. For this work, the estimation of SDR was performed in a raster based GIS method. The SDR for each grid cell of the watershed area was calculated with the following equation proposed by Ferro and Minacapilli (1995):

$$SDR = exp\left[-\beta \sum_{p=1}^{m} \frac{l_p}{\sqrt{S_p}}\right] \quad (7)$$

where β is watershed-specific parameter and is considered constant for the watershed, m is the number of cells from the flow path to the nearest channel, p is a cell along the flow path, lp is the length of the flow path and Sp is the slope of the flow path. The value of 1 was selected for the β parameter, according to the literature (López-Vicente et al. 2011).

Based on the SDR calculation for each grid cell, the sediment yield SYi for each cell is given by:

$$SY_i = SDR \times A_i \quad (8)$$

where Ai is the soil erosion rate for a cell for the time period i.

The calculation of SDR, based on Eq.7, was implemented using the System for Automated Geoscientific Analyses(SAGA) software, which has a module called "Overland Flow Distance to Channel Network" that incorporates the grid cell sediment ratio calculation based on a given DEM.

Results

The R-factor was calculated for each meteorological station on a monthly, seasonal and annual basis using Eq. 2,3 and the long-term monthly rainfall data (Table 1); years with incomplete rainfall time-series were excluded from the calculations. Using the seasonal R-factor values of each meteorological station and by applying an Ordinary Kriging interpolation method in ArcGIS environment, a continuous surface for the whole watershed was produced representing the seasonal rainfall erosivity. The annual R-factor raster map (Figure 2) was generated as the sum of the four seasonal R-factor raster maps. Table 2shows the monthly average rainfall and the monthly and seasonal average erosivity values for the Lake Kerkini watershed as computed by the geostatistical interpolation (Ordinary Kriging).

Table 2. *Average monthly rainfall, monthly and seasonal R factor values in the study area*

Season	Months	Monthly rainfall (mm)	Monthly R-factor (MJ mm ha^{-1} h^{-1} m^{-1})	Seasonal R-factor (MJ mm ha^{-1} h^{-1} $3m^{-1}$)
Winter	January	38.78	22.65	88.71
	February	47.04	39.72	
	March	40.83	26.34	
Spring	April	44.22	30.54	113.26
	May	50.79	38.37	
	June	48.71	44.35	
Summer	July	33.69	16.91	57.09
	August	40.65	25.73	
	September	31.79	14.45	
Autumn	October	48.40	35.11	171.81
	November	55.76	47.68	
	December	58.21	89.02	
Annual		538.87		430.87

The annual average erosivity factor for the Lake Kerkini watershed ranged from 320 to 633 MJ mm ha^{-1} h^{-1} y^{-1}, with a mean value of 430.87 MJ mm ha^{-1} h^{-1} y^{-1}. From the spatial distribution of the R-factor (Figure 2), it can be denoted that the topography of the watershed affects the values of the R-factor and the rate of erosivity risk. The flat areas in the central part of the watershed have considerable lower rainfall erosivity values than the mountainous areas, with the steep terrain, in the N and SE of the watershed. Furthermore, based on the results of Table 2a clear seasonal effect of the R-factor values is observed, which follows the seasonal pattern of rainfall in the study area. The highest seasonal rainfall erosivity value was noticed in autumn (171.81 MJ mm ha^{-1} h^{-1} $(3months)^{-1}$) and the lowest in summer (57.09 MJ mm ha^{-1} h^{-1} $(3months)^{-1}$).

Combining the three soil textural maps (% clay, % silt, % sand) each grid cell of the watershed area can be classified in the USDA classification system. In the Lake Kerkini watershed most of the grid cells belong to the loamy texture class, followed by clay loamy and sandy loamy. The soil erodibility values in the Lake Kerkini watershed ranged from 0.011 to 0.045 t ha h ha^{-1} $MJ^{-1}mm^{-1}$, with a mean value of 0.033 t ha h ha^{-1} MJ^{-1} mm^{-1}(Figure 2). The highest soil erodibility values were observed in the plain area of the watershed and around Lake Kerkini (0.03-0.045 t ha h ha^{-1} MJ^{-1} mm^{-1}). The lowest erodibility values occurred in the northern mountainous areas of the watershed (0.01-0.02 t ha h ha^{-1} MJ^{-1} mm^{-1}).The generated K-factor map has grid cell size of 500 m x 500 m, as the three soil textural raster layers from which it was produced. To apply the RUSLE function and produce consistent results the K-factor raster layer was resampled to 30 m x 30 m grid cell size.

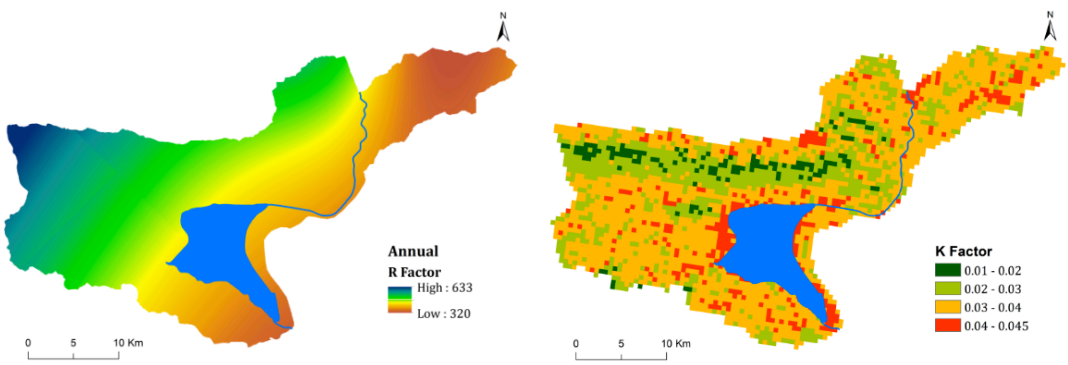

Figure 2**.** *R-factor map (left) and K-factor map (right) of the study area*

Before calculating the LS-factor, the first step was to create the slope gradient map of the study area from the available DEM. Slope values vary from 0% to 85%, with an average value of 23.91%. The topographic factor values range from 0 to 110, with an average value of 5.7 and standard deviation (SD) of 7.59 (Figure 3). From the spatial distribution of the slope gradient map and the LS-factor map, it can be observed clearly that high LS-factor values are associated with steep slopes.

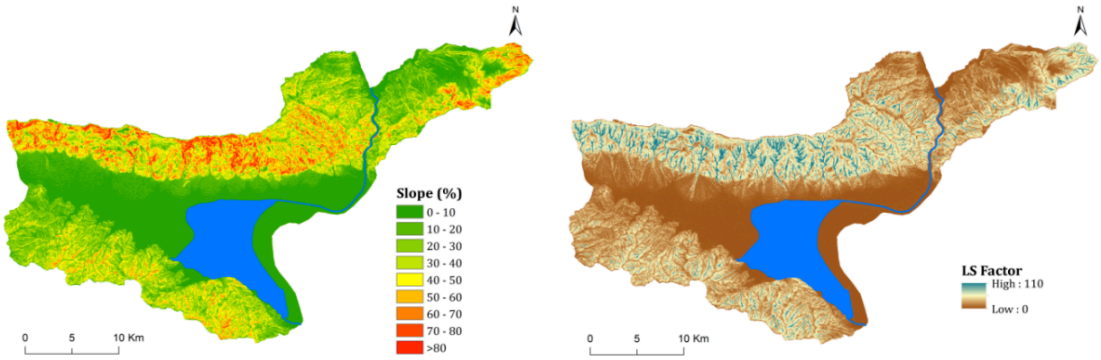

Figure 3.*Slope gradient map (left) and LS-factor map (right) of the study area*

The lowest values for the LS-factor are found in the central part of the watershed, where the slopes are very low, and the highest values are found in the steep hill slopes of the two mountains north and south of the Lake Kerkini watershed.

The seasonal vegetation cover (C-factor) values of the study site were generated from remote sensing data. The first step was to derive an NDVI image from the representative Landsat ETM+/TM image of each season. The calculated NDVI values describe relative density and health of vegetation in each season. High NDVI values were observed in summer and spring, demonstrating that the canopy foliage was dense during that seasons and low NDVI values were found in autumn and winter. These results can be further explained from an ecological aspect as broad-leaved forests, which cover over >50% of the watershed, have seasonal appearance of canopy. In autumn, due to cold temperatures, they lose the leaves of their canopy and in spring, as the temperatures become warmer, the leaves grow again.

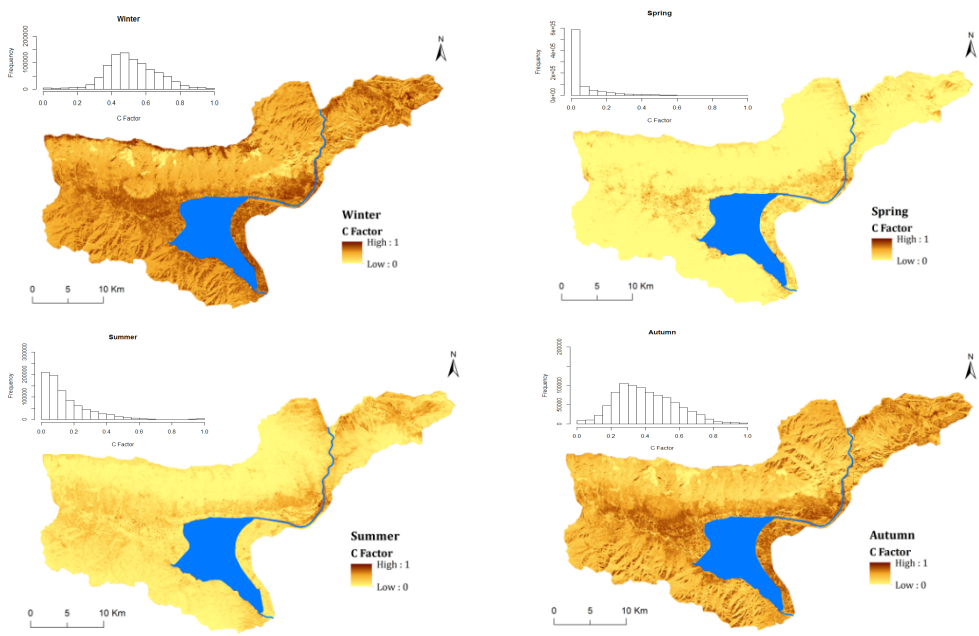

Figure 4.*Seasonal C-factor maps and histograms of the study area*

The seasonal C-factor maps were generated using Eq.6 and the corresponding NDVI values of each season. In Figure 4the spatial distribution and the histogram of the C-factor values for each season are shown. The highest C-factor values are observed in winter, with a mean value of 0.516 (SD=0.15), while similar high C-factor values can be seen in autumn, with a mean value of 0.406 (SD=0.177). The lowest C-factor values are noticed in spring with a mean value of 0.069 (SD=0.129), while low C-factor values are also observed in summer, with a mean value of 0.155 (SD=0.149). High NDVI values produce low C-factor values, meaning that greater vegetation/canopy cover can considerably reduce soil erosion. On the other hand, low NDVI values produce high C-factor values indicating that the vegetation/canopy cover cannot act as constraint on soil erosion processes.

The potential soil loss values for each season were computed by multiplying the five raster layers corresponding to the RUSLE factors (R, K, LS, C, P). This process was performed within the ArcGIS environment, using the Raster Calculator of the Spatial Analyst tool. The spatial distribution of potential soil erosion for each season can be seen in Figure 5. The highest values of potential soil loss are found in autumn, with an average value of 10.43 t $ha^{-1}(3month)^{-1}$. Similar high values of potential soil erosion are observed in the winter season with an average value of 9.19 tha^{-1} $(3month)^{-1}$. Both summer and spring seasons demonstrate very low values of potential soil loss, with 0.99 t $ha^{-1}(3month)^{-1}$ and 0.59 t ha^{-1} $(3month)^{-1}$, respectively.

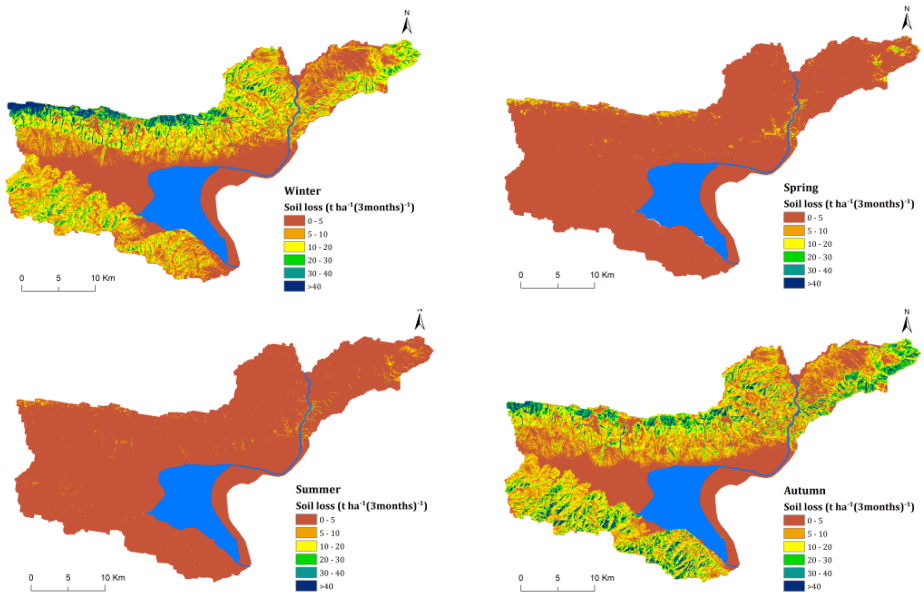

Figure 5.*Spatial distribution of potential seasonal soil erosion of the study area*

The annual potential soil loss map was created by adding the four seasonal soil loss raster layers (Figure 6). The contribution of each season to the annual soil loss is the following: autumn with 49.20%, winter with 43.35%, summer with 4.67% and spring with 2.78%. The estimated annual soil loss for Lake Kerkini watershed ranged from 0 to 128 t $ha^{-1}yr^{-1}$, with an average value of 21.2 t $ha^{-1}yr^{-1}$. The estimated average seasonal and annual soil loss in the Lake Kerkini watershed were grouped into six different soil erosion risk classes to identify the watershed's area under serious soil erosion risk (Table 3). Regarding the annual soil erosion, the results presented in Table 3demonstrate that approximately 26.33% of the study area is exposed to severe erosion rates (> 30 t $ha^{-1}yr^{-1}$).

Table 3. *Seasonal and annual soil erosion classes with erosion rate and area covered*

Erosion risk classes	Seasonal soil loss (t ha^{-1}3month^{-1})	Winter Area (%)	Spring Area (%)	Summer Area (%)	Autumn Area (%)	Annual soil loss (t ha^{-1}yr^{-1})	Area (%)
Very low	0-2	22.57	91.15	84.13	18.35	0-2	8.73
Low	2-10	41.29	7.84	15.61	41.06	2-10	24.20
Moderate	10-30	30.10	0.97	0.25	32.23	10-30	40.74
Severe	30-50	4.05	0.03	0.01	5.81	30-50	14.70
Very severe	50-100	1.72	0.01	0.00	2.24	50-100	9.36
Extreme severe	>100	0.26	-	-	0.31	>100	2.27

Observing the spatial distribution of the annual soil erosion (Figure 6), it can be seen that the areas with severe erosion risk are associated with steep slopes. These areas are located primarily in the northern mountainous regions of the study area and secondary in the southeast and northwest regions of the watershed. The areas with lower erosion risk are in the central part of the watershed, where the terrain is flat. Based on Eq.7, spatially distributed sediment delivery ratios (SDR) have been calculated for each grid cell of the Lake Kerkini watershed (Figure 6). The average sediment delivery ratio (SDR) for the whole watershed was estimated as 0.19. High SDR values (0.8-1) were observed along the stream channels of the watershed, moderate SDR values (0.2- 0.6) at the upper drainage area of every stream channel, where steep stream gradients occur, and finally values close to zero in the low altitude-flat areas of thewatershed. Following Eq.8, the potential annual sediment yield for every grid cell of the watershed was computed by multiplying the SDR and the annual soil erosion at each grid cell. The potential annual sediment yield of the Lake Kerkini watershed was calculated by adding the potential sediment yield of all grid cells in the study area, as approximately 298,500 t (3.62 t ha^{-1}year^{-1}).

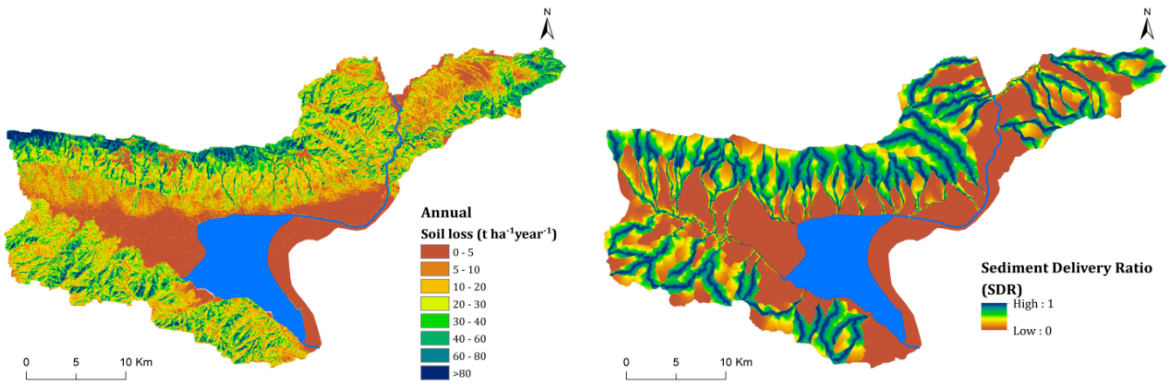

Figure 6.*Spatial distribution of potential annual soil erosion (left) and sediment delivery ratio (right) of the study area*

Discussion-Conclusions

In the present study, a quantitative assessment of average annual and seasonal soil loss for the mountainous Lake Kerkini watershed was performed, using the RUSLE model within a GIS framework.

For the assessment of seasonal soil loss two RUSLE factors, namely the rainfall erosivity and the vegetation cover, were estimated on a seasonal basis using long-term monthly rainfall measurements and seasonal NDVI values from Landsat TM/ETM+ images, respectively. The average annual soil erosion was found to be 21.2 t ha^{-1}yr^{-1}, of which over 90% was produced during the autumn and winter seasons of the year. The seasonal pattern of soil erosion in the Mediterranean region, mainly due to the seasonal variations in rainfall and vegetation coverage, has been confirmed in other studies too, which also concluded that the highest erosion rates occur in the autumn season because of high rainfall rates

and low vegetation cover during that period (Panagos et al. 2012, Ferreira and Panagopoulos 2014). It must be noted that the application of empirical models, like RUSLE, for assessing the seasonal variability of soil loss in mountainous watersheds may underestimate the soil loss in spring and summer season and the corresponding sediment yield produced by flash floods, which are typical in the Mediterranean region.

The spatial distribution of soil erosion in the Lake Kerkini watershed, which has a complex terrain, confirmed the findings of many other studies suggesting that soil movement is controlled by topography and that soil loss results from the RUSLE model are strongly correlated with the topographic factor (Kouli et al. 2009, Ali and De Boer 2010).

Concerning the quantitative results of the RUSLE model, Panagos et al. (2012) reported mean annual soil erosion of 7.01 t ha^{-1} (12.09 t ha^{-1} in forests and natural lands) for the Hellenic part of the Strymonas River basin, using the G2 model. The higher potential soil loss predicted by this study could be attributed to the mountainous location of Lake Kerkini watershed. The average slope gradient and rainfall in the study area are considerable higher than in the entire Strymonas River basin, resulting in higher rainfall erosivity and topographic factor values and consequently higher average annual soil erosion rates.

Furthermore, according to Psilovikos and Margoni (2010) the average annual sediment yield deposited in Lake Kerkini from the entire Strymonas River basin is 4,285,000 t. Based on the results of this study the estimated annual sediment yield from the Lake Kerkini watershed is calculated as 298,500 t, which is 6.96% of the total annual deposited material in Lake Kerkini.

The quantitative assessment of potential soil loss using an empirical model like RUSLE has great uncertainty. Nevertheless, the spatial and seasonal distribution of soil erosion seem to be accurately simulated, leading in the identification of severe erosion risk zones which should be considered for the protection of agricultural areas, urban areas and the Lake Kerkini wetland.

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A GIS APPROACH TO IDENTIFYING CONNECTIVITY POTENTIAL BETWEEN BROWN BEAR (*Ursus arctos*) HABITAT IN NORTHERN GREECE

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Abstract

The brown bear (*Ursus arctos*) distribution in Greece is divided between two main large populations, one situated in the Pindos Mountain Range (NW Greece) and the other in the Rhodope Mountain Complex (NE Greece). As a result of recent recolonisation, a number of understudied, separate populations are found in other parts of mainland Greece. This study modelled landscape connectivity of brown bear habitat between recently recolonised areas and larger populations with regard to population dispersal potential. Using Geographical Information System (GIS) software, the species' home range and a Habitat Suitability Index (HSI) of the study area were integrated to generate an estimate of connectivity potential among known populations. The analysis suggests that recently recolonised areas may be functioning as stepping stones, connecting the core population nuclei, and identified areas which are likely to be important in terms of providing landscape connectivity.

Keywords: *landscape ecology; fragmentation; habitat corridors; species distribution*

Introduction

European populations of brown bear (*Ursus arctos arctos*), are showing a stable or in some cases increasing trend in many parts of their range (Kaczensky *et al.* 2012; Chapron *et al.* 2014). However, the long-term survival of such a space-demanding species depends both on the management of their habitats and the linkages between suitable habitat patches (Swenson *et al.* 2011; Kaczensky *et al.* 2012). Large carnivores are particularly vulnerable to habitat loss and degradation because of their low population densities and large habitat requirements (Kaczensky *et al.* 2012; Chapron *et al.* 2014).

Landscape connectivity has been a significant focus for conservation efforts across Europe in the 21st century. Wildlife corridors connecting habitat patches promote the movement of individuals across populations, allowing gene flow and thus reducing homogeneity and the potential for inbreeding (Bennett, 2003). Furthermore, corridors can provide escape routes in case of a stochastic catastrophic event such as a wildfire (Bennett, 2003). Digital models of potential suitable patches and corridors, can facilitate an initial, rapid examination of extensive study areas and highlight areas of interest. In species conservation, when both functional connectivity and structural connectivity for the focal species between patches are considered together, the resulting model becomes more robust (Velez-Liendo *et al.* 2014; Almpanidou *et al.* 2014). Habitat Suitability Indices (HSI), introduced by the U.S. Fish and Wildlife Services (1981), are used to assess a habitat's fitness in regards to a single species. Based on the ecological behaviour of the target species, an HSI assigns scores to assess the quality of variables such as land cover, topography and distance from risk areas. HSIs can be useful in spatial studies as they can provide an insight into the animal's dispersal and habitat utilisation (Kusak and Huber 1998; Chouvardas *et al.* 2013; Almpanidou *et al.* 2014).

In Greece, there are two core brown bear populations found in the Pindos Mountain Range (NW Greece) and the Rhodope Mountain Complex (NE Greece) (Mertzanis, 2012). In Pindos, the population reaches the lowest latitudinal range of the continent (Mertzanis 2012). The northwest population is connected populations in the Former Yugoslav Republic of Macedonia (FYROM) (n = 160-200 bears) and Albania (n = 180-200 bears), while the northeast population is linked to Bulgaria (n = 530-590 bears) (Kaczensky *et al.* 2012; Chapron *et al.* 2014). In addition to the two core areas, a number of areas in mainland Greece which were within the species' historical range have been re-

colonised by brown bears in the last 40-60 years (Mertzanis 2012). Although conservation efforts have resulted in a recent population increase (Chapron *et al.* 2014), bears in Greece are still listed as Endangered in the Greek Red Data Book on Threatened Wildlife species (Mertzanis *et al.* 2009).

This was an exploratory study based on literature review and expert opinion, using digital spatial data to assess the suitability of habitats across Greece, the southern Former Yugoslav Republic of Macedonia (FYROM) and the southernmost part of Bulgaria. It attempted to use freely available spatial data to identify potential corridors, linking the newly re-colonised habitat patches and core areas. Specifically, the study focuses on the connectivity of the newly re-colonised areas and their role as large-scale stepping-stones or corridors that could facilitate the exchange of individuals between the two core areas. Furthermore, it discusses the advantages and disadvantages of this method and its potential role in aiding conservation plans on a national and international scale.

Materials and Methods

Study Area

This study focused on the smaller, recently recolonised areas in central Northern Greece extending between the core populations in the west (Pindos region) and in the east (Rhodope region), as well as southern regions of FYROM and Bulgaria; an area of 54,250km^2 (Figure 1). The study did not consider the full extent of the core areas because the focus was on the connectivity between these areas rather than the quality of the core areas themselves. For the purposes of this study, the massifs and their surrounding habitats were grouped into nine regions (Figure 1).

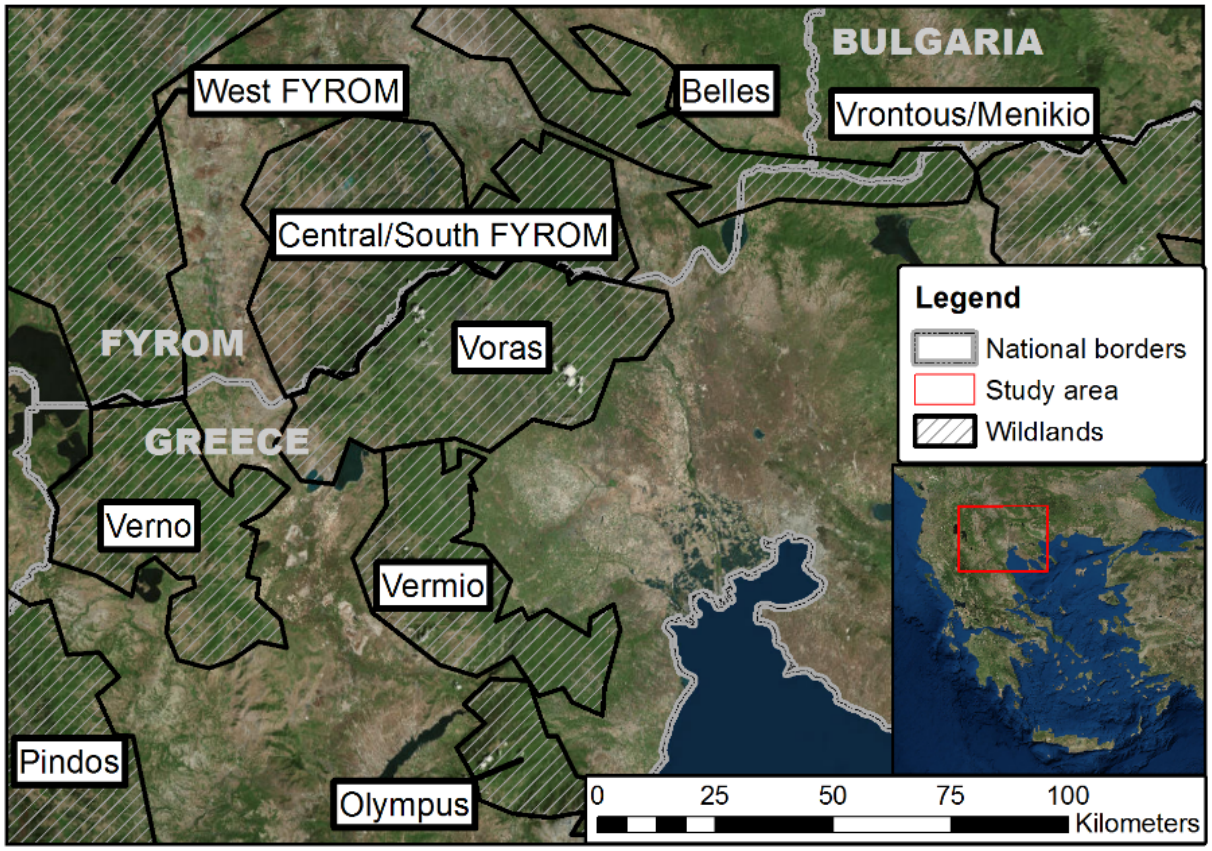

Figure 1. Study area (size: 54,250km2) and nine Wildland areas (Pindos, Verno, West FYROM, Central/South FYROM, Voras, Belles, Vrontous/Menikio, Vermio, Olympus).

Connectivity modelling

This study utilized the GIS tool CorridorDesigner, which was developed specifically for the purposes of modelling habitat suitability assessments and corridor design (Majka *et al.* 2007), operated within ArcGIS v.10.2.2 (ESRI, 2014)

A Habitat Suitability Index (HSI) was created by drawing on published data to evaluate the relative importance of four key variables (land cover, altitude, topography and distance from urban areas) and weighting these according to their importance for the target species (see tables 1-3). Land cover data was obtained from the Corine Land Cover (CLC) dataset (resolution 100 meters) (EEA 2000) to ensure data consistency for the three countries. Altitude was derived from a Digital Elevation Model (DEM; resolution 25 meters) obtained from the European Environment Agency (EEA 2013). A number of studies highlight altitudinal preferences in brown bears, especially regarding denning sites with the average altitude being reported as 863m above sea level in Croatia (Kusak and Huber 1998, see also Kanellopoulos *et al.* 2006). The optimum altitudinal range for this HSI was deemed to be between 800 m and 1700 m, as 800 m is the lowest elevation used significantly by brown bears (Kanellopoulos *et al.* 2006), while 1700 m is the average altitude where the tree line ends (low food availability and canopy cover). The lower HSI altitude groups (0-800 m) are associated mainly with foraging. There is a relative paucity of data concerning how brown bears specifically use the topography of a landscape, apart from denning sites often being located in steep canyons (Mertzanis, *et al.*, 2005). Bears often select paths of least resistance to conserve energy and thus may avoid steep terrain (Nawaz *et al.,* 2014). A Topographic Position Raster, created from the DEM, was used to generate four different categories of slope terrain (Table 2). Proximity to areas of human activity, has been identified as an important factor affecting the suitability of habitats for large carnivores (Chapron *et al.* 2014). All human activity areas found in the CLC dataset were merged to create an urban layer (Table 1). Three distance groups were identified (Table 2).

Whilst the road network is often used in HSI assessments, this study did not include the road network within the corridor analysis as it was not possible to obtain a layer of consistent quality for the entire study area. Alternatively, the road network was taken into account in the final assessment by identifying areas where roads bisect potential corridors. It is important to note that while highways and railways seem to affect bear movement negatively, forestry roads are consistently used by bears as they provide a more energy-efficient passageway within suitable habitat (Huber *et al.* 2005).

The relative importance of each of the four variables were weighted against each other in terms of their impact on brown bears and following the methods of Majka *et al.* (2013; see figure 2 for weightings).

The analysis also required an estimation of home range. Brown bear home ranges vary greatly, even amongst Southern European populations (see Kusak and Huber 1998; Kanellopoulos *et al.* 2006; Mertzanis *et al.* 2011). Brown bear home range telemetry studies in Greece varied from 25-30 km^2 for adult females with cubs of that year to as much as 507 km^2 for adult males (Kanellopoulos *et al.* 2006, Mertzanis *et al.* 2011). In an attempt to select an area suitable for both sexes, this study defined the home range as 150 km^2.

Table 1. Habitat suitability scores assigned to land cover categories (see Kusak & Huber, 1998; Kanellopoulos *et al.,* 2006; Mertzanis *et al,.* 2008; Paralikidis *et al.,* 2009; Karamanlidis *et al.,* 2014; Can *et al.,* 2014; Savvantoglou 2015).			
CORINE code	CORINE Layer	Score	Justification
1.1-1.4.2	Urban areas (codes 1.1 to 1.4.2)	0	Areas of high human activity
2.1.1	Non-irrigated arable land	50	Occasionally used for feeding, but not suitable for breeding
2.1.2	Permanently irrigated land	30	Potentially occasional feeding areas, but not suitable for breeding.
2.1.3	Rice fields	10	Not suitable
2.2.1	Vineyards	30	Potentially occasional feeding areas, but not suitable for breeding.
2.2.2	Fruit trees and berry plantations	30	Very good source of food, but plantations associated with intensive agriculture. Occasional visits. Not suitable for breeding
2.2.3	Olive groves	0	Unsuitable food source. Not suitable for breeding
2.3.1	Pastures	50	Occasionally used for feeding, but not suitable for breeding
2.4.1	Annual crops associated with permanent crops	30	Occasionally used for feeding, but not suitable for breeding
2.4.2	Complex cultivation	30	Occasionally used for feeding, but not suitable for breeding
2.4.3	Land principally occupied by agriculture, with significant areas of natural vegetation	60	Frequent use for feeding, possible breeding potential
2.4.4	Agro-forestry areas	80	Consistent use for feeding and breeding
3.1.1	Broad-leaved forest	100	Consistent use for feeding and breeding
3.1.2	Coniferous forest	80	Consistent use for feeding and breeding
3.1.3	Mixed forest	90	Consistent use for feeding and breeding
3.2.1	Natural grassland	60	Frequent use for feeding, possible breeding potential
3.2.2	Moors and heathland	60	Frequent use for feeding, possible breeding potential
3.2.3	Sclerophyllous vegetation	60	Frequent use for feeding, possible breeding potential
3.2.4	Transitional woodland shrub	50	Occasionally used for feeding, but not suitable for breeding
3.3.1	Beaches, dunes, and sand plains	0	Not suitable
3.3.2	Bare rock	80	Consistent use for feeding and breeding
3.3.3	Sparsely vegetated areas	20	Bears might cross in search for good habitat types
3.3.4	Burnt areas	0	Not suitable
4.1.1	Inland marshes	20	Bears might cross in search for good habitat types
5.1	Water courses and bodies	0	Not suitable
Other habitat types from CLC2000		All missing CLC habitat types were not present in the study area	

Data processing

The *Habitat Suitability Tool* analysed the four different layers according to their weightings and produced a habitat suitability layer that reflected the given scores. The *Patch Tool* was used to reclassify all areas with habitat quality above 60 (60 = lowest value associated with occasional use and breeding) and group them according to their size (Majka *et al.* 2007). A suitable area smaller than 150 km^2 was classified as '*smaller than breeding patch'*. An area between 150 km^2 and 750 km^2 was considered a '*breeding patch'* and would be able to support a single individual or a mother with cubs. Any suitable area larger than 750 km^2 was considered a '*population patch'*, an area that could support five individuals (5x the home range of the species; Majka *et al.* 2013). Finally, '*Create Corridor*

Model' developed the corridor analysis where the most suitable pathways between the patches were selected and displayed as potential linkages (Majka *et al.* 2007). See figures 2 and 3 for illustrations of the entire process.

Table 2. Habitat suitability scores of altitude, topography and distance form urban areas (synthesized from Kusak and Huber, 1998, Mertzanis *et al.* 2008, Kanellopoulos *et al.* 2006, Mertzanis *et al.* 2011, Savvantoglou 2015)

		Scores	Justification
Altitude (meters above sea level)	0 - 400	20	Rarely used in search for food
	400 - 800	60	Frequent use for feeding, possible breeding potential
	800 - 1700	100	Ideal altitudinal range
	1700-2889	50	Tree line ends and alpine vegetation begins. Occasionally used for feeding
Slope	Canyon bottom	40	Based on observations due to lack of data on this type of landscape structure in Greece
	Flat-gentle slope	80	Less energetically costly. Consistent use for feeding and breeding
	Steep slope	50	Use for commuting between places. Narrow field of vision and energetically costly. Occasionally used for feeding, not suitable for breeding.
	Ridge top	90	Best field of vision. Path of least resistance. Consistent use for feeding and breeding.
Distance from urban areas (meters)	0 - 500	50	Infrequent feeding. Not suitable for breeding.
	500 - 1500	60	Frequent use for feeding, potential breeding
	1500 and above	100	Ideal minimum distance

Table 3. Habitat suitability variable weights

Variable	Weight (%)	Justification
Land cover	65	Highest contributor to habitat selection for Brown bears
Topography	15	Preference for energy efficient terrain, but use of steeper areas to den or find water courses
Altitude	10	Not as important as topography as bears are often observed foraging in low altitude
Distance from urban areas	10	Small score due to the increasingly high instances of bears trespassing into inhabited areas to forage on human waste or fruit trees

Results

The tool identified fourteen potential corridors linking the wildlands, with some of the patches sharing more than one linkage (figure 3). All patches were connected to at least one other patch, while the largest number of corridors was found around the Vermio wildland (n=6). The Vrontous/Menikio region was the only patch connected to just one other patch (Belles). The average number of corridors between patches (median = 2) suggests a relatively high degree of connectivity between the brown bear populations across the study area. The length of the corridors varied from 3 km (linkage zone 4, figure 3) to 82 km long (linkage zone 5).

The model suggests a that ecological linkages exist between the Rhodope mountain range (east of Vrontous/Menikio) in the East and the Pindos mountain range in the West of Greece, and another

route connecting the FYROM populations with the newly recolonised Olympus patch via Mt. Vermio and Mt. Voras. A secondary corridor linking Mt. Olympus with the Pindos mountain range was identified, but in this case the corridor is much longer and narrower. The Belles patch in itself provides an extensive corridor due to its shape and is further connected via a short, wide corridor (approx.. 6 x 9 km) to the C/S FYROM patch. The transport network often cuts through the species' habitat, adding another barrier to bear movement and this requires further study.

The analysis suggests that bears moving between Voras and the eastern Greek population (Rhodope-Vrountous-Menikio-Belles) may be moving across two or three countries; possibly entering into Bulgaria (Vrontous - Belles), crossing to FYROM (Belles - West FYROM patch) and from that back to Greece (Voras patch).

A few remarks need to be made with regards to the application of this HSI model. Firstly, no presence/absence data was used to create this model. Presence data improves the design and refines it according to verified patterns of actual bear movement. However, this study focuses purely on the creation of a connectivity model using freely available spatial data with an aim to create a system of rapid examination of a given study area without the existence of prior field surveys, but merely the understanding of an animal's ecology and behaviour. Secondly, a few of the identified suitable habitat patches do not correspond with evidence of bear activity. Specifically, the highlighted areas in Figure 2 are not colonised by bears nor has there been evidence of bear activity, but the model has labelled them as areas of suitable habitat. This is because this model maps suitable habitat no matter whether it is colonised by bears or not. As bears are not present in these patches, the corridor modelling of these areas was excluded from the corridor design. However, this approach may provide a projection of future colonisations within the study area.

Information on the linkage zones and the corridors within them in relation to their function, physical attributes and HS values has been summarized in Table 5.

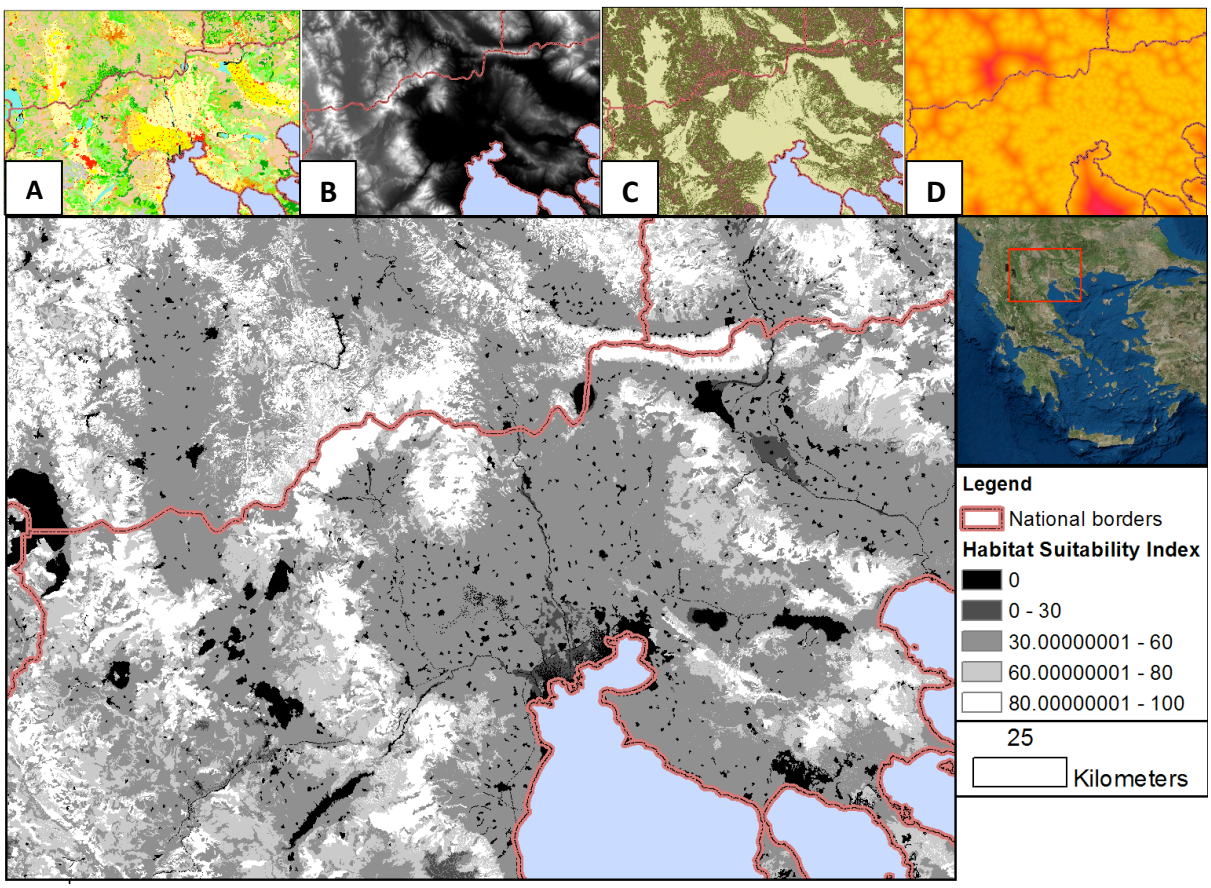

Figure 2. Corridor model: CLC (A), Altitude (B), Topography (C) and Distance from urban areas (D) developed the Habitat Suitability Index (main panel). HSI scores represent: 100 = optimal habitat associated with highest survival and reproductive

success; 80 = Lowest score typically associated with successful breeding; 60 = Lowest score associated with consistent use and breeding; 30 = Lowest score associated with occasional use for non-breeding activities; < 30 = Avoided HSI (Majka *et al*. 2013) (Layer sources: EEA 2000, EEA 2013).

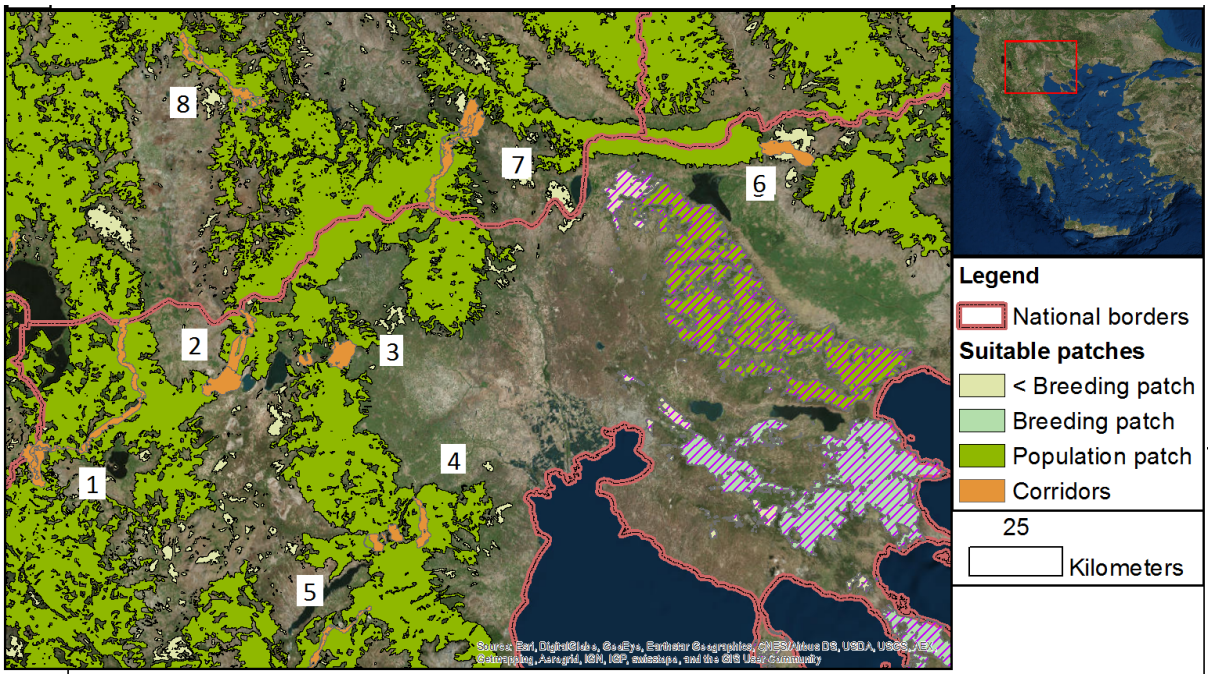

Figure 3. Home range defined breeding patches (green). The areas known not to be inhabited by bears (hatched) were excluded from the corridor model to reduce processing time. The final model revealed the potential areas likely to be serving as corridors for bear dispersal (orange). Numbers represent linkage zones between wildlands.

Table 5. Summary of linkage areas. See figure 3 for illustration of linkage zone numbers.									
Linkage zone		Pindos - Verno	Verno - Voras	Voras - Vermio	Vermio - Olympus	Pindos - Olympus	Belles-Vrontous/Menikio	Belles - FYROM	FYROM
Linkage zone no		1	2	3	4	5	6	7	8
Signs of bear use	Confirmed	x						x	x
	Unconfirmed indications		x	x					
	Not Confirmed				x	x	x		
Type of connection	C-C								x
	S-R	x							
	C-R		x						
	R-R			x	x		x		
	C-R					x		x	
Corridor attributes	Length	9km	6km	3km	3km	82km	15km	9km	27km
	Min width	2km	4km	1km*	0.5km*	0.25km	1.5km	5.5km	0.5km
	Primary land cover (CLC)	2.4.4	2.1.1	2.4.4/3.2.2**	2.4.4/ 3.2.2**	2.4.4	3.2.2	3.2.2	2.4.4
	Connecting countries	-	-	-	-	-	Yes	Yes	-
	Overall HS value	74	65	65	75	78	68	65	79
	Bisected by major roads	-	A29	E86	E90	E92, E65	E79	A1	E75, E65
	SD of HS value	15.31	16.33	16.32	18.84	15.25	14.11	16.9	16.84

Discussion

This was a pilot study, assessing the connectivity potential for the brown bear dispersal across its Greek range and neighbouring habitat patches in FYROM and Bulgaria. The purpose of this desk-based connectivity study was to identify the potential linkage areas, allowing for a remote assessment of the study area.

It is widely understood that an HSI model is only as good as the input data (Majka *et al.* 2013). The aim of this study was to demonstrate the use of spatial corridor modelling as a tool for landscape conservation and identify its role in conservation planning. Indeed the CorridorDesigner software was able to identify those areas between the habitat patches where the habitat is, according to this HSI, able to support bear dispersal. Some of the limitations of this study have already been highlighted in the methods section, while below there are additional points regarding the reliability of the model. However, it is important to emphasise on the efficiency of such a model as an introductory step to a larger project assessing and improving connectivity between brown bear populations in its Greek range. This study was completed with freely available layers and without the use of species presence data. In the early planning stages of landscape connectivity in Greece, this study provides a rapid habitat assessment, highlighting the areas potentially acting as bear crossings. Further ground-truthing

in collaboration with researchers from Bulgaria and the FYROM, would allow for an assessment of bear activity within the highlighted corridors.

Study area connectivity

The model suggests that, in terms of human disturbance and geographical factors, the two core areas might be potentially joined via a series of smaller habitat patches and corridors. The mean length of all the corridors identified is 19.5 km, while the median is 9km. Interestingly, a number of the smaller patches, pivotal in the exchange of individuals between the East and West of the country, are areas of recent recolonisation. The Voras, Belles, and Vermio patches may be acting as larger scale stepping-stones, facilitating the movement of bears between larger populations. Perhaps, given this information, the importance of these smaller populations should be foregrounded, with a view to raising their profile in future brown bear conservation management plans. To support this recent range expansion, surveys into the intermediate areas (potential linkage areas between patches) would help to pinpoint those areas that best accommodate bear dispersal and highlight barriers in connectivity. This model shows that in order to create a robust network where bears can freely move between patches individually or across generations, the areas that require attention first are the linkage zones 1, 2, 6 and 7 (core to core area). Secondly, conserving and improving the corridors in zones 3, 4 and 5 would support the bear expansion to the south of Greece (Vermio and Olympus).

Comments on variables affecting brown bear dispersal

Possibly the two weakest points of every ecological modelling study are the lack of quality input data and information on the species life history and ecology (Almpanidou *et al.* 2014, Velez-Liendo *et al.* 2014). Regarding GIS data, detailed and homogenous spatial information is hard to obtain, especially when it comes to cross-country studies. Even though the CLC data (derived from a 25x25m Landsat-7 satellite imagery) is categorised into 44 different habitat types, a more detailed HSI model for a focal species with distinct preferences would require more detailed information on plant species and canopy cover. Additionally, very little information was obtained on how brown bears specifically use the topography of a landscape. These limitations might have led to inaccuracies in the suitable habitat patches and corridors.

Human-Bear Conflict

Wide-ranging foraging and breeding activities result in brown bears having large home ranges, often causing a variety of unfavourable human-bear interactions. It is expected that as human population increases, HBC will escalate, endangering bears across their range (Can *et al.* 2014). Therefore, it is very important for an HSI and corridor design to include areas of high risk for HBC. This study only included distance from urban areas in terms of possible HBC issues. Future modelling would benefit from information on the positions of farms, beehives and mountainous areas where livestock is taken to graze. This would help highlight the areas where HBC prevention measures could be taken and further evaluate the degree of HBC risk for the proposed corridors.

Home Range

The selection of the home range size for this study (150km^2) was done using a relatively low value for male bears (Kanellopoulos *et al.* 2006) but large enough for a female adult bear with cub(s) of the year (Mertzanis *et al.* 2005). Using three different home range groups; one for adult males (>150km^2), one for solitary females (<150km^2) and one for females with cubs (=150km^2), resulting in three different sets of patches and corridors may provide more nuanced results.

Finally, this model was designed for *U. a. arctos*, taking into account its spatial behaviour as studied in SW Europe. The classification scores and weighting of variables may differ between countries, as the spatial behaviour observed in the same bear species can vary greatly between populations (e.g. Kusak and Huber 1998, Kanellopoulos *et al.* 2006, Mertzanis *et al.* 2011). The brown bear is an umbrella species, with their large home ranges inhabited by many other animals. Although the conservation of bear habitat often benefits other smaller species, it is not necessarily the case that

the predicted corridors will aid the dispersal of other animals in the same way they could do for bears (Majka *et al.* 2013). A more holistic conservation project could attempt to create a number of HSIs for different species, project the different sets of corridors on a single map and highlight the overlapping corridors to reveal the habitat linkages between suitable areas.

Conclusions

The spatial model revealed a number of suitable patches and connecting corridors between brown bear habitats in Greece, the southern FYROM and south-western Bulgaria. Areas of recent recolonisation were found to be connected to two or three other patches, allowing the movement of bears between larger populations. This was a pilot study testing the function, advantages and disadvantages of using specialised software to map areas of suitable patches and habitat connectivity based on the spatial behaviour of a focal species in Greece. As a next step ground-truthing would be required to assess the function of the suggested areas as active corridors. Nevertheless, the potentially high degree of connectivity between suitable brown bear patches is a very encouraging find. In the face of habitat fragmentation, the future of brown bear conservation in Greece will rely greatly on the protection and expansion of wildlife corridors. If proven largely accurate, the use of this type of habitat modelling could aid the design of conservation management plans for brown bears and other umbrella species.

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THE PUBLIC PERCEPTION TOWARDS THE GREEN AREAS IN NICOSIA, CYPRUS AND THE SUSTAINABLE DEVELOPMENT OF LINEAR PARK OF PEDIEOS RIVER

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Abstract

At present, the need for creating outdoor green areas is unquestionable. Their value is shown through their use for recreation, sports, cultural and socioeconomic purposes, the ecology and especially biodiversity, which has always been considered as one of the most important factors in recent years, as well as in the future. With the creation of new parks and open green spaces, the legacy will be continued for the next generations, with designs that will be pleasantly utilized through the years.

In this study, we examined the way the largest urban green spaces in Nicosia affect and contribute to the lifestyle of the inhabitants of the city, as well as the reasons why the citizens of Cyprus embraced urban parks in their everyday life, making them so popular. With the G.I.S programwe create a space presentation of the urban linear park of Pedieos, where the area was mapped and the positive and negative elements of the park were analysed.

Keywords: *Urban green spaces, Nicosia, Cyprus, biodiversity, Linear Park of Pedieos*

Introduction

Over the years, many definitions and concepts were adopted regarding the urban outdoor spaces. Indicatively, some of them include "open spaces", "free spaces", and "green spaces". Nowadays, they have become integral parts of the urban fabric, as they shape the identity of the urban landscape, connecting the built environment and serve as moving passages. As for urban green spaces, their separation from the urban open spaces has been a controversial topic, particularly among environmentalists and urban planners (Lionatou 2008). At international level, the concept of urban greenery includes parks, small and large gardens managed by the state or by individuals, unstructured sites and other non-landscaped spaces where flora or fauna are found (Nicol C and Blake R 2007).

In the wider Mediterranean area, the concept of "urban green" is included in the communal space facility, without further separation. So, according to the General Building Code of 1985, public areas include all kinds of roads, squares, groves and all generally intended for sharing open spaces, as defined by the approved street plan of the town or have been shared with any other legal way. The urban green, therefore, is a city park located within or in direct contact with nature, and may be reformed by the urban population for recreation, education, sports etc.

Historical development of urban green spaces

The first appearance of public urban green spaces, in the way that is comprehended today, appeared in the early 19th century and was associated with the period of the industrial

revolution, when parks acquired a new role and used to maintain a form of nature in the heavy urban environment of industrial cities. So, urban green spaces, for the benefit of all residents, began to form and especially among the working class, which at that time suffered from unfavorable living conditions (Kosmaki P, Loukopoulos D 2007).

Up until the 19th century, buildings, roads and open spaces were treated as elements of the urban fabric that were not affected by the presence of greenery and that are why there is lack of measures regarding the urban greenery. The absence of organized greenery in public places, of course, were not conceived as something deficient that time, as the distance from the natural green spaces was very short (Lionatou 2008).

Then, in the late 19th to early 20th century the theory of public green space appears, according to which green spaces should be carefully designed and integrated in the fabric of the city, to evolve along with it, to be maintained by public funds and to reflect the cultural status, to meet the needs of citizens and create a pleasant environment that offers fresh air, a place to rest and be used as a recreation area for all citizens (GreenKeys Team 2008).

Two of the most influential movements that gave special importance to the existence and design of green space was the "City Beautiful" and "Kipoupoli". The "City Beautiful", which was firstly operated in the United States was intended to improve the living conditions of residents in degraded and unhealthy environment that existed in cities and was thus implemented in the early 20th century. More specifically, Chicago, based on Burnham's project would be redrawn and its connection to the suburbs would pass through major highways that were surrounded by urban parks and green spaces. The diagonal avenues would penetrate the urban grid and would also lead to a large green space area, whose center would accommodate the administrative services.

Generally, the role of green spaces were of primary importance in the design and site requirements (Komninos N, Karayiannis E 2002). In the model of "Kipoupoli" on the other hand, which was founded by Ebenezer Howard, the positive elements of a large urban center and the countryside were combined. "Kipoupoli" would have a maximum limit of 32,000 residents in population, who would live in an area of 1000 hectares. It would also be surrounded by a green zone, while functions such as farms would be sited to it and other functions such as hospitals would benefit from it (Komninos N and Karayiannis E 2002).

D. Arbor Networks and the effect of urban green network environment

A green network is a complex cluster of open green spaces, which are joined together by green paths, and includes both designed green spaces, and unplanned natural areas, regardless of size, location and use (Tzoulas K and James Ph 2010).

The integration of urban green spaces and their transformation into a network contributes long-term to maintain and protect native habitats in the urban web and emphasizes the essential presence of nature protection zones within the city (Tzoulas K and James Ph 2010).

The mere presence of urban green spaces in modern cities have diverse and multiple benefits for both the people and the environment. However, networkingthese areas can amplify the above benefits even more and further improve the quality of life in cities, improving the overall functioning of the urban system (Hough M 2004).

They even encourage cycling, public transport and walking, while improving the accessibility of green areas (Rodenburg Cet al. 2009). Also, the integration of green spaces through green paths contributes to paving and road separation and serves as a barrier of illegal parking of cars in the curbs of the pavements.

Regarding the environment, the ecological green networks connect natural ecosystems, facilitate the diffusion of flora and fauna in the city, and maintain and increase the biodiversity of plant and animal species.

Considering that most public spaces were designed in the past in order to meet the recreational needs of the time, their contribution to the leisure market is also evident. In modern times when leisure is more active, rather than a static form of entertainment, with action and movement including walking, cycling and exploration, the presence of a green tissue facilitates the implementation of those activities.

It also contributes to the people's mental and physical health, as it reduces state costs regarding their responsibility to restore public health and increases the productivity of the working population (Nicol C and Blake R 2007).

Finally, it creates new cultural attractions, recreational and commercial interest, promoting the development of economic activities throughout the city, thus enhancing the opening of new jobs. The green paths are also an increasing attraction for tourists as well (Levent T.B and Nijkamp P 2011).

The type of the green space, its size, degree of maintenance, its position in the urban fabric and other special factors are directly related to the benefits of each individual area. It is worth noting that in order to have positive benefits in an urban area, the green space should be large enough to accommodate an ecosystem (Nicol C and Blake R, 2007). However, in limited green areas this is not possible because the environmental benefits are only spotted at a regional level, whereas the effect of a green network is assessed globally, not regionally.

It could be further noted that the upgrading and expansion of urban green spaces in the context of creating a green network in an urban area leads, in the long run, to an increase in land values and housing, thus attracts business investment, not only in the designed urban area, but also in its neighboring areas (Lionatou 2008).

E. Functions of urban and suburban greens spaces - multiple benefits

It is of great importance to maintain and improve an urban environment, in a way that it can provide people with good quality of life, especially in densely - built cities.

Besides their important ecological benefits, urban and peri-urban green spaces can also offer significant economic and social benefits.

Materials and Methods

F. Study Area

Nicosia is positioned in the central part of Cyprus. It is the capital of the island and accommodates all government buildings and ministries, as well as the main employment center, cultural center, higher education and specialized services. It is the largest city in Cyprus, built in the middle of the central plain Mesaoria at an altitude of about 140 m. above sea level.

For many different reasons, Nicosia is a typical example of a divided city - split in halfwith precision by an international border that divides the island in two communities: the Greek Cypriot and the Turkish Cypriot. A look at the plan of the city presents the perfect circle of the city's historic center and the Buffer Zone, which was violently shattered it in the middle- a no man's land that negatively affects thisperfect geometry. This perfect circle is anenormous stone construction, three miles in perimeter, which includes eleven heart-shaped fortifications, surrounded by moat. These walls reflect the Renaissance military architecture since it was built by the Venetian leaders in 1567, theybuilt their everlasting walls around a living town, which existedeven before the Roman period. They demolished the presentedmedieval city walls and distant structures, and thenbuilt this new shell to protect and surround the existing town center. Interestingly, there seems to be some tension, in that case, in existence given that the outset of the walls between the container and the one contained within; that is, between the planned and the organic. Similarly, this tension is also reflected by the dynamics of remembering and forgetting in divided Nicosia (Bakshi2011).

However,the interruption that runs through its historic center is responsible and affects the development of the city's form by the physical alteration of its fabric. This division, which wasinitially instituted in 1958 with a wire fence called the Mason-Dixon Line, gelled in 1964, and became permanent with the Turkish invasion of the island in 1974. Since 1964, the United Nations havepreserved control over the Buffer Zone, which separates the island. The borders might have opened in 2003, but it was not until 2008 that Lokmaci Crossing openedin Ledras Street, and thus made it possible to cross the Buffer Zone in the walled city. The Buffer Zone has, surely, separated the walls, with five bastions looking north, five in the south, while there is one that has been included into the Buffer Zone. As shown in Figure 1, the form, spaces, uses, and populations of the old city have largely been defined by this operation of division. (Bakshi2011).

Figure 1. Nicosia's local plan, green public urban green spaces. The study took place at the Greek-Cypriot (south) side of the city of Nicosia and includes urban green spaces, which offer free entrance. These spaces are described below.

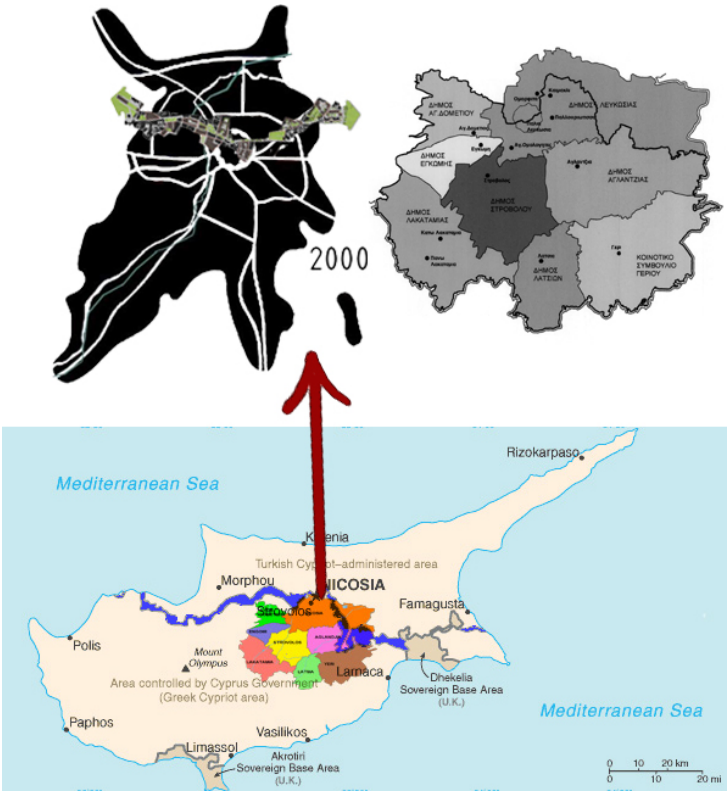


Table 1: Parks that are studied in Nicosia

No	Green areas of Nicosia	Area (ha)	Description
1	Athalassas Forest	840,2 ha	Peri Urban forest managed by the Forest service
2	Pedieos Linear Park	86 ha	Linear park 14 km length managed by the Municipality of Nicosia
3	Academia Forest	45 ha	Urban Park at the city center managed by Forest Service
4	Eleftheria Square	1 ha	Main Square at the city center (under construction) designed by Zaha Hadid office and managed by the Municipality
5	Acropolis Park	3.5 ha	Urban Park at Acropolis Area of Nicosia designed by Ioakeim and Loizas managed by the Municipality

G. Questionnaire Survey on Park Services and investigation of each area

The main purpose of the survey is to investigate and manage the existing urban green spaces in the Greek Cypriot side, to determine to what extent they contribute to lowering the temperature, particularly during the summer months, and whether there may be some improvement or even the opportunity to create new urban green spaces.

During the editing process of the questionnaire, a check was performed to find if similar work had been done in any green spaces within the city. After an extensive search of the existing bibliography,few relevant studies were identified, however, they were dealing with different issuesand not the urban green that is studies here.

Also, the questionnaire enables the study to explore the citizens' views regarding urban green spaces, as well as other various issues dealing with the condition of each park and the adequacy of their use.

The most important element of the research was to clearly define the problem under investigation for which the survey was asked to provide answers. The problem, then, is the study of the main and largest green areas of Nicosia though data collection by the residents and other visitors in the city's urban green spaces, from their creation until today. For the proper outcome of the research, appropriate literature and visual means were used, as well as personal contact with visitors, where necessary.

The method used was the quantitative research, using questionnaires from a total of 380 participants.

The selection of people who were interviewed was random, and included ages from 14 to 92 years old, at all levels of education, social and professional status.

Question Types: a) Open b) Closed c) Scales (e.g. rating, ranking, or agreement).

The results of the questionnaires were processed using the SPSS Statistics program and then tables were created using Windows Microsoft Excel.

All subsequent stages of the investigation should have always taken into account the wider context in which the investigation wasfocused on, and the particular issue under assessmentto notbe diverted from the study's original objectives, but to drive reasonably and scientifically acceptable results / conclusions.

H. G.I.S. research

Using the G.I.S program, the study has mapped the public urban spaces in Nicosia urban green areas and gathered important information, such as the acreage, so that it can draw more accurate and qualitative results. Then each region was mapped and analyzed so that they could be then separately analyzed in terms of their spatial data. Lastly, maps and other diagrams were printed in order to extract accurate results.

The total acreage of the Nicosia free-zone area reaches 2719 ha, while the total acreage of green spaces is 976, 7 ha.

Results

Survey results

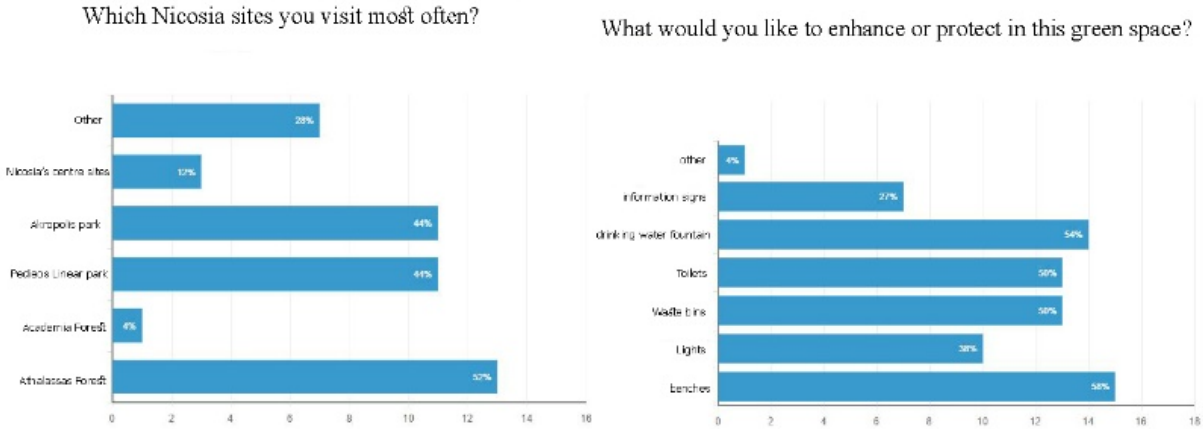
The results drawn from the questionnaires reflect an equal division of opinions. While the green areas of Nicosia are considered as satisfactory to very satisfactory, most people who were surveyed believe that a future upgrade of these sites would immensely contribute to the development of their sustainability, resulting to more people visiting the public urban parks in Nicosia on a daily basis.

In Cyprus, the design of urban public parks is prepared with the assistance of experienced professionals and aims to improve the image of the space aesthetics. Each municipality is separately required to contribute at times to the maintenance and improvement of the site.

A significant percentage of the citizens in Nicosia spend their free time in the public urban spaces of the city. Observing the design of urban public parks and how the planting is distributed therein, we can draw the conclusion that these spaces, which were designed and kept in good condition until today, serve the purpose for which they are created, that is, to keep every citizen engaged.

In most public urban parks of Nicosiaplanting is naturally distributed, so that the city would seem like a forest landscape and not a place covered in concrete and aluminum. What it is observed is a design whose primary concern is not to enhance recreation of the visitors, but to improve their interaction with nature and to make these visitors further respect the environment.

Figure2. "Which Nicosia sites do you visit more often?" and "What would you like to improve or protect in the green space?"



Improvement measures in Pedieos Linear Park

Both PedieosRiver and Athalassa Park belong to the most important sources of greenery in Nicosia.Pedieos is the longest river in Cyprus with an area covering 98 km. The source is located at Troodos mountain, near the monastery of Machairas. It flows northwest, crossing the plain of Mesaoria and the capital of Nicosia. It then proceeds to the east, and finally reaches Famagusta Bay, near the ancient city of Salamis.

Plans for the linear park were prepared by the Department of Planning and Housing and the environment and the geological singularity of the river were taken into serious consideration. The materials used for the construction of the Linear Park are environmentally friendly, such as stone and wood. Stone bridges were built for the most part, so that the level of the river not to hinder the people's path during the winter months.

A pedestrian and bicycle path were formed on the river bank and hundreds of bulbs were placed along the promenade in order to provide safety during the evening hours.

The Linear Park of Pedieos was created in 2002 and provides a pedestrian length of 14 km., which extends mainly to the municipalities of Lakatamia, Strovolos and Nicosia. Apart from that, the park offers bicycle paths, walkways etc.

It is significant for the walker to be able to connect with the surroundings of the riverbed plan area of the park, so the first and most important operation within the Linear Park is the removal of planting within the riverbed, since it might outweigh the riverbed, which results to a limited visual contact between the river and the Linear Park.

Another important disadvantage of the park is the lack of rest areas, which makes the stroll a merely faint line that only serves for walking in the pedestrian and bicycle path. For this reason, more rest spaces should be added in ways that arecompletely harmonized with the surroundings.

The Urban Park of Pedieos riverbed is considered as one of the most expensive projects annuallyby the municipalities, because of the money spent on lighting and maintenance of the space. An easy and practical way to discharge lightingis,for example, the use of solar energy by adding photovoltaic panels, so as to exploit solar energy that would produce light where needed. Also, electricity would be channelled to the various resting areas that would be created in the space, which would make the Linear Park next to the riverbed area to be considered as a bio climatically designed green park, which is aligned to the surrounding regions of the city.

In conclusion, it can be said that the park needs just a few improvements and not to be redesigned. A thorough cleaning of the riverbed is needed, mostly for the aesthetics.

What is initially needed is to place signs that would explain the pathway to the visitors and add more information signs throughout the path,which would provide more details regarding various things related to the park, such as planting, some historical inscriptions or simply give descriptions of the surrounding nature.

The park needs annually a sufficient amount of electricity in order to meet the needs in its entirety. Our proposal is the installation of a series of photovoltaic panels, which will derive solar energy thatwill be transformed to electricity in order to cover the needs of the linear park. In this way, municipalities will not be charged with unnecessary costs and the park maintenance will be scheduled more regularly and more successfully.

Kiosks, which would be installed in the environment should be built in many spots of the park to serve as resting areas and would offer a variety of uses to the public.

Finally, the linear park needs further improvement along the city hall of Strovolos area, so that the buildings would coexist with the surrounding space of the park in a way that would not disrupt the balance of the whole area.

Discussion-Conclusion

Despite the significant progress made in recent years regarding the creation of public green spaces in all sub-urban areas, the need to increase the resources available from the public sector to shape, equipment, management and maintenance of public green spaces is highlighted. Resources must be allocated in priority to the provision and upgrading of basic elements of each space, rather than costly landscaping of limited number of public green spaces. Moreover, it is clear that while there is considerable potential in terms of available space, there is still considerable room to accelerate and expand the project execution plans.

Likewise, visitors were reported to prefer linear parks for their physical activities such as cycling, jogging and fast walking (Brown et al.2014). Evidence taken by 25 studies as a part of a meta-analysis, showed how beneficial to health is the ability to jog or walk in a natural environment rather than a synthetic one; people showed less signs ofanger,sadness or tiredness (Bowler et al. 2010). Although proximity was not a part of the choices in the closed-ended question, 9% of the people addedthis under the section of 'other reasons for visiting the park'. As Kaczynski and Henderson (2007) emphasize, proximity to parks is normallyconnectedto increased levels of physical activity while Rantzoudi and Georgi (2017) concluded that the shade factor of urban trees is a significant issue for the bioclimatic improvement and energy savings at Mediterranean city scale that should be taken into consideration by city planners, designers, landscape architects, and architects.

It is worth noting that a research project has been recently commenced for the improvement of the Linear Park of Pedieos area by Lakatamia, Strovolos and Engomi municipalities. Specifically, thiscollaborative project is part of a broader intervention of a total area of 14.7 km. The study area begins from the start of the Linear Park to Strovolos Town Hall. It provides an analysis of planting, the current situation and partial presentation of the problems, which arose during the collection of questionnaires about the area and the views

of the citizens. Therefore, the planting scheme of the area with local species will contribute to the improvement of the microclimate of the city (Georgi G.N and Dimitriou D 2009).

As it is clearly apparent from the results of the questionnaires in the present study, there is an equal distribution of people's opinions. While the green areas of Nicosia are labelled as satisfactory to very satisfactory, most people that were asked believe that a future upgrade of these sites will hugely contribute to the development of their sustainability, thus the public urban Nicosia parks would attract more visitors daily.

The largest collection of questionnaires (more gained with personal contact) was gathered in the urban Linear Park of the riverbed plan area in Pedieos. It was definitely an easier and safer area for intervention and improvement of some problems that exist in the area.

While using the park, it is necessary for the walker to have connection with the surroundings of the riverbed plan area, so the first and most important intervention in the Linear Park has to be the removal of plants inside the riverbed, since it is quite unpleasant and outweighs the riverbed, thereby reducing contact between the river and the Linear Park.

Another important area in which the park needs improvement is the lack of restingareas, which makes the stroll a merely faint line that only serves for walking in the pedestrian and bicycle path. For this reason, municipalities should add more resting points, which should be completely harmonized with the surroundings.

The Urban Park of Pedieos riverbed is considered by the municipalities as one of the most expensive projects in annually, because of the money spent on lighting and maintenance of the space. An easy and practical way to discharge lighting is the use of photovoltaic panels which will utilize solar energy to produce light where needed. Also, electricity would be channelled to the various resting areas that would be created in the space, which would make the Linear Park of the riverbed area to be considered as a bioclimatically designed green park, which is aligned to the surrounding regions of the city.

In conclusion, it can be said that the park needs just a few improvements and not to be redesigned. A thorough cleaning of the riverbed is needed, mostly for the aesthetics.

What is initially needed is to place signs that would explain the pathway to the visitors and provide some other signs presented throughout the walk path which would provide descriptions of the planting, information about some historical inscriptions or simply give details regarding the surrounding nature.

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A NEW MODEL OF PROXIMITY AGRICULTURE AND CIRCULAR ECONOMY

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Abstract

In everyterritory, food systems are called to satisfy global instances and contribute to the implementation of a "Territorial Sustainability Paradigm" (TSP), based on the following pillars: a "quality system approach"and a"non homologation strategy".

This latter element of the TSP becomesfundamental for the sustainable competitive positioning of territorieswhen based on new production processes capable of internalizing the costs of scarcity and on new marketing strategies that are able to recognize the value ofthis new model of proximity agriculture.

Starting from these considerations, the paper aimsat investigatingwhethera stakeholder approach based on a shiftfrom a linear economy to a circular economy can be consideredcapable of giving strength to this new model of proximity agriculture.

Keywords:*circular economy, proximity agriculture, territorial sustainability paradigm, food system, non omologation strategy.*

Introduction

Globalization, climate change and international conflicts are the three fundamental determinants of the evolutionary dynamics of today's society. The combination of these three closely interconnected forcesis increasingly threatening to escape the control of multilateral institutions and of the governments of countries that are historically responsible for such dynamics. Desertification, structural changes in economic and social systems across the world, accentuation of inequalities, rising youth unemployment, migration and environmental degradation are some of the major factorsdue to whichterritories risk being "crushed" in the absenceof global governance and an effective, efficient, ethical and fair endogenous response strategy.

This creates the need for all economic systems to define a "sustainable wellbeing project" which, although there are no global responses to the above-mentioned emergencies, can, by way of example, cope with mitigation or adaptation strategies. This means that territorial systems must be able to independently search for a new "Territorial Sustainability Paradigm" (TSP) that sees all stakeholders involved through the adoption of new behavioral patterns.

Due to its strong, and now widely recognized,connectionswith the various aspects of territorial well-being (health, environment, identity, etc.), agriculture is called upon to contribute to the implementation of the TSP.

In the light of these considerations, this paper proposes a focus on "proximity agriculture", wherethe latter is taken asa central element that necessarily needs to be given a completely new meaning and is in line with a new model of local development.

To this end, the transition from an economic paradigm focused on the linear Economy to one based on the Circular Economy, if implementedby all stakeholders in the agricultural system, can be an important and no longer postponable answer.

Materials and Methods

In the current socio-political and institutional scenario, a new notion of agriculture has emerged, increasingly rooted in the territory. When projected in global markets, itincreasingly attempts at recovering competitive margins throughtime and space, in other words it seeks a sustainable competitive path (Cesaretti et al. 2014). At the same time, market boundaries lose meaning when the ultimate goal of agricultural products has to be re-centered on the well-being of a person, a community, a territory and, above all,on its sustainability. This is all the more true since the adoption of the 2030 Agenda for Sustainable Development (the Action Plan for People, the Planet and Prosperity signed in September 2015 by governments of the 193 UN member states), which clearlysanctionsthe relevance of agriculture in relation to each dimension of human life.

This agriculture is growing closer to thecities, that arecalling forinnovative ideas tosatisfy consumer demands for products to befresh, safe and healthy. Yet this agriculture alsohas a new task to accomplish: that ofbeingconsistent with its functions by establishing itself as the main engine for the relaunch of a territory. In fact, the unmanufactured component of agriculture is inextricably linked to the distinctive features of a territory that for example confer a particular taste to wine or a particular flavor to vegetables. We could say that if the *humus* of agriculture is its territory, then the responsibility of agriculture to be consistent withits functionsis a responsibility of its territory (Misso et al., 2015).

In this framework, it is therefore necessary to re-think the role of the territories as well asthe consequent responsibility of the relevant stakeholders to implement increasingly "appropriate" strategies for the sustainability of well-being (Cesaretti et al. 2013; Misso et al., 2013; 2017).

In this context, it is useful to enquire into the pillars of a “Territorial Sustainability Paradigm” (TSP), which are able to give concrete meaning to the objective of territorial sustainability.

In this regard, examining the "not homologated" component of the well-known "proximity agriculture", two elements capable of ensuring the implementation of a TSP need to be leveraged:

- a non-homologation strategy;
- the quality system approach.

More specifically, one ought to define the ways in which a strategy of "non-homologation" of the Asset "Proximity Agriculture System" should be supported by:

- production models based on the "Quality System Approach", namely on internalization of the cost of scarcityby the producers concerned, and on new territorial marketing strategies capable of recognizing the "economic, environmental and social value of the new production model;
- new consumption models (De AngelisandKononova2015) capable of creating a stronger "proximity market";
- a local knowledge system capable of forming human capital (citizens and professionalism) consistent with that strategy (Viola, I.,2017);
- a system of non-profit organizations capable of integrating the requirements of protecting the quantity and quality (of the conditions) of the local factors (environmental, natural, cultural and landscaping fields) with a strategy that can transform the environmental wealth factors in drivers for sustainable development.

Indeed, the characterization of this approach requiresa new economic model, the circular one. In this respect, the circular economy has become the predominant paradigm to overcome existing production and consumption models based on constant growth and increases in resource amounts. Circular economy aims at increasing the competence of resource usage to reach an equilibrium and synchronization between theeconomy, the environment and society (Andersen, 2007; Murray et al. 2017; Schulte, 2013; Witjes and Lozano, 2016). .

In the light of this, we can state that the shiftfrom the linear to the circular paradigm is crucial to the implementation ofa new model of proximity agriculture based on three key elements:

1. the strengthening of the “non-homologated”component of agriculture, i.e.: the enhancement of the distinctive features of agricultural products in a territory, only carriers of a multiplier effect on the territory and its different dimensions of well-being;

2. the consolidation of the social function of agriculture;

3. the recognition ofthe fundamentalrole of agriculture in generating positive environmental externalities.

Results

The main purpose of the paper was to highlight the motivations that should push local stakeholders to adopt a new proximity agriculture model leveraging on the non-homologated component of proximity agriculture. This is because the latter allows both to internalize the costs of scarcity and to fuel new formulas and strategic forms of territorial enhancement.

From the achievement of the aforementioned objective, some very important reflections have emerged that characterize the functions and characters of what the new model of proximity agriculture should be, compared to the classic one.

More specifically, the affirmation of proximity agriculture has occurreddue to its ability to secure certain conditions such as:

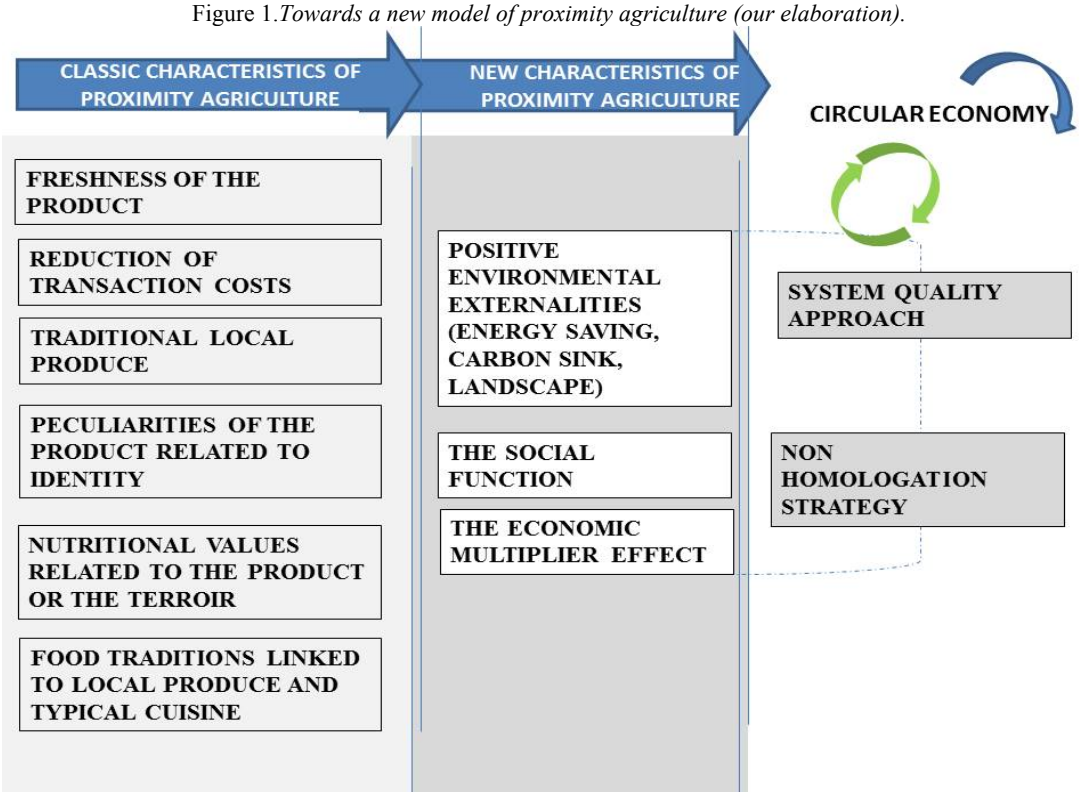
- freshness of the product;
- reduction in transaction costs;
- food traditions linked to local produce and typical cuisine;
- traditional local products;
- peculiarities of the product related to identity (terroir-craftsmanship);
- nutritional values related to the product or the terroir.

The new model of agriculture, however, includes new elements that make it possible to implement a TSP, namely:

1. the economic multiplier effect;
2. the social function;
3. positive environmental externalities (energy saving, carbon sink, landscape)

These can be precisely defined as the three characters of the new proximity agriculture model.

Figure 1.*Towards a new model of proximity agriculture (our elaboration).*



Discussion-Conclusions

The transition to a new proximity agriculture necessarily requires an integrated stakeholder approach to circular economy. In fact, the latter alone possesses the intrinsic value elements that ensure lasting

prosperity over time and space, stimulating agriculture to become the testing ground for the necessary strategic actions.

Future debate, in particular, will have to cover the elements and the social actors called upon to deliverconcrete answers so as todetermine a cultural change in the approach to agriculture itself.
Agriculture and proximity, in fact, must not be understood as an agriculture that chases the demands of society and consumers or an agriculture that chases the city, but rather as a synonym for a "city that chases agriculture", with a greater interest of the territories (also those with a strong urban connotation) to welcome the countryside into the city along with all the externalities and benefits that it can determine for its population.

This change in the cultural approach to agriculture will be determined by the simultaneoustransition from the notion of “proximity agriculture” to one of “proximity to agriculture”.

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RADIO FREQUENCY IDENTIFICATION: CURRENT STATE OF THE ART AND CHALLENGES FOR IMPLEMENTATION IN WOOD SUPPLY CHAINS

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Abstract

The traceability ofwood products is very important towood supply chains. The successful implementation of chain of custody procedures is difficult due to the complex nature of the forestry sector. Radio Frequency Identification is a promising technology, under close examination during the last decades, on the ways it can improve wood traceability. In this paper, the basics of RFID technology are described, as well its current state of the art. The main challenges for its full implementation in wood supply chains are discussed, which fall into two categories, the technical problems and the increased cost. Technological developments and focused future research efforts can help overcome the present inadequacies of RFID technology, expand its usage in wood supply chains, and increase their operational efficiency.

Keywords: *Forest operations, traceability, forest products, logistics, optimization.*

Introduction

In a forestry context, the "wood supply chain" may be regarded as a series of handling and processing stages that begin with standing trees in the forest and end with final wood products(Dykstra et al., 2002). Wood supply chains can be very complicated, as in most cases, a large number of assortments can be produced in the same harvested area, while later on, a large number of forest products from various origins can be transported to the same intermediate or final user(Dykstra et al., 2003). Hence, in order to have a good control of what is really happening in a wood supply chain it is imperative that the respective "chain of custody" is well–known. More specifically, the term "chain of custody" refers to the custodial sequence that occurs as ownership or control of the wood supply is transferred from one custodian to another along the supply chain (Gilani et al., 2016, Dykstra et al., 2002). It comprises a set of technologies, procedures, and documents that are used to provide information useful for managing the wood supply chain.

A valuable tool used in the identification of forest products is marking. Various log identification methods have been used in forestry (Chiorescu and Grönlund, 2004). The most commonly used marking methods are punching, as well as marking logs with paint and barcodes. Technological developments have permitted the emergence of new technologies such as QR Codes, DNA fingerprinting methods to verify the origin of wood, microwave sensor, Radio Frequency Identification (RFID) (Tzoulis et al., 2014, Tzoulis and Andreopoulou, 2013). While most of them are still in experimental state, research efforts with promising results have been made for the implementation of RFID in forestry in the last 20 years.

The paper analyzes the complexity of wood supply chains and the importance of reliable traceability systems in them. It also describes the RFID technology and recent implementations of this technology in the forest sector. Finally, it describes the challenges for a wider adoption of RFID in forestry and suggests topics demanding further improvements.

Traceability in wood supply chains

Forest operations result in the production of a large number of wood assortments ranging from large-dimensioned logs to energy wood originating from small branches or even parts the root system of the harvested trees. Three basic wood supply chains can be identified: High grade timber, industrial timber, and energy wood (Erhardt et al., 2010)(Figure 1).These three different supply chains focus on wood biomass of very different dimensions, which suggest the usage of different handling methods, equipment and processing installations.

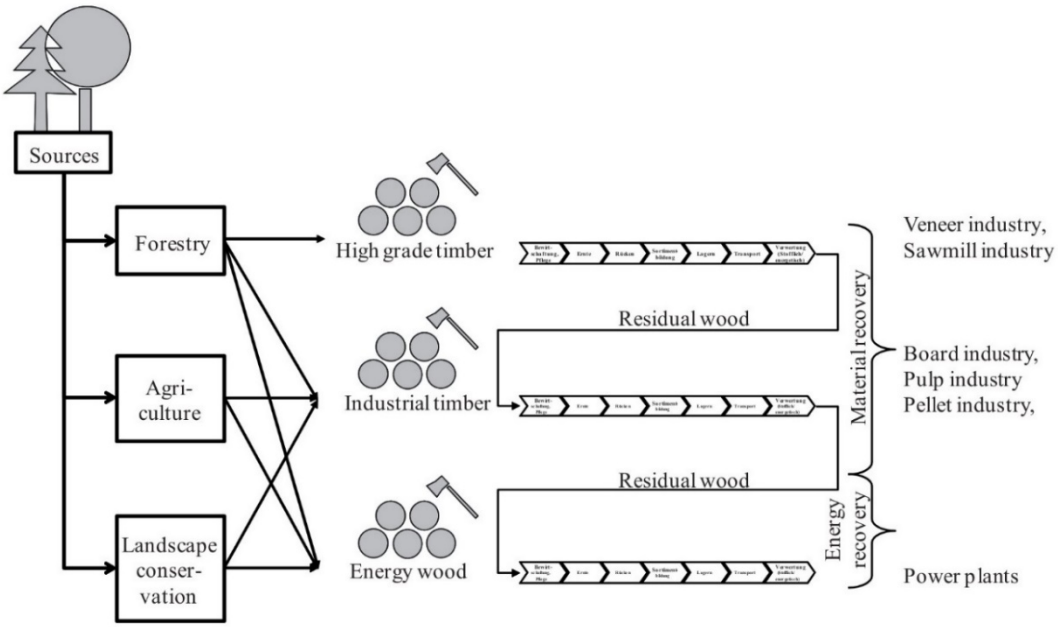

Figure 1.*Basic wood supply chains (Ehrhardt et al. 2009)*

The above described basic supply chains refer to the generic forms of woody biomass procurement from a logistics point of view. However, realistic supply chains are more complicated as shown in Figure 2. Given that wood products are transported in large volumes and from various locations to a large number of intermediate and final users, organizing and maintaining an efficient chain of custody is a very difficult and costly task(Dykstra et al., 2002, Sperandio et al., 2017, Chiorescu and Grönlund, 2004). Nevertheless, the advantages of a well-designed chain of custody system are very important, the manager of a wood supply chain (or of any link in that chain) should be able to determine where the wood supply is coming from, where it is at any point in time, where it is intended to go, and when it is scheduled to arrive there. This knowledge is of special interest, given the complex nature of wood supply chains, where a large number of products is delivered to various interested parties. Information on species, volumes, and quality grades is also necessary, so that the manager should be able to trace the wood back to its origin so, or even to the forest management of the specific area of origin.

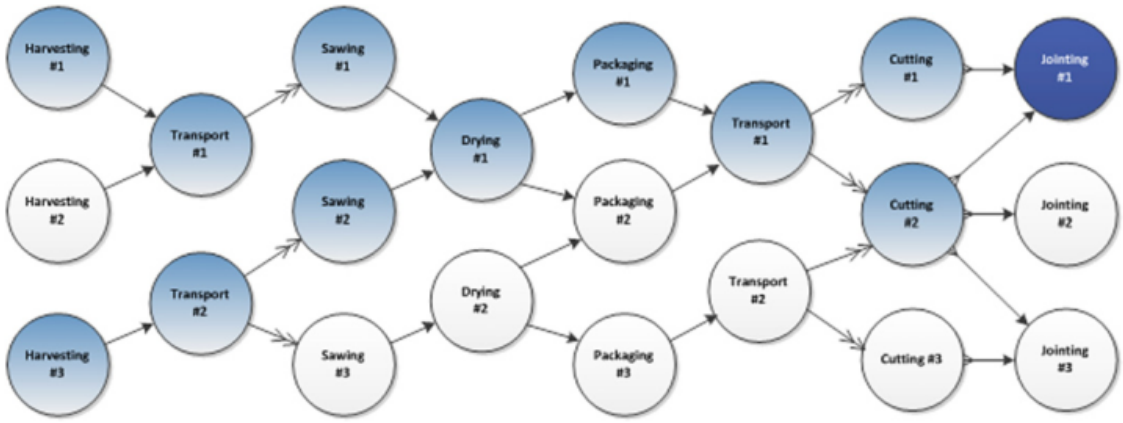

Figure 2. *Complexity of wood supply chains*

Nussbaum (2002) described the main principles of identification,segregation, and documentation that are necessary for any system designed to monitor the chain of custody of logs. According to these principles in order to set up an efficient traceability system:

- The logs must be *identified* using some type of labelling technology.
- At any point along the supply chain when logs from a known source could potentially become mixed with logsfrom unknown sources, the logs should be *segregated* and handled or processed separately.
- Labels affixed to the logs must be keyed to *documentation* so that information on species, volume, quality, and other attributes is available to managers of the supply chain.

Effort has been made and that the above-mentioned principles have been implemented in log supply systems since many decades. Thus, the high grade timber process chain is highly individualized, due to its high monetary value. Every single log is recorded and marked with its dimensions and qualitycharacteristics(Murphy and Cown, 2015). On the contrary, the smaller dimensions of the industrial timber make it suitable for other uses, of lower monetary value compared to high grade logs, such as mechanical or chemicalpulping and subsequent process into pulp, pellets or more complex products such as composite wood panels. The procurement of industrial timber differs in many aspects; it is sold in large quantities of pre-arranged cordwood (typical length of one ortwo meters), where individual marking would be out of the question. Information is usually gathered from truck loads arriving at a mill and it is later on used for delivery, inspection, and invoicing purposes. Marking is least advanced in the energy wood process chain because thebiomass structures impede attachment and feasibility(Erhardt et al., 2010). It is quite common that the origin of energy wood is largely unknown.

The forest industry operates on a global market where effectiveness in all parts of the wood supply chain is crucial to stay competitive (Erlandsson, 2013, Björk et al., 2011). Still, efficiency gaps are detectable even in technologically advancedcountries. It is estimated that wood raw material worth of approximately 5 billion € is wasted annually in Europe.The major reason for this is that the raw material is not used in the most efficient way as informationneeded regarding the wood raw material is not available throughout the supply chain. Nevertheless, an automatictraceability system makes it possible a) to utilize raw material information efficiently throughout theforestry-wood production chain b) to maximize the raw material yield, and c) to optimize and to monitor the environmental impact, by linking the relevant information to the traced objects (Björk et al., 2011). Wood traceability can bring direct financial benefits to the forest industry because of the information it provide to the

managers, both at the forest and factory level. The financial benefits can be in the forms of quality management and safety, besides that of financial control.

Chain of custody systems can be used to expose log theft and prevent "log laundering" i.e. mixing illegally harvested wood with others of legal origin. Thus, chain of custody systems can be essential components of any effort to reduce illegal logging, currently recognized as a major concern among all countries worldwide. Fighting illegal logging and illegal trade is very difficult and has important and adverse environmental, economic and societal impacts (Athanasiadis et al., 2013). Illegal logging world-wide has a total value in the area of 100bn € (Neslen, 2015).

Modern consumers care more for the environmental impact of wood products than in the past. Various eco-labels have been introduced in order to consumers' mistrust, however there is some skepticism whether these eco-labels truly deliver their purpose. On the contrary, there is evidence that wood products consumers find it easier to believe information based on traceability systems (Appelhanz et al., 2016). When consumers come across information, which they value as ethical (e.g. wooden products coming from certified forests), their trust in the respective products is increased as well as their willingness to purchase them. Thus, traceability in wood supply chains seems to have the potential to be used as a marketing tool by capturing, processing, and provision of product information (Appelhanz et al., 2016, Tzoulis and Andreopoulou, 2013).

Significant changes can be evidenced even among the wood supply chains of neighboring countries and should be taken into consideration. The wood supply chains in Sweden are more efficient than the respective ones in Germany, where more intermediate actors are involved. This, from a traceability point of view, suggests a more difficult and challenging environment (Erhardt et al., 2010). Another example comes from the Mediterranean, more specifically Italy and Greece, two countries which use more than 70% of the annual produced forest products for energy purposes, most notably firewood (Tsioras, 2015). In Greece all harvesting operations are carried out motor-manually and wood processing into firewood brickets is done with older machinery. On the contrary, in Italy modern harvesting and processing equipment is used allowing for higher productivity rates and lower production cost.

RFID Technology and its usage in forest operations

RFID technology enables the control, detection and tracking of items electronically using radio transmission (Häkli et al., 2013). More specifically, a RFID system consists of a reader and a transponder. The transponder consists of an antenna and an integrated circuit (microchip), which contains all the information we have stored in it (such as unique ID number for this product) (Häkli et al., 2013), protected in a tag which can be affixed to or embedded into a product (Tzoulis and Andreopoulou, 2013). When the reader and the transponder are in close proximity, the reader emits a radio signal, which is received by the transponder and sent back to the reader. The information sent to the reader enables the identification of the object/product.

There are two types of RFID tag: active and passive. Active transponders include a battery, whereas passive transponders obtain their energy from a radiofrequency signal sent from the interrogation unit or reader. The identification capability of the battery-free transponder lasts for the lifetime of the product or system in which it is located. For this reason, recently passive RFID technology based on the same general principle has found numerous applications in marking and identifying objects in diverse industries, for example in logistics, in access control and in anti-theft devices (Figure 3)(Zhu et al., 2012). Various types of RFIDs have been developed satisfying the special needs of the different production sectors and markets. The RFID market is growing fast and in 2016 had a monetary value of 12.03bn $ which is expected to grow at 47 bn US$ by 2017. The growth of Internet of Things is expected to have a profound impact on the further growth of the RFID market.

Figure 3. *Examples of various RFID implementations*

One important characteristic of RFID-based tags is that they do not require line of sight between the transponder and the reader (RFID antenna), overcoming the limitations of other automatic identification approaches, such as barcoding, which are widely used in the forestry/wood industry (Chiorescu 2002). Thus, RFID systems work effectively in the hostile environments such as in forestry and sawmills, where excessive dirt, dust, moisture and poor visibility would normally hinder rapid identification. Another important characteristic is speed, with response times less than 100 ms, in most cases. Once the reader and transponders are set correctly the identification can run from this point on without the need for more personnel responsible for the manual scanning of the products, saving significant costs to the companies (Chiorescu and Grönlund, 2004).

Wood products traceability must take into consideration the two distinct methods the harvesting operations are carried out, motor-manually and highly mechanized. In the first case, the attachment of the RFID tag is done by means of a specially designed axe, hammer or tagging stapler (Figure 4) and must be easy to operate (Häkli et al., 2010). In highly mechanized harvesting, a tagging device is attached on the harvester head (Figure 5). This is the optimum position for tagging the logs, since even small delays during this highly automated process may have a large impact on the forest operations' efficiency.

Figure 4. Manual attachment of RFID tags on the log end

Figure 5. Harvester head with a RFID tagging device (Korten and Kaul, 2008)

A complete RFID system in forestry is expected to have the following IT architectural elements:

- Data generators (measuring devices), e.g. harvester, log/board scanner,
- Marking/reading information devices, e.g. RFID tag, barcode, printed code,
- Central and local databases for storing information, and
- Software for processing, analysis, and simulations

Using RFDI under the harsh conditions of the wood supply chains sets as a precondition good readability and long reading range. Initially, the use of commercially available RFID transponders in the marking of trees has been experimented (Mohamed et al., 2009). The conclusion derived from these trials was that the commercial transponders were not very well suited for large scale tree or log marking as they were not designed for this purpose (Björk et al., 2011), suggesting the need for new designs with improved characteristics. Readability rates of 99% are the acceptance threshold (Haekli 2013) but such results have been reported only for relatively small-scale studies. Under real conditions readability rates are in the range of 95%, which, althouth high, entails a large error potential for the forest industry. This suggests that more research is necessary on this topic. Furthemore, the reading range is affected by the frequencyrange used (Finkenzeller, 2003). Low frequency (LF / e.g. 125 kHz

transponder) has a reading range of a few centimeters to one meter, high frequency (HF / e.g. 13,56 MHz transponder) may reach 1,5 meters and ultra-high frequencies (UHF / e.g. 868 MHz transponder) may reach several meters (Korten and Kaul, 2008). On the other hand LF transponders are relatively resistant to metals and liquids, HF transponders are strongly influenced by metal environments and UHF transponders are strongly influenced by both liquids and metals in their proximity (Korten and Kaul, 2008, Picchi et al., 2015). Thus, the choice of RFID type should be done after considerations of the working environment and only on the basis of a single performance factor.

Another precondition is that RFID tags have a high survival rate and arrive intact first at the landing site and then to the processing facility (e.g. sawmill). The results of current studies are very positive with survival rates in the range of 91% - 98%, depending on the type of equipment and harvesting methods used (Picchi et al., 2015). Innovative materials can also be used that offer the combination of good protection to the transponders and are also pulping compatible and biodegradeable, posing little danger to the expensive factory equipment (Häkli et al., 2010).

Production cost is of paramount importance to the forest sector. Adopting RFID technology is an extra cost which should be well justified. This cost is a big capital investment for small- and medium- sized companies and a cost-increasing agent for large companies. Gjerdrum (2009) estimated that the annual cost for a sawmill utilizing RFID technology would be US$60.000–US$450.000 depending on mill size. For this reason, RFID currently is used almost exclusively in high-value products (e.g. utility poles).

A recent study in Calabria (Sperandio et al., 2017) showed that the combination of RFID technology and open source technologies for wood traceability led to an increase in timber price by 8% under the worst scenarios (average market prices for timber ranging 80-120 € / m^3). However, this increase can be economically sustainable, as 40% of private companies stated their willingness to pay a premium price (on average 3,25% higher) for purchasing certified local wood products. Moreover, it is expected that the price, power and availability of RFID will improve rapidly in the future(Bhattacharyya et al., 2010).

Furthermore, there is ongoing research work showing successful in situ applications where the RFID tags are used for the non-destructive interrogation of wood properties, e.g. for diameter sensing (Tetuko et al., 2000) moisture content sensing (Kamaguchi et al., 2001) or chemical composition sensing (Chiorescu and Grönlund, 2004, Tetuko et al., 2000). Positive results from such research efforts can further justify the expansion of RFID technology in the forest sector.

Conclusions

The RFID technology is a very promising method, mainly for log marking, at this moment. The readability in the real-life tests and demonstrations is very high (95%), given the handling large quantities of wood in a difficult environment, but still lags behind the industry standards target of 99%. For this reason, research efforts must continue in order to a) improve the current weaknesses of this traceability technology and b) explore its enhanced implementation potential in the context of the Internet of Things.

Apart from the technical performance, RFID represents a sophisticated technology that could lead to more efficient use of the forest resources and simplify wood procurement operations. Cost is a serious consideration, which currently is a big capital investment for small- and medium- sized companies and a cost-increasing agent for large companies. However, technological developments are expected to increase the readability and drop the costs in the future. This fact, accompanied by the promising results of studies, that consumers are willing to pay more for certified wood may open the way for broader usage, both quantitatively, as well as in terms of more wood product categories (e.g. energy wood) of RFID technology in the wood supply chains.

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PROMOTING GREEN SPECIES IN URBAN CLIMATE: A MULTIPLE CRITERIA DECISION ANALYSIS FOR THESSALONIKI, GREECE

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Abstract

Urban green is vital for improving urban climate's status, especially for densely populated and air polluted urban conurbations. This paper presents a decision-making scheme for benchmarking, selecting and promoting species of green in urban areas. The methodological framework is based on Multi-Criteria Decision Analysis for prioritizing available options applicable to an urban area. In contrast to most real-life cases based only on selection criteria such as cost or aesthetics, decision-makers can use the proposed approach to account simultaneously more criteria such as life span, required growth space, aesthetics, tolerance, pollution attenuation, adaptation to local climate, cost, and potential allergenicity of species. Although there are still gaps of knowledge and uncertainties, especially in the quantification of the green species effectiveness in reducing air pollution concentrations, the proposed approach provides a roadmap for decision-makers to put forward green urban policies in an organized manner.

Keywords: *Decision-support, green species, urban climate, ELECTRE III, Air pollution*

Introduction

The quality of urban climate plays an important role in urban sustainability and has become a major challenge for environmental managers and public authorities around the globe. Urban areas are characterized by high levels of both population density and air pollution, which adversely affect environmental quality, with profound negative effects on human health and well-being. A consensus among public health experts reveals that air pollution, even at current ambient levels, aggravates morbidity (especially respiratory and cardiovascular diseases) and leads to premature mortality (e.g. Curtis et al. 2006, Kassomenos et al. 2011, Pope et al. 2011). In addition, urban air pollution is the source of problems such as accelerated corrosion and deterioration of materials, damage to historical monuments and buildings and damage to agricultural crops around the city (Vlachokostas et al. 2010).

Green species eliminate air pollutants through dry deposition. Gaseous pollutants are absorbed through stomata during photosynthesis and respiration, whereas particulate matter is transported to leaf surfaces by gravity sedimentation or impaction (Yin et al. 2011). Various studies have investigated the removal rate and resuspension of particulate matter. According to McDonald et al. (2007) an increase of green species from 3.6% to 8% in Glasgow, resulted in a reduction of 2% in PM_{10} concentration. Urban canopies in Greater London Area are estimated to reduce PM_{10} concentrations by 0.7% to 1.4% (Tallis et al. 2011). In addition, urban vegetation contributes to noise abatement, as well as to aesthetic appeal of an urban environment. Street trees and urban vegetation can reduce air conditioning loads by shading buildings and lowering air temperatures, which enhances energy saving potential and cooling effect (e.g. Leuzinger et al., 2010). Furthermore, urban vegetation contributes to stormwater reduction, since tree crowns have the ability to store water. On the other hand, urban vegetation can also affect air quality negatively, by causing allergenic effects and by emitting volatile organic compounds (Setälä et al. 2013).

There are a number of other factors which may affect the urban planners' decisions on which species of trees should be planted in urban environments, climate conditions of the area, conditions in paved sites, life span, growth (rate, potential and crown density), root quality, resistance to diseases, drought tolerance, pesticide susceptibility, resistance to limb breakage, foliage, plant and maintenance cost, water requirements, aesthetic appeal, required surface area for planting, shading, potential to cause allergies, litter (cause by falling leaves, flowers or fruits). Thus, decision-makers and urban planners should take into account a series of criteria -often conflicting to each other- in order to put forward specific green species in urban areas, especially when the locations are densely populated, crowded and air polluted. In the material to follow, a methodological scheme based on multi-criteria decision analysis is presented. The approach aims towards the optimal selection of green species in an urban climate, that origin from a pool of available ones, combining economical, environmental, social and practical aspects on this selection. The approach is implemented for the first time for the historical center of Thessaloniki, Greece. Thessaloniki is considered as one of the most polluted cities within Europe, especially with respect to airborne particles and photochemical air pollution (e.g. Moussiopoulos et al. 2009). According to recent studies for the area under consideration, 10,200 Years of Life Lost (YOLL) and approximately 450 new cases of chronic bronchitis can be attributed to increased chronic exposure to PM_{10}. As concerns cardiac and respiratory hospital admissions for the entire population they are estimated in the order of 1,100 and can be attributed both to particulate and photochemical air pollution (Vlachokostas et al. 2012a). According to the official data of Municipality of Thessaloniki, total amount of planted trees reaches 40,000 and the average green space per capita indicator in the city is 2.15 m^2/citizen, which can be characterized as considerably low compared to other EU cities (ORTh 2008). Thus, active involvement of public authorities, experts and local stakeholders is a necessity in order to promote urban green in the city center.

Materials and Methods

Figure 1 presents the decision-making scheme for selecting urban species of green. The first phase includes the selection of the area under study, taking mainly into consideration percentage of green spaces in the total area (green status), the population density, and air pollution levels. Green status also includes inventorying of the species already present in the area under study. This is followed by a thorough review of available green species that can be considered in the study area. At this step taking into account constraints regarding special -mainly regional climatic and practical- characteristics of the area under study is required, thus a first feedback of both city experts and municipality practitioners should be embedded. The combination of the above steps synthesizes the "pool of green species" as an initial set available for selection.

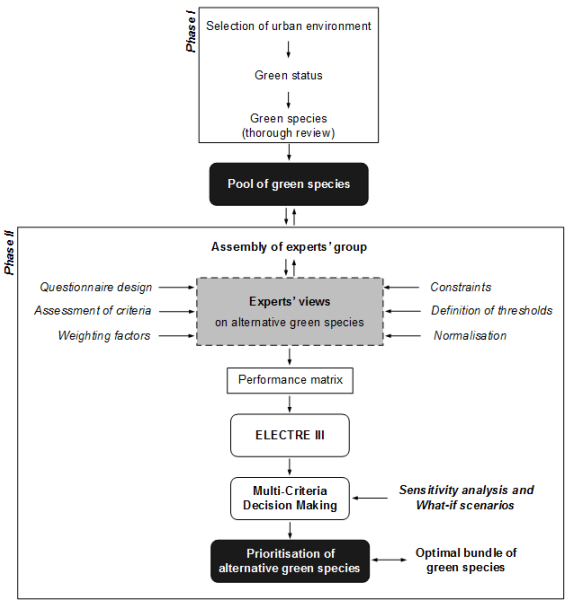

Figure 1. *Decision-making scheme for benchmarking/selecting green species for urban areas*

In the second phase a group of experts to be involved in the decision-making process needs to be defined. This group should be composed of scientists, researchers and municipality practitioners, while keeping its synthesis representative and flexible. Furthermore, experts should be capable to qualitatively evaluate, compare and provide professional judgments on the economic, environmental, practical and social aspects, characterizing all available species. The first critical decision of the group lies on the total number of green species considered in order to ensure both flexibility and applicability of the approach. In that sense, an upper limit for species needs to be defined, taking also into account the species already present in the area under study. Furthermore, they are requested to decide on the number and most important criteria and their relative significance (appoint weighting factors for them), as well as to assess an applicable number of green species in the area under consideration, through rounds of discussions for construction of consensus, by using an ad-hoc questionnaire.

A critical decision in the methodological process lies with the choice of the MCDA technique to be employed. Although there are a number of other methodologies for ranking and classifying alternatives, the method applied to provide the optimal ranking in the framework of this analysis is the "ELimination Et Choix Traduisant la REalite III" (elimination and choice expressing reality) method, referred to as ELECTRE III, as it disposes several advantages. Firstly, Maystre et al. (1994) have demonstrated the general applicability of the ELECTRE methods to decision-aid problems in the field of environmental management. The ELECTRE III is a multi-criteria decision-aid model, particularly suited to the environmental appraisal of complex engineering projects, i.e. a significant advantage of ELECTRE III for the case under study is its utility in examining environmental issues (Rogers and Bruen 1998). The mathematical background is analytically presented in Roy (1985) and Roy and Bouyssou (1993).

In order to facilitate monitoring and direct comparison between individual species of urban green, the quantified values of all criteria j for all alternative species of urban green S are normalized in a scale 0 - 10 with the utilization of the normalization index $N_j(S)$, as follows:

$$N_j(S) = \frac{v_j(S) - v_j^{\min}}{v_j^{\max} - v_j^{\min}} \cdot 10,$$

[1]

where: $v_j(S)$: Value of criterion j for alternative S, $v_j^{\min}$: Minimum value of criterion j, $v_j^{\max}$: Maximum value of criterion j.

Having defined the criteria and alternatives under consideration, the weighting factors and the performance of alternatives, the next step in the managerial framework is the assessment of thresholds (Figure 1). ELECTRE III requires the determination of three thresholds, namely threshold of preference (p), indifference (q) and veto (v) in order to better adapt to uncertainties (Roy and Bouysou 1993).

- The preference threshold indicates the largest difference between the performances of alternatives, such that one is preferred over the other on the considered criterion.
- The indifference threshold indicates the largest difference between the performances of alternatives on the criterion considered such that they remain indifferent for the decision-maker.
- The veto threshold may be activated in the case that an option performs badly on a single criterion compared to another. The former will then be considered as outranked, irrespective of its performance on the other criteria. However, this is a parameter activated (or not) by the group of experts.

Thresholds are not experimental values to be approximated to, but are values set for assessing the appropriateness of planned alternative, necessary for representing approximate or arbitrary features of the data. Rogers and Bruen (1998) proposed a comprehensive approach for specifying realistic limits for p and q within the context of an environmental assessment, where error/uncertainty and human sensitivity to different levels of the criterion are taken into account. Preference and indifference thresholds for each criterion can be calculated with the use of equations [2] (Haralambopoulos and Polatidis 2003) and [3] (Achillas et al. 2010), respectively:

$$p_k = \frac{1}{n} \cdot (N_{wk_{MAX}} - N_{wk_{MIN}}),\ w \in (S_1, S_2, \ldots, S_n),\ k \in (1, 2, \ldots, n)$$

[2]

$$q_k = A\% \cdot p_k, k \in (1, 2, ..., n)$$

[3] where: $N_{wk_{MAX}}$: Maximum normalized average performance of alternative *w* for criterion *k*, $R_{wk_{MIN}}$: Minimum normalized average performance of alternative *w* for criterion *k*, *n*: Number of available alternatives of urban green species, *A%*: percentage of the p_k.

On this basis, Haralambopoulos and Polatidis (2003) adopted a preference value equal to the difference between the maximum and minimum for each criterion divided by the number of scenarios. In addition, Kourmpanis et al. (2008) adopted a p value that equals to 10-30% of the difference between the maximum and minimum for each criterion, whereas q equals to 5-15% of this difference. Achillas et al. (2010) adopted a value of A=30% in equation [3]. However, the selection of preference, indifference and veto values lays also on the characteristics of the specific problem under study and the input of the experts/decision makers relevant to the sensitivity analysis and what-if scenarios defined.

Based on the expression of indifference and preference via the mathematical definition of the imbedded thresholds, the last step of the approach presented is sensitivity analysis (Figure 1). It is already mentioned that sensitivity analysis is most advantageous in the adopted methodological scheme, since parameter values (weighting factors, thresholds, criteria qualitative values, etc.) in real-life cases and applications originate from estimations which are sometimes more or less reliable. This also goes to evaluating species of urban green compared to numerous criteria, such as aesthetics or pollution attenuation. In any case it should be underlined that the simultaneous consequences of potential variations of parameter values, decision variables and constraints could be studied by new runs of the model, since the low computational time gives the opportunity for fast reformed solutions. A sensitivity analysis tests the result by varying the values of the main parameters and observing the effect on the final outcome. The comparative analysis of the classifications leads to a final robust result or to a model re-analysis.

Results

The methodology is demonstrated through its application for the city center of Thessaloniki, Greece. Thessaloniki is the second-largest city in Greece with a population of approximately 1 million citizens, and the capital of Macedonia, the country's largest region. The Greater Thessaloniki Area (GTA) is characterized by an increasing trend of the local population. Moreover, the area is densely populated, with 21,631 inhabitants per km^2 for the city of Thessaloniki. The area is the second major economic, industrial, commercial and political center in the country, and a transportation hub for the rest of south-eastern Europe and the Balkans. Vehicle and industrial emissions are the two main sources of air pollutants in GTA.

The majority of the local population is concentrated within and adjacent to the city center. The urban core is a critical area of various types of activity and has a past and present record of high traffic volumes (ORTh 2008, Moussiopoulos et al. 2010). Within this area, the main source of air pollution is by far motor vehicles (Vlachokostas et al. 2009). Many citizens who live, work, commute, shop or visit for recreation purposes areas close to heavy traffic are exposed to high levels of traffic-related air pollution. In parallel, significant noise pressure occurs in the urban core of the city center (Vlachokostas et al., 2012b).

In the city of Thessaloniki there is a variety of native and non-native trees. The total number of trees is approximately 40.000. Most of them and especially the fast growing species were planted many years ago and for this reason present many problems. The main species which appear most in the city of Thessaloniki are the following: *Sophora japonica*, *Robinia pseudoacacia, Albizia julibrissin, Acer negundo*, *Populus sp*, *Ligustrum japonicum*, *Platunus orientalis*, *Koelruteria paniculata*, *Celtis australis*, *Citrus aurantium*, *Liquidambar sp*, *Tilia cordata*, *Hibiscus syriacus*, *Ulmus sp*, *Cercis siliquastrum.*

Following the methodological scheme described in Figure 1, a decision-making group was set up to evaluate tree species for planting in the metropolitan center, considering the area's characteristics. The ten experts included in the group of experts represented local municipality decision-makers and practitioners, as well as scientists actively involved in the corresponding "urban forestry" thematic area. Experts methodically discussed (i) the alternatives of the available "pool of green species", (ii)

criteria to be employed in the decision-making process and (iii) the corresponding weighting factors. According to the relevant discussion and brainstorming among the experts, a total of 10 tree species were put forward as most appropriate for the case of the Thessaloniki's city center. Table 1 presents the performance matrix that illustrates the experts' average point of view on the available alternatives species of urban green to the selected criteria. In our case, the following criteria were selected by the group of experts: C_1: life span, C_2: required growth space, C_3: planting capability in built environment, C_4: aesthetics, C_5: tolerance, C_6: pollution attenuation, C_7: adaptation to local climate, C_8: crown density, C_9: cost, C_{10}: allergenicity. The direction of preference is ascending for all criteria, except for C_9 and C_{10} where the direction is descending. Based on the methodological insights and the input of the experts, two scenarios were defined for *p* and *q* values: (i) *p* was set equal to 20% of the difference between the maximum and minimum performances and *q* was set equal to 30% of the preference value, (ii) *p* was the output of equation [2] and *q* was set equal to 30% of the corresponding *p* value.

Table 1. *Performance matrix for the basic scenario, preference (p) and indifference (q) threshold values for sensitivity analysis scenarios*

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
M1. Celtis australis (Hackberry)	8.1	7.5	6.4	7.3	8.7	8.6	8.4	8.7	9	10
M2. Sophora joponica (Scholar tree)	8	7.4	7	7.1	8.1	7.9	8.5	8.7	8.8	9.1
M3. Koelreuteria paniculata (Goldenrain tree)	7.3	7.8	7.9	7.9	7.7	7.4	8.7	7	8.6	10
M4. Cercis siliguastrum (Judas tree)	6.2	6.6	8.2	7.5	7.2	6.5	8.5	6.3	7.4	10
M5. Platanus orientalis (Plane)	8.7	6.6	6.3	8.2	7	8.1	6.8	8.6	6.8	9.5
M6. Ulmus hollandica (Elm)	8	7.1	7	7.3	7.2	7.1	7.5	7.5	7.2	9.1
M7. Linguidanbar styraciflua (Sweetgum)	8.8	7.2	7.2	9	8.1	8.2	7.3	8.2	7.3	9.8
M8. Morus alba,nigra, platanifolia (Mulberry)	7.7	8.5	8.6	8.2	8.2	7.2	7.2	7.4	7.1	8.6
M9. Tilia cordata (Linden)	7.1	7.8	8	8	7	7.2	5.4	7.2	7	8.4
M10. Acer pseudoplatanus (Maple)	6.5	8.1	7.1	8.2	7.4	7.1	6.4	7.2	7.7	9.7
Weighting factors	9.5	13.1	9.4	6.6	11	7.6	15.6	7.1	13.3	6.8
Preference threshold	0.26	0.19	0.23	0.19	0.17	0.21	0.33	0.24	0.22	0.16
Indifference threshold	0.078	0.057	0.069	0.057	0.051	0.063	0.099	0.072	0.066	0.048

The methodological approach continues with the application of ELECTRE III. The "basic" scenario refers to the average normalized performances for the ten urban green species and the weighting factors of the 10 adopted criteria, as those were suggested by the group of experts. The preference and indifference thresholds are depicted in Table 1, whereas a veto threshold was not considered for any criterion within this case study. Based on the two pre-orders, the final ranking results were calculated following the ELECTRE III technique for the "basic" scenario (Figure 2).

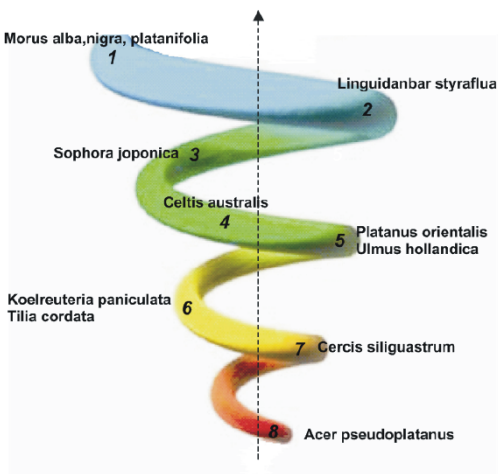

Figure 2. *Multi-criteria results for the final ranking of urban green species for the city center of Thessaloniki*

The application of ELECTRE III put forward *Morus Alba*. This is based mainly to the fact that *Morus Alba* possess ornament features, with good characteristics of development and is not easily affected by diseases or insect infestations. Its durability in regular pruning makes it suitable for limited available growth spaces, and thus can be controlled to increase the diameter and height of its crown. *Morus alba* has high resistance in coastal environments, such as the one of Thessaloniki. Howewer, it shows low resistance to air pollution. *Linguidanbar styraciflua* followed as a second optimal option. The experts emphasized mainly on the good adaptability to the urban climate of Thessaloniki and the significant air pollution abatement characteristics. It can be planted in city sidewalks if it is provided with sufficient growth space, it has beautiful ornamental features like its trunk and leaves. However, its main disadvantage is the requirements in fertile soil and sun, while it can also suffer from chlorosis when planted in alkaline soils.

Sophora japonica, usually an option for the local authority the last years, ranked third. It might not have the ornamental features of *Morus alba* or *Linguidanbar styraciflua* but it does not seem to be significantly affected by dust and gaseous pollutants. The experts remarked that it presents an excellent resistance to both high and low temperatures, thus showing a very good adaptability to the urban climate of Thessaloniki. It has also high endurance in injuries as well as on degraded soil condition. *Celtis australis* grows fast and possess excellent resistance to injuries, barren soils, pest and diseases. It can also tolerate severe pruning, dirt and dust, while it has good resistance to extreme temperatures. *Celtis* might not have ornamental features but is a very good option for the city of Thessaloniki, since it has the best air pollution abatement properties compared to the other species.

Depicting the sensitivity analysis capability for the parameters of the study, the problem was resettled with modified preference and indifference thresholds by the group of experts. Ten parameter-based scenarios with differentiating preference and indifference thresholds by 50% (increasing and decreasing) were examined in addition to the "basic" scenario. The percentage (%) increase/decrease amount was applied equally all across the options. The corresponding final rankings adopted are summarized in Table 2. The solution remains practically unaltered which provides the decision-maker with additional confidence that the ranking is adequately robust. *Morus Alba* and *Linguidanbar styraciflua* can be promoted as the best options in this benchmarking process, whereas *Acer pseudoplatanus* and *Cercis siliguastrum* are considered the least optimal options. In conclusion, the optimal alternatives are invariant for the scenario considered. This suggests a high level of robustness to the presented decision support system.

Table 2. *Sensitivity analysis for the scenarios under consideration*

	Basic scenario	Scenario +10%	Scenario +20%	Scenario +30%	Scenario +40%	Scenario +50%	Scenario -10%	Scenario -20%	Scenario -30%	Scenario -40%	Scenario -50%
1	S8	S8	S8	S8	S8	**S7** S8	S8	S8	S8	S8	S8
2	S7	S7	S7	S7	S7	**S2**	S7	S7	S7	S7	S7
3	S2	S2	S2	S2	S2	**S1** **S3**	S2	S2	S2	S2	S2
4	S1	S1	S1	S1	S1	**S5** **S9**	S1	S1	S1	S1	**S3**
5	S5 S6	S5 S6	S5 S6	S5 S6	**S3**	**S4** S6	**S3** S5	**S3** S5	**S3** S5	S5	*S1* S5
6	S3 S9	S3 S9	S3 S9	S3 S9	S5 S9	**S10**	*S6* S9	*S6* S9	**S4** *S6* S9	S3	*S6* S9 **S10**
7	S4	S4	S4	S4	S4 *S6*		S4	S4	**S10**	*S6* *S9*	S4
8	S10	S10	S10	S10	S10		S10	S10		*S4* S10	

Note: Measures in bold fonts refer to those ranked higher than their rank in the "basic" scenario.
Measures in italics fonts refer to those ranked lower than their rank in the "basic" scenario.

Conclusions

This paper presents a decision-making scheme for benchmarking, selecting and promoting green species in urban areas. The methodological framework is based on employment of a multicriteria mathematical technique i.e. ELECTRE III. The methodology is successfully demonstrated through its application for the city center of Thessaloniki, Greece. A decision-making group was set up to evaluate tree species for planting in the metropolitan center, considering the area's special characteristics. *Morus Alba*, *Linguidanbar styraciflua*, *Sophora japonica*, *Celtis australis* can be considered as the optimal alternatives of the available pool of green species. In addition, extensive sensitivity analysis via parameters' resettling highlighted the robustness of the optimal final ranking.

Urban climate quality has become an issue of critical importance for urban sustainability and a major challenge for environmental managers and public authorities around the globe. Urban green is vital for improving the quality of urban climate in many aspects and dimensions. It should be emphasized that the current state of knowledge regarding the green species effectiveness in reducing air pollution concentrations for specific air pollutants has still numerous gaps and uncertainties. In the case under study the experts used available literature review in combination with their personal expertise. The purpose of ongoing research is to cover more this thematic area and thus reduce gaps and in addition refine the presented methodology to reduce uncertainties. Clarity in defining the presented criteria and especially the effectiveness of green species in reducing air pollution is required for a better interpretation of the results in the policy arena. However, the probable magnitude of the impacts avoided for all receptors in the city would justify the decision to implement strategies of urban green in urban areas incorporated holistically in strategies to reduce air pollution in the area under study.

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NEW TECHNOLOGY FOR REUSING BREWING YEAST DURING BEER FERMENTATION CONTRIBUTING IN A GREEN SUPPLY CHAIN

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Abstract

The number of viable cells and the total concentration of yeast slurry are important indicators for the performance of the fermentation. In many breweries, fresh yeast is propagated every 8–10 generations (fermentation cycles), or earlier if contamination or a fermentation problem is identified. Lager yeast is normally a pure culture, whereas ale yeasts have often been a mix of strains.

For applying new technologies nowadays has been contributed as green supply chain, green marketing, consumer behavior, applying in the beer food industry. In this study, the spin method was applied for determining the cell concentration of yeast slurry. Samples were taken from *Saccaromyces uvarum* (*carlsbergensis*) lager yeast at different generations, from I to XI, after a serial repitching. Meanwhile, yeast slurry samples were analyzed for the concentration of cells. The focus of this study was to evaluate the concentration of yeast slurry in different fermentation cycles. Two trials were carried out in a 12 months period per each. Based on the obtained results, the average value for all the generations was above 60%. The results showed fluctuating data, starting from 67% in the first generations, followed by a sharp decrease in the third generation.

Keywords: *green supply chain, yeast, fermentation, cell concentration, green marketing, consumer behavior*

Introduction

New supply chain technology can power up existing operations, streamline inventory, and increase revenue—if implemented correctly. Making sure new solutions integrate with existing technologies and processes is crucial.

Yeast pitching is governed by a number of factors, such as wort gravity, wort constituents, temperature, degree of wort aeration, and previous history of the yeast. Ideally, one wants a minimum lag in order to obtain a rapid start to fermentation, which then results in a fast pH drop, and ultimately assists in the suppression of bacterial growth. Pitching rates employed vary from 5 to 20 million cells per ml, but 10 million cells per ml is considered an optimum level by many and results in a lager yeast reproducing four to five times (Carvell, 2000). Increasing the pitching rate results in fewer doublings, as yeast cells, under given conditions, multiply to a maximum number of cells/unit volume, regardless of the original pitching rate. The pitching rate can be determined by various methods, such as dry weight, turbidimetric sensors, hemocytometer, and electronic cell counting (Maule, 1980).

Inoculating, or 'pitching' brewer's worts with the correct number of yeast cells is critical for consistent fermentation performance. Under-pitching results in longer fermentations, which has negative economic consequences. Over-pitching, although producing a more rapid fermentation, can lead to lower viability yeast crops, loss of bitterness, filtration problems and increased risk of yeast autolysis (Boyd, 2003).

Since the yeast is considered as the most important ingredient of beer – its properties play a decisive role in the quality, taste and flavor, and the improvement of beer post-treatments. The yeast culture is added in lyophilized form as dry active yeast, or it may be subjected to propagation process

from a single cell (Smart, 2003). In most of the cases, the local production operates by using dry active yeast, and there are only a few companies that carry out the propagation process. First, in yeast propagation the aim is to produce large quantities of yeast from tiny amounts, i.e. from laboratory stock culture (single cell) to pitching yeast. The modern practice is to replace the yeast culture at regular intervals by a freshly grown culture from the yeast propagation plant (Priest, 2003).

Materials and Methods

The effect of the long-term maintenance method used with a brewer's yeast on its technological properties was determined in laboratory fermentation trials with a 11°P malted barley wort. The trials were performed at a constant temperature and under conditions of constant substrate concentration. A culture of a bottom fermenting yeast, *Saccharomyces carlsbergensis* W34/70 (the yeasts collection HEFEBANK WEIHENSTEPHAN, Germany) was tested, maintained by subculturing on wort agar slopes at 4°C. Parameters under investigation included yeast vitality measured as the percentage of viable cells, the yeast cell count, and the spin method for the concentration of yeast slurry.

Table 1. *Propagation parameters for the yeast strain S. carlsbergensis*

Strain	**Lager W34/70**
Apparent extract	11°P
Temperature	12°C
Duration	10 days
Pitching rate	30 x 10^6 cells/ml
Dissolved oxygen (ppm)	7.8 mg/L

The cell concentration was analyzed by spin method. The yeast slurry (47 ml) was centrifuged for 15 min in Rotofix 3500 rpm, 22°C, in a 100 ml tube. The cell concentration percentage was reported as pellet volume compared to total volume (Thornton, 2002).

Table 2. *The number of samples (yeast slurry) taken at different fermentation cycles*

Yeast generations	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Samples 2015	8	10	9	9	15	19	12	5	2	2	4
Samples 2016	12	14	22	28	33	27	6	3	0	0	0

Considering the cell concentration in the yeast slurry, the accepted level is 60%. The estimated percentage is calculated according to the following formulation:
Initial weight – x
Final weight – y

$$\boldsymbol{Concentration}\ \% = \frac{\boldsymbol{y}}{\boldsymbol{x}} \cdot \mathbf{100}$$

Results

Concerning the yeast cell concentration, the average value for all the generations was above 60%. The results showed fluctuating data, starting from 67% in the first generations, followed by a sharp decrease in the third generation.

Figure 1. The average values of concentration at 1st and 2nd generation

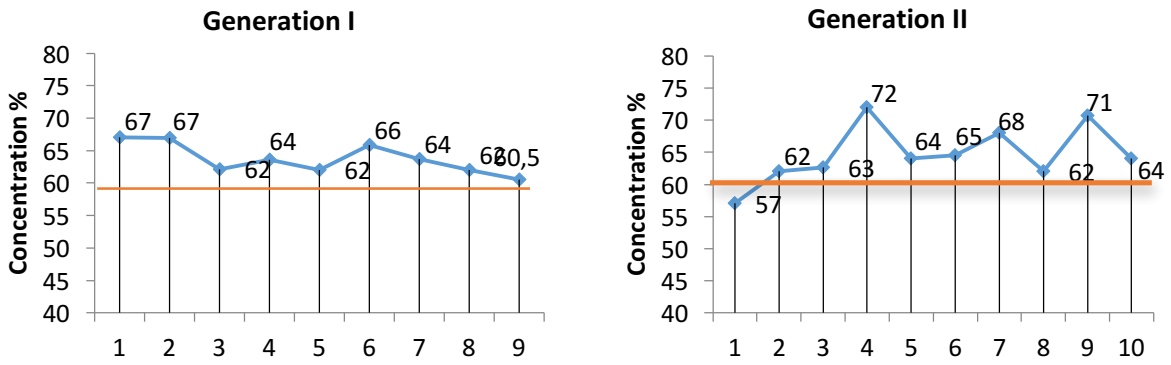


Figure 2. The average values of concentration at 3rd and 4th generations

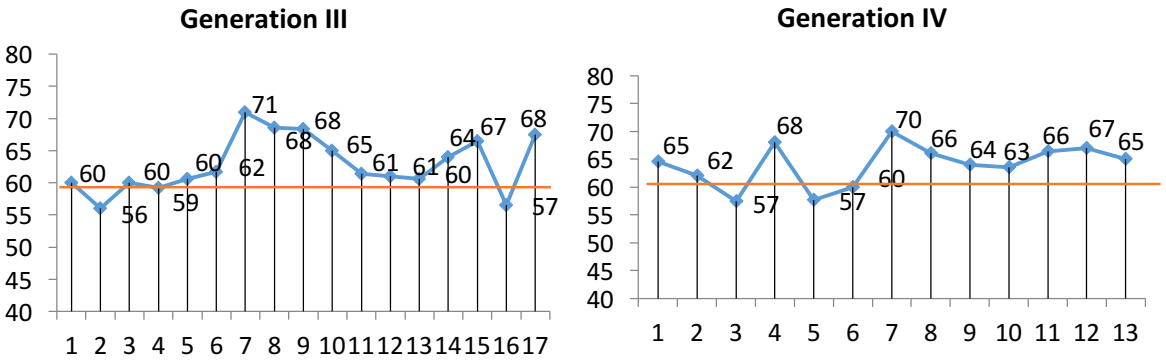


Figure 3. *The average values of concentration at 5th generations*

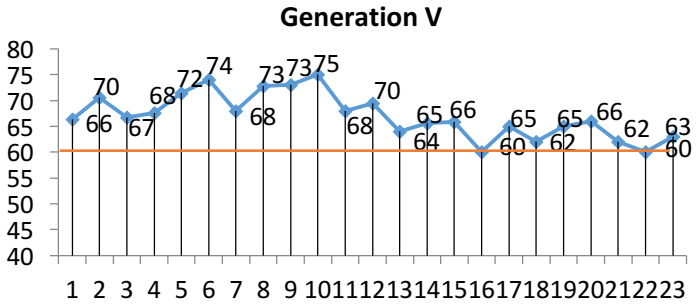


Figure 4. *The average values of concentration 6th generations*

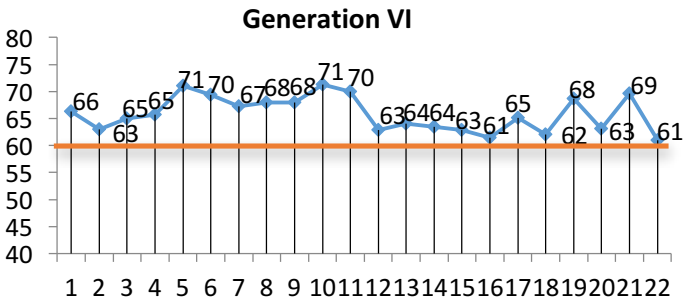


Figure 5. *The average values of concentration at 7th and 8th generations*

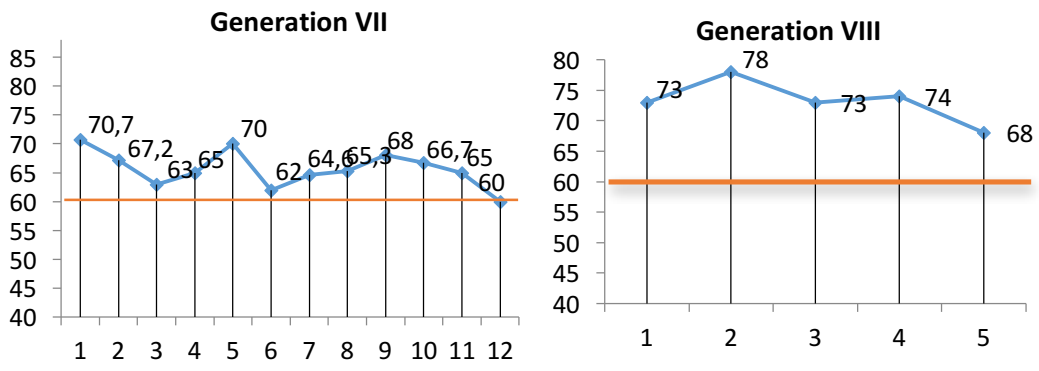
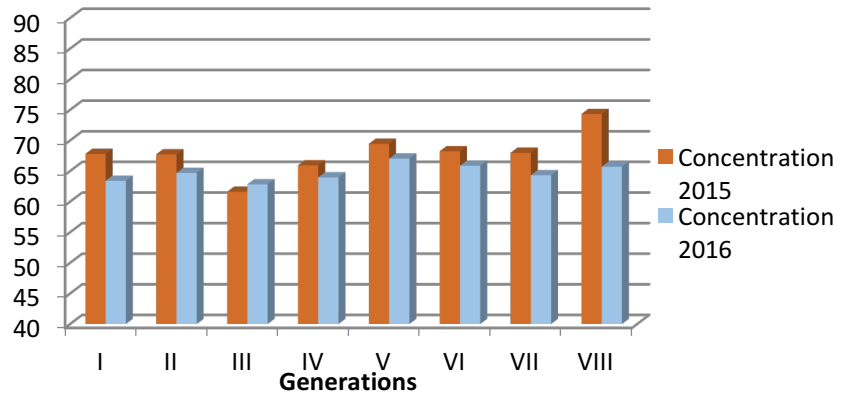


Figure 6. The summarized values of concentrations from generation I to VIII



Discussion – Conclusions

Integrating new technology into existing operations can help significantly increase customers service, reduce costs, and streamline supply chains. The new technology must be fully synthesized with existing policies, practices, and people, however, to tap its full power.

The values of cell concentration in the yeast slurry show a slight fluctuation, but not a significant change towards the number of the generations used. In the first generations there was a constant concentration of about 63%, meanwhile there was a slight increase in the fifth generation with 67%, following a decrease to 65%. In both cases, there is no evidence of concentration values falling under the accepted threshold (60%), which is a very important aspect in the fermentation performance.

When implementing the new technology, which helped automate its previous manual environment, "we started slowly and waited until we felt comfortable that our first test was running smoothly," Lunsford explains. "Then we started the next phase. We wanted to make sure we didn't overwhelm our users with too many changes at one time."

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CHEMICAL COMPOSITION EVALUATION OF ALBANIAN *JUNIPERUS COMMUNIS* CONES EXCTRACT ESSENTIAL OILS

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Abstract

The aim of the present study was the determination of the chemical composition of *Juniperis communis* blue-black seed cones essential oils growing wild in three different zones of Albania. Sampling was made in Albania respectively in Rrajca, Martanesh and mountain Tomorr. The analytical technique liquid-liquid extraction was followed by gas chromatography peak identification.

The GC/FID analyses of the cones revealed that the major constituents identified were more than 90 constituents detected in the extracts, and the contents of 18 compounds were reported in the work. The monoterpene hydrocarbons ranged from 38.79 %, (Rrajca) to 36.316 % (Martanesh) to 35.78 % (Tomorr). Likewise, the oxygenated monoterpenes ranged from 4.38%, to 2.31% to 1.89%. Percentage composition of total sesquiterpenes in oils was 13.17 % (Martanesh), 16.69 % (Rrajca) and 16.7% from, and (Tomorr). The examination of data reveals that *Juniperus communis L.* cones essential oils growing in these three different areas have significant differences in their chemical composition. The monoterpene hydrocarbons are the major group of components of the essential oil from Martanesh area, while in Rrajca zone the major groups are the sesquiterpenes.

Key words: *Juniperus communis L., cones, chemical-composition, monoterpenes, sesquiterpenes, GC/FID*

Introduction

Juniperus communis L., known as common juniper, is the most widespread of the European conifers worldwide (Enescu, C. M. and al.) Common juniper is one of the few shrubs that occurs in both the Eastern and Western Hemispheres and is widespread in Albania (Plava-Guci, Malësi e Madhe, Martanesh, Rrajca, Tirana, Zerqan, Mokra, Tomorr etc).

Juniper plant is used mainly for medical use and other uses. The ripped berry-like cones collected in autumn and dried slowly in the shade could be used as diuretic, antiseptic, aromatic, stomachic and antirheumatic (Kandeel et al. 2015).

Traditional use includes cystitis, flatulence and colic. The oil mixed with lard is also used in veterinary practice *(EMEA, 1999*). Various extracts of *Juniperus communis* L. have up to 63.3% higher inhibitory effect compared to penicillin, on certain kind of bacteria.

Juniper is also used for flavouring food (sauerkraut, stuffing, vegetable pates etc.) and beverages (tea, gin). The roasted seed is a coffee substitute. Juniper is highly valued as an ornamental shrub.

Juniperus communis L., in Albania grows wild (*Akademia e Shkencave, 1990*) all over the country. Main constituents found in volatile oil (0.2 – 3.4 %) of this plant are, proanthocyanidines, flavonoids,

lignin, diterpene acids, sesquiterpenes, sugars, resin, vitamin C (Uran Asllani, 1991-2004). Dissimilarities in the oil's yield and the chemical composition can vary from the geographical location, age and degree of plant ripeness, harvesting methods, distillation techniques and other factors.

The aim of the following study was the analysis of the chemical composition of *Juniperus communis* essential oils collected from the largest known populations in three different zones of Albania with higher contents of most useful constituents.

Whereas analytical data on volatile components of *Juniperus communis* cone oils have been reported in the literature, the Albanian cone essential oil has never been studied carefully.

Materials and methods

Plant Material

Aerial parts of the plants were collected, in the Rrajca, Martanesh and Tomorr zone area during June - July 2016. Voucher specimens were deposited at the herbarium of the Pharmacy Department in Albanian University. The air-dried plant material, was subjected to hydro distillation using a Clevenger-type apparatus according to standard procedures. The essential oils obtained were stored under refrigeration until further testing.

Yield of essential oil

The essential oils were obtained from dried plant material through steam distillation using all glass Clevenger type apparatus. For that purpose, 20 g of minced plant material was distilled for 4 hours. The essential oil yield was calculated on dried plant material and was expressed in ml/kg. The percentage oil yielded was determined using Clevenger-apparatus method according to the European Pharmacopoeia 9th Edition.

GC/FID essential oils analysis

Essential oils analysis (GC/FID) was performed using a Varian GC-450 FID detector apparatus. The carrier gas was azoth with a constant flow rate of 1.5 mL/min, injector temperature was 280°C, FID detector temperature 300°C. Injector mode was selected split (1:100). Oven program: 1 min at 50°C, then 6°C/min to 150°C and again 10°C/min till 300°C for 5 min. FID detector: N_2 (1 ml/min) and N_2 (24 ml/min). VF-1ms (30 m x 0.33 mm x 0.25μm) capillary column was used for the separation of the compounds. Sample injection volume was 2 μl.

Retention indices of reference compounds from literature data (*ESO 2000. Leffingwell & Associates*) were used to confirm peak data. Quantification of compounds was performed via peak area calculations of the FID chromatogram. The n-oktan (C_8) with eikosan (C_{20}) were used to calculate Kovats index needed in the literature for identification of main constituents. (*David F. et al*).

Results

The results of the GC/FID analysis of samples are reported in Table 1. Data analysis of the chemical composition revealed four main classes of components: monoterpene hydrocarbons (MH), oxygen-containing monoterpenes (OM), sesquiterpene hydrocarbons (SH) and oxygen-containing sesquiterpenes (OS).

Table 1. Qualitative and quantitative analysis of the fruit essential oils of *Juniperus Communis* growing wild in three zones in Albania

Compounds (%)	**Martanesh**	**Rrajcë**	**Tomorr**
Triciklen	1.392	1.462	1.197
α-pinen	38.79	36.316	35.776
Kamfen	0.795	0.654	0.431
Sabinen	2.194	1.959	1.69
β-pinen	2.918	2.57	2.642
Myrcen	16.061	16.946	13.943
α-terpinen	0.364	0.428	0.43
Para-cimen	-	0.147	0.166
Limonen	4.384	2.314	1.885
Terpinolen	0.069	0.772	1.578
Linaleol	2.895	4.154	4.413
Kamfur	1.309	3.559	2.557
Terpinen-4-ol	0.948	1.549	1.162
α-terpineol	1.138	0.598	0.442
β-karafilen	9.961	0.932	0.867
Humulen	2.189	12.631	12.433
Germacen	1.023	2.143	2.328
Kadinene	-	0.98	1.071
Compound groups			
Monoterpene hydrocarbons	66.967	63.568	59.738
Oxygenated monoterpenes	6.29	9.86	8.574
Sesquiterpernes	13.173	16.686	16.699
Total, %	86.43	90.114	85.011
Oil yield, %	1	1.48	1.25

Discussion

The quantitative yield of essential oils, expressed as percentage of dry matter, were 1%, 1.48% and 1.25% for Martanesh, Rrajca and mountain Tomorr. These percentage values fall within the range defined by the Analytical Methods Committee Analyst (1984).

A total of 99 compounds were detected in the oil of Martanesh, 90 compounds in Rrajca and 105 compounds in Tomorr mountain.

The composition of juniper berry essential oil from Martanesh area was dominated by *monoterpenes* (9 components, 66.97%). Also, the main component of monoterpenes α-pinen have

higher value in this area (38.79%) than the other two (Rrajca 36.35 % and Tomorr mountain 35.77%); we can say the same thing for the other components of monoterpenes as myrcene that have higher values in this zone ranged from 16.06% to 13.94% in Tomorr mountain; sabinene ranged from 2.19% to 1.69%; limonene from 4.38% to 1.88%;

Percentage composition of total sesquiterpenes in oils were 13.17%, 16.69 % and 16.7%, in Martanesh, Rrajca and Tomorr mountain, respectively. It is evident that the quantity of β-caryophyllene of total sesquiterpenes in Martanesh, is much higher (9.96 %) than those of the other sites (0.93 and 0.87% respectively). Humulen has the lowest value in Martanesh area (2.19%) with a big difference from Rrajca (12.62%) and Tomorr areas (12.433%).

It is obvious that the essential oil collected from *Juniperus communis* L. In Martanesh has higher amounts of the main components α-pinene, myricen, limonene and β-caryophyllene than the other two sites, Rrajca and Tomorr. These differences could be related to the variable conditions of the geographical locations in question.

Essential oils from all three sites have lower amounts of the monoterpene hydrocarbon α-pinene compared to samples from Germany (70.8%) but they are similar with those from Norway (34.5%) and Hungary (35%) (Pashalina S., Chatzopoulou and Stavros T. Katsiotis. 1993).

Close examination of the GC data reveals great differences in the chemical composition of *Juniperus communis* L. essential oil collected from Martanesh mountain compared to Rrajca and Tomorr mountains. Furthermore, monoterpenes (66,97%) constitute the major group of Martanesh essential oil with higher percent of α-pinen and myricen. Essential oil from the same site, also has higher amounts of the main constituent of sesquiterpenes β-caryophyllene.

Conclusions

From the analysis it results that *Juniperus communis L.* cones essential oils growing in the three abovementioned different areas in Albania show significant differences in their chemical composition. The monoterpene hydrocarbons are the major group of components of the essential oil from Martanesh area, while in Rrajca zone the major groups are the sesquiterpenes.Regardless of the domination of monoterpene compounds in the oils, there are differences in quantitative composition of three samples due to a number of factors: geographical location, degree of ripeness and age which are factors influencing the individual biological properties of juniper berry essential oils.

The *Juniper Communis* essential oils from three zones of Albania was found to be more similar to the Norwegian and Hungarian cones oils.

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CLIMATE CHANGE IMPACTS ON WATER RESOURCES OF THE OLYNTHIOS RIVER BASIN

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Abstract

Climate change is one of the biggest threats the world faces today and its impacts on different aspects of social activity and on the natural environment require careful assessment. In the coming decades many areas such as the Mediterranean Basin are projected to suffer an intensification of water resources stresses due to its impacts. In the present paper, the impacts of climate change on the water resources of the Olynthios River Basin in Northern Greece, was studied. For this purpose, three climate change scenarios were used (SRES scenarios B1, A1B and A2) - which were taken from two General Circulation Models (GCMs), CGCM3.1/T63 and MPEH5-OM - for two time periods of climate change (2020-2050 and 2070-2100) and for the baseline period (1977-2000). Based on the data derived from the GCMs, the downscaling of daily climate variables was performed using the weather generator ClimGen. The monthly water balance of the Olynthios River Basin was estimated with the use of a Thornthwaite - Mather type model. Results showed that climate change will decrease the runoff of the water basin of Olynthios for all three SRES scenarios for the two time periods examined in this study.

Keywords: *climate change, water resources, ClimGen, Thornthwaite and Mather*

Introduction

Climate change is the largest threat the world ever faced as it widely affects different aspects of social activity and the earth's natural resources from tropical to arctic and from sea to land and atmosphere (IPCC 2013). **S**cientists are more than 90% certain that warming of the climate is primarily caused by increasing concentrations of greenhouse gases (CO_2, CH_4, O_3, CFCs and Nitrous oxide) produced by human activities such as the burning of fossil fuels and deforestation (IPCC 2007). According to IPCC (2013), warming of the climate system is unequivocal**,** and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished and the sea level has risen.

Climate warming observed over the past several decades affects water through a number of mechanisms and is associated with changes in a number of components of the hydrological cycle and hydrological systems. An issue of global concern is the possible change in water resources availability in response to different scenarios of climate change. Water resources play a crucial role in crop production regionally and worldwide. On the one hand, in the regions, that agricultural land is rainfed, crop productivity depends solely on sufficient precipitation to meet evaporative demand and associated soil moisture distribution (FAO 2003). Crop production will be very vulnerable to climate change especially in regions such as the Mediterranean Region where precipitation is limited (FAO, 2003). On the other hand, crop production depends on the available water resources for irrigation. In most countries, water use has increased over the recent decades, due to population and economic growth, changes in lifestyle and expanded water supply systems, with irrigation water use being by far the most important cause. Irrigation accounts for about 70% of total water withdrawals worldwide and for more than 90% of the consumptive water use and generates about 40% of total agricultural output (Fischer et al. 2006). The above indicate that changes in water resources in relation to shifts in climate

will affect crop production and can become critical for the sector of agriculture; as a result climate change impacts on water resources require careful assessment.

At a global scale, there is evidence that climate change will have a range of impacts on water resources, with some regions experiencing an increase in annual runoff and others experiencing a decrease (Milly et al. 2005). In Northern Europe (Andréasson et al. 2004) annual runoff is projected to increase while the opposite is expected in the rest of Europe included Mediterranean Region (Etchevers et al. 2002, Menzel and Bürger 2002). Annual average runoff will increase in Northern Europe by approximately 5-15% up to the 2020 and by 9-22% up to the 2070, under the A2 and B2 SRES scenarios from two different climate models (IPCC 2007). Meanwhile, runoff is projected to decrease by 0-23% up to the 2020 and by 6–36% up to the 2070 in Southern Europe according to the SRES scenarios.

The objective of this study was to investigate the effect of climate change on water resources on Olynthios water basin for the middle (2020-2050) and the end (2070-2100) of the running century. For this purpose, data was derived from the General Circulation Models (GCMs) CGCM3.1/T63 and MPEH5-OM, for three climate change scenarios SRES B1, A1B and A2 for two time periods of climate change (2020-2050 and 2070-2100) and for the baseline period (1977-2000). Based on the data taken from the GCMs, the downscaling of daily climate variables was performed with the use of the weather generator ClimGen (Stöckle and Nelson 1999) for the generation of synthetic time series which depict the future change of the climate variables. The monthly hydrological model of Thornthwaite and Mather was applied to estimate the water balance of Olynthios River Basin and runoff estimation referred at the reservoir's location. For the estimation of the monthly water balance, the calculation of precipitation and temperature of the water basin is required. Finally, the annual runoff of Olynthios River Basin was predicted for two climate change periods 2020-2050 and 2070-2100 under the SRES B1, A1B and A2.

Materials and Methods

Study area and data

The Olynthios River Basin is situated within the prefecture of Chalkidiki in Northern Greece and is geographically located between 40°27' latitude and 23°26' longitude. The study area extends at the Southeast part of Thessaloniki and the South part of municipality of Chalkidiki, coming from mount Holomonta and its mouth is at the Gulf of Kassandra. The climate in the Prefecture of Chalkidiki is mainly Mediterranean, with hot summers and cool winters. Site along the Olynthios river (Louziki - Figure 1) has been selected for the construction of the reservoir (Karamouzis et al. 2008) which aims to serve (1) the urban requirements and (2) irrigation water requirements of the study area. The Olynthios River Basin covers 252 km^2 while the catchment contributing to reservoir inflow has been estimated at 131.5 km^2.

The climate variables used in the study were taken from the meteorological station of Agios Mamas which is located near the study area and include the period 1977-2000 (23 hydrological years). For the estimation of the monthly water balance of Olynthios River Basin, precipitation and temperature time series of the water basin are used as inputs to the Thornthwaite and Mather model.

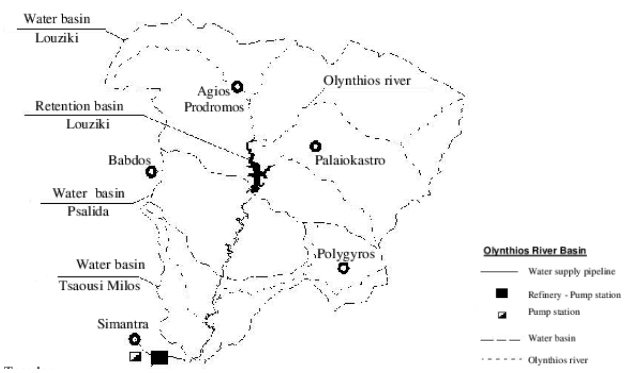

Figure 1. *The Olynthios River Basin.*

Climate change scenarios

In order to provide information on possible changes in the climate, GCMs are used based on the emission scenarios (SRES) which make projections of possible future climate change. The B1, A1B and A2 emission scenarios (SRES), developed by the IPCC Special Report on Emissions Scenarios (IPCC 2000), were used for the prediction of climate changes in this study. The B1 scenario describes a convergent world with a global population that peaks in mid-century and declines thereafter but with rapid changes in economic structures toward a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies (IPCC 2000). The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional climate initiatives (IPCC 2007). The A1B scenario describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. The technological emphasis is a balance across all sources, not relying too heavily on one particular energy source. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income (IPCC, 2007). The A2 scenario describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing global population. Economic development is primarily regionally oriented and per capita economic growth and technological changes are slow. According to the IPCC (2000) the atmospheric concentration of carbon dioxide (CO_2) is predicted to reach 550 ppm for B1, 720 ppm for A1B and 850 ppm for A2 SRES scenarios in the year 2100.

In this study, the CGCM3.1/T63 (Flato et al. 2000) developed at the "Canadian Centre for Climate Modelling and Analysis" (CCCma) and the MPEH5-OM (Roeckner et al. 2003) from the "Max Planck Institute for Meteorology" (MPI), which are Coupled Atmosphere-Ocean General Circulation Models (AOGCMs), were used and considered as significantly more sophisticated than earlier versions. The CGCM3.1/T63 model has a surface grid whose spatial resolution is roughly 2.8 degrees lat/lon and 31 levels in the vertical. The ocean grid shares the same land mask as the atmosphere and there are six ocean grids underlying every atmospheric grid cell. The ocean resolution is therefore approximately 1.4 degrees in longitude and 0.94 degrees in latitude. This provides slightly better resolution of zonal currents in the Tropics, more nearly isotropic resolution at mid-latitudes, and somewhat reduced problems with converging meridians in the Arctic. The MPEH5-OM model has an atmospheric grid resolution 1.9 degrees lat/lon and 31 levels in the vertical. The ocean resolution is approximately 1.5 degrees lat/lon and 40 levels in the vertical. The climate variables used from the models were, on a daily scale, maximum and minimum temperature (^{o}K), specific humidity ($kgkg^{-1}$), eastward and northward wind (ms^{-1}), longwave and shortwave solar radiation (Wm^{-2}), and precipitation ($kgm^{-2}s^{-1}$). The weather data were obtained from the General Circulation Models (GCMs) CGCM3.1/T63 and MPEH5-OM for two time periods of climate change 2020-2050 and 2070-2100 under B1, A1B and A2 SRES scenarios and for the baseline period (1977-2000) for climate change impact assessment.

Weather generator ClimGen

Stochastic models that generate a suite of long series synthetic weather data from observed weather data have become important to address the inadequacy of short-term observed weather data, for analysis of agricultural, hydrological, environmental and other weather-driven systems (Richardson 1985, Georgiou and Papamichail 2008). ClimGen (Stöckle and Nelson 1999, Stöckle et al. 1999), a daily time step stochastic model, generates daily precipitation (mm), maximum and minimum temperature (^{o}C), solar radiation ($MJm^{-2}d^{-1}$), maximum and minimum relative humidity (%) and wind speed (ms^{-1}) data series which preserve the statistical characteristics of the historical weather data. The model requires inputs of daily series of these weather variables to calculate the parameters used in the generation process for any length of period at a location of interest (Figure 2). ClimGen preserves, in the generated weather data, the correlation among the weather variables as well as the seasonal characteristics in the actual weather variable at the site of interest and, thus, does not take into account the climatic extremes and climatic variability that are expected to be increased in the future (Stöckle and Nelson 1999, Stöckle et al. 1999).

ClimGen uses the Weibull distribution (Weibull 1951) to represent daily precipitation and its spline approach is an improvement over the one-term Fourier series used by many other weather generators to simulate seasonal variation in climate data (Safeeq and Fares 2011). A two-state Markov chain model (Richardson and Nicks 1990) is used to generate the number and distribution of events. Daily maximum and minimum air temperature details are generated using an approach similar to the weather generator WGEN, considering temperature as a continuous multivariate process with the daily mean and standard deviation conditioned by the precipitation status (Stockle et al. 1999). However, ClimGen uses a spline fitting procedure to adjust for variations in season means and standard deviations compared to Fourier series used by other weather generators (e.g. WGEN and CLIGEN) (Safeeq and Fares 2011).

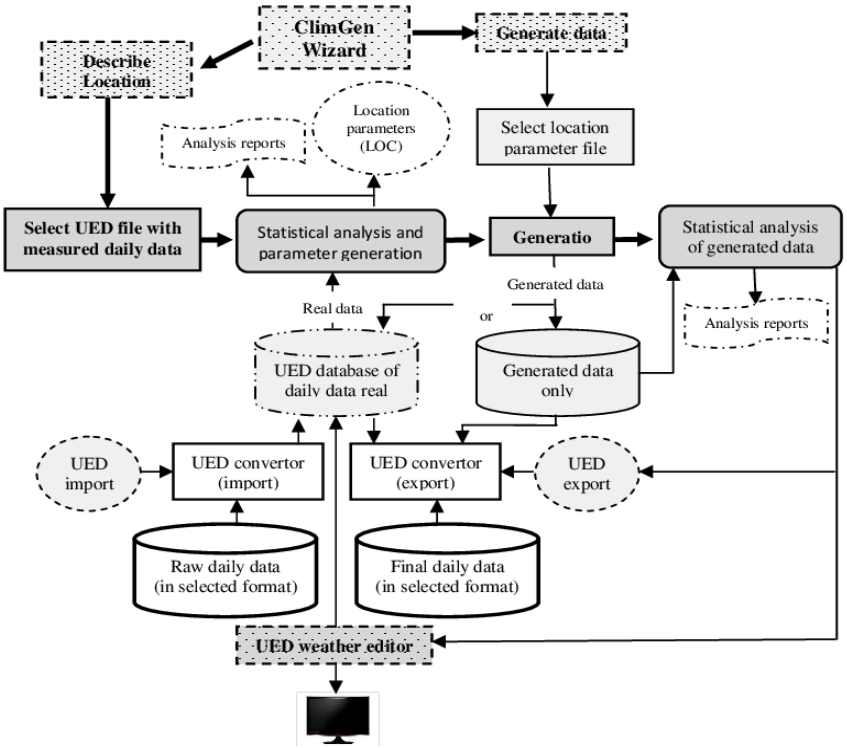

Figure 2. *Stages of synthetic generation of weather data by weather generator ClimGen (http://sites.bsyse.wsu.edu/CS_Suite/ClimGen/help/).*

Based on the data derived from the General Circulation Models CGCM3.1/T63 and MPEH5-OM, the downscaling of a 23-year data set (1977-2000) of daily climate variables performed using the weather generator ClimGen for the generation of synthetic time series which depict the future change of the climate variables. The climate variables that were used included precipitation (Pr), maximum and minimum temperature (T_{max}, T_{min}), solar radiation (R_s), maximum and minimum relative humidity (RH_{max}, RH_{min}), and wind speed (u_2). In the case of precipitation, a 25 year data set (1975-2000) was used in order to meet the model's requirements for the synthetic generation of precipitation. For the different climate variables, the change between the baseline period and the period of climate change was calculated. According to that change, the historic data series of the study area was perturbed. The perturbed time series then was used by ClimGen for the generation of synthetic time series of the weather variables which preserve the statistic characteristics of the historic time series. The generated weather data series was compared with the observed weather data series for their means, variance and skewness coefficient for the confirmation of the ability of the method in the synthetic generation of time series. The observed and generated weather data series were used as inputs to the Thornthwaite and Mather model to estimate the monthly water balance of the Olynthios River Basin for the two periods of climate change 2020-2050 and 2070-2100 under SRES B1, A1B and A2.

Thornthwaite and Mather model

Water balance estimation is an important tool for climate classification, hydrological characterization for water management, environmental studies and agricultural planning to define land use and agricultural practices. Monthly water balance models were first introduced by Thornthwaite (1948), followed by Thornthwaite and Mather (1957), in order to establish realistic and deterministic procedures for partitioning rainfall into evapotranspiration and water surplus. Despite their simplicity, these models have been shown to estimate monthly runoff reasonably (Alley 1984; Karpouzos et al. 2011). In this study, a Thornthwaite and Mather type model - a three parameter monthly water balance model - was used for evaluating potential climate change in Olynthios River Basin.

The three parameters used by the model are: the maximum soil moisture S_0, deep percolation coefficient b and coefficient of lag runoff a. Maximum soil moisture S_0 is estimated with the use of Curve Number (USDA 1986) based on the geomorphological characteristics and land use of the water basin. The deep percolation coefficient b can be calculated according to the individual coefficients of deep percolation of each geological formation of the river basin. Finally, the coefficient of lag runoff a is based on geological structure, land use and water basin slope. The Thornthwaite and Mather modeling procedure as it is implemented in the current study is in the following Figure 3. Initially, the soil moisture (S_0) is calculated using water surplus (F_p) and water deficit (D_p) for each month. Deep percolation (G) is estimated as the difference between soil moisture (S_0) and actual evapotranspiration (ET_c). Available volume for runoff (V) gives direct runoff (R_1) whereas in case soil moisture is above field capacity, available volume results in indirect runoff (R_2). Total runoff (R) is estimated as the linear sum of direct and indirect runoff.

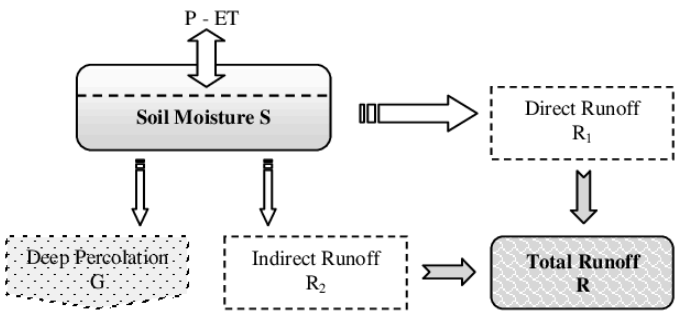

Figure 3. *Schematic description of Thornthwaite and Mather type model.*

Mean areal precipitation and temperature time series of the Olynthios River Basin are used as inputs to the water balance Thornthwaite and Mather model, including 1977-2000 time period (23 hydrological years) and the two climate change periods in a monthly time step. In addition to Agios Mamas station, precipitation data were collected from five stations situated in the study area to conduct a linear relationship between mean annual precipitation and the elevation of each station. These stations are Taxiarhis, Arnaia, Megali Panagia, Plana and Ormylia. It is observed that precipitation increases with altitude by 36.69 mm/100 m. Mean areal precipitation of Olynthios River Basin was computed using the data from the Agios Mamas station as the reference time series and the above variation. The mean areal temperature time series of Olynthios River Basin was computed using the temperature - elevation linear relationship (lapse rate method) over Greece for each month by setting data from the Agios Mamas station as the reference time series.

Results and Discussion

This study was mainly focused on the impact of climate change on the water balance of the water basin of Olynthios River in Northern Greece. For this purpose, the Thornthwaite and Mather type model was used for the estimation of the monthly runoff of Olynthios River Basin, as well as the monthly precipitation, temperature, actual evapotranspiration and percolation. In Figure 4, the monthly precipitation and temperature of Olynthios River Basin under SRES B1, A1B and A2 projected by CGCM3.1/T63 and MPEH5-OM for the periods of climate change (2020-2050 and 2070-2100) and for the baseline period (1977-2000), are depicted. The results indicate that future monthly precipitation is predicted to decrease according to the three SRES scenarios during the periods 2020-2050 and

2070-2100. Monthly temperature of Olynthios River Basin is projected to increase during the periods of climate change 2020-2050 and 2070-2100, compared to the historical period. The observed changes in monthly precipitation and temperature of the water basin will be higher for the climate change period 2070-2100 compared to 2020-2050. The lowest value of temperature is observed in March varying from 2°C - 5°C whereas the highest is in July and goes up to 23°C - 27°C during 2020-2050 and 2070-2100, respectively. The lowest values of monthly precipitation in the basin are recorded in November and December while the highest values in February and March for both periods of climate change.

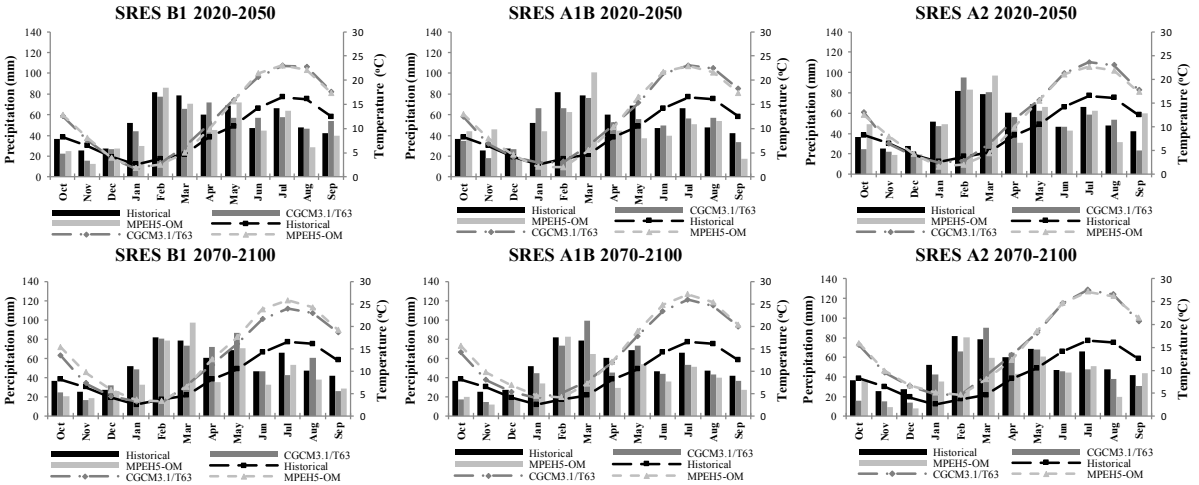

Figure 4. *Monthly precipitation and temperature of Olynthios River Basin according to CGCM3.1/T63 and MPEH5-OM during 2020-2050 and 2070-2100 under SRES B1, A1B and A2 in relation to 1977-2000.*

The mean monthly percolation and the actual evapotranspiration in the river basin for the periods of climate change 2020-2050 and 2070-2100 are depicted in Figure 5. It can be noted that the lowest values of monthly percolation are detected from July to September, approximating 0. Actual evapotranspiration is projected to increase under the three SRES scenarios during both climate change periods, due to higher temperatures and lower precipitation in the future, affecting, in turn the water balance of Olynthios River Basin.

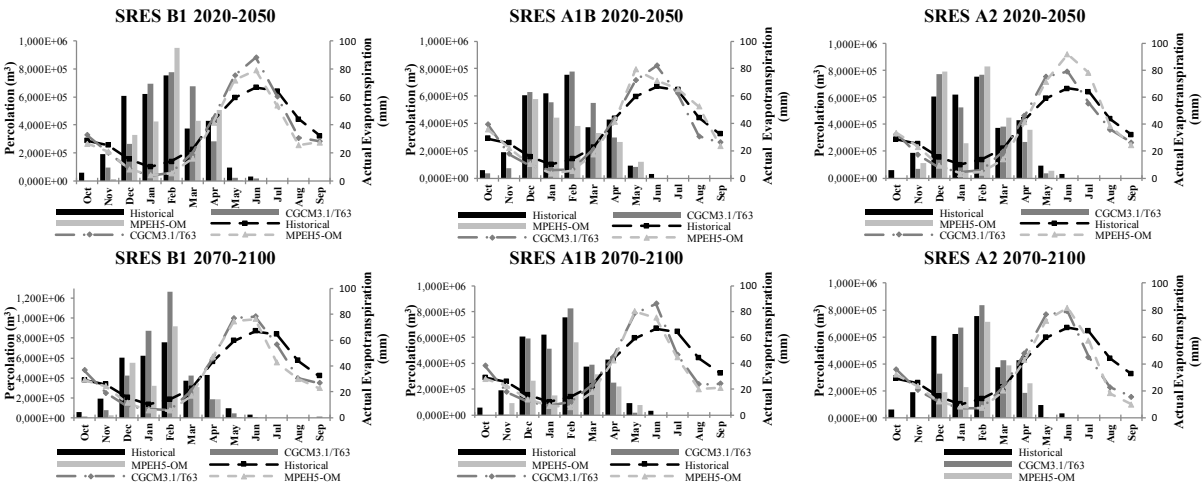

Figure 5. *Monthly percolation and actual evapotranspiration of Olynthios River Basin according to CGCM3.1/T63 and MPEH5-OM during 2020-2050 and 2070-2100 under SRES B1, A1B and A2 in relation to 1977-2000.*

Table 1 shows the differences in annual runoff of Olynthios River Basin according to CGCM3.1/T63 and MPEH5-OM under SRES B1, A1B and A2 for the periods of climate change 2020-2050 and 2070-2100 in relation to 1977-2000. It can be noted that both General circulation Models predict a decrease in the annual runoff for the three SRES scenarios for both climate change

periods compared to the historical period. The GCMs produced higher changes in annual runoff for the climate change period 2070-2100 than for the period 2020-2500. CGCM3.1/T63 under SRES B1 gives a slight increase (5%) in the annual runoff of Olynthios River Basin for the time period 2070-2100. MPEH5-OM predicts a higher decrease (9% to 47%) of the annual runoff compared to CGCM3.1/T63 (5% to 23%) under the studied SRES scenarios. For the period 2020-2050, the greatest decrease of the annual runoff (33%) is detected under SRES A1B according to MPEH5-OM and the slightest decrease (5%) under the same SRES scenario according to CGCM3.1/T63. For the climate change period 2070-2100, MPEH5-OM under SRES A2 predicts the highest decrease. Figure 6 shows the monthly runoff of Olynthios River Basin during the climate change periods 2020-2050 and 2070-2100, under SRES B1, A1B and A2 according to CGCM3.1/T63 and MPEH5-OM General Circulation Models. It can be noted that the greatest values are detected in February, March and April while the lowest values occur in August, September and October.

Table 1. *Differences in annual runoff of Olynthios River Basin according to CGCM3.1/T63 and MPEH5-OM during 2020-2050 and 2070-2100 under SRES B1, A1B and A2 in relation to 1977-2000.*

GCMs Models	**Mean Annual Runoff of Olynthios River Basin (m^3)**						
	Historical 1977-2000	**SRES B1**		**SRES A1B**		**SRES A2**	
		2020-2050	2020-2050	2020-2050	2070-2100	2020-2050	2070-2100
CGCM3.1/T63	**22504329**	**20152602** -10%	**23684402** 5%	**21323982** -5%	**18436073** -18%	**20149115** -10%	**17364997** -23%
MPEH5-OM		**18900996** -16%	**16445140** -27%	**15048106** -33%	**20395789** -47%	**20395789** -9%	**12632210** -44%

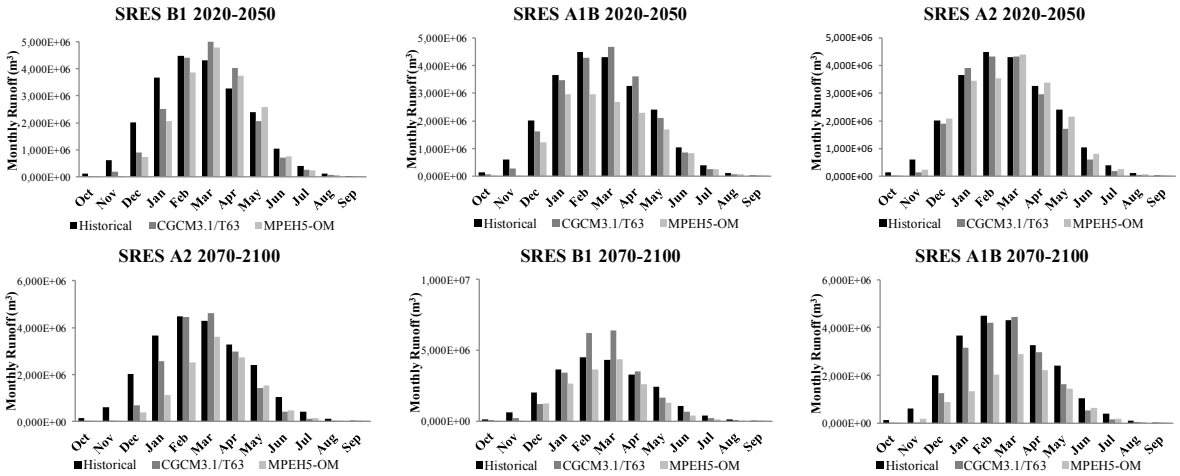

Figure 6. *Monthly runoff of Olynthios River Basin according to CGCM3.1/T63 and MPEH5-OM during 2020-2050 and 2070-2100 under SRES B1, A1B and A2 in relation to 1977-2000.*

Conclusions

In this study, the effects of climate change on the water balance of Olynthios River Basin in Chalkidiki, with the implementation of the Thornthwaite and Mather type model, were assessed. The results suggested that monthly temperature will increase while monthly precipitation in the water basin is expected to decrease for both periods of climate change relative to the baseline period (1977-2000). Changes in actual evapotranspiration which are controlled by changes in precipitation and temperature of the water basin will, in turn, impact on the water balance of Olynthios River Basin. The results indicate that climate change will decrease the runoff of the water basin of Olynthios under B1, A1B and A2 SRES scenarios for the two time periods of climate change 2020-2050 and 2070-2100. The predicted decrease in annual runoff will be higher for the climate change period 2070-2100 in relation to 2020-2050. The above changes in water balance due to future climate change will decrease the water resources availability. As a result, this can lead to a deficit in water available for irrigation or a decrease of the irrigated areas affecting crop production and thus the sustainability of the agricultural sector. Climate change impacts on water recourses require careful assessment and it is important to

develop adequate adaptation strategies which could improve agricultural water management and reduce the impacts of climate change on agriculture.

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SUSTAINABLE DESIGN THROUGH THE EXAMPLE OF THE INNOVATIVE BIOCLIMATIC EUROPEAN SCHOOL IN CRETE

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Abstract

Through the example of the Innovative, Bioclimatic European School in Heraklion, Crete, principles of sustainable, holistic design will be discussed, considering the aspects of a harmonious coexistence between natural and built environment. The bioclimatic and ecological design of the school enables experiential environmental education. Natural lighting and air quality are achieved through non-toxic materials, which ensure a healthy environment and well-being. The integration of nature into architecture, the natural environment of the inner courtyards, small scaled building volumes and an immediate contact with earth cultivate a positive attitude towards life and develop ecological consciousness. Vegetation improves microclimate and enables the use of outdoor space throughout the year. With passive design and some supplementary use of RES, renewable energy sources, the energy performance of the building complex achieves almost zero energy consumption.

Keywords: *European School Crete, bioclimatic design, sustainable design*

Introduction

The project is the 1st prize of the International Architectural Competition 'Innovative Bioclimatic European School Complex in Crete, Greece' organized by the School Buildings Organization (SBO) in association with the International Union of Architects (UIA). The realization process is at the stage of the Detailed Design (2017). Preliminary and Final Design have already been approved. The European School is addressed to 780 pupils aged 5 to 18 years. It is comprised of Preliminary, Primary and Secondary Education, with independent sub-directorates and a General, Central Administration. The building complex of 7,700 m², where sheltered outdoors are included, stretches across an olive grove of 15,748 m² next to the University campus.

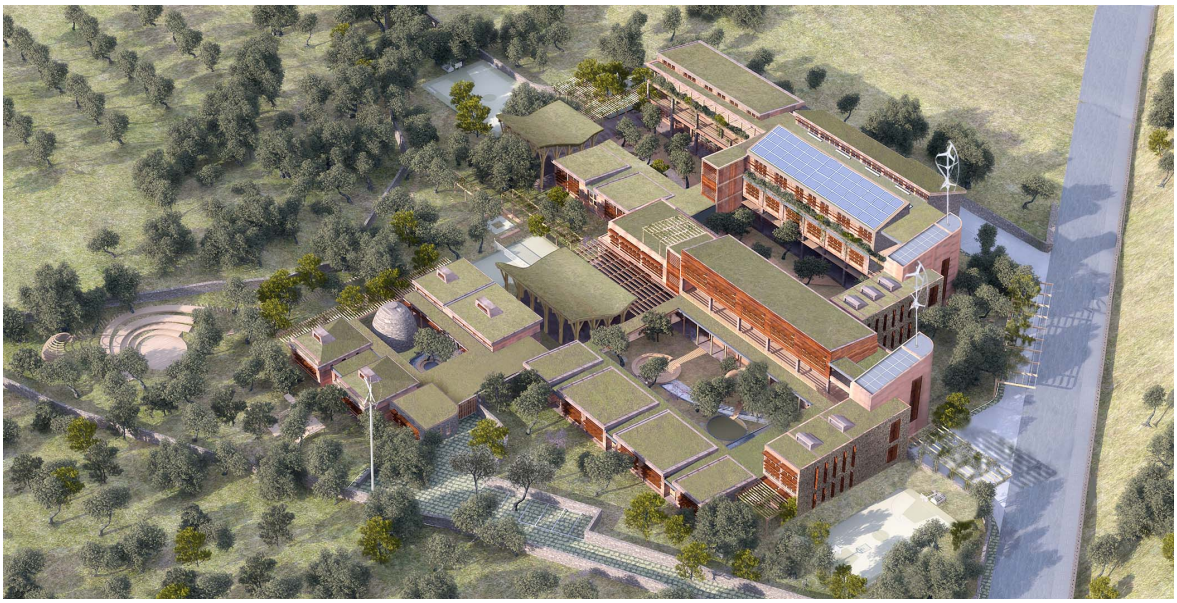

Image 1. SE bird view perspective of the school complex

The school is organized around a sequence of courtyards – patios, which are formed as natural environment. In their function as lungs of action, courtyards surrounded by arcades provide access to the teaching spaces. Buildings connected to each other by those courtyards have small volumes. The three schools define through their volumes their territory and avoid any fencing. Liquidity on the boundaries between inside and outside, with arcades and sliding windows, give to the interior a sense of semi-outdoor and encourage outdoor classes. All buildings have south orientation for maximum thermal gains and natural lighting due to their small depth. This supports the learning process and stimulates the production of serotonin, the hormone of happiness. The bioclimatic design offers to pupils experiential environmental education. They experience the cycle of life, the day and seasons changes.

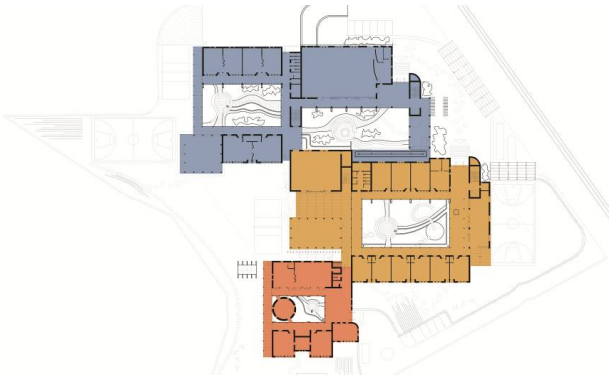

Image2. Plan of the three schools: Secondary School, Primary School, Kindergarten

Image 3. Inner courtyard of the Kindergarten

Materials and Design Methods – Concept

Courtyards formed as a natural environment

The buildings are organized around courtyards of varying sizes. Access to all spaces happens through the galleries. The creation of a natural environment plays an important role in the psychomotor development of children. Sheltered outdoor spaces accommodate places for play, exploration and action. A variety of natural materials and natural experience stimulates the neurotransmitters and produces a sense of well-being. The element of water, except of its cooling properties, is an educational tool for natural observation. Shallow ponds and streams enable experiments in Physics through play.

The school is a place of inspiration for environmental awareness

The contact with the natural environment plays a catalytic role in students' perceptual ability, cultivates respect and self-esteem. Nature penetrates into the class rooms through large southern windows. Natural, ecological construction materials introduce to children a manmade natural environment.

Image 4. The courtyard of the Secondary School

Small scaled buildings in harmony with the natural environment

Following the slope of the plot and its particular shape, buildings embrace the courtyards with small volumes and a narrow depth. Buildings are integrated into the environment and are reflecting the pupils' ages.

Bioclimatic design

A combination of passive cooling and heating systems in harmony with timeless principles of ancient and vernacular local architecture are adopted. Principles of Socrates' solar house, with

small northern and large southern openings with horizontal shades are followed. Buildings in the south keep a low height, so that courtyards and southern facades remain sunny in winter. In the summer deciduous trees, sheltered outdoors and pergolas provide shade.

Image 5. Inner courtyard of the Primary School

Southern orientation

All buildings are turned 100% to the south for a maximum heat gain in the winter. When the sun comes in contact with glass surfaces and penetrates into the interior space, it converts to thermal energy and is trapped. With southern orientation, sun protection is easy in the warm months. The shallow depth of buildings enables passive heating in the numerous sunny days of winter, even in secondary areas. Having good insulation and adequate thermal mass, thermal comfort is ensured.

Thermal mass

Earthen blocks are used inside of the buildings as filling walls. Earth is a material of maximum heat capacity for decreasing temperature fluctuations in the interior and achieving thermal comfort all seasons. In the winter, earthen blocks are heated during the day and give the heat back, maintaining a constant inner temperature. In the summer, the night temperatures cool down the earthen blocks and keep the interior of the building cool until next sun set.

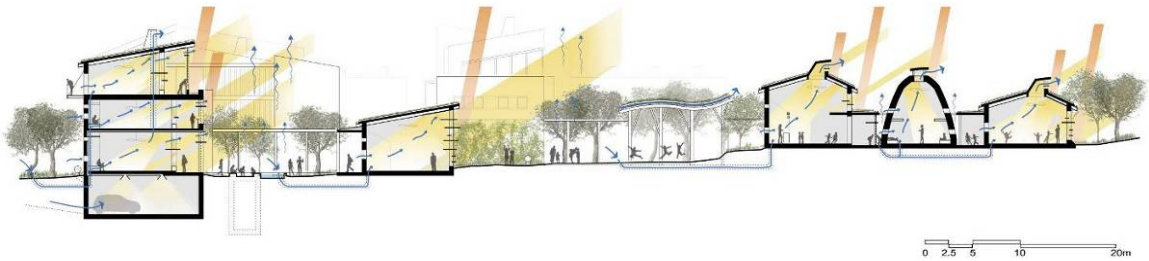

Image 6. Section of the school complex with summer and winter sun and natural cooling through stack effect

Passive heating systems

In addition to direct sunlight, passive heating systems such as winter gardens and Trombe walls, are adopted on the southern elevations. Heat transmission happens without additional mechanical support. The southern arcades of the buildings are transformed into winter gardens. Winter solar radiation penetrates the glass, heats the air and the structural elements inside. Heat is transmitted to the neighboring spaces. In the summer, glass is removed and stored in adjacent, shaped cupboards. Arcades are used as outdoor spaces during the hot months. Thermal walls Trombe are designed next to large southern windows where arcades are missing. In the summer they are ventilated in their lower and upper zone. Horizontal blinds protect the glass surface from the summer sun. Thermal mass materials ensure balanced inner temperature.

Natural cooling in the summer and passive cooling systems

Natural cooling without any mechanical air conditioning utilizes mainly ambient night temperatures. Night temperatures cool down thermal mass elements. Then, they give back their low temperature to the interior space during the day. Natural cooling is achieved: 1. With appropriate external shading. 2. With the stack effect, a vertical ventilation inside the buildings. Each room has low northern and high southern openings, as well as cooling chimneys. Hot air of the higher zones escapes through high openings, while incoming cool air rises upwards. Outside of the low openings, planting and shading keep temperatures low. The optimal thermal comfort is ensured through simulation programs, which examine air and fluid movement and thermal behavior. 3. With thermal mass materials, which contribute to the maintenance of a cool interior in the summer.

Sun protection

Full sun protection of the southern glass facades is a prerequisite for natural cooling. This is achieved with wide, horizontal blinds, with arcades, pergolas and climbing plants. Western and eastern sides require outside of the openings vertical blinds, cooling corridors made of pergolas and climbing plants creating vertical green walls, as well as trees. An effective sun protection on the southern facade is shading the soil, so that it does not overheat and reflect loads to the buildings. Deciduous trees are planted, which while shading effectively the southern terrain, do not shade the facade.

Natural ventilation and natural lighting

Every space, even the auxiliary ones, have natural ventilation. Respective care has been given for natural lighting. Reflectors in halls and louvers in the south, west and east elevations provide indirect, diffused natural lighting, suitable for work. All spaces are naturally lit from at least two directions to avoid glare and guarantee visual comfort.

Microclimate improvement

The architectural design of the school complex creates protected outdoor spaces with comfort conditions facilitating their use throughout the year. Microclimate improvement is achieved due to the reduction of summer temperature and the creation of thermal comfort during the winter season outdoors. Furthermore, deciduous trees decrease the speed of winter winds and increase summer shading.

Plantation

Roofs receive the greatest amount of solar radiation. Therefor they need sun protection and a good thermal insulation with an intermediate layer of air. They are planted with endemic species that do not need grooming. The 15 cm soil thickness prevents growth at height and therefore no care is needed. With the same logic, many walls are planted with indigenous climbing plants, which help to maintain a balanced climate. In the courtyards deciduous trees reduce the average temperature of the area during the warm months while evergreen trees at the northern sides of the complex ensure a mild climate in the winter and a balanced humidity. Vegetation, in addition to ensuring shading, has the unique property of absorbing solar radiation and consuming its energy loads during the photosynthesis process. It contributes to the recycling of carbon dioxide in the area, as well as to the retention of toxic compounds and dust particles. It is necessary to relocate trees from the areas where the buildings are placed. Immediate transplantation takes place at selected locations on the plot, especially in northern areas. In the southern direction new deciduous trees are planted.

Image 7. Interior of the Kindergarten with sun reflectors on the windows

Planting also has an educational purpose. For this reason, plants that provide a variety of flowering and fruiting are proposed, which are in harmony with the olive grove. Small labels are proposed indicating each different variety of trees and shrubs.

The element of water

To improve thermal comfort, the element of water is used as an important cooling medium. The climatic statistics of the area show that the average relative humidity for the whole year ranges between 56% and 68% in the morning hours and 45% 56% at noon. This means that it is possible to cool the area's breeze currents through water elements such as water walls, streams and small, shallow ponds, using rainwater.

Winds

The school complex has openings – passages to the local summer breezes in order to cool the internal courtyards and buildings. Increasing planting and enriching it with high and medium evergreen vegetation creates a windbreaker that filters and significantly reduces the intensity of the northern winter winds.

Outdoors floor material

The choice of materials for outdoors use is determined by four factors; their impact on the microclimate, safety, maintenance and low cost.

Microclimate simulation studies

To optimize the thermal comfort levels of outdoor areas, to select the appropriate thermophysical properties of their flooring materials and the layout of tree plantations, microclimate simulations were made with the ENVI-met model.

R.E.S. Photovoltaics and Wind Turbines

The building complex incorporates energy saving systems such as photovoltaic panels, wind turbines, monitoring and management system of the building - BEMS (Building Energy Management System), rainwater, drinking water and waste management systems. Three small wind turbines are placed for educational purposes, one at the entrance of each school. Few photovoltaics are also placed for educational purposes on the roofs above the physics laboratories for students to experiment, at the stairwells and pergolas of outdoor spaces in the form of louvers.

It is a conscious decision of the designers to give emphasis on the natural element, the green roofs, the passive design, which cost as a conventional construction, and to avoid as much as possible the R.E.S., which burden the budget and alter the natural landscape. The control of building energy circuits is carried out by central BEMS energy management systems. The aim is to ensure the safety of

the various energy systems of the school and their cooperation in order to achieve the minimum possible electricity consumption and consumable resources with the maximum use of the systems based on the natural energy resources of the area (sun, water, biomass, etc.). Also the BEMS system ensures automatic night opening of the ventilation.

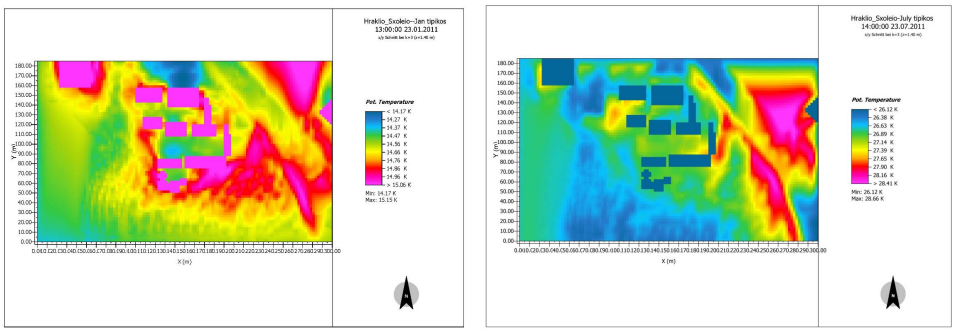

Image 11. Average winter and summer outdoor temperature at a height of 1,50m at 14:00

Sewage treatment and rainwater collection system

As part of the effort to reduce energy consumption and dependence, as well as apply natural methods to meet building needs, the sewage treatment system is using sedimentation and absorption of the biological load through a series of low plants, shrubs and reeds. There is a rainwater collection system that ends up in tanks and is then recycled.

Construction and materials

All materials used in the European School are ecological. Priority is given in the regional resources and in low embodied energy materials. The use of natural materials creates a high-quality of indoor air, resulting in the well-being for the users. A healthy built environment is a priority for a learning space as well as for the cultivation of eco-consciousness. Materials with toxic pollutants are avoided, while only clean, natural ones are proposed. Thus the building's latent breathing is ensured and the moisture of the indoor air is released. The loadbearing structure is from reinforced concrete, while the multipurpose buildings of the Secondary and the Primary School have mixed construction. All sloping roofs are timber with visible woodwork inside. The outdoors sheltered multi-activity areas are made of plywood, which imitates the curves of the terrain and the relief of the olive groves. Several arcades and pergolas of the complex are made of timber.

The excavation soil is being utilized for the construction. The soil has been tested for its use as a building material for non-bearing walls by the specialized, certified Building Materials Laboratory of the Aristotle University of Thessaloniki, School of Civil Engineering, Department of Construction Science and Engineering, Professor I. Papagianni. Laboratory tests were carried out for the preparation of stabilized earthen blocks, as well as manufacturing instructions. One of the primary reasons for using earth internally is the great thermal mass of the material. This achieves the quench of external climatic changes, a depreciation of the external climatic changes and the keeping of internal temperature at relatively constant values. The internal plasters are made of earth. The insulation is mineral wool with ecological binding, without formaldehyde.

Stone, a material fount in abundance in Crete, is used mainly outdoors in the school complex as well as in external wall surfaces that need protection from weather conditions and use. Formations of open and sheltered spaces are also made of stone. The second floor above the Elementary School, which houses the General Secretariat of the whole complex, has an exterior cladding of thermo-wood, to emphasize its different use. There are such wooden claddings in the local traditional architecture. In the north, east and west facades, green walls are formed with the support of a light metal structure. Indigenous climbing plants with no

maintenance requirements are selected. A thin, stainless steel mesh on the northern elevation of the Elementary School wall, forms an elongated 'wall of water', directing a flow of water from the upper floor to the ground. This element separates the Elementary from the Secondary School and brings coolness in the warm months. In winter, the rainwater flows down through the same wall but locally in chains, as well as in other points of the courtyards, making it possible for students to observe the water. In the layout and landscaping of the open spaces pressed earth is applied, tree trunks, perforated blocks and stones. Reeds, which are found abundant in Crete, are used for outdoor constructions as well as for interior design.

Earth as building material

It is a local material found in abundant quantities all over Greece, especially in flat areas. Earth is the friendliest building material for users and environment.

1. In terms of thermal mass, earth is ideal.
2. Earth regulates internal air-humidity. It absorbs excessive humidity or reemits the necessary humidity maintaing its percentage around 50 to 55%. In contrary, in conventional building materials the fluctuations of indoor air humidity usually ranges between 20% in winter and 70% in the summer.
3. It absorbs the toxic pollutants, filtering and purifying the air.
4. It blocks harmful high-frequency electromagnetic radiation.
5. It is a low embodied energy material.
6. It is recyclable. After its demolition it is completely assimilated from the natural soil. Its building components can be re-used.
7. In terms of toxicity, it is the cleanest among the soil building materials and beneficial to health.
8. It opens up opportunities for low cost construction. In Germany earth adobes cost 40% less than fired blocks.

Results - Conclusions

The school complex will consume very little energy per year and at a low cost. It has particularly low heating and cooling requirements. The European School Project has been registered to the international assessment program LEED (Leadership in Energy and Environmental Design) which certifies the energy and environmental performance of buildings. The project contains a synergy of techniques, holistic approach, focusing on the natural environment and not just on energy planning. The aim is the implementation of this school to act as a prototype for planning and building healthy environments. Experiential learning and experimentation is the one parameter and saving energy in a broader sense is the other. In addition, it is expected that the repetition of the construction methodology will lead to the formulation and application of ecological materials on a large scale, such as the production of earthen blocks in Greece. Finally, a sustainable school is the best place to activate love for the environment and life.

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Image 11. Harmonious coexistence of natural and built environment

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AGRO-FOOD PRODUCT COMPANIES AND FACTORS AFFECTING CONSUMERS' COMPLAINING INTENTION: A KEY POINT FOR THEIR SUSTAINABILITY THROUGH ECONOMIC CRISIS

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Abstract.
In this paper consumer's dissatisfaction of agro-food products is studied. Specifically, the main reasons for triggering dissatisfaction are identified and ranked. Additionally, the factors that affect consumer's complaining behavior is also studied and the level of complaining adoption are investigated. Moreover, consumer's future intention to complain traditionally or electronically is depicted. Lastly, relationships of their complaining behavior and intention to some demographics are found and commented.

Keywords: consumers' satisfaction, Agro-food products, complaining behavior, electronic means

Introduction

The ability of an enterprise to handle the complaints of its customers has become one of the most controversial issues and a focal-point in the business field. Many firms have utilized the Customer Relationship Management (CRM) system for improving customer services and increasing customer value through understanding and satisfying individual customer's needs. Service providers that fail to match their customers' needs and tastes and keep in track with changes in customers' preferences, put their firm's existence in danger (Tsoukatos 2008).

The effective cure of customer's complaints brings benefits to the organizations that collect and process that kind of information of their customers. It is not only the complaints but the whole consuming profile of the customers that is needed to be stored. Without customer data, the companies will not be able to segment the market and project the potential sales from each group. All firms are collecting information about their customers at every possible way. The type of information collected could not be standardized, but the quantity and quality depend on the sophistication of the system used. Especially, for agro-food businesses, the internet offers the potential to gather and store a lot of information. Many social media Websites provide online platforms within which consumers communicate with others who have information or previous experience about products and services. In this context, online reviews play a key role in buying products and thus, social networking websites traffic has increased (Mauri and Minazzi 2013). These reviews provide customers experience and offer recommendations to potential customers. This phenomenon is quite strong in for some economical areas like the hotel industry for example, where Gretzel (2006) stresses that 77,9% of online users are affected in deciding "where to stay" based on online reviews. However, in areas like agro-food products this is slightly developed or not developed at all. This is a gap in the Literature and it exists due to the fact that agro food companies especially in Greece are not mature enough to use the electronic means and/or not understand fully the need to store information regarding their customers.

The analysis of online customer negative comments, originating from third parties, or even from the companies' website if available, is needed. The marketing variables entailed in the websites are usually those that have to do with product's quality, price, etc. Simultaneously, the negative comments and/or complaints are necessary for the companies to find out weaknesses. Moreover, the complaining behavior and intention of the consumer is rather important.

Agrofood Companies should entail the customer complaining behavior variables in their IT systems and, especially, in the CRM software and store data for further manipulations. The aim of this paper is to investigate the consumer's dissatisfaction related to agro-food products and their attitude, behavior and intention to complain. Specifically, the objectives of the paper are:

To investigate the profile of the sample of the research

To investigate the reasons of the consumer's dissatisfaction

To investigate their complaining intention

To investigate whether the consumer's characteristics are related to the degree of the consumer's complaining intention

The paper is organized as follows. In section 2 there is the literature review. In section 3 the methodology is described. In section 4 results are depicted and in the last section some conclusions are presented along with limitations and further research.

Literature review

Individual customer satisfaction is quite important for a company. Relationship marketing is at the center of companies activities. The adoption of customer-centric orientation though all business procedures, has as goal to establish long-term relationships with customers. Thus, improved customer services and customer satisfaction is achieved, and hence customer retaining and purchase increase is accomplished (Sarmaniotis and Stefanou, 2005). Nevertheless, customer relationship management (CRM) aims to a more forward step. CRM is defined as an approach of the management that among others aims to maintaining successful customer relationships over time in order to increase profitable customers (Bradshaw and Brash, 2001). Moreover, Fjermestad and Romano (2003) maintained that successful CRM requires attracting and keeping economically valuable customers while eliminating economically invaluable ones.

All companies want to collect information about their customers. The most important thing is their ability to achieve the collection of customer information and moreover, to exploit using data mining techniques to extract useful information out of this enormous data collection. Undoubtedly, the latter has been identified as a critical ability of a company to reinforce its relationships with the customers. Although, there are papers in CRM in particular that have shown that customer satisfaction is a critical point in retaining a competitive advantage for a company's sustainability and repeat sales (Oliver, 1999; Parasuraman and Grewal, 2000) and finally to customer retention.

Customers usually have some expectations about a product or service and when their expectations are not met they feel dissatisfaction which might lead to the adoption of one or more types of complaining behavior as Stefanou et al. claimed (2003). Moreover, it should be noted that customer complaining is strongly related to the notion of customer dissatisfaction. Hence, consumers' complaints should be studied so that the management could have the ability to find out how consumers perceive service quality. However, there is a lack of including the customer complaining behavior data collection in the CRM systems applied and especially in the agro-food companies.

There is a range of channels which can provide fast and easy methods to express one's experience (Au et al. 2009), such as social media (facebook, twitter, linkedIn), petition lists to sign, blogs, or even more to some areas special websites. For example in the hotel industry, there are many electronic means to express their comments. Prior studies (Houser and Wooders, 2006) showed that customers seriously consider online feedback when making purchasing decisions, Ye et al. (2009) present a quantitative analysis that shows how a 10% improvement in reviewers' rating can increase sales figures by 4.4%.

Thus, review websites for products, or more generally electronic means of complaining should be considered by companies and even more from agro-food companies in order to understand their customers complaining behavior, decrease customer dissatisfaction by increasing customer's perceived product quality. To the best of the author's knowledge electronic complaining behavior regarding agriculture food products has not been studied extensively yet, although it is a quite important industry especially for Greece.

Methodology

A structured questionnaire has been used to facilitate the needs of this survey. There were questions that were used to identify whether the customer had a previous bad experience with some agro-food products. Additionally, there were questions investigating the complaining behavior followed after their sad experience. Finally their intention is investigated. The profile of the consumer is also examined using demographic parameters and psychographic characteristics.

350 sample members were gathered by interviews electronically or by face to face interviews. The sample although random it was not stratified. Descriptive statistics and significance test hypotheses are used in order to statistically process data. Results of the statistical analysis are followed.

Paired samples T-Test has been used to determine whether there is a statistical significant difference between the consumers complaining behavior and their intention to complain in the future. Their future complaining behavior depends somehow on the experience they had after their recent actual complaining behavior. An interesting point would be to investigate if the future reaction is stronger or milder.

Results and discussions

The majority of the sample was females (57,6%). Regarding the education level of the consumers the fourth of the sample holds a graduate degree or a post graduate degree, 56,9% were students and the rest of the sample has up to 12 years education. 70,1% was aged up to 24 years old, 15,3% was from 25 to 34 years old, 8,3% from 34 to 44 years old and 6,3% more than 45 years old. 38% of the sample has an annual income up to 10000 euros, 17,4% from 10001-15000 euros, 8,3% 15001-20000 euros and the rest of the sample more than 20000 euros.

Many reasons have been found as a source for consumer's dissatisfaction. 47,9% recognized that the product did not have good taste, whereas 45,8% responded that quality was not the appropriate and 38,2%% claimed that the product shortly degraded after buy. 20,1% said that the price was high, 12,5% that the product and its commercial differ substantially 5,6% that the product's package was misleading 4,9% that the package was not functional and 2,8% that the package information was not clear.

Regarding the complaining behavior results shown that more than 76,6% did nothing or just discussed the situation with others, when they experience a problem with an agro-food product. On the contrary more than 97% intent to have a more intensive reaction in the future compared to the reaction they had in the past. Both results depicts that there is a difference to their behavior and their future intention.

Table 1. *Complaining behavior of a consumer towards problems originating from agro-food products*

Complaints			
	Frequency	**Valid Percent**	**Cumulative Percent**
Do nothing	8	5,7	5,7
Weak complaining behavior	100	70,9	76,6
Moderate complaining behavior	27	19,1	95,7
Strong complaining behavior	6	4,3	100,0

Table 2. *Intention to complain of a consumer towards problems originating from agro-food products*

Intention			
	Frequency	**Valid Percent**	**Cumulative Percent**
Weak complaining behavior	4	2,8	2,8
Moderate complaining behavior	103	71,5	74,3
Strong complaining behavior	37	25,7	100,0

Comparing reaction by reaction between the actual complaining behavior and their intention to complain the difference is prominent in any case and statistically significant. The latter means that the consumer is not satisfied probably with the results of his/her behavior and he/she regrets that the reaction was not more intense. Moreover the future reaction will be stronger as consumer is less ready to forgive a problem originating from the consumption of problematic agro-food products.

Paired Samples Test

	Paired Differences					t	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			
				Lower	Upper		
Did nothing- Will do nothing	,23944	,53169	,0446	,1512	,32764	5,366	,000
WOM – Will do WOM	,30496	,49198	,0414	,2230	,38688	7,361	,000
Did not use the same label/branch again – Will not use the same label/branch again	,26761	,48983	,0411	,1863	,34887	6,510	,000
Complained written or orally to the selling point – Will Complain written or orally to the selling point	,38732	,53060	,0445	,2993	,47535	8,699	,000
Complained written or orally to the consumers protection organization or to the Mass Media – Will Complain written or orally to the consumers protection organization or to the Mass Media	,21127	,47387	,0397	,1326	,28988	5,313	,000
Demanded reimbursement from the selling point- Will demand reimbursement from the selling point	,20423	,43822	,0367	,1315	,27693	5,553	,000
Used legal means against the producer or the selling point – Will use legal means against the producer or the selling point	,04225	,20188	,0169	,0087	,07575	2,494	,014
Complaints on twitter, facebook or other social media, blogs or electronically signed petitions– Will complain on twitter, facebook or other social media, blogs or e-petitions	,35211	,47932	,0402	,2725	,43163	8,754	,000

Conclusions

It can be seen that the product quality can be considered as one of the most important reasons that contribute to consumer's dissatisfaction. The latter is very important in building stable relationships with a company's customers and hence, maintaining customers loyal.

Product's quality is the most important reason for not having satisfied agro-food consumers. Regarding their reactions when they face such a bad situation the so called word-of mouth and the boycott are the most popular complaining behaviors. The latter way of reaction rated as a weak reaction is preferred by the majority (70%) of the sample. However, this study reveals that the intention to complain is a step more intense. The intention to complain in a way that is rated moderate or strong reaches 96% of the sample which actually show that consumer's tolerance is reduced.

The paper cannot be generalized due to the geographical limitation of the sample. Further research should be made in the area for identifying demographic relationships and e-complaining behavior.

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BLUE SMART ECONOMY- NEW OPPORTUNITIES AND CHALLENGES: THE CASE OF GREECE

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Abstract

This paper attempts to critically analyses blue smart growth, as the long term strategy to support sustainable growth, in order to define its contribution to achieve the goals of the Europe 2020 strategy. This paper asserts that marine and blue related sectors constitute main drivers for the modern European economy, as well as a great potential for innovation and growth within European Union, committed to contribute to the goals of smart, sustainable and inclusive economic growth, as called for in the European Blue Growth Strategy within Agenda 2020. More specifically, the paper focuses on the case of Greece, based on the blue component, leveraged in the potential of different economic activities with technological innovation, contributing to the development of the economy. It mainly regards the potential of Greek sea and coastal regions, as well as the industries which use and exploit them as drivers of economic growth, as a tool towards current crisis.

Keywords: *Blue Growth, Smart Growth Sustainability, Greece*

The Concept of a 'Blue Economy'

Blue Growth is the long term strategy to support sustainable growth in the marine and blue sectors as a whole, recognizing that seas and oceans are drivers for the economy with great potential for innovation and growth.The blue economy consists of all the economic activities related to the oceans, seas and coasts. This includes the closest direct and indirect supporting activities necessary for the functioning of these economic sectors.With the simultaneous growth of the ocean economy and the current rate of change to the ocean's ecological systems, the concept has become a more widely used lens for viewing the risks and opportunities in the ocean, as a tool for policymaking that provides a lens for looking at economic and environmental policy together, focusing on economic growth without a reduction in aggregate natural capital.

Figure 1: Blue economy conceptual framework

Source : Siemers, 2008

This conceptual framework explains graphically the key factors, and the presumed relationships among them. This Blue Economy Conceptual Framework aims to illustrate the inputs received by the ocean economy from the underlying natural capital, and at the same time the outputs from that economy that affect the levels of this natural capital and the flows of benefits that they can sustainably provide. This framework aims to capture the value of changes in the natural capital assets together with changes in economic activity, to measure the net benefit to society from this integrated blue economy (OECD 2016). Such interactions happen horizontally between different sectors of the ocean economy, and between different ecosystems of the ocean, as well as vertically between the economic sectors and ecosystems, which in aggregate affect the outcomes of the blue economy.

As such, governments that introduce policies to enhance or encourage the transition to the blue economy could help countries capture the potential benefits.

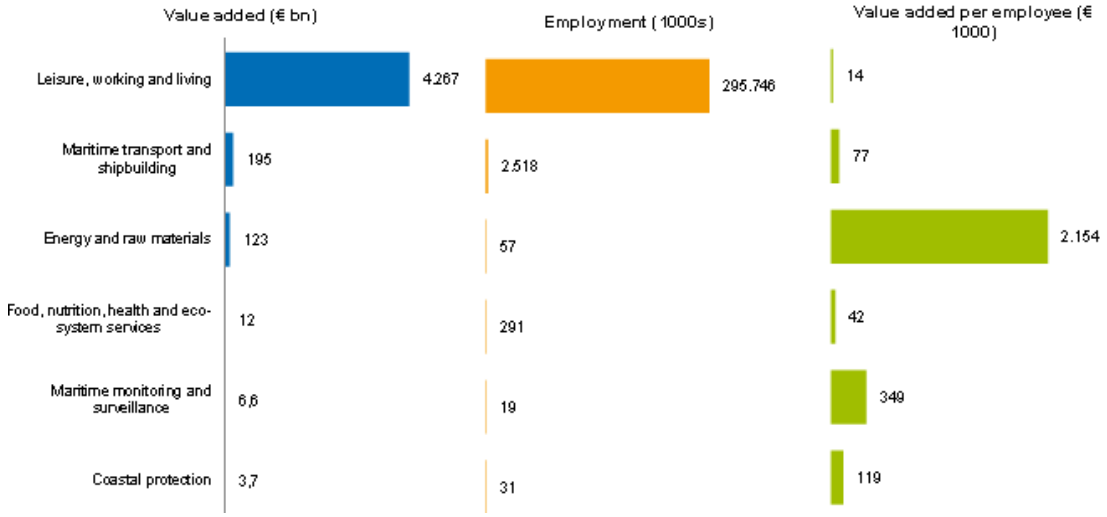
The case of European Union

Nowadays, driven by a growing global population and the need for new sources of growth, the ocean is becoming more and more an economic frontier. Two thirds of the Earth is covered by oceans and seas.Estimates of the ocean's contribution to the world economy range from US$1.5 trillion to US$3 trillion a year, about 3-5 percent of all economic activity in the world. Traditional economic activity of the ocean is projected to continue to rise—seaborne trade by 3 to 4 percent annually to 2030, global tourism by almost 4 percent annually to 2025. OECD projections show ocean-based industries as a group outperforming the growth of the global economy in the years ahead, doubling their contribution to GDP by 2030(Patil et al., 2016).

In essence, the transition to a blue economy involves shifting from the long-standing conventional wisdom of focusing on the costs of protection to instead recognizing the benefits of its ecosystems, incorporated as part of the measures of sustainable growth. Therefore, the impact of all ocean economy activities on the underlying ecosystems need to be minimized or else jobs and economic growth depending on the living resources will be put at risk(Patil et al., 2016).The goal, then, is to decouple economic growth from environmental decline. Common policy recommendations for this type of growth focus on better efficiency, new technologies, new markets, and the boosting of investor confidence (Patil et al., 2016).

Figure 2: Blue economic activities in the EU

The six main blue functions



Source: European Commission, 2017

The seven *biggest* blue economic activities alone today provide over 5 mln jobs.4 Coastline tourism and deep-sea shipping are the blue activities which currently provide most employment, followed by shortsea shipping – all employing from almost 1 to over 2m jobs each. Oil and gas are above all important for their GVA contribution (€ 23bn). Yachting and marinas, passenger ferry services and catching fish for human consumption each provide currently around 250,000 jobs. The blue economy is already vast with over 5 million people employed in blue sectors such as coastal and blue tourism, shipbuilding and fisheries, and it could grow further and employ 7 million by 2020. European Policies on blue economyCommon policy recommendations for green growth, such as those included in the OECD's global green growth strategy, often focus on:

■Enhancing efficiency in the use of resources and natural capital, and reducing waste (embracing 'circular economy' strategies for example);

■Spurring innovation of new technologies to simultaneously increase economic growth as measured by GDP and enhance natural capital, with a focus on the energy system;

■Creating new markets by stimulating demand for green technologies, goods, and services;

■Measuring natural capital as part of the economy, thereby incorporating considerations of the environment into broader economic decision making; and

■Boosting investor confidencethrough greater predictability and continuity in addressing environmental issues, while better understanding the scale of risks.

In 2011 the Commission adopted a Communication on Blue Growth showing how Europe's coasts, seas and oceans have the potential to be a major source of new jobs and growth that can contribute to the Europe 2020 strategy and improve the way we harvest the planet's resources. Innovation across all sectors of the blue economy is crucial for realising its growth and jobs potential.

Figure 3: Blue economy strategy

<table>
<tr><th>Monitoring Indicators</th><th>OP</th><th>NOS 2013-2020</th><th>Atlantic Action Plan</th></tr>
<tr><td rowspan="2">Context Indicators</td><td rowspan="3">Priorities</td><td>Strategic Objectives</td><td rowspan="2">Objectives</td></tr>
<tr><td>Action Plans Objectives</td></tr>
<tr><td rowspan="2">Outcome Indicators</td><td>Expected Effects</td><td>Specific Objectives</td></tr>
<tr><td>Output Indicators</td><td>Operations</td><td rowspan="2">Projects Monitorization/ Mar-Portugal Plan</td><td rowspan="2">(Projects of the Atlantic)</td></tr>
<tr><td>Financinal Indicators</td><td>Expenditure</td></tr>
</table>

Source : Siemers, 2008

The EU's Innovation Union Flagship Initiative is already helping to create an innovation-friendly environment. Small and medium enterprises (SMEs) have been supported by the Competitiveness and Innovation Framework Programme which mobilised more than €15 billion for SME's from 2007-2012. The new €79 billion Horizon 2020 programme has now become the EU's largest ever research and innovation programme and includes enhanced measures to support SMEs. In addition, a significant proportion of the EU's Structural and Investment Funds have been earmarked for innovation.

Remarkable progress has been made since the Commission adopted its European Strategy for Marine and BlueResearchin 2008. Under the Seventh Framework programme for research (2007-2013) the Commission contributed an average of around €350 million a year towards marine and blue research. In addition, as Figure 2 shows,a substantial amount of marine research is carried out through Member States' programmes. Under Horizon 2020, research will focus on how new technologies can put marine resources to productive use and create sustainable growth and jobs. So as to capture the cross-cutting nature of marine research and the potential for discoveries in one area to have applications in others, the Oceans of Tomorrow initiative has funded 31 projects for a total EU contribution of nearly €195 million.

To ensure complementarity between the strategic research and innovation agenda of Member States and Horizon 2020, the Commission will work closely with the Joint Programming Initiative 'Healthy and Productive Seas and Oceans' which has been set up to allow Member States to align their national marine research programmes. This will also improve the knowledge and evidence base for environment policy, a priority objective of the 7th Environment Action Programme26 (European Commission, 2014). This will deliver a gateway into insights emerging from research projects that can accelerate the uptake of new ideas by industry. It will help ensure that public research funding pays off through innovation by business(European Commission, 2014). These long-term challenges are recognised by the European Union: the Europe 2020 strategy opts for smart, sustainable and inclusive growth as a response. However, the economic and financial crises have eroded our response capacity and our financial means. Hence, there is now a need to approach the Europe 2020 goals from unconventional, integrated and innovative perspectives (European Commission, 2012).

Figure 4: Strategic development domains

Groups	NOS 2013-2020 - Strategic Development Domains				
	Living resources	Non-living resources	Infrastructures, uses and activities		Governance
			Indus-trial	Servi-ces	
1.Fisheries, aquaculture, processing, wholesale and retail of its products	x				
2. Non-living resources (1)		x			
3. Ports, transports and logistics			x		
4. Recreation, sports, culture and tourism				x	
5. Shipbuilding, maintenance and repair			x		
6. Maritime equipment			x		
7. Infrastructures and maritime works			x		
8. Maritime services				x	x
9. New uses and resources of the ocean (2)	x	x	x		

Source : Siemers, 2008

Figure 5: Europe 2020 Blue Growth

Source : Siemers, 2008

Within this framework, the 'Blue Growth' initiative aims to elaborate the blue dimension of the Europe 2020 strategy (European Commission, 2012). Blue Growth is hence defined as "*smart, sustainable and inclusive economic and employment growth from the oceans, seas and coasts*". The starting point for the Blue Growth project is the grounded belief that seas, coasts and oceans can play a pivotal role in the solutions to many of the above challenges and tensions. Blue economic activities need to be sustainable – an integrated approach with a long-term focus and responding to the world's resource, climate and environmental challenges.

Most recently, the European Commission strategy towards the "EU's Blue Growth Strategy" aims at creating sustainable economic growth and employment in the marine and blue economy to help Europe's economic recovery (European Council, 2017).

The Council conclusions welcome the progress made in the EU blue policies, such as the agreement on the reform of the Common Fisheries Policy, the adoption of Strategic Guidelines for the sustainable development of EU aquaculture or the adoption of the LeaderSHIP 2020 strategy which gives new impetus to innovation and diversification of the shipbuilding industry (European Council, 2017). The

Council also recognises that developing the blue economy requires financial support and encourages Member States to support innovation, growth and employment in Europe's blue activities through the European Structural and Investments Funds in the context of the Multiannual Financial Framework 2014-2020, showing that delivering the potential of the Blue Economy in terms of growth, jobs and competitiveness is a European commitment. Blue growth is a long term political strategy and the support for its first steps is very encouraging.

The case of Greece

To make it through the crisis, Europe, and especially Greece, needs the contribution of all sectors of its economy. In this context, the marine and blue sectors – the 'blue economy' – have an important role to play in the overall road to Europe's economic recovery. The Blue Growth initiative aims at highlighting economic opportunities in the blue economy, identifying sectors with the highest growth prospects and exploring further measures that need to be taken to support Member States to realise fully this potential (European Commission, 2012a).

In terms of achieving synergies between economic actors, Greece faces multiple challenges:

• A complex and unstable legal framework: e.g. no regulatory certainty post-2020 for offshore wind;

• The lack of integrated blue spatial planning: access to space and conflicts linked to space for aquaculture and offshore wind; barriers to the establishment and funding of pilot farms; etc

• Complex permit and licensing procedures: offshore wind, blue biotechnology;

• Gaps in EU regulation for some activities: exploitation of seabed marine resources, offshore aquaculture, offshore wind, etc

Currently, the BLUEMED initiative, jointly developed and agreed between Cyprus, Croatia, France, Greece, Italy, Malta, Portugal, Slovenia, and Spain and facilitated with the support of the European Commission, aims to advance a shared vision for a more healthy, productive, resilient, better known and valued Mediterranean Sea. This initiative seeks to promote the social well-being, prosperity of both local and EU citizens now and for future generations and to boost economic growth and jobs:

• Innovative and multi-disciplinary research to address the Mediterranean coastal and marine ecosystem management;

• Development of new marine-related technologies that are adapted for the specific needs of the Mediterranean Sea, to boost the safe and sustainable economic growth of the blue sectors in the EU and beyond, as well as conserving and valorising of marine cultural heritage;

• An interoperable, fully integrated multiplatform observing and forecasting capability supporting the conservation of biodiversity, forecasting and management of risks and emergencies at the coast and at sea;

• The EU citizens' awareness of the importance of a sustainable and prosperous Mediterranean Sea for the surrounding countries and for Europe as a whole;

• Implementation of the EU Integrated Blue Policy1 by providing knowledge-based support to policy decisions towards ensuring the sustainable growth of the EU Mediterranean marine and blue economy.

• Improving the sharing and joint exploitation of existing data, knowledge, capacities, project outcomes and bilateral/multilateral research and innovation initiatives and frameworks related to the Mediterranean;

• Fostering cooperation between public and private sectors to maximize the leverage effects from research investments in marine and blue issues and their influence on public policy at regional, national and EU level;

• Promoting joint actions including coordination, planning and programming of relevant research and innovation activities related to the Mediterranean at regional, national and EU levels;

• Supporting researcher careers, training and mobility, and the development of skills in relevant sectors to ensure the necessary highly qualified workforce capable of underpinning a prosperous and sustainable Blue economy *in primis*within the EU Member States bordering the Mediterranean Sea;

• Advocating public understanding of the value of the blue economy in the Mediterranean.

However, Greece is still to combat barriers to innovation: under-investment in knowledge, poor access to finance, the high cost of intellectual property rights, slow progress towards interoperable standards, ineffective use of public procurement and duplications in research. A number of these issues are already being tackled at the appropriate levels of administration, but some barriers are specific to the blue economy and will need further complementary action, such as, gaps in knowledge and data about the state of our oceans, seabed resources, marine life and risks to habitats and ecosystems;diffuse research efforts in marine and blue science that hinders inter-disciplinary learning and slows the progress of technological breakthroughs in key technologies and innovative business sectors;lack of scientists, engineers and skilled workers able to apply new technologies in the marine environment.

Conclusions - Policy implications

Globally, in the coming decades every sector of the ocean economy is likely to be affected by technological advances such as innovations in advanced materials, subsea engineering and technology, sensors and imaging, satellite technologies, computerization and big data analytics, autonomous systems, biotechnology, and nanotechnology. The OECD modeled the development of the ocean economy to 2030, projecting many ocean-based industries to outperform the growth of the global economy—indeed doubling its contribution to global value added from 2010. In particular, the OECD projects strong growth rates in shipping and transport, port services, marine aquaculture, offshore wind, and ocean-based tourism, among others, while marine renewable energy, marine biotechnology, and carbon capture and storage are also considered to have significant potential (though unlikely to be realized by 2030) (OECD 2016).

When these trends continue, they will lead to unprecedented tensions between the current methods of production, of consumption and the future availability of non-renewable resources. These tensions are likely to focus on food, health, energy, raw materials, and water. Additional challenges will arise in the areas of trade, investment and Europe's industrial competitiveness, but also in leisure and urbanisation. A continuous search will remain for new energy sources to reduce the dependency on third countries and world regions.

The Commission's Blue Growth agenda does not prioritise growth over sustainability, but rather prioritises sustainable growth. In many cases sustainability is a actually a pre-requisite for growth: cleaner water allows shellfish from aquaculture to be sold for a higher price, healthy fish stocks will ensure a sustainable future for our fishermen for generations to come, whilst offshore energy can provide a sustainable solution to our energy needs as well as creating jobs and growth across Europe.

The Commission is explicit that the blue economy must develop in such a way that it is compatible with wider ecosystem management and the preservation of the marine environment for future generations. The specific objectives for this pillar are:To promote research, innovation and business opportunities in blue economy sectors, by facilitating the brain circulation between research and business communities and increasing their networking and clustering capacity, to adapt to sustainable seafood production and consumption, by developing common standards and approaches for strengthening these two sectors and providing a level playing field in the macro-region, and to improve sea basin governance, by enhancing administrative and institutional capacities in the area of blue governance and services (European Council, 2017).

This calls for an integrated approach across the different sectors and disciplines and a long-term oriented, strategic coordination between the European Countries bordering the Mediterranean Sea coasts and the whole EU. Such synergies and complementarities between sectors and countries will provide added value to regional, national and EU investment, avoid duplication and reduce fragmentation, promoting innovative multi-disciplinary research that will generate the knowledge needed to increase ecosystems resilience; creating an interoperable, fully integrated observing and forecasting capability. Innovation can help develop the blue economy in a way that not only fuels EU growth and job creation but also maintains public support for the commercial use of marine resources while ensuring the protection of the marine environment (European Commission, 2014).

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SPATIAL ORGANIZATION AND PLANNING OF TOURISM DEVELOPMENT IN THE REGIONAL UNIT OF XANTHI

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Abstract

This paper's purpose is the exploration of developmental and innovative proposals concerning the development of tourism within the Regional Unity of Xanthi. The criteria set out are related both to the protection of the natural environment and to the preservation of the area's identity. That is why the population changes and the services offered to the visitor were investigated. Furthermore, the importance of the relief in terms of tourism potential and the impact of activities on the protected areas and also on the local population, were examined as well. Proposals for redefining the existing institutional framework based on the logic of integrated sustainable management and development of degraded areas were drafted and documented. Finally, the need to promote and highlight all of the above through the use of the Internet and various technologies is mentioned.

***Key Words**: tourism development, sustainable development, protection and preservation of the nature, preservation of the identity, the usage of Internet and technology*

Introduction

The relation among the natural and community sectors and how they influent Xanthi's Regional Unity tourism developmentwas analyzed.More specifically, the population changes of the cities and communities of unity and the way in which they influenced the services offered to the people were examined.Also, development capabilities were analyzed based on the physical characteristics of each region and their location in the whole unit of Xanthi. A key feature of the area is the existence of protected areas (Natura SCI / SAC, Natura SPA, national parks), are governed by the similar statutory institutional frameworks, which play a major role in the planning and the proposals we made.For example, few of the resources they already exist are the Nestos River, Lake Vistonida, Livaditis, same archaeological sites and some settlements with a peculiarity in terms of architecture, activities and their culture.

This study aims to propose some changes that will help the development and promotion of the region at both national and European level.From the above mentioned areas, there are some types of tourism that can be developed in their own capacity.Such as rivers, lakes, seas and mountain areas that the region possesses, are capable of development planning, which defines specific tools and actions to be implemented so it will be considered successful.An integrated planning for tourism should seek to interlink between treating it as an economic activity and at the same time as a business.Based on the first one, the planning focuses on local, regional and national providers.Whereasbased on the second one, therequired planning must include feasibility, market research, projection-promotion and strategic prediction.Planning, according to these two parameters, as a business activity and as a factor of socio-economic development, affects and influences the objectives and choices made in these two cases.Taking this into account, we are adapting our proposals, seeking both the development of tourist activity across the whole range of regional unity and the gradual spread of the population from the urban center to the rest of the region.

Materials and Methods

Tourism development planning usually affects the whole of the national, regional or local host economy to the point that it is a complex economic and social phenomenon (G. Zacharatos and P. Tsartas, 1999).In areas where tourism is being developed, planning is necessary to rationalize the development of tourism, seeking the maximum benefits from its development and ensuring its future viability (Slee et al., 1997).Thus, the direction of thinking for the right planning, which seeks to combine society and its spatial identification, is presented in a common line from these two special analysts.That is the initially factor for the integration of the design in a direct relationship, influence and the existence with thespecific conditions for a proper development.The components of a developmental design are: the necessity and object, the types and basics, the process and principles to be used for the best result. To complete the study, we followed four phases of research. The first stage concerns the analysis of the regional population changes and their importance for the formation of the whole Region.The second concerns the identification of theintervention areas and the areas where the tourist activities will be developed, which differ in their form and intensity.The third stage deals with the installation of appropriate infrastructure to support these tourism activities in each area. Finally, the fourth phase sets out the principles of an institutional framework on which these proposals are based.

FIRST STAGE

Initially, an investigation was carried out based on the population censuses that took place in Greece from 1951 until 2011. We focused on the changes and movements of the population of the Regional Unit of Xanthi. To determine these population changes, some criteria have been set thatcontributed to the understanding of the conclusions. These criteria are: the large increase (over + 20%), the moderate increase (from + 5% to + 20%), the minor change (from -4% 5% to - 20%) and finally the big reduction (more than - 20%).By the comparison of the 1951 and 1971 censuses, we have drawn thesame conclusions with the most significant being that the population has dropped appreciably.Continuing with the comparison of the 1971 and 1991 censuses, it was found that in addition to the center of regional Unity, all other regions suffered a sharp decrease in their population.From the comparison of the 1991 and 2011 censuses, the resultsshowed a general decrease in the Unity's population, witha rapid increase of the central Unity's population, while the rest of the area (mountainous and lowland) decreased.By gathering all the above facts, we have come to the conclusion that the center of Regional Unity has been a pole of attraction and interest for the whole of its population.Therefore, there isa possibility that many residents of the Unity turned to the urban center (Xanthi) and led to the abandonment of their bases, thus reducing the number of the population in the other areas and increasing drastically in its central part.

The changes and upgrades inthe population helped us understand the state of Unity in terms of the services it offers. Therefore, we observed a contrast between the mountainous and the ground volumes, bringing together most of the services to the lowland.On one hand, this is due to the morphology of the soil, as in the mountains the development of the infrastructure becomes difficult and on the other hand to the accumulation of the population in the lowlands.Thus, it is understood that the tourist development of the wider region depends directly on the degree of protection and comfort it offers to visitors.Also, these population changes showed us the desire of people to move away from the inhospitable mountainous mass, resulting in the desolation and decline of the villages there.Finally, this study gave us the opportunity to sociologically evaluate the districts and helped us plan and design appropriate actions to make them attractive to all visitors.

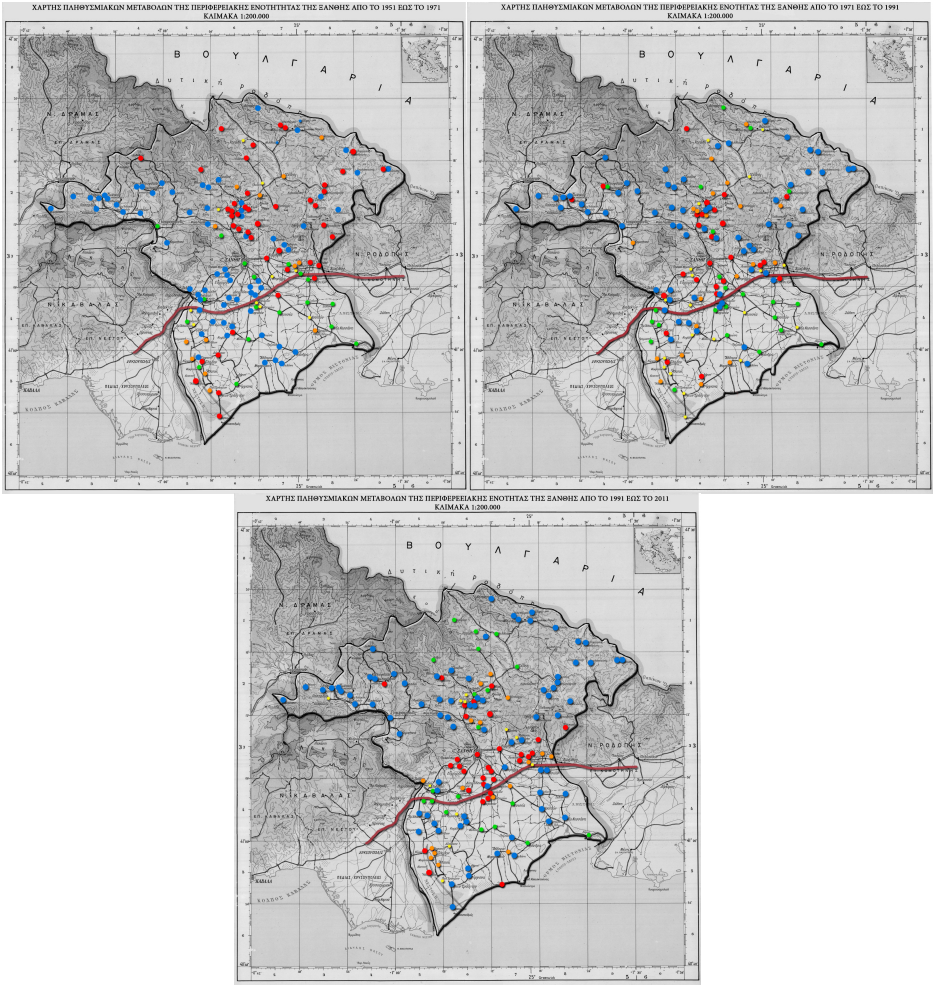

Figure 1. *Maps of Population Changes1951-1971,1971-1991,1991-2011 (Source: Hellenic Statistical Authority)*

SECOND STAGE

Three major categories of tourism are identified: the Mass-Classic, the Alternative and the Special or Thematic.

Alternative forms of tourism are developed mainly in non-urban areas. In the same areas, forms of thematic tourism are more limited and also the Massive tourism develops mainly in the city of Xanthi and in very few settlements of theregion's area.

Our basic commitment to the development of the area is to have the least possible impact on the environment but with the greatest possible benefits. That is why the majority of our proposals for tourism development in the region include special and alternative forms of tourism. The main components for the development of alternative tourism are destination, business, state and local society. (Andriotis 2008).

In recent years there has been a diversification of tourism demand and a shift towards new forms of special interest tourism.Our study involves the emergence of special resources and characteristics of the Regional Unit of Xanthi. Different forms of tourism have different needs that involve special infrastructures, activities and human resources, seasonal operation and a different degree of interest and knowledge from the tourist. (Vagiannis et al., 2005).

The forms of tourism we use in our proposals are urban tourism, cultural tourism, mountain sports recreation, healing tourism, rural tourism, health tourism, ecotourism and adventure tourism.

More specifically, urban tourism is based on the significance of cities as autonomous destinations also known as city-break tourism, the upgrading of historical centers, monuments, archaeological sites and other remarkable elements of the natural and cultural environment of urban centers. In the Unity of Xanthi, this kind of vocation mainly appears in the city of Xanthi, which as the capital it gathers most

of the services and operations. Apart from this, there are also some smaller settlements, which have the preconditions for this kind of development, but for various reasons such as lack of information about them, they are being excluded from this category.

The concepts of cultural and heritage tourism refer to the part of the tourism industry which emphasizes on various cultural and heritage attractions that include museums, archaeological sites, theater and musical performances, exhibitions etc. (usually in developed countries), but also traditional religious ceremonies, handicrafts and cultural events (usually in upgrading destinations) (Christou 2005). The development of cultural tourism contributes to the sustainable economic and tourism development of a destination and consequently strengthens its competitiveness. It also empowers cultural and traditional events, promotes gastronomic tourism and integrates directly into the tourism product but also indirectly contributes to other productive sectors through the development of organic products, the reassurance of the quality and thecertification of the value and their uniqueness.In the current state of the region, there are several events in the villages, as well as areas of archaeological importance, through which they promote their culture and history.The correspondingsectorsdo not act properly for their right exploitation, so they are unknown to the visitor. According to the study, we have considered it important to create two branches of the Natural History Museum of Xanthi, in the villages of AnoKaryofytos and NeaKessani, due to the importance of their flora and fauna. In addition, the creation of information booths in Stavroupoli, Vistonida and Xanthi, linking the areas and offering quantity, quality and updatedinformations to the visitors about the activities and the surrounding areas, may be encountered as a beneficial action for the entire Unit.

The development of sport activities in the mountainous area (e.g. mountain climbing, canoeing, rafting, hang gliding, paragliding), with some of which can also be implemented in the semi-mountainous and flat volumes, can help attendance of visitors of all ages. We have considered that the mountains of Unity are appropriate for the bloomingof sporting tourism activities. Leivaditis is an example of these possibilities, having already developed activities in its wider area such as mountain climbing, which are not yet well organized and associated with tourism producers. Increasing and improving the infrastructure for these activities is a necessary action in order to enable it to have the right development.

In the healing tourism, the use of natural healing resources is necessary to get developed in order to promote their regions. This can be accomplished by the development of spa baths thrives in areas that have natural healing resources (natural waters, vapors, natural gases, etc.).In same areas this kind of baths already existandin others is important to get developed toa global supply of tourism activities, products and services focusing on the provision of health, wellness services and rehabilitation. There are two areas in Xanthi that have thermal springs, one in Thermes and one in Potamia. The infrastructure of these sites is in a very poor condition and is therefore inhospitable to the visitor. In a worse situation are the baths of Potamia, which are under-exploited. In Thermes, an upgrading effort has recently been made without substantial infrastructure improvements. It is necessary to complete the planning of the two areas as well as to create a network that connects them, making it easier for the visitor to reach them and also to offer him a unique experience of proper service and relaxation.

Rural tourism is being developed in areas that present a specific interest to tourism, including the areas of the National System of Protected Areas, except from those of absolute nature protection. The area we have studied, as mentioned above, includes several protected areas and two national parks. This makes it obvious of the importance of the natural environment, where there are many rare species of flora and fauna. By strengthening these areascorrectly it could be a pole of attraction not only for domestic tourists but also for many others from abroad. It could also attract the interest of the scientific and educational community by conducting conventions and experiential acquaintances with species that are difficult and perhaps forbidden to be found in a lab or elsewhere.

Health tourism has been established as a form of holiday that provides a wider range of medical services and wellness. The main aspects of health tourism can be distinguished in medical tourism aimed at tourists - patients who usually use specialized medical monitoring and treatment services, as well as in wellness tourism for tourists who want to improve their health or maintain their health services (Hydrotherapy, spa, thalassotherapy, etc.).Based on the climatic and morphological conditions of the area, we have considered the mountain area to be compatible with the creation of a patient center. There, the patients will be fed entirely with products from the area, but will also be able to

participate in their production. Additionally, we believe that there should be a connection with Thermal spas in the area in order to combine these two servicesfor the visitor's best experience.

Ecotourism is targeted at sensitized eco-conscious tourists, who usually choose to stay in traditional settlements. Ecotourism is a mean of development that contributes to the sustainability and exchange of information on good practices of sustainable design, development, management and marketing. (U.E., 1998). The complex of the Pomaks's villages (Pomakochoria) is distinguished by its peculiarity, both at architecturaland in historylevel, and is therefore addressed to visitors who are particularly interested in these areas. Another example of this type of development is Lake Vistonida, which can accommodate visitors who are interested in the avifauna.

Finally, adventure tourism combines sports and the visitor's fitness with the adventure and challenge of various activities.This is a form of tourism that consists of a very wide range of activities that take place on the ground, in the air, in the water and in the survival.The geomorphological character of this area, as well as the regions that develop this type of tourism, play a decisive role in its development. The area of Livaditis fulfills this territorial specificity by allowing the development of these activities. Both the mountain element and the presence of the Nestos River create a combination of images and experiences, making it more competitive than other areas in Greece that develop this type of tourist.

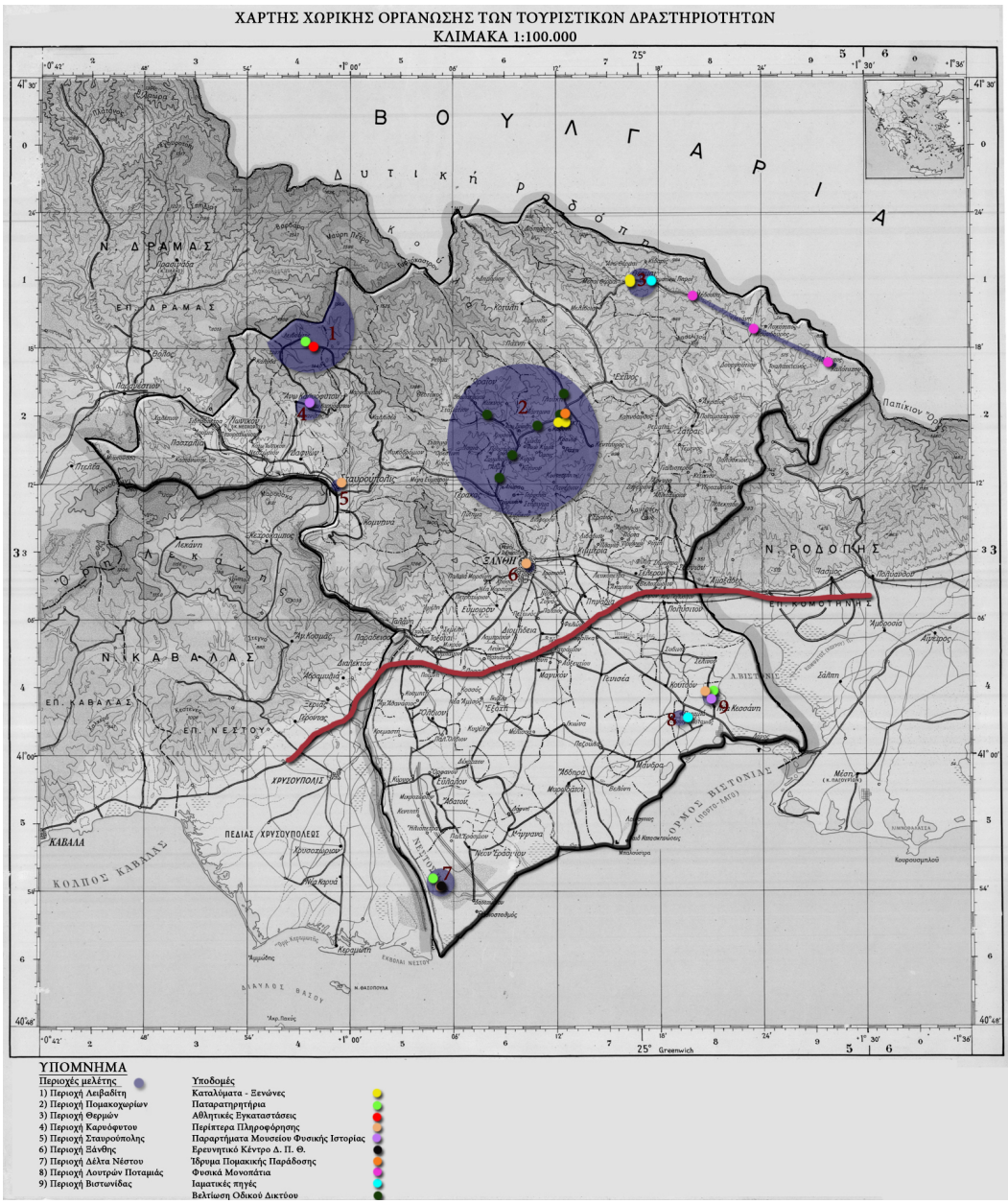

Figure 2. *Maps of Spatial Organization of Tourist Activities*

THIRD STAGE

Our proposals are influenced by all of the above and they form a series of decisions and future actions aimed at improving existing infrastructure and create new facilities in the areas are considered to be right.Essentially, the first area of intervention is located in the mountainous region of Xanthi's Unityand includes the wider area of Livaditis.As the second one, was chosen the region of Thermes (Thermes, Medusa) and as the third one all the villages of Pomaks (Pomakochoria) with their central point the village ofMyki (same other villages are Oreio, Kotyli, Glafki, Sminti, Kendavros, Echinos, Satres).Moreover, our proposals include pointed interventions in the villages of Karyofytos and Stavroupoli.In the southern part of the studied area that is covered by lowland areas, the spatial units we consider of necessary development for the tourist activities are Lake Vistonida and the Delta of the river Nestos. In more detail:

1) In the wider area of Leivaditis, we consider appropriate the creation of supportive infrastructures that will serve new sports activities. These are established in the context of sustainable design, which respects the natural peculiarities but at the same time it can secure the conditions for the social well-being of the local population.Practically, in addition to mountaineering, which already exists, it is proposed to develop extreme sports such as climbing and rappel with the assistance of qualified and trained personnel.Moreover, due to the natural beauty of the area, we propose the creation of an annex of the Natural History Museum of Xanthi, which will specialize in the mountain fauna of the Unit and will inform the visitors.We recommend that it will be in the village of AnobKaryofytos and cooperate with an observatory that will be located in Leivaditis, where visitors will be able to see all of these species.

2) The areas of Thermes and Potamia, which are opposed to the map, are considered as a tourist attraction due to their thermal springs. It is important to improve the infrastructure of both thermal springs, which are quite neglected, with incomplete equipment and constructions that lack of modern technology.Thus, it is necessary to modernize the construction of the available means and to upgrade the knowledge of the human potential in order to create modern services that give the guests the feeling of hospitality and security.Additionally, it is important to define a network that will unify these two areas to act as a common organization and evolve them at becoming recognizable in a national and international level.It would further enhance the importance of installing more than one hostel in Thermes, giving the opportunity to the visitor spending more days in that area and explore it.Therefore, the operators should address the development and improvement of the road network as a productive axis that will help to increase the area's wealth.

3) In the wider region of Thermes, there are a considerable number of monasteries of Nature. The monasteries of Nature, as their name suggests, are elements created by man, which harmoniously adapt with the natural landscape and give a more elegant scene to the visitor. There is a peculiarity in the relief of Mithras in Medusa's settlement and also three traditional, stone-built bridges almost in aline, in the neighboring villages, Koundouros and Kalotycho. So we propose to unify these settlements with a natural path that will start at the settlement of Thermes and end up in the settlement of Kalotycho. This is a very long journey, which will take advantage of that mountainous natural landscape and at the same time it will give the walkers the opportunity to come closer and to admire the monasteries of Nature that are an integral part of it.Some shelters where guests will have the opportunity to rest for a short period of time, but also be offered first aid whenever it is considered necessary will interrupt the long length of the path.Some of these points will be linked to the road network for quicker access by both the rescue services and the visitors, so they will have the ability of approaching this area from different points.

4) In the area of Pomaks' villages (Pomakochoria), we propose actions that aim at highlighting their cultural characteristics and their interconnection with the economic and functional area of the rest of the region. Firstly, it is necessary to improve the existing condition of the road network that is in a declining situation in orderto be better accessed both by the visitor-driver and the resident of the settlements.At the same time, the construction of an institution that would expose the Pomak tradition and history would help in the disclosure of their culture. We also believe that in the context of economic growth and incentives for locals, it would be advisable to create stores that offer culinary experiences based on their traditional cuisine.However, it is worth mentioning that the Pomak community is extremely introverted and there is a serious risk of not supporting such actions.Their

approach should be careful to present them these proposalsof development without letting them believe that their religious or ethnic characteristics are being affected.One way of approach would be with proposals for the renovation and restoration of some of their individual dwellings, through the corresponding European programs for the protection and development of major settlements (ESPA).This will help the acceptance of the developmental plans by their society, as well as the general image of the settlements, acquiring a more preserved and homogeneous character.In this planning, we recommend the participation of the Democritus University of Thrace andmore specifically the Faculty of Architecture of the Polytechnic School, which is based in the city of Xanthi. More specifically, the scientific work will be part of the department's responsibilities and the formation of research student groups will help at the supervision of the works, giving them the opportunity to see how a building site works.

5) In the area of Lake Vistonida, the existence of the great avifauna makes it very important on both the European and the worldwide map.Right now there is only one observatory in the area that belongs to the military.So we conclude that there is insufficient use of this area.Its peculiarity leads us to develop a kind of tourism that focuses on the observation of wild and rare birds known as bird-watching tourism. Therefore we propose setting up one more observatory to help the development of the general tourism in this area, attracting people who are interested in this specific activity.An area to be identified on the world map as a tourist destination, needs to develop same interactive material linked to relevant web portals of special or general interest, which we think is right to apply in this case.We also consider it necessary to create another branch of the Natural History Museum of Xanthi, in the village of NeaKessani. So, we are attracting the world to visit it and to get to know more about ornithology by achieving the visitor's complete information.

6) In the area of Nestos, we propose the creation of a research center in the village of Neo Erasmio. Its operation will focus on the natural environment of the wider area and more specifically the river. In this center, experiments and studies based on information from the environment aroundwill be conducted.As a result the protectionagainst environmental pollutionwillbe achieved because there will be regular collection and analysis of the data from the river's soil and water.This research center could be in constant contact and cooperation with the departments of the Production and Management Engineering and Environmental Engineering of the University of Thrace.An additional goal is to develop a connection with the students who will be able to attend and conduct workshops with respective scientists and to participate voluntarily in the functions of the center. Tour guides for visitors can expand this volunteer action.

7) The town of Stavroupoli is a center that has several archaeological sites developed around it. So we propose to create an information kiosk for these areas, as there are settlements with important archaeological discoveries.Indicatively we mention the settlements of Myrthousa, Komnena and Toxotes.This action will cover the lack of information that exists today, which detracts and degrades from their significance.

8) The city of Xanthi is a special category due to the concentration of a large number of activities and services.That is why we do not propose any action to rebuild or interfere with its urban fabric.What we propose is the creation of an information center with a central location, in order to be easily accessible by visitors, which will provide constantly updated information about the region.Also, in cooperation with the Chamber of Commerce and Chamber of Hotels, it can provide integrated packages that combine the areas and the activities there.For the further development of entrepreneurship, we would advise local tour operators to create a transport network starting from Xanthi to all settlement of the region, with weekly one-day excursions, allowing those who do not have a means of transport to visit them.We also propose the development of multilingual Internet services and ICT exploitation, including all the relevant information for the unity, so as to provide immediate and interactive information to local and international tourists.

FOURTH STAGE

Initially, we believe that the existing areas of unity have been properly defined as protected and we propose some modifications in terms of increasing and decreasing their degree of protection. In areas around the Nestos River and Lake Vistonida, we consider it necessary to increase their protection due to the variety and the significance of the environment.An increase in protection can be achieved by

setting up a public sectorfocusing on frequent inspections of these areas to ensure compliance with the law and the imposition of corresponding sanctions on offenders.This team will also include scientists who will study and examine the soil and water at regular intervals to both avoid and rapidlyrespond to any contamination.

Similarly, it is appropriate to set up a corresponding service in the Livaditis area, which will be responsible for overseeing the surrounding area and ensuring its proper protection. In this area, as mentioned above, we consider it accessible to the development of recreational sports activities associated with the mountainous element.For this reason, we propose to change its protection zone, allowing the increase of these activities, while introducing legislative provisions that foresees for its more specialized protection against any form of contamination and erosion.A bigger proposal - intervention that we plan is to establish as a protected area the one from AnoThermes to the border of the regional unit of Xanthi with the regional unit of Rodopi and the land along the border line, which will also include the Maselitsa peak.With the intention to create a path that will bind the bridges, there will be an economic and social upgrading with the arrival of more visitors and at the same time the development of hiking tourism. But we also consider that it is necessary the institutional protection of the natural environment in the context of sustainable development.

Finally, for the unity's coastal zone, we believe that it is futile to improve its tourist development due to its morphological situation.That is why we are proposing a change of status by reducing bans and allowing the development of accommodation or some small hostels.We also plan interventions with water and beach improvements from the cooperation of the Region with the Municipality so it will be more accessible to the visitor.In this way, various activities can be developed in the coastal zone that included at the sport tourism.This is suggested by taking into account the sporting infrastructure and activities that already exist in the city of Xanthi.In particular, such an action would initially aim at enriching the athletic tourist product targeting athletic teams, offering activities such as: jogging-paths, beach volley- beaches, water sports-seawater.Thus, it will be a link between the areas ofNestos, Vistonida, Livaditis, highlighting the beauty of the environment and completing the tourist's picture.

For the implementationof all these actions, we consider that it is necessary to create a permanent committee with the main coordinating role of the public sector (East Macedonia and Thrace - Development Program Directorate, Ministry of Environment & Energy, Municipalities of the regional unit of Xanthi), with advisory role of the sectorRodopi Management Organization, Greek Biotope/Wetland Centre (EKBY), WWF, Democritus University, and the Chamber of Commerce.We also believe it is nessesary the contribution of a development company for the better implementation of our proposals.The existence of the private sector in these projects is important because, as has been shown, the public cannot support them alone. But the crucial role will be played by the public, linking it with services that either exist or will be created in the future by helping to connect with society and the economy through new jobs.Finally, we believe the assistance from European development programs through the Special Management Service to implement and summarize all the above mentioned in the short and long term will be automated, through the collaborations that have been developed.

Table 1. *Table of Protected Areas according to the corresponding GG-JMD*

Protected Areas (JMD 40379/01-10-2009, GG 445 Δ΄/02-10-2009)	
Areas	**Protection zones**
Areas of Ultimate Protection of Nature	A1, A2, A3
Areas of Nature Protection	B, B2, B3, B4, B5, B6, B7
Areas of Special Management and Sustainable Use and Development	C1, C2, C3, C4, C5

Results

After studying and evaluating the opportunities offered by each region separately, our proposals were formed to bring the desired future results according to the principles of sustainable tourism development.

Sustainable development pillars are to improve the existing situation, to meet human needs, to conserve resources, to balance, to establish rules and limitations (Andriotis 2008).

By following the principles of sustainability and taking into account the parameter of capacity, we conclude that in some areas planning and actions must be intense due to specific factors such as soil morphology. All of our proposals are based on the holistic approach of Regional Unity, aiming to become a tourist attraction pole both for the inhabitants of the Greater Regional Unity and for the international visitors. The results of our above suggestions are as follows:

1) In the area of Leivaditis, the enrichment of recreational sports activities in the mountain range will enhance the tourist attractiveness of the area due to the varied forms of alternative tourism. At the same time, with the establishment of the Natural History Branch at AnoKaryofyto and its connection with the observatory in Livaditis, the visitor will be invited to participate in more activities and to obtain information about the life in the area, feeling that he is part of the environment he observes.

2) The improvement of the existing thermal springs of Thermes and Potamia is an action that will enhance the almost nonexistent thermal tourism. It is certain that the modernization of infrastructure will increase the number of visitors. Additionally, linking the two sources to a network will make them recognizable at national and international level and will spread the visitors to a larger part of the Regional Unity.

3) The unification of the villages of the wider region of Thermi will probably restore some sections of the population that abandoned it and at the same time will be the cause for a visit. So far, although there are reasons to visit and admire the monasteries of Nature, this is not feasible due to the inconvenience of the mountainous mass and the great distance between them.By implementing our proposals, areas can be developed economically, socially and ecologically. The creation of special natural paths, will successfully contribute to the development of walking tourism and combined with the accommodation facilities and the improvement of the road networking will make them more accessible and attractive.

4) In the settlement of Pomaks's villages (Pomakochoria), the proposed actions have as their main objective the communication of history and culture with respect to the peculiarities of the inhabitants, as well as the social development of the degraded so far part of the Regional Unity.The area will be accessible, which will bring economic growth and raise the standard of living of the local community.In addition, the proposed collaboration with the Polytechnical School of Xanthiwill increase mobility in this area while at the same time the opportunity to gain knowledge through the practical educational process will be provided to the students.

5) Because of the importance and peculiarity of the Vistonida area, it was our expectation that our planning would be focused on its further promotion and development. Essentially, the area itself, combined with its rare species of life, is the center for shaping and organizing an entire unit that will have the Nature and its history (flora and fauna) as the main thematic axis.Besides, it is widespread that the fauna species found there are not observed anywhere else in the rest of the world.This fact, together with the proposed actions, will make the region "unique", known and recognizable at a national and international level and will achieve the visibility not only by visitors who knowledge its existence and the lovers of nature but also by the the rest of the audience who will want to get to know Nature a little better and get to know the rare types of life in the area.

6) The implementation of the proposed programs in the Nestos river region will have as a primary result the increase of tourist mobility and at a later stage the stimulation and sensitization of the visitors on ecology and environmental protection issues. It is extremely important to think that for the first time in the Regional Unity of Xanthi, the development of scientific and educational tourism is planned.

7) The area of Stavroupolis today has extremely low rates of traffic compared to the size of its historical interest. With the information kiosk that we propose, we aim at the bloom of archaeological tourism, as the tourists will have the opportunity to learn how to follow a course that includes the whole area.

8) Finally, the city of Xanthi is the urban center of whole Regional Unity, where at the moment are concentrated most of the services and activities that offers in order to visit it. This particular planning is aimed at enhancing traffic across Regional Unity.It is trying for an equal traffic across the region and the design of actions aimed at disseminating visitors to the surrounding areas.To summarize, all of

the proposed actions have as their main objective the creation of an informed visitor through valid information.

Discussion

The relief and geomorphology of this Regional Unity play an important role in its development and the way to apply the means that will be needed to achieve its tourist development.The intense separation of the mountainous and lowland areas leads to the corresponding division and diversification of the functions that can be developed.The characterization of certain areas as protected, has the effect of limiting the degree of intervention. Such interventions can be considered as: a) the construction of building units, b) the reduction of the number of activities that could take place in those areas.A typical example is the beaches of the Unity, which are forbidden to implement interventions - improvements, and so it is caused their gradual decline.Of course, there are also cases such as Nestos, in which any intervention affects the natural environment and can pose a danger to the species of flora and fauna. The areas of Lake Vistonida and Livaditis operate in a similar way.

In this way, the responsible bearers are called to create activities and organized spaces, which will be able to cope with the conditions and individualities of each region, but at the same time to offer their services to the visitors.Thus, apart from the development of the site, Greek tourism will be achieved by a different point of view from the usual one that goes along with the beaches, the sea and the sun.The development of alternative forms of tourism will help in the development of same monthly dead areas, and because of their natural potential they are favoredto this action.Also, in this way there will be economic boom in the local communities as visitors will multiply and due to the demands of competition they will be helped to evolve and become modern.

Their promotion through the Web will be necessary as well as the usage of applications that can make them known at both European and worldwide level.Nowadays, technology and the Internet play a key role in promoting a business, as information is spread more quickly to a larger number of people.This has the effect of increasing the competition and making the recipient more demanding on what they are looking for and in the end choose.The right promotion of an area, such as the one we are studying, through the Internet and the way it is chosen to be emerged, plays a key role in driving the visitor to choose it as a holiday destination.The creation of such a network is necessary in order to achieve the planning of the tourist development of the entire Regional Unity and some of its areas, apart from those already known as tourist areas.

Conclusion

The geographical location of the Regional Unity of Xanthi has an important role as it is in direct relation to the Balkan Peninsula, the rest of Europe and is very close to Turkey.This is a comparative advantage to become a tourist attraction.Improving the road network will result the increase in the population inflows from interior Greece and abroad.An important positive impact of the above will be the acquisition of extroversion that will contribute to the development and production process of the Regional Unity.

In our view, when we think about Greece and its tourism, we have as a first picture the beaches, the sun and generally the summer fun. However, Greece has a large proportion of mountainous percentage that remains untapped so far.The design of alternative forms of tourism in these areas will bring substantial benefits related to the extension of the tourist season, protection of the natural and man-made environment and economic activity.In addition, increasing the visibility of mountain areas will contribute both to the emergence of natural wealth in flora and fauna and to the development of ecotourism consciousness.In the studied Regional Unity, the model of activities and the areas we propose to develop, mainly in the mountainous part, aim to create a welcoming environment for the visitor and leave him experiences and images that will make him want to return in the future and reunite with a region that includes unchanged tourist, cultural, historical, archaeological and physical identity.This is also the fundamental idea of sustainable development and nature protection.

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ORGANIZATION AND MANAGEMENT OF VOCATIONAL EDUCATION AND TRAINING AS A FACTOR FOR THE DEVELOPMENT OF INTEGRATED AGROTOURISM SERVICES IN GREECE

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Abstract

The purpose of this paper is to present agrotourism as an integrated model within the tourism sector thatmeets the needs of modern tourism demand for alternative activities and experiences at international and national level. Initially, the social, economic and legal contextin which agro tourism develops in the rural areas of the European Union and Greece is presented. In the second part of this paper, in order to explore the perspectives for integrated management and the prospects of further growth of Greek agro tourism, the forms of education and training related to the agrotourism sector and are offered in Greece are recorded.This correlation is necessary when we want to plan, with a commitment to sustainability, the marketing and promotion of integrated packages of tourist services. To ensure success, account must be taken of the role of education as a key factor in the economic development of a destination, measuring its influence on employment and shaping the quality of the products and services offered.

Key words:*Regional Sustainable Development,agro tourism, vocational education and training*

Introduction

The last two decades have seen a shift from mass tourism to a more environmentally friendly and sustainable forms of tourism. In order for new forms of tourism to develop effectively, planning strategies are required, taking into consideration the unique characteristics and the existing socio-economic and cultural realities of the destinations. At the same time, management and marketing policies have to be based on the proper exploitation of the local natural and cultural resources,developing new, alternative and sustainable forms of tourism (Avdimiotis et al. 2006). It is crucial for the present study to be defined the tourism industry in Greece by analyzing and correlating the patterns of mass and alternative forms of tourism, as these are the dominant ones that determine our destination. As rural tourism has already developed to such an extent that it contributes significantly to the emergence of rural areas in Greece, this research focuses on agrotourism as one of its predominant forms of development.

Agrotourism is a form of rural tourism that was devised in the 1960s in Europe and America. In Europe the term agrotourism refers to tourist services offered exclusively by farmers and developed with more enriched features than in America due to the rich local tradition and the variety of local handicrafts and products as well as the funded programs and learning actions of lifelong learning. In Greece, the development of agrotourism began in the 1990s, coupled with European rural income subsidies to revitalize the countryside. As a result, women's agricultural cooperatives, hostels in traditional villages of Epirus and then observatories in protected areas, lakes, rivers, wetlands and particular areas of many islands of the Aegean and Ionian seas were originally developed.In order to better understand and

identify further parameters of integrated development in the context of sustainability, we analyze the vocational education and training provided in the agro tourism sector, as this is one of the crucial indicators of avoiding carrying capacity violation of a destination and at the same time the only way to achieve that kind of development.Education is a vital investment for human and economic development and is influenced by the environment within which it exists.The integrated organization and management of education in general, as well as in this field, can serve both human needs and visitor satisfaction, contributing to the overall agrotourism product experience.

Materials and methods

Characteristics and standards of modern tourism

The fact that tourism is now one of the main factors controlling the global economy is a common field for many researchers. The five main stages of the modern journey are: dreaming, planning, booking, experiencing and sharing. Worldwide there is an increase in tourism activity faster than the growth rate of global GDP and arrivals according to UNWTO forecasts and profiles of Market Segments are expected to exceed 1.6 billion by 2020(Madrid: World Tourism Organization 2001). Global tourism demand is affected by continuous geopolitical changes, unexpected events and adverse economic conditions, resulting a change in the global geographical map of tourism with new destinations and new markets. Against this background, there is a need to boost entrepreneurship, employment and social cohesion. Increasing competition enhances the importance of marketing and leads to constant and more demanding and specialized standards in the production and management of the tourist product. (Middleton et al.1997). Destination marketing is the attempt to preserve, or even promote the attractiveness of its natural recourses (Bergstrom 1991). Strategic planning at regional and local level should lead to the specialization of the sites and be used as a tool for economic development and improvement of the area, aiming at improving citizens' lives, attracting capital, businesses and specialized human resources. Efficient planning and management of a destination imply the use of any available tool in order to detect early signals of decline and take preventive measures with the purpose of rejuvenating the destination. In order to have an effective strategy, once the realistic situation of the carrying capacity "violation" has been identified, strategic options should proceed regarding demand with regular surveys on new forms of tourism, in terms of supply with constantly development of new tourism services and regarding destination resources by implementing projects on environmental protection and sustainability, resident’s awareness of the role of tourists, human resources training, co-operation between different stakeholders, creating partnerships with other destinations and of course with investment in new technologies.Greece is one of the most famous destinations in the world with a strong "Brand name" without having made systematic efforts to acquire it. Despite the constant increase in the number of tourists, the Greek tourist product presents fatigue strength. At the national, regional and local level, the tourist product needs to be repositioned as authentic, good in quality and modern. There is a need to strengthen the local tourist activity, through the commitment of everyone that they will support their place and offer the visitor a complete experience. Management according to the principles of sustainable tourism development and sustainability is one-way. Sustainability has an economic, social and environmental dimension and is achieved only when a balance is struck between the individual components of the life-sustaining system. Sustainability emphasizes the moral obligation towards future generations in order to have sufficient social, economic and environmental capital, and to enjoy levels of prosperity at least the same as ours (World Commission on Environment and Development 1987). Sustainable tourism development is considered to lead to the management of all resources in such way that economic, social and aesthetic needs can be achieved while maintaining cultural integrity, important ecological processes, biological diversity and the life support system.

Basic concepts and characteristics of Alternative Tourism

Tourism in post-war period, globally developing the dominant model of organized mass tourism, has emerged as one of the most dynamic and fastest growing sectors of the global

economy. Its operation has been linked to the internationalization of a large number of productive sectors as well as financial service industries, contributing to the generation of income, jobs and tax revenues. This development was based on specific parameters and patterns of tourism demand and supply, involving tourism businesses, socio-occupational groups and international, national and local tourism policy. Over the last twenty years, these patterns have begun to change and tourists' wishes have begun to divert in new directions, far from the conventional pattern of mass tourism. This has led to the creation and promotion of different tourism patterns in tourist areas in order to achieve balanced development, organization and management of tourism. Thus, two large sets of standards were created: a) a set including organized mass tourism, pavilion tourism, summer tourism, urban tourism and rural tourism, b) a set including alternative tourism, sustainable tourism, rural tourism and urban tourism. Alternative forms of tourism give countries the opportunity to annihilate external influences, develop their own infrastructure and superstructure by participating in rational development. Same alternative tourism forms are cultural and historical heritage tourism, religious tourism, rural tourism, agrotourism, ecotourism, adventure and active tourism, sports and recreation,wilderness tourism, volunteering. It is important to be clarified whatever does not follow the pattern of mass tourism, does not necessarily mean it is alternative tourism.

Table 1. Variations of alternative tourism

Alternative Tourism	**Mass Tourism**
Natural Enviroment	Urban - urbanized environment
Active tourist	Passive tourist
Wide variety of activities	3S Activities
Isolated	Organized
Small scale investments	Quantitative
Controlled growth	Large-scale investments
Small impacts	Uncontrolled growth
Positive effects> Impacts	Positive effects <effects
Endogenous growth	Exogenous development

Source: (Andriotis 2008)

The steady increase in the demand for outdoor living, the demand for local products and activities, favors the increase at self-employment by providing a high degree of independence from intermediaries and wholesalers. Equally important are the environmental impacts of alternative tourism as it contributes to protecting the environment and natural resources, defining areas of land development / use, upgrading biotopes, improving / creating infrastructure for material recycling, water purification, supporting scientific research and studies, etc. Finally, the social and cultural effects are related to the revitalization of customs and traditions, the preservation of cultural resources, the expansion of social contacts, the change of direction of demand towards traditional accommodation and restaurants.

Concepts and characteristics of agrotourism

- *Concept and forms of rural tourism and rural tourism*

Tourism as an industry is often perceived important as a means of development in marginal rural zones, such developments are thought to appeal to a post-modern market seeking unique experiences. Understanding of entrepreneurial opportunities and challenges associated with rural tourism in different socio-cultural, economic, and institutional contexts is important for developmental planning. The study and analysis of both the experiences of tourists and residents, the interactions between the various operators are the social and emotional dimensions of experience directly related to rural tourism development. Rural tourism is not a new phenomenon in many parts of the world, but it has only recently received increased

attention from researchers, politicians and managers as a result of new market trends, the recognition of the “rural crisis” and the urge to solve it. One of the activities of rural tourism is agrotourism, which is the tourist activity developed in a non-urban area by those employed mainly in agriculture, in small units of family or cooperative form, with the aim of creating additional income. Furthermore the links between agriculture and rural tourism vary, this difference being due to the role of the community in these areas. In Europe the difference between agro tourism and rural tourism is critical. In areas where farm production is highly specialized and where one can notice the existence of close links in the rural community, it is advisable to use the term rural tourism instead of agro tourism. In broad terms agro tourism also includes services related to food production companies according to tradition. This aspect of agro tourism is crucial for the rural product promotion in countries with high levels of food production. So agro tourism includes agricultural, social and economic policies in the EU, and it is defined as the economic multidimensional development of agricultural farms and rural areas. Being an example of extra development of agricultural and rural areas, nowadays agro tourism includes extensive knowledge in the fields of economics, marketing and management. Agro tourism is very important for rural communities as well as for urban areas. It can provide several advantages: income, employment, use accommodation, activities, natural resource conservation, recreation and education. Agro tourism intends to obtain higher standards of living for rural communities especially through increased income for people who work in agriculture. For this it uses various financial and agricultural policies. The main instrument of the quality assessment is assertiveness and standardization of agricultural production and rural tourism. Agro tourism is more than just a tourist product as it includes many services that accompany the product. It is a way of understanding the journey as a new sensation or positive behavior in relation to the environment, the community and their culture. Agro tourism is a leisure activity and it is very successful. The possibility of enjoying the rural environment and culture extends to these different markets of tourists attractions. Agro-tourism tourists travel with family and usually come from urban areas. They show respect for the customs of the rural areas and seek information about the places they intend to visit. Agro touristic services are not for mass tourism. In addition to the benefits from accommodation, catering and other activities or direct selling, agro tourism also brings other benefits such as: recognition and assessment of architectural and cultural heritage. Thus agricultural environment is not only the manufacturer of concrete goods, but also of intangible goods, especially those relating to culture, education, food, landscapes and environment.

In Greece, within the meaning of agrotourism, several agrotourist cooperatives with women's initiatives have been developed since 1980 with a goal to develop, promote and distribute local products. In terms of tourism policy, both EU and Greece have set up many funding programs such as the LEADER, INTERRREG, MIP's, etc., including support measures. According to the Hellenic Agrotourism Federation (SEAGE), there is a strong part of Greek tourism, which develops without giving any impetus, as there is still no national agrotourism strategy. The "automatic" development of agrotourism takes place in the Greek villages, which are attractive to the Europeans tourists, who are mainly middle-to-high-educated and in a good economic situation, aged 45 to 60. They visit Greece during the low season when traveling alone and during the summer period when traveling with their families, they stay on average from seven to ten days and usually in hostels. The modern agrotourist is attracted by the nature, the specific characteristics of a region, the rural activities and combines his journey with cultural tours or religious tourism. Countries of origin are mainly Finland, the Netherlands, France, Italy, Germany, England, the Czech Republic and recently Russia. Some agro-tourism businesses have developed relationships with European universities, which have theme seminars and choose to spend their free time in agritourism. It is an important fact that when tourists visiting a small village in Greece, are looking for

complex experiences combining ancient theater, traditional feast, walking on a path, participating in the process of vintage or picking olive, aromatic plants, greek gastronomy and cuisine and, of course, Greek hospitality and interaction with local residents. Agrotourism could be said to be the diplomacy of the countryside. Agrotourism in Greece is in a process of maturing. Agrotourists want to learn everything about the tastes, the place and the people in the area they are visiting. Thus, the professionals involved should know well what and how to sell it but also how to train tourists in various activities. This role is a responsibility. Therefore it is necessary, to know what they are doing, what is the space they have, what they can make of it and how. To achieve all the above effectively, a least satisfactory knowledge of the English language, internet handling, attendance of tourist seminars and basic knowledge of hotel services are necessary. A key tool for managing a tourism development model like this is the management of human resources through specialized vocational education and training programs for everyone involved and with environmental education programs, both in the management of protected areas and in the provision of quality services. The existence of education and training programs geared towards agrotourism is considered a necessary factor in integrated agro-tourism services.

- *Educational and training systems in agro tourism in Greece*

The global challenge for education is not just about providing access, but also ensuring progress. The skills and competencies of the work force, in turn, are dependent upon the quality of the country's education and training systems. Vocational education is perceived as one of the crucial elements in enhancing economic productivity (Min1995). The economic argument in favor of vocational education is linked to the perceived need to orient the formal educational system to the needs of the world of work (Middleton, Ziderman and Adams, 1993; Neuman andZiderman, 1989). Vocational education is traditionally non-academic in nature and is totally related to a specific trade, occupation or vocation. Demand for vocational professionals is required more than ever in various industries such as retail, tourism, information technology, as well as in the traditional crafts and cottage industries. In this chapter, after a thoroughly elaborated and scientifically selected study, the education and training programs in the field of agrotourism provided by the Greek educational system are recorded and presented at all levels of formal and informal education and vocational training as well in thelong life training.Then, the existing programs are compared with the needs of the respective operators and the role and participation of the tourism education and tourism industry in their design and implementation are examined. Lastly, there is an effort to find any European and international cooperation activities in the development of training systems in this sector. Educational programs related to agrotourism are mainly offered by the Greek Ministry of Education, Research and Religious Affairs, in secondary education, in tertiary education and as well as in post-secondary vocational training at the Public Vocational Training Institutes (IEK). Also, in private education there are corresponding programs offered to IEK and colleges.In Higher Education there are no schools or departments of agrotourism, both at undergraduate and postgraduate levels. For this reason, an analytical search was made between universities in initially undergraduate programs, with basic criteria related to: rural and regional development, management of the natural environment and agricultural products, with the aim of identifying schools that could indirectly approach the Organization and Management of Agrotourism. The schools studied are listed in the following table:

Table 2. University schools in the agricultural sector

University	School
Aristotle of Thessaloniki	- Agriculture - ForestryandNaturalEnvironment
Democritus of Thrace	- Rural Development - Forestry, Environmental Management and Natural Resources - Business Administration
Agricultural of Athens	- Agricultural Economics and Development - Agricultural Biotechnology - Utilization of Natural Resources and Agricultural Engineering
National Kapodistriko of Athens	- Geology and Geoenvironment
Aegean	- Geography - Environment
Thessaly	- Agricultural Production and Rural Environment - Engineering Planning, Urban Planning and Regional Development
Ioannina	- Management of Environment and Natural Resources - Management of the Cultural Environment and New Technologies - Business Administration of Agricultural Products and Food
Harokopio of Athens	- Household Economics and Ecology
Panteion	- Economic and Regional Development
Patras	- Management of Environment and Natural Resources - Business Administration of Agricultural Products and Food

It is noted that most schools include mainly elective courses, in which is made a general reference to agrotourism management, such as alternative forms of tourism, rural development, environmental education, ecology.At the Higher Technological Institutes there are several departments with programs of study that could include courses of the Organization and Management of Agrotourism as a side-by-side but important knowledge, such as at the Alexandrio Technical University of Thessaloniki / Department of Rural Development And Agricultural Business Administration, at TEI of Kozani / Department of Commerce and Quality Control of Agricultural Products, at the TEI of Epirus / Department of Organic Agriculture, at TEI of the Ionian Islands / Environmental Technology the Natural Environment Technologies, at TEI of Lamia / Forestry and Environmental Management and at TEI of Mesolongi / Department of Cooperative Organizations and Operations. Unfortunately, in this study of their curricula did not identify any relevant lesson.

The same research was carried out at the Business Administration Teams of some TEI, which operate sections of the Management of Tourism and Hospitality Management Departments. The following table shows the institutes where cources are taught with references to agrotourism, the semester, the weekly hours and ECTS.

Table 3. Technological Educational Institutes/ Tourism and Hospitality management

Technological Educational Institute	Faculty Department	Seme-Ster	Lesson	H / W	ECTS
Western Mecedonia	Tourism and Hospitality management	7th	Organization and management of small medium-sized Agrotourism Businesses	2 h	4
AlexanderTEI of Thessaloniki	Tourism and Hospitality management	4th	Management of Agrotourismand Alternative Forms of Tourism	4 h	5
Epirus	Tourism and Hospitality management	7th	Alternative forms and sustainability	3 h	6
Crete	Tourism and Hospitality management	7th	Special and alternative forms of tourism / rural tourism. (selection course)	4 h	5
Thessaly	Tourism and Hospitality management	6th	Alternative forms of tourism	4 h	5

At the postgraduate level, the Department of Rural Economics and Development of the Agricultural University of Athens offers the program "Agrotourism and Integrated Rural Development". In several other Universities, there are a number of postgraduate programs that concern regional - environmental - economic - rural - sustainable development, nature management, integrated rural development, which indirectly reference and study of the rural tourism.In the secondary education provided by the Ministry of National Education and Religious Affairs, according to the recent legislation made in general and vocational education, this research shows that there are some theoretical references to agrotourism only in Professional Lyceums, where the studies last for three years and offer a professional degree level 3. The first year is common to all students with general study programs. In the second class in the field of Food and Environment, there is only a theoretical lesson "Modern Agricultural Enterprises". In the third class of vocational high schools in the same field, there are the following specialties: a) Production technician, b) Technician of animal production, c) Technician of Food and Drink Technology, d) Florist and Landscape Architect. At the Ministry of Labor, Social Security and Social Solidarity until the school year 2015 - 2016 in the Occupational Schools of apprenticeship of the OAED (Organization of Labor Force Employment), the specialty "Agrotourism and Agro-Biotechnology" offered in seven different EPASs in Greece: Almyros Volos, Langadas, Koufalia, Kilkis, Moudania, Karlovasi Samou and Kalloni Lesbos. These schools belonged to secondary education with duration of two school years, aimed at high school graduates, aged 16-23, working with the apprenticeship system, combining vocational education with classroom with paid internship in enterprises. The curriculum was holistically addressing to agrotourism education, as it included courses in tourism, rural tradition, folk art and agro-technical guidance.In post-secondary education and training at the Institutes of Vocational Training of the Ministry of National Education and Religious Affairs there are two relevant specialties: a) agrotourism technician b) executive and economy executive in the field of rural economy. During the current academic year, these specializations that presented in the following table took place in the IEKs:

Table 4. Public Vocational Training Institutes offering agrotourism specialties

A/A	Geographical Region of Greece	IEK / City	Agrotourism Technician	Management and Economy Executive in Rural Economics
1	NORTH AEGEAN	IEK of Chios	✓	
2	WESTERN GREECE	IEK of Agrinion		✓
3	WESTERN GREECE	IEK of Mesolongi	✓	
4	IONIAN ISLANDS	IEK of Lefkada	✓	
5	CENTRAL MACEDONIA	IEK of Kilkis	✓	
6	CENTRAL MACEDONIA	IEK of Sindos	✓	
7	CENTRAL MACEDONIA	IEK of Cassandra Prison	✓	✓
8	CRETE	IEK of Sitia	✓	
9	PELOPONNESE	IEK of Nafplion	✓	
10	PELOPONNESE	IEK of Stemnitsa	✓	
11	MAINLAND GREECE	IEK of Amfissa	✓	

The following specialties are operating in private IEKs as shown in the following table:

Table 5: Private Vocational Training Institutes offering agrotourism specialties

α/α	City	Name of IEK	Agrotourist Technician	Management and Economics in the field of rural economics
1	Athens, Piraeus, Thessaloniki	Alpha	✓	✓
2	Athens, Piraeus	Omiros	✓	
3	Larissa	Openmellon	✓	
4	Agrinio	Tomh	✓	
5	Athens, Piraeus, Patras	Ωmega	✓	
6	Heraclion, Crete	Morfh	✓	
7	Athens, Thessaloniki, Ioannina	Delta	✓	✓
8	Thessaloniki	Paster	✓	
9	Athens / Chalkida	Praxis	✓	
10	Heraclion, Crete	Agrofood School of Crete	✓	

In public and private IEKs, graduates of general and vocational secondary schools of secondary education are admitted. The studies last for four semesters, with an additional internship or apprenticeship of a total duration of 960 hours. To the graduates of IEKis given a Vocational Training Certificate and then, if they wish, they can take part in certification exams, which are carried out on a regular basis by EOPEPP. Successful students are awarded with a Level 5 Vocational Training. Throughout their studies, the weekly timetable consists of 20 hours of theoretical and laboratory lessons. The courses taught in the specialty of the Agrotourism technician during the first two semesters are: Agrotourism and Development, Organic Farming Data, Agricultural Installations, marketing of agro-tourism and agro-craft products. In the third and fourth semesters are taught the following courses: Agrotourism, Agribusiness, Alternative Forms of Rural Tourism, Owned Agricultural Products, Agricultural Tradition and Folk Art. There is also a laboratory course entitled "Practical Application to Specialty", which is taught three hours a week in all four semesters of study.In the private sector, the American Farm School and its division Perrotis College based in Thessaloniki, provide education and research in agriculture, food systems, environmental studies and other life sciences related to sustainability. The curriculum includes training for 4-6h/week. Also the Association FILOXENIA, which is the hosting organisation in Greece of the project "Foreign internships for students and graduates of vocational schools and vocational training staff", participated unfortunately only until 2013 in the ERASMUS+ programme of the European Commission's Education and Vocational Training Sector for students with studies on Agribusiness, Landscape Architecture and Rural Tourism, enabling them to stay in Greece for a month gaining new skills while doing work experience within

their profile orientation. Ending the presentation of training providers with regard to lifelong learning, there are several vocational training centers offering programs of up to 250 h. Training varies, according to the levels and sector of activity such as “Environment and Sustainable development” “Culture, Tourism, Regional development”, etc.

Conclusion

According to the present research study on the Greek educational system concerning the agrotourism sector, the following were observed: a) It is a positive fact that the Higher education includes courses on agrotourism and rural development at undergraduate level and it is more targeted at the postgraduate programs, since scientific knowledge and research are always necessary for social and economic development.The research project, however, should be directly related to the tourist reality; b) in secondary vocational education following the latest reforms, there is no longer the specialty of agrotourism, both in the Professional Lyceums of the Ministry of National Education and Religious Affairs and in the OAED Professional Schools. This creates a huge gap that has a direct impact on young people in rural areas in particular, reducing employment opportunities in agro-tourism;c) in the post-secondary vocational training of the public and private sector, the specialties of the agro-tourism technician and the management and economy executive in the field of rural economy in fact are the only original agrotourism education offered by our country. Negative factor is the relatively small geographic and quantitative offer of specialties in public IEKs, relative to the current rate of growth Greek agrotourism and to private IEKs where the specialties are mainly offered in the major urban areas of the country; d) a negative factor is also the fact that any curricula are completely disconnected from the philosophy of tourism education and also that they are provided only on a theoretical level; e) it is also worth noting of the country's total abstinence in participating in European and international related programs; f) finally, regarding training seminars carried out by various private bodies, for employees in the agricultural and tourism sector, either as entrepreneurs or as workers, there is as yet no framework or certification body for skills and knowledge content, so they cannot be evaluated with appropriate qualitative criteria.

In conclusion, the agrotourism programs offered by the Hellenic Educational System in all its structures are unfortunately not part of some national strategic planning for agrotourism, they are not linked to state and professional bodies, they do not take into account the need to diversify employment at the local level , they do not link academic knowledge provision to tourism and rural sustainable development, and thereby each institution takes it’s own responsibility for education, research and development of certain sectors of agriculture and agro tourism. The education system has to begins to address this task and there remains a lot to be done. The balanced sustainable development for a country and the ensuring of sufficiently high quality of people’s life can be possible only through education which should acquire support at all levels, preserve its historic achievements and yet be permanently in a quest for progress. It is truly evident that the sustainable development has become a core of teaching programs, αt the same time, knowledge and skills have become necessary not only for young people but also for adults. Greek agrotourism and the agri-food sector are two mature activities that can offer authentic experiences to the tourist visitor, as in recent years they are evolving in terms of modern Marketing in the standardization of their products and services, following international standards and sustainability criteria. The fact that agrotourism is now referred to as an agro-tourism industry at international and national level confirms its degree of growth. It is a special form of tourist activity that develops in a non-urban area through specific consumer patterns, incorporates the concept of innovation, includes a multitude of activities and complements the traditional hospitality of tourists from rural people by offering complex services.Quality in the tourist experience is directly related

to the service offered and the contact with the local population. Tourists now place more emphasis on quality services and value for money as well as on their better personal service. A precondition for securing the positive effects of tourism is the continuous upgrading of the services provided. This is achieved only by investing in the human resources that is or will be employed in the tourism sector by providing education and training capable of meeting modern needs and requirements. The key issues to be included in a national strategic plan for the development of the agro-tourism industry are the training of stakeholders, setting standards for the development of agro-tourism products and services, the adoption of marketing rules. The Global Sustainable Tourism Council has set up a set of standards and criteria that are used both for certification, education, awareness-raising and policy-making to help businesses, governments and destinations achieve social, environmental, cultural and Economic viability. Agrotourism must be offered in a coordinated and targeted manner to people who want to take up or are already engaged in the sector and should be linked to tourism education and training. By designing a framework for agrotourism education, we must always keep in mind the quality of the general education education system. This is because prospective students come from the formal education system and this is reflected in the availability and skills for learning and developing their skills. Of course the most important role is played by the organization of specialized education, study content, teaching, teaching staff and internship. Particular emphasis should be placed on designing structures at secondary technical vocational education level, emphasizing training programs without reducing the already existing academic role, making the most of research and innovation for the benefit of the industry. The objectives of agrotourism education and training should be: to improve and upgrade the quality of the accommodation services provided to meet the demands and trends of the tourist market and consumers and the best practices of operating Agrotourism accommodation. Curricula should include theoretical and laboratory courses as well as compulsory internships enabling graduates to have access to professional choices that, combined with knowledge and skills, meet the requirements of the agro-tourism sector and enhance Relations with the real economy and the ever-increasing competitive environment. Practical training is a well-established educational process and has been shown to function as a link to the labor market. A curriculum should summarize the following main areas of study: (a) finance, accounting, costing, financing; (b) marketing, standardization of agricultural products, quality assurance; (c) tourism with an emphasis on alternative forms, organization and operation of hotel accommodation, food, cooking, environmental protection, local history and culture; (d) rural development, good agricultural practice, organic farming; (e) basic computer applications, internet use and e-commerce. During the course of study, compulsory educational visits should be included in areas with agrotourism, local traditional products, organic farming, habitats etc. Like ecotourism, agrotourism has the potential to enhance environmental learning. There are remarkable empirical evidence that increased environmental knowledge is positively associated with more favorable environmental behaviors (Bradley et al. 1999).Environmental education is likely to serve multiple objectives and it is therefore useful to include it in curricula, contributing positively to both the awareness of trainees and future behaviors as workers. The system of education, retraining and lifelong learning for the tourism industry (with particular emphasis on ecological and sustainable tourism, especially in rural areas and for the whole families), the research on agro-tourism, ecological and sustainable tourism, international workshops for the exchange of experience in agro-tourism should be organized. The ecological education of the local population should be increased, disseminated best practices, and that all rural tourism resources be recorded. Agrotourism schools should be located mainly in rural areas and each of them should be an important factor in diversifying employment opportunities in its area. Agrotourism, in addition to all that we have analyzed, should be seen as a philosophy and way

of life, as the challenge to continue the heritage of the ancient Greek spirit. In Greece, we can create a specialized model of agrotourism for each region. Our country has the unique privilege of having inexhaustible resources that vary from region to region, rare natural beauty, history, tradition, gastronomy, architecture. To stimulate rural life, liven up the villages, strengthen economic income.

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AN EXPLORATORY COMPARATIVE STUDY OF THE EFFECTS OF MARKETING STRATEGIES UPON FIRM PERFORMANCE: THE CASE OF RURAL FIRMS IN GREECE.

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Abstract

The main goal of this paper is to increase the knowledge into the topic of the relationship between marketing strategies and firm's performance and examine the differences between rural and industrial firms. Moreover, the research is going to identify the existence of a relationship between the years of operation and the level of marketing strategies. An exploratory research has been conducted in order to answer the research hypothesis that set during the methodology section. Among others the findings incorporate that industrial firms show higher level of use of marketing strategies than the rural firms but there is no significant association between the type of the company and the level of marketing strategies, as well as, there is positive correlation between the level of marketing strategy and performance. Moreover, it was found that there is a positive relationship between performance and all the indicators of marketing strategies.

Keywords: Marketing, strategy, performance, rural firms, industrial firms

THEORETICAL BACKGROUND

Business Capabilities and Performance

The term capabilities refer to the mix of skills and knowledge that a company have available in order to accomplice its objectives (Yeoh & Roth,1999). Capabilities are the source of competitive advantage which can offer to a company the chance to differentiate in the market and achieve higher performance. Moreover, according to Day and his colleagues (1994), capabilities are the mean to combine different resources in order to maximize their performance.

Over the years, the impact of marketing capabilities on business performance receive great attention by the academics (e.g., Sakakibara, 1997; Day, 1994; Vorhies & Morgan, 2005). However, there is limited empirical research on the impact of marketing strategies and capabilities on performance. Commonly, the importance of the role of marketing capabilities lies on their connection with business value through the performance of the company (Zaheer & Bell, 2005). According to Haas and Hansen (2005), the different types of capabilities have different impact on performance of a company. Generally, the dominant view on the relationship of capabilities and performance is that there is a positive relationship between them (Day, 1994). However, some academics (Haas & Hansen 2005) note that in some cases capabilities can have a negative effect on some parts of company's performance.

Marketing capabilities are a specific type of capabilities that help a company to detect and understand the needs of consumers better that the competitors and offer the appropriate products and services according to those needs (Day, 1994). Other forms of capabilities are the research and development capabilities which include the ability of a company to develop new products and services and the operations capabilities which refer to the company's ability to use its skills and knowledge in order to use its resources as effectively as possible (Van Den Bosch, Volberda & De Boer, 1999). Marketing capabilities are a core organizational function that can drive a company to develop and sustain competitive advantage (Vorhies & Morgan, 2005) and according to previous researchers it has a positive relationship with performance (Ray, Barney & Muhanna, 2004). Moreover, Rust and his colleagues (2004) marketing capabilities have the stronger effect on company's performance than any

other type of capabilities.

According to the resource based view concept, the resources that characterized as rare, difficult to imitate and with high value are the ones that lead to competitive advantage (Peteraf, 1993). The use of the resource based view concept allow the company to understand which of its resources are connected with competitive advantage and profitability (e.g., Peteraf, 1993; Barney, 2001). On the other hand, the capabilities perspective argues that the capabilities are more important than the resources since they help a company to increase its performance (Vorhies, Harker & Rao, 1999). The use of capabilities enables a company to operate effectively by perform specific and unique organizational processes that cannot be easily replicate. Capabilities are strongly connected with these processes within a company and drive manager's decisions (Lin & Wu, 2014). Furthermore, the use of capabilities on a company's strategic decisions creates stronger barriers of imitation and leads to sustainable competitive advantage in the marketplace (Breznik & Lahovnik, 2014). On the other hand, Schilke (2014) suggests that in some cases the existing capabilities of a company are the reason of losing the competitive advantage since the company focuses on the existing capabilities rather than developing new ones. In summary, capabilities are highly connected with competitive advantage and therefore with company's performance (Day, 1994).

Impact of Different Types of Capabilities

Capabilities impact on performance is highly connected with two characteristics of capabilities, the difficulty to copy those capabilities and the difficulty to obtain them. Different types of capabilities may differ in terms of those two characteristics and as a result their impact on performance may be differ as well. Marketing capabilities are based on the knowledge of the market place and specifically on the knowledge of consumer needs (Day, 1994). Market knowledge is a process that can be developed through the implementation of marketing strategies. According to Zhou and Li (2012), market knowledge has a complex nature and it is difficult to codify it. Based on the facts that marketing knowledge is developed through implementation and that it has a high level of complexity, it can be stated that marketing capabilities is difficult to be copied by the company's competitors and even in the cases that this marketing knowledge can be codified it is still difficult to be obtained in the market. In summary, marketing capabilities are difficult to be copied by the competition (Zhou & Li, 2012). On the other hand, research and development capabilities are codified and shared easier than the marketing knowledge and processes (Mahmood, Zhu & Zajac, 2011). Likewise, operations capabilities are very frequently based on actions and processes that have been codified by a competitor. Summarizing, it can be stated that marketing capabilities are more difficult to be copied and transferred than research and development and operations capabilities. Therefore, their relative importance is much higher than of the other types of capabilities since they can lead to competitive advantage against the competitors.

Other Factors that Affect the Relationship between Capabilities and Performance

Besides the type of the capabilities and their nature, there are also other factors that can affect the relationship between capabilities and performance (Day, 1994).

The size of the company. The relationship between capabilities and performance is different for firms of different sizes. As it was mentioned before capabilities are connected with actions and operating processes (Day, 1994). Larger companies are characterized by more complex processes which are more difficult to be copied by the competitors while small companies have more simple operation processes. Therefore, the link between capabilities and performance is stronger for large companies.

The type of the industry. The impact of a particular capability type varies across the industry type (Reilly & Drzycimski, 1974). Different industries have different characteristics, different barriers of capabilities' copy and different customer needs, thus the importance of a specific capability type and its impact on performance maybe low for a particular industry type but it maybe be high for another industry (Yi, Davey & Eggleton, 2011).

Geographic Factors. Companies from different geographic location sometimes illustrate a different set

of capabilities and similarly with the type of the industry, those capabilities maybe important for a market place but may not be so important for another market (Yi, Davey & Eggleton, 2011).

PRIMARY RESEARCH

Primary Research Justification

The interest on this specific topic has been aroused by the dearth of studies regarding the relationship of marketing strategies and firm's performance regarding rural and industrial firms. According to the existing literature, there has been noted an impact of various factors of marketing strategies on firm's performance. Additionally, as it has been made obvious from many studies, high levels of performance on specific marketing activities can result in favorable performance of the company in financial and market level. Thus, the value of marketing strategies derives of their influence on performance. The link between marketing activities and firm's performance have been demonstrated by various researchers, who conclude that marketing activities can have a positive impact on company's performance. Furthermore, taking into consideration that the economy of Greece based a lot on the performance of rural sector, the comparison of two different types of companies (rural and industrial firms) will illustrate their differences in terms of use of marketing strategies as well as in terms of performance. Under this scope, the objectives of this study are to conduct an exploratory comparative primary research in order to increase the knowledge into the topic of the relationship between marketing strategies and firm's performance and examine the differences between rural and industrial firms.

Research Methodology

Research Hypothesis

Taking into consideration the literature review and in line with the research aims, the following research hypothesis, were formed:

1. The type of the company is a differentiating factor in terms of the level of marketing strategies
2. The type of the company is a differentiating factor in terms of firm performance
3. There is a positive relationship between marketing strategies and performance
4. All the factors of marketing strategies are statistically related with firm's performance.
5. There is a relationship between the years of operation and the level of marketing strategies.

Primary Research Process

Data collection

The recruitment of participants in the research took place in the last week of March 2017. A pilot questionnaire was tested in order to correct any possible mistakes and meet the requirements of the investigation.

All questionnaire items were extracted from well-established scales with high validity that were used in previous studies. Particularly, the questionnaire was formed based on the academic articles of

- Menon, Bharadwaj, Adidam and Edison (1999) regarding «Antecedents and consequences of marketing strategy making»,
- Kotler (1997) with title «From sales obsession to marketing effectiveness»,
- Yoon and Kim (1999) with the title « The new approach to assessing the marketing effectiveness of Korean firms», and finally the article of
- Homburg and Pfesser (2000) with title «A multiple-layer model of market-oriented organizational culture: measurement issues and performance outcomes».

However, necessary changes have been made and some question were added in order to answer the research questions. The questionnaires were completed by the managers of the firms, hand by hand, and an additional information sheet was available in order to let them know the purpose of the research and assure them about the confidentiality of the data, their anonymity and the use of the research outcomes only for academic purposes.

Data analysis

The analysis of the data was made with the statistical software for data analysis SPSS. Descriptive statistics will be used to illustrate the answers of the respondents while inferential statistics will be used to examine the relationship between the variables. Specifically, the two Independent T-test and the Pearson correlation test were used in order to examine the relationships needed to answer the research hypothesis. Moreover, for every couple of variables the hypothesis testing process that was used, was the following (The level of significance was 0.05):

H_0 = There is no relationship/difference between the two variables
H_1 = There is a relationship/difference between the two variables

Sampling

The sample of the research is primarily going to be consisted of 100 respondents/companies, 50 rural and 50 industrial firms. All of the subjects will be English speakers and managers or marketing managers of the firms. Based on previous studies on similar topics and the market size, this sample size can provide reliable information. Nevertheless, the size of the sample could be a limitation in case of generalization of the results. A non-probability judgmental/purposive sampling is going to be used as a sampling method, based on certain criteria. The choice of the particular sampling method was made with regard to the recruitment of the participants in the research. The criteria of selection are set in line with the existing literature but also according to the research objectives. Thus, the criteria for sample selection are going to be the following:

- English speakers: This criterion was selected in order to maximize the quality of the received information and avoid misunderstandings.
- Managers or marketing managers of the firm.

Questionnaire Design

The questionnaire that was used to provide the researcher with data regarding the marketing strategies and firm's performance consists of three (3) sections. The first page of the questionnaire was used to present the researcher, inform the respondents about the purpose of the research and provide instructions on how to complete the questionnaire. Section one (1) includes two demographic questions such as the type of the company and the years of operation in the market and an extra question with 7 statements regarding environmental turbulence which measured with a 5-point likert scale where 1=No change and 5=Very frequent change. Section two (2) consist of questions regarding the marketing strategies of the firm. There are 7 different categories which assess different areas of marketing strategies. Specifically, the sections are:

a) Situational Audit (4 statements),
b) Comprehensiveness (3 statements),
c) Cross-functional Integration (5 statements),
d) Communications Quality (4 statements),
e) Consensus Commitment (3 statements),
f) Emphasis on marketing assets and capabilities (13 statements) and
g) Resource Commitment (3 statements).

All statements were measured with a 5-point likert scale where in the most cases 1= "strongly disagree" and 5= "strongly agree" while for "Emphasis on Marketing Assets and Capabilities" 1= Not emphasized and 5= Strong emphasis.

Finally, section 3 consists of 2 different categories of firm's performance, market performance (6 statements) and financial performance (3 statements). Performance statements were measured with a 5-point likert scale where 1= "strongly disagree" and 5= "strongly agree".

RESULTS OF DATA ANALYSIS

Descriptive Statistics

Total Marketing strategies components and Performance

Table 1 show the differences between rural and industrial firms regarding the total marketing strategy and performance. Specifically, it can be stated that industrial firms have better implementation of marketing strategies (3.38 - 3.37) and higher performance (2.72 – 2.63) than the rural firms.

Table 1: Total Marketing strategies components and Performance

	Firm type	Minimum	Maximum	Mean	Std. Deviation
Marketing strategy	Industrial	2.80	3.87	3.3886	.23888
	Rural	2.79	3.80	3.3717	.19630
Performance	Industrial	1.50	4.08	2.7283	.70325
	Rural	1.17	3.67	2.6383	.64826

Inferential Statistics

Type of the company/level of marketing strategies

The following table presents the mean values regarding the marketing strategies in relation with the type of the company. Industrial firms show higher level of use of marketing strategies than the rural firms. Because the two different types of companies have unequal means, two independent t-test has to be used in order to investigate if there is an association between the type of the company and the level of marketing strategies. After the test carried out, it can be concluded that there is no significant association between the type of the company and the level of marketing strategies since the sig. is 0.699.

Table 2: Type of the company/level of marketing strategies

	Type of company	N	Mean	Std. Deviation	p-value
Marketing strategies	Industrial	50	3.3886	.23888	.699
	Rural	50	3.3717	.19630	

Type of the company/Firm performance

The following table presents the mean values regarding firms' performance in relation with the type of the company. Industrial firms show higher level of performance than the rural firms. Because the two different types of companies have unequal means of performance, two independent t-test has to be used in order to investigate if there is an association between the type of the company and firm's performance. After the test carried out, it can be concluded that there is no significant association between the type of the company and firm's performance since the sig. is 0.507.

Table 3: Type of the company/Firm performance

	Type of company	N	Mean	Std. Deviation	p-value
Performance	Industrial	50	2.7283	.70325	.507
	Rural	50	2.6383	.64826	

Level of marketing strategies / performance

In order to examine the relationship between the level of marketing strategy and performance, Pearson correlation test was carried out. The correlation coefficient is 0.741, which can be considered as quite high and the associated sig. is 0.008. Given that we conclude that there is positive correlation between the level of marketing strategy and performance.

Table 4: Correlation of Level of marketing strategies / performance

		Marketing strategies	Performance
Marketing strategies	Pearson Correlation	1	.741
	Sig. (2-tailed)		.008
Performance	Pearson Correlation	.041	1
	Sig. (2-tailed)	.688	

Indicators of marketing strategies / Firm's performance.
In order to examine the relationship between indicators of marketing strategies and performance, Pearson correlation test was carried out. Specifically, it was found that there is a positive relationship between performance and all the indicators of marketing strategies.

Table 5: Correlations of Indicators of marketing strategies / Firm's performance.

		Performance
Situational Audit	Pearson Correlation	.685
	Sig. (2-tailed)	.003
Comprehensiveness	Pearson Correlation	.803
	Sig. (2-tailed)	.010
Cross-Functional Integration	Pearson Correlation	.618
	Sig. (2-tailed)	.042
Communication Quality	Pearson Correlation	.621
	Sig. (2-tailed)	.038
Consensus Commitment	Pearson Correlation	.915
	Sig. (2-tailed)	.001
Emphasis on Marketing Assets and Capabilities	Pearson Correlation	.588
	Sig. (2-tailed)	.042
Resource Commitment	Pearson Correlation	.617
	Sig. (2-tailed)	.046

DISCUSSION OF THE FINDINGS AND LIMITATIONS

Overview of Descriptive Statistics

The sample of the research consists of industrial and rural firms by 50% for each category. The average years of operation for the rural firms was 7.82 years while for industrial firms was 8.88 years. Regarding environmental turbulence, it was found that in total industrial firms' environment (M = 3.37) is more stable than the environment of rural firms (M = 3.33) and specifically, industrial firms' environment is more stable in terms of market opportunities, production technology, legal and political constraints and competitive intensity while rural firms' environment is more stable in terms of services innovation, research and development, and customer preferences and expectations.
Following the research hypothesis, it was found that:

1. The type of the company is a differentiating factor in terms of the level of marketing strategies

Industrial firms show higher level of use of marketing strategies than the rural firms. Moreover, there is no significant association between the type of the company and the level of marketing strategies. Given that, the first hypothesis is rejected.

2. The type of the company is a differentiating factor in terms of firm performance

Industrial firms show higher level of performance than the rural firms. Moreover, there is no significant association between the type of the company and firm's performance. Given that, the second hypothesis is rejected.

3. There is a positive relationship between marketing strategies and performance

There is positive correlation between the level of marketing strategy and performance. Given that, the third hypothesis is accepted.

4. All the factors of marketing strategies are statistically related with firm's performance.

There is a positive relationship between performance and all the indicators of marketing strategies. Given that, the fourth hypothesis is accepted. These findings are also in line with the findings of Menon and his colleagues (1999) and the study of Kotler (1997).

5. There is a relationship between the years of operation and the level of marketing strategies.

There is no relationship between the level of marketing strategy and performance. Given that, the fifth hypothesis is rejected.

CONCLUSION

The current article aims to increase the knowledge into the topic of the relationship between marketing strategies and firm's performance and examine the differences between rural and industrial firms. The appropriate literature review was made and the research methodology was presented. The primary research was designed in order to answer the research questions that sat up at the methodology section and based on previous research. The results should be used with caution for reasons that they were analysed at the limitations section, but they can give to the reader an overview for the impact of marketing strategies on firm's performance.

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CIRCULAR ECONOMY. A PRELIMINARY CONSUMERS' MARKET RESEARCH IN GREECE

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Abstract

Unlike the traditional linear economic model based on a 'take-make-consume-throw away' pattern, a circular economy is based on sharing, leasing, reuse, repair, refurbishment and recycling, in an (almost) closed loop, where products and the materials they contain are highly valued. In practice, it implies reducing waste to a minimum. Moving towards a more circular economy could deliver opportunities including reduced pressures on the environment; enhanced security of supply of raw materials; increased competitiveness; innovation; growth and jobs. The present prototype research, is a preliminary investigation regarding the opinions of Greek consumers in the model of circular economy. Based on a specially constructed questionnaire for the purposes of the study, a research was conducted regarding the awareness of the model of Circular Economy, practical implications of the model in citizens' everyday living and the benefits that could derive by adopting the specific model of production and consumption. The results are encouraging for the development of the circular economy model in the Greek market, boosting innovation, environmental protection, responsible consuming and financing, towards the adoption of the model by the industry too. However, a new culture needs to be also established regarding the Greek economic model shifting towards closed loop solutions.

Key words: *Circular Economy, resource efficiency, innovation, market research,*

Introduction

The transition to a more circular economy, where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimized, is an essential contribution to the EU's efforts to develop a sustainable, low carbon, resource efficient and competitive economy. Such transition is the opportunity to transform our economy and generate new and sustainable competitive advantages for Europe (European Commission 2017, 2015).

Unlike the traditional linear economic model based on a 'take-make-consume-throw away' pattern, a circular economy is based on sharing, leasing, reuse, repair, refurbishment and recycling, in an (almost) closed loop, where products and the materials they contain are highly valued(Bourguignon, 2016; Ellen McArthur Foundation, 2013). In practice, it implies reducing waste to a minimum. Moving towards a more circular economy could deliver opportunities including reduced pressures on the environment; enhanced security of supply of raw materials; increased competitiveness; innovation; growth and jobs. However, the shift also poses challenges such as financing; key economic enablers; skills; consumer behaviour and business models; and multi-level governance (EY, 2016; Tukker, A. 2015; Ghisellini, et al. 2015).

On 2 December 2015, the European Commission presented a new circular economy package. The package contains an action plan for the circular economy, mapping out a series of actions planned for the coming years, as well as four legislative proposals on waste, containing targets for landfill, reuse and recycling, to be met by 2030. (European Commission, 2015; 2017).

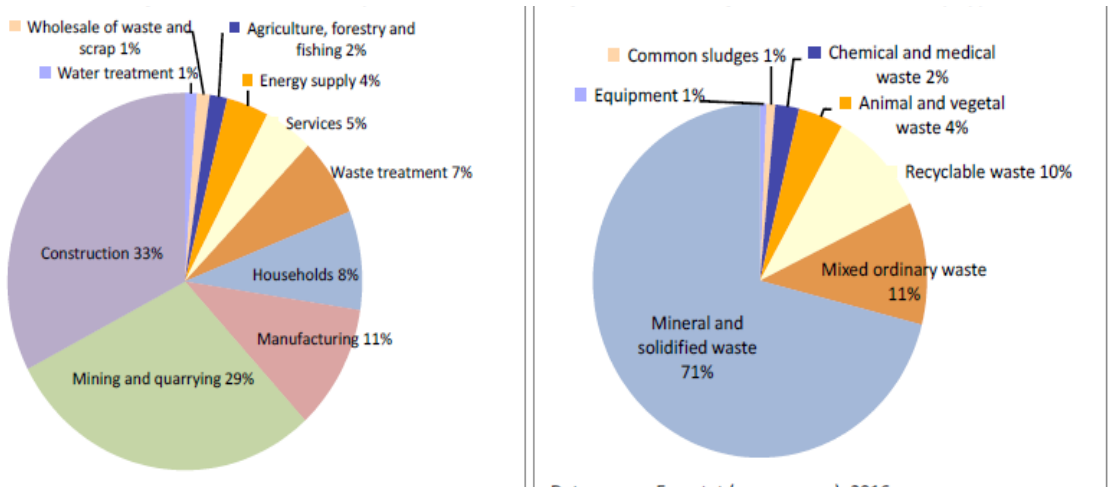
Background

The circular economy concept is generally described as one in which products and the materials they contain are highly valued, unlike in the traditional, linear economic model, based on a 'take-make-consume-throw away' pattern. This production and consumption model is based on two complementary loops drawing inspiration from biological cycles: one for 'biological' materials (which can be decomposed by living organisms) and one for 'technical' materials (which cannot be decomposed by living organisms). In both cases, the aim is to limit the leakage of resources as much as possible (Ellen McArthur Foundation, 2013).

In practice, a circular economy implies reducing waste to a minimum. When a product reaches the end of its life, its materials are kept within the economy wherever possible. These can be productively used again and again, thereby creating further value. Measures leading towards a circular economy include reusing, repairing, refurbishing and recycling existing materials and products. What used to be considered as 'waste' can be turned into a valuable resource. (EY, 2016; European Commission, 2015; 2017).

The amount of waste generated in the European Union (EU) appears to be declining. According to the European Environment Agency (EEA), between 2004 and 2012 waste generation from manufacturing and services sectors in the EU-28 and Norway declined by 25 and 23 respectively, despite respective increases of 7 and 13 in sectoral economic output. Meanwhile, total municipal waste generation in EEA countries declined by 2, despite a 7 increase in real household expenditure. However, 2.5 billion tonnes of waste (or about 5 tonnes per capita) are still generated each year in the EU. Figures 2 and 3 show the breakdown of waste generated by sector and by type. (European Commission, 2017).).

Figure 1 and 2. *The breakdown of waste generated by sector and by type (Source: European Commission, 2015*



Opportunities and challenges

Potential opportunities

Moving towards a more circular economy has both an environmental and economic rationale. Potential opportunities include: (EY, 2016; Tukker, A. 2015; Ghisellini, et al. 2015).

- Reduced pressures on the environment: a circular economy would significantly reduce greenhouse gas (GHG) emissions through better waste management and reduced use of resources (such as energy, water, land and materials) in manufacturing, with positive impacts on the climate. Large-scale reuse of raw materials could help reduce landscape and habitat disruption as well as marine littering, which would in turn help to limit biodiversity loss.
- Enhanced security of supply of raw materials: a circular economy would mitigate risks associated with the supply of raw materials, such as price volatility, availability and import

dependency. According to Eurostat data, the EU currently imports, in raw material equivalents, about half the resources it consumes.

- Increased competitiveness: a circular economy could bring savings to businesses and consumers through improved resource efficiency. A 2015 Ellen MacArthur Foundation report estimates that by 2030, a shift towards a circular economy could reduce net resource spending in the EU by €600 billion annually, bringing total benefits estimated at €1.8 trillion per year once multiplier effects are accounted for. Additionally, research suggests that stricter environmental legislation can provide a competitive advantage to businesses.
- Innovation: a circular economy could trigger a large innovation drive across sectors of the economy because of the need to redesign materials and products for circular use. The McKinsey & Company consultancy highlights that this would apply even in sectors not normally considered as innovative, such as the carpet industry.
- Growth and jobs: a circular economy could strengthen growth and create new jobs. It is estimated that the transition would increase GDP by 1 to 7 percentage points by 2030, depending on whether a higher pace of technological change is taken into account,6 and that it would have an overall positive imp

Materials and Methods

The present research investigates consumer attitudes toward the model of circular economy. The survey conducted during the months of April and May 2017. To carry out the survey a questionnaire developed, in order to collect the necessary information. Google documents were used as a platform to create the online questionnaire, which then promoted through social media. Google docs platform allows free design of electronic questionnaires and at the same time it constitutes a user-friendly application to fill in online questionnaires and submit it directly. According to the international literature the Internet is a fruitful area for conducting survey research for many and various reasons, as it can overcome some problems and enhance consumers' willingness to respond to a survey. First of all, an Internet-based survey research can save time for researchers as it allows a researcher to reach people in a short amount of time (Taylor 2000; Yun and Trumbo 2000). Online survey researchers can also save a great deal of money, as they eliminate the travel costs to conduct interviews. Moreover, by conducting an online survey there is no need for paper and other costs, such as those incurred through postage, printing, and data entry (Llieva et al. 2002).

Consumers were invited to complete the questionnaire that looked at specific issues related to circular economy. It was divided into four distinct unites, to assist participants in completing it. The first section examines participants' level of knowledge throughout the meaning of circular economy. The second section deals with practical implementation and promotion of circular economy, while throughout the third one attempted the identification of consumers' attitudes towards the benefits that can be derived from the application of described model. The last section contains questions on demography and socioeconomic status, to outline the profile of the participants. A simple random sampling is used in the survey, as it is the most widely-used probability sampling and it provides satisfactory results. It is also pinpointed that a pilot study conducted, in order to assess the reliability of the questionnaire.

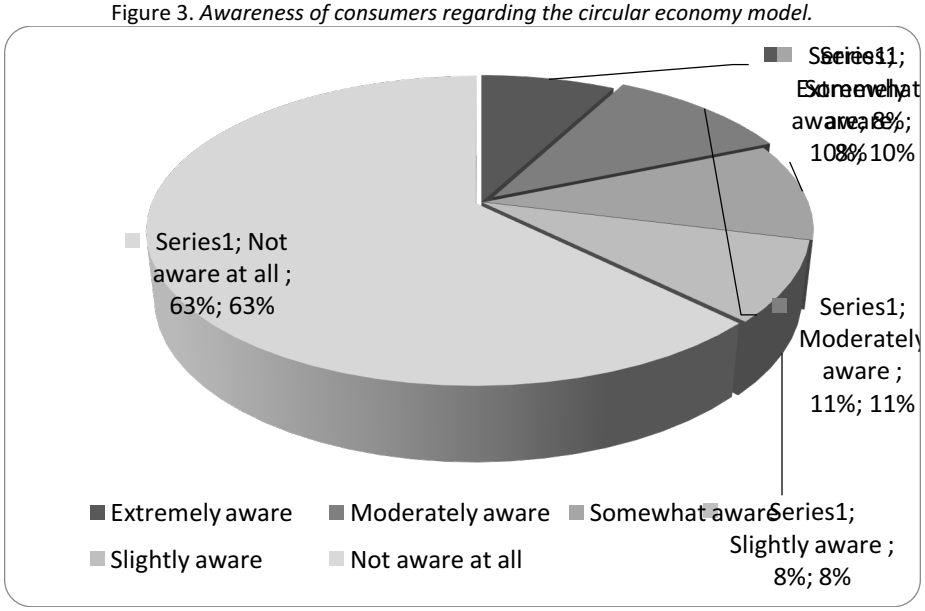
Results

This survey yielded 166 usable responses. All the questionnaires were returned fully completed and they contained valid answers, this is the reason why they were included in the survey results as a whole. There is a balanced sex composition within the survey, as 84 of the participants are men and 82 women. Significant percentage (27%) of respondents is bachelor's degree holders, while 18 per cent of the respondents hold a master or doctoral degree. 37 percent of the consumers are secondary school graduates, followed by those who have received primary education. The majority of participants in the survey were people under the age of 40 years, with the 21-30 years age group to be highlighted as the largest group of respondents (28%). The majority of the participants (52%) declare "employees", followed by those who declare "unemployed" (31%) and 17% "without employment".

During the interviews, consumers were asked about their level of awareness related to circular economy. It is obvious from the results, which are depicted on the Picture 3, the very high percentage

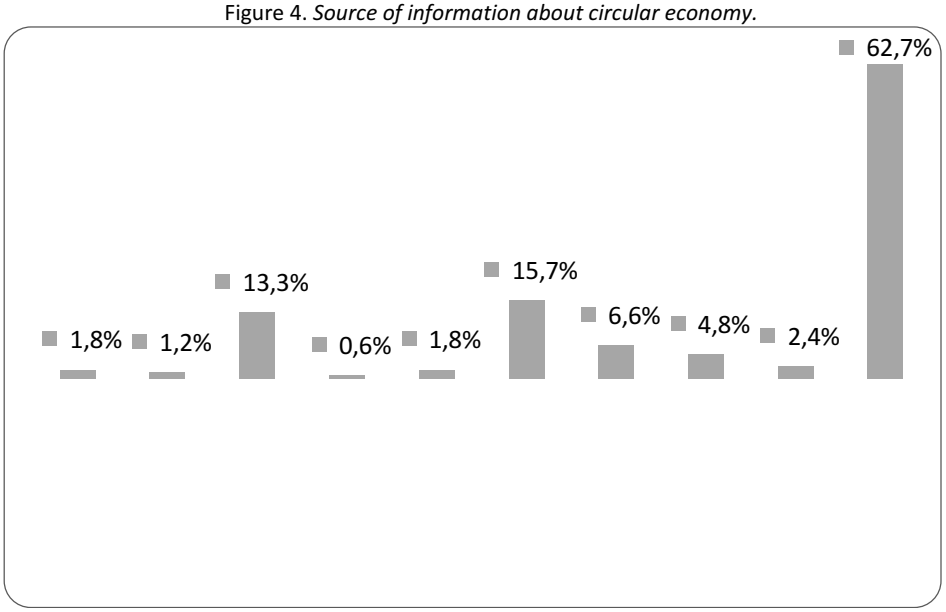
of those who are not aware at all (63%). On the other hand only 8% of the participants declare that they are aware about the meaning of circular economy.

Figure 3. *Awareness of consumers regarding the circular economy model.*



With regard to those who felt aware about the investigating issue, they state that they received information concerning the circular economy, mainly, from Internet (16%) as well as during their university studies (13%). The picture below (Picture 4) shows the relevant responses.

Figure 4. *Source of information about circular economy.*



Among the others, people surveyed were asked to rate five options best represent the circular economy model. From the results of analysis, presented in Table 1, arises that the circular economy is mainly addressed as a model of natural resource management. In particular, 34 percent of our sample perceives it as “absolutely important” and 23 percent as “moderately important”. In addition to, 25% of respondents claimed that it can be “absolutely” characterized as a model of consumer behavior and 19% as a new model of economic growth. The description of “a new business model” matches perfectly to circular economy according to 17% of the responses and moderately according to 22% of the answers. It is recorded, also, percentage 28% of the people surveyed who claim “undecided” about this option.

Table 1. Options representing the circular economy model *(%)*.

	Absolutely important	Moderately important	Undecide/ Neutral	Hardly important	Not important at all
A new model of economic growth	19.0	13.0	36.0	18.0	14.0
A model of natural resource management	34.0	23.0	16.0	16.0	11.0
A model of creating wealth and value for products	13.0	19.0	33.0	28.0	7.0
A model of consumer behavior	25.0	22.0	28.0	19.0	7.0
A new business model	17.0	22.0	28.0	23.0	9.0

The third part of the questionnaire encompassed questions related to benefits arising from the application of circular economy model. As cited in the table below (Table 2) we enquired on the respondent's personal opinion about the areas where the circular economy model can positively affect consumers. As it is obvious from the results they rank very high the strengthening of environmental consciousness (39.8%), as well as the developing of "green" products and processes (39.8%). It is also worth mentioning the fact that consumers believe, to a certain extent that circular economy contributes to waste reduction (32.5%) and households' energy saving (28.9%). On the contrary, the contribution of circular economy in tackling the economic crisis is assessed particularly low (24.7% of respondents regard that it is not important at all).

Table 2. *Areas where the circular economy model can positively affect consumers (%).*

	Absolutely important	Moderately important	Undecided/ Neutral	Hardly important	Not important at all
Households energy saving	28.9	26.5	22.3	13.3	9.0
Saving/increasing annual income	13.9	19.3	27.1	23.5	16.3
Lower product prices	16.3	22.9	24.7	19.9	16.3
Access to quality products	19.9	21.1	24.7	20.5	13.9
Reduction of waste	32.5	22.9	19.9	16.3	8.4
Improving consumer health and safety	15.1	16.3	23.5	23.5	21.7
Creating new jobs	24.7	19.9	23.5	17.5	14.5
Developing "green" products and processes	39.8	30.7	18.7	6.0	4.8
Developing products that meet safety standards	18.1	19.9	24.1	21.7	16.3
Strengthening environmental consciousness	39.8	29.5	18.1	6.6	6.0
Improving living standards	13.9	24.7	23.5	20.5	17.5
Tackling the economic crisis	19.3	19.9	17.5	18.7	24.7

When asked to rank the benefits can arise from the application of the circular economy model in the society and economy, 31.3% of respondents evaluate as extremely important the possibility of enhancement consumers' environmental sensitivity. Furthermore, as absolutely important evaluated by a large proportion of consumers the possibility of new jobs creating (29.5%), as well as the creation of a sustainable urban environment (23.5%). 22.3 percent of the people surveyed said that the circular economy contribute decisively to the development of responsible consumer behavior, however on the other hand, 26.5 percent of our sample claimed that circular economy may not reduce the inequalities for vulnerable social groups.

Table 3. *Ranking of benefits to society and economy from the application of the circular economy model (%).*

	Absolutely important	Moderately important	Undecided /Neutral	Hardly important	Not important at all
Jobs creating- reducing unemployment	29.5	27.1	24.7	10.2	8.4
Enhancing income	21.7	23.5	20.5	19.3	15.1
Development of responsible consumer behavior	22.3	18.7	22.9	19.9	16.3
Introducing new skills and knowledge into the labor market	16.9	18.7	24.7	21.7	18.1
Strengthening economic activity at a local level	18.7	22.3	26.5	16.9	15.7
Enhancement of environmental sensitivity	31.3	25.3	21.1	14.5	7.8
Mobilize local resources	16.9	18.7	22.3	25.9	16.3
Reducing inequalities for vulnerable social groups	12.7	14.5	18.7	27.7	26.5
Tackling the economic crisis	18.7	16.3	25.3	22.9	16.9
Creating a sustainable urban environment	23.5	25.9	24.7	16.3	9.6
Services of general interest	15.7	21.7	22.3	21.7	18.7

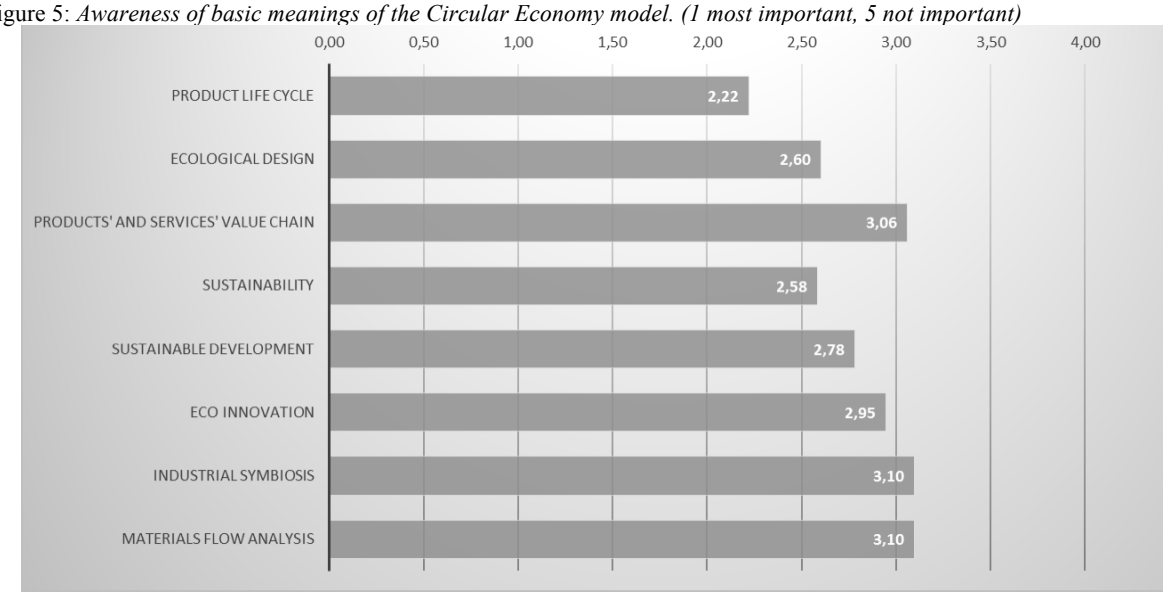
Concerning the question, "Which procedures of businesses and environment can be helped by the implementation of the circular economy model?", 48.8% replied that recycling of materials, products energy and water is "absolutely important" and 20% evaluated it as "moderate important". 47.6 percent of our sample assessed as "extremely important" the reduction of waste, followed by 20.5% which regard it as "moderately important". Moreover our results suggest a high value of waste minimization, as 44.6% of respondents regard that environment can benefit to the greatest extent from this procedure. As indicated by further results, the implementation of the circular economy in saving of raw materials and sustainable management of natural resources have a significant recognition, given that 39.2% of the sample perceive it as "absolutely important" and 21.7% as "moderately important". In addition to, participants tend to believe that circular economy may not contribute to improving business liquidity, 26.5% of the respondents replied "not important at all" and 18.7% "hardly important". Finally, respondents claimed not to regard important at all the contribution of circular economy in development of business innovation (24.7%) and in strengthening of Corporate Social Responsibility (CSR) (24.7%).

Table 4. *Procedures for businesses and environment which can be helped by the implementation of the circular economy model (%).*

	Absolutely important	Moderately important	Undecided/ Neutral	Hardly important	Not important at all
Efficient use of resources	33.7	24.1	21.1	14.5	6.6
Recycling of materials/products energy/water	48.8	20.5	13.3	12.7	4.8
Production of energy/water	26.5	19.9	29.5	12.7	11.4
Use of environmentally friendly raw materials	34.3	31.9	15.1	11.4	7.2
Saving of raw materials/ Sustainable management of natural resources	39.2	21.7	16.3	13.3	9.6
Waste minimization	44.6	26.5	13.9	8.4	6.6
Waste management	42.8	28.3	13.9	9.0	6.0
Reduction of waste	47.6	20.5	11.4	9.6	10.8
Emissions monitoring	9.6	24.7	25.9	26.5	13.3
Creating wealth-Reducing production costs	10.2	28.3	26.5	18.7	16.3
Improving business liquidity	13.3	20.5	21.1	18.7	26.5
Develop of win-win collaborations	17.5	14.5	24.1	22.9	21.1
Innovation Development	17.5	11.4	23.5	22.9	24.7
Development of "green" products / processes	33.7	24.7	19.9	12.7	9.0
Strengthening Corporate Social Responsibility	12.7	10.2	24.1	28.3	24.7

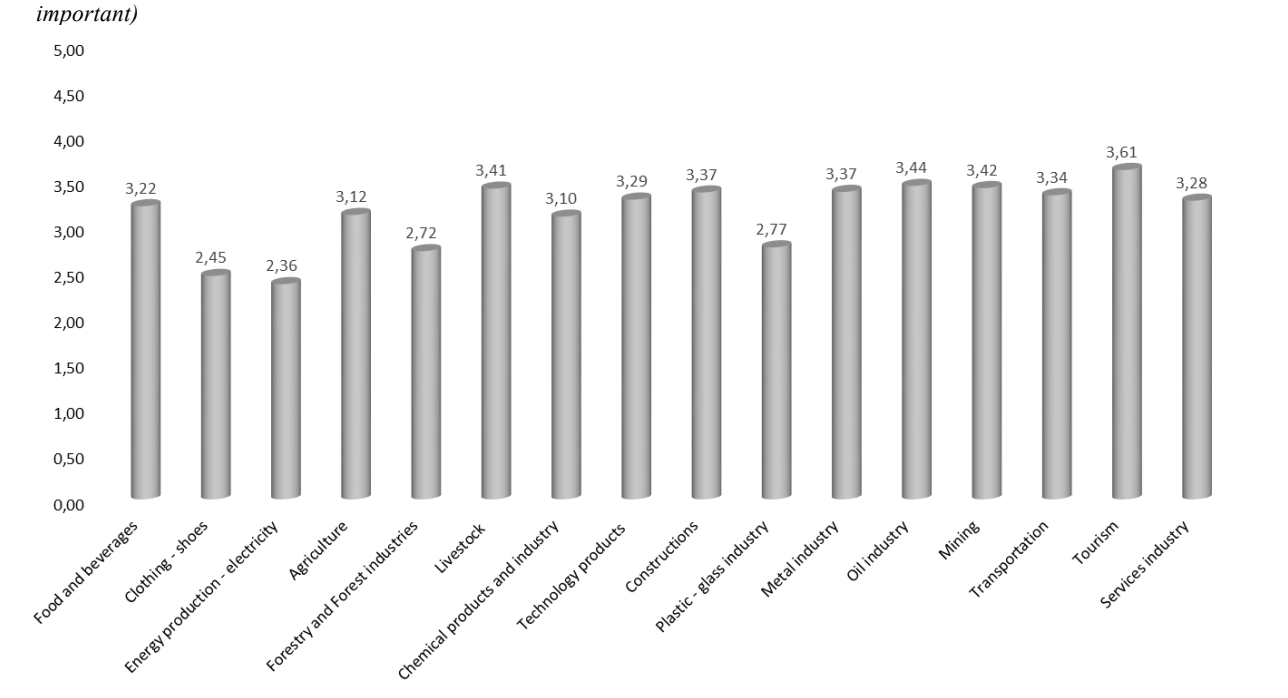
The following results show the general awareness of the participated consumers, regarding basic meanings of the Circular Economy model. Figure 5 shows that the consumers are aware of meanings such as product life cycle, ecological design and sustainability. More complex meanings, regarding and the transition to a new economic model such as eco innovation, industrial symbiosis etc. are meanings that the consumers are not aware of.

Figure 5: *Awareness of basic meanings of the Circular Economy model. (1 most important, 5 not important)*



Finally, regarding the sector that the Circular Economy model is anticipated to be better implemented, the participants ranked first the energy and electricity production sector (Figure 6), then clothing and footwear, forestry and forest industries and plastic and glass industries.

Figure 6: *Sectors that the Circular Economy model is most expected to be implemented in Greece (1most important, 5 not important)*



Discussion-Conclusions

Summary findings of survey indicate that Greek consumers have limited familiarity with the meaning of circular economy, since they have received fragmentary information about all its dimensions. Respondents connect circular economy, mainly, with environmental issues, as well as broader issue of sustainability. From their point of view circular economy addressed as a model of natural resource management, the implementation of which strengthen consumers' environmental consciousness. Nevertheless, they realize the "double win" of the economy and environment that arises from it. As it is apparent from the results, the implementing of circular economy strategy is not only beneficial to the environmental sustainability and resources conservation, but also to the development of economy and society.

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ASSESSMENT OF A PILOT HYBRID E-COURSE BY STUDENTS FROM FACULTY OF AGRICULTURE, FORESTRY AND NATURAL ENVIRONMENT.

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Abstract
This paper concerns the evaluation of a pilot hybrid e-learning course by students from the School of Agriculture, Forestry and Natural Environment who attended it. The thematic unit that is covered is Agro-forest ecosystems and its teaching method is hybrid (synchronous, asynchronous and traditional). Student's opinion and critical position on topics such as studying material, structure, content, clarity of the goals of thematic unit,flexibility of the teaching method regarding its shaping according to the students' personal needs, usability of the course, ease of handling, collaboration with the teacher, student assessment, but also self-assessment issues, is what has been gathered, analyzed and depicted by this research. The decisive effect of mixed (hybrid) learning with successive changes between electronic and traditional lectureshelped to the understandingof the lesson and the enthusiasm of the participants was great.

Keywords: *e-learning, hybrid e-course, evaluation of hybrid e-learning course, Agriculture and Forestry Higher Schools, Agroforestry*

Introduction

Traditional learning has been the staple for hundreds of years, from the very founding of higher education institutions(Gounopoulos et al. 2017). Today there is a lot of information gathered and it is a challenge to distribute it for the disseminationand application of knowledge. There is a storm of research and data and knowledge extraction that cannot contribute to the advancement of science in general but also to social progress unless there is a similar mechanism of dispersion where everyone can be a participant. New information technologies are helping in this need to disseminate information and knowledge and, in terms of educational needs, diffusion is taking place through eLearning platforms and the areas that they can cover.

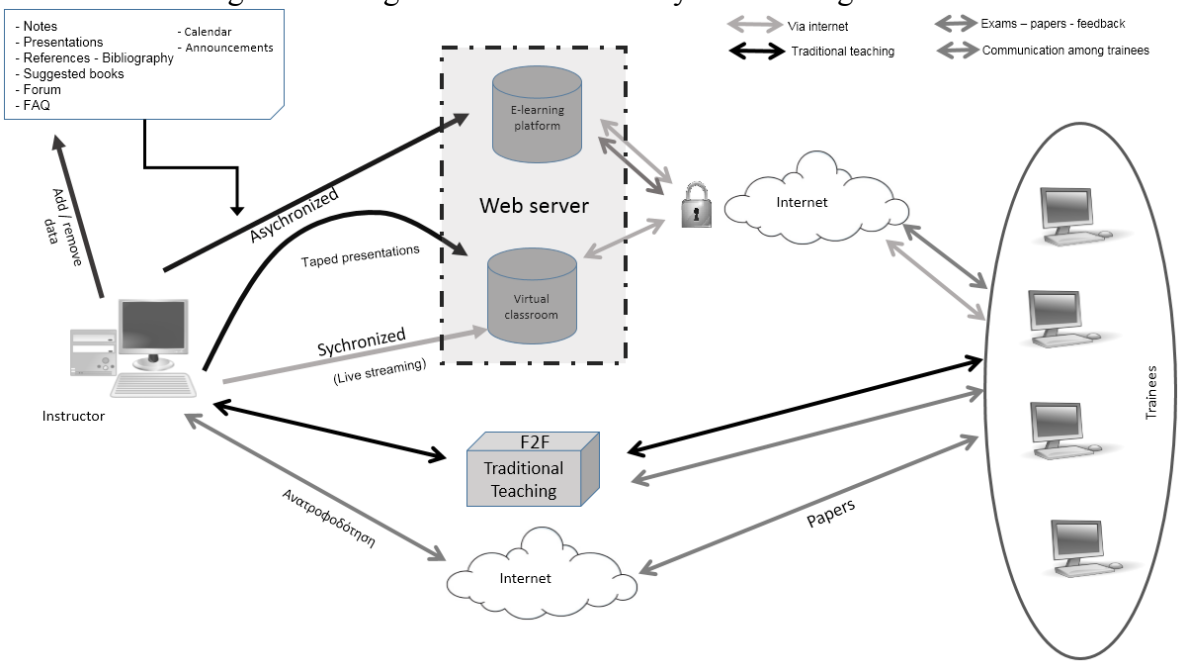
New technologies have been dynamically entering our lives and online services are a lever of sustainableregional development. The electronic services provided by the new ICTs have proved to be an important tool in the efforts to disseminate e-learning in modern education(Wang et al. 2007, Várallyai et al. 2015). E-Learning is an extremely broad term covering everything related to the use of modern technologies in education, whether online, offline or in combination (Black 2002, Koutroumanidis and Andreopoulou 2009). The technological background is extremely broad (networks, video, PCs, Interactive TV, Satellite Broadcasts, etc.). Broadband networks offer quality communication and show ever-increasing penetration rates in our country. Broadband technologies have entered dynamically in our country by producing useful products and services for the community. In particular, networks and broadband can be used for e-learning programs that contribute to improving the quality of life of residents even in less favored areas according to the EU, such as remote regions, mountainous regions and islands (Khan 2001).

The concept of e-learning is quite general and encompasses any form of education using network resources or, in general, the capabilities of computers and distance education. E-learning courses can be categorized in synchronousand asynchronous depending on whether the pupils are actively involved in real time or not(Abazi-bexheti and Dika 2008, Adler and Ziglio 1996, Adomßent et al. 2011, Aharony and Bronstein 2013, Aharony and Bronstein 2014, Alarcon 1992,Pahl and Donnellan

2003,Wagner et al. 2008, Andreopoulou et al. 2006) and hybrid (blended), which combines synchronous and asynchronousteaching methods with transfer of knowledge in the traditional way through personal contact of trainees and instructors in a room, workshop or educational excursions(Kirkenidis and Andreopoulou 2015, Koutroumanidis and Andreopoulou 2009). Furthermore, it can include extrainstructions as a text, theexplanationsoncertaintopics, referencestointernetlinkswherethesourcesofinformationareinexhaustible, andalternativeformsofcommunicationwiththecoursemanagerformoredirectandintegratedteaching (Koutroumanidis and Andreopoulou 2007)E-learningcanthereforebeatoolfordirectknowledgetransfer without spatial constraints as an online educational evolvement based on advanced technology, which outperforms the traditional learning (Baharum et al. 2017). The number of educational institutions, companies and other users applying e-Learning systems has grown significantly in the last decade, therefore they have become as important means and resources as other informational systems of the institutions (Lengyel et al. 2017).

e-learning is not simply the publication of text and material on the Internet, nor the posting ofgrading and announcements. It is a series of interactions between trainer-trainee-learning material, with the aim of transferring knowledge and skills over the internet (DeLone and McLean 2003, Szilágyi 2012).

Figure 1. Design and interaction of hybrid learning environments



The design of the pilot e-learning course was carried out following the research results (Kirkenidis and Andreopoulou 2016, Kirkenidis et al. 2016)and was structured basedon content, communication capability andsupport, as well as the general characteristics of the e-course. Great importance was given to the learning material that was available on the internet, to electronic communication through forums for problem solving and to online help. Moreover, the application of the Big Blue Button virtual room was also used by the research on distance on-line learning (Synchronized) (Jadhav 2006). The implementation of the e-learning course took place at the Aristotle University of Thessaloniki, at elearning.auth.gr, where MOODLE is used as an e-learning platform. One of the additional programs that was also used on the same website and combined with MOODLE is BigBlueButton

The pilot e-learning course was attended by volunteer students of the School of Agriculture, Forestry and Natural Environment, actively participating in three modules of the course that include all kinds of hybrid process (synchronized, non-synchronized, traditional teaching).

Evaluation is the process of determining in a systematic and objective manner the result of a certain activity in relation to the objectives it pursues and the suitability of the means and methods used to achieve them. Based on the above definition of assessment, in the context of the learning process control and feedback, specific stimuli should be perceived to provide information on the strengths and weaknesses of the whole learning effort and improve the quality of the e-course, highlighting the positive aspects and trying to eliminate, if any, the negative ones.

Materials and Methods

Research was conducted on students from the Department of Forestry and Natural Environment who attended the pilot e-learning course at Aristotle University of Thessaloniki (Kirkenidis and Andreopoulou 2016, Kirkenidis et al. 2016).

Survey sample size and duration. The size of the sample was calculated using the simplified Yamane method,

$$n = \frac{N}{1+N*e^2} \qquad (1)$$

where n is the sample size, N the population under survey, e is the precision level ± 10% (0.10), with a confidence level of 95% and a P = 0.5 (Yamane 1967).Taking into account that the number of students in a school year is 120, we calculate the sample size (55 students). The survey was conducted with a questionnaire which was distributed to the students after the completion of the lesson and took place between May and June 2016.

Evaluation process. Upon completion of the pilot e-learning course, students from the School of Agriculture, Forestry and Natural Environment have been approached to volunteer to attend. They will be informed of the effort that takes place and their obligations if they participate in this phase of the survey. Students who will accept to participate in the survey will receive an entry-participation code in the pilot e-lesson. They will participate in all the activities that are included in it. They will attend distance learning lectures, participate actively in the course's activities (synchronized, non-synchronized but also traditional), take part in visits, educational excursions and the traditional way of teaching skills, register, perform any tasks that will be assigned to them and be graded after being evaluated with final exams.

Upon completion of the teaching and assessment of the trainees, they will be given a questionnaire in which they will be able to evaluate the lesson both in terms of structure, content, teaching, but also how understandable it is, giving them the ability to analyze and evaluate separately the e-course.

The results from the evaluation will be elaborated and will be recorded, while within the critical approach of the course, any remark that can improve the pilot e-lesson will be included into it. The evaluation of the course will be carried out continuously by the instructor so that its perpetual feedback can be sustained.

Results

The process of teaching the pilot e-learning course was conducted in May 2016. During the semester, a visit and briefing was made to various faculties of the School to announce the existence of this effort. During these visits students were asked to participate voluntarily in their teaching. An e-mail address was given to all present students and they were asked to declare their will to attend the e-course. 59 students from the School of Agriculture, Forestry and Natural Environment had stated their decision to participate

Each of them received a response email, including instructions for entering the online learning platform using their institution account, and a password for access to the online lesson. In the same message, there were also written instructions for the course management, which were given verbally in their briefing.

Attendance of the pilot e-course. All the e-learning categories were included in the teaching. Thus, the corresponding modules of the course were selected to cover all three categories (synchronized, non-synchronized and traditional teaching).(a). Not synchronized. This type of non-synchronized teaching exists in the first section (introduction) but also in the second section (Agro-Forestry Systems – Agro-Forestry Ecosystem Characteristics, Environmental and Economic Benefits). Their duration (i.e. the time available to students) started from the day before the program, until the end of the lesson.

The material that was available to the students was the notes of the specific module of the course, issues of work to be done by the students, self-assessment sheets of students and their automatic feedback, the ability to communicate with the teacher, to solve questions through forums, bibliography and web resources related to the module, as well as the presentations used during the synchronized teaching (powerpoint). (b). synchronized. The synchronized teaching was carried out under the second module (Agro-Forestry Systems – Agro-Forestry Ecosystem Characteristics, Environmental and Economic Benefits). To achieve this, the virtual room BigBlueButton was used, which is available on the e-learning platform of the Aristotle University of Thessaloniki. The process initially included students enrolling in the application to watch it. Then the teacher joined first and the students followed, into the virtual classroom. Later, a lecture was presented with simultaneous presentation of powerpoint as would be the case in a traditional classroom teaching. During and after the course, students were given the opportunity to intervene and ask questions to clarify all the issues that were developed. After the presentation of the lecture through the Virtual Classroom, a discussion followed. (c). Traditional way (workshop). The science of agriculture and forestry cannot be taught only through books, notes and lectures, and there is a need for a hybrid e-learning method. For this reason, a traditional meeting was held so that the ability to transmit skills through live demonstration and the students' contact with the field, as foreseen by the fifth module of the pilot e-lesson. The meeting took place in the premises of the Department of Forestry and Natural Environment in Thessaloniki.There were fully covered issues, and showed on site, related to tree handling for the creation of high quality artificial wood, the displaying and planting of seedlings, the sowing and management of agricultural crops, as well as the harvest, covering all the points originally imprinted on the corresponding course plan.

Assessment of the course by the students. With the completion of the procedure of the pilot e-learning course, every student who participated received (using the online Google Forms application, where the online questionnaire was implemented) a questionnaire (assessment of structure, content and teaching of the pilot e-learning project entitled "Agroforestry Issues").

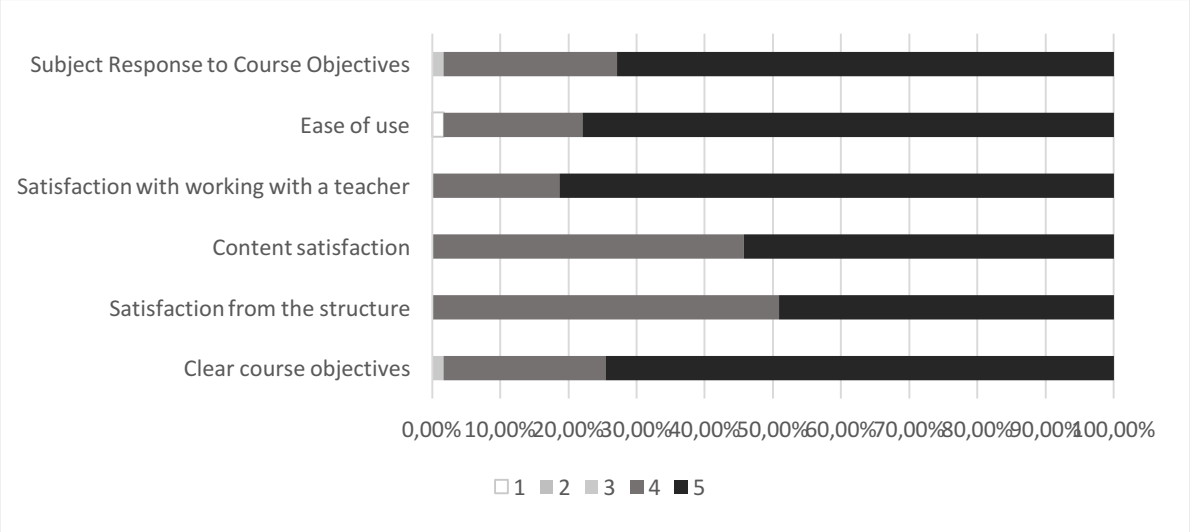
The questionnaire contains sixteen (16) questions. Of these, two (2) refer to student demographics, eleven (11) are closed type questions and two (2) are queries regarding the structure, content and teaching of the pilot e-course. Finally, there is an open type questions in which students can give their opinions on features that will improve the pilot e-course.

The completed evaluation questionnaires were collected in the last week of May and the results were processed and analyzed.

As for the gender of the participants, 61.29% were men and 38.71% were women. According to the results of the survey, none, unfortunately, had attended the e-learning seminar taking place in the library of Aristotle University of Thessaloniki. Only 29.03% have attended an online course (Coursera / iversity / Udemy / Open e-class). The 54.84% said they did not know these courses even existed, the 9.68% did not have the proper knowledge and training and 3.23% said that the courses were difficult to use.

The objectives of the course were very / quite clear (74,19% and 22,58% respectively) and the material covered corresponded to the objectives of the course very / quite well (74,19% and 19,35%). The way this pilot e-learning course is structured, contributes to the transfer of skills very and quite well (58.06% and 41.94%).

Figure 2. Evaluation of the structure and content of the pilot pilot hybrid e-learning course by students



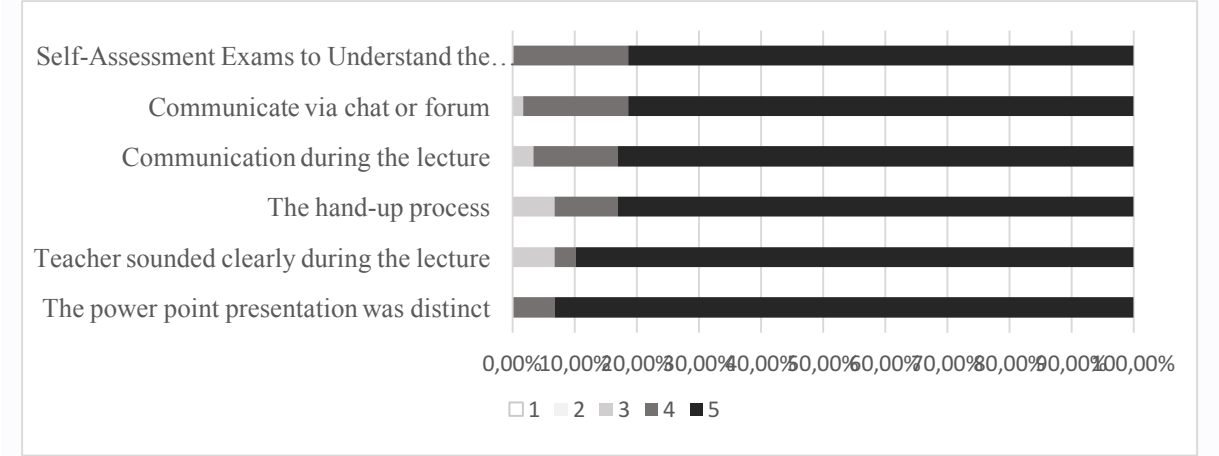
A significant fact is that the absolute 100% of the students that were questioned believe that the pilot e-learning course is flexible in being personalized. They are all very / quite satisfied (48.39% and 51.61%) of the structure of the pilot e-learning course, while regarding the content are very / quite satisfied (54.84% and 45.16%). As for the cooperation with the teacher, there was no problem and the satisfaction was great (very much 80.65% and pretty much 19.35%).

The use of the e-learning system was very easy (77.42%) and quite easy (19.35%), while there was a 3.23% that did not consider the use of the online platform to be easy. The visit to the website of the pilot hybrid e-learning course helped them understand the content of the course very / quite well (58.06% and 41.94%). The use of the pilot e-course has kept their interest throughout its duration, as the absolute 100% of questioned students stated.

In addition, they were asked to grade specific features during the lecture. According to their statement, the PowerPoint presentation was distinct and the teacher was clearly heard during the electronic lecture. The hand up procedure was evaluated as very good (83.87%), quite good (9.68%) and good (6.45%). Live communication during the lecture and chat were rated as very good and quite good (83.87% to 12.90% and 80.65% to 16.13% respectively). The self-assessment for the understanding of the course was evaluated with a high percentage (80.65%) as very good and 19.35% as quite good.

The decisive effect of mixed (hybrid) learning with successive changes between electronic and traditional lecturesis shown by the statement that it helped them very / pretty much (64.41% and 35.48%). The enthusiasm of the respondents was great, since 100% would suggest that the lesson should be attended in this form by their colleagues as well.

Figure 3. Evaluation of Pilot Hybrid e-Course Characteristics



Finally, the users had the opportunity to include in the open-ended question, anything else that they wanted to add in the course to be complete. Most said that it fully covered them and they would like all lessons to function with this philosophy.

Discussion-Conclusions

The attitude of the students involved was very positive and there was a strong encouragement for the completion of the pilot course and the furthermore expansion of this teaching method to other courses in the curriculum. At the end of the course, the students responded to a questionnaire to assess the whole effort.

During the evaluation of the pilot course by the students who attended it, it is depicted that the course objectives were clear and the covered content corresponded to the objectives of the course, while the way in which this pilot e-learning course is structured, contributes to the transmission of skills. A significant fact is that all respondents feel it is flexible for personalization. They are all satisfied with its structure and content. As for the cooperation with the teacher, there was no problem and they are very satisfied. The use of the e-learning system by respondents was easy except for one person who found it difficult without clarifying the reason.

The website of the pilot e-learning course that they visited helped them understand the content of the lesson, while the use of the pilot e-course, kept their interest throughout its duration, as stated by the absolute 100% of the respondents.

The decisive effect of mixed (hybrid) learning with successive changes between electronic and traditional lectureshelped them understand the lesson and the enthusiasm of the respondents was great, since 100% would suggest that the course should be followed in this form by their colleagues as well.

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BENEFITS FROM THE ADOPTION OF PRECISION AGRICULTURE TECHNOLOGIES. A SYSTEMATIC REVIEW.

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Abstract

Precision agriculture (PA) as a whole-farm management approach using information technology, satellite positioning data, remote sensing, and data gathering is still considered as a very promising technology aiming to optimize returns of inputs whilst reducing environmental impacts. New technologies offer the potential to incorporate technological advances in agriculture providing evidence for lower production costs, increased farming profitability and reduction of the environmental impacts. However, application costs and investment on equipment and trained employees have caused dissension and raised criticism about the cost-effectiveness of Precision Agriculture. For this reason, this systematic review attempts to present the economic, agronomic, and environmental benefits from adopting PA technologies, based on the systematic search and evaluation of related eligible articles.

Keywords: *precision agriculture, precision farming, conservation agriculture*

Introduction

Population growth and the increasing demand for food (Baudron and Giller 2004), anticipated resource limitations, rising energy prices and increased production of biofuel crops together with climate change, and tougher environmental regulations are putting constantly pressure on crop production systems. The new challenge is to invest in technologies that aim at increasing farming efficiency while mitigating or reducing environmental impacts (Foley *et al*. 2011, Awan 2016). The widespread adoption of PA technologies was mainly motivated from economic returns from reduced agricultural inputs and improved farm management efficiency while limiting the excessive use of agro-chemicals in accordance with the latest environmental legislation (Nawar*et al*. 2017). Technological innovations have long been tested and optimized recommendations were presented to improve farming efficiency and reduce environmental impact. However, increased implementation costs with limited or in some cases uncertain benefits lead farmers to be unwilling to adopt available PA technologies on their farms (Castle *et al*. 2016).

The last two decades there have been many studies about factors affecting the adoption of new technologies to encourage farmers to step into the new era of digital agriculture (Robertson et al. 2012,Tey and Brindal 2012, Daberkow and McBride 2003). Individual studies (Basso *et al*. 2011, Calegari*et al*. 2013, Liu *et al*. 2017, Jayakumar *et al*. 2017) have demonstrated the economic (monetary), agronomic (yield increase) and environmental benefits (reduction of negative impacts) of adopting PAtechnologies and how data derived from soil characteristics, plant populations and environment can be organized to deliver targeted input applications to crop production systems.

In the whole-field approach of the traditional farm management model, each field is treated as a homogeneous area (Srinivasan 2006), where soil variability or other topographic and environmental conditions are not considered and inputs are applied uniformly regardless the potential heterogeneity of the field. Although this approach is quick and easy to implement it implies unwanted explicit

economic costs because of the inefficient application of inputs. In addition, unused nutrients (10-30% of the total N input) end up to the environment through leaching of water-soluble nitrates (Meisinger and Delgado 2002), or runoff and gaseous emissions that increase the contamination risk (Follett and Delgado 2002,Hyytiainen*et al*. 2011; Rodriguez *et al*. 2011). The main promising possibility of PA adoption was and remains the same: to efficient vary the application of inputs under different conditions (Pierpaoli*et al*. 2013) or apply a single rate of a specific crop input to attain maximum efficiency (Vrindts*et al*. 2015) to sub-regions of broad similarity, defined as management zones, which regularly provide low or high yields (Fleming *et al*. 2004).

After more than 10 years of development, the adoption of PA technologies seems to reach a cross board, where the necessary technology is available at a lower cost but still the economic and environmental benefits are not always certain (Stafford 2000, Basso *et al*. 2011). Economic and environmental benefits from PA adoption, have proven difficult to be measured precisely and they seem to depend on the farm size on the basis that greater income provides bigger margin for new technology investments. However, there are many studies that succeed to present tangible benefits of replacing the traditional practices with PA technologies (Basso *et al.*, 2011, Boyer *et al*. 2011, Panagopoulos *et al*. 2014, West and Kovacs 2017).

The economic, agronomic, and environmental benefits of the adoption of PA technologies seem to define the future of the new technologies on how they can be incorporated to the existing agronomic practices to improve farm profitability and environmental conservation. For these reasons the aim of this systematic review was to analyze the last decade literature to reveal trends and strategies to achieve economic, agronomic and environmental benefits. For this reason, the purpose of this study was to highlight the economic, agronomic, and environmental benefits from the adoptionof PA technologies.

Materials and Methods

Study design

A comprehensive protocol was developed and approved by all the authors for the current systematic review including all aspects of the systematic review including the focused question, search strategy, inclusion/exclusion criteria, screening methodology, data extraction, outcome measures, data analysis/synthesis, and quality assessment of the included studies.

Focused questions

What are the economic, agronomic and environmental benefits of adopting PA technologies? Can the adoption of PA technologies have a positive allocative and cost efficiency effect in agriculture with aim to reduce production costs? Can PA contribute to the environmental conservation?

Search strategies

Web-based search engines of on-line article databases and a reference search were the strategies used to identify published studies that reported benefits from the adoption of PAtechnologies. A systematic search of three digital scientific journal databases was performed: Web of Science, Scopus, and Science Direct. Relevant studies were identified based on a combination of a group of terms. The search strategy terms pertained to farm economy, crop quality, and food safety, and environment, respectively.

The terms within each group were combined with ‘OR’, and three groups were linked with ‘AND’. The full search syntax used is shown in Table 1. Research studies that did not meet the eligibility criteria of the systematic review were eliminated through screening titles and abstracts of these articles. To examine the eligibility of those studies that could not be screened out through their titles and abstracts, a detailed review of full texts was conducted. For those studies that fulfilled the given eligibility criteria, a further examination for additional relevant studies was performed using Google Scholar to locate related articles. The article screening and selection were performed by two independent reviewers (TK and GM) and any disagreement was settled during a consensus discussion with a third reviewer (W M van der Windt et al., 2000).

Eligibility criteria

The inclusion criteria for paper selection were studies that: (1) had a purpose of examining the benefits from the adoption of PA technologies on the farming efficiency or on the environmental conservation; (2) articles published in peer-reviewed English language journals; (3) reported results related to PA implications on farming efficiency, farm economy, crop quality and food safety, and on the environment. The exclusion criteria were as follows: (1) studies which investigated the benefits of Precision on a theoretical basis; (2) literature reviews, conference papers or symposiums; (3) Articles published before the year 2007 (although manually 16 studies were identified and added for eligibility).

Table 1. *Search strategy. The search strategy was performed at first on February 11, 2017 to identify articles for initial screening. On April 25, 2017, the final search strategy was applied to screen to articles to be assessed in this systematic review.*

*1. **Web of Science**: (N=16): (TI = (precision agriculture) AND TS=(benefits) AND TS=(lower costs OR efficiency OR environment OR conservation OR protection OR risk OR economy OR effectiveness OR technology OR gains OR implications OR impacts)) AND LANGUAGE: (English) AND DOCUMENT TYPES: (Article) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=2007-2017.*
*2. **Science Direct**: (N=19): TITLE-ABS-KEY ("precision agriculture") AND TITLE-ABS-KEY ("benefits") AND TITLE-ABS-KEY ("costs") AND TITLE-ABS-KEY ("implications" OR "lower costs" OR "efficiency" OR "environment" OR "conservation" OR "protection" OR "risk" OR "economy" OR "crop quality" OR "food safety" OR "effectiveness" OR "technology" OR "mapping").*
*3. **Scopus**: (N=48): (TITLE-ABS-KEY ("precision agriculture") AND TITLE-ABS-KEY ("benefits") AND TITLE-ABS-KEY ("costs") AND TITLE-ABS-KEY (("implications" OR "lower costs" OR "efficiency" OR "environment" OR "conservation" OR "protection" OR "risk" OR "economy" OR "crop quality" OR "food safety" OR "effectiveness" OR "technology" OR "mapping"))) AND PUBYEAR > 2006 AND (LIMIT-TO (SRCTYPE , "j ")) AND (LIMIT-TO (DOCTYPE , "ar ") OR LIMIT-TO (DOCTYPE , " cp ") OR LIMIT-TO (DOCTYPE , "ar ")) AND (LIMIT-TO (LANGUAGE , "English "))*

Strength of evidence

One of the major challenges and obstacles, at the same time, through the process of assessing the studies included in this systematic review, has been the quest for proven benefits, particularly in relation to cost. Adopting PA technologies requires investment in hardware, software, and training. Before farmers adopt a new technology as an alternate to existing methods, they need to be convinced that this solution is economically viable with additional environmental gains. In some of the studies, it is feasible to show the monetary savings from PA applications, such as the variable rate applications (VRT) or whether direct or indirect impacts on crops and environment are expected. It is, however, more difficult to assign a consensual monetary value to benefits especially to the environment which resulted from the adoption of these technologies. Environmental gains have usually monetizing indirect benefits (i.e. from using remote sensing data) and it is complex and challenging to be assessed (Kalluri*et al*. 2003).

All selected studies were labeled depending on the economic, agronomic or environmental benefits that presented (Table 2). For the economic assessment three general categories grouped methods are used to evaluate the economic feasibility of method proposed by each study: (1) **partial budget or substantiated report (PB)**; (2) **rough partial budget reports (RP)** and (3) **unsubstantiated reports (UR)**. Articles providing detailed partial budgets with documented changes in costs are labeled as 'partial budget or substantial' reports. The changes in costs include: (1) input costs; (2) application costs; (3) information or management costs; (4) equipment costs; (5) sampling costs (soil tests, mapping costs); (6) labor costs or any other custom cost type.

Articles or reports that mention changes in costs but failed to enumerate providing a more detailed economic analysis are labeled as "rough partial budget reports". Articles or reports providing numerical estimates of changes in these costs suggesting the net returns attributable to PA application without providing monetary information about changes in costs and revenue were classified as "unsubstantiated reports". Articles not providing any kind of economic information in change of costs are labeled as "not applicable". For the agronomic assessment of the studies on the farming efficiency, three categories grouped methods are used: (1) **field trials (FT)**; (2) **simulation models (SM)** and (3) **response functions (RF)**. All three of the above methods are used to mimic crop response under

alternative agronomic practices. Field trials are experiments on a smaller controlled area having the advantage of reflecting a broader range of yield limiting factors. Response functions that are generally simple equations and computer simulations are both digital simulations that facilitate comparison between input changes or the cost of making these changes. For the environmental assessment three general categories grouped methods are used to evaluate the environment impact of each study: (1) **documented benefits (DB)**; **(2) potential indirect environmental benefits (IB)** and **(3) unsubstantiated benefits**. Articles providing detailed environmental gains are labeled as having "documented benefits", articles that mention potential benefits but failed to enumerate them are labeled as having 'potential indirect environmental benefits" and articles that mention of having environmental benefits without providing further information are labeled as having "unsubstantiated environmental benefits" (Table 2).

Table 2. *Strategy for assigning strength of evidence (S) to the selected studies*

Strength of evidence	***Economic***	***Agronomic***	***Environmental***
Strong evidence **(S1)**	Partial budget reports or substantiated (**PB**)	Field trials (**FT**) with documented benefits	Documented benefits (**DB**) (i.e. reduction in nutrients, pesticides, herbicides, water)
Moderate evidence **(S2)**	Rough partial budget analysis (**RP**)	Simulation Methods (**SM**) using software or hardware	Potential indirect environmental benefits (**IB**)
Some evidence **(S3)**	Unsubstantiated reports (**UR**)	Response Functions (**RF**)	Unsubstantiated environmental benefits (**UB**)
Inconclusive evidence **(S4)**	Not Applicable (**NA**)	Not Applicable (**NA**)	Not Applicable (**NA**)

The strength of evidence (S) was classified as follows: (1) **strong evidence (S1)**: consistent results of high quality, proven economic, agronomic or environmental benefits from the adoption of the proposed PA technology (PB or FT or DB); (2) **moderate evidence (S2)**: consistent results with rough partial budget analysis or articles that use simulation methods or present potential indirect benefits to the environmental conservation; (3) **some evidence (S3)**: unsubstantiated reports or articles that use response functions or studies with unsubstantiated environmental benefits regardless quality; (4) **inconclusive evidence (S4)**: studies with inconsistent results of low quality or findings not relative to the focused questions of this systematic review. Consistent results were defined by the fact that the results of the studies that clearly presented economic, agronomic or environmental benefits. The above classification refers to how well the selected study presents proof of evidence for the expected economic, agronomic or environmental benefits, and does not reflect the quality of the study itself.

All records based on their classification regarding their economic, agronomic and environmental benefits (table 2), were labeled automatically with regard to the strength of evidence at the Excel file using the following set of nested IF functions:

=IF(A2="PB";"S1";(IF(B2="FT";"S1";(IF(C2="DB";"S1";IF(A2="RP";"S2";(IF(B2="SM";"S2";(IF(C2="IB";"S2";IF(A2="UR";"S3";(IF(B2="RF";"S3";(IF(C2="UB";"S3";"S4")))))))))))))), where A: economic, B: agronomic and C: environmental benefits columns, respectively.

2.6. Data extraction

A systematic search of three digital scientific journal databases was conducted: Web of Science, Scopus and Science Direct, and study characteristics from the eligible records were extracted as follows: (1) title of the published article, (2) journal/conference/symposium, (3) year of publication, (4) country/continent region, (5) design of the study, (6) type of crops.

Results

Study selection

A preliminary search for 'Precision Agriculture' was attempted at first to figure out the maximum number of records to be identified (*N*=49.779). Based on search strategy of this systematic review, 83 records were finally identified (*N*=48 from Scopus, *N*=19 from Science Direct and *N*=16 from Web of Science). Study characteristics for the above studies were extracted from the three digital sources (Scopus, ScienceDirect and Web of Science) using the BibTex format (*.bib) and 80 records were

imported separately into JabRef, an open source bibliography reference manager that runs on the JavaVM. Using the 'remove duplicate' option, 17 records were removed. Finally, 159 records were identified and added into Zotero Citation Manager. Using export to *.csv format the records were imported into Excel and several pivot tables were constructed to present descriptive statistics. The systematic search of the on-line digital databases and the application of the inclusion criteria identified 108 records to be assessed for eligibility (Figure 1). After assigning strength of evidence to each article 14 records were excluded with S3 or S4 strength of evidence. Overall, there were found 94 full-text articles designed to present benefits from the adoption of PA technologies concerning farming efficiency and environmental conservation.

Study characteristics

The systematic review of the studies included revealed different application groups of PA technologies that aim to improve farming efficiency and management and contribute to the environmental conservation. The studies selected to be assessed for eligibility were assigned to the following application groups that reflects benefits from the adoption of the corresponding PA technologies: (1) Technologies for managing spatial variability; (2) Precise nutrient applications; (3) Precise pesticide applications; (4) Guidance Systems (Table 3). Most of studies (*N*=72) were assign to the category "Precise nutrient applications".

Table 3. *Frequencies (N; %) of the articles per application group.*

Groups	***Frequencyof records assessedfor eligibility (N = 108)***	***Frequencyof records withS1 and S2 (N = 98)***	***% Records S1 and S2 %***
1. Managing spatial variability	71 (S1=4; S2=56; S3=5; S4=6)	60	63.8
2. Precise nutrient applications	27 (S1=17; S2=8; S3=1; S4=1)	25	26.6
3. Precise pesticide applications	3 (S1=0; S2=3; S3=0; S4=0)	3	3.2
4. Automations (Guidance Systems)	7 (S1=1; S2=5; S3=0; S4=1)	6	6.4
Totals	108	98	100.0

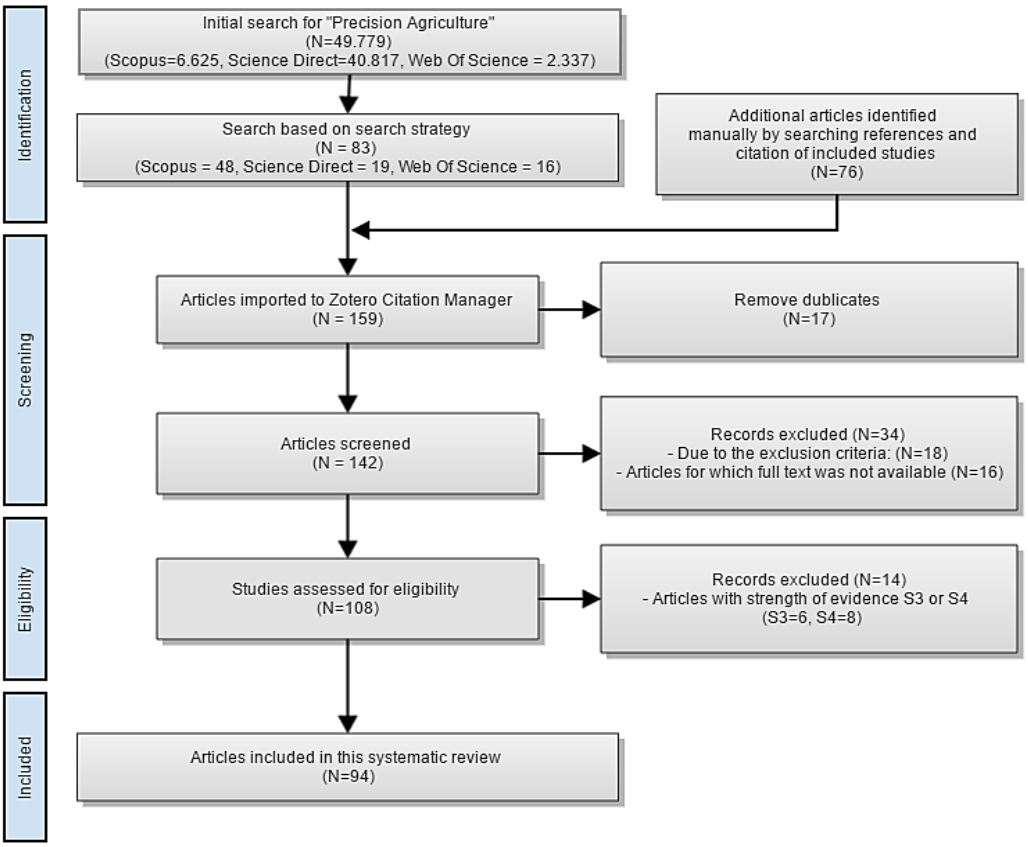

Figure 1. *Flowchart of article selection process.*

Almost half of studies (PB+RP, *N*=48) reported detailed information in the potential change of costs (PB, *N*=13) or rough partial economic analysis (RP, *N*=35), while the rest (UR+NA, *N*=60) either failed to enumerate the economic benefits or changes in costs are not mentioned. Concerning the agronomic assessment, most of studies used response functions (RF, *N*=66) and field trials with documented agronomic benefits were only eighteen (FT, *N*=18). As probably expected, the environmental benefits were complex and hard to be estimated. Most of the studies did not referred to any environmental benefits from PA technologies and only fourteen articles (DB+IB, *N*=14) presented documented or potential indirect benefits, mainly because of the reduced nutrients due to allocative inputs (Table 4).

Table 4. *Frequencies (N; %) of the articles per strength of evidence and assessment of studies*

Assessment of studies	1. Managing spatial variability	2. Precise nutrient applications	3. Precise pesticide applications	4. Automations using guidance systems	*Totals* ***(N; %)***
Economic					
Partial budget reports (**PB**)	3	9		1	**13**
Rough partial budget reports (**RP**)	20	13		2	**35**
Unsubstantiated reports (**UR**)	18	2		3	**23**
Not applicable (**NA**)	30	3	3	1	**37**
Totals	71 (65.7%)	27 (25.0%)	3(2.8%)	7 (6.5%)	**108; 100%**
Agronomic					
Field trials (**FT**)	2	15		1	**18**
Simulation Methods (**SM**)	6	4		1	**11**
Response Functions (**RF**)	53	7	3	3	**66**
Not applicable (**NA**)	10	1		2	**13**
Totals	71 (65.7%)	27 (25.0%)	3(2.8%)	7 (6.5%)	**108; 100%**
Environmental					
Documented benefits (**DB**)		1			**1**
Potential indirect benefits (**IB**)	10	3			**13**
Unsubstantiated benefits (**UB**)	10	10			**20**
Not applicable (**NA**)	51	13	3	7	**74**
Totals	71 (65.7%)	27 (25.0%)	3(2.8%)	7 (6.5%)	**108; 100%**

Based on the country of each study defined as the area of application of the proposed methodology (or if it was not available, the country of the first author), all records were grouped per continent (Table 5) to highlight the region of each study. Most records were from Europe (*N*=31, S1=4 and S2=27) and North America (*N*=27, S1=11 and S2=16).

Table 5. *Frequencies (N; %) of the articles per region.*

Region of studies	***Frequency of records assessed for eligibility*** **(N = 111)**	***Frequency of records with S1 and S2*** **(N = 94)**	***% Records S1 and S2*** **%**
1. Europe	37 (S1=4; S2=27; S3=3; S4=3)	31	33.0
2. North America	29 (S1=11; S2=16; S3=1; S4=1)	27	28.7
3. Asia	15 (S1=4; S2=10; S3=0; S4=1)	14	14.9
4. Australia	14 (S1=1; S2=10; S3=0; S4=3)	11	11.7
5. South America	11 (S1=2; S2=7; S3=2; S4=0)	9	9.6
6. Africa	2 (S1=0; S2=2; S3=0; S4=0)	2	2.1
Total	108	94	100.0

Quality of reviewed articles

Based on the Strength of Evidence as it was defined for the needs of this systematic review, there 24 records classified as S1, 45 records as S2, 38 records as S3 and 3 records as S4. A total of

34 records were excluded based on the exclusion criteria. Top three PA categories with the most records assigned were (figure 2): (1) [1.3] Use of wireless networks (*N*=16 records); (2) [2.2] Variable rate technology applications (*N*=14 records) and (3) [1.6] Management of environmental sensitive areas (*N*=13 records). Top three PA technologies with the most records finally included (sum of records with S1 and S2 strength of evidence) were: (1) [1.3] Use of wireless networks (*N*=14); (2) [2.2] Variable rate technology applications (*N*=13 records); and (3) [1.6] Management of environmentally sensitive areas (*N*=11).

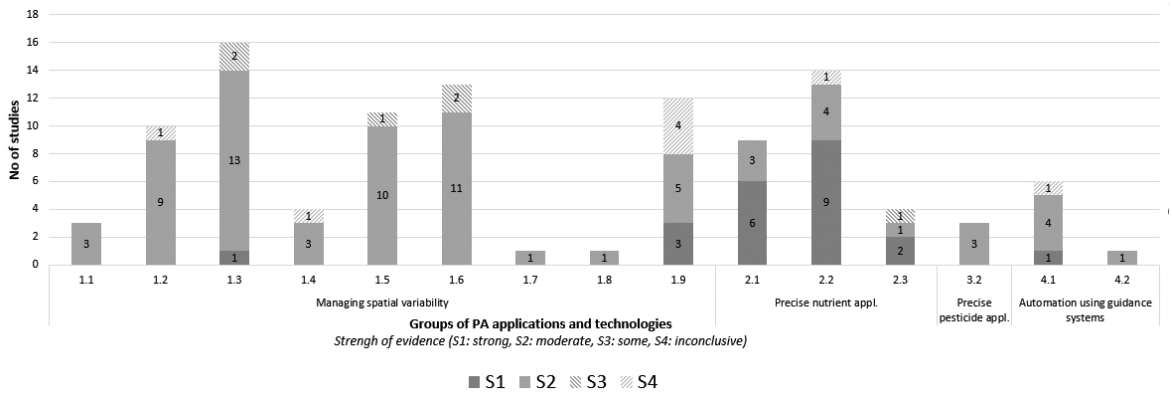

Figure *2. Strength of evidence for selected articles per PA technology category. Strength of Evidence: (a) strong evidence (S1); (b) moderate evidence (S2); (c) some evidence (S3); (d) inconclusive evidence (S4), PA technology categories: 1. Technologies for managing spatial variability for decision making: [1.1] Directed sampling; [1.2] Geo-mapping, [1.3] Use of wireless sensor networks; [1.4] Proxy-detection; [1.5] Aerial or Satellite Remote Sensing; [1.6] Management of environmentally sensitive areas; [1.7] Profitability maps; [1.8] Divert animal intrusion; [1.9] Economic/Comparative Analysis for decision making, 2. Precise nutrient applications: [2.1] Allocate inputs; [2.2] Variable rate Technology (VRT); [2.3] Zone management, 3. Precise pesticide applications: [3.1] Light bar guidance systems; [3.2] Unmanned aerial vehicles or robots, 4. Automation using Guidance Systems: [4.1] Automated steering systems; [4.2] Automations for agronomical practices.*

Most studies (*N*=71) were assigned to the category [1] "Managing spatial variability"(figure 2), which has also the most records with S1 and S2 strength of evidence: *N*=60 records. Twenty-seven (*N*=27) studies were assigned to the second category [2]"Precise nutrient applications" (*N*=28) with S1 and S2 strength of evidence: *N*=25 records. Most of the studies (*N*=87) presented rough partial budget analysis regarding the change in costs and only 13 articles provided detailed cost information (Table 5). Regarding the agronomic benefits, most of studies referred to simulation methods or hardware/equipment and only 18 were field trials with documented benefits (Table 6). Concerning the environmental benefits, most of studies reported unsubstantiated benefits (N=20) or potential indirect benefits (N=13) and only one article presented documented environmental benefits.

Table 6. *Frequencies (N; %) of the articles per strength of evidence and assessment of studies*

Assessment	Strong evidence **(S1)**	Moderate evidence **(S2)**	Some evidence **(S3)**	Inconclusive evidence **(S4)**	*Totals* ***(N; %)***
Economic					
*Partial budget reports (**PB**)*	13				**13**
*Rough partial budget reports (**RP**)*	9	26			**35**
*Unsubstantiated reports (**UR**)*		21	2		**23**
*Not applicable (**NA**)*		25	4	8	**37**
Totals	22 (20.4%)	72 (66.7%)	6 (5.6%)	8 (7.4%)	**108; 100%**
Agronomic					
*Field trials (**FT**)*	18				**18**
*Simulation Methods (**SM**)*	1	65			**66**
*Response Functions (**RF**)*	3	4	4		**11**
*Not applicable (**NA**)*		3	2	8	**13**
Totals	22 (20.4%)	72 (66.7%)	6 (5.6%)	8 (7.4%)	**108; 100%**
Environmental					
*Documented benefits (**DB**)*	1				**1**
*Potential indirect benefits (**IB**)*	2	11			**13**
*Unsubstantiated benefits (**UB**)*	11	8	1		**20**
*Not applicable (**NA**)*	8	53	5	8	**74**
Totals	22 (20.4%)	72 (66.7%)	6 (5.6%)	8 (7.4%)	**108; 100%**

Clustering PA technologies into application categories

To highlight the potential benefits from the adoption of PA technologies and their applications, the studies, that were assessed for eligibility, were clustered based on the technology they use. Four main categories where benefits were identified: (1) Technologies for managing spatial variability for decision making; (2) Precise nutrient applications; (3) Precise pesticide applications; (4) Guidance Systems. In each group, several sub-groups were identified and the selected studies for the systematic review were assigned to each sub-group (Table 7).

Table 7. *PA technologies grouped into application categories for the studies included*

PA technologies grouped into application categories	#	*References**
1. Managing spatial variability for decision making	**71**	
1.1. Directed sampling: collecting data and monitoring field-related parameters: PA provides field information (i.e. weighing biomass, measuring leaf chlorophyll content, weighing fruit, etc.)	3	*(Mesas-Carrascosa et al., 2015), (Martínez et al., 2017), (Bramley and Janik, 2005)*
1.2. Geo-mapping: mapping soil type and characteristics, nutrients levels or other information in layers and assign that information to the field location. Use of GIS and GPS to produce thematic maps.	10	*(Oliver et al., 2010), (Palaniswami et al., 2011), (Beeri and Peled, 2009), (Inamura et al., 2004), (Mazloumzadeh et al., 2010), (Bier and de Souza, 2017), (Moharana and Dutta, 2016), (Le Cointe et al., 2016), (Soderstrom et al., 2016), (Bramley et al., 2013)*
1.3. Use of a wireless sensor network with GPS support: the use of sensors in the fields allows a continuous monitoring of soil characteristics, plant physicochemical parameters and climatic conditions. The field is usually delineated using an in-vehicle GPS receiver.	16	*(Javier Ferrandez-Pastor et al., 2016), (Srbinovska et al., 2015), (Nikolidakis et al., 2015), (Mafuta et al., 2013), (Camilli et al., 2007), (Bogue, 2017), (Bauer et al., 2016), (Delibasic and Pejanovic-Djurisic, 2017), (Fernandes et al., 2013), (Dias et al., 2013), (Rosell and Sanz, 2012), (He et al., 2007), (Moreenthaler et al. 2003), (Christy, 2008), (Bontsema et al., 2011), (Riquelme et al., 2009)*
1.4. Proxy-detection (or proximal sensing): robots or in-vehicle sensors can measure plant related parameters (i.e. leaf status or plant growth stage). Ground based proximal sensors mounted on agricultural machinery, can collect valuable information on spatial variation within a field.	4	*(van Vuuren et al., 2006), (Cao et al., 2017), (Rossel and Bouma, 2016), (Wetterlind et al., 2010)*
1.5. Aerial or Satellite Remote Sensing (RS): use of Remote Sensing images and maps. Various RS applications based on these data can provide useful information for decision making	11	*(Candiago et al., 2015), (Lyle et al., 2013), (Seelan et al., 2003), (Conţiu and Groza, 2016), (Hunt et al., 2005), (Al-Gaadi et al., 2016), (Noori and Panda, 2016), (Lyle and Ostendorf, 2011), (Matese et al., 2015), (Kyveryga et al., 2011), (Casa et al., 2012)*
1.6. Management of environmentally sensitive areas: PA technologies provide information by calculating greenhouse gas emissions due to mechanized operations and therefore they can indirectly limit emissions to the environment. They can also lead to higher marginal abatement costs in the form of forgone profits.	13	*(Schieffer and Dillon, 2015), (Shaw et al., 2016), (Cordoba et al., 2016), (McConnell and Burger, 2011), (Bramley et al., 2008), (Stull et al., 2004), (Schemberger et al., 2017), (Kassam and Brammer, 2016), (Garibaldi et al., 2017), (Cambouris et al., 2014), (Hoffmann et al., 2017), (Lobell and Azzari, 2017), (Kalluri et al. 2003)*
1.7. Profitability maps: Mapped yield data combined with overlaid actual farm-level costs can convert yield maps into profitability maps.	1	*(Bazzi et al., 2015)*
1.8.Divert animal intrusion (in the agricultural lands)	1	*(Bapat et al., 2017)*
1.9. Economic/Comparative Analysis for decision making: Economic analysis using PA technologies or comparative analysis of previous case studies.	12	*(Silva et al., 2007), (Melo Dematte et al., 2014), (Bramley, 2009), (Jochinke et al., 2007), (Liu et al., 2017), (Nawar et al., 2017), (Bachmaier and Gandorfer, 2009), (Zude-Sasse et al., 2016), (Bora et al., 2012), (Rickard, 2015), (Schellberg et al., 2008), (Plant, 2001)*
2. Precise nutrient applications	**27**	
2.1 Allocate inputs: soil/yield maps can be used to alter fertilizer applications to suit current soil's characteristics. Soil maps can also be used to alter irrigation plans.	9	*(Bryan et al., 2011), (Mitralexis and Goumopoulos, 2015), (Sadler et al., 2005), (Biermacher et al., 2006), (Krell et al., 2003), (Timmermann et al., 2003), (Jayakumar et al., 2017), (Parihar et al., 2017), (Devkota et al., 2016)*
2.2 Variable Rate Technology (VRT): variable rate application of inputs, based on soil properties, can increase yield and reduce costs. With PA technologies, a better allocative inputs plan can be applied instead of the average rate of inputs based on farmer's knowledge and experience.	14	*(Havlin and Heiniger, 2009), (Maine et al., 2010), (Schimmelpfennig and Ebel, 2016), (Basso et al., 2011), (Tekin, 2010), (Robertson et al., 2009), (West and Kovacs, 2017), (Pahlmann et al., 2017), (Boyer et al., 2011), (Johnson and Richard, 2010), (Biermacher et al., 2009), (Panagopoulos et al., 2014), (Yang et al. 2012), (Lawes and Robertson, 2011)*
2.3 Zone management (ZM):yield monitoring with determination of productivity zones or poor fertility zones/zones prone to diseases	4	*(Basso et al., 2011), (Zandonadi et al., 2013), (Robertson et al., 2007), (Robertson et al., 2008)*
3. Precise pesticide applications	**3**	
3.1. Light bar guidance systems: Light bar guidance systems are relatively inexpensive guidance systems and they provide an easy way to guide equipment across a field to prevent overlapping when spraying pesticides.		
3.2. Unmanned aerial vehicles (UAV), use of robots (for weed control), automatic boom	3	*(Zavala-Yoe et al., 2017), (Sabanci and Aydin, 2017), (Berge et al., 2012)*
4. Automation using Guidance Systems	**7**	
4.1. Automated steering systems:autosteer systems can reduce the number of overlaps tractors make across the land using GPS. Auto pilot guidance systems installed on tractors can also reduce fatigue and labor costs and can expand hours of operation. Autosteer can also reduce the skill level required to operate farm machinery.	6	*(Shockley et al., 2011), (Edwards et al., 2017), (D'Antoni et al., 2012), (Oberthür et al., 2007), (Lamb et al., 2008), (Schuster et al., 2011)*
4.2. Automations for agronomical practices	1	*(Kroulík et al., 2011)*

**References are given in full at the supplementary file.*

Discussion

Through the process of analyzing the studies included in this systematic review several PA technology categories were identified. Benefits from the adoption of PA technologies, grouped per PA application, are given at Table 8.

The benefits identified can be summarized to the following: **(a) Benefits from using technologies for managing spatial variability**. The benefits from sampling and organizing data allow the farmer to make more logical decisions. Analyzing sampling data (with sensors/satellite images/GPS-GIS maps) may identify problems and opportunities that the farmer should was aware of. The management of low-yielding patches or environmentally sensitive areas can lead to increased farming efficiency and environmental conservation. After each cropping season the applied PA plan can be evaluated and revised for decision making. As more and more data is gathered, more can be learned about the field and this information allows further refinement of the PA plan to improve farming efficiency. Economic or comparative analysis of different applications can also be very helpful for decision making; **(b) Benefits from precise nutrient applications**. Applying only the nutrients that the plants need or can use, input costs can be reduced, thus there can be an environmental benefit from controlling inputs. Based on the detailed information sampled on existing fertility levels, soil types and environmental sensitivity different rates can be applied to maximize potential yield and minimize environmental hazards. Another benefit may be the reductions of the number of trips needed by applying a blend of nutrients (N and either P or K) that best matches the required ratio of these nutrients and then making another pass to spot apply the third nutrient to areas that are deficient in it; **(c) Benefits from precise pesticide applications**. Light bar guidance systems can provide a quick and least expensive way to guide equipment across a field to prevent overlapping when spreading pesticides. Use of automated robots can be very promising to apply more targeted variable rate pesticides for weed control; **(d) Benefits from using guidance systems**. The main benefit from the adoption of guidance systems is the reduction in labor costs. Several authors (Dunn *et al*. 2006, Han *et al*. 2004, Stoll and Kutzbach 2000, Debain*et al*. 2000, Cordesses*et al*. 2000) reported many benefits from the use of guidance systems, such as: (1) managing driver fatigue: guidance systems can reduce the human effort associated with maintaining accurate vehicle paths; (2) reduction in costs: increased accuracy minimizes costs between neighboring passes in the field; (3) increase in productivity: higher operating speeds can be achieved; (4) improved quality; (5) improved safety; (6) reduced impact on the environment (reduction of machinery pass frequency, reduction of soil compaction); (7) possibility for work even when visibility is not adequate.

Table 8. *Type of benefits from the adoption of PA technologies*

Application Groups	Type of benefits
1. Managing spatial variability	Indirect benefits from sampling data information for the state of crops. Organized data provide information for better decision making.
2. Precise nutrient applications	Direct economic and environmental benefits from reduced or targeted placement of crop inputs such as nutrients and water.
3. Precise pesticide applications	Direct economic and environmental benefits from the reduced or targeted use of pesticides using automated systems.
4. Automations using Guidance Systems	Direct economic benefits from using automated unmanned systems (reduced labor costs) and reduced impact on the environment (reduction of machinery pass frequency and reduction of soil compaction).

Therefore, based on the previous analysis, the answer to the focused questions as were defined at a previous chapter is that PA technologies can benefit and improve farming efficiency and reduce production costs by: (a) managing field spatial variability, (b) performing allocative and more precise nutrient applications, (c) achieving more precise pesticide applications and (d) provide automation solutions for minimizing labor costs. In addition, the adoption of PA technologies can reduce the environmental impact of the agronomical practices by allocating and minimizing inputs, reducing tractor laps and gas emissions from mechanized operations.

In this review, the attempt of finding more tangible benefits was not clearly successful. Although many of the studies examined were assigned as having S1 or S2 strength of evidence, the heterogeneity of studies does not allow to make a more general conclusion or define a monetary benefit (per ha). Benefits reported in detail inS1 studies are given at Table 9 (*supplementary material*). Based on this information, it was concluded, that it is very complex to decide whether the amount of monetary savings from the adoption of PA technologies would be the same in another situation under different criteria.

Limitations of this review

There are some limitations in this systematic review. Unpublished peer-reviewed studies and non-English written articles as well as the exclusion of studies concerning advanced technology in the field not directly connected with PA may introduce bias in this review. Most of the research studies, sent to be published, present positive results compared to those that present negatives. Following a bad strategy in the past, many research studies with negative results may never reach the stage of publication, which may be misleading. In addition, some studies may have probably been missed out although an extensive literature search was performed. Finally, it should be noted that in case of change of search strategy, a different number of articles may be obtained with different strength of evidence.

Conclusion

In this systematic review, thirty-four articles were assessed as having S1 strength of evidence and thirty-six were evaluated as having S2 strength of evidence (a total of 70 studies were assessed). Although separately per article case proven benefits were presented, it is very difficult and complex to conclude to a generally consensual monetary value as an economic or environmental benefit from adopting PA technologies. However, articles (with strength of evidence S1 and S2) present tangible benefits, either providing lower costs for installing and implementing PA strategies (i.e. Open Source Hardware, cheaper GPS systems, easy-customized GIS Systems etc.) or even direct benefits from allocative inputs (nutrients and pesticides) and lower production costs based on automation integration using Guidance Systems. Therefore, the adoption of PA technologies can provide a steady stream of farming data that can be used to positive allocative of nutrients and fertilizers or other inputs to reduce costs and increase efficiency. More high-quality and prospective studies are needed to establish the relationship between the use of PA technologies and the more accurate allocative of inputs.

The results of the review can be summarized as follows:

- All studies included in the systematic review reported positive implications.
- Most studies included in this review demonstrated benefits from the adoption of PA Technologies for managing spatial variability and precise nutrient applications.
- The heterogeneity of the studies included does not allow to make comparisons or meta-analysis.
- Studies with more detailed information in the change of costs were about 'precise nutrient applications'.

The present review synthesizes the evidence on the effectiveness of potential „win-win" PA technologies that promote the adoption of advanced technology to improve farming efficiency while mitigating environmental impact. This systematic review presents the current state of the adoption of PA regarding the potential economic, agronomic and environmental benefits to crop production systems. Although many studies attempt to present tangible benefits from the adoption of PA technologies, there is still much work to be done to fully incorporate new technologies and deliver targeted efficient applications to crop production systems.

References of studies included, characteristics of studies included and quality assessment is given at Table 10 (*Supplementary material*).

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POLITICAL SCIENCES DEPARTMENT: DESIGNING A SURVEY OVER STUDENTS' ATTIDUTE TOWARDS URBAN FORESTS

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Abstract

This paper deals with the implementation of a survey concerning the attitude of the undergraduate students' in the Department of Political Sciences (A.U.Th.) towards urban forests in Greece. The first part focuses on the development of the questionnaire and the application of sampling techniques while on the second part the explanatory survey is conducted. Almost 200 undergraduate students participated in the survey one week before their final exams. The survey records students' understanding about forests and forest resources in order to establish a comprehensive overview about forests' benefits and their contributions to quality of life in urban areas and the well-being of the citizens. Alongside students' awareness on the climate change, environmental policy making, green technology and forests' protection acts, is noted. Finally students' correspondence to legislation, regarding forests and their protection is accessed.

Keywords: *forest, survey, resources, green technology, environment*

Introduction

The definition and the context of the word "forest" can have various meanings in a person's (everyday) life and especially in a young person's life. Students are a particular social group with discrete characteristics such as age, study field, background and they have different urbanization origin coming from different cities in the country. Therefore, students of the Department of Political Sciences have been selected and participated in this survey by a face-to-face survey.

The aim is to establish a more detailed overview about forests in students' life and their understanding or even appreciation of the forests' contribution to their environment. It is recorded their point of view on what area can be consider as a forest (or according legislations' context), if nowadays, they visit forests for work or recreational purposes (such as walking, relaxing, nature study, bird watching, picnicking, walking etc), how often/ or when was the last time that they visited a forest. Additionally, students were asked if they happen to participate in an environmental project in primary or secondary education, what was the field that they were occupied with and which areas had they visited during that time.

The survey, also, records the benefits of a forest in everyday life, their resources and their contributions to quality of life in urban areas and the well-being of the citizens and forests' inhabitants. Students' could make significant remarks by addressing problems that have observed or by proposing more effective ways to protect natural environments. The environmental protection and green technology are crucial factors that can be in a long-term beneficial to everyday life in cities. Therefore, this survey can be consider as an evaluation tool of the existing status of life in correlation with state' actions, volunteering and non-profit organizations actions about protecting forests and their inhabitants.

Moreover, students' comprehension over forests and protection acts in a national or E.U. level is recorded and also their awareness on the climate change, environmental policy making and green technology.

The following chapters describe the questionnaire, the organization of the survey, the sampling methods and the realization of the survey that were put in practice in order to provoke and endure students towards environmental awareness.

Materials and Methods

Multistage stratified sampling method is used based on gender and origin city by 'face-to-face' interview during last week of July. Correspondence and Cluster Analysis are used for the analysis. Sampling methods were based on faculty's population and therefore 220 undergraduate students participated. In particular, 30.5% are male students and 69.5% are female students. And according to semester records, 1% students of 2nd semester have participated in the survey, 53.6% of 4th semester, 19.5% of the 6th semester, 15.5% of the 8th semester and 10% of students of 10th semester or above it.

According to origin, 34.1% come from urban areas, 41.4 % come from semiurban areas and 18.6% from rural areas.

Results

First of all, students noted their definition about that is a "forest" from their own perspective. We code their definition in three different concepts about forest. The first set of definitions is focused on flora and fauna, the second one in trees and plants, and the last one into human activities and the use of forest by humans. Many students gave a precise definition of a forest based on living inhabitants or trees and plants. But there are some students that define forests from the physical and philological pleasure to human beings such as a relaxing and refreshing place.

Figure 1. *Forest Definition*

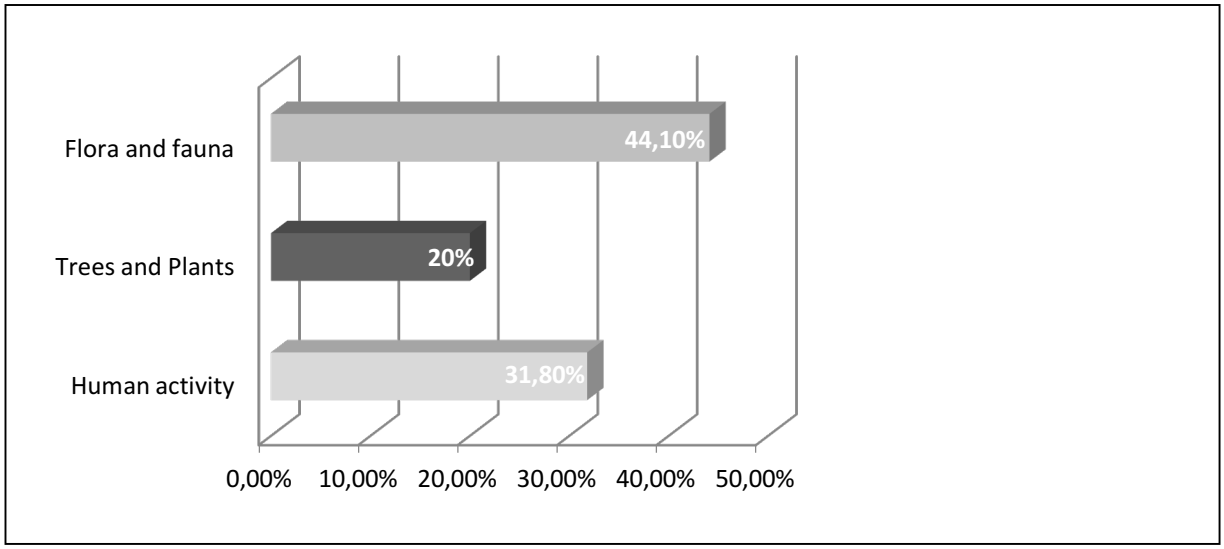


Figure 1, presents the different definitions of the "forest" according to undergraduate students of Political Sciences Department. The 44.1% define forest by flora and fauna, 20% in trees and plants (nature) and a 31.8% defines "forest" by its contribution to a person's life.

According to the Greek Constitution, article 24, "As forest or forest ecosystem is meant the organic whole of wild plants with ligneous trunk on the requisite land surface, which, together with the co-existing flora and fauna, form throughout their mutual interdependence and interactions, a certain biological community (forest biological community) and a certain natural environment (forest environment)".

It seems that the 44.1% of the students is familiar with the legal framework and correlates the forest's biological community with the forest environment but the 20% is limited in describing "trees and plants" within natural environment without mentioning the interdependence of the flora and fauna. Moreover, 31.8% of the students seem to acknowledge nature's contribution in a person's physical and physiological state rather than forest environment.

Even tough, the 77.7% of the students believe that there are enough forest areas in Greece. The 20% believe that there are not enough and 0.5% that there are no forest areas at all. From those who claim that there are enough forest areas, 43.3% come from semiurban areas, 32.2% from urban areas and rural areas 18.1%.

Students' satisfaction and appreciation rate is analyzed towards visiting forests. The 25% stated very satisfied, 50.5% somewhat satisfied by visiting random forest areas and 11.8% say is neither satisfied nor dissatisfied. Also, 10.5% is dissatisfied and 1.4% is very dissatisfied by visiting forests. Forests' visiting rate indicates that students indeed visit forest areas for recreational purposes quite frequently. The 6.4% stated that have visited a forest less than a week ago, 18.6% have visited a forest area 1-4 weeks ago, 23.6% 1-2 months ago, 10% 3-4 months ago, 9.5% 5-6 months ago, 11.8% 7-12 months ago, 8.6% 1-2 years ago, 6.8% more than 2 years ago, 3.6% more than 5 years ago and only 0.9% stated than had never visited a forest at all.

Students who live in semiurban areas (45.5%) stated that they extremely enjoy and appreciate visiting forest while 29.1% of the students who live in urban area and 16.4% those who live on rural areas enjoy and appreciate visiting forest. The origin seems to be correlated with students' understanding or even appreciation of the forest areas. Moreover, for the students who visited forest areas in a 'less than a week" period, the 50% come from semiurban areas, the 28.6% from urban areas and the 21.4% from rural areas.

Those, who claimed to visit forests for recreational purposes, were asked as well the means of transportation that they usually choose in order to visit forest areas. The 56.4% usually visit forests by car, 23.6% on foot, 10.9% on bike, 4.1% by motorbike and only 4.1% use public means of transportation.

Table 1. *Means of transportation/Origin areas(%)*

	Origin Areas		
Transportation	Urban areas	Semiurban areas	Rural areas
Car	62.7%	49.5%	53.7%
Motorbike	4.0%	5.5%	2.4%
Public Transportations	6.7%	4.4%	0%
Bike	8.0%	14.3%	9.8%
On Foot	17.3%	25.3%	34.1%

Table 1, shows a correlation between means of transportation and origin. The students in urban areas tend to use 62.7% cars and 17.3% on foot activity in order to visit forest areas. The same choice is made by students in semiurban and in rural areas. Also, students in semiurban areas tend towards more athletic means of transportation for instance riding a bike 14.3% and on foot 25.3%.

And as long as the recreational purposes of visiting a forest, the 65.9% usually visit forest areas for relaxing, the 36.4% for hill walking/climbing, the 26.4% for taking photographs, the 16.4% for camping, the 16.4% observing/learning about nature, the 15.5% for picnicking, the 11.4% for cycling, the 7.7% walking the dog, the 3.6% for hunting/ fishing and the 3.2% horse riding.

Concerning environmental projects in schools, 46.8% did not participate in environmental projects at school but for those who answer positively 23.6% participated in Elementary school, 24.5% in Middle-High school and 16.4% in High school. Female students seem to participate in environmental school projects by 72.6% and male students by 27.4%. More interactive students come from semiurban areas who participate in such projects 44.4% and afterwards students from urban areas 27.4% and rural areas 21.4%. Further analysis indicates that 4.1% of the students, participated in an environmental project in Elementary school continue to participate in such project during Middle-High school. Moreover, 6.8% of the students that participated in a project in Middle-High school

participated in such a project in High School. And only the 0.9% stated that participated in all primary and secondary education.

In general, environmental projects deal with reforestation, recycling and projects dedicated to environmentally protected regions.

Humans' benefit by protecting forest areas is another crucial matter that is analyzed. The 83.2% estimate that forests offer cleaner atmosphere, the 38.6% climate adaptation, the 30% flood protection, the 12.7% clean water supplies, the 12.3% relaxation and enjoying nature and the 9.5% fertile soil. Students that selected "cleaner atmosphere", 33.6% come from urban areas, 38.8% from semiurban areas and only 20.2% of the students come from rural areas. Cluster Analysis offers the opportunity to define benefit's clusters. One cluster consists of "clean water supplies", "relaxation and enjoying nature" ," fertile soil" and the second one includes "cleaner atmosphere", "climate adaptation" and "flood protection".

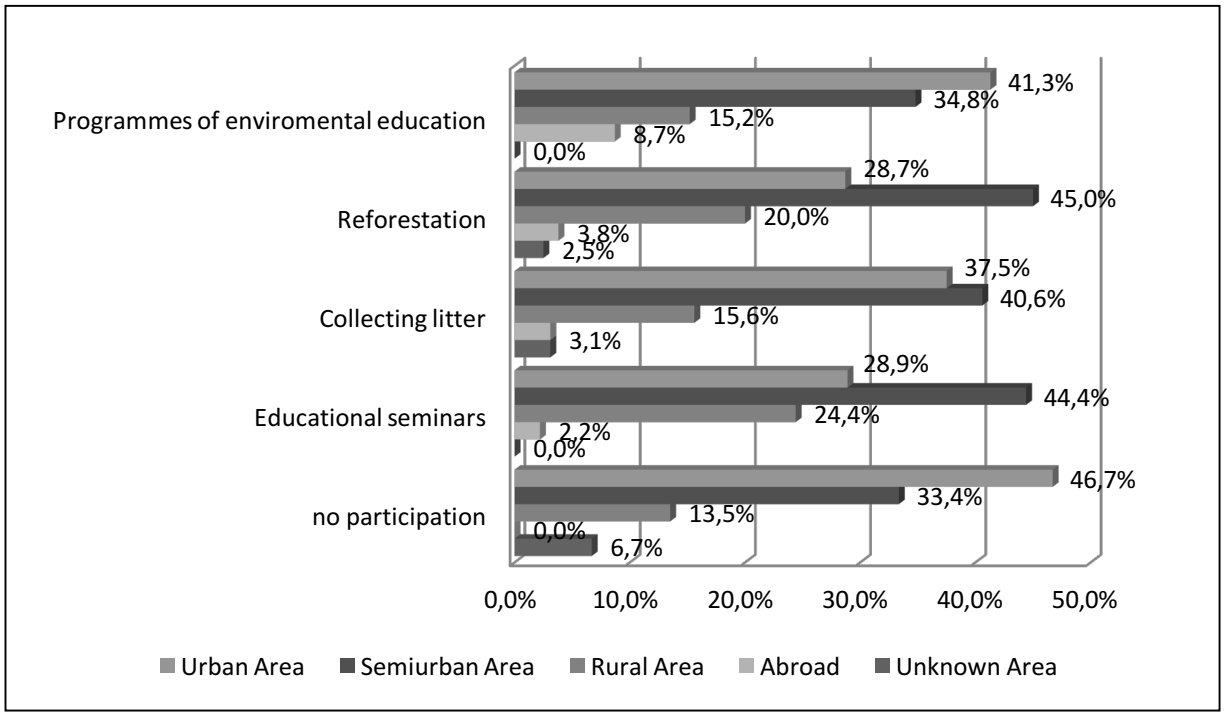
Also, the threats that forest areas deal with, is according to students, the 86.8% fires, the 39.5% litter, the 26.4% lumbering, the 19.1% illegal hunting, the 12.3% illegal house building, the 4.1% farming and the 1.4% noise pollution. Cluster Analysis offers the opportunity to define threat's clusters. The first cluster includes "farming", "illegal house building" and "noise pollution" and the second one includes "illegal hunting", "litter", "fires" and "lumbering".

NATURA areas, is also discussed and specifically students had to select characteristics that areas must have in order to be consider NATURA areas. Unfortunately, no one student could identify all the given characteristics. The 87.3% pointed out that the protection of a natural environment and ecosystem can suggest that an area is protected, the 17.3% an area for environmental training and research, the 4.5% development of local communities and the 3.2% as a park of tourism and relaxation. It is estimated that students that select as a first characteristic "protected area of a natural environment and ecosystem", select as a second characteristic "area for environmental training and research" by 15.1%, "a park of tourism and relaxation" by 3.1% and "development of local communities" by 3.1% as a second characteristic.

In fact, students reported that their information about NATURA 2000 is limited, the 30.5% stated that the information is insufficient, the 30.5% there is some sufficient, the 15.9% neither-nor, the 12.3% very effective and the 1.4% extremely effective. When students were asked if they would want to participate in NATURA's acts in order to protect forest areas 36.4 percent stated that would want to participate in reforestation, 20.9 percent in programmes of environmental education, 20.5 percent in educational seminars for forests' protection and 14.5 percent in collecting litter. Only 6.8 percent did not express any interest in participating in such protection actions.

Further analysis indicates (figure 2) that 46.7% of the students from urban areas are not interested in participating in NATURA's protection actions on the contrary students from semiurban areas are more willing to participate in such actions. In particular, 44.4% of the students from semiurban areas and 28.9% of the students from urban areas stated that are willing to participate in educational seminars. Also, reforestation is more appealing to students from semiurban areas (45%) than students from urban and rural areas. Thus, programmes of environmental education attract students from urban areas attention (41.3%) than all the others. To conclude, the origin seems to be correlated with students' attitude towards NATURA's protection actions.

Figure 2. *Participation in NATURA's acts/ Origin Areas*



Students seem to have poor awareness, as far as concern green technology. A list with actions for green technology was given and students have to select the right ones. Once again no one could note all the given actions. In particular, the 64.1% choose photovoltaic installations, the 46.8% recycling electrical appliances, the 49.1% electrical vehicles, the 43.6% green houses, the 36.4% biomass fuel, the 22.7% eco-friendly laptop and shell phones and the 15.9% artificial photosynthesis.

Political Science students seem to have limited awareness about green technology and the appropriate actions to be taken in order to protect, recycle and save earth's resources.

Finally, some issues concerning environment were analyzed in order to examine students' opinion.

Ellinikon International Airport was the international airport of Athens, Greece for sixty years up until 2001, when it was replaced by the new Athens International Airport "Eleftherios Venizelos". Nowadays, it is examined on how this area could be used (table 2). The first option is to be transformed into a public "green area" accessible to all citizens. This proposition seems attractive to students (24.5% strongly agree, 49% agree). The other preposition is to be transform into a park with mild cost intervention but students are rather confused (45.5% agree, 37.3% neither) and the third preposition is that the Greek State could decide about the investments and defend citizens' rights over the area (39.5% agree, 30.5% neither). This issue is highly controversial so students seem to be confused and indefinite.

Table 2. *Agreement-Disagreement over local issues(%)*

	Ellinikon Airport		
Scale	"green area"	Park with mid intervention	Greek state, manager
Strongly Agree	24.5	6.8	11.4
Agree	49.1	45.5	39.5
Neither-nor	20.9	37.3	30.5
Disagree	3.2	8.2	12.3
Strongly disagree	0.9	1.8	0.9

The other issue is focused on Scouries gold mine (table 3) and the question refers to employees strike. Students seem divided once again about this issue (strongly agree 10.9%, agree 31.4% and neither 42.7%).

Table 3. *Agreement-Disagreement over local issues(%)*

Scouries	
Scale	Employees strike
Strongly Agree	10.9
Agree	31.4
Neither-nor	42.7
Disagree	10
Strongly disagree	3.6

The last issue refers to Aheloy river aberration; students are neutral about stopping constructions in the area 56.4%. And Aheloy's water, if it could be used by households and industries and in terms of producing energy, students seem to agree by 40% and disagree by 8.2% (table 4).

Table 4. *Agreement-Disagreement over local issues(%)*

	Aheloy river	
Scale	Stop constructions	Aheloy water
Strongly Agree	6.4	6.4
Agree	17.7	40
Neither-nor	56.4	42.7
Disagree	16.8	8.2
Strongly disagree	2.3	2.3

Discussion-Conclusions

This overview analyzes issues about forests in students' life and their understanding or even appreciation of the forests' contribution to their environment. Students appreciate the contribution of forests in their life (75%) and frequently visit forest areas for recreational purposes. Students who visited forest areas in a 'less than a week" period, the 50% come from semiurban areas, the 28.6% from urban areas and the 21.4% from rural areas. The origin seems to be correlated with students' understanding or even appreciation of the forests.

The 56.4% usually visit forests by car and 23.6% on foot. And as long as the recreational purposes of visiting a forest, the 65.9% usually visit forest for relaxing and the 36.4% for hill walking/climbing.

There are recorded three different approaches on what area can be consider as a forest. Firstly, it is defined by flora and fauna, secondly in correlation with nature (trees and plants) and last but not least a definition correlated with its contribution to a person's life. The 44.1% of the students is familiar with the legal framework and 31.8% of the students seem to acknowledge nature's contribution in a person's physical and physiological state rather than forest environment.

Additionally, students tend to participate in environmental projects but only the 0.9% stated that participated in all projects during primary and secondary education. The field that they are usually occupied with is reforestation, recycling and projects dedicated to environmentally protected regions.

The survey, also, records students' opinion over the benefits and threats of forests, resources and contributions to quality of life in urban and semiurban areas and the well-being of the citizens and forests' inhabitants. Students (83.2%) estimate that forests offer cleaner atmosphere and the higher threat is (86.8%) fires.

Students made significant remarks by addressing problems, such as that their information about NATURA 2000 is limited; the 30.5% stated that the information is insufficient and the 30.5% is somewhat sufficient. Students were willing to participate in NATURA's acts in order to protect forest areas. Particularly, 36.4 percent stated that would want to participate in reforestation and 20.9 percent in programmes of environmental education. The environmental protection and green technology are crucial factors that can be in a long-term beneficial to everyday life in cities but students seem to have limited awareness about green technology and appropriate actions. Students are not sufficiently informed, but are willing to participate in such actions.

Finally, students are rather confused and indefinite over environmental issues that were raised in the survey in order to examine students' agreement or disagreement.

Therefore, this survey can be consider as an evaluation tool of the existing status of life in correlation with state' actions, volunteering and non-profit organizations actions about protecting forests and their inhabitants. Moreover, it could be recorded students' comprehension over forests and protection acts in a national or E.U. level and finally their awareness on the climate change, environmental policy making and green technology in the future.

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APPROACHING SUSTAINABLE FOREST MANAGEMENT THROUGH IT, AIMING TO ENHANCE THE FOREST ROAD NETWORK ACCESSIBILITY

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Abstract

In this paper, it is presented the development of an information system which enhances the accessibility of the forest road network. It uses HTML5 and CSS3 for the frontend and WAMP Server with MySQL as backend. Users receive the necessary information via notifications on their Android smartphone using an application. This application uses the Google Maps app to receive the route that should be followed. Forwarding information to users is operated through Firebase Cloud Messaging. Finally, it should be highlighted that free and open source software was used to implement the aforementioned system.

Keywords**:** *Information System, Accessibility, Forest Road Network, Android Application, Firebase, Google Maps, Open Source Software*

Introduction

In Greece, 25% of the total land area consists of forests, ranking it fourth in forestry wealth among the countries of Europe. Changes in forest landscapes resulting from road construction have increased remarkably in recent years. Roads are essential structures to provide access to the forest from the establishment phase to the harvesting stage. Thus, it is important that roads are properly planned in order to ensure the transportation of forest products as well as the safety, comfort and economy of vehicle operations. The sustainable management of forest resources can only be achieved through a well-organized road network (Athanasiadis and Andreopoulou 2015).

The complex structure of the forest road network makes it necessary to use navigation technologies to facilitate the movement of vehicles, citizens and employees working in it. Most of those technologies are based on GPS navigation devices or GPS navigation applications for smartphones. Land navigation methods and tools such as Compass with adjustment for magnetic declination, Clinometer, Topographic maps etc., have been used widely so far but their accuracy can be improved by the Information Technologies and the Internet (Tzoulis et al. 2015).

Internet has generated an enormous level of excitement, where like no other technology it has captivated the media's, general public's and marketers (academicians) attention. There are many reasons given for the growth of Internet usage over recent times, including for example, its size as a source of information, being accessible for multiple devices (PC, laptops, tablets, smartphones, etc.), increasingly becoming much more user friendly and less expensive (Andreopoulou 2011).

This paper describes how combining different open source technologies can lead to the development of a multifunctional and useful tool for devices running Android. It reduces the unnecessary vehicle shifts and ensures the shortest route, thus allowing us to approach the sustainable forest management.

Materials and Methods

The programming languages and the technologies which were used for the development of this Information System, will be presented below.

HTML5 is the World Wide Web's markup language. HTML (Hypertext Markup Language) was primarily designed as a language for semantically describing scientific documents, although its general design and adaptations over the years have enabled it to be used to describe a number of other types of documents. HTML5 includes detailed processing models to encourage more interoperable implementations. It extends, improves and rationalizes the markup available for documents and introduces markup and application programming interfaces (APIs) for complex web applications. (Hickson 2014).

CSS3 (Cascading Style Sheets) is a style sheet language used for describing the presentation of a document written in a markup language. Although most often used to set the visual style of web pages and user interfaces written in HTML. Along with HTML and JavaScript, CSS is a cornerstone technology used by most websites to create visually engaging webpages, user interfaces for web applications, and user interfaces for many mobile applications (Clark 2014). CSS3 has been split into "modules". It contains the "old CSS specification" (which has been split into smaller pieces). In addition, new modules are added. Some of the most important CSS3 modules are: Selectors, Box Model, Backgrounds and Borders, Image Values and Replaced Content, Text Effects, 2D/3D Transformations, Animations, Multiple Column Layout and User Interface (Lazaris 2010).

PHP (Personal Home Page or Hypertext Preprocessor) is a server-side scripting language designed primarily for web development but also used as a general-purpose programming language. PHP code may be embedded into HTML or HTML5 markup, or it can be used in combination with various web template systems, web content management systems and web frameworks (Lerdorf 2007).

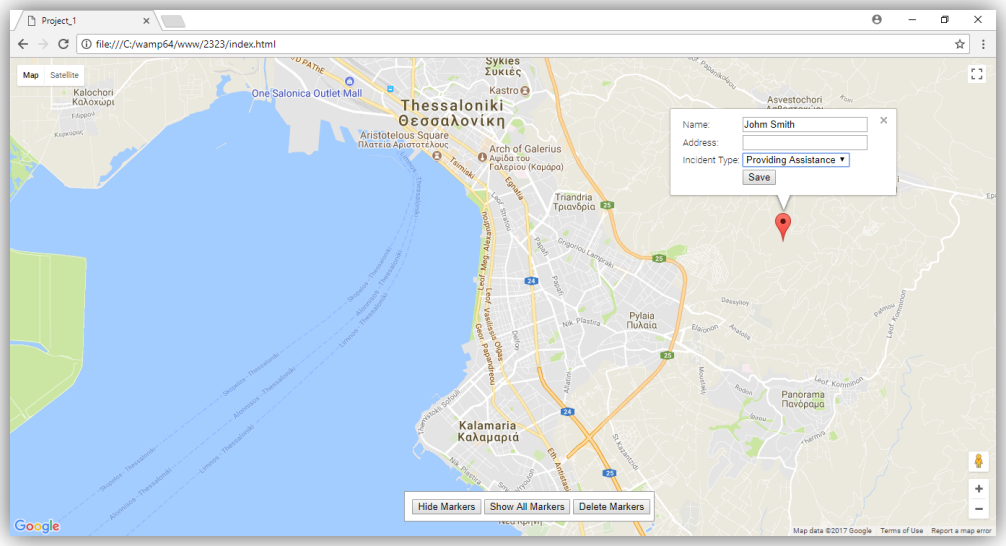

Figure 1. *Website with Google Maps*

WampServer refers to a software stack for the Microsoft Windows operating system and consisting of the Apache web server, OpenSSL for SSL support, MySQL database and PHP programming language. The most important part of the WAMP package is Apache (or "Apache HTTP Server") which is used run the web server within Windows. By running a local Apache web server on a Windows machine, a web developer can test webpages in a web browser without publishing them live on the Internet (Bourdon 2012).

MySQL is an open source relational database management system (RDBMS). Its name is a combination of "My", the name of co-founder Michael Widenius's daughter, and "SQL", the abbreviation for Structured Query Language (MySQL 1995).

Firebase is a mobile and web application development platform, has grown inside Google and expanded their services to become a unified platform for mobile developers. Firebase now integrates with various other Google services to offer broader products and scale for developers (Firebase 2011).

Google Maps is a web mapping service developed by Google. It offers satellite imagery, street maps, 360° panoramic views of streets (Street View), real-time traffic conditions (Google Traffic), and route planning for traveling by foot, car, bicycle (in beta), or public transportation. Google developed Google Maps App (mapping mobile app) for the Android and iOS mobile operating systems and it uses Google Maps for its information. The Google Maps apps on Android and iOS have many features in common, including turn-by-turn navigation, street view, and public transit information (Murphy 2012).

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built based on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems (AndroidStudio 2013). It is a replacement for the Eclipse Android Development Tools (ADT) as primary IDE for native Android application development.

Postman is a powerful GUI (Graphical user interface) platform to make your API development faster & easier, from building API requests through testing, documentation and sharing (Postman 2012).

Results

It is often observed that the terms, information system and information technology are used interchangeably. In a literal sense, information technology is a subset of information systems. Information systems consist of people, processes, machines and information technology. The great advancement in information systems is due to development in information technology and introduction of computers.

Information technology (IT) is the application of computers to store, study, retrieve, transmit, and manipulate data, or information, often in the context of a business or other enterprise. IT is considered a subset of information and communications technology (ICT). In 2012, an ICT hierarchy was proposed where each hierarchy level "contains some degree of commonality in that they are related to technologies that facilitate the transfer of information and various types of electronically mediated communications" (Zuppo 2012).

The IS of this paper consists of a website using Google Maps, WAMP server, Postman (GUI), Firebase Cloud Messaging and an Android Application (Figure 2). It will be described how the Information System interacts with the users so as to store the necessary data and send a notification or more, with the coordinates and other useful information. This IS requires at least two end users, User1 and User2, with very distinct roles in order the system to be functional. User1 creates the marker(s), stores the data and transmits the information. User2 receives the information in his/her Android smartphone.

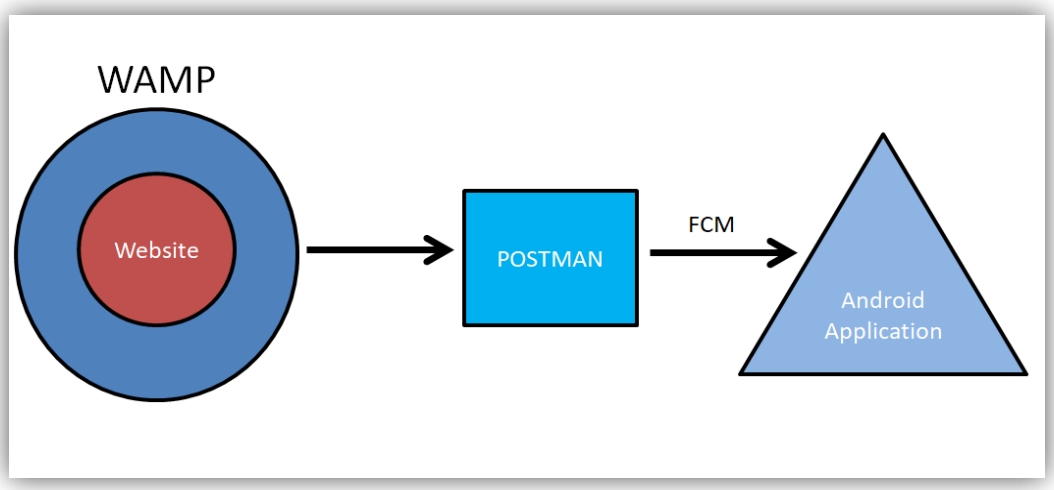

Figure 2. *Information System structure*

After the User1 requests the html page from the server (by selecting the file Project1 from the "Your VirtualHost" tab of WampServer's Home page), Google Maps is loaded. Then, the User1 can click anywhere to the map creating a marker. By clicking on the marker, a pop-up window shows up with empty fields to fill in (Figure 1). All the data inserted by the User1 and the coordinates are stored automatically in the database. Afterwards, the selected data from the database are aggregated by using the Postman GUI in order to create the message which will be sent as notification. The User2 receives the notification on his/her Android smartphone (Figure 3). Finally, the delivered notification triggers the Google Maps application (Android) showing the route that should be followed (Figure 4).

Figure 3. *Notification*

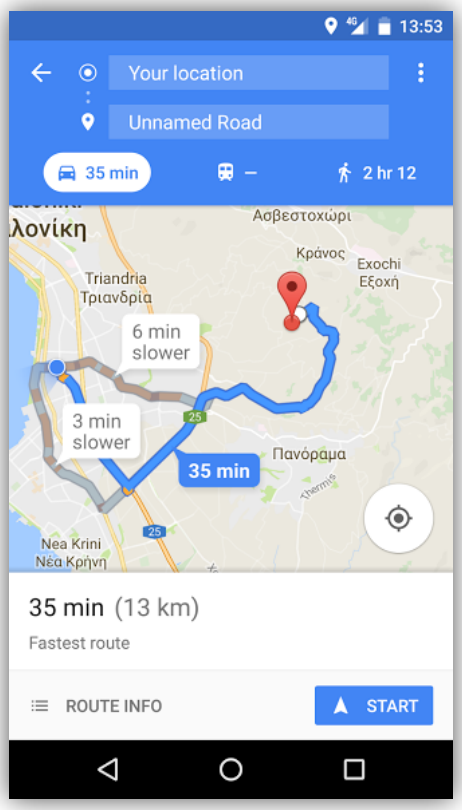

Figure 4. *Google Maps (Android)*

Discussion-Conclusions

Information and Communication Technologies can play a key role in the environmental protection, the environmental sustainability, the environmental education and the rural sustainable development (Andreopoulou 2014).

Information Systems is an academic study of systems with a specific reference to information and the complementary networks of hardware and software that people and organizations use to collect, filter, process, create and also distribute data. An emphasis is placed on an information system having a definitive boundary, users, processors, storage, inputs, outputs and the aforementioned communication networks (Jessup and Valacich 2008).

As it mentioned above, the forest road network accessibility plays a significant role in the sustainable forest management. Further, enhances forest's socio-economic development apart from providing a safe and suitable mode of transport. In order to succeed this, an Information System was successfully developed reducing the unnecessary vehicle shifts and ensures the shortest route. Furthermore, it could be used as a guide system for hikers, employees of the Forest Service – Police and Fire Department or even for transporting injured persons. Finally, it should be pointed out that free and open source software was used to implement this system.

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E-COMMERCE CHALLENGE IN MUSHROOMS AND TRUFFLES IN INTERNET SOCIAL NETWORKS: THE STATE OF GREEK SMEs

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Abstract

This paper studies the promotion of mushrooms and truffles of SMEs located in Greece, through social media. Mushrooms and truffles, as an important component of Non - Wood Forest Products, play a vital role in forests and rural communities, being part of their normal diet since antiquity. Nowadays agribusinesses use Internet as a marketing tool for the promotion of their products. With the find of Social Media Networks, a modern digital technique, a great amount of SMEs started to use them as a marketing, management and service tool in order to achieve win-win deals with customers. In this study the research focuses on registration and assessment of SMEs located in Greece and operating in field of mushrooms and herbs, with emphasis on the classification of their social media profiles in groups according to their marketing and digital characteristics. Due to characteristics of the Social Media communication that is created between SMEs and consumers, SMEs have a different acceptance from consumers.

Keywords: *E-commerce, Mushrooms and Truffles, Marketing, Social Media profile*

Introduction

There is a strong connection between forests and people who live around them. This is something not new, but it was mentioned since ancient times. Forests are exploited not only for aesthetic but also for economic reasons. Changes in the forestry sector have been made through the adoption of new policies and legislation, changes in the area of land tenure, and private property rights (Weiland, 2010; Bouriaud et al., 2013;), which have brought about new possibilities for improving the sector governance and for fostering multifunctional forest management. Multifunctional forestry is a globally accepted way of forestland management. Nevertheless, regarding production, the attention is historical, prevailingly focused, in many cases, on market timber production. Non-timber forest products (NTFP) were not treated as an important commodity in many countries and communities. Following the principles of multifunctional sustainable forest management (MSFM), forest management and exploitation started aiming to the optimization of different products and services to the respective societies while keeping the sustainability of the forest ecosystems (European Commission, 2013).

Since 1999 FAO (FAO, 1999) mentioned the importance of Non Wood Forest Products. Non – Timber Forest Products have a potential future importance in many Central, Eastern and Northern European countries as published by Barszcz (2004), for Poland by Polevshchikova (2005), for North – West Russia by Saastamoinen et al. (2004), for Finland by Kovalčík (2014), for Slovakia. According to FAO as non-wood forest products are defined products other than wood, derived from forests, scrub and tree plantations and are calculated around 4000 - 6000 species. Although the importance of Non-Wood Forest Products are recognized and accepted, research on forest ecosystems remains focused primarily on timber production. Therefore, knowledge about the situation in Non-Wood Forest Products of EU forests is incomplete (Kardell, 1980; Janse and Ottitsch, 2005; Stryamets et al., 2012). Mushrooms and truffles are part of this category.

In recent times, Internet has generated an enormous level of excitement, where like no other technology it has captivated the media' s, general public' s and marketers (academicians) attention. There are many reasons given for the growth of Internet usage (not specifically retailing) over recent times, including for example, its size as a source of information, increasingly becoming much more

user friendly, and it is increasingly becoming more accessible and less expensive. Internet is an interactive channel that can be used for educational and marketing reasons for smaller or bigger enterprises. This can be achieved by having in mind the possibilities that are given to Internet users such as: free software for developing web pages and posting them on the Internet (Bonn et al., 1999; Tsekouropoulos et al., 2005; Andreopoulou et al., 2008). A business social profile can develope relationship with the customers and achieve win – win deals with them (Seock and Chen-Yu, 2006; Töllinen and Karjaluoto, 2011; Andreopoulou et al., 2012;).

Electronic-commerce (e-commerce) is regarded as an appropriate strategy for marketing, selling and integrating online services that can play a significant role in identifying, obtaining and maintaining customers (Choshin and Ghaffari, 2017). E-commerce optimizes and enhances the relationship and communications between the organization, producers, distributors and customers. However, it should be noted that success in e-commerce depends upon determining effective factors. It is widely acknowledged that e-commerce can boost efficiency and effectiveness of SMEs in both developed and developing countries (Jagoda, 2010).

Social Media Networks are gaining ground to the daily life. SMEs started to adopt polices in order to use them as a new marketing communication method and to avoid threats. Social Media promote the interaction of users and groups; sharing, discussing, modifying, co-creating are only some of their uses (Vlachopoulou, 2003). Because of the Internet and e – commerce, SMEs are increasingly powerful driving force in the emerging global marketplace, creating new jobs and spurring innovation and economic development all over the world (Da Costa, 2016).

In this paper, the study focused on search and record of SMEs located in Greece giving emphasis on mushrooms and truffles promoted through social media and more specifically Facebook. Moreover, in this study, are presented and described the Social Media Network profiles of SMEs as to their characteristics.

Materials and Methods

For the aim of the study, 24 firms located in Greece and having Greek products that are only cultivated in Greece, were studied, analyzed and categorized with regards to 7 marketing and organizational criteria in their corporate social media profiles (Table 1. In Table 1, some Facebook pages contain Greek words because the creators of the pages used them). The quantitative data were collected from their individual social media sites such as number of fans (according to the "Likes" that companies have), followers (according to people who "Follow" them), frequence of postings (that was categorised in three groups: daily, every 2 days and rare*), response time, clear managerial aims and goals (described by their management status), promotion techniques that use "like and share" for competition and gaining products and general information for the products and their characteristics. The social media profiles of the SMEs herb firms that were selected for the research were collected from the Greek Facebook with the use of proper search engines in 2017. We are mainly interested in how many fans or follower's herb SMEs had on their social media profiles and the level of engagement.

Initially, an analysis is performed in order to examine the type of marketing and organizational criteria, introduced in the retrieved corporate firms' social media profile. A comparison between fans (Likes) and posting divided in 3 groups (every day, every 2 days, rare) was held (Kruskal – Wallis analysis). After that, a linear regression was conducted to compare fans (Likes) with all dichotomous independent variables (response time, clear objects and goals, promotion techniques with "like and sha1re" and general information for the products and their characteristics). Frequence of posting was transformed into a dichotomous variable, also, and included in the linear regression analysis. For every indented variable a simple linear regression was conducted.

Table 2. *SMEs participated in the research (Brand - Facebook profile).*

A/A	Brand	Facebook
1	Hydnon trufles and more	https://www.facebook.com/Υδνον-Hydnon-1193832457295261/
2	Mushroom product of Grevena	http://www.facebook.com/Manitaroproionta.GR
3	Forest garden - truffles & mushrooms	http://https://www.facebook.com/greektruffles/?pnref=about.overview
4	Mushroom - Truffle (Giorgos Sergiannidis)	http://www.facebook.com/troufa.truffle/
5	Mushroom Kechagias	https://www.facebook.com/Μανιτάρια-Κεχαγιά-455038581362090/
6	Mushrooms Of Kolindros	https://www.facebook.com/manitariakolindrou
7	FungiHellas	https://www.facebook.com/fungihellas/
8	Truffle of Pieria	https://www.facebook.com/troufa.pieria.EleftheriaTziatziou
9	Precious Truffle	https://www.facebook.com/precioustruffle/?hc_ref=SEARCH
10	Magic Mushrooms	https://www.facebook.com/Τα-μαγικα-μανιταρια-677196602307712/
11	Remountaki	https://www.facebook.com/Μανιτάρια-Πλευρώτους-Remountaki-1493003074332272/
12	Greek Mushrooms	https://www.facebook.com/Άγρια-Μανιτάρια-Τζουμέρκων-Greek-Mushrooms-1118310021601404/about/
13	Manitria Potamoula	https://www.facebook.com/manitariapotamoula/
14	Manitaria Attikis	https://www.facebook.com/ManitariaAttikhs/
15	Alexandroupolis Oyster Mushrooms	https://www.facebook.com/manitariaalex/
16	Idigefston Mushrooms of Grevena	https://www.facebook.com/Ηδύγευστον-Μανιτάρια-Γρεβενών-122224221177684/
17	Papapanagiotou Mushrooms	https://www.facebook.com/Μανιταρια-Παπαπαναγιωτου-1628664424052209/
18	Mushroom of North Greece	https://www.facebook.com/Μανιτάρια-Βορείου-Ελλάδος-906932899360366/
19	Manitaria Ellinikis Gis	https://www.facebook.com/ManitariaEllinikisGis/?ref=ts&fref=ts
20	Me manitaria	https://www.facebook.com/Με-Μανιτάρια-171005632987973/?ref=ts&fref=ts
21	Greek Wild Mushrooms	https://web.facebook.com/Greek-Wild-Truffles-167323783433032/?fref=ts
22	Greek Truffle	https://web.facebook.com/elliniki.agria.troufa/
23	Truffle Cultivation and Truffle dogs	https://web.facebook.com/panpanag/
24	Troufonomades	https://web.facebook.com/pg/troufonomades/about/?ref=page_internal

Results

According to the geographic region that the SMEs are located the following Table (Table 2) was organised.

First the comparison of the three groups for the frequence of posts (rare*, every 2 day posts and daily posting) to people who liked the pages (as mentioned by the "Likes" of the pages) was conducted and results are presented in Table 3. From the normality test that was conducted, the analysis showed that one variable was not distributed normally, as the p value in the Shapiro – Wilk test is smaller than 0.05 (Table 4).

Table 3. *Geographical Region of SMEs as it derived from the location of the enterprise.*

Geographic region of SMEs	No of SMEs
Central Greece	4
Crete	1
Macedonia	12
Pelloponnesse	1
Epirus	2
Thrace	4

Table 3. *Likes Median of different groups of posting frequence.*

Frequency of posting	Likes Median
Every day	6382.5
Every 2 days	877.5
Rare	337.5

Table 4. *Tests of Normality.*

Frequency of posting	Shapiro-Wilk (p)
Every day	0.678
Every 2 days	0.004
Rare	0.258

Because of the non – normality of the distribution of the 2 variables ("Every day" and "Rare" posting frequency), the Kruskal – Wallis analysis was selected for the comparisons of the medians. During Kruskal – Wallis analysis it was mentioned that at least the median of one group was statistically different from others (H (2) = 11,376, p=0.03) (Table 5). Then, an analysis was held for the groups in pairs to find out which median of groups differs significantly statistically. This resulted that the number of "Likes" was significantly greater in the group of "Every day" posting (Median=6382,5) than in the group of rare posting (Median=337.5) (U=<0.001, p=0.003) (Table 5).

In the linear regression analysis there is a statistically significant relation between the number of fans (as seen by the "Likes") and one of the variables ("respond to comments" p=0.017 (Table 7)). A non - significant relation mentioned between fans ("Likes") and "posts frequency" p=0.066, "aims – goals" (p=0.148), and "general information" (p=0.349). No relation was found between the number of fans ("Likes") and "promotion with Likes and Share".

Table 5. **Kruskal - Wallis Comparison of the Medians.**

Chi- Square	p
11,376	0.03

Table 6. **Mann - Whitney U Analysis. Comparison between Medians of "Rare Posting" and "Every 2 days" posting.**

Mann - Whitney U	p
<0.001	0.005

Table 7. **Linear regression analysis of Respond to comment – Likes.**

	Unstandardized Coefficients		
	B	Std. Error	p
Responds to Comments	2996.2	1157.157	0.017

The coefficient of the variable "Respond to comments" was 2996.2, which means that the profile that responded to comments had 2996.2 "Likes" on average more than those that did not respond to comments (Table 7).

Discussion - Conclusions

Nowadays the majority of SMEs prefer to use Internet and Social media in order to inform and communicate with clients (Kalfagianni et al., 2017). In this paper we tried to focus on special characteristics of the Social Media communication that is created between SMEs and consumers.

The sector of mushrooms and truffles can become an important tool for local development. Since antiquity mushrooms and truffles are part of every day life and SMEs that are in the area of them should focus on contemporary marketing processes, such as social media aiming to improve their competitiveness and their viability.

The "response to comments" was examined and mentioned as the most important factor that attracts a lot of followers and fans.

As it was mentioned above the "Rare posts" group has remarkably less fans (Likes) than the other groups of posting frequency, especially with the group of the "Every day" posts; as mentioned with the comparison of the three groups of different frequency of posting and with the linear regression analysis between "Posts" variable and "Likes" variable.

It is believed; that in Greece SMEs should also pay attention to the frequency of posts that they do, as it is seemed that there is coherence between people who follow the social media profiles.

Findings of that research could help managers of social media profiles to create an attractive profile for an enterprise that will have a number of fans that will rise daily.

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DEVELOPMENT OF WIRELESS SENSOR NETWORKS IN AQUACULTURE

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Abstract

Global fish production resume to leave behind world population development, and aquaculture is the remaining part of the fastest-growing food producing areas. The aim of this paper, is to present architectures of Wireless Sensor Networks (WSNs), that can be used for the monitoring of aquaculture units. These systems collect wirelessly the signals produced by the sensor module in order to achieve real-time monitoring and control. The sensors records water quality parameters, providing early warnings. The low power consumption, low cost, and high reliability characteristics of WSNs, make them to be suitable for the aquaculture units.

Keywords: *aquaculture units, WSNs, monitoring, architectures*

Introduction

Aquaculture is the fastest growing food-producing sector in the world, with an average annual growth rate of 8.9% since 1970 (Subasinghe, 2005). In 2012, aquaculture set another all-time production high and now provides almost half of all fish for human food (FAO, 2014). Intensive aquaculture is seen as a solution to high demands for fish and sea food amidst declining sea and ocean stocks (Daudi et.al, 2014).

The water condition in aquaculture units affects the health of fish, therefore directly influences the farming yield. Therefore it is essential to upgrade the automation and artificial intelligence level in monitoring the parameters of the water, such as temperature, dissolved oxygen etc. (Zhu and Ran, 2001). The appropriate control of the water quality, which keeps the concentration of the water environment in the optimal range can enhance the fish growth rate, affect dietary utilization and reduce the occurrence of large-scale fish diseases (Stigebrandt et al., 2004; Sim et al., 2008).

Sustainable fishery management and decision-making in water ecosystems based on forecasting and planning strategies can be supported using ICT (Information and Communication Technology) applications and services which should incorporate local, regional, social, economic and biological data except of the basic fishery and biological data for the fish species. Stakeholders should decide for local environmental interventions taking into consideration to preserve the special protection character of the wetlands and policy must be within the framework of sustainability and in respect to their natural environment.(Andreopoulou and Kokkinakis, 2014).

For the past few years, (WSNs) have been used in various fields and mostly in environment monitoring applications. Environmental monitoring is the main autonomy which may contribute large effects (Othman and Shazali, 2012).

Recent technologies in wireless communications and electronics, have increased the growth of low cost, low power and multi-functional sensors that are small in size and can communicate in short range. Each node consists of microcontrollers, memory and transceiver. The microcontrollers are used to execute task, data processing and assist the functionality of other components in the sensor node. For the memory, it is mainly used for data storage while the transceiver acts from the combination of transmitter and receiver functions (Jalil, 2011). These technologies have been applied throughout the world but are mainly used in Asia as it is described in the next section.

An online water quality monitoring system for intensive fish culture in China, which blended web-server-embedded technology with mobile telecommunication technology was reported by Zhu et al. (2010). Based on historical data, this system is intended to predict water quality with artificial neural networks (ANNs) and control the water quality in time to minimize catastrophic wastes.

According to Nayyar (2013), an energy efficient dynamic power management technique terminates the sensor node when there is no work. The primary idea behind this technique is to halt the sensor devices when not needed and wake them up when required which yields better savings of energy and increase lifetime. Finally,

A real-time water quality environment monitoring system based on a WSN was implemented by Zhang and Wang (2011), which collects data for several environmental parameters, which are related to water quality. Furthermore, the system can supply expert knowledge to deal with data for making control decision. Such a system is tempting since it protects the quality of aquaculture water, and has satisfied results in practical application.

Materials and Methods

This paper is a review of WSNs that are being used in aquaculture units. To begin the study, we collected data by examining modern bibliographic databases. In the next part of the research process, we discussed about the architecture of WSNs that are being used in aquaculture units, the design of WSNs, the design of hardware systems, the design of software, wireless communication networks and the parameters that they are measuring.

Results

I. Architecture of Wireless Sensor Networks

A WSN is an ad-hoc network system composed of a great number of tiny low cost and low power consumption sensing nodes which are capable of sensing, calculating and communicating data (Jiang et.al, 2009). It is also an intelligent system, which automatically accomplishes all types of monitoring tasks in accordance with the changing environment.

II. Design of Wireless Sensor Networks

A WSN has important applications such as remote environmental monitoring and target tracking. This has been enabled by the availability, particularly in recent years, of sensors that are smaller, cheaper, and intelligent. These sensors are equipped with wireless interfaces with which they can communicate with one another to form a network. The design of a WSN depends significantly on the application, and it must consider factors such as the environment, the application's design objectives, cost, hardware, and system constraints (Yick et.al, 2008).

The sensor nodes are randomly deployed in the monitored area and they are responsible for collecting the data. They convert the collected analog signals to digital ones and send the digital signal to the sink node via wireless transmission. Finally, the sink node sends the received data to the task management node via wire or techniques (Chen et al, 2014).

In Liu and Cheng (2012), the WSN is mainly composed of coordinators and sensor nodes. The system also has a monitoring center. The coordinator is the bridge between the sensor nodes and the monitoring center, so all the gathered data is transmitted to the monitoring center through the coordinator, and the control command is sent to the sensor node through the coordinator.

III. Design of Hardware

The nodes of WSN are divided into three categories: Coordinator, Router and Terminal node. Each node is responsible for their respective functions. At the same time, they are supported each other to complete network establishment and operation (Dong and Zhang, 2012). In Duy et.al (2015) research, each end-node in the hardware system is consisted of two common parts, a microcontroller and a radio chip. The variation hardware implemented between each node is in accordance with the responsibility of the node and that such variation can be classified into four groups named (1) sensor platform; (2) control platform; (3) cluster head platform; and (4) management platform. In Kumar et al. (2010), a sensor node is made up of four basic components as shown in Fig. 1: a sensing unit, a processing unit, a transceiver unit and a power unit.

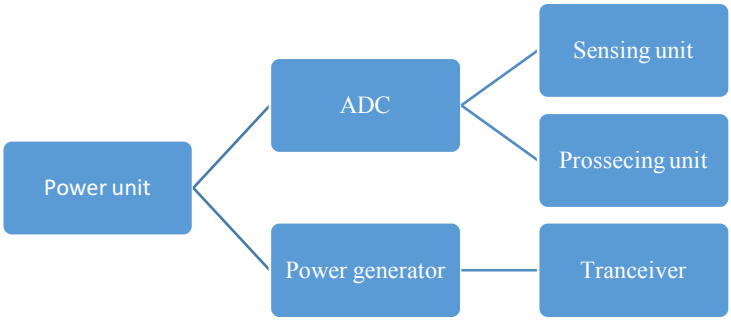

Figure 1. The framework of the hardware system

IV. Wireless Communication Networks

The design of the communication network is an important aspect of WSN. The network architecture can be separated into two main parts: (1) local network communication, which is transmission of the data from the sensor nodes to a local monitoring station (or base station), and (2) remote network communication, which is transmission of the data from the local monitoring station to a remote monitoring station that enables users to access the data (Adu-Manu, 2017).

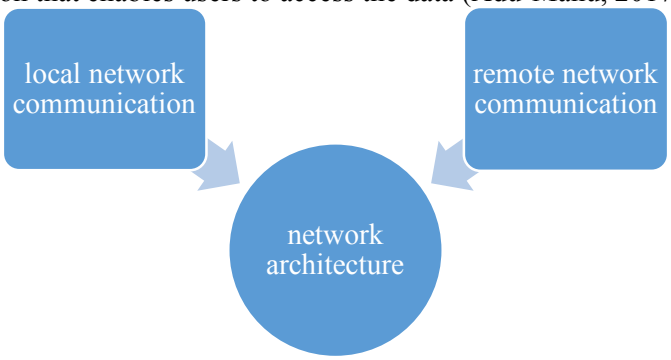

Figure 2. Design of the communication network in WSN.

V. Software design

The transport layer helps to maintain the flow of data if the application requires it. The network layer takes care of routing the data supplied by the transport layer. In addition, the power, mobility, and task management planes monitor the power, movement, and task distribution among the sensor nodes. These planes help the sensor nodes coordinate the sensing task and lower the overall power consumption. The power management plane manages how a sensor node uses its power. For example, the sensor node may turn off its receiver after receiving a message from one of its neighbors. This is to avoid getting duplicated messages. Also, when the power level of the sensor node is low, the sensor node broadcasts to its neighbors that it is low in power and cannot participate in routing messages. The remaining power is reserved for sensing (Akyildiz et al. 2002).

V. WSNs measuring parameters

WSN systems are employed to monitor freshwater sources and to measure water quality parameters (Nasser et al. 2013). Water quality narrates the main composition of water with reference to its chemical, physical, and biological belongings (Farrell-Poe, 2005). In Cline (2012), water quality is a crucial factor when culturing any aquatic organism. Optimal water quality departs by species and must be monitored to protect growth and survival. The quality of the water in the production systems can significantly influence the organism's health and the costs related with getting a product to the market. Furthermore, some species are observed to be highly fragile to the parameters that affect water quality in aquaculture units.

(WSNs) applications can give rapid informations to make determinants manipulations for the ensurance of sustainability (Gerontis et al. 2017). Thus the deployment of sensors is not only important to monitor water quality but also to provide early warning for contaminants in water as well (Harun et al., 2012).The sensors can be categorized in sensors of : pH, temperature, turbidity, dissolved oxygen, pollutant levels, pressure, turbidity value, water level, suspended solids and

amoniacal nitrogen. The table (Fig.2) shows the parameters of the quality water that the wireless sensor networks measures in aquaculture units.

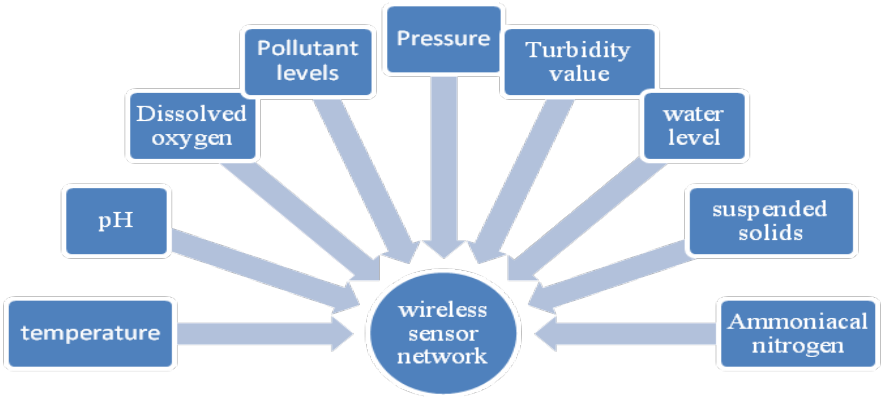

Figure 3. WSNs measuring parameters in aquaculture units (Gerontis et al, 2017).

Discussion-Conclusions

The development of WSNs for aquaculture units has been studied. In addition, a detailed architecture of the WSNs, together with the hardware design of the smart sensor nodes and their measuring parameters is also presented. These systems has been operational in improving the water quality management by monitoring in real-time, providing early warning for contaminants in water as well and reducing the operational cost of aquaculture units. Information and Communication Technologies can play a key role in the environmental protection, the environmental sustainability, the environmental education and the rural sustainable development (Andreopoulou, 2012). WSNs will soon become as important as the Internet. Just as the Internet allows access to digital information anywhere, sensor networks will provide vast arrays of real-time, remote interaction with the physical world (Kannan, 2014).

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A DEA WINDOW ANALYSIS FOR ASSESSING THE EFFICIENCY OF BIOMASS ENERGY PRODUCTION IN CENTRAL MACEDONIA, NORTHERN GREECE

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Abstract

In this study a Data Envelopment Analysis (DEA) model was implemented in order to estimate the relative efficiency of the seven prefectures of Central Macedonia region in Northern Greece in biomass energy production; to propose a better allocation of inputs in each prefecture; and to evaluate whether a prefecture is operating at an optimal operation size. As inputs, the land available, the variable costs, the labour, the fertilizers and the tractors used are considered, while the only output in this model is the bioenergy produced from the conversion of biomass of agricultural residues. Furthermore, a DEA window analysis was performed for the period 2010-2015 in order to assess the efficiency of biomass energy production in Central Macedonia and its stability over time.

Keywords: *Relative efficiency, Data Envelopment Analysis, Biomass energy*

Introduction

The concept of organization of agro-energy districts and the promotion of relevant biotechnologies meets the main targets of EU concerning energy use and environmental sustainability. The new renewable energy directive, for at least 27% renewable alternatives to fossil-based energy sources and reduction of emissions of carbon dioxide up to the target of 40% by 2030 (EU Directive, 2016), render these agro-energy structures good potential allies for realization of EU environmental strategies.

A DEA model can measure the relative efficiency of decision making units (DMUs). Outputs and inputs of the same type used in the production process are compared, efficient and inefficient units are defined and the optimal combination of inputs and outputs is determined.

The aim of the present paper is the estimation of agricultural production performance at a regional level, based on Data Envelopment Analysis implemented for evaluation of relative efficiency and allocation of inputs used in the production process. Each prefecture, considered as a DMU, forms potentially an agro-energy region, where bioenergy by crops residues is produced. The DEA Window Analysis based on time series data in the period 2010-2015, estimated the changes in efficiency over time. The main advantage of this methodology is its capability to compare at the same time the performance of each prefecture in a particular period with its performance in other time periods, and at the same time with performance of other prefectures.

Founder of DEA methodology was Farell with his seminal work in 1957, succeeded by the influential study of Charnes et al. in 1978. Comprehensive treatments of this methodology is also available in Coelli et al.(2005), Cooper et al. (2007), Zhu (2009) and Fried et al. (2008).

Materials and Methods

This study developed a DEA model of input orientation, in its Constant Returns-to-Scale (CRS) and Variable Returns-to-Scale (VRS) form, employed to seven DMUs (prefectures), with five inputs and one single output considered, in order to estimate the technical (TE CRS) efficiency, pure technical efficiency (TE VRS) and scale efficiency (ratio of TE CRS to TE VRS). The seven prefectures are Imathia, Pella, Thessaloniki, Serres, Pieria, Chalkidiki and Kilkis. Inputs are land available in acres, variable costs (except labour and fertilizers) in euro, total labour used in hours, the total fertilizers in kgs and number of tractors used, while the only output considered is bioenergy produced from the conversion of biomass of agricultural residues related to main cultivated crops of each prefecture measured in MWh. Many recent studies addressed the production of bioenergy in the framework of agro-energy districts (Manos et al., 2014; Fantozzi et al., 2014; Tziolas et al., 2017)

The DEA model was performed for the year 2015 and the results are compared with DEA window analysis performed during the 2010-2015 time period. For the purpose of the analysis both CCR and VRS versions of the model were obtained and the scale efficiency was determined. The DEA window analysis was conducted in three windows of four years length each. The analysis of the first window is performed for the time period of 2010-2013 (W1), of the second window for 2011-2014 (W2) and of the third window for 2012-2015 (W3). The main difference of the two models is the number of DMUs considered. The DEA model uses seven DMUs ($n=7$), while DEA window model uses 28 DMUs ($n \times l = 7 \times 4 = 28$) for the analysis of each one of the three windows considered. The number of DMUs in DEA window analysis is a product of window length ($l=4$) and the number of DMUs used ($n=7$). So instead of comparing the seven prefectures in one year only, the window performance of each prefecture is compared with performance of other prefectures during four years of respective window length and at the same time. The DEA model used is the following:

$$\min z_k - \varepsilon \left(\sum_{r=1}^{s} p_r + \sum_{i=1}^{m} q_i \right) \qquad (1)$$

and is subject to the following m + s constraints:

$$z_k x_{ik} - \sum_{j=1}^{n} x_{ij}\lambda_j - q_i \geq 0, \qquad i = 1,2,.....,m$$
$$\sum_{j=1}^{n} y_{rj}\lambda_j - p_r \geq y_{rk}, \qquad r = 1,2,.....,s$$
$$\lambda_j, p_r, q_i \geq 0, \quad j = 1,2,\dots,n, \quad i = 1,2,\dots,m, \quad r = 1,2,\dots,s, \qquad z_k \text{ free variable}$$

where z_k is relative efficiency of prefecture k, p_r is auxiliary variable related to output r, q_i is auxiliary variable related to input i and λ_j is auxiliary variable that measures the distance from efficiency frontier of j prefecture.

Data was collected for the time period 2010 to 2015 from the General Directorate of Rural Economy and Veterinary of each prefecture, from Ministry of Rural Development and Food, and from Hellenic Statistical Authority. Crops related to the largest percentage of cultivated land of seven prefectures of Central Macedonia region are considered. Thermal and electric energy produced from agricultural residues, were quantified, based on the existing literature (Di Blasi et al., 1997; Gemtos and Tsiricolgou, 1999; Jolli and Giljum, 2005) and includes the measurement of yield of agricultural residues, of humidity percentage, of dry residues and biomass. Equations *(2)* and *(3)* are used to determine the thermal and electric energy produced, when boiler efficiency is considered 90% and 20% respectively. The energy is measured in MJ and converted to MWh.

$$TE = 0.9 \times Biomass\ (kg) \times LHV\ (MJ/kg) \quad (2)$$

$$EE = 0.2 \times Biomass\ (kg) \times LHV\ (MJ/kg) \quad (3)$$

where *TE* is Thermal energy production, *EE* is Electric energy production and *LHV* are lower heating values.

Results

The results obtained from the envelopment form of static DEA and DEA window analysis are presented in Tables 1 and 2.

Discussion-Conclusions

This study uncovered the inefficiencies in allocation of inputs in agro-energy regions in Northern Greece, in relation to the output of bioenergy that is potentially available from agricultural residues in these regions. These inefficiencies were quantified through input-oriented DEA window analysis that measures the productive efficiency of prefectures and allows the best practice relationship to be identified over time between multiple inputs and outputs.

The empirical results from the CRS version of the dynamic model revealed that all prefectures are below efficiency frontier over time and can improve their inputs allocation. The benefit from DEA analysis is that more efficient prefectures that have adopted the best practices and perform at the most productive scale could be a benchmark for producers for more efficient organization of their inputs and differentiation in crop preferences, when also environmental objectives define decision making process.

The results from both models showed stability over time in potential biomass production and with no significant shift in efficiency, which means that the preferences of farmers concerning crops selection remain similar related to the goal set. The dynamic model provides more realistic representation of aggregated data, because it is capable to discern better, due to many DMUs compared, the inefficiencies occurred overtime and not evident in the annual data analysis. The main form of scale inefficiency, revealed by the empirical results of the VRS DEA version, is determined as IRS and in a few cases as DRS. Variable returns-to-scale explain the condition when a change in all inputs by the same proportion results in an output change by a greater extent in the long run. So in case of DRS and IRS they are not operating at their most productive scale size and they have to increase and decrease respectively their operation in order to reach pareto optimality. The adjustment and better allocation of inputs is necessary for the inefficient prefectures so they can reach the efficient frontier and operate at most productive scale size.

The DEA window analysis is a useful tool for analysis of productivity and efficiency at a regional level because the evaluation is performed over multiple time periods at the same time. The modeling of bioenergy in the context of agro-energy regions, where collection and conversion of crop residues to bioenergy takes place, meets environmental standards and sustainability criteria as set out in the EU renewable energy directives and is an important policy tool for fulfillment of national action plans of member states for renewable energy.

Table 1 Relative efficiency by DEA CRS (2015) and DEA CRS Windows (2010-2015) compared in each prefecture

Technical Efficiency Score (CRS)	Window	2010	2011	2012	2013	2014	2015	Average per window	DEA window	Ranking	DEA	Ranking
Imathia	1	0.930	0.966	0.961	0.985			0.961	0.952	4	0.942	3
	2		0.965	0.960	0.984	0.988		0.974				
	3			0.891	0.903	0.978	0.915	0.922				
Pella	1	0.962	0.930	0.940	0.994			0.956	0.932	5	0.862	4
	2		0.927	0.936	0.991	1.000		0.963				
	3			0.843	0.892	0.901	0.862	0.875				
Thessaloniki	1	0.959	0.944	0.954	0.979			0.959	0.963	3	0.980	2
	2		0.935	0.944	0.970	1.000		0.962				
	3			0.940	0.964	0.996	0.974	0.969				
Serres	1	1.000	1.000	1.000	0.991			0.998	0.996	1	1.000	1
	2		1.000	1.000	0.991	0.992		0.996				
	3			1.000	0.990	0.990	1.000	0.995				
Pieria	1	0.711	0.692	0.718	0.747			0.717	0.725	7	0.752	5
	2		0.692	0.718	0.747	0.731		0.722				
	3			0.716	0.745	0.729	0.752	0.736				
Chalkidiki	1	0.810	0.793	0.814	0.817			0.808	0.797	6	0.704	6
	2		0.793	0.814	0.817	0.808		0.808				
	3			0.802	0.804	0.793	0.704	0.776				
Kilkis	1	1.000	0.980	0.992	1.000			0.993	0.992	2	1.000	1
	2		0.978	0.991	1.000	1.000		0.992				
	3			0.973	0.987	1.000	1.000	0.990				

Table 2 Projection for potential improvement of inputs DEA CRS (2015) and DEA CRS Windows (2010-2015) compared in each prefecture

DMUs	INPUT 1: Variable Cost (euro)			INPUT 2: Land (acres)			INPUT 3: Labour (hours)			INPUT 4: Fertilizers (kgrs)			INPUT 5: Tractors (number)			OUTPUT
Prefectures	Existent	Deviation % from Existent		Existent	Deviation % from Existent		Existent	Deviation % from Existent		Existent	Deviation % from Existent		Existent	Deviation % from Existent		Electric energy (MWh)
		DEA	DEA W		DEA	DEA W		DEA	DEA W		DEA	DEA W		DEA	DEA W	
Imathia	44,288,443	-57%	-47%	541,272	-6%	12%	20,628,335	-70%	-59%	24,877,167	-50%	-37%	10,300	-6%	4%	128,407
Pella	45,814,991	-47%	-35%	658,142	-14%	-6%	27,806,385	-70%	-52%	26,451,570	-43%	-30%	23,615	-46%	-39%	154,238
Thessaloniki	38,821,896	-23%	-27%	1,100,172	-2%	-14%	8,092,040	-2%	-16%	25,560,181	-13%	-21%	14,479	-11%	-26%	227,513
Serres	40,755,698	0%	2%	959,768	0%	27%	14,002,355	0%	-6%	25,543,073	0%	14%	21,621	0%	-16%	260,803
Pieria	13,701,804	-32%	-30%	398,078	-25%	-26%	9,920,141	-73%	-70%	8,746,715	-25%	-23%	9,876	-56%	-58%	67,437
Chalkidiki	15,421,194	-35%	-22%	660,745	-32%	-32%	15,561,361	-86%	-80%	11,684,772	-30%	-22%	7,320	-51%	-37%	84,685
Kilkis	19,289,125	0%	0%	867,893	0%	-4%	4,074,969	0%	-9%	15,909,941	0%	-4%	6,953	0%	-6%	163,763

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Posters

IRRIGATION FREQUENCY AND THE EFFECTS ON *ROSMARINUS OFFICINALIS*

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Abstract

Mediterranean ecosystems are characterized of a particular ecological importance, but they are facing restoration problems mainly due to their prevailing semi-arid climate. The aim of this work was to study the response of *Rosmarinus officinalis* under different irrigation frequencies. Specifically, the treatments were, one watering every two weeks, one watering every week and three watering every week. The studied variables were the morphological characteristics of the seedlings and their biomass allocation. According to the results the species was able to maintain its normal physiological condition for a month, even for the irrigation frequency of one watering per week. However, until the second month of growth, the frequent irrigation of three watering per week had a better response. Consequently, *Rosmarinus officinalis* is able to survive under low watering frequency for a month, with an optimum growth under the frequency of three watering per week.

Keywords: *Climate change, conservation, ecophysiology, nursery production, water stress.*

Introduction

Mediterranean ecosystems are characterized by their high biodiversity levels and their particular ecological significance. However, they face restoration problems due to the prevailing semi-arid climate (Mitrakos 1980, Scarascia-Mugnozza et al 2000, Rudel 2007). The most important factor that affects negatively the survival and growth of plants is drought, particularly during the summer months (Salvador et al. 1999). The percentage of soil moisture content is a critical factor for the growth and survival of plants. Plants help with the movement of water from the ground into the atmosphere through "transpiration" that is noticeably reduced under drought conditions. The ability of each plant species to respond to the availability of water is associated with morphological and physiological characteristics, with particular emphasis on the ability of a well-developed plant root system (Carlson and Miller 1990, Puertollas and Pardow 2003, Villar-Salvador et al. 2008). These characteristics could be very good indicators of drought and the ability of plants to survival (Keeley 1998, Sircelj et al. 2007, Mitchell et al. 2008, Ackerly 2004, Lambers et al. 2006).

Rosmarinus officinalis (rosemary) is a drought-tolerant, evergreen aromatic shrub and belongs to the *Lamiaceae* family (Al-Sereitietal 1999). Its height can reach up to 2 meters (Crivellaro and Schweingruber 2013). It can be found in the southern Mediterranean regions such as Greece (Al-Sereitietal 1999, Slamenovaetal 2002). The main objective of this study was to investigate the effect of irrigation frequency on the characteristics of *Rosmarinus officinalis* in order to benefit nursery practicies and regeneration efforts by conserving water while maintaining vigor plants.

Materials and Methods

Experiment conditions

The plants that were used for the experiment were three years old and were grown in 55x60x160 cm containers under standard nursery conditions under daily watering and weekly fertilization. The experiment was carried out during the autumn of 2015 and lasted for two months (from September to November, 2015) because this is the period that plants allocate biomass in their roots in order to acclimate for winter (Matsson 1986). The composition of the soil consisted from one part of perlite and three parts of peat (1-to-3). The experiment took place in the area of Amisiana in Kavala, under outdoor shaded conditions to fully control the frequency of the irrigated water by unexpected rainfall events. Prior to the beginning of the experiment, the plants were transplanted into larger pots of 110x120x320 in order to assess the potential of the root growth of the *Rosmarinus officinalis* plants during the experiment. In particular, the first treatment was a watering every two weeks; the second was a watering per week and the third was three watering per week. At the end of each growing month the species were harvested and evaluated.

Studied variables

The studied variables were measured during the first and second month of the experiment, with six plants being evaluated for each irrigation frequency. After the root systems of the plants were cleaned from the soil substrate, their characteristics were assessed. In particular, the number of leaves (NL), the number of lateral roots (NLR), the height (HGT), the root collar diameter (RC) and the length of new roots (MRL) were estimated using digital calipers. Continuously the plants were placed in a conventional oven for 24 hours at 80 °C (Wilson et al., 1999) to determine their dry weights through the use of an electronic scale (accuracy of 4-digits). In particular, the dry weight of the leaves (LDW), the stem (SDW) and the total above ground (UPDW= LDW+ SDW) seedling part were measured. Also, the dry weight of the tap root (TRDW), lateral (LRDW) and the newly developed roots (RGDW) and the total below ground seedling part (DWDW= TRDW+ LRDW+ RGDW), as well as the total dry weight of plants (SDDW) and the ratio of the above ground and below ground part of the plant (RUPDW= UPDW/ DWDW) were also measured.

The statistical analysis of the data was conducted by using the ANOVA analysis with the SPSS® statistical software v. 15.0 (SPSS. 2006). Data were tested for normality and homogeneity. The mean differences were tested with the Duncan's multiple range tests at significance levels of $p<0.01$.

Results

According to the results of the experiment there was a substantial effect of the irrigation treatments on the characteristics of the plants (figure 1 and figure 2). We notice that the treatments were effective only in the second month of the experiment. Specifically for the height (HGT), the plants with three watering per week had smaller height than the other treatments (Fig. 1). On the contrary, the number of leaves (NL) was higher for plants that were watered three times a week than the other more conservative watering treatments. Based on these results it is evident that the effect of treatments were more effective during the second month of the experiment for the height (HGT), the number of leaves (NL),the root collar diameter (RC), the new root length (MRL) and the number of lateral roots (NLR).

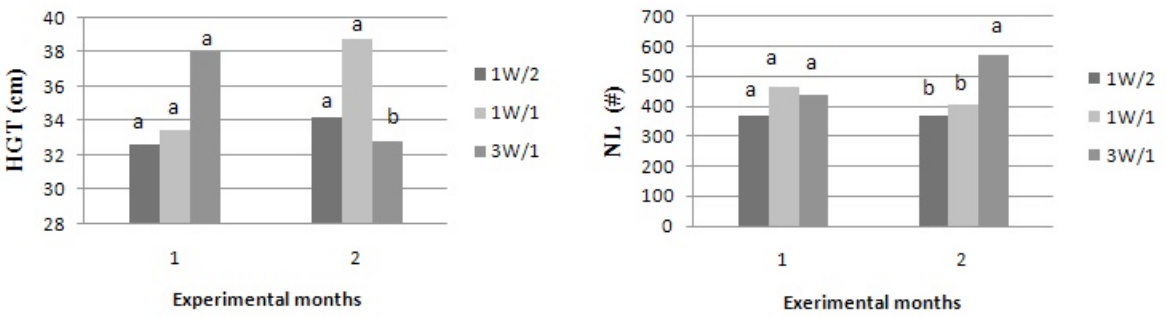

Figure 1.*Differences of Rosmarinus officinalis (above part) among irrigation frequencies for the first (1) and second (2) experimental months for the studied variables of Height (HGT) and the Total Number of Leaves (NL).*

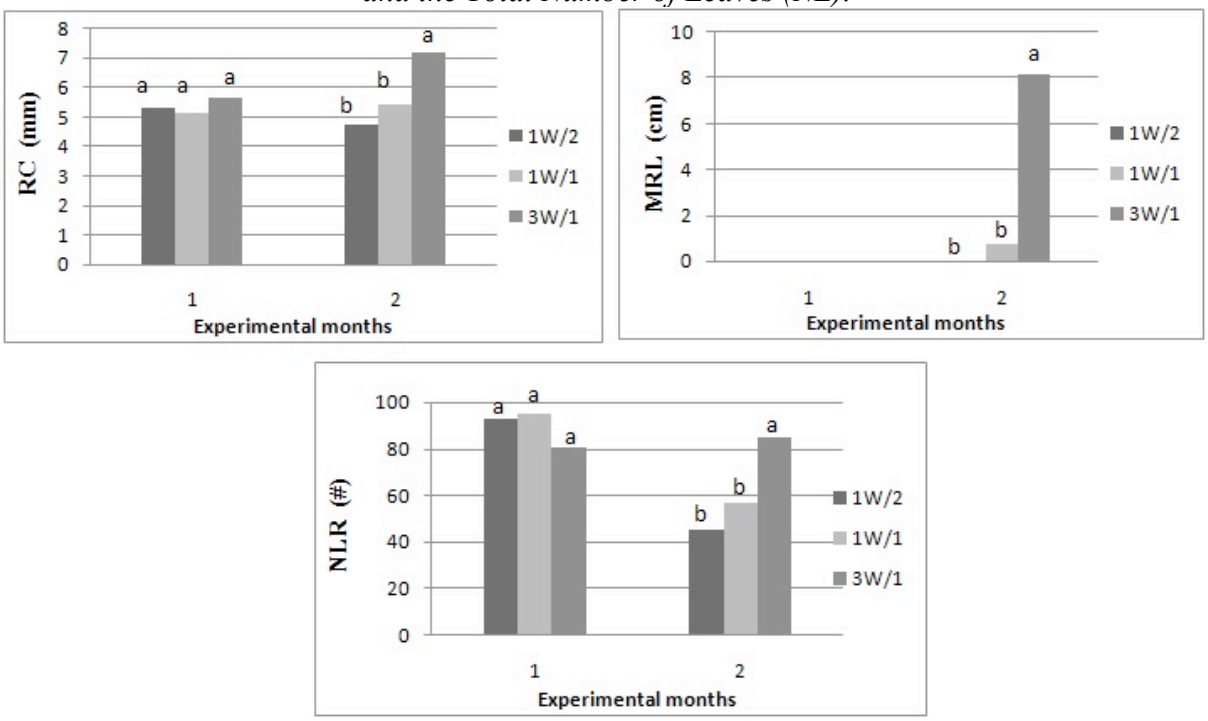

Figure 2.*Differences of Rosmarinus officinalis (below part) among irrigation frequencies for the first (1) and second (2) experimental months for the morphological studied variables of Root Collar (RC), Length of Max Root (MRL) and Number of Lateral Roots (NLR).*

Similarly, at the first month of the experiment, the root collar diameter (RC), the length of the new roots (MRL) and the number of lateral roots (NLR) did not differ among the irrigation treatments. However, at the second month of the experiment, the root collar, root length and the number of lateral roots were greter for plants that were watered three times a week (Figure 2). However, plants that were watered once a week had the ability to produce new roots (Figure 2). Also, in Figure 3 it is evident that at the first month the plants did not show a difference between LDW, SDW and UPDW, while at the second month the SDW and the UPDW were greater for plants that received the most frequent watering (three times a week).

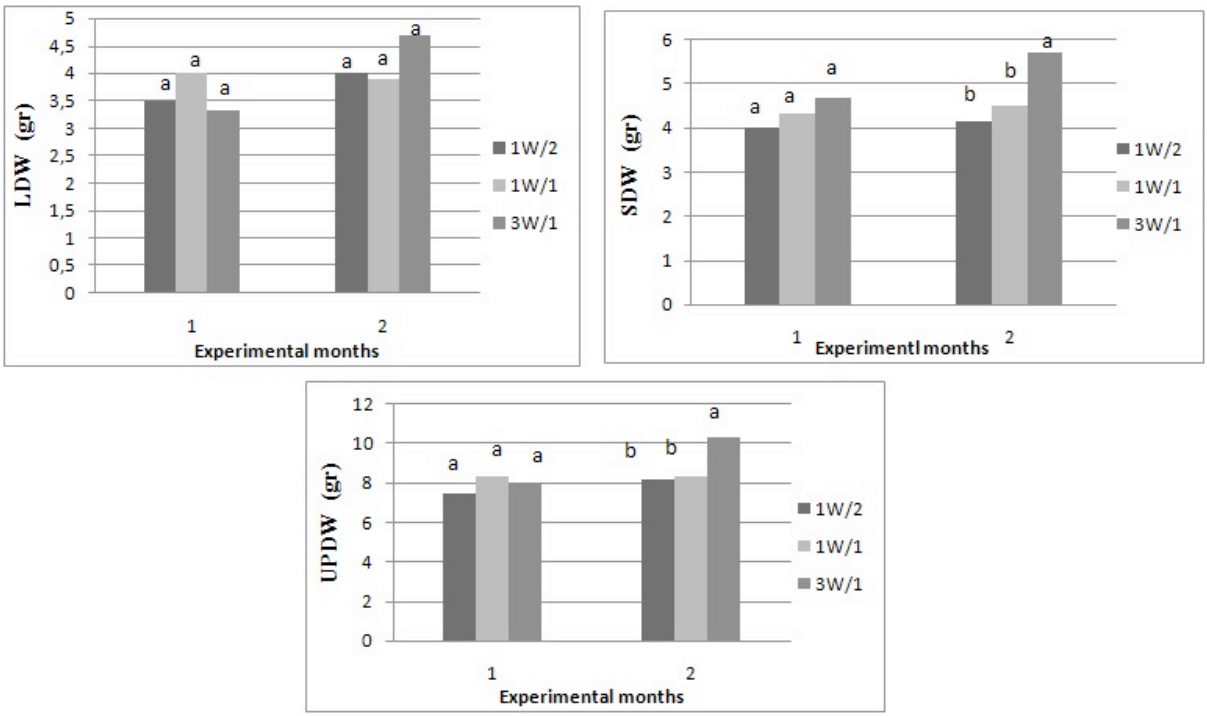

Figure 3. *Differences of Rosmarinus officinalis (above part) among irrigation frequencies for the first (1) and second (2) experimental months for the physiological studied variable of Total Dry Weight of Leaves (LDW), Dry Weight of Stem (SDW) and Dry Weight of Above Part (UPDW),*

The same growth pattern was observed for the dry weights of the bellow ground seedling parts. Specifically, there were no differences among the irrigation treatments at the first month, while at the second month, the plants that were watered three times a week had a greater root dry weight (TRDW), new root (RGDW), bellow ground seedling parts (DNDW), the lateral roots (LRDW) and total dry weight of plants (SDDW) (Figure 4). Only the ratio of the above ground and bellow ground seedling parts of the plant (RUPDN) had the smallest value for the treatment of three watering per week, indicating that this frequency produced larger plants with greater biomass allocation in the root systems. This shows that as the frequency of irrigation increases, so did the dry weight of the lateral roots.

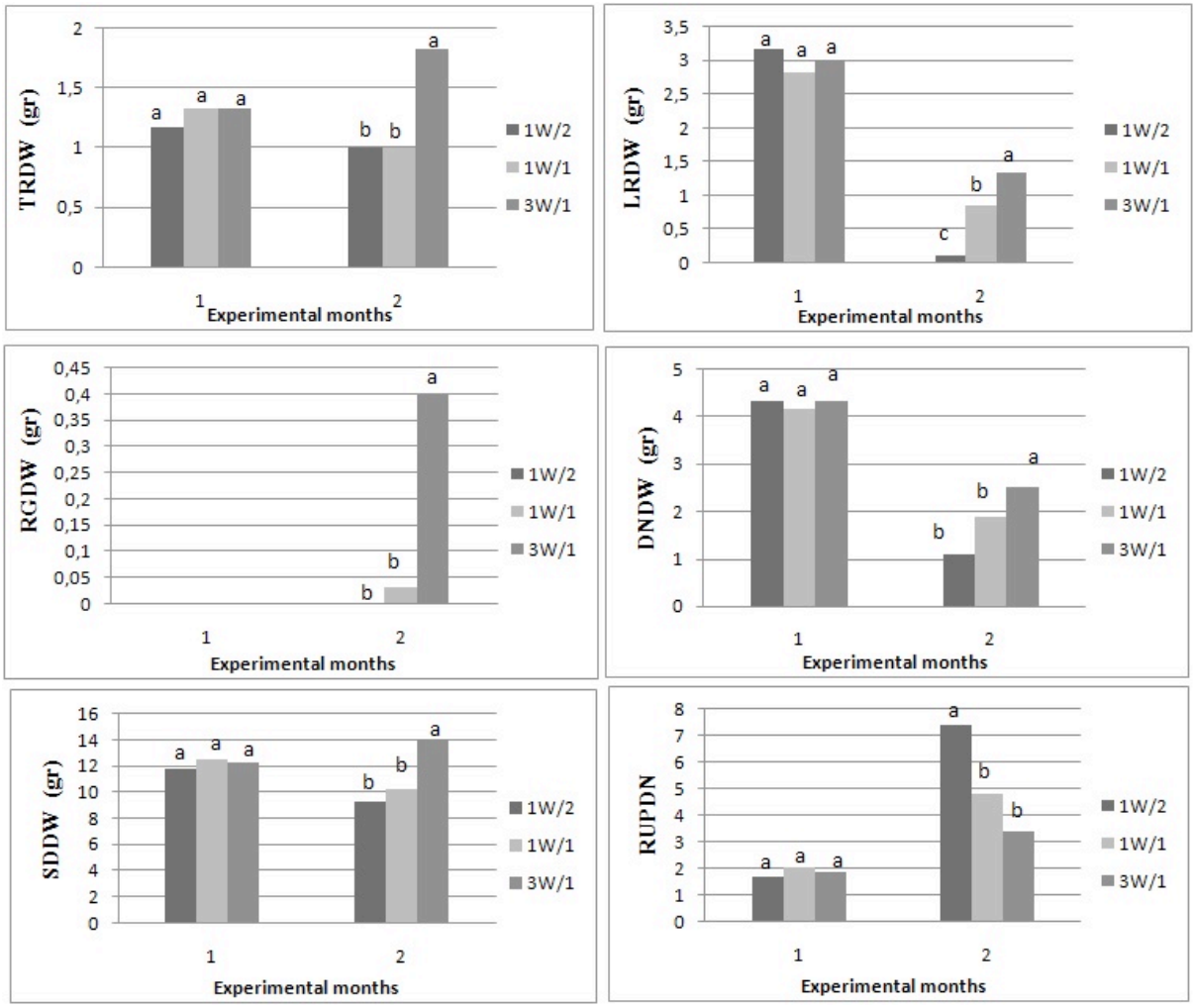

Figure 4. *Differences of Rosmarinus officinalis among irrigation frequencies for the first (1) and second (2) experimental months for the physiological studied variables of Dry Weight of Tap Root (TRDW), Dry Weight of Lateral Root (LRDW), Dry Weight of Root Growth (RGDW), Dry Weight of Down Part (DNDW), Dry Weight of Seedling (SDDW) and the Up-Down Ratio (RUPDN).*

Discussion-Conclusions

According to the experimental results, the effect of irrigation frequencies was more profound during the second month of growth. This shows that for the period of one month the species of *Rosmarinus officinalis*, even for a n irrigation frequency of one watering every two weeks, was able to cope with reduced water supplies and maintain its physiological condition according to the evaluated seedling characteristics. However, after the period of one month the results indicated that the plants were facing difficulties in coping with the adverse watering growth conditions of one watering every one or two weeks.

Therefore, in the second phase of the experiment, the effects of water scarcity on the characteristics of plants were more evident. *Rosmarinus officinalis* had better growth with frequent watering (three times per week) as opposed to the other two treatments (one watering per week and one watering per two weeks) for the variables of height (HGT), number of leaves (NL), root collar diameter (RC), new root length (MRL) and number of lateral roots (NLR). Therefore, for these simple variables, the two-month interval was necessary to detect the effect of irrigation treatments on these plants characteristics. Only the ratio of the above ground and bellow ground seedling parts (RUPDN) had the lowest value for the treatment of

three watering per week. Consequently, there has been an increase in the bellow ground biomass of the plants by reducing the frequency of water supply, which is consistent with cited literature that was conducted for forestry species (Iakovoglou and Halivoloulos 2016). This showed that as the watering frequency increased, more biomass was allocated in the root system of the plants. For the species of *Pinus halepensis* it has been indicated that for the experimental duration of one month, watering once every two weeks resulted in better root growth potential. The results might differ from our study due to the altered experimental conditions (field vs laboratory) and the analyzed species in each study (*Rosmarinus officinalis* vs *Pinus halepensis*) (Symplex 2014). Consequently, the species-effect should never be neglected since it highly affects the experimental results.

Further, the MRL indicated intresting results, where the plants that were watered three times a week had the largest root length and were able to produce greater amounts of new roots (Fig. 2). This indicates that for the species of *Rosmarinus officinalis* that is considered drought tolerant, it can withstand water stress for at least one month without a noticeable negative effect on the physiological state of the plants. However, after the period of one month, the plants needed at least one watering per week in order to maintain their normal growth. Further, for this species, the three watering per week were ideal for the normal growth of plants for the duration of two months, with increased ability to grow new roots; a characteristic that will allow the species to further explore nutrients and water to maintain its physiological status.

In all of the above variables, it seems that the increased watering frequency plays a dominant role in the plant growth, so as water availability decreases it adversely affect its morphological and physiological characteristics of the plants. Therefore, the results of the experiment showed that *Rosmarinus officinalis* was able to survive under unfavorable drought conditions for one month with a watering frequency up to once every two weeks. However, until the second month of the experiment, watering once every week and every two weeks led to negative effects on the plant growth. So, three watering per week were adequate to maintain the growth of the plants and their ability to develop new root systems which is an important characteristic for their survival. However, these results cannot be generalized for all species. Therefore, further research on the effects of irrigation frequency is needed to have a holistic view for the Mediterranean flora species in order to save irrigation water while increasing the transplanting success.

Acknowledgements

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PALYNOMORPHS STUDY OF MYRTACEAE FAMILY IN ELBASANI TOWN - ALBANIA.

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Abstract

The study is done in Elbasan city. This town is positioned in the middle of Albania. It is one of the biggest cities of Albania, with a population of 120,000 and an area of 1,290 km². This study gives some palynological data about the dispersion of *Myrtus* Type, part of Myrtaceae family in depositions of last XX centuries (last historic period of New Holocene, last Quaternary, in the area where is positioned Elbasan city. The goal of this paper is to present the correlation between the depth and dispersion of Myrtaceae family on different periods of time. For this aim we took some samples from various layers of soil, starting from the surface to four meters depth. Paleopalynological data for this family were provided for the first time in the Albania's literature. Getting started to the test of these samples we found out several interesting data that showed clearly the correlation between the depth and number of spores and pollens for this family.

Key words: *Palynological, Myrtaceae Family, New Holocene, spore, pollen.*

Introduction

Palynology is the science that deals with studies of the pollens, spores, acritarchs, scolecodonts, chitinozoans, above all this science includes the study of current and fossil palynoforms. (Faegri and Iversen 1989, Davis 1999). Palynology is an Interdisciplinary Science, linked above all to biological sciences and also geology, particularly moreover of botanical science. (Pacini and Franchi 1978, Kapidani 1996).

The given material presents palynological problems of Holocene deposits in Elbasan city. There is no kind of study by neither native or foreign authors for spore and pollen content data in Holocene deposits in our city and microfossils plants have not been studied previously from any of the localities in Elbasani town. (Kapidani 1996, Kapidani and Jançe 2004, Jançe 2015).

Our study attempts to reconstruct the flora and vegetation and finding possible links to the impact of climatic and human factors in plant and environmental history of the Elbasan city in the anthers analysis fossils belonging to the last period of 20 centuries of our era. Comparison of plant spores and pollen present in those primitive, allows judging the performance of primitive and specialized features of outer wall of the grains, and their evolutionary paths (Pacini and Hesse 2005).

This study in Quaternary deposits also provides important information about the reconstruction of paleoflora, paleoclimate, stratygraphy of the Holocene, etc. The study provides the factors which have their impact on the potential transformation of the flora in Elbasan city, focused on evolution of Myrtaceae family. (Moore and Webb 1978, Shalla et al. 1983, Forest 1999, Kapidani and Jançe 2004, Jançe and Kapidani 2011, Jançe 2015).

The quantitative data through spores and pollens variety of Myrtaceae family deposited on the underground, shows the direction of evolution of this family mentioned in the study. (Muhameti et al. 1984, Kapidani 1996, Kapidani and Jançe 2004, Jançe 2015).

Materials and methods

Palynologic analyses are most commonly used and most accurate for paleoclimates and paleoecologic studies of Quaternary period (Huntley and Prentice 1993, Allen et al. 2000, Lotter et al. 2000). Through these data are provided for the transformation of the natural environment and human impact of this transformation (Behre 1981, Miras et al. 2004, Court-Picon et al. 2005). During this study we have taken 16 soil samples, starting from 4 meters of depth to 0.25 m. The distance between the sampling stations is 0.25 m. We collected sediments that contained an assemblage of fossil pollen

and spores. Basically all the extraction ways, join in principle methods of physical and chemical processing of 1 cm3 sediment (Faegri and Iversen 1989).

The method of acetolysis of Erdtman.

The soil sampling is based on Erdtman method (Erdtman 1960, 1969). Erdtman acetolyze method consists on processing the material by mixing concentrated acetic acid (glacial) $(CH_3COO)_2$ with sulfuric acid (H_2SO_4) in 9:1 rapport. In order to get better results first mix 1cm^3 soil with 10ml KOH (10%). After that we cleaned it with distillated water, and then we mixed it with acetolyze solution, until a neutral environment is obtained.

After that the precipitate is mixed with glycerin and observed on 1000x magnification microscope. The acetolyze method is widely used in palynology, it gives better visibility over the spores and pollens compared with the other methods used during the microscopic observation process. (Erdtman 1969, Moore and Webb 1978, Davis 1999, Kapidani 2005, Jançe and Kapidani 2011, Jançe 2015). We then use this method to assess the paleoclimate and paleoelevation represented by the assemblage and will discuss the results in terms of their implications for the uplift history of the Elbasan region.

Fixture of prepared samples.

The fixture of samples prepared with the method of the above-mentioned was realized by based on the method of glue-preparations by gel-glycerin. The gel-glycerin was prepared in the Kisser method (Kisser 1935) by using 50 gram of gelatin, 175 ml of distillate water, 150 gram glycerins, 7 gram phenols (crystals). Distillate water was warm up to 50°C and the gel was immediately added in.

Results and discussions

On table 1 are presented the data about the number of spores for Myrtaceae family according to the depth. Also is presented and the total number of spores for this family.

The maximum number of spores of Myrtaceae family (34 spores per sample) is taken in 0.25 m of depth while the minimum number, 19 spores, is taken exclusively in the deep samples, respectively under 4 m of depth.

Table 1. *Number of spores according to the depth*

Sample	Depth (meters)	Number of spores (Myrtaceae)
1	4	19
2	3.75	21
3	3.5	22
4	3.25	23
5	3	28
6	2.75	21
7	2.5	20
8	2.25	21
9	2	22
10	1.75	28
11	1.5	29
12	1.25	27
13	1	29
14	0.75	28
15	0.5	32
16	0.25	34
Total number of spores		404

On figure 1 is clearly shown the sustainability and the easy upward trend of number of spores of Myrtaceae family from the bottom near to the surface, also is clearly shown the increasing number of spores for this family above all near to the surface. Based on the data presented in table 1 and figure 2 the spore's total number of Myrtaceae family is 404 spores. (Figure 2).

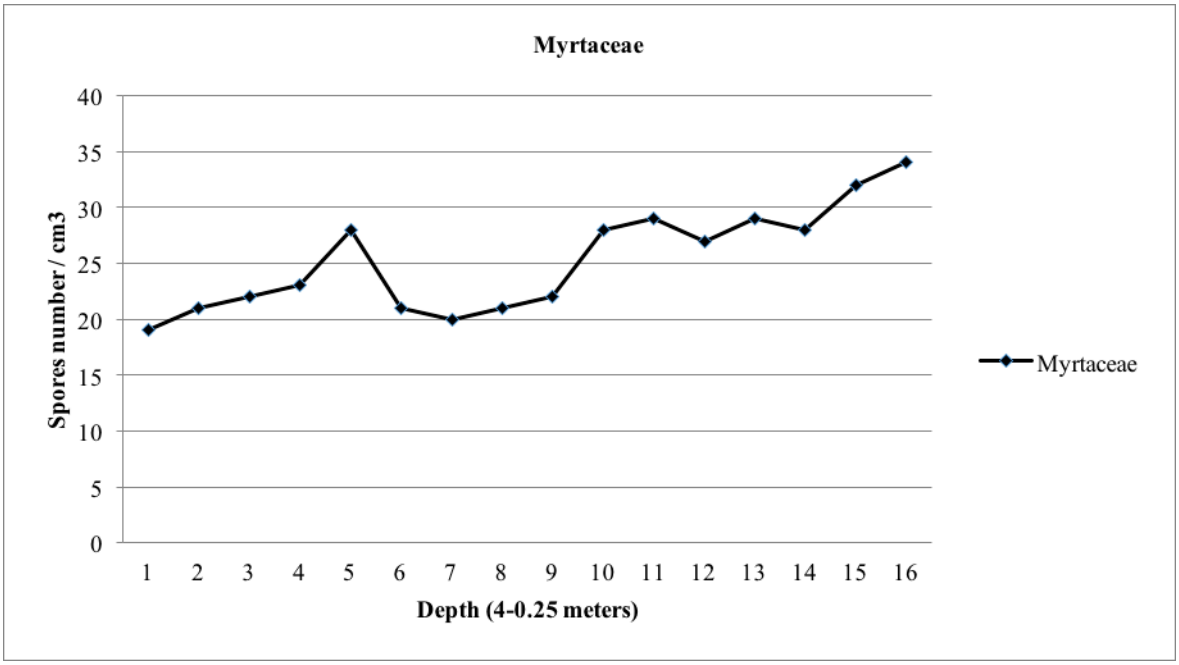

Figure 1. *The spore's dispersion of Myrtaceae family according to the depth*

In sample 10 and 15, the number of spores for Myrtaceae family **undergoing** an immediate increase. (Photo 1). The data show that the increase of the representative's presence of family Myrtaceae near to the surface should be associated with human impact for the transformation of the natural landscape through cultivation of useful and ornamental plants in Elbasan city (Jançe 2015). As shown in Figure 1, all Myrtaceae family forms, especially the *Myrtus* Type from the bottom toward the surface are present and tend to increase their overall presence.

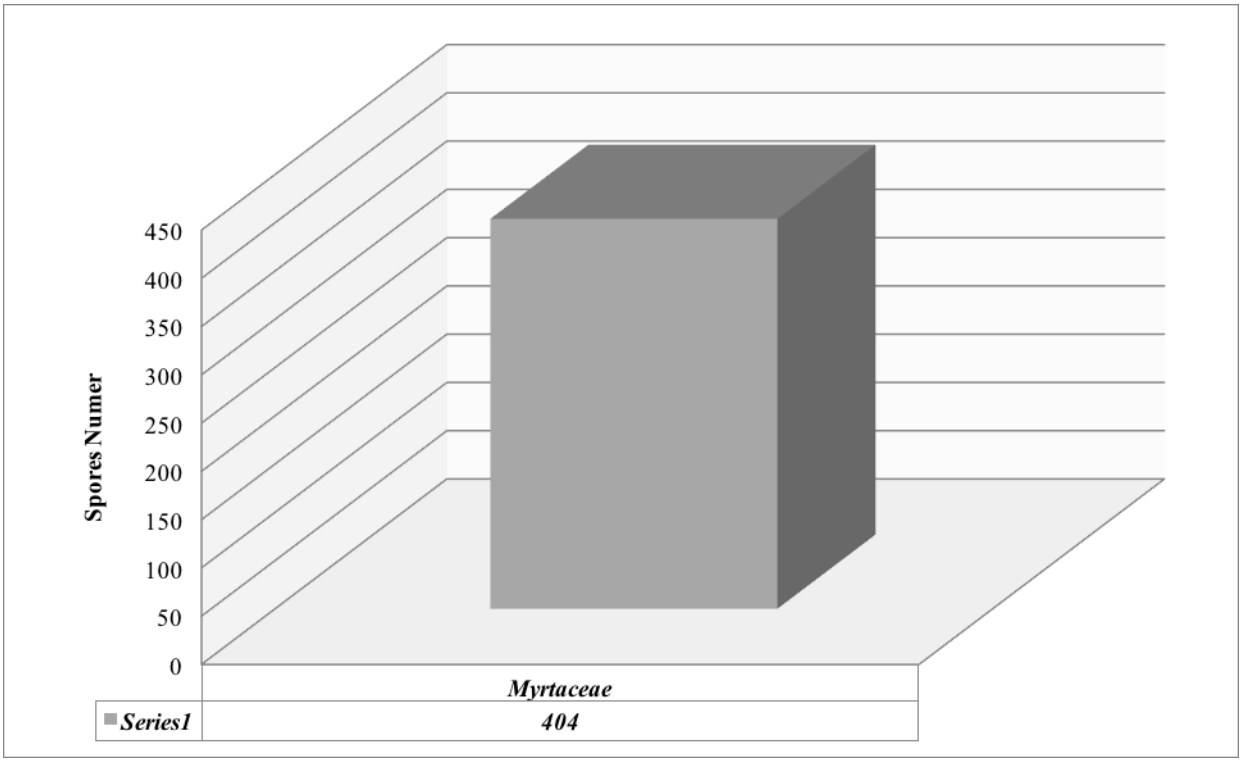

Figure 2. *The total number of spores according to Myrtaceae family*

One of the reasons for this increase may be related to the fact that new forms of pollen are stored better than older ones to meet the depths samples. But in this storage may have affected the ecological factors. Myrtaceae is the myrtle family, a family of dicotyledonous plants placed within the order Myrtales. Myrtle, pohutukawa, the bay rum tree, clove, guava, acca, allspice, and eucalyptus all are members of this group. All species are woody, with essential oils, and flower parts in multiples of four or five. (Johnson and Briggs 1984).

Interesting is the fact that the samples matched depths approximately 2-1.5 m with years 900 to 1200, the number of pollen is smaller than in years about it, despite the general trend of their growth. Unable to find data on climatic factors, are supported in medieval history of Albania (Hasanaj et al. 2004, Jançe 2015), in which it is alleged that this period was associated with wild wars of extermination of the Bulgarian and Serbian occupation where the population the area is greatly reduced and the city loses the economic importance. Given the presence of particles carbon micro grains in the sample we believe that herbal landscape of the city of Elbasan, as a result of the war would have suffered devastation from massive burns and consequently for its reconstruction probably had plenty of time.

Myrtus communis, the "common myrtle", is native across the Mediterranean region. The plant is an evergreen shrub or small tree, growing to 5 metres tall. The leaf is entire, 3–5 cm long, with a fragrant essential oil. *Myrtus communis*, is widely cultivated as an ornamental plant for use as a shrub in gardens and parks. Because of its elegance of habit, appealing odour, and amenity to clipping by the topiarius, the myrtle was an indispensable feature of gardens. (Wilson et al. 2005).

Elbasan city crowns today is mainly composed of olive plantations associated with fruit trees and a rich vegetation grass, the major part of which is cultivated. The impact of human activity is the main cause during the crowns and the landscape transformations of Elbasan city.

The presence in all samples of *Myrtus* type also allows us to believe that regardless to the economic growth of what may have been the Elbasan city, the shrub of *Myrtus* have always been present at any time and throughout the town.

Conclusions

- The representatives of Myrtaceae family, in particular *Myrtus* Type, are always present to for depth 4 meters up the surface.
- The spore's numbers of Myrtaceae family from the bottom toward the surface, tend to increase their overall presence.
- In all depths samples meet particles of carbon micro grains as evidence of fires.
- The presence of the palynomorphs of *Myrtus* Type at all the stations and at all the depths, allows us to judge that: the *Myrtus* shrub have been constantly always present in the space of the Elbasani town, being cultivated mainly as an ornamental plant.

Appendix 1. Microscopic photos

Photo 1. *Myrtus Type Pollen (Source: Jançe 2014).*

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RFID TECHNOLOGIES AND WOOD SUPPLY CHAIN

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Abstract

This paper examines the innovative Traceability System of Radio Frequency Identification (RFID) in forestry and the wood supply chain. RFID is an enabling technology that is being increasingly used and promises to produce value through better prominence in the forestry wood value chain network, advanced product velocity, further efficient transportation management and enhanced quality control. It is very supportive and makes the whole procedure of the wood supply chain easier, once the objective of the supply chain of wood is to minimize the cost of the cut until the point of sale at the right time. There are several alternatives particularly computer-based information systems for traceability from latest studies, but the RFID technology is the most promising method for marking logs at this moment. The aim of the paper is to describe the RFID technologies used in forestry and the wood supply chain, and display its use and how it is connected with the supply chain.

Keywords: *RFID, supply chain, Traceability Systems, wood, forestry*

Introduction

Nowadays wood is treated as bulk material in the forestry wood supply chain and it has to be graded in the final stages of the production process to find out if it meets the demands of the customer. By using the new innovative technologies, such as RFID to identify the individual objects in the supply chain we can enable the pull model for the wood material. Traceability in general and RFID specifically, improve control over the flow of wood and the follow-up of the processes of the supply chain. The more accurate and complete information about the wood origin and the processes allows big improvements in the supply chain (Sirkka 2008). The concept of traceability is defined in accordance with ISO 8402 as "the ability to retrieve the history and use or location of an object or activity with registered identification". This involves two main aspects: on the one hand, identification of the product by marking and on the other, the recording of data regarding the product all the way along the production, processing and distribution chain. The application of traceability to the wood industry has been delayed due to the limits of automated identification systems in relation to the nature of the wood and the characteristics of the production processes. The idea of traceability came to the forefront with the tropical forest management in the early 1980s and the growing global awareness of environmental issues (FAO, 2016). Radio Frequency Identification (RFID) is an enabling technology that is being increasingly used and promises to produce value through better prominence in the forestry wood value chain network.

Wood Supply Chain in Forestry

Wood supply chain in forestry, can be defined as a network of autonomous or semiautonomous business entities collectively responsible for procurement, manufacturing and distribution activities of the product. The problem of non-optimal use of resources can be solved by introducing the real-time traceability solution for the material flow. The wood supply chain is a facility network procuring forest raw materials, transforming them into intermediate goods and final wood products which are delivered to end customers through a

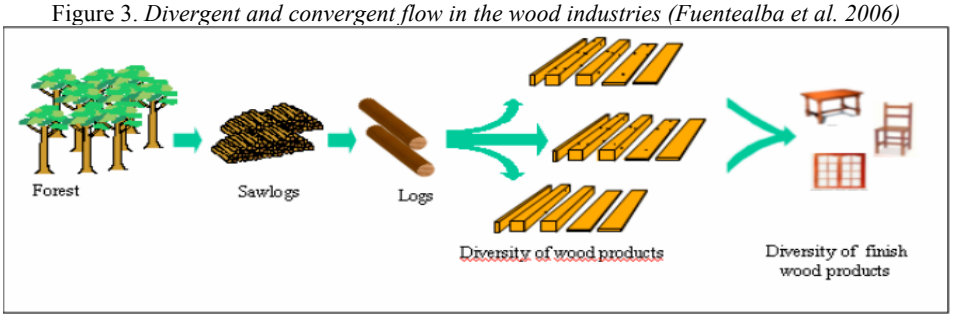
distribution system (Appelhanz et al. 2016). The forestry wood supply chain is a complex process. In fact, each provider involved in the wood supply chain can take independent decisions. The objective of the supply chain of wood is to minimize the cost of the cut until the point of sale at the right time (Tzoulis et al. 2014b). For this reason it is extremely useful the analysis of the levels of the supply chain related to timber harvesting, moving, storage in forest and transport of forest products to processing plants. The management of the supply chain of wood is designed to manage more than a database with an abundance of numerical and quality data but also spatial data and data should be managed with an information decision support system (Andreopoulou et al. 2012).

Traceability

Traceability, under EU law, means the capability to track any product, throughout all phases of production, processing and distribution (Tzoulis et al. 2014a). The ability to perform and track the whole follow-up of products in industries has been doable with the implementation of information systems, of automatic identification, which create a link between the product, the database of the product and of process. The productivity and profitability of forest timber supply chains are expected to increase rapidly by implementing the tools and methods of precision forestry (Holopainen et al. 2014). Tracking of tree logs is an economic requirement to map the ownership of each log (Schraml et al 2016). Better complete control of the information and material flows might improve the efficiency of production in the forestry network and minimize environmental impact (Häkli et al 2010).

Traceability systems (TSs), provide accurate and consistent information about material flows and processes through the supply chain. Each stage in harvesting operations must be recorded and then entered into a general traceability database. Perfect traceability that goes back to the original individual tree is not generally sought, given the complexity of the chains of operations. Indeed, during the next processes (figure 3), effects due to: the loss of raw material in the cutting steps, the diversity of products, the divergent character at the beginning and convergent at the end of the process, and the high implementation cost, have led to slow down implementation of the fore-mentioned techniques (Fuentealba et al. 2006).

Figure 3. *Divergent and convergent flow in the wood industries (Fuentealba et al. 2006)*



A supportive traceability system relies on being able to track product one step forward and one step back at any point in the supply chain. In order to follow-up products, new solutions have been considered by the use of nondestructive control techniques (Tzoulis et al. 2014a). Traceability of wood products is more and more relying on high technology systems. These information systems cover data on the source and movement of wood throughout harvesting area until its final destination. The exceptionally changeable nature of wood, such as knots and cross grain, helps the existence of exclusive characteristics that can be used as a model of recognition (Charpentier and Choffel, 2003). It is important to achieve detailed tracking of the log production and movement of timber and wood products aiming to guarantee the legality

of the product (Tzoulis, et al. 2015). The aim of the paper is to describe one of the most important sections of traceability, the RFID technologies, used in forestry and the wood supply chain, and display its use and how it is connected with the supply chain. This would be beneficial, through the supply chain, providing enhanced quality for wood and its products, from legal sources.

Materials and Methods

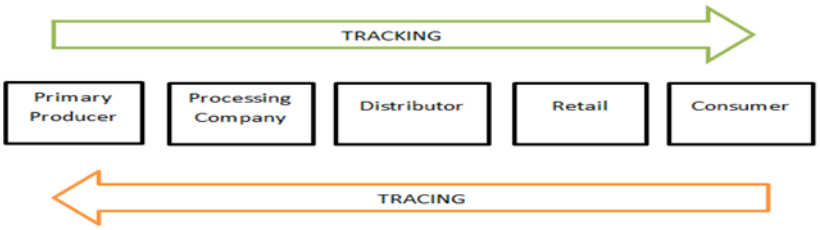
Innovative Traceability System of RFID in forestry and the wood supply chain, are reviewed in addition to new information, in order to improve the function of the supply chain of wood and also add value and reliability to the wood. We did a major review in Traceability Systems and especially the use of RFID. Furthermore Wood Supply Chain is investigated and the connection points with traceability methods. In our review we observe that Traceability is essential to increase the value of supply chain operations, for the reason that it provides accurate and consistent information about material flows and processes through the supply chain. Radio Frequency Identification (RFID) is an enabling technology that is being increasingly used and promises to produce value through better prominence in the forestry wood value chain network. Several advantages of RFID-based tagging systems over other visual coding systems are displayed. Results regarding the use of RFID through the supply chain of wood are summarized in a schematic representation.

Results - RFID Traceability System

Traceability, in our paper with the use of RFID, is important for many reasons such as wood value chain maximization. It increases the end product quality by optimal use of resources when allocate the right raw material for the right final product (Möller, 2011). RFID traceability system, improves control during the wood processes in the supply chain by providing the accurate and complete information about the wood origin. More specifically, to locate a product, we must link information and wood movements though the forestry supply chain from origin to destination to be traced back. Emerging traceability technologies in general, and RFID specifically, function as a means for communication, making information accessible along the supply chain, thus, deficient management among these links creates a gap in the information chain and a consequent loss of traceability (Tzoulis et al. 2014a).

Traceability is essential to increase the value of supply chain operations. There are several traceability definitions in the literature. For example, in (Sirkka 2008), the author defined traceability as the tracking of dynamic interactions between process and objects. Moreover, traceability provides means to verify the chain of custody and the origin of the timber (Häkli et al 2010). Traceability is the way by which we can make information available at different stages along the forestry-wood production chain (Björk, et al. 2011). Figure 1 is showing where tracking sends information forward and tracing enables you to go back to find the origin (Schwägele, F. 2005):

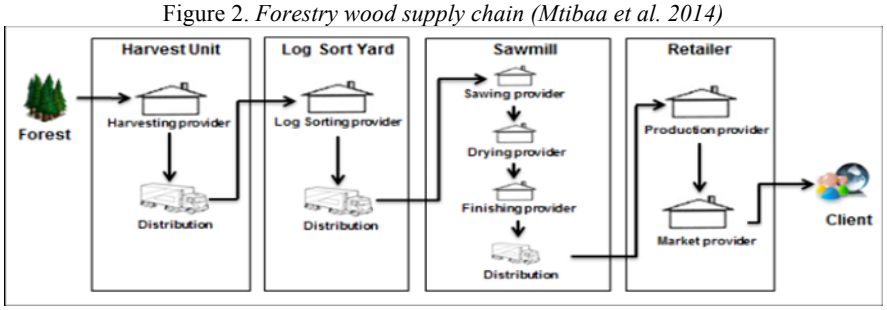
Figure 1. *Tracking and tracing along the supply chain (Schwägele, F. 2005)*



Radio Frequency Identification (RFID) is an enabling technology that promises to create value through greater visibility in the forestry wood value chain network, higher product velocity, more efficient transportation management and improved quality control. In the forest sector case the object is wood and any product based on wood after transformation (Mtibaa et al, 2014). RFID use radio waves and allow the automatic identification of data that carry smart RFID tags. RFID tags can be automatically tracked by fixed or portable readers and without having to be scanned serially. RFIDs are simple to hide or fit in other items. The RFID tag can be affixed to an object and used to track and manage inventory, assets, wood, etc. (Várallyai, 2012). The RFID technology is the most promising method for marking logs at this moment. RFID technology has a number of advantages when compared to the other marking methods in the forestry: line of sight is not needed, the reading can be done over a distance allowing highly automated identification, the transponders are not sensitive to dirt or moisture, and there are a large number of unique identification codes or memory for coded data.

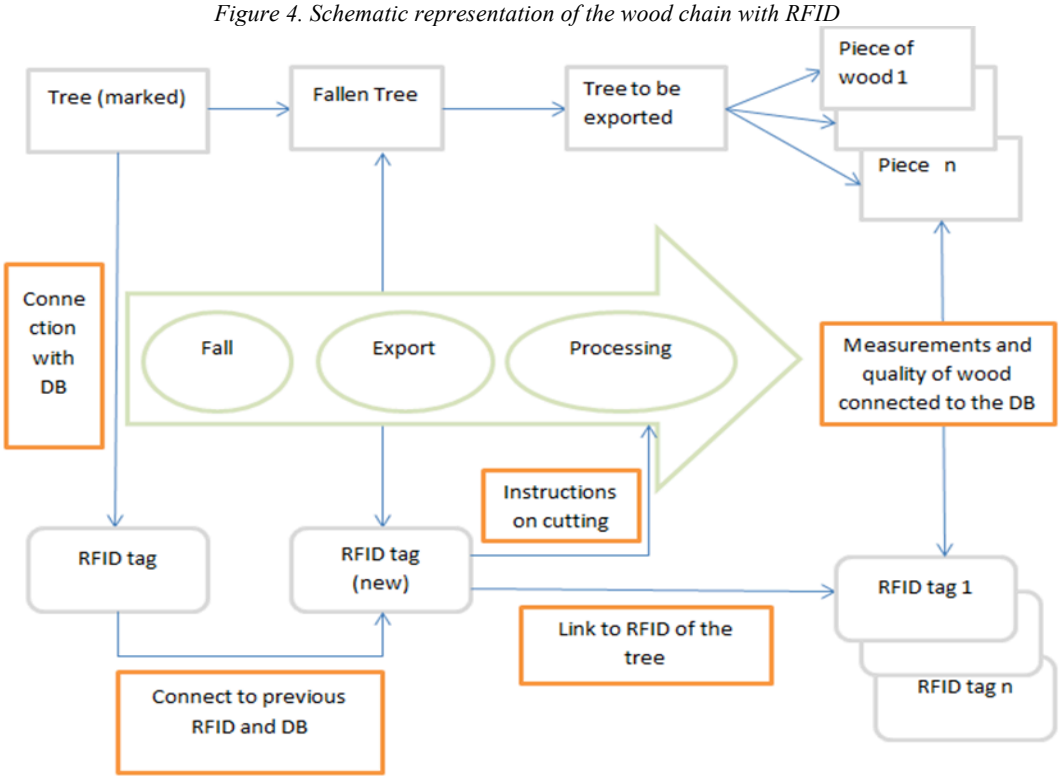
The key for implementing this control is the identification and traceability of the wood products through the value chain. The forestry wood supply chain has a concern with allocating the right raw material for the right final product. This is caused by the following facts: Firstly, the supply chain is not continuous and consists of many steps. Secondly, the biological raw material is very complex. Accurate data is collected during every step but most of this data is lost later in the supply chain (figure 2). The core problem is to acquire product and production information for each item and enable utilization of this information through the supply chain.

Figure 2. *Forestry wood supply chain (Mtibaa et al. 2014)*



The traceability of timber throughout the whole supply chain, with the use of RFID for log marking, may increase the degree of automation of the log inventory, reduce the need for repeated measurements of the timber and increase the overall efficiency, with evident economic benefits (Häkli et al. 2010). RFID-based tracing of logs was identified as a suitable approach for tracking the movement and fate of logs in the wood supply chain, as we present the whole procedure in the figure that we created (figure 4), from the point of harvesting to their eventual destruction at the sawmill when the logs are cut into boards. The tags should have to be accurately readable and reliably at some distance and in all weather conditions. The full potential of RFID marking, particularly when used for transmitting instructions, can be expressed only if the reliability of the system is high.

Figure 4. Schematic representation of the wood chain with RFID



RFID-based tagging systems have several advantages over visual coding systems, for instance:

- In-line code reading with no time cost as items pass through an RFID reader gateway
- The potential to integrate RFID readers into existing machinery and
- The code cannot be tampered with or changed in a way that makes it impossible to read.

Radio frequency identity tags can be read-only or read-write, and can be programmed in the field or in advance. They are passive in that they only transmit data when 'excited' by a signal from an appropriate reader. Aiming to automatic identification and tracking, radio-frequency identification (RFID) uses a wireless non-contact system with radio-frequency electromagnetic fields for data transmission from a tag, in a product. The automatic application must be very tough with a minimum of production disturbances. The current trend is positive for the RFID technology and generally the cost per tag is expected to decrease (Tzoulis et al. 2014a).

Conclusions

This paper has examined the innovative traceability System of RFID, in order to improve the function of the supply chain of wood and also add value and reliability to the wood. Products based on RFID technology, would mean improve the quality and the logistics of the chain and offer therefore, environmental friendly and cost-effective solutions to optimize the production flow. It is certain that a comprehensive monitoring of every stage of the supply chain of production is essential to guarantee the success of a system applied. The forestry industry presents some unique challenges for traceability solutions. The data is used in the supply chain so that the information is typically produced by one party and the information has to be used by another party. The future evolution of traceability based on RFID should focus on further improving the reliability of localization close to 100% for all logs of wood.

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ESSENTIAL OIL EXTRACTION FROM *Pinus Halepensis* Mill. AND CHARACTERIZATION BY SPECTROSCOPY TECHNIQUES

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Abstract

Balkan countries are recognized as a hotspot of rich biodiversity and biocultural heritage.The mountainous relief in combination with Mediterranean climate are the key factors for having such an ecosystem variety and biodiversity. Balkan counties are also home to a large number of aromatic and medicinal plants. *Pinus halepensis*, also known as the Aleppo pine; it is native to the Mediterranean region. It is one of the many trees that are well known for their medicinal properties, as well as for their economical significance. In this work essential oils/extracts of *Pinus halepensis* needles were acquired by hydro-distillation (Clevenger type) and Soxhlet extraction. The pine oils were analysed by FTIR spectroscopy and UV-Vis spectrophotometry aiming the identification of the main chemical constituents of the oil extracts of Albanian pine needles. FTIR analyses indicated presence of cariophyllene and pinene as the main chemical constituents in the essential oil of pine needles.

Keywords: *Pinus Halepensis* Mill. extracts, Soxhlet and Clevenger extraction, FTIR spectroscopy, UV-Vis spectrophotometry.

Introduction

The Balkan countries are becoming increasingly recognized as a hotspot of rich biodiversity and biocultural heritage (Kathe *et al.* 2003, Pieroni and Quave 2014*)*. Albania, Greece, Bosnia-Herzegovina, Bulgaria, Croatia and Romania are remarkably rich in their biological, ecological and landscape diversity and are home to a large number of herbs, medicinal, cosmetic and aromatic plants (MAPs) (Kathe *et al.* 2003, Metaj 2007, Pieroni and Quave 2014). In particular, Albania possesses a wide range of ecological systems including coastal zones, lagoons, lakes, wetlands and alpine vegetation (Kathe *et al.* 2003, Metaj 2007, Pieroni and Quave 2014). Medicinal and aromatic plants (essential oils extract) have a long history of importance in the culture and traditional knowledge of Albania. About 30 % of all known European plant species occur in Albania (Kathe *et al.* 2003). In particular, Albania is a large producer and exporter of salvia species (Schmiderer *et al.* 2013).

Pinus halepensis (Pinaceae), also known as the Aleppo pine, is native to the Mediterranean region (Abi-Ayad *et al.* 2011)[1]. It is one of the many trees that are well known for their medicinal properties, as well as for their economical significance (Cheikh-Rouhou *et al.* 2006). Its range expands from Morocco, Algeria, Spain to France, Italy, Croatia, Albania (Toromani *et al.* 2015) and Greece (Roussis *et al.* 1995). Many authors have reported the major chemical components of *Pinus halepensis* extract oils are β-caryophyllene and α-pinene (Roussis *et al.* 1995, Dob *et al.* 2005, Cheikh-Rouhou *et al.* 2006, Abi-Ayad *et al.* 2011, Fekih *et al.* 2014). Chemical structures of the main components in the oil extract of *P. Halepensis* are presented in Figure 1.

[1]https://en.wikipedia.org/wiki/Pinus_halepensis

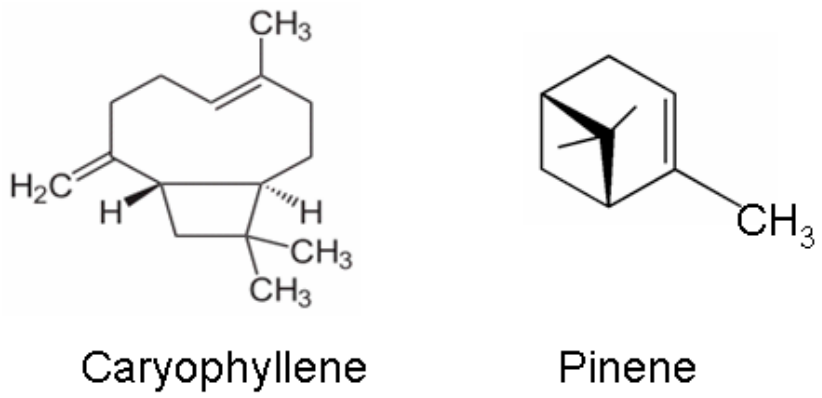

Figure 1. *Chemical structures of the main components (β-caryophyllene and α-pinene) of P. Halepensis oil extract as reported in the literature.*

Essential oils from *Pinus* species are reported to have different therapeutic properties. They are used as fragrances, flavoring additives for food and beverages, and intermediates in synthesis of perfumes (Fekih *et al.* 2014). Usually the oil extraction from plants are carried out by water distillation and organic solvent extraction using a Soxhlet technique (Dob *et al.* 2005, Taraj *et al.* 2013, Andoni *et al.* 2014, Ciko *et al.* 2016, Taraj *et al.* 2017). Following our previous studies on the essential oils extraction from Albanian plants (Taraj *et al.* 2013, Andoni *et al.* 2014, Ciko *et al.* 2016, Taraj *et al.* 2017), we further extended this work by utilizing a Clevenger type apparatus (hydrodistillation extraction) and a Soxhlet extractor to obtain essential oil from *P. Halepensis*. The aim of the present work is to obtain essential oil from pine needles by utilizing different extracting methods, compare the yields and subsequently identify the presence of major chemical constituents (bioactive components) by FTIR spectroscopy and UV-Vis spectrophotometry. FTIR UV-Vis analysis indicated presence of caryophyllene and pinene in the oil extracts of pine needles.

Material and methods

The origin of *P. Halepensis* used in this work is from Vlora region (Himara) in Albania. The pine needles were dried in shadow at room temperature and cut off in small pieces. The water distillation extraction was carried out by means of Clevenger apparatus in a round bottom flask using a ratio of 10:1 water/dried needles. A schematic representation of steam distillation apparatus, Clevenger type is shown in Figure 2a. A Clevenger apparatus and a condenser were attached to the round flask. The flask was put on an electric mantle (heating bowl). The water-flower mixture was then subjected to distillation for an optimum number of hours which was determined to be 3 hours. In the first 30 minutes once the oil had started collecting in the collecting column of the Clevenger apparatus, about 1 ml of hexane (oil phase) was put through the condenser to wash down any oil which had stuck to the walls of the condenser. The essential oil (dissolved in hexane) was then separated in a separating funnel.

In the Soxhlet extraction, pine needles were placed inside a container made of thick filter (Figure 2b). The container is located into the main chamber of the Soxhlet extractor. The Soxhlet can be slotted onto a flask which contains hexane (in this work), as extraction solvent. The Soxhlet is afterward equipped with a condenser, whereas the hexane is heated and allowed to reflux. The solvent vapour goes up to a distillation arm and overflows into the chamber which contains the herb in it. The condenser makes sure that the solvent vapour cools down, and drops back down into the chamber. Whilst the Soxhlet chamber is almost full, the chamber automatically gets emptied by a siphon side arm (Figure 2b), with hexane going back down to the distillation flask. This cycle may be allowed to repeat over several hours (Ciko *et al.* 2016). The amount of the herb used for Soxhlet extraction was ~10 g, whereas the amount of the solvent (hexane) used was 300 mL. In the current work the extraction process was allowed to run approximately 3 hours. During each cycle non-volatile compound dissolve in the solvent. After repeated cycles the desired compounds are concentrated in the

distillation flask. Consequently the extraction is stopped and hexane is removed, by means of a rotary evaporator, yielding though the extracted compounds.

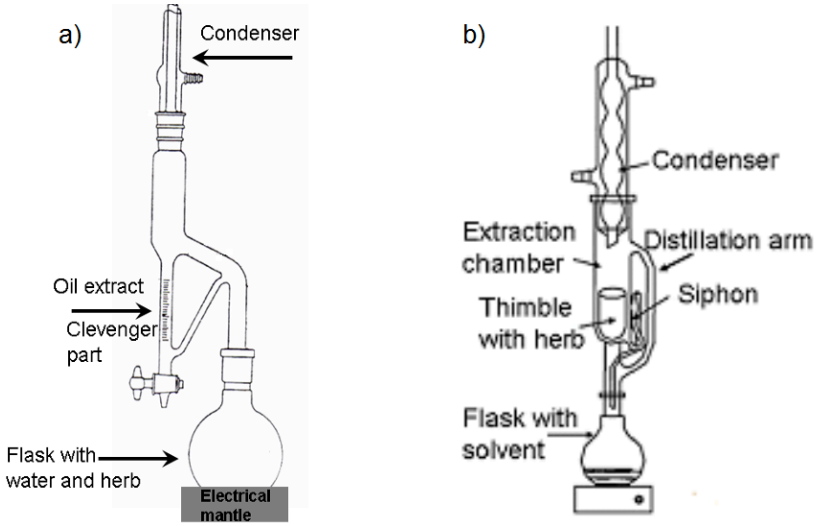

Figure 2. *a)Schematic representation of Clevenger apparatus indicating by arrow the main parts. 2b) Schematic representation of Soxhlet extractor indicating by arrow the main parts.*

FTIR spectra were obtained by Nicolet 6700 spectrometer, manufactured by Thermo Electron. In this study, measurements were carried out in the range mid Infra-Red (4000 – 400 cm^{-1}). The spectra were analyzed using OMNIC software. UV-Vis spectra measurements were carried out by 6800 UV-Vis. spectrophotometer Jenway.

Results

Table 1 displays overall results of the yields for the oils obtained with different methods. It is evident from table 1 that the Soxhlet extraction gives rise to higher yield when compared to the yield obtained from the extraction with the Clevenger apparatus. In this respect *Dob et al. (2005)*, reported yield of 0.52% for the essential oil of P. Halepensis extracted by hydro-distillation.

Table 1. *Overall results for the extraction of essential oil of P.Halepensis.*

Extraction method	**Amount of *P. Halepensis***	**Extraction solvent**	**Extraction time**	**Extraction Temperature**	**Yield of extract**
Clevenger (distillation)	10 g	Water	3 h	120^0C	0.30%
Soxhlet (distillation)	10 g	Hexane	3 h	80^0C	3.54%

Figure 3 exhibits FTIR spectrum (representative spectrum) of the *P. Halepensis* oil extract obtained with the hydro-distillation method (Clevenger type). The spectra of all extracts revealed very similar features. The acquired essential oil obtained by hydro-distillation had a pale yellow color whereas the extract obtained with the Soxhlet method had yellow color.

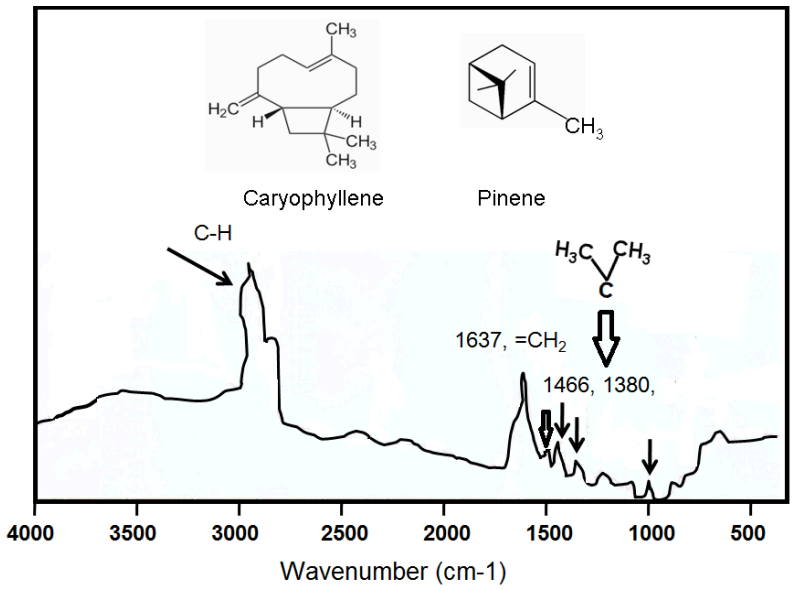

Figure 3. *FTIR spectrum of P. Halepensis essential oil obtained by a Clevenger type hydro-distillation. In the insert are indicated by arrows the main components identified in the FTIR spectrum.*

FTIR spectrum of the oil extract indicates peaks positioned at ~1637 cm^{-1}, ~1466 cm^{-1} and ~1380 cm^{-1}. Other IR signals appear in the region ~3000-2800 cm^{-1} along with minor peaks evident at ~ 1000 cm^{-1} and at ~700 cm^{-1}. Additionally, UV-Vis spectrum (figure 4) of *P. Halepensis* oil extract indicates peaks in the regions, 200-210 nm, 230-235 nm and a minor peak at 270-290 nm.

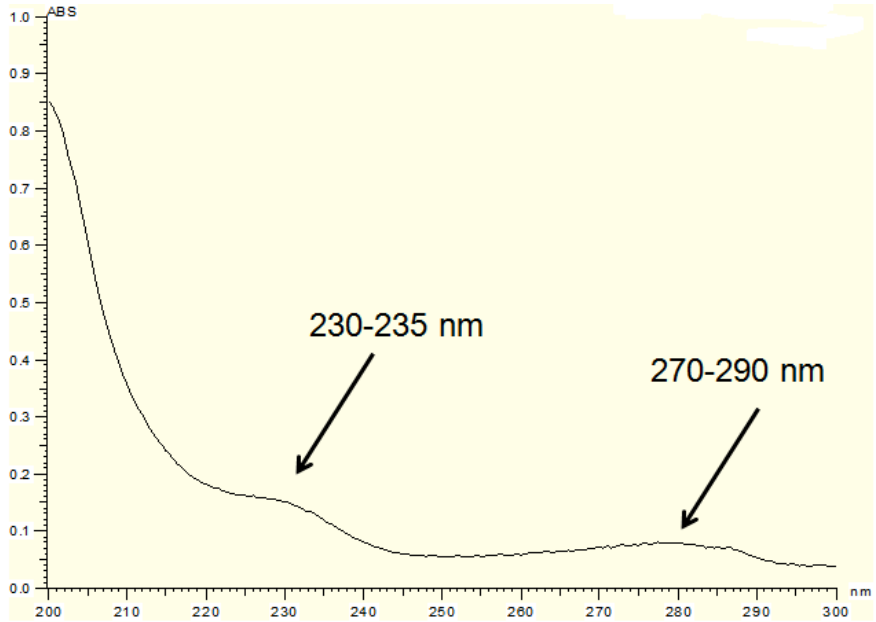

Figure 4. *UV-Vis spectrum of P. Halepensis essential oil obtained by hydro-distillation.*

Discussion

In the FTIR spectrum of the *P. Halepensis* oil appears two peaks positioned at ~1466 cm^{-1} and at ~1380 cm^{-1}. It is known that isopropyl and *gem*-dimethyl groups give rise to a split umbrella mode with two peaks in the IR spectrum positioned at ~1385 to 1365 cm^{-1} (Smith 1999). The splitting is caused by vibrational interaction between the umbrella modes of the two methyl groups. The split of the umbrella modes is of about equal intensity. Meanwhile, *t*-butyl and isopropyl groups also give rise to a split umbrella mode with two peaks positioned between ~ 1393 to 1366 cm^{-1} (Smith 1999). However, the approximate intensity ratio in this case is 1:2 (Smith 1999). Additionally, the band at ~

1466 cm^{-1} can also indicate the presence of a CH_3, a CH_2 or both groups; whereas CH_3 symmetric bend (umbrella mode) shows up at 1375±10 cm^{-1} (Smith 1999). The chemical structures of caryophyllene consists of isopropyl or isobutyl groups, therefore we assign the peaks at at ~1466 cm^{-1} and at ~1380 cm^{-1} to caryophyllene. These findings are in good agreement with IR data reported for oil extracts of different herbs (peak position of the same functional groups) (Schulz *et al.* 2004, Schulz *et al.* 2005). In this respect, the same authors (Schulz *et al.* 2004, Schulz *et al.* 2005) reported IR spectrum of caryophyllene and indicated presence of three peaks in the region 1500-1300 cm^{-1}. The latter is in good agreement with our findings.
The C=C stretches appear at ~1660-1630 cm^{-1} (Smith 1999), therefore the IR at ~1630 cm^{-1} belong to pinene and caryophyllene (vinyl group, $=CH_2$) (Schulz *et al.* 2004, Schulz *et al.* 2005). In addition, UV-Vis spectrum of pine essential oil gives rise to features in 200-290 nm region. These features originate from the double bonds (or conjugated double bonds) of caryophyllene and pinene (Taraj *et al.* 2013).

Conclusions

The extracts from *P. Halepensis* were obtained by means of Clevenger apparatus (hydro-distillation) and Soxhlet extractor using hexane as solvent. The extraction with Clevenger apparatus gave rise to lower yield compared to the yield obtained with Soxhlet method extraction. IR spectrum of *P. Halepensis* essential oil indicated presence of caryophyllene and pinene as two major chemical constituents in the extract. IR signals for the isopropyl groups (1466-1380 cm^{-1}) and vinyl group (1637 cm^{-1}) were in good agreement with IR data reported by Schulz and co-authors. UV-Vis signals supported IR findings for the caryophyllene and pinene presence. To this end, the chemical composition of Albanian *P. Halepensis* oil is similar to the chemical composition reported in the literature for the pine needles (*P. Halepensis*).

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DATA TREATMENT FROM CRUDE OIL DISTILLATION USING ASPEN HYSYS SIMULATION

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Abstract

One of the first important processing plants in each refinery is the distillation of crude oil. In this study a simulation schemes is presented to optimize the process in order to obtain a larger amount of light compounds using a crude oil of a given oilfield. This method specifies exactly the operating conditions of the column as a function of the design parameters. Also in the study were determined the specific parameters for the optimal case of an Albanian crude oil source which, during its treatment, requires a smaller amount of energy. Two Albanian oilfield sources to perform the simulation for an efficient use of energy were used.

Keywords: *Aspen HYSYS, simulation, light component, crude oil, distillation process*

Introduction

In this study, a simulation procedure is proposed to determine the most optimal oil refining scheme in the refinery. This procedure specifies exactly the operating conditions of the column as a function of the design parameters. In the refinery the crude oil from multiple sources (storage, pipeline, etc) enters the refinery after some initial treatment to remove impurities and sediments.

The crude oil enters to heat recovery section to raise its temperature and recover heat from downstream units. The heated crude then enters in a desalting section, which removes dissolved salts and associated impurities. Once the salts have been sufficiently treated, the crude enters in the preheat train, consisting of heat exchangers associated with various downstream equipment throughout the refinery. The preheat train typically raises the temperature of crude significantly and reduces the overall energy consumption in the refinery. After leaving the preheat train, the heated crude enters the atmospheric crude distillation furnace. The main purpose of the furnace is to vaporize the portion of the crude that is recovered as product from the column. The vapor-liquid crude mixture enters in a distillation column. In this study the column has 32 trays. Light components (i.e., pentanes and lighter) travel up the column and leave from the off-gas and the column-condenser liquid output. In this column are presented also the pump around. These units reduce the vapor flow in the column (by lower temperature) and allow for heat recovery.

The Aspen HYSYS program is used for simulation, based on two oilfields in our country. The purpose of the study is to compare the simulation results in order to produce higher amounts of light component. The optimum conditions of operation have been determined and the most efficient oilfield source is determined to achieve optimum process conditions, from the result of simulation.

The modern refineries use (Chang et al. 2012) the experimental data to characterize crude oil and its fraction. In this study Aspen HYSYS was used for the simulation of the process (*Aspen HYSYS, 2015*). Aspen HYSYS is a comprehensive process modeling tool that is used by leading oil and gas refineries and engineers to simulate and optimize crude oil processing. The Aspen HYSYS software application

performs process simulation by carrying out material and energy balances over the process unit. Once pseudo-components are defined, a thermodynamic model is chosen.

We classify the process in modern refinery into two categories: separation units and reaction units. To develop a process model for any unit, it is necessary to check mass and energy balances of the flowsheet and perform calculation to describe the performance of the target unit. After the characterization of pseudo component, is choose a thermodynamic model. Process thermodynamics also set material and energy transfer limits on various fractionation and reaction units in the model and in the actual plant itself (Wenkai et al. 2005). For modeling purposes some thermo physical properties required for a complete model should also make predictions about certain oil properties that are commonly seen in refineries. Usually these properties of the oil or its product include; the true boiling point (TBP), average density, molecular weight, light compound composition, density and viscosity of crude oil fractions (Shuncheng et al. 2001; Liu et al. 2012).

The most rigorous approach is the equation of state (EOS) approach. When is used an EOS, both vapor and liquid phases uses the same model. There are many types of EOS with a wide range of complexity. The Redlich-Kwong EOS is a a popular EOS that relies only on critical temperatures and critical pressures of all components to compute equilibrium properties for both liquid and vapor phases. For the purposes of refinery fractionation and reaction modeling, the most useful EOS models derive from either the Peng-Robinson (PR) EOS or Soave–Redlich-Kwong (SRK) EOS. (Zhang et al. 2000; Chang et al. 2012).

Materials and Methods

To achieve simulation in Aspen HYSYS are realized several experiments. Sampling and measurement are determined with ASTM standards. For determining TBP (true boiling point) is used ASTM D-86, for determine the specific gravity and viscosity is used (Anton Paar SVM 3000 viscometer, ASTM D5002-99, *ASTM, 1980)*. A Varian 450 Gas Chromatography (equipped with PTV injector and flame ionizer detector, FID) is used to determine the light component in the fractions obtained from distillation. Figure 1 showed the simulation scheme.

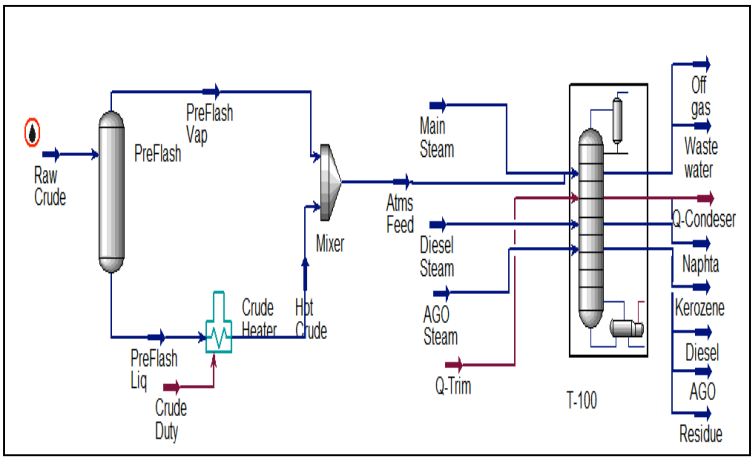

Figure 1. *Simulation scheme for atmospheric distillation of crude oil, in Aspen HYSYS*

The simulation scheme contains a Para fraction column, side strippers which contain 4-6 tray, pump around and a main distillation column with 32 tray. The reflux absorber is selected as the simulation column. The main column has 32 trays. Streams at the entrance of the distillation column are Atmospheric Feed and Q-1 streams, which are inserted into tray 28. The process converges quickly after the side stripper column characteristics were added.

There are times when simulation does not converge. In the distillation process to provide simulation we have chosen the "Modified HYSIM Inside-Out" method. The most important factor in the impact of productivity and product quality profile is the food composition. For the simulation scheme are used three pump around and three side strippers.

The first step for a successful simulation is correct choice of the thermodynamic method that will be used in the calculations of the state variables and the physical properties. The second step is the characterization of crude oil and input data.

Results-Discussion

For the atmospheric distillation column the most important profiles work are: temperature profile, especially for the condenser, upper and bottom section temperatures, distillation curve for main products, bulk product density, etc.

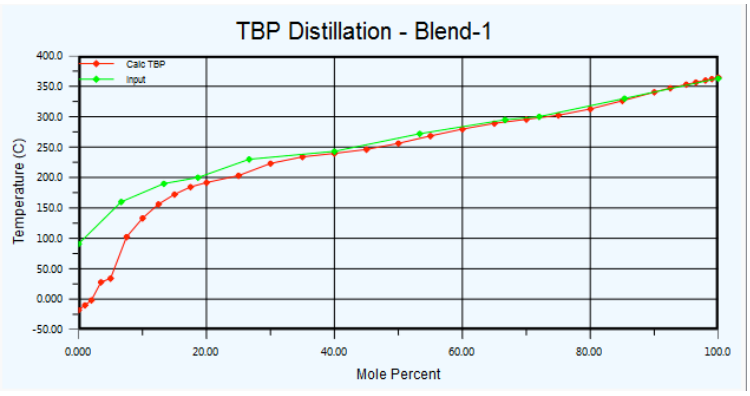

Figure 2. *Simulation and experimental ASTM D86 curve for Marinza crude oil*

Figure 2 and 3 showed the simulated (from Aspen HYSYS) and experimental ASTM D 86 curves which have compatibility between them. The maximum difference between the experimental and simulation results was around from the beginning of boiling point up to 20°C.

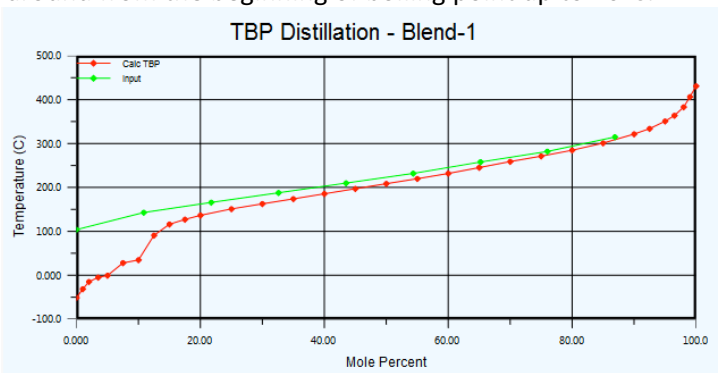

Figure 3. *Simulation and experimental ASTM D86 curve for Kuçova crude oil*

There is a deviation at the beginning of the distillation curve (figure 2, 3), because the crude oil samples taken at the decanter plants did not contain light component.

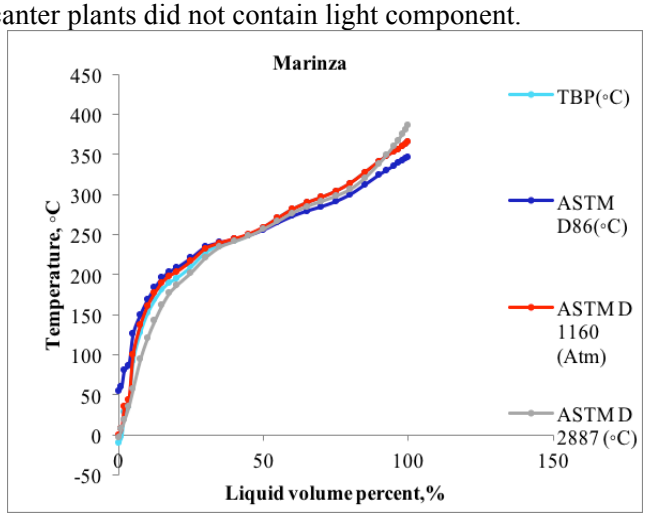

Figure 4. *True Boiling Point with different ASTM standard*

From simulation we are able to define TBP with different standards ASTM, (figure 4).

Table 1. *Mass flow data simulation of output streams in the distillation column*

	Kuçova	**Marinza**
Oilfield source	kg/hr	
Atmospheric Feed	84780	86180
Gases at the outlet of the condenser	0.0003442	0.0002811
Naphtha	13920	15260
Waste water (condenser)	5854	5860
Residue (condenser)	40640	40220
Kerosene	6823	6990
Diesel	14550	14790
AGO	8890	8956

Table 2. *Heat Flow data simulation of output streams in the distillation column*

	Kuçova	**Marinza**
Oilfield source	kw	
Atmospheric Feed	31500	33220
Gases at the outlet of the condenser	-0.0002231	-0.0002021
Naphtha	-8776	-9225
Waste water (condenser)	-25760	-25600
Residue (condenser)	-20610	-19470
Kerozene	-3516	-3311
Diesel	-7943	-7648
AGO	-4813	-4669

From the simulation procedure it can be derived the following results and conclusions:

The sample from Kuçova oilfield source showed a greater content of pseudo-component, except those components which have a determined boiling point temperature. In the analysed sample there are also present some hypo components, such as: Hypo 10029, Hypo10033 and Hypo 10031. In total there were discovered 36 pseudo components.

The distillation Kerosene stream has a higher content of compounds with a boiling point temperature; 156°C, 167°C, 179°C and 190°C. The distillation Diesel stream has a higher content of compounds with a boiling point temperature; 190°C, 202°C, 213°C and 225°C.

In the Marinza crude oil source there were discovered 28 pseudo-components. The distillation Kerosene stream was composed by components with boiling point temperature; 213°C, 223°C, 233°C, 242°C and 252°C. The distillation Diesel stream consists of components with boiling point temperature; 242°C, 252°C, 261°C, 271°C and 281°C, while the distillation AGO (gasoil) stream consists mainly by components with a boiling point temperature; 291°C, 299°C and 310°C.

Table 1 showed that the largest mass flow of naphtha, kerosene and diesel was produce from the distillation of Marinza crude oil source. Table 2 showed that Marinza crude oil source required more energy to produce diesel, kerosene and AGO (gasoil). To produce naphtha from the distillation of Marinza crude oil source was spent more energy than the distillation of Kuçova crude oil source, but is achieved a greater amount of naphtha.

Conclusions

In this study, the light component, TBP distillation curve, density, viscosity is used in characterizing the crude oil. The simulated TBP (true boiling point) data by Aspen HYSYS for the given crude oil are compared to the experimental data to identify any inaccuracies. The maximum difference between the experimental and simulation results was around from the beginning of boiling point up to 20°C, because the crude oil samples taken at the decanter plants did not contain light component.

The largest mass flow of naphtha, kerosene and diesel are produce from the distillation of Marinza crude oil source. To produce naphtha from the distillation of Marinza crude oil source was spent more energy than the distillation of Kuçova crude oil source. To achieve specific information was necessary to simulate the fractionation of residues with higher boiling temperatures than 370°C (vacuum distillation process).

Simulation software is becoming nowadays one of the best tools for a crude oil refinery. This can be used during the conceptual design, as well during the entire life of the equipments. The process can be easily understood while using Aspen HYSYS.

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RESIDENTS' EVALUATION TO THE URBAN GREEN INFRASTRUCTURE IN A MEDIUM SIZE CITY IN GREECE

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Abstract

The present paper uses a structured questionnaire to record the views of Alexandroupolis residents, concerning the urban parks and green spaces in their municipality. More specifically, the residents were asked to evaluate the local parks and green spaces as regards their number and size, suitable design, safety for children, the variety and care of plants, and the facilities for people with disabilities. They were also asked to record problems such as noise pollution, mess from stray animals or pets, unpleasant odors, lack of information, signposting and other facilities (i.e. shelter, seating). The satisfaction of the residents regarding the local authorities and their contribution towards improving parks and green spaces was also evaluated. The residents' answers led to useful proposals that can be used by the local authorities to manage the city's green infrastructure and to anticipate the daily and future needs of the people who visit parks and urban green spaces.

Keywords: urban parks, green spaces, residents' opinions and perceptions, questionnaire, quality of life

Introduction

Urban green spaces include urban parks, different types of active and passive recreational grounds with vegetation cover, street greenery, and pockets of remnant natural vegetation. The potential urban green spaces include also open spaces which have the potential to be converted into formal green spaces and provide ecosystem services to the urban environment (Qureshi et al. 2010, Anberger 2012). Urban green spaces play a very important role for people living in large cities, because they can benefit the residents physiologically offering them settings for activities (Bjork et al. 2008, Qin et al. 2013).International studies have documented positive health effects of them on human's life, especially, cardiovascular disease, hypertension, colon cancer and diabetes (Nielsen and Hansen 2007).

Also the amount of green spaces close to where people live has a significant relation with their perceived quality of wellbeing (Schipperijn et al. 2010). This relation might be explained by the fact that increased presence of urban green space and parks is likely to increase the use of them (Arnberger and Eder 2012). It is important to know what residents really need from the green infrastructures to their neighbourhood (Sanesi and Chiarello 2006, Panagopoulos et al. 2016).

The totally area of urban green space and parks in the most European cities is very limited. This fact makes it an interesting subject for research the residents' perception about green spaces so that the results show the ways for improvement them to the city planners and managers (Schipperijn et al. 2010, Nesbitt et al. 2017).

Greek cities do not have the green they should have (Karanikola et al. 2012, Karanikola et al 2016). In Greece only 2.8 m^2 of green space is available to each individual, where as in Western Europe 20m^2 / person is available (Hatzistathis et al. 1999).

In Greece there are only few studies investigate this influence of green space and parks to the residents of the cities (Ganatsas et al. 2002, Zagas 2003, Tampakis et al 2012) and only one (Tsitsoni et al. 2005) partly evaluates satisfaction of the residents about green infrastructure of the urban environment. There is a gap of knowledge in that point.

Aims of the present paper are to investigate residents' attitudes towards the urban green infrastructures in the city of Alexandroupolis and compare the results from a similar research

conducted in 2014 (Karanikola et al. 2016) to the larger size city of Thessaloniki. In now days, because of the current economic downturn, it is often for the state to slash money for park spending, threatening the health of existing parks and curtailing the creation of new parks. For this reason it is important to know exactly the main problems and deficiencies there are in the parks so the little money given from the state to the local authorities utilized for the actual needs of the resident's (Sherer 2006).

Materials and Methods

Study area

The Municipality of Alexandroupolis was the research area of this paper. Alexandroupolis is the capital of the Evros regional unit in East Macedonia and Thrace with population 72,959 (under the census of 2011). It is an important port and commercial center of northeastern Greece. In the municipality there are 25 parks that cover a total green area of 98,141.91m^2, 19 pockets of remnant natural vegetation covering 15,206 m^2, 6 green spaces with green area of 8,682.32 m^2 and 8 squares 18,998.60 m^2 with 15.09% planted mainly with forest plants (Figure 1).

Figure 1. Scouts' Park in the city of Alexandroupolis

Methodology

There are different ways of studying people's attitudes, perceptions and behaviour. These can include various techniques for taking samples and for asking questions (Sanesi and Chiarello 2006). Interviews have been used as tool for investigation for over 10 years in scientific fields of urban green studies (Lohr et al. 2004, Sanesi et al. 2006). The present research is another study carried out with the application of personal interviews.

Simple random sampling was applied due to its simplicity and requires less possible Knowledge for the population than the other methods (Kalamatianou 2000). Simple random sampling presupposes the existence of a full catalogue (sampling frame) of the population data without deficiencies or reiterations (Filias et al. 2000). The applied sampling frame was the consumer's lists of domestic electricity. The estimation of the proportion of the population and the estimation of the standard error of the proportion of the of the population s_p, as the estimate of mean of and the estimation of the standard error of the mean s are given by the formulas of the simple random sampling. In order to calculate the size of the sample we needed to carry out pre-sampling, with the size of the sample being 50 individuals.

The size of the sample was estimated according to the formulas of simple random sampling (where t = 1.96, e = 0.05 that is 5%) (Pagano and Gauvreau 2000). The total number of interviews was 400.

Data were collected in 2016. A total of 18 questions constitutes a multi theme variable to be tested through reliability analysis. More specifically, in order to find out the internal reliability of the questionnaire (Frangos 2004), i.e. if our data had the tendency to measure the same thing, we used the alpha co-efficient (or Cronbach's alpha reliability coefficient) (Howitt and Gramer 2003). When the alpha coefficient is 0.70 or higher, it is regarded as satisfactory (Howitt and Gramer 2003); if it is higher than 0.80, it is regarded as very satisfactory. In practice, lower reliability coefficients, with values no higher than 0.60, are also commonly accepted (Siardos 1999).

The relevant checking must not only be reliable but also credible; this is ensured through the application of factor analysis (Siardos 1999). Factor analysis is a statistical method which aims to discover the existence of common factors within a group of variables (Sharma 1996). We used the principal component analysis method, which is based on the spectral analysis of the variance table (correlation) (Karlis 2005). The selection of the number of factors is a dynamic process, which presupposes the evaluation of the model in a repeating fashion. In this case, we used the Kaiser rule, the percentage of variance that can be explained on the screen plot (Karlis 2005). Furthermore, we also used the matrix rotation of the main factors and applied Kaiser's method of maximum variance rotation.

Results and Discussion

During the interviews, the residents were initially asked about their demographic profile. 47.3% of the respondents questioned were male and 52.8% were female. Most of them (28.3 %) were young aged (18-30 years), married (51.3%), without children (56%). As regards their profession, they were mainly public servants (48%) or students (19.5%).

As is the case in other Greek cities, the total area of green spaces in the municipality of Alexandroupolis in Greece is limited (Karanikola et al. 2012). For this reason, the majority of residents are of the opinion that the urban green spaces in their municipality are insufficient in number (57%) and that the total area of existing green spaces is also insufficient (55.8%). Concerning the distribution of green spaces, the attitudes of residents vary between good (49.8%) and bad (40.8%), while accessibility is good for the majority of residents (73.3%) (Table 2). These results are generally in line with previous studies conducted in Kalamaria in Thessaloniki (Karanikola et al. 2016), to Ioannina, a city in western Greece (Tampakis et al., 2012) and in the Italian city of Ancona (Sanesi et al., 2006). According also to a similar study by (Sanesi and Chiarello 2006) carried out in the city of Bari, almost the entire population (93.1%) think that the urban green areas in their city are insufficient in number and about two thirds of the residents interviewed think a larger area of their city should be covered by green spaces.

As regards the questions related to assessing the existing infrastructure in urban green spaces in the municipality of Alexandroupolis (Table 2), the residents stated that they were a little (54.5%) or very satisfied (33%) with the architectural design, although their opinions are divided between good and bad when asked about the available infrastructure (40% και 46.8% respectively) and the condition of children's playgrounds (48.8% και 40.5% respectively) (Table 1).

The residents consider the safety measures for children as bad (46.3%), together with the facilities for people with disabilities (53.5%) and the sports facilities (49.5%). On the contrary, they found the cleanliness of the green spaces (44.5%) and the plant care (53.8%) good. The residents considered the plant diversity to be small (71.3%), along with the number of visitors at the parks and the other green spaces (45.8%).

Regarding the evaluation of problems affecting green spaces, noise pollution seems to be most the important problem according to residents, who characterized is as being a big (51.8%) or very big (13%) problem. Unpleasant odors also bother the residents who say they are a big (47.3 %) or very big (9.3%) problem. On the contrary, the presence of stray animals and pets is a little problem (36.8%).

According to another study about the existence of stray animals in green spaces, more than half the residents (67.8%) seem to be bothered by them, while 20.5% say that they are indifferent to their existence (Karanikola et al., 2012). In the last question of the questionnaire, the residents state they are

mostly dissatisfied with the deficient management by the local authorities, since 61% are a little satisfied and 16.8% are not at all satisfied.

Table 1. Residents' perceptions about essential issues related to the condition of the urban green spaces in their municipality.

Number of green spaces	Absolutely sufficient 1.0%, (s_p=0.0050)	Sufficient 36.8% (s_p=0.0241)	Insufficient 57.0% (s_p=0.0248)	Absolutely insufficient 5.0% (s_p=0.0109)
Total area of existing green spaces	Absolutely sufficient 1.0% (s_p=0.0050)	Sufficient 37.0% (s_p=0.0241)	Insufficient 55.8% (s_p=0.0248)	Absolutely insufficient 5.5% (s_p=0.0114)
Distribution of green spaces in the municipality	Very good 3.3% (s_p=0.0089)	Good 49.8% (s_p=0.0250)	Bad 40.8% (s_p=0.0246)	Very bad 5.5% (s_p=0.0114)
Accessibility of green spaces	Very good 9.3% (s_p=0.0145)	Good 73.3% (s_p=0.0221)	Bad 14.3% (s_p=0.0175)	Very bad 3.0% (s_p=0.0085)
Number of visitors	Very good 5.5% (s_p=0.0114)	Big 42.5% (s_p=0.0247)	Small 45.8% (s_p=0.0249)	Very small 5.5% (s_p=0.0114)
Architectural design	absolutely satisfied 2.0% (s_p=0.0070)	Very satisfied 33.0% (s_p=0.0235)	A little satisfied 54.5% (s_p=0.0249)	Not at all satisfied 10.3% (s_p=0.0152)
Infrastructure available	Very good 2.5% (s_p=0.0078)	good 40.0% (s_p=0.0245)	Bad 46.8% (s_p=0.0249)	Very bad 10.3% (s_p=0.0152)
Cleanliness	Very good 5.3% (s_p=0.0112)	Good 44.5% (s_p=0.0248)	Bad 38.5% (s_p=0.0243)	Very bad 11.3% (s_p=0.0158)
Plant diversity	Very big 1.3% (s_p=0.0056)	Big 9.0% (s_p=0.0143)	Small 71.3% (s_p=0.0226)	Very small 17.5% (s_p=0.0190)
Plant care	Very good 2.8% (s_p=0.0082)	Good 53.8% (s_p=0.0249)	Bad 31.8% (s_p=0.0233)	Very bad 10.5% (s_p=0.0153)
Children's playgrounds	Very good 2.8% (s_p=0.0082)	Good 48.8% (s_p=0.0250)	Bad 40.5% (s_p=0.0245)	Very bad 7.5% (s_p=0.0132)
Sports facilities	Very good 3.0% (s_p=0.0085)	Good 30.0% (s_p=0.0229)	Bad 49.5% (s_p=0.0250)	Very bad 17.3% (s_p=0.0189)
Safety for children	Very good 2.5% (s_p=0.0078)	Good 36.8% (s_p=0.0241)	Bad 46.3% (s_p=0.0249)	Very bad 13.5% (s_p=0.0171)
Facilities for people with disabilities	Very good 0.5% (s_p=0.0035)	Good 20.5% (s_p=0.0202)	Bad 53.5% (s_p=0.0249)	Very bad 24.8% (s_p=0.0216)
Presence of stray animals and pets	very big problem 9.8% (s_p=0.0148)	big problem 29.8% (s_p=0.0229)	little problem 36.8% (s_p=0.0241)	No problem 23.8% (s_p=0.0213)
Noise pollution	very big problem 13.0% (s_p=0.0168)	big problem 51.8% (s_p=0.0250)	little problem 28.5% (s_p=0.0226)	No problem 6.5% (s_p=0.0123)
Unpleasant odors	very big problem 9.3% (s_p=0.0145)	big problem 47.3% (s_p=0.0250)	little problem 33.0% (s_p=0.0235)	No problem 9.5% (s_p=0.0147)
Management by the local authorities	absolutely satisfied 1.8% (s_p=0.0066)	Very satisfied 20.0% (s_p=0.0200)	A little satisfied 61.0% (s_p=0.0244)	Not at all satisfied 16.8% (s_p=0.0187)

Reliability analysis applied to the above variables after completing all the necessary checks. The value of the reliability coefficient alpha is 0.886. This constitutes a strong indication that our data has the tendency to measure the same thing. In fact, this is also supported by the significantly high partial reliability coefficients alpha after the deletion of any variable, since even then no increase of the

reliability coefficient is observed. Also before proceeding with the application of factor analysis, we conducted all the necessary checks. The value of the Keiser-Meyer-Olkin indicator is 0.911. Furthermore, Bartlett's test of sphericity rejects the null hypothesis that the correction table is unitary and that the partial correlation coefficients are low. The fact that the measures of sampling adequacy have high to very high values also supports the view that the factor analysis model is acceptable. The factors extracted are three. Table 2 reveals the loads that are the partial correlation factors of the eighteen variables with each of the three factors resulting from the analysis. The higher the load of a variable in a factor, the more this factor is responsible for the total degree fluctuation of the considered variable.

Table 2. Table with factor burdens after rotation.

Variable	Factor burdens after the rotation		
	1	2	3
Number of green spaces	0.170	**0.816**	0.064
Total area of existing green spaces	0.176	**0.802**	-0.035
Distribution of green spaces in the municipality	0.199	**0.744**	0.167
Accessibility of green spaces	0.241	**0.521**	0.319
Number of visitors	0.334	0.262	0.172
Architectural design	**0.523**	**0.534**	0.117
Infrastructure available	**0.725**	0.313	0.045
Cleanliness	**0.644**	0.034	0.367
Plant diversity	**0.436**	0.347	-0.167
Plant care	**0.698**	0.161	0.121
Children's playgrounds	**0.710**	0.144	0.253
Sports facilities	**0.634**	0.205	0.170
Safety for children	**0.782**	0.132	-0.169
Facilities for people with disabilities	0.660	0.264	0.016
Presence of stray animals and pets	0.065	0.033	**0.726**
Noise pollution	0.115	0.113	**0.743**
Unpleasant odors	0.205	0.099	**0.603**
Management by the local authorities	**0.485**	0.414	0.298

The variables that "belong" to each factor are the ones for which the load (columns 1, 2, 3) is higher than 0.5 in this factor. Factor 1: the variables "architectural design", "available infrastructure", "cleanliness", "plant care", "children's playgrounds", "sports facilities", "safety for children", "sport facilities", and "facilities for people with disabilities", belong to this factor. We can give this factor the title: 'functionality of the parks'. We can also accept the variables "plant diversity" and "management by the local authorities" in the first factor, because their values are very close to 0.5.

The second factor includes the variables: "number of green spaces", "total area of existing green spaces", "distribution of green areas in the municipality", "architectural design", "sport facilities", "accessibility" and "number of visitors", and can be given the title: 'land use planning'. Since the values of the variables "architectural design" and "management by the local authorities", which are included in the second factor, are very close to 0.5, we can accept that these variables belong to both factors and constitute a bridge between them.

This means that the residents are of the opinion that the management of the local authorities is important for the land use planning in their municipality.

The third factor, with the title 'problems', includes the variables "presence of stray animals or pets", "noise pollution" and "unpleasant odors". We accept that the variable "cleanliness" belongs to the first and third factor, since its value in the third factor is close to 0.5, and it therefore constitutes a bridge between the two. The negative value of this variable shows that, the better the cleanliness, the fewer the problems there are relating to the presence of stray animals and pets, unpleasant odors and noise pollution.

Conclusions

This study offers a general understanding of public perceptions regarding urban green spaces from the residents' point of view. In the municipality of Alexandroupolis, a medium size city the combination of the current economic downturn and the reduction of money they have to spend for recreation activities however, lead the residents to the parks and green spaces as a good and costless proposal to spend their free time.

Through the analysis, it becomes obvious that the existing green spaces are insufficient in number, expanse and architectural design, and that their distribution is unsatisfactory for over half the residents. The infrastructure at the green spaces is rather mediocre because an equal number of residents evaluate them as being good or bad, accordingly (sport facilities, playgrounds for children, e.tc). When the issue of how safe the existing green spaces are is raised, especially for children, the residents state their concern through their answers.

What can one learn from this study about future plans concerning the design and management of green spaces in the municipality of Alexandroupolis?

The results can be used as a valid tool in the planning, design and management of urban green spaces, thus promoting the adoption of participatory processes in decision-making by the local authorities. The questionnaire used in this research, when answered appropriately, will lead to a better understanding of residents' choices in the urban environment. Subsequently, a better urban planning framework could be developed with a higher satisfaction level that would be more appreciated by the public (Qureshi et al., 2013).

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LAND USE CHANGE IN THE VICINITY OF ZAGREB LANDFILL

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Abstract

The goal of this study was to give a spatial review and quantification of the present land use and land use change in the area surrounding Jakuševec landfill in Zagreb, capital city of Croatia. A map of land use types of approximately 2 km zone around the landfill was created, based on photointerpretation during 2012 and according to Corine Land Cover 2000, 2006 and 2012 database. Spatial analysis revealed thirteen land use categories of total size around 3161 ha. These categories were divided into three larger groups based on land use types (water: 5 %, agricultural land: 50 % and city: 45 % of the total analysed area). The main land use changes in the analysed period included increase in industrial or commercial units and transport infrastructure, and decrease of agricultural land. Mixed agriculture is very important in this urban area, because it relies on fertile soil and vicinity of large market of the capital city. However, the closure of waste landfill is foreseen in the near future, which will probably induce loss of agricultural land and the conversion into green urban areas or some other type of urban planning.

Keywords: *land use, waste landfill, mixed agriculture, urban area, spatial analysis*

Introduction

In the past few years major waste problems have appeared in the capital of Croatia, on the landfill Jakuševec, Zagreb, which are far from being solved. For years there has been no holistic waste management system and no new location for the landfill meant to fully replace the overloaded Jakuševec after nearly 50 years has been founded. The Prudinec landfill in Jakuševec is categorized as landfill category 1 and no waste disposal that doesn't belong to this category is allowed (Official Gazette of the Republic of Croatia 2007, 2011). All waste is disposed of on a regulated surface which means all environmental protection regulations should be met. The disposal of dangerous waste, especially infectious, radioactive, explosive, asbestos, liquid and gaseous is forbidden. The company ZGH-ZGOS has a primary task to run the facility and to rehabilitate Prudinec/Jakuševec landfill, as well as to procure and coordinate the monitoring of groundwater and air quality but does not monitor the soil quality in the vicinity of Jakuševec landfill (Croatian Environment Agency 2012, ZGOS 2012). The groundwater quality control is understandable seeing how Zagreb is located on an aquifer that provides drinking water for the entire city, as well as the monitoring of air which the local residents inhale. We believe the soil has been unrightfully neglected as an element of the environment and as a mean of food production i.e. the concern for the quality of agroecosystem (meadows, arable land, and pastures) in that area should be much higher, especially because that aspect of the economy is one of the most important to the domicile inhabitants not only as an existential necessity but for its historical and cultural reasons as well.

We cite the words of members of the Environmental Protection Association Jakuševec (2001): "The neighbourhood Jakuševec is not Turopolje nor it is Zagreb's periphery. It does not lead a life of the noble municipality of the proud "plummers", nor does it rot like the poverty-stricken settlers that inhabited the city edges in a series of illegally constructed huts and streets without any infrastructure. That it has the city's waste so close it started to suffocate it, is the shame of the city, not Jakuševec. The Jakuševec area is clenched between the city suburbs and the nobles of Turopolje; it is an enclave that resists the impacts of its surroundings by guarding their distinctive identity. One could say it is a living monument of the past, but of no talk of a nature reserve that artificially preserves the scenes from a former way of life. The given impression is that of a noble farmer living in this cramped area, changing his way of life in his own way."

Urban agriculture, as it can be categorized here, becomes an ideal complement to the rural production, crucial for the city food system, with its multifunctional role ranging from its contribution to food security, economic and environmental sustainability, and preservation and implementation of the green space (Zasada 2011, Orsini et al. 2013, Cavallo et al. 2016). However, agricultural land in the urban environment is distributed according to the available space (generally on marginal areas, e.g., close to railways, main roads, nearby industrial areas and landfills).

Agriculture as an industry is relying on natural renewable resources and is extremely important for the people of Jakuševec. As a prerequisite it requires clean, preserved environment hence it represents a pillar of the concept of development. Because of this, the natural resource that requires comprehensive protection and preservation the most is the soil, a key factor in organic matter production. There are multiple and important roles for soil in the environment, that is in the terrestrial and aquatic ecosystems. The most important one is its production role – the supply of water, air and nutrients for plants, which enables production of organic matter and the supply of food, fodder, renewable energy and raw materials i.e. the products of agriculture and forestry as key industries of this area. The soil produces 97% of the food the mankind consumes today and, therefore, its role in the modern concept of economy development, that will surely mark this millennium, is irreplaceable. The key corner stone of this development is sustainable agriculture, in which again sustainable soil management bares the key significance (Bašić and Herceg 2012, Kisić 2012).

The goal of this study was to give a spatial review and quantification of the present land use and land use change in the area surrounding Jakuševec landfill in Zagreb, capital city of Croatia, as well as an interpretation of agricultural soils in the vicinity of the landfill.

Materials and Methods

Maps of land use in approximately 2 km zone around the landfill Jakuševec were created, based on the photointerpretation during 2012 and according to the Corine Land Cover (CLC) 2000, 2006 and 2012 database (European Environment Agency) in a 1:50 000 scales (ESRI, ArcMap 10.1). Land use change between 2000 and 2012 was calculated to observe if there would be decrease in the area of agricultural land. Soil types were classified according to the soil map (General Soil Map 1: 50 000) of the surrounding area.

Results and Discussion

The landfill is located in the south of Zagreb, just 5 km from the city centre, by the right bank of river Sava (Figure 1). The landfill stretches to the northwest-southeast alongside the bank of river Sava separated by a local road. To the west a famous park Bundek and neighbourhoods Dugave, Utrina, Travno and Zaprođe are located, to the south there is the neighbourhood Jakuševec (distance about 400 m), railway yard and Zagreb beltway, to the east we find the neighbourhood Mičevec and large area of agricultural land, and to the north there is a heating plant (HEP- Toplinarstvo) and a famous swamp area Savica (Savica was declared an important landscape with allocated special zoology reservoir, and since 2003 The Croatian Ornithology Society conducts bird mapping activities there). The natural wealth of this area is one of the biggest resources for development. The investigated area overlaps with heterogeneous agricultural land, forests and a swamp. To show the condition of the environment around the landfill, maps of the present land use and quantification of land use change according to the former land use inventory (CLC 2000, CLC 2006) was made.

After the literature review, similar situation was found in Ukraine where municipal solid waste landfill in Myronivka city is mainly bordering with agricultural fields with arable crops (Makarenko and Budak 2017). The distance to the nearest residential development and the river is 800 m and 1400 m, respectively. Hydrogeological conditions of region are characterized by an unconfined groundwater aquifer, as is situation in Zagreb as well. In that direction, authors have been investigated the impacts of the landfill on the surrounding agricultural areas, and natural resources (soil, plants, water, air). Chrysikou et al. (2008) carried out their research on the municipal waste landfill "Tagarades" located in a rural area of northern Greece, around 20 km southeast of the city of Thessaloniki surrounded by several residential communities. The main activity in the area is agriculture (mainly vegetable, olive trees and wheat cultivation) and extensive animal husbandry at variable distances from the landfill (0.5–7.5 km). They have studied distribution of pollutants after a large scale landfill fire.

Figure 1. *Satellite image of the Zagreb waste landfill and surrounding land features (Source: Google Earth 2017)*

The maps of land use in the area of 2 km around the waste landfill Jakuševec in Zagreb are shown in Figure 2. Based on the photointerpretation during 2012 and according to the Corine Land Cover 2000, 2006 and 2012 database, spatial analysis revealed thirteen land use categories of total size around 3161 ha (Table 1). These categories were divided into three larger groups based on land use types (water: 5 %, agricultural land: 50 % and city: 45 % of the total analysed area). According to the recent data (CLC 2012), water includes: river Sava (84.3 ha) and its streams (the swamp area of Savica the size of 74.8 ha). The city includes city areas (settlements, villages and neighbourhoods the size of 970.8 ha), industrial units (186.8 ha), roads and railway network (111.5 ha), the airport (0.03 ha), green spaces in the city (43.3 ha) that are also fit for agriculture but don't produce plants fit for human consumption but for horticultural purposes, and finally, the landfill itself (131.5 ha). Agricultural land includes non-irrigated arable land (east from Savica the size of 45.8 ha), farming land with larger areas of natural vegetation (downstream from the landfill, by the right and left banks of Sava, the area east and west from the swampy area of Savica and ex-military range of JNA - Yugoslav National Army "Maršal Tito" in the neighbourhood Travno the size of 351.3 ha), pastures (7.7 ha) and a complex of cultivated parcels (most of them south and northeast from the landfill the size of 1133.9 ha). It is important to emphasize that agriculture is extremely important to this urban area, no matter its vicinity to the landfill. The agricultural land makes a staggering 50 % of total surface under observation, which makes 1557.6 ha in the zone of approximately 2 km from the landfill site in Jakuševec. Intensive agricultural production takes place even alongside the very edges of the landfill. There are only a few abandoned parcels within the landfill zone. The people mostly produce vegetables, arable crops (corn, wheat) and fodder crops, but there are also pastures and forests. Since the local agricultural production relies on fertile soils located near a large Zagreb market, such a structure is implied.

Slightly different situation was detected when calculating land use change in the vicinity of the landfill over the years. According to the land use change analysis for CLC 2000 vs 2012, results revealed increase in area of artificial land use features (20 % of industrial or commercial units, 10 % road and rail networks and associated land, and 10 % of green urban areas). Landfill site area (code: 132) decreased for 30 ha (18.2 %) which were converted to recycling center (Prudinec - Jakuševec, code: 121). Infrastructural development caused general decrease of agricultural land over the years

(more than 28 % of non-irrigated arable land, high 48 % of pastures, and 1-4 % of complex cultivation patterns and land principally occupied by agriculture, with natural vegetation). New agricultural land use appeared in 2012 which have taken up to 20 ha (222 - Fruit trees and berry plantations). According to the CLC 2006, significant land use change compared to CLC 2000 was observed for pastures which area was decreased up to 7 ha, and for green urban areas which were reduced doubly in 2006. As stated by Cavallo et al. (2016), public policies have a key role to deal, on the one side, with the sustainable restructuring of existing buildings and, on the other, with building density in relation to protecting the agricultural territory and marginal areas.

Table 1. *Land use and land use change of 2 km zone around the waste landfill Jakuševec, Zagreb (Source: CLC 2000, CLC 2006, CLC 2012)*

Code	Area, ha			Land use change 2000 vs 2012, %
	CLC 2000	CLC 2006	CLC 2012	
112	963.4	991	970.8	0.8 ↑
121	149	149	186.8	20.2 ↑
122	100.1	100.1	111.5	10.2 ↑
124	-	-	0.03	new code
132	160.7	160.7	131.5	18.2 ↓
141	39	18.1	43.3	9.9 ↑
211	63.8	63.8	45.8	28.2 ↓
222	-	-	18.9	new code
231	14.8	8.2	7.7	48.0 ↓
242	1145.7	1145.7	1133.9	1.0 ↓
243	365.4	365.4	351.3	3.9 ↓
511	84.3	84.3	84.3	NC
512	74.8	74.8	74.8	NC

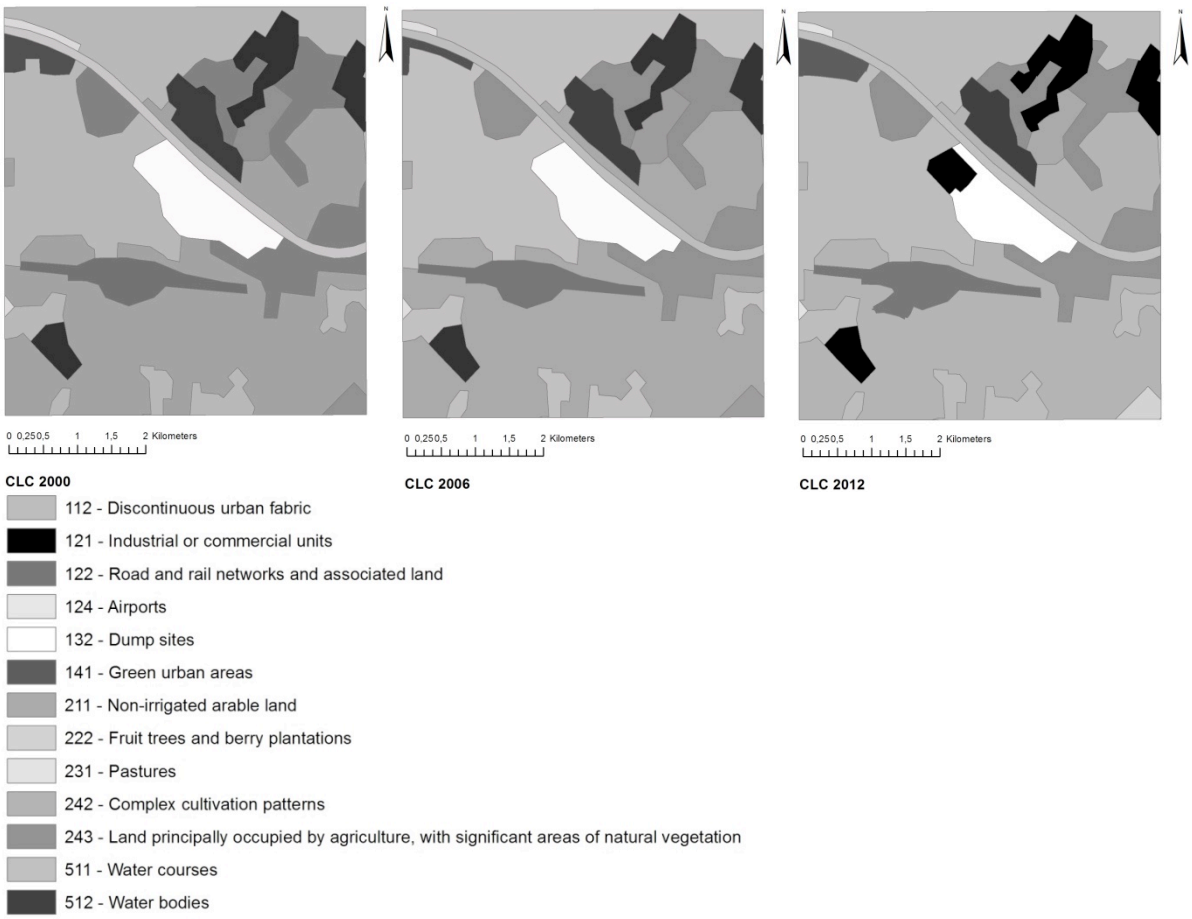
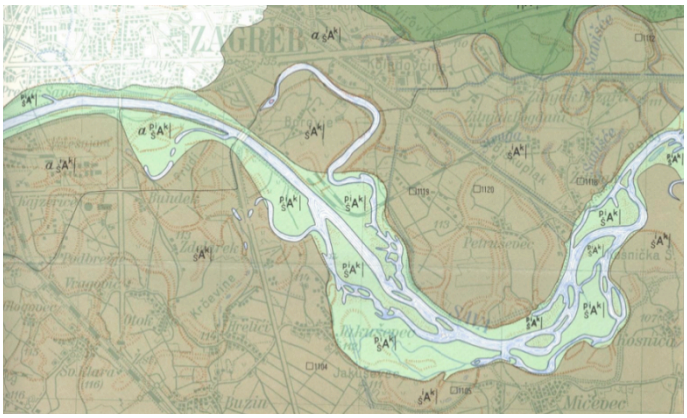


Figure 2. *The maps of land use in the area of 2 km around the waste landfill Jakuševec, Zagreb (Source: CLC 2000, CLC 2006, and CLC 2012)*

According to the soil map (General Soil Map 1: 50 000) of the surrounding area, two sub orders of soil types have been classified: alluvial carbonated sandy loam and alluvial carbonated, in some places slightly gleyed loamy soils (Figure 3). They are undeveloped, hydromorphic soils, created by flooding of the river Sava, sedimentation of materials and are formed as deep alluvial deposits of the first – Holocene Sava terrace. Although the banks were built in 1964 to defend from the floods caused by the river Sava and no further flooding of that area had occurred, these soils still bear the stamp of alluvial sedimentation (Martinović 2000). The soils are predominantly non-gleyed, hence without any signs of excessive moisture or water stagnation within 150 cm of soil depth. As these soils have been intensively used in agriculture, anthropogenic influences are very pronounced.

It is hard to tell the influence of the landfill Jakuševec on the potential pollution of the surrounding agricultural soil used in intensive agriculture from the start of waste disposal (since 1965 uncontrollable disposal, in 1998 ZGOS was founded, since 2003 remediation of the landfill). Very few studies have been conducted on the basis of which an estimation of the quality of the surrounding soil could be done.



A. Alluvial soils	
	Alluvial calcareous sandy-loam soils
	Alluvial calcareous sporadically slightly gleyed loamy soils

Figure 3. *Soil map of the area surrounding landfill Jakuševec, Zagreb 1, M 1: 50 000 (Source: Kovačević et al. 1972)*

Conclusions

Spatial analysis revealed thirteen land use categories of total size around 3161 ha. These categories were divided into three larger groups based on land use types (water: 5 %, agricultural land: 50 % and city: 45 % of the total analyzed area). The overall trend in land use change in the vicinity of the Zagreb landfill indicates loss of traditional suburban agriculture in exchange for an increase in industrial or commercial units and transport infrastructure area, which represents negative impact for local people and Zagreb food market. Mixed agriculture is typical land use feature of the investigated area. Zagreb is the capital city, but its urban structure is directly surrounded with pitiful landscape composed of complex pattern of agricultural land which productivity relies on fertile alluvial soils. As regards other marginal parts of the city, it can be assumed that land use change tends to convert agricultural land to other usages, but the area in the vicinity of the landfill gradually loses its main identity. The question is when the landfill will be officially closed and what will be the new solution for waste management in the city of Zagreb. It can be assumed that surrounding area will be converted into green urban areas or industrial/commercial units.

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EXPERIMENTAL TESTING SETUP OF SOME WASTE OIL SEEDS TREATMENT F0R BIODIESEL OBTAINING

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Abstract

Recent environmental and economic concerns have prompted resurgence in the use of biofuels throughout the world, there is increase in CO2 emissions as well as several other air pollutants. Edible and non-edible seed oil crops have proven to be recognized sources of vegetable oils for biodiesel production, although the production process has been developed for edible seed oil. Hence this paper highlights the production of biodiesel from plant seed oil, some of the factors that influences its production, the criteria the pure biodiesel must meet, the conversion techniques and the various methods of production acknowledging transesterification as the preferred choice.

Keywords: Biodiesel, Plant Seed Oil, Transesterification, Catalyst, Petrodiesel

Introduction

Fossil fuels are currently the main resources of energy meeting the world requirements. The major part of all energy consumed worldwide comes from fossil based resources (petroleum, coal and natural gas). Recently, due to increase in crude oil prices, limited resources of fossil oil and environmental concerns, there has been a renewed focus on searching for alternatives that are renewable and sustainable. [Gashaw, A. and Lakachew, A. (2014].

A potential diesel oil substitute is biodiesel, hence, Biomass derived fuels such as methane, ethanol, and methanol are well-accepted alternatives to diesel fuels as they are economically feasible, renewable, environmental friendly and can be produced easily in rural areas where there is an acute need for modern forms of energy. Biodiesel is attracting an increasing deal of attention worldwide for it is currently the only renewable energy carrier which could directly replace diesel fuel in compression ignition engines [Arjun B. C, Watts K. C and Islam M. R. (2008)].

Biodiesel is an ecofriendly, alternative diesel fuel prepared from domestic renewable resources, It is a renewable source of energy which seems to be an ideal solution for global energy demands. It has attracted considerable attention during the past decade as a renewable, biodegradable and non-toxic fuel which has served as an alternative to fossil fuels [Vonortas, A., Papayannakos, N., (2014)].

The American Society for Testing and Materials (ASTM) defines biodiesel fuel as mono alkyl esters of long chain fatty acids derived from a renewable lipid feedstock, such as vegetable oil or animal fat.

"Bio" represents its renewable and biological source in contrast to traditional petroleum-based diesel fuel; "diesel" refers to its use in diesel engines. As an alternative fuel, biodiesel can be used in neat form or mixed with petroleum-based diesel .Biodiesel represents a largely

closed carbon dioxide cycle (approximately 78%), as it is derived from renewable biomass sources [Arjun B. C, Watts K. C and Islam M. R. (2008)]. Compared to petroleum diesel, biodiesel has lower emission of pollutants, it is biodegradable and enhances the engine lubricity [Arjun B. C, Watts K. C and Islam M. R. (2008).] and contributes to sustainability.

A major obstacle in the commercialization of biodiesel production from edible vegetable oils is their high production cost, which is due to the demand for human consumption "the food versus fuel dispute" .Reducing the cost of the feedstock is necessary for biodiesel's long-term commercial viability. The cost of feedstock accounted for 88% of total estimated production cost [Jaichandar, S. and Annamalai, K. (2011)]. One way to reduce the cost of this fuel is to use a less expensive feedstock including waste cooking oils and vegetable oils that are non-edible and/or require low harvesting costs. In all cases, more than 80% of the production cost is associated with the feedstock, such as recycled cooking oils. Reusing of these waste greases not only reduce the burden of the government in disposing the waste, maintaining public sewers, and treating the oily wastewater, but also lower the production cost of biodiesel significantly. Waste vegetable oil (WVO), which is much less expensive than edible vegetable oil, is a promising alternative to edible vegetable oil.

Material and methods

Methods

In biodiesel preparation from vegetable oils and alcohol in the presence of a catalyst. The mixture is blended into the vegetable oil causing a chemical reaction, called transesterification, which separates the vegetable oil into two components. One component is a heavier liquid called glycerol (also called glycerine). The by-product, glycerol, has an economical value. Glycerol has many food and industrial uses such as cosmetics, toothpaste, pharmaceuticals, foodstuffs, plastics, explosives and cellulose processing, hand cream and soap However, the material obtained from biodiesel production requires purification before it could be used for these purposes. The second component is called an ester of the oil or biodiesel. The ester is lighter than the glycerol and so rises to the top after the reaction is complete. The ester after carefully processing to remove all remaining catalyst, alcohol and glycerol can be used as a fuel in diesel engines. The esters are good solvents, cleaning agents, and can be used in cosmetics. They have been used to prevent asphalt from sticking to metal such as truck beds, and are used as surfactants in agricultural chemicals. They are lubricants and have other similar uses.

Process Production of Biodiesels Based on Catalyst

Two preferred methods for the industrial production of biodiesel from non-edible oils are base catalyzed and acid catalyzed transesterification.

Base-Catalyzed Transesterification

This is the traditional technology commonly employed for the commercial production of biodiesel from there fined vegetable oils/fats that are low in free fatty acids (FFAs < 0.1 wt %). It involves the transesterification of triglycerides present in oil/fat with a lower alcohol(mostly methanol) in the presence of a catalytic amount of a base (alcoholic solution of KOH/NaOH or sodium methoxide) at the atmospheric pressure under the reflux condition for alcohol (60-70 °C) [Tyagi, O.S., Atray, N., Kumar, B. and Datta, A.(2010)] .

Characteristics of Plant Seed Oils Affecting Their Suitability for Use as Biodiesel

Biodiesel is better than diesel fuel in terms of sulfur content, flash point, aromatic content, and biodegradability. Biodiesel esters are characterized by their physical and fuel properties

including density, viscosity, iodine value, acid value, cloud point, pure point, gross heat of combustion and volatility.

Calorific Value, Heat of Combustion

This is the amount of heat energy released by the combustion of a unit value of fuel. One of the most important determinants of heating value is moisture content. Air-dried biomass typically has about 15-20%moisture, whereas the moisture content for oven-dried biomass is negligible. Moisture content in coals varies in the range 2-30%. However, the bulk density of most biomass feed stocks is generally low, even after densification – between 10 and 40% of the bulk density of most fossil fuels. Liquid biofuels however have bulk densities comparable to those for fossil fuels.

Melt Point or Pour Point

Melt or pour point refers to the temperature at which the oil in solid form starts to melt or pour. The pour point is the lowest temperature at which the oil specimen will flow. In cases where the temperatures fall below the melt point, the entire fuel system including all fuel lines and fuel tank will need to be heated.

Flash Point

The flash point temperature of a fuel is the minimum temperature at which the fuel will ignite (flash) on application of an ignition source. Flash point varies inversely with the fuel‘s volatility. Minimum flash point temperatures are required for proper safety and handling of diesel fuel. The flash point of biodiesel is higher than the petro diesel, which is safe for transport purpose. High values of flash point decreases the risk of fire.

Materials

Refined safflower oil, soybean oil, corn oil, methanol, KOH,

Process Conditions

Pre- heating of oil: 46-50ºC

Pressure: 1 atmosphere

The mixture of reaction time: 60 min

Transesterification method: the method applied is basic transesterification with KOH as catalyst.

Feedstock: vegetable oil (soybean, corn and sunflower).

Transesterification process

Oils that we use to produce biodiesel are soya, corn oil, sunflower oil. For the production of Biodiesel using transesterification with basic catalyst (KOH) followed this worked procedure:

The oil sample was heated in a beaker to 45-50ºC to evaporate the water.

In order to determine the amount of catalyst needed for transesterification, titration was carried out using a standard KOH solution (0.1%) because KOH was used as the catalyst in this process. From the titration, the total amount of catalyst per liter of vegetable oil was determined to be 4 grams of KOH per liter of vegetable oil. This amount was confirmed to be correct by actual experiment.

The transesterification reaction was carried out using 100% technical grade methanol. The alcohol used was 160ml per liter of vegetable oil. First the alcohol and catalyst mix to form methokside. Then oil were poured into the reactor vessel in which the reaction was to be carried out. When the temperature was 50°C we put into the vessel methokside. Transesterification was carried out using a heating plate and a magnetic stirrer.

The reaction temperature used was 50ºC. After heating at 50ºC for 60 minutes, the mixture was cooled in air for about 48 hours at room temperature (24ºC) to settle the glycerin phase and biodiesel phase by gravity.

After mixing the liquid, it is allowed to cool down. After the cooling process, the bio fuel is found floating on the top while the heavier glycerin is found at the bottom. The glycerin is easily separated by allowing it to drain out from the bottom. In this way pure Bio Diesel is prepared.

- Allow the glycerin to settle.
- Settle the mixture overnight.
- The successful chemical reaction between the oil, alcohol, and the catalyst will have broken down the oil into several layers.
- The top layer will be biodiesel, chemically called an Ester, the next layer may contain soap, and the bottom layer will be glycerin.

Biodiesel and glycerin will separate due to density difference. Glycerin and unreacted catalyst will sink to the bottom and can be easily drained .After separation of biodiesel it must be washed with hot water to remove unreacted methanol and potassium hydroxide.

All the water contained in the residual gangue is removed which makes the reaction faster. The water is easily removed by boiling the liquid at 500C for some time.

Results

Table 1 summarizes the physico-chemicals indicators of biodiesel producing by different raw materials. And figure one shows us the different appearance of biodiesel.

Table 1: Physic-chemical characteristic of process of transesterification basic and qualitative indicators biodiesel

	Physic-chemical indicators	Biodiesel from soya	Biodiesel from sunflower	Biodiesel from corn
1	Density of biodiesel; (t= 24 ºC)	0.893	0.874	0.893
2	Density of biodiesel; (d_4^{20}); (gr/cm^3)	0.8946	0.876	0.8946
3	Angle of refraction; (n_D^{24})	1.473	1.458	1.473
4	Flash point; (ºC)	238 ºC	108 ºC	238 ºC
5	Cetane Number	58	60	59

Fig 1: Pictures during the process of decantation

Fig 2: Biodiesel from soya, from corn and from sunflower oil

Discyssion-Conclusion

The world‘s accessible oil reservoirs are gradually depleting, it is important to develop suitable long-term strategies based on utilization of renewable fuel that would gradually substitute the declining fossil fuel production. In addition, the production and consumption of fossil fuels have caused environmental damage by increasing the CO2 concentration in the atmosphere. Biodiesel derived from vegetable oil or animal fat by transesterification with alcohol such as methanol or ethanol, is recommended for use as a substitute for petroleum based diesel because biodiesel is oxygenated, (the gasses released during combustion are essentially the gasses absorbed from the atmosphere whilst the plant was growing.) Efforts should be made to; establish sustainable bio energy crops mainly non-edible within existing and future cropping systems and agro climates and to develop new, value-added technologies to make in-state production of biodiesel more economical "from seed to pump.

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SOCIAL FARMING AND SUSTAINABLE TERRITORIAL DEVELOPMENT

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Abstract

Agriculture by its characteristics plays a key role in the realization of sustainable development proposed by 2030 Agenda and this becomes even more relevant in the individual territorial systems. All this, however, is subordinated to a change of paradigm, it must be capable to *internalize the cost of scarcity of the four capital stocks*. The paper, after a brief analysis of the role of agriculture in Agenda 2030, will develop some reflections on how social farming responds to the demands of inclusion of that human capital marginalized by society, offering real opportunities that can value it. The different forms of social farming could be considered as genuine governance tools for implementing welfare policies aimed at improving the "social sustainability" of the reference territory.

Keywords: *social farming, sustainable development, territorial development, 2030 Agenda*

Introduction

Agriculture, which in the past was destined to engage in food-producing activities through the use of highly intensive techniques, is now called to play a central role in sustainable development strategies. The 2030 Agenda for Sustainable Development, adopted by the United Nations in September 2015, is one of the first international non-sector-specific documents in which food and agriculture are key to achieving the entire set of SDGs (FAO, 2014).

Agriculture, though not explicitly stated, is the focus of Goal 2 "End hunger, achieve food security and improved nutrition and promote sustainable agriculture". The analysis conducted on the goal shows clearly that producing in a sustainable way is a constraint to overcome the difficulties linked to food supply, both in quantitative and qualitative terms. In other words, producing in a sustainable way is the background to all the targets covered by Goal 2.

Specifically, it appears that sustainable agriculture can contribute to create a better future for the 5 Ps (action plans of which 2030 Agenda is composed), namely:

- Peace: especially in developing countries, it can promote gender equity through a greater involvement of women;
- People: in addition to food production, sustainable agriculture plays an important role for people's health and the building of consumer awareness;
- Planet: sustainable use and conservation of natural resources links directly with more sustainable agriculture, but there could be potential trade-offs with some environmental dimensions, such as halting biodiversity loss;
- Prosperity: agriculture accounts for an important employment segment in most developing countries and stands out as a crucial source of income for the poorest ones;
- Partnership: for its development, sustainable agriculture requires the creation of partnerships amongst various areas, namely: policy, trade, technology, and capacity building.

To put in place a sustainable agriculture is not an easy task, as compromises and trade-offs amongst the different constraints slow down this change (UN, 2015).

FAO declared that, in order to be deemed sustainable, agriculture must meet the needs of present and future generations with its products and services, while ensuring profitability, environmental protection and greater social and economic equity (FAO, 2014).

All this inevitably also influences the interpretative approach of the concept of sustainable agriculture: we witness the transition from a commitment towards ensuring itself over a long period of time - protecting its productive resources - to the concern of having to produce, in order to contribute towards the sustainability of the welfare of the territories and of society. In other words, from a so to speak of "food-for-food" logic, we move towards one of "food for sustainability" (Cesaretti et al.,

2015). In particular, being able to move towards sustainable agriculture requires a major commitment of governances at all levels and that, with their decisions, can define the directions to follow. Thus, agriculture appears to be at a pivotal stage in terms of societal demands for agricultural systems with improved sustainability that is, systems that address and balance social, economic, and environmental performance, and increase robustness in the face of new challenges (National Research Council 2010, De Angelis and Kononova 2015).

In this work, emphasis will be on the contribution that agriculture can give in terms of social sustainability. In particular, you addressed the issue of social farming is understood as a means of strengthening the capacity of a local system of worrying instances of particular stakeholders, that is, to those who for various reasons cannot actively participate in the development model (Misso 2013) and very often are at risk of falling victim to "culture of waste" (Cesaretti 2017). The spread of these activities can be configured as one of the basic drivers for achieving the transformation hoped for in the 2030 Agenda.

Materials and Methods

Over time, the role of agriculture in society has renewed itself, moving from a strategic single food goods production, in order to ensure greater wellbeing. Think of natural resource maintenance, landscape management, the protection of cultural heritages, and culinary traditions, as well as proposals that are increasingly linked to quality assurance and food safety. Therefore, the multifunctional role of agriculture has been recognized. The emergence of a multifunctional character if, on one hand, responds to the new needs of the consumer; on the other hand, it offers new opportunities to agricultural enterprises towards diversifying their income. Diversification strategies are numerous: focusing on activities closely related to agricultural production, expanding the functions performed by the company, and/or reallocating productive factors outside of the company itself (Van der Ploeg e al. 2002). The development of these activities also marks the birth of many interconnections with other economic sectors. This view of agriculture is increasingly valued, so much so that the European Union identifies in multifunctionality the expression of the "model of European agriculture", which plays a strategic role through the sustainable management of rural territories and provides effective responses to the new needs of citizens.

In this context, multifunctional agriculture acquires its fullest significance and shows its potential as a driving force for integrated development. That is, multifunctionality can be defined as a mechanism for integrated development and a tool for potential territorial enhancement in agricultural activities, crucial for rural sustainability (Andreopoulou et al. 2012, Casini et al. 2012).

Compared to the contribution that agriculture can give a territorial development practice yet little coding but which has now become a reality is social farming. The Social Farming concept can be associated with agriculture as a multifunctional activity, giving agricultural practice new meanings and functions and incorporating social services, medical treatment and rehabilitation, and educational training and support. In addition, agriculture must be considered as a means of employment and social integration for groups as diverse as individuals who are unemployed or living with mental retardation, mental disorders, or addictions, among others (Tulla et al. 2014).

Secondo Opinion of the European Economic and Social Committee on 'Social farming: green care and social and health policies' (2013/C 44/07), "*social farming could thus be provisionally defined as a cluster of activities that use agricultural resources – both animal and plant – to generate social services in rural or semi-rural areas, such as rehabilitation, therapy, sheltered jobs, lifelong learning and other activities contributing to social integration (according to the definition used in COST (European Cooperation in Science and Technology) Action 866 – Green Care). In this sense, it is about – among other things – making farms places where people with particular needs can take part in daily farming routines as a way of furthering their development, making progress and improving their well-being. There are currently four main areas of social farming: a)rehabilitation and therapeutic activities; b)work inclusion and social integration; c)education activities; d)personal support services*" (Willems 2013).

Social farming spread throughout Europe with very different modes. In some countries (United Kingdom, Ireland and Slovenia), social farming focuses on therapeutic aspects rehabilitation and is practiced in "institutional farms" put under hospital wards, health institutions, charities and religious or

secular. In the Netherlands, Belgium (Flanders) and Norway, where therapeutic rehabilitation appearance is privileged, social farming developed mainly in private farms, as opposed to Italy, France and Germany, where the social farming has found its roots in the voluntary initiatives, although in Italy is now spreading even in private companies (Finuola 2011). Social farming practices spread in Italian and European campaigns unexpectedly and silent, by changing the shape and nature of logic, but maintaining a different way of conceiving the inclusion of low-contractual character entities.

Social farming provides some possible responses to the crisis of services in rural areas and peri-urban areas and mobilizing innovative resources of the area (agricultural) to contribute to the development of a welfare State in which the issues of subsidiarity, of the value of the relationship, the co-production, are multiple meanings and applications (Di Iacovo et al. 2013).

Social farming is linked to agricultural and rural development from two different points of view, because:

• adopts a multifunctional vision of agriculture by linking the management of production processes in the creation of services and welfare for the people involved (Casini et al. 2010).

• Contributes to development in rural areas, consolidating the network of services available to local people, enhancing the reputation and the ability of the agricultural enterprises to operate in new networks of stakeholders, improving the visibility of their offer and diversifying income opportunities, stimulating the entry of new players in the management of innovative economic activities (Di Iacovo 2003, Di Iacovo et al. 2013).

On the one hand, provides possible answers for the renewal of the social safety net, mobilizing resources and new actors. At the same time, the organization of these resources can provide alternative answers to a question payor of potential users, that is, be lowered within a new network of relations between enterprises and public service, with a view to strengthening the social safety net (Di Iacovo et al. 2011).

Social farming is gaining importance in the context of rural development policies. The Regulation (EU) No 1305/2013 of the European Parliament and of the Council on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) n art. 35 "Cooperation" makes explicit reference to social farming, sign of how there is a vested interest and support of the European institutions to develop these practices. It is important to observe how individual countries have transposed this address and what strategy they intend to implement (Viola et al. 2015). To this end, it is considered interesting to analyze the Rural Development Programs (RDP) elaborated by each Italian regions, highlighting first whether measures have been taken that relate to social farming, deepening then the address that is given to its implementation.

Results

The analysis of the RDP Italian regions show a great attention to social farming. There are few regions not made explicit references to this type of diversification. Furthermore, it confirms the many facets that can take on the concept of social farming.

As was apparent from the literature, also in development programmes we are faced with a range of activities ranging from simple transfer of knowledge concerning the food and environment to provide nursing services. The regions to handle this very varied offer adopted two strategies, mutually opposed, some have decided to define a fairly detailed what activities are included while others have preferred to use the big umbrella "social farming", leaving more degrees of freedom in interpretation and participation of enterprises. Below is the summary in the table 1.

Table 1. M*easures of RDP on the social farming*

Region	Measures	Elements of diversity
Abruzzo	6.4.2	Social farming (therapeutic-rehabilitation services, occupational training)
Basilica	1.1 16.9	No specification on the type of activity of social farming
Bolzano	no	
Calabria	6.4 16.9	Educational activities and/or social life in farm (childcare, elderly care, health care and people with disabilities, teaching farms)
Friuli Venezia Giulia	6.2 6.4	Social activities for people with forms of disadvantage, disability and discomfort, as well as the implementation of social services for children and the elderly; Reference to social innovation
Campania	16.9	Social farming widely understood. Reference to the insertion of young people seeking their first employment business
Emilia Romagna	16.9	The promotion and implementation of social services by farms in partnership with public entities.
Lazio	6.4 7.4.1 16.9.1	Social farming widely understood. Reference to the integration of migrants and refugees
Liguria	6.2 16.9	Social farming widely understood
Lombardia	6.4.2 16.9.1	Social farming widely understood
Marche	6.4.2 16.9.1	Social farming widely understood
Molise	no	
Piemonte	16.9	Social farming widely understood. Reference to social innovation
Puglia		The LAG should be involved in supporting a social policy aimed at improving the quality of life in their area in compliance with community and national guidelines and also addresses defined on social farming.
Sardegna	16.9	Social farming widely understood
Sicilia	6.4 16.9	Social farming widely understood. Reference to the purpose and the sustainable development of urban agriculture tourism and rural peri-urban
Toscana	16.9	Social farming widely understood. Reference to social innovation
Trento	no	
Umbria	16.9	Social Farming tools of welfare and to promote social innovation.
Veneto	16.9	Social farming widely understood

From the description of the measures shows that the common denominator is the help to people in difficulty, but the focus varies from region to region. For example, only two regions refer to the disadvantaged category, or type, Lazio is the only region that has explicitly among disadvantaged groups of migrants. Other interesting difference is in the management of labour inclusion. The Campania region is the only one who has extended among the potential beneficiaries beyond the categories with disabilities young people seeking their first jobs. Sicily combines services for people caring for the environment, promoting the preservation and sustainable development of the urban and suburban agriculture in rural areas (urban gardens in rural areas, spaces of integration between urban and rural world of farms who insist in peri-urban areas).

Most of the regional programmes have included references to social farming in two main areas: the development of non-agricultural services in rural areas and the creation of cooperation between parties and other stakeholders in the local areas. Both, however, have as objective the enhancement of quality of life in the territory. It aims to launch an integrated development of activities to promote sustainable territorial development.

On the need for integration and improvement of services to the area, deserves to be highlighted the initiative of Emilia Romagna that has limited the access to measurements on social farming in the presence of an agreement between subject agriculture and local authority. The Umbria region,

moreover, refers explicitly to the synergy to be created for improving the quality of welfare in rural areas.

Another interesting aspect, which should be developed further thoughts, is the importance that is accorded to these practices: for most regions social farming is considered a further opportunity to diversify agricultural activity, but some start to make their way to the idea that creating an integration between social functions of agriculture and services to the territory could represent a model of social innovation. In other words, social farming can represent an innovative solution to territorial cohesion, speaking both on the need to meet new social needs of protection and services to people in rural and peri-urban areas, both on the possibility of facilitating the development of rural networks.

These brief reflections allow us to state that the conditions exist to assist in the coming years for a development of agricultural diversification in social.

Discussion-Conclusions

Social farming can represent the action that manages to combine an interest in diversify agricultural holdings with the need of local communities, especially those in rural areas, to have access to services that enhance the quality of life. In this perspective, social farming experiences, allow local systems to increase their inclusive and their ability to provide useful answers to the needs of *particular stakeholders*.

Moreover, it will promote greater integration of the agricultural enterprises at the local level with other economic and social sectors, and it will enhance the role of agriculture not only economically, but also supervision and protection of land, landscape and environment and social integration**.**

While it is true that in the programming 2014-2020 the reference to social farming is strong it remains to see how this will be implemented. We need a strong awareness of governance so that does not stop only to diversification but points to our well-being in the territories, generating a real social innovation oriented to overcome the *culture of waste***.**

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MANAGER OF SUSTAINABLE TERRITORIAL DEVELOPMENT

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Abstract
Today, to go to a new global society project where well-being and sustainability are the key strategic goal, it is necessary to achieve sustainability in the various territorial systems. Well-being sustainability in territorial systems can only be achieved with the adoption of a new and successful "Territorial Sustainability Paradigm" based on a Quality System Approach and a Non-Approval Strategy. To adopt the new Territorial Sustainability Paradigm, it is necessary to create new professional profiles able to know how to apply this paradigm. It is the task of the Knowledge System to form these new profiles, curving the present training offer through the integration of the principles of the circular economy. These new training models will have the task of forming a human capital capable of governing the paradigm of territorial sustainability, and responding to the principles of sustainability. You must then create a Sustainable Job. In this paper we will show that the Manager of sustainable territorial development is the sustainable job capable of applying the new paradigm.

Keywords: *sustainable job, Knowledge System, Territorial Sustainability Paradigm, Quality System Approach, Non-Approval Strategy.*

Introduction
One element that distinguishes the different visions of sustainability concerns the consideration of the plurality of dimensions that sustainability itself involves (environmental, economic, cultural, social, political, etc.) (Lombardini G., 2017).

Both at the level of visions of the key definition of sustainability and at the level of practices, distinctions can be made on the basis of accentuation on one of the dimensions of sustainability and, above all, on their integration, ie on the ability to identify common objectives between different sizes. Alongside these dimensions, not least architects, urbanists and geographers, but also economists, anthropologists and sociologists attentive to the spatial dimension of social events, especially those of the sciences of the territory, they also point to the need to refer to territorial sustainability, as one of the other dimensions of sustainable development, which is based on the fact that society is organized on the territory and therefore also the territorial organization has to be tested for sustainability. Sustainability does not refer to an abstract space, an inert and regular background, and not just a dehumanized natural environment. Human beings do not inhabit space, nor the natural environment, but a territory, or, as C. Raffestin (1981) states, "*a space in which work, energy and information have been projected; a space that has been and is used, inhabited, exploited, known and cared for by the inhabitants*". G. Dematteis (2004) reminds us that "*a territory is not a simple geographic area, a pure material entity. It's not a thing but a set of relationships*". In different words A. Magnaghi (1990) states that "*territory does not exist in nature: it is a dynamic and stratified outcome of successive cycles of civilization; Is a complex system of relationships between established communities (and their cultures) and the environment, of which the anthropised landscape is the sensible outcome and perceivable identity. In this sense, the territory is a living organism of high complexity, produced by the encounter between cultural events and nature, composed of places (or regions) endowed with identity, history, character, long-term structure*".

Sustainability and, in particular, the well-being sustainability in territorial systems can only be achieved by adopting a new and successful "***Territorial Sustainability Paradigm***" based on a ***Quality System Approach*** and a ***Non-Approval Strategy*** (Cesaretti G.P., 2017). To adopt the new "***Territorial Sustainability Paradigm***", it is necessary to create new professional profiles that are able to apply this

paradigm. It is the task of the *Knowledge System* to form these new profiles, curving the present training offer through the integration of the principles of the circular economy. Training, which in turn assumes a fundamental strategic role, will have to be able to generate professional figures capable of recognizing the emergence of conditions conducive to sustainable development and at the same time to identify the conditions of instability, to draw up processes of sustainability of development and planning corrective practices in contexts of unsustainability, promoting the emergence of conditions conducive to sustainable territorial development.

The idea behind this paper is to present one of the main achievements in the study path that has developed over the last few years, with regard to the sustainability of territorial development and new frontiers of knowledge. In this paper we will show that the *Manager of sustainable territorial development is the sustainable job capable of applying the new paradigm*.

Materials and Methods

The centrality of human capital is now recognized both in theory and in the concrete experience of the productive world. The importance of knowledge as a strategic resource has brought the focus of attention to the quality of the human factor as a key element for the competitiveness of an enterprise as a territory.

Strengthening relationships between businesses and local actors, such as universities, schools, research centers, can be a key vehicle for building new knowledge production and making it available in the territorial context. In this context, the importance of training is understood as a means of disseminating knowledge and upgrading the professional skills of workers in a manner consistent with the changes in the competitive environment. Even in training activities, there is a need to be proactive today, ie to be able to anticipate the times, from the point of view of the identification of training needs and the goals that companies, but also the territories, aim at achieving thanks investment in training. The need for innovation in this area also invests in teaching methodologies. In fact, while in the past, the role of training was essentially to transfer well-known and consolidated principles, techniques, tools and know-how into the present context, it is increasingly about generating new know-how (Rebuffo, 2000). New intervention strategies should be able to build real learning contexts to trigger knowledge creation processes. Resuming the Porterian approach, the competitiveness of a country system is conditioned by the availability of qualified human capital and physical and technological infrastructures, by the presence of research and training centers, services and territorial support, and market features (Viola I., 2017).

A new qualified human capital with respect to sustainability issues, and in particular the sustainability of well-being in territorial systems, is at the heart of the research path here shown. Well-being Sustainability in territorial systems can only be achieved with the adoption of a new and successful "***Paradigm of Territorial Sustainability***" based on a Quality System Approach and a Non-Approval Strategy. To adopt the new "Territorial Sustainability Paradigm", it is necessary to create new professional profiles able to know how to apply this paradigm (Cesaretti G.P., 2017). It is the task of the Knowledge System to form these new profiles, curving the present training offer through the integration of the principles of the circular economy. These new training models will have the task of forming a human capital capable of governing the paradigm of territorial sustainability, and responding to the principles of sustainability.

You must then create a Sustainable Job.

The professional figure to be formed should, in our view, be able not only to meet the three dimensions of sustainability (economic - environmental - social); but should be able to offer its contribution in defining this paradigm of territorial sustainability. In order to achieve this goal, the training offer should cover issues related to Territory Economics, Circular Economy and Organization of a Territorial System.

Results

In a territory the central point is the availability of "human capital". Accumulated knowledge, acquired skills, and skills acquired through education contribute to determining the human capital of the person. There is a widespread belief that human capital accumulation is crucial today to support

sustainable economic growth and to strengthen social cohesion. Human capital is, in fact, considered essential to introduce technological and organizational innovations from which factor productivity depends and is also seen as a condition for access to higher salaries in the course of their career. In fact, in order to meet growing inequalities in remuneration, it is now time to invest in human capital. Specifically, in our research path we have focused on the definition of human capital on young people, which in our view constitute the architrave for par excellence of a territory. When a territory presents in its strategic assets the non-homogeneous elements to which it must be made to orient itself towards adopting a paradigm of territorial sustainability, here is the central role of the availability of human capital formed according to the principles of sustainability.

The territorial sustainability paradigm provides for the territory three fundamental steps: to make a system, ie to create a territorial network; able to adopt a system approach to Quality, from a linear economy to a circular economy; valorize and leverage on elements of non-homologation of the segments of strategic assets of the territory.

It is therefore necessary to have the availability of new human capital - new professional profiles capable not only of meeting the three dimensions of sustainability (economic - environmental - social); but must be able to offer their own contribution in defining this paradigm of territorial sustainability.

For doing so, we must better anticipate the future need for qualifications; better balance the supply of skills and labor market needs and bridge the gap between education and work. Work must therefore be done to ensure that the labor market is "*rebalanced*", in fact, with the presence of companies operating in segments of non-homologated sectors that "requires" qualified work, the response to be given is necessarily the presence of human capital "skilled work".

Who can fill this gap?

The knowledge system that plays a key role, which will have to provide a new training offer, different and above all functional to the new professional profiles that are compatible with the experiences of a territory that adopts a system approach to quality, enhances the homologation, system elements. It is therefore necessary to curve the training offer to meet the needs of the labor market and thus contribute to the definition of the *Territorial Sustainability Paradigm*. The training offer, integrated with the principles of the circular economy, will enable the creation of a new professional figure, which:

1. has competence to allow for a change of paradigm,
2. does it make a network,
3. has high skilled in the field of specialization.

This new professional figure takes the name of Sustainable Job. Sustainable Job is a professional, unequal, but eclectic and professional figure, a professional figure that recognizes the importance of making a system, is a professional figure that adheres to the principles of the circular economy, is a professional figure in its field.

For example.

The Manager of Sustainable Territorial Development:

1. has competences in the field of Territorial Economics (because he / she must know the territory, its peculiarities, its advantages, its products, its cultural heritage),

2. it has competences in the field of circular economy,

3. has competence in the organization of a territorial system.

The competences in the field of territorial economics are focused on the study of the functioning of the territorial economic system, the fundamental economic problems, the various types of economic system, also analyzing the activities of economic operators and the relations between them. In particular, the competences relating to the analysis of territorial systems and the use of cultural resources and creative industries are conceived as a factor for local development, quality and social cohesion and competitive positioning of territories (Dematteis, G., 1989). Culture in its contemporary meaning is both a capital asset with economic value and an individual and collective source of positive externalities essential for economic development and income generation and jobs. It is crucial to understand the link between territorial systems and the enhancement of heritage, resources and cultural industries, with particular attention to local development policies based on culture and creative industries.

To ensure "*sustainable territorial growth*" we have to use our resources in a smarter and more sustainable way. We cannot build our future on a "*us-and-throw model*" (Andersen M. S., 2007). Many natural resources are not infinite: we need to find a way to use them to be environmentally and economically sustainable, and it is also in the economic interest of businesses and territories to make the best possible use of their resources. To this end, it is important to emphasize winning strategies for the implementation of the circular economy in print: efficient resource management, circular chains, product life extension solutions, and new recovery and recycling models. A professional figure in support of a territorial system must acquire a methodology and an approach aimed at enhancing the linkage with the territories, the integration of politicians and actors, management innovation, with a careful look at the national and European guidelines. To this end, it should acquire a "*capacity to collaborate in synergy with other experts in interdisciplinary working groups*" and a "*capacity to establish professional relationships knowing how to manage human relationships with other people*", important for a figure who has to constantly relate to other professional skills (experts from other sectors, institutional staff, etc.). The presence of these skills, in a new professional figure, in the service of a territorial system, would certainly allow it to adopt, to put in place its "*Territorial Sustainability Paradigm*" based on a *Quality System Approach* and a *Non-Approval Strategy*.

Discussion-Conclusions

The centrality of human capital is now recognized both in theory and in the concrete experience of the productive world. The importance of knowledge as a strategic resource has brought the focus of attention to the quality of the human factor as a key element for the competitiveness of an enterprise as a territory. The *Manager of Sustainable Territorial Development* encloses, in our opinion, all the usefulness of the territorial system to leverage its strategic assets in a sustainable way, in order to put in place a model of development consistent with the principles of sustainability. It is therefore strongly hoped that the training system will take into account the need to invest in professional figures such as that outlined by research and proposal to the territories. Only if the training offer grows in quality, it can help to improve the conditions of a territorial system and in the case of decision-making and implementing processes that are good for the good governance of cities.

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INTEGRATED CONSERVATION ACTIONS FOR THE RELICT AND ENDEMIC CRETAN TREE *ZELKOVA ABELICEA* (ULMACEAE)

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Abstract

Zelkova abelicea is an endangered, relict and the only endemic tree species of the island of Crete. This rare species is threatened mainly by browsing and trampling by flocks. We present here a project initiated in 2014 for the conservation of *Z. abelicea* which includes specific in situ and ex situ conservation actions such as fencing of small natural stands, seed and vegetative material collection for seed bank or ex situ plantations, as well as public sensitization actions. *Z. abelicea* individuals reacted positively in most fenced areas by growing fast and producing long shoots directly after fencing took place, and plant species richness and coverage were found to be higher than in areas still subject to browsing. Regarding ex situ conservation actions, definitive results are still expected in the following years. Finally, numerous local people have been informed about this threatened and rare tree and the project actions through environmental education programs and local public events.

Keywords

Plant conservation, Threatened tree, Browsing pressure, Crete, Zelkova abelicea

Introduction

The genus *Zelkova* (Ulmaceae) diversified and evolved during the Paleogene ca. 55 Ma ago, in subtropical-temperate forests of the North Pacific region between eastern Asia and North America, and later spread towards western Eurasia. Species of the genus *Zelkova* were important elements of the vast forests that prevailed throughout the Northern Hemisphere during much of the Cenozoic Era (Mai 1995, Wang et al. 2001, Fineschi et al. 2002, 2004). The oldest fossils attributed to *Zelkova* date from the early Eocene (55 Ma) in western North America, where the genus is extinct today (Burnham 1986). The climatic oscillations during the Quaternary, and notably the glaciations that occurred in Europe, had dramatic effects on the distribution of the local flora, with species becoming extinct, dispersing in new areas or surviving in glacial refugia and possibly recolonizing areas during warmer phases (Comes and

Kadereit 1998, Hewitt 2000). This was also the case with the ancestral *Zelkova* species, which survived throughout the Quaternary climatic oscillations only in specific refugial areas (Wang et al. 2001). The genus now comprises six extant species, with disjunct distribution patterns (Zheng-Yi and Raven 2003, Denk and Grimm 2005): three in eastern Asia (*Z. serrata, Z. schneideriana* and *Z. sinica*), one in southwestern Asia (*Z. carpinifolia*), and two species endemic to the Mediterranean islands of Sicily (*Z. sicula*) and Crete (*Z. abelicea*).

Zelkova abelicea (Lam.) Boiss. is the only endemic tree species of Crete. This species was supposedly widespread in the past and may have formed a forest belt in the Cretan mountains (Søndergaard and Egli 2006). It is currently found in scattered and isolated stands within the five main mountain ranges of Crete distributed from 900 m a.s.l. to the upper tree limit at approximately 1800 m a.s.l. (Egli 1997). In some areas, *Z. abelicea* may form mixed stands with *Acer sempervirens*, *Quercus coccifera* and occasionally *Cupressus sempervirens* (Fazan et al. 2012). Most frequently however, the species has a scattered distribution with few to no arborescent individuals in a more or less degraded phrygana with numerous dwarfed individuals. The species does not tolerate very xeric conditions and is therefore preferentially found on north-facing slopes in and around dolines where moisture and water supply is most adequate. The species is also found growing on scree slopes and in or around river beds that are active only during extreme precipitation events as well as at high elevations on south-facing slopes (Egli 1997, Søndergaard and Egli 2006, Fazan et al. 2012). *Zelkova abelicea* is most frequent in the Levka Ori and Dikti mountains, with only one known population in the Psiloritis and Thripti mountains, and a very scattered but widespread population on Mt. Kedros (Egli 1997, Fazan et al. 2012).

The large majority of *Z. abelicea* stands show an asymmetric population structure, possessing individuals with two distinct morphological types: few arborescent individuals and numerous dwarfed shrubs (Figure 1). Large arborescent trees of 5-20 m in height with a well-developed crown and bearing fruit are very rare and may represent only 5% of all known individuals (Kozlowski et al. 2014). All other individuals are present in a dwarfed, bushy, shrub-like form with multiple stems, dense growth and leaves < 2 cm (Fazan et al. 2012, Kozlowski et al. 2014). This morphology is mainly due to the extreme pressure of browsing by goats, which prevents young individuals from developing into fully shaped trees. Arborescent trees are able to produce fruits and can reproduce sexually, whereas dwarfed individuals never flower and only propagate clonally through root suckers, which the species produces abundantly in disturbed or eroded areas (Kozlowski et al. 2012). Interestingly, dwarfed and heavily browsed individuals grow extremely slowly, with an average growth rate of 0.24 mm/yr and can be very old (> 600 yr), and may surpass in age normally-growing arborescent trees (Fazan et al. 2012). Furthermore, vegetative propagation may have allowed dwarfed individuals to propagate and persist for centuries (perhaps even millennia) in disturbed (e.g. browsed) or degraded areas.

High levels of genetic variability were found in chloroplast markers within *Z. abelicea* (33 haplotypes), and as well as a strong phylogeographical structure, as each of the mountain ranges of Crete represents a separate genetic unit (Christe et al. 2014).

Pastoral activities (ovine and caprine) seem to pose the most important threats to the species. Browsing by goats but also trampling and erosion of soil due to the presence or passage of numerous sheep or goats in the areas where *Z. abelicea* individuals grows prevent seedlings and saplings from establishing and dwarfed shrubs from growing tall and fructifying (Fournaraki and Thanos 2006, Kozlowski et al. 2012). The very dry summer climatic conditions as well as future climate change may also pose threats to the species, as seeds germinate very slowly and require cold stratification for several months in order to germinate (Fournaraki and Thanos 2002), and seedlings germinate late in the spring and are thus very sensitive to drought conditions. Fire, as well as altered water regimes resulting from the

construction of reservoirs, land-use changes, road construction and changes in the dynamics and seasonality of pastoral activities may also pose further threats to the species. Although soil erosion is detrimental to seedling establishment, it may facilitate asexual propagation of the species by exposing roots and promoting suckering (Fazan et al. 2012, Kozlowski et al. 2012). Moreover, sexual regeneration is hindered also due to the low percentages of viable seeds (Fournaraki and Thanos 2002, Fournaraki 2010, Thanos et al. 2010). Furthermore, Z. *abelicea* has a strong cultural value on Crete, as traditional shepherd sticks (κατσούνες) are made preferentially from its hard, light and durable wood (Fournaraki and Thanos 2006). However, the pruning of plants and illegal collection of wood hinders the growth and development of fruiting trees.

Z. abelicea is listed as vulnerable in the first version of the Red Data Book of Greece (Egli 1995), and is classified as endangered on the IUCN Red List of Threatened Species (Kozlowski et al. 2012). The species is protected under Greek law (presidential Decree 67/81), forbidding the collection and export of any plant material without a specific permit. Most populations fall within NATURA 2000 sites. Moreover, it is also included in the Bern Convention and in Annexes II and IV of the European Habitats Directive 92/43/EEC.

The fragmentation of *Z. abelicea* populations as well as its specific genetic structure requires considering each mountain range where the species occurs as a separate conservation unit, with locally adapted conservation strategies. Each of these isolated, and in some cases small populations is at risk of being lost as a result of an accidental, deliberate or stochastic event. However, until recently, there were no particular management and conservation actions taken for the conservation of *Zelkova abelicea*, apart from some very local actions such as fencing of a small population in the Rouvas forest (Psiloritis, Rethymno) in the framework of an old LIFE project (LIFE99 NAT/GR/006497, 1999-2001), or the fencing of a small stand on Katharo plateau (Lassithi) in 2000 in the framework of the ARCHIMED project as well as collection of seeds coming from some populations of the Levka Ori (Chania) for ex situ conservation in the seed bank of the Mediterranean Agronomic Institute of Chania (MAICh).

In 2013 and 2014, two Greek National Programs of the Ministry of Environment for monitoring species and habitat types of the European Habitats Directive were initiated (one particular for the area of Samaria National Park in the Levka Ori, and the other for all other Cretan areas), and *Z. abelicea* populations started to be systematically inventoried and monitored but without implementing concrete measures to improve the conservation status, or the protection of the species.

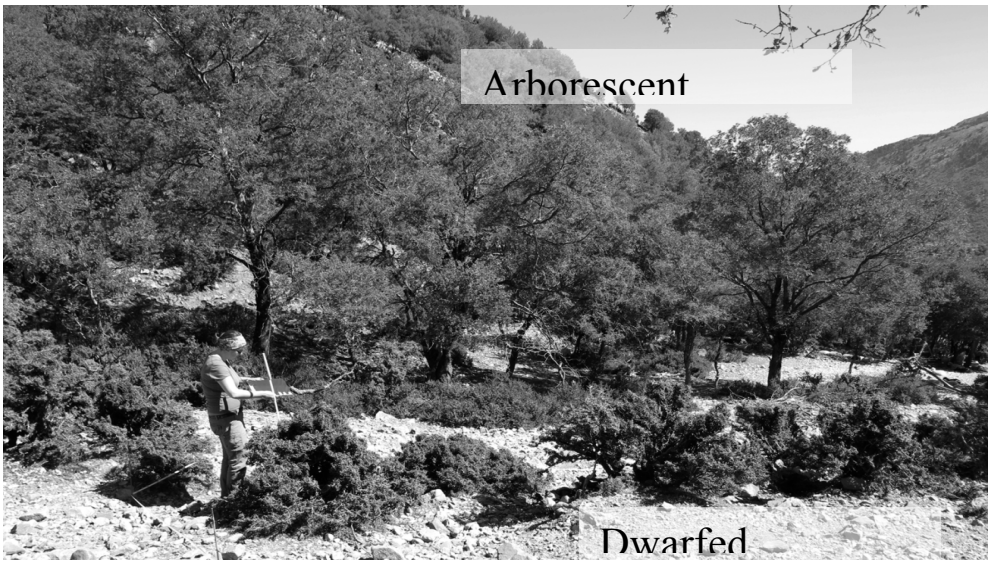

Figure 1. The two morphological types of *Z. abelicea*: arborescent trees in the background, and

In 2014, a project was initiated for the conservation of *Zelkova abelicea* in collaboration between the University of Fribourg (Switzerland), the Mediterranean Agronomic

Institute of Chania and the four Forest Directorates (Chania, Rethymno, Iraklio, Lassithi) of Crete, with actions aiming at i) the implementation of in situ measures (fencing of small plots) for protecting and studying the effect of browsing and grazing exclusion on the growth of *Z. abelicea* and the general vegetation, ii) the ex situ conservation of all known populations of the species (with both seed banking and ex situ cultivations), as well as iii) increasing public awareness through various dissemination and public sensitization actions. The first phase of the project ended in 2016, and the project continues for a second phase from 2017 to 2020. We present here an outline of the project actions and some preliminary observations and results from the in situ and ex situ conservation actions from the first phase (2014-2016) of the project.

Materials and Methods

In situ conservation actions

In the first phase of the *Z. abelicea* conservation project, the main objectives of the in situ project actions were the protection of selected stands of *Z. abelicea* from browsing and trampling in all mountain ranges of Crete by fencing as well as monitoring the effect of the protective measures on plant growth and on vegetation regeneration within the selected fenced pilot plots. In total, 32 fenced plots were established in 12 sites throughout the mountains of Crete in areas in which there are natural populations of *Z. abelicea* (with the exception of the *Z. abelicea* population of Mt. Psiloritis for which no agreement could be made with local land users, and of Thripti Mountain in Eastern Crete which was fenced during the 2nd phase of the project in early 2017). See Table 1.

Table 1. Number of fenced plots and area fenced in each mountain range.

Mountain	No of fenced plots	Total area fenced (m^2)
Levka Ori	18	1128
Kedros	4	115
Psiloritis	0	0
Dikti	10	338
Thripti	0	0
Total	32	1581

The main criteria for plot selection were presence of *Z. abelicea* individuals, morphology of individuals (dwarfed trees with nearby fruiting individuals when available), feasibility of installing fencing due to natural elements (slope, rock outcrops), accessibility of the site (for material transport), natural hazard possibility (e.g. rockfall), as well as contact with and motivation of local land users. Plot size varied between 2.25m^2 and 360m^2 with a median size of 25m^2. It was decided to have mostly small sized plots, to avoid deliberate destruction as well as minimize their impact on local land user activities. Within each fenced plots, the position of every *Z. abelicea* individual was mapped, and growth parameters (e.g. tree height, diameter, crown diameter, number of trunks) were measured. This was also done on other tree species growing within the plots. These measurements were taken in autumn (i.e. at the end of the growing season) of every year (T1, T2, etc.), starting with the year before fencing occurred (T0) for reference purposes.

Additionally, the vegetation of each fenced plot was monitored, in May of every year (i.e. when the majority of plants are flowering or setting fruit), and presence and number of plant species as well as vegetation cover (in percentage of total surface) for each species were recorded, and compared with an adjacent non-fenced plot subject to browsing. Number of species was recorded in a 16m^2 area in every plot in order to be able to compare number of species between plots of various sizes (for the plots smaller than 16m^2, the whole plot surface was recorded).

Ex situ conservation actions

One of the main objectives of the project is to create ex situ collections of *Z. abelicea* using plant material (seeds and vegetative material) collected from all the mountain regions where *Z. abelicea* occurs in order to preserve as much of the genetic diversity of the species as possible. Until the start of the project in 2014, ex situ collections of *Z. abelicea* did not exist in Greece apart from some seed collections of *Z. abelicea* coming from the Levka Ori and preserved since 2000 in the Seed Bank of MAICh following international standards (initially acc. FAO/IPGRI 1994, and revisions and later acc. ENSCONET 2009a,b,c). Germination protocols and experiments to test seed variability have already been developed and undertaken for the previously collected *Z. abelicea* seeds by the Seed Bank of MAICh in collaboration with the Department of Botany of the University of Athens since 2002 (Fournaraki and Thanos 2002). These protocols and experiments were used and adapted if necessary in the *Z. abelicea* conservation project to the different seed collections acquired throughout Crete.

Seedlings that develop after the germination experiments are cultivated at the nursery of MAICh and two nurseries of the Forest Directorates of Crete (Chania and Iraklio) in order to be used for ex situ plantations of *Z. abelicea* and/or for restoration projects. These ex situ plantations will contain genetic material coming only from neighboring natural populations to avoid genetic pollution and will serve for several purposes: conservation of the genetic diversity, environmental education and public awareness and in the long term will also give the possibility to provide material (wood) for the making of the traditional walking sticks of shepherds, with certified origin of cultivation and not from natural populations.

Z. abelicea has a masting cycle producing massive amounts of fruit every ca. 3 yr, and almost no fruit in the unfavourable years. The species also has a very low percentage of sound seed (Egli 1997, Fournaraki and Thanos 2006, Søndergaard and Egli 2006) and some stands contain no fruiting individuals. Therefore, there is also the aim to develop a protocol for the vegetative propagation of the species, particularly for the conservation of *Z. abelicea* populations in which few or no fruiting individuals are found, and which cannot give accessions for seed banking. Experiments using different concentrations of rooting hormones in summer and winter cuttings as well as shoot and root-stolon cuttings are still under way.

Results

In situ conservation actions

Out of the 32 fenced plots, 27 were still standing in autumn 2016. Four plots were destroyed by people for unclear reasons (possibly land-use conflicts), and one by heavy snowfall during the winter 2014-2015 and not rebuilt. Several plots also sustained considerable damage due to heavy snowfall during the winter 2014-2015, and one was impacted by rockfall in early spring 2015, but all were subsequently repaired. Furthermore, three plots were "visited" by goats after having being fenced.

In most cases, as soon as fencing occurred, *Z. abelicea* individuals, started to grow, and shoots to elongate (Figure 2). On average, individuals were 15 cm taller one year after fencing (T1) compared to the reference year (T0), and one year later (T2) they had grown on average 14 cm more. Average maximal elongation of the longest shoot was of 28 cm for the first year (T1) after fencing and 30 cm for the second year (T2) after fencing, while absolute maxima was 120 cm for the first year and 57 cm for the second year.

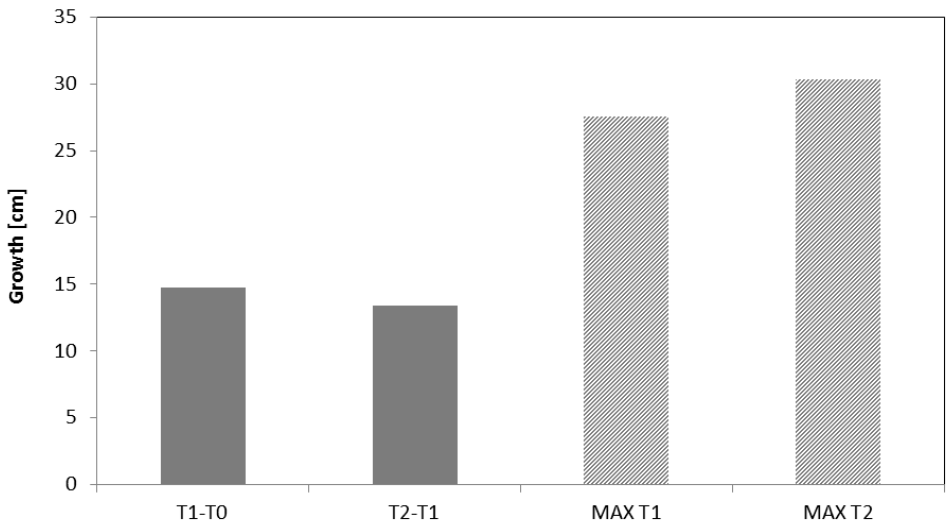

Figure 2. Average elongation of *Z. abelicea* trees between different time periods as well as average maximum shoot elongation.T0 is the reference year before fencing, T1 the first year after fencing and T2 the second year after fencing.

The average number of species found within the fenced plots was significantly higher ($p < 0.01$) compared to the external areas monitored for comparison that were still under browsing pressure both for the first year and the second year after fencing. There were on average 55 species in the fenced plots in the first year after fencing (T1) and 58 species in the second year after fencing. Comparatively, in the external areas, only 42 species were found in the first year, and 46 in the second year (Figure 3).

Investigations about vegetation cover are still ongoing, and no definitive results are yet available. However, in areas where browsing pressure was strongest, visual differences were already seen in the first spring after fencing. The vegetation cover was higher within most of the fenced plots compared to the surrounding areas still under browsing pressure (Figure 4). Only in areas where browsing pressure is thought to be less intense were visual differences not so evident in terms of vegetation cover, although in these cases, *Z. abelicea* individuals showed elongated shoots that were not found in browsed areas, and species richness was on average also higher within the fenced plots compared to external areas

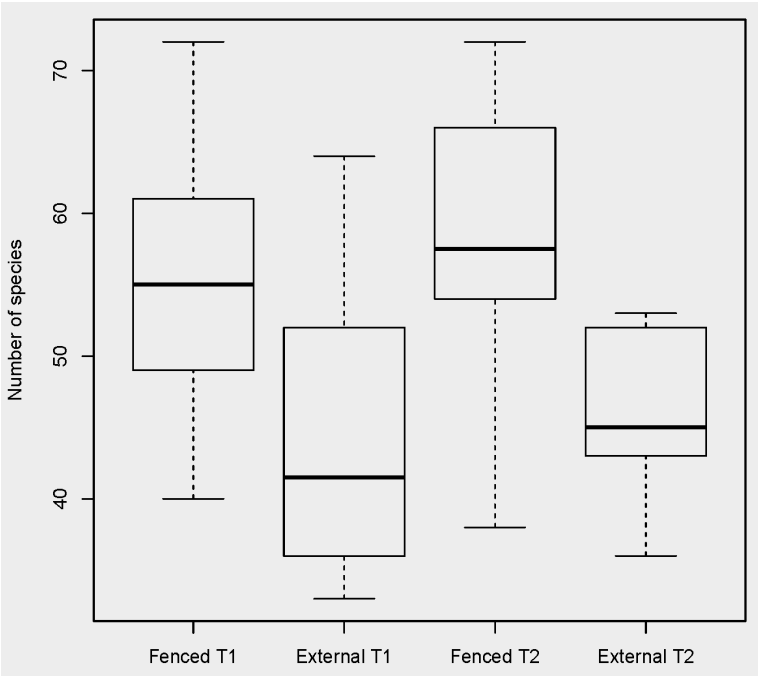

Figure 3. Average species richness within the fenced plots compared to external plots under browsing pressure for the first year after fencing (T1) and

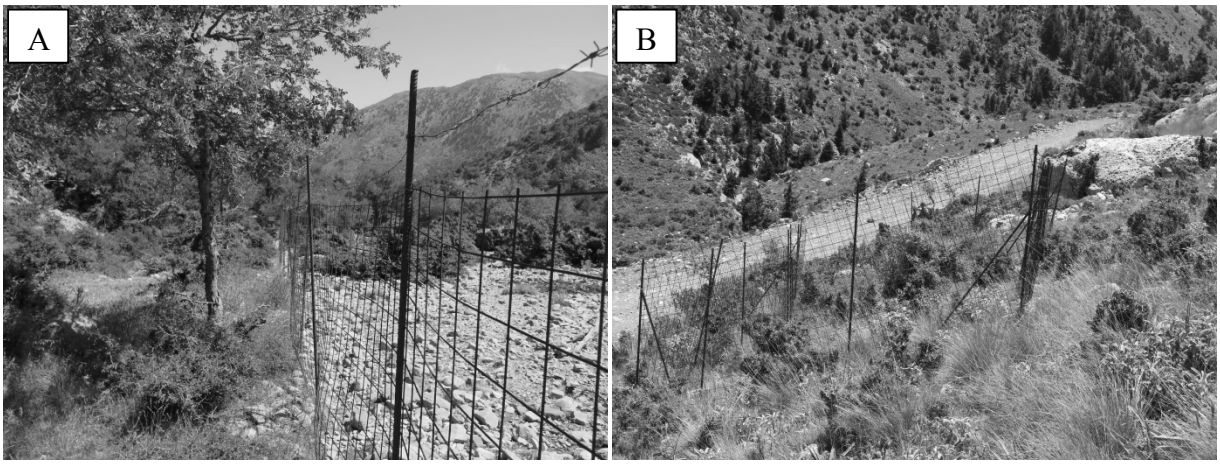

Figure 4. Visual differences in vegetation cover between fenced plots and external areas subject to browsing. A. Plot situated in an area with strong browsing pressure, with visually higher vegetation cover inside the plot (left) than outside (right). B. Plot situated in an area with supposedly little browsing pressure, with no clear visual differences between inside and outside of the plot.

Ex situ conservation actions

During the first three years of the project, only 2015 was a masting year with abundant fruit production for *Z. abelicea*, but sound seed production was extremely low (between 0-9%) and fluctuated strongly between sampled populations. So far only three accessions (all from the Levka Ori) had enough quality and quantity to be stored in the seed bank. Furthermore, the first results of the vegetative propagation of the species show very low success and further investigations are still necessary to develop more effective propagation protocols. A first ex situ plantation was established in 2016 on public land. The field was

offered by the Municipality of Platanias on the Omalos Plateau in the Levka Ori. The plantation of 50 trees was performed by pupils and teachers of the local primary school of Skine-Fourne in collaboration with the project partners. Further trees of *Z. abelicea* are planned to be planted in the same field when planting material (seedlings) from the local natural population will be available and ready for transplanting.

Discussion – Conclusions

The most important pressures on *Z. abelicea* natural populations are pastoral activities mainly through browsing and trampling by goats and sheep, inducing a domination of dwarfed, severely browsed non-flowering individuals. The protection of dwarfed individuals in the first phase (2014-2016) of the conservation project yielded promising preliminary results. Overall, *Z. abelicea* individuals reacted positively to the removal of browsing pressure by producing long shoots and elongating, both in areas of low and high browsing pressure. Both vegetation cover and species richness also showed to be higher within the fenced plots than in areas under browsing pressure. However, in some areas, the effect of fencing on both *Z. abelicea* growth or vegetation seems to be less significant, implying that other factors may be of importance (e.g. local weather and soil conditions, or a delayed reaction).

Furthermore, intentional destruction of fenced areas or intentional introduction of animals within the fences was very low, which showed how important it is to tightly collaborate with local communities and local land users, as well as the importance of public outreach and communication actions.

The very low percentage of sound seeds as well as the masting pattern of *Z. abelicea* hampered the collection of sufficient seeds to be stored in the seed bank or used for ex situ plantations or restoration purposes. Within the next years, emphasis will be made to further collect seeds. Moreover, collection of vegetative material for propagation from populations with few or no fruiting individuals is an essential part of the conservation actions. However, the first trials have showed little success, and an effective protocol still needs to be developed within the next years.

During the second phase (2017-2020) of the project, it is planned to maintain the existing fenced plots, continue the monitoring work in the fenced plots in order to follow growth and changes over several years, and to study other biotic (e.g. insect) or abiotic (e.g. weather and soil data) factors that may influence *Z. abelicea* growth and vegetation development. Further fencing of new plots is also planned, especially in areas in which no plots had been previously established or that were underrepresented. Moreover, more emphasis will also be given on more targeted actions towards local inhabitants and authorities of the areas close to natural populations of *Z. abelicea* so as to better promote the wider consensus needed for a more efficient project implementation, particularly in areas where deliberate destruction of plots has taken place.

Acknowledgements

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ENVIRONMENTAL EDUCATION: PROJECTS (WORK PLANS) ON THE FOREST WHICH CAN BE APPLIED IN SCHOOLS

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Abstract

Today Environmental Education serves mainly the need to inform and to sensitize children towards questions regarding the available resources of the Earth and its pollution by human activity with the aim to form active citizens who have set limits concerning human interventions and who live eco-logically in practice. It seemed that children practiced many skills during an environmentally educational project entitled 'I learn about forest' which took place in a protected area by the European Network NATURA 2000, in collaboration with a network with the same name in Greece that is supported by the Hellenic Society for the Protection of Nature; by means of projects that involved student teamwork and were organized before, during and after going to the specific field, it was noticed that children practiced their critical as well as their post cognitive skills; learning, emotional and social aims of environmental as well as general education were achieved, too.

Keywords: *Environmental education, forest, cooperative learning plans*

Introduction

Trying to approach the ongoing educational process pedagogically Dewey (2009) mentions that 'every modification of educational methods and the syllabus in schools is the result of social conditions that change and at the same time an effort to satisfy the needs of the new society that is being formed'; the social and environmental changes and transformations of today require a modification and adaptation of the educational process with new semantic and teaching orientation so as to satisfy the needs that arise (Georgopoulos 2004, Papanikolaou et al. 2009).

Today environmental underestimation and degradation is internationally considered to be one of the most serious crisis threatening the planet. When professor Ragkou (2015) interprets the root of this environmental downgrading she attributes it to the prevailing model of development that was based on a productivity without limits that identified progress with economic growth, regarded overconsumption as the greatest value and created the illusion that there are no limits in the resources of the Earth. After this environmental downgrading it was realized that the Earth does have limited resources as well as pollution (Passet 1979) and, thus, international organizations were activated to take care of it (Jackson 2011), so as to solve its problems and cure the situation in the short run and to prevent them in the long run.

The national education of every state was considered fundamental in the solution and the prevention of this environmental downgrading according to international environmental discussions and organizations. With aim to promote a love of nature, knowledge, ecological behavior, action skills (Williams & Chawla 2016). In Greece it was during the decade of 1970 that an optional educational course in school was initiate, 'Environmental Education', and later on with the same or a different name, like 'Education for Sustainability', 'The Environment and Education for Sustainability'. Today with Education for Sustainability it is considered that its basic principles are being served: a) the improvement of the quality of life within the limits that are set by the ability of the ecosystems, b) the understanding of the interdependence and connection among society, economy, natural environment, c) the fair distribution and share of natural resources as well as the equality of, not only for the present generation but also for the future ones (Papanikolaou et al. 2009).

Courses of Environmental Education in school curriculums 2011 have been realized optionally or at an experimental level since then sometimes with the cooperation of Non-Governmental Organizations or Centers of Environmental Education or the support of Educational Directorates. These courses inform and sensitize regarding topics of environmental debasement, as it was mentioned

before, but they also educate with the aim to form an ecologically active citizen. The project on *The Forest* which is being made known to the public with this announcement was designed and materialized with this concept.

Educational programs are implemented with the cooperation of the Hellenic Society for the Protection of Nature which in 2002 incorporated in its educational programs the coordination of the program ' I Learn about Forests' in Greece. Participating in the Program – Network 'I Learn about Forests' I undertook the design of Projects to be applied in the last class of primary school on a south Aegean island in a cedar forest on the island that is under the protection of NATURA 2000 network and because they seem to be effective since then I have been applying them with the necessary adaptations according to the environmental conditions I have every time at hand. Part of these projects, and especially the application stage in a field, are described below as proposals of projects in forest ecosystems which can generally be applied to natural endemic ecosystems. Wherever there is no access to a *Forest* with its common meaning they can be applied to seaside Mediterranean bush ecosystems, brushwood, cedar bushes etc. which are usually included in the network of NATURA 2000- (Papastavrou & Goupos 2007, Sfikas 2008).

The learning theory that this design is based on is *constructivism* (approach which is considered (Moseley et al. 2016) that can be implemented the environmental education) according to which new concepts taught within the student's environment, in authentic situations – dilemmas that trigger his/her active participation which is constructed of and is the outcome of authentic experiences and students' teamwork with the purpose of developing mental functions (Vygotsky 1997, Driver 1998, Kokkotas 1998), in cooperation opportunities (Feszterova & Jomova 2015). It is regarded to be the educationalist's responsibility to lead his/her students from their personal ideas towards scientifically accepted positions (Matsagouras 2002).

Moreover, as far as its process is concerned, it is based on *Projects* with which it is regarded that the application of environmentally educational programs is achieved in the best way (Eleftherakis 2011). With the term 'work plans' that Matsagouras (2002) uses he means that:

- they consist intentional and methodical forms of action that lead to the solution of personal or social problems ,theoretical study of topics or matters, the production of constructions and the composition of artistic creations
- they activate the wholehearted involvement of students because they concern topics that interest them
- they are conducted through collective procedures which students prefer because they help their socialization , the social integration of outsiders, the democratization of teams and ensure positive learning conditions and development.
- they encourage research for necessary information inside school as much as outside school ,in nature
- they offer students, both at an individual and at a collective level**,** the possibility to choose their own topics as well as the means and the ways to present the results.

It is considered that work plans offer concerning knowledge, skills, predispositions, feelings, they are a source of in depth learning, they connect school with society, they encourage cooperation (Frey 2005, Bell 2010), they consider children as a part that forms society (Katz & Chard 2009), as equally responsible for their learning (Helm & Katz 2012), characteristics that reveal some additional aims of the Work Plans under discussion.

Especially in Environmental Education the prevailing point of view is that there is a need to approach the challenge of sustainability through education, not in a pluralistic or abstract way (Jickling & Wals 2008), but with plans addressing problems and with a series of complete drafts aiming at healthy solutions on how to face environmental problems (Kopnina 2015). As a matter of fact, this theory suggests plans through direct contact with the natural world, a contact that develops a personal ecological identity through knowledge and emotional bonds deriving from direct contact with nature, through the chances that are given during a formal visit as part of programmes about nature, in fields where local natural areas (with successive experiences) exploited (Williams & Chawla 2016).

The purpose of the realization and the trial of these projects was to investigate to what degree the organization of a project before, during and after visiting the place makes a program on

Forests effective. Forests consist as a topic maybe the most important one in Environmental Education since they are natural ecosystems that instill to the children several ideas, such as *existing capability, limits, interaction, system, values* (Ragkou 2015) and over the last years they are being destroyed (Feszterova & Jomova 2015).

The aim of publication of this endeavour is to submit the Work Plans that were adopted with the assumption that they may prove to be effective in environmental education as well as education as a whole (holistic education).

Materials and Methods

Field transition out of the classroom was chosen to be a seaside cedar forest protected by the European Network NATURA 2000. In order to select it we took into consideration that it represents a forest ecosystem that is also protected by a European network and the working conditions in the field during Working Teams as well as in their Plenary Sessions.

The Method that was adopted was Work at Stages (Phases) within a Work-Plan (Project) as it was mentioned in the introduction. This work was designed to make the most of the existing ideas and concepts of the children according to the theory of Constructivism which has also been mentioned before, encouraging the discovery of new knowledge –a learning process that serves the aims of education, both environmental and general.

Description of the Work Plan used in the field:

The basic plan of our thinking was work *before, during and after our visit.*

Before our visit:

We had been working on the program 'I Learn about Forests' throughout the school year with an interdisciplinary method *involving many subjects* in the classroom. This was done as their main task. It should also be noted that the children worked *in teams and* were trained within the team; later on they had to present their work to the whole class.

At the field:

The following Work Plan on the Cedar forest was adopted in the field:

In the protected by NATURA 2000 cedar-forest, we did what we had pre- planned to do in the project, that is, to

'*Learn about the Forest ….in the Forest*'

Our purposes, when we visited the forest, were environmental, cognitive, emotional, social. More specifically we intended:

- to approach the forest primarily with happiness and enthusiasm
- to learn about the Forest ….in the Forest'
- to get informed about the protected areas of NATURA 2000 generally as well as the ones in our region
- to learn more things about the area under protection that we visited, such as its course in time, the kind of flora and fauna it has, the dangers that are threatening it and the measures which are taken to protect it today
- to learn about endemic species and to get to know if there are any of them in our country
- to compare trees to bushes and think about the photosynthesis process
- to think about the course of a forest ecosystem historically in time, learning simultaneously about any natural or human generated (anthropogenic) changes
- to criticize and disapprove of environmental degradation with a critical way of thinking
- to practice counting species in the forest and the age – height of trees
- to practice counting , searching, selecting, recording information and presenting a topic
- to feel that the natural environment is thought – provoking
- to feel that the natural environment makes us willing to work
- to feel like scientists at time of work in a scientific domain

- to feel happiness in the forest ,to feel like investigators in it, to play in the forest so that we enjoy it in the short run but we also love it in the long run
- to feel the protection of forests as a necessity
- to feel the joy of cooperation, communication, recognition while working in a team
- to train in being responsible to carry out a task , working in teams, in a specific place (field)
- to practice communicative and cooperative skills
- to appreciate the value of dynamic relationships and reactions in a team

***THE STAGES OF WORK**:*

STAGE 1: *Preparation in the classroom:*

- interdisciplinary activities on the topic ‘ the Forest’ (they precede)
- selection of an area in a forest & time to go there
- cooperation regarding the design of the methodology that will be adopted
- a new distribution of team members as they are going to function in the place (field of action)
- arrangements about certain materials (notepads ,measuring tapes, cameras for photographs)

STAGE 2: *Access and arrival at the place:*

- recognition of the place
- familiarization of the area by a short free exploration
- selection of a place for presentations of plenary sessions and other places around for teams to work

STAGE 3*: The Work of teams & Successive Presentations to plenary gatherings:*

STAGE 3a:

- the kids sit in work teams at a place where they can work (discuss, write)
- a coordinator gives a topic to them on which they talk about for a specific time (5´- 15´) in their teams ,they write down what they have decided and one team at a time lets the plenary session know about it

✍ Topics that they were asked to work on:

- note down what comes to our mind when we hear the word ‘forest’
- note down products of a forest
- note down biotic and abiotic elements in the forest
- note down sounds, smells, colours of the forest-the forest through our senses
- note down the flora , fauna and any endemic species that possibly live there
- note down any possible human activity in the forest
- note down any global environmental problems that are related to the forest.

STAGE 3b:

- Every work team of students takes an *envelope with materials*-different in each envelope-for the sub-topic they are going to deal with at a specific time (45´-50´), and creates a text that announces to the plenary meeting:
- the sub-topics that are given to the teams are:
  ‘Greek Forests- Flora-Fauna-Cedar forest-Endemic Species’
  ‘Areas under protection –NATURA 2000 Network’
  ‘Human Activity in the forest in the past and now’
  ‘Environmental crisis and forests’
- every team opens their envelop with the material that they have received, they contemplate and they produce a text on their topic
- the work teams present the results of their work at the plenary session in a place in the forest they have selected for their presentations.

STAGE 4: *Forest games:*

- We search for traces of animals, people in the forest

- we conduct specimen measures, we measure the height and the age of trees
- we act out the following scene: we pretend to be a forest dweller, we simulate that a member collapses and we notice the reactions among the different species
- we collect small things found in nature (without cutting anything) and we make a collage
- we form a circle and we keep quiet, we listen, sense and say what we felt and thought when we were hearing sounds in the forest.

STAGE 5: *Free time for games in the forest:*

After the work described above it is imperative to play games that have not been planned before; thanks to them, educational education is being served, too.

After the visit to the place:

Firstly, the interdisciplinary tasks in teams about the forest that had happened in the classroom were continued with more enthusiasm in the forest. After the visit to the place the children felt a responsibility to make adults more sensitive and willing to protect the environment. Therefore they decided to organize an 'Environmental Festival' in which they invited the local community. The children expressed everything they had lived in the forest through theatrical performances with carefully prepared scenery, through posters, songs, music, a leaflet written by the children which was called 'A Forest- protection Guide' which they distributed to all those who were there.

Results

Initially we realized after observation that the students always worked happily and with enthusiasm when they searched and presented interdisciplinary material on the forest in class before they went to the field. It seemed that these feelings helped them to love the forest, which was also shown when they went there. They were serious, interested, excited that they were, at last, lucky enough to go and see the forest.

In the forest (field) it was noticed that the children continuing the aforementioned Project they expressed a willingness to search, investigate, explore, learn, cooperate in teams and announce the results of their teamwork like scientists-explorers.

The benefits were more obvious in the *Environmental festival* which we organized after our visit and experience in the forest. The children invited the local community as a final thing to do and presented what they had learned about forest ecosystems by means of theatrical scenario, a Forest-protection Guide, texts they wrote which exhibited appropriate and exact speech semantically and syntactically, rich vocabulary, arguments.

Through the specific Project they seemed to have aquired post cognitive abilities. They managed to convey the knowledge they had acquired to the local community in conceivable and comprehensible ways, with presentations, theatre, music, songs, various messages, a poster, informative texts -and thanks to their spontaneousness and mood- they managed to sensitize the local community.

After systematic observation of the way the teams communicated it seemed that they exhibited a feeling of duty, mutuality, equality, compensation for one another's weaknesses.

The fact that the children functioned with enthusiasm, happiness and they improvised throughout the project is an especially significant and obvious advantage. Their initiative and improvisational skills were increased. Moreover, they became willing to work even beyond school hours and responsibilities.

Apart from systematic observation, there were results after an informal Questionnaire was conducted (cf Musser & Malkus 1994, *Children's Attitudes Toward the Environment Scale (CATES)*) with questions that detects the concepts and knowledge of children about the forest –completed by the children initially and finally-, in which, what was noticed was that both cognitive as well as emotional development of children regarding the forest had been achieved to a great degree; additionally, a tendency towards ecological principles respecting it. However, the questionnaire is not depicted in this announcement because its purpose is to present how to implement Work Plans that show signs of effective application of Programmes on the Forest.

Let us mention, at this point, one more good result of this work, which was the Primary School award we received from Athens Primary School Directorate as well as the Hellenic Society for the

Protection of Nature. It was a several day summer school on Taygetos Mountain in 2003 for the educationalist involved as well as the students of the work teams.

Another element that signifies the effectiveness of the Project is that it has been organized since 2002 until now with similar results.

Discussion-Conclusions

With the description of a Project that involved visiting a cedar forest, which we implemented within a program on forests, at stages and work teams, we attempted to inform people about a way to approach forest ecosystems regarding the expected purposes and aims of Education as well as *Education for Continuous Renewability and Growth* as these are described in the relevant syllabuses (2003 & 2011), as they were mentioned in the Introduction, to inform and to sensitize children regarding concepts such as *existing capability, limits, interaction, system, values* (Ragkou 2015), *knowledge* and *emotions* (Williams & Chawla 2016).

With the aforementioned project it seemed that:

- Many *cognitive educational aims* are achieved. Students practice in subjects such as Language; they improve pragmatically, phonologically, morphologically, in terms of vocabulary, semantics and grammar; they understand meanings better, they express themselves better orally, in written as well as in symbolic form. They become better at Mathematics, too; they learn through authentic situations, by measuring surfaces, populations in ecosystems, for instance. They understand Natural Sciences better (ecosystem topics), they are trained in subjects such as Social Education (active participation as citizens), Art, Music and Theatrical Education (acting out and making presentations to the local community).
- *Pedagogical – emotional aims* in education are also achieved. It seems that the children acted with enthusiasm (Hammond 2012), a fact that affected their feelings towards school positively, they live important and strong experiences thanks to their school, they learn to take initiatives and act by themselves, which makes them emotionally healthy and mature.
- *Pedagogical-social-participation aims* of Education are also accomplished because children learn to undertake responsibilities and roles; they learn to learn empirically, to work methodically; they practice observing and recording, searching, selecting, working as scientists – researchers (Matsagouras 2000, 2002); they learn to cooperate, to communicate, to create collective tasks.
- We endeavour to form *critically thinking citizens* as well as *active* citizens (Ragkou 2015) because it seems that children think spontaneously on authentic problems of ecological nature, they try to find reasons, to make suggestions, to become actively involved.
- The aims of *Educational Education* (which for this age consist of transmitting knowledge-sensitivity of children and the cultivation of their love towards natural environment and the understanding of the systemic relation of beings and natural functions) are realized (Papanikolaou et al. 2009, Ragkou 2015).
- It is confirmed that constructivism is an effective theory in the learning process, because, as it was noticed, through the experiences that the children had in the field (forest) where the existing experiences of the children were also used, the children were helped to conceive new knowledge with enthusiasm or to discover it themselves through activities and research.
- It connects school with society in an effort, on part of children, to bring local community inside school and to complete their ecological action by aiming at changing adult behaviour, too (Krasny et al. 2015).

According to Monroe (2010), however, the evaluation attempts of educators so as to notice changes in students' sensitization, knowledge, attitudes, skills, intention and behaviour regarding the effectiveness of the aims of Environmental Programs are not enough. Moreover, they should answer the question *where should the success of the program me be attributed.*

Concerning this question there are indications through its application that:

- It seems that in class preparation before the visit plays an important role, so that the visit functions as the climax and outcome of it.
- An educator's preparation and planning are extremely important to the effectiveness of the programme of environmental education (Moseley et al. 2016).

- An extremely important factor for the effective functioning of environmental programmes according to other researches, too, (eg Cenc 2015, Costel 2015) seems to be designed learning.
- The application is effective if it is used after the visit to the field.
- Students' team work in the field was effective.
- The allocation of work to be done at a specific time, repeatedly, in work teams of students, in the field and which is presented in the plenary session yields knowledge that is the outcome of discovery, investigation, synergy, communication and is effective in the long run.

There is no doubt that a visit to a specific place (field) is important in every educational program. The purpose of this publication, though, is, with the introduction of team work to be applied in a forest, on the one hand, to suggest the construction of enriched or specialized meanings on top of previous limited ideas of students that had to do with 'Forest' as a concept with endemic species among forest ecosystems; this is achieved by working in fields of local surroundings so that children enhance their view of the environment. On the other hand, with this publication we would like to stress the importance of organization and planning before, during and after the visit to a place so that it is an effective and fruitful experience. This was achieved with the stage analysis that was presented and applied here. Education, as a result, strengthens critical thinking and becomes conceptual as well as didactic, which is a method that approaches the environment from many aspects and in a systemic way contributing, thus, to the cultivation of a person who will be able to satisfy the need for sustainability.(Papanikolaou et al. 2009, Ragkou 2015).

The Work Plans which are publicly made known here have been implemented for 15 school years and they seem to be successful concerning, on the one hand, cognitive, emotional, social aims of education ,as these are determined in the scientific bibliography for children and the basis of all Syllabuses for studies .On the other hand, they serve the aims of Environmental Education .Therefore they are submitted and described here as practical environmental education methods and tactics which can be applied to a wide range of students and forest ecosystems so that it can be investigated whether a well organized Work Plan at Stages before ,during and after the visit to the forest (field) successfully meets the aims of education and more specifically Environmental Education, since environmental education is considered to depend on teaching options in the learning process (Jickling & Wals 2008, Kopnina 2015).

With the application of organized Work Plans at Working Phases on Environmental Education, it was possible to construct enriched or specialized meanings on top of previous limited ideas of students that had to do with 'Forest' by working in fields of local surroundings so that children enhance their view of the environment (Kokkotas, 1998). In order to achieve a fruitful visit to the field environmentally and pedagogically what is required is organization and planning before, during and after the visit to a place, as it was analyzed in the present work, so that education strengthens critical thinking with a didactic, methodogical orientation approaching the environment from many aspects and in a systemic way contributing, thus, to the cultivation of a person who will be able to satisfy the need for sustainability (Papanikolaou et al. 2009, Ragkou 2015).

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ENVIRONMENTAL EDUCATION FOR SUSTAINABLE DEVELOPMENT: A THEORETICAL FRAMEWORK OF ON LINE CERTIFIED LEARNING

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Abstract

The aim of this paper is to design and develop an integrated on line framework of certified learning in the environmental education for sustainability, focusing on the social pillar of sustainability. The proposed approach is multidisciplinary, since it combines environmental education for sustainability, internet and communication technologies and adult learning. Methodology is consisted by five distinct steps: analysis of the educational needs; design of adult educational programs; evaluation of the program, development of the on line courses; and determination of the thematic units. The design of the online course will be based on the content, the communication potential, the support and other characteristics of online courses. The innovative nature of the proposal is substantiated by the following characteristics: a multidisciplinary approach, on line certification and affirmation of attendance in the thematic field: "environmental education", the potential of update and improvement of the educational material, adaptability, as well as a user friendly procedure. Moreover, the proposal takes into consideration the modern trend that recognizes the role of the two neglected pillars of sustainability: environment and society. The target groups include management executives, policy makers and development-oriented leaders; entrepreneurs (especially in the field of Corporate Social Responsibility-CSR); and Scientific and Educational Staff. The proposal enhances environmental awareness, while providing incentives for the reinforcement of the curriculum vitae of target group members. Furthermore, it could contribute to the extroversion of the involved parties, resulting to a "product" which will be available to the interested target groups.

Keywords: *environmental education, sustainable development, ICT, certified learning*

Introduction

The vast majority of researchers worldwide (Schubert et al. 2005, Sneddon et al. 2006) agree that the term "sustainable development" gained its significant dynamic after the publication of "The Brundtland Report" (Brundtland 1987). While it is broadly accepted that sustainable development relies on three distinct and equal pillars: economic growth, environment protection and social equity (Gibson 2006, Murphy 2012), most researchers dwell on the economy pillar and short term economic benefits (Drexhage & Murphy 2010). The past years social sustainability gained popularity as a part of a wider sustainability agenda (Davindson 2009), while there have been efforts to develop theoretical frameworks about social sustainability (Boström 2012).

Environmental Education For Sustainability (EEFS) is a holistic approach of how people interact with their total environment and address environmental problems (Tilbury 1995). According to UNESCO (2014), environmental education is vital in imparting an inherent respect for nature amongst society and in enhancing public environmental awareness.

ICTs (Information and Communication Technologies) constitute an important tool for the environmental protection and the sustainable use of natural resources (Koliouska and Andreopoulou 2016). The definition of Information and Communications Technologies (ICTs) is an umbrella term that includes any communication device or system encompassing, inter alia, radio, television, mobile phones, computer and networking hardware and software, satellite systems, as well as the various services and applications associated with them (ITU 2008). ICTs such as Internet provide various advantages and benefits by offering a rich, dynamic environment for the exchange of information and resources (Andreopoulou et al. 2014, Andreopoulou et al. 2015)Introduction should include concise remarks outlying the specific aim of the paper.

The international developments in the economic - technological and socio - cultural sector led to significant changes in terms of production structures and highlighted the need for modernization of national economies. Thus, emerges the need to improve the services that the employees offer and their continuous adaptation to the changing business context, since the development of science and technology contributes to the rapid obsolescence of professional knowledge. Every modern employee must possess specialized professional knowledge and must develop a set of skills that will then be certified to be able to claim a better career path. Under these conditions adult education covers a necessary aspect of daily life in the society of knowledge.

Adult learning has increased in the European Union in the last years and the Renewed European Agenda for Adult Learning provides a vision for the development of adult learning in European Union by 2020 (European Council 2011). Moreover, the relation between adult learning and internet technologies has been mentioned (Zhang and Zeng 2013).

The aim of this paper is to design and develop an integrated on line framework of certified learning in the environmental education for sustainability, focusing on the social pillar of sustainability. The paper aspires to improve the adult learning conditions in Greece, since our country is falling short compared with the European Union average.

Materials and Methods

Data regarding adult learning were collected from the European Commission's Statistical Database; Eurostat.

The methodology used for creating the theoretical framework is consisted by five distinct steps: 1) Analysis of the educational needs, 2) Design of adult educational programs, 3) Evaluation of the program, 4) Development of the on line courses, 5) Determination of the thematic units.

The design of the online course will be based on the content, the communication potential, the support and other characteristics of online courses.

The theoretical framework focuses on:

- the quality of the educational material (video, presentation-powerpoint, document-word) that will be available on the Internet
- the electronic communication through a forum for possible discussion between trainers and trainees
- the final exams which will be mandatory for all trainees in order to receive their certificate of attendance
- the course evaluation form, as feedback constitutes a critical part of planning and executing an interactive online course.

Results

Non formal education and training in Greece is falling short compared with the average in the European Union of 28 countries and the gap is actually increasing (Figure 1).

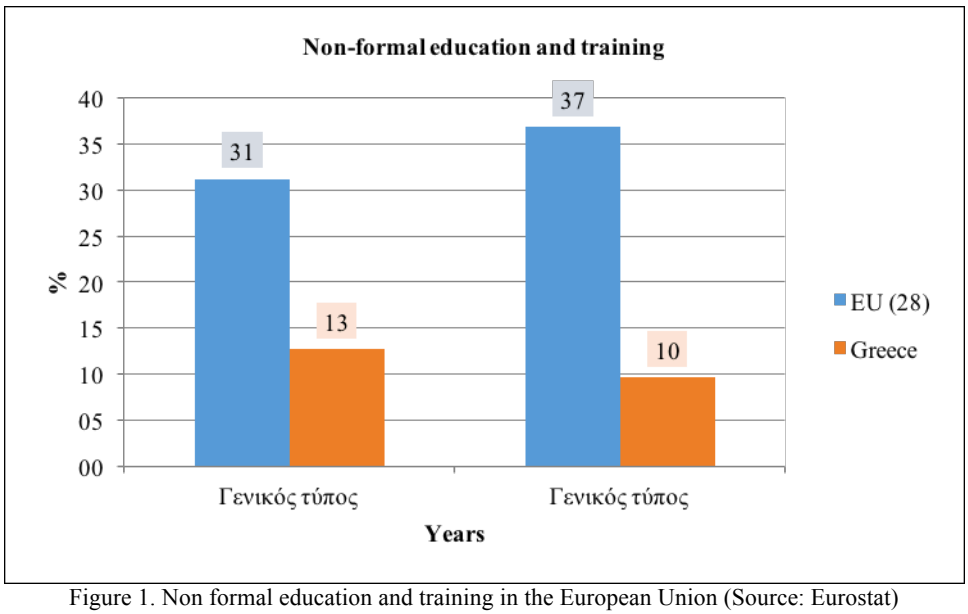

Figure 1. Non formal education and training in the European Union (Source: Eurostat)

On the other hand the differences are significantly reduced regarding formal education and training between Greece and the European Union (Figure 2).

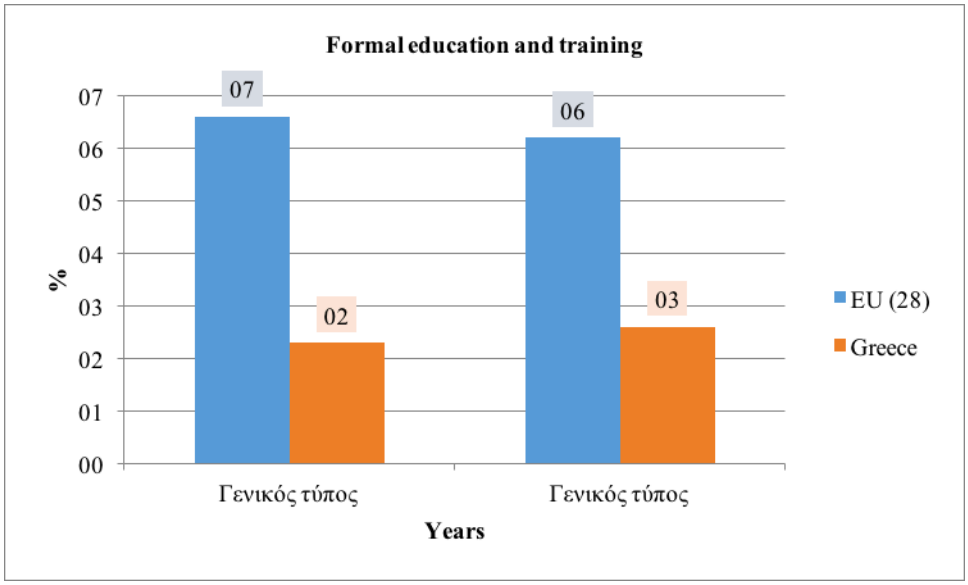

Figure 2. Formal education and training in the European Union (Source: Eurostat)

Furthermore, the access to information on learning possibilities is quite limited in Greece compared with the European Union (Figure 3).

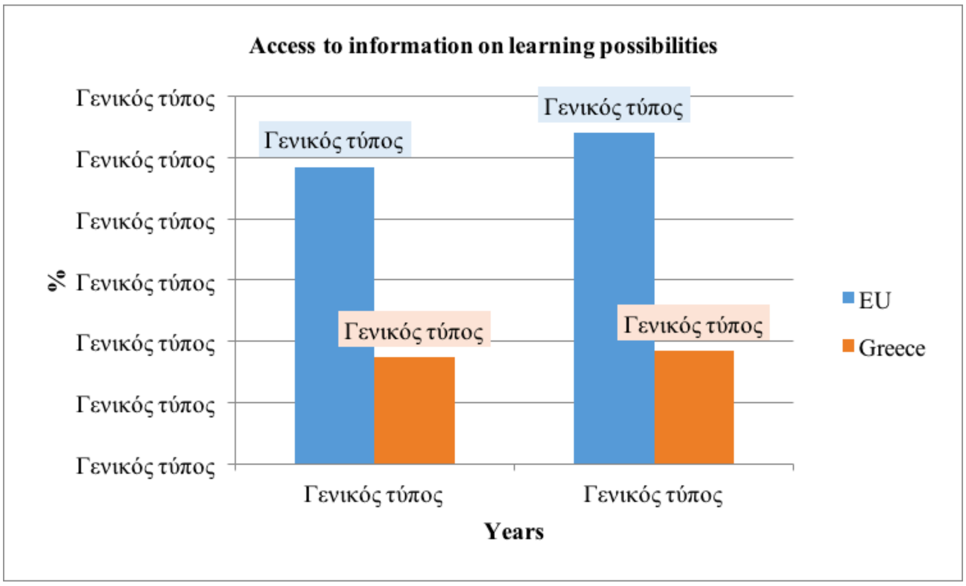

Figure 3. Access to information on learning possibilities in the European Union (Source: Eurostat)

On the other hand the participants in adult training and education in Greece spent 60 hours more than the mean participants in the European Union (Figure 4).

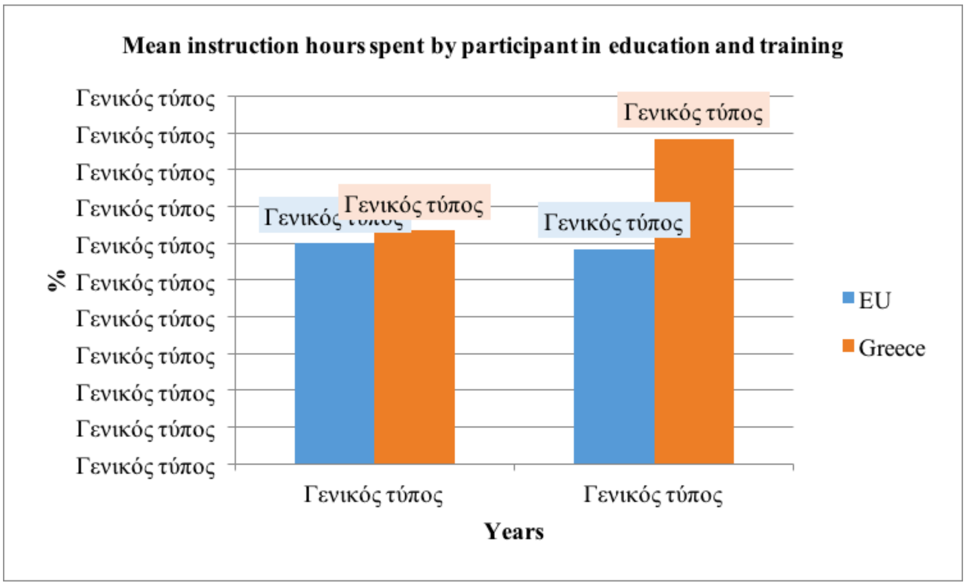

Figure 4. Mean instruction hours spent by participant in education and training in the EU (Source: Eurostat)

Taking into consideration the steps described in the methodology section and the data regarding adult learning from Eurostat, we conclude to a list of possible thematic units that cover the environmental education for sustainability:

1. Timeline of sustainable development. Definitions, concept and adaptation in the modern era
2. Sustainability and financial crisis: the social impact
3. Sustainability and local society
4. Sustainability in Less Favoured Areas
5. Sustainability indicators

6. The social pillar of sustainability in entrepreneurship: Corporate Social Responsibility

The theoretical framework has the following characteristics:

- Multidisciplinary approach. The research proposal combines environmental education for sustainability, internet and communication technologies and adult learning
- On line certification and affirmation of attendance in the thematic field: "environmental education"
- Potential of update and improvement of the educational material
  - Adaptability. The proposal takes into consideration the modern trend that recognizes the role of the two neglected pillars of sustainability: environment and society
  - User friendly procedure

Discussion-Conclusions

In Greece adult learning has not been adequately developed and there is a gap with the European Union. The theoretical framework developed in this paper, aims to fill this gap.

The innovative characteristics of the theoretical framework are:

- Multidisciplinary approach. The research proposal combines environmental education for sustainability, internet and communication technologies and adult learning
- On line certification and affirmation of attendance in the thematic field: "environmental education"
- Potential of update and improvement of the educational material
- Adaptability. The proposal takes into consideration the modern trend that recognizes the role of the two neglected pillars of sustainability: environment and society
- User friendly procedure

The target groups are:

- Management executives, policy makers and development-oriented leaders
- Entrepreneurs (especially in the field of Corporate Social Responsibility-CSR)
- Scientific and Educational Staff

The framework enhances environmental awareness, while providing incentives for the reinforcement of the curriculum vitae of target group members. Moreover, it provides the opportunity to effectively utilize the scientific educational staff in Greece specialized in environmental education.

The research could be extended by using the integrated on line framework of certified learning in environmental education for sustainability as a prototype for the evolution of on line certified learning in Greece, providing qualitative electronic services and reliable educational material.

Furthermore, the research proposal could contribute to the extroversion of the involved parties, resulting to a "product" which will be available to the interested target groups, through the web site https://elearning.auth.gr/. We have also predicted the possibility of editions of the educational material in foreign languages (e.g. English, French, German, Italian) in future versions, aiming at the hosting of the on line course in the international learning platforms that provide electronic courses by certified Institutions (e.g. edX, coursera). Pilot design application for mobile phones and tablets is also feasible (mobile apps), in accordance with the spirit of modern era where the educational approach is used by utilizing efficiently the expanded penetration of internet and communication technologies.

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INTERNET OF THINGS DRIVEN WASTE MANAGEMENT SYSTEM FOR GREENER CITY

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Abstract

With a rising number of people and their mitigation to urban centers, the expansion of waste and its harmful effects on human health and environment have never been more noticeable. At the same time demand for smarter, safer and greener places to live constantly increases. The Internet of Things (IoT) progress shows a positive influence on achieving the vision of smart and sustainable cities, particularly through the development and evolution of IoT-driven waste management systems. This paper suggests the work schedule of an IoT-based smart waste management system, discusses its benefits and possibilities for the evolution and implementation of smart systems that will enable safe, and efficient waste management. It is expected that the IoT-powered waste management system will deal successfully with a massive volume of diverse types of waste and consequently solves many problems related to human health and environmental pollution.

Keywords: *Internet of Things (IoT); smart waste management; green city; sustainability*

Introduction

According to numerous estimates, the global human population will reach 9 billion people by 2050, with 75% of the population living in cities (Samuels n.d.). As more people means more waste, the urban areas will generate large amounts of diverse types of waste than other areas of residency (Fig. 1).

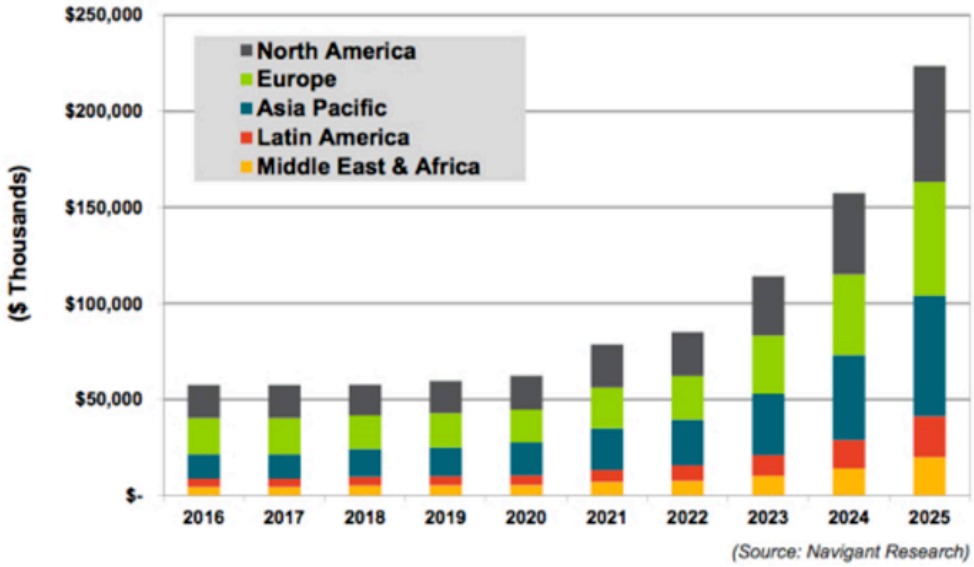
Figure 1. *The different types of waste (Source: Southern Waste and Recycling 2015)*

It is expected that the total volume of waste generated globally will grow by nearly 50% over the next few years and that it will reach 2.3 billion tons by the end of 2025 (Martin 2014; Future Market Insight 2017). Irrespective of the waste type (Fig. 1) and their source (e.g., residential and commercial buildings, industry, hospitals, transport, etc.) the smart waste management is something that must be successfully realized in order to create smart, green and sustainable city. Hence, the realization of smart, safe, green and sustainable urban center demands accomplishing one of the most unglamorous but essential tasks – the collection, transportation, disposal or recycling, and monitoring of waste. The

efficient managing of materials produced through diverse peoples' activities is essential to avoid their harmful effects over human health and the environment (Waste Management Resources n.d.).

The recent intensive technology advancements have dramatically changed almost every aspect of our lives and in each way possible. It is expected that the adoption of innovative technologies in waste management will create more opportunities for all stakeholders (Greentechlead 2014). In other words, with the help of novel Information and Communication Technologies (ICTs), Internet of Things (IoT) particularly, the waste management becomes smarter, faster and more efficient than ever before. As based on the utilization of smart technologies, smart waste management helps to reduce the overall operating costs of waste management by almost 50% (Future Market Insight 2017). Since the waste is becoming a strategic renewable resource, according to the Navigant Research reports, the global smart waste collection technology market will grow from 57.6 million USD in 2016 to over 223.6 million USD in 2025, representing a compound annual growth rate of 16.3% (Fig. 2) (Martin 2014; Hardcastle 2016).

Figure 2. *Annual smart waste collection technology revenue by region*



As the implementation of a smart waste management system is important in reducing environmental pollution and decreasing influence of waste materials on public health and climate changes, this paper represents the analysis of its role in realizing smarter and greener places to live through smart waste monitoring, collection, transportation, disposal, or recycling. Hence, the rest of the paper is organized as follows. The second section presents how the novel technological advancements can contribute to the more efficient waste reduction. The proposition of the work flow of an IoT-based system for waste management, and benefits of such smart systems, are shown in Section 3. The last section contains the concluding remarks.

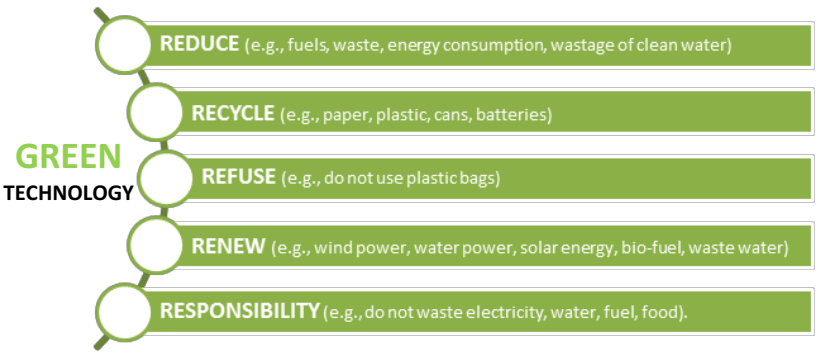
The possibilities of waste reduction with the help of IoT

Since the waste generated represents a major growing concern in today's world, the realization of smart waste management systems has become a hot topic. The waste crisis is seen as both a challenge and as an opportunity to create new solutions for efficient waste management (Heinze 2016). However, the waste monitoring and its possible reduction or elimination are of huge importance.

Thanks to IoT technology, waste management has never been smarter, more effective and more sustainable. The IoT with the help of a constantly increasing number of smart devices enables easier and faster monitoring of waste and pollution generated in numerous sectors (homes, buildings, medicine, industry, construction, transportation, agriculture, etc.) as well as their reduction. Nevertheless, the technological progress at the same time results in increased quantities of electronic waste (e-waste). According to (Vertatique 2014), if just 10% of IoT devices are trashed per year beginning in 2021, this could mean 2+ billion new e-waste items annually. E-waste is considered as the fastest growing waste stream (3-5% per year) (Cucchiella et al. 2015) and represents the global concern. However, waste from electrical and electronic equipment is one of the most controllable parts of the waste streams.

In order to successfully deal with e-waste, society is moving towards the development of green methods and techniques that satisfy the goals shown in Fig. 3. The minimization of the negative impacts of IoT use on human health and the environment is constituted in the technology applied to eliminate or at least lessen the measure of pollutants or toxic compounds as products of operations. Additional goals are to remove pollutants or hazardous waste from the environment and to reduce, reuse and recycle waste (Maksimovic 2017).

Figure 3. *The goals of green technology (Source:Maksimovic 2017)*



Present and anticipated economic benefits of e-waste recycling are:

- Conservation of rare, critical and valuable natural materials (e.g., gold, silver, aluminum, platinum, copper, iron), as well as glass and plastics (Maksimovic 2017).
- E-waste recycling contributes to significant energy efficiency (CFES 2012). The energy savings consequently lead to the less dependence on finite oil reserves, reduced air pollution and greenhouse gas emissions (Nayab 2011).
- Repaired and reused electronic products appear as cost-effective and more convenient compared to completely new products (Maksimovic 2017).

- E-waste recycling companies strength economies and produce more business opportunities. According to Morgan (2015), the potential revenue from the recycling of e-waste is around 2 billion USD and it is expected to rise to almost 3.5 billion USD by 2020.

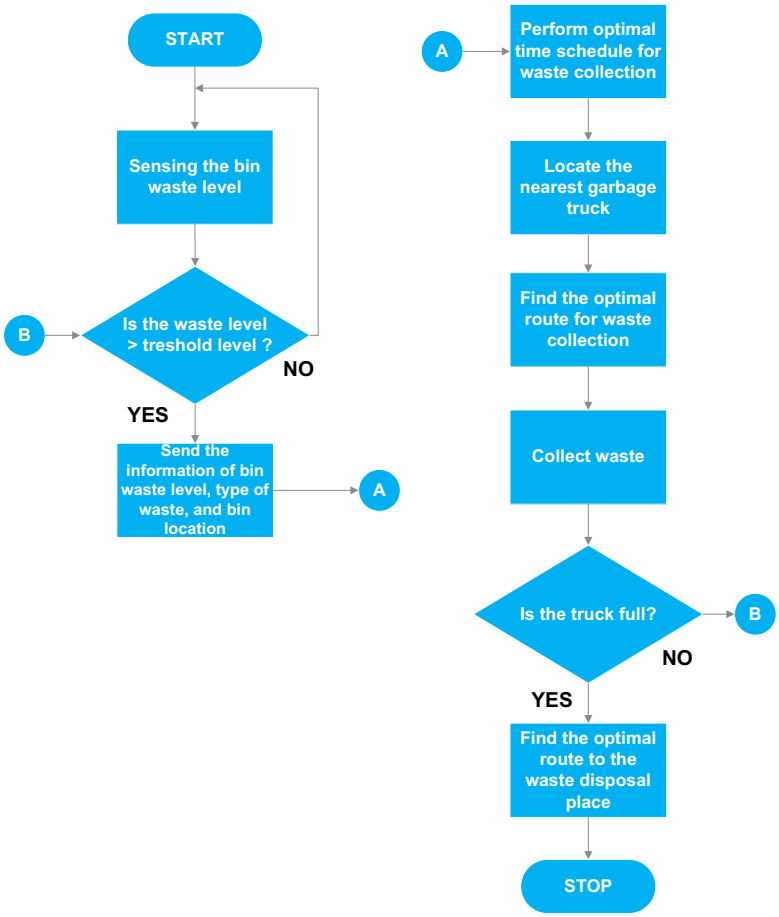
As can be seen, the green, environmental or clean technology involves environmental sustainable designing, manufacturing, using and disposing, without harming effects on the environment and human health (Green ICT n.d.). The IoT that helps reduction of the greenhouse effect within other industries, and also reduces the effect that IoT itself could have on the environment is known under the term Green IoT (G-IoT). The entire life cycle of G-IoT consists of green design, green manufacturing, green appliance and green disposal/recycling with no or very small impact on the human and the environment (Tracy 2016). On this way, significant amounts of solid and toxic waste and greenhouse emissions as well as the consumption of natural and non-renewable raw materials can be significantly decreased or even eliminated. The most present benefits of G-IoT usage are seen in the sectors that consume the large amounts of energy and natural resources and that are at the same time the largest sources of greenhouse gas emissions – buildings, industry, and energy sectors. The G-IoT potential to save and more efficiently use natural resources is present in agriculture, forestry, fisheries and aquaculture sectors. The benefits of the G-IoT appliance are present also in transport and tourism sector, and particularly in waste management. Hence, the advantages of G-IoT implementation in numerous sectors of modern society are significant socio-economic and environmental benefits (Maksimovic 2017). Evidently, G-IoT development and its widespread use significantly contribute to the realization of smarter, safer and more sustainable places to live.

IoT-driven waste management system

The IoT progress has enabled smarter and more efficient waste management than ever before. The advantages of an IoT-based waste management system are: reliability, mobility, user convenience, service continuity and energy efficiency (Hong et al. 2014). Nevertheless, significant cost savings and increased profit as a consequence of successful waste management are especially worth mentioning.

There are numerous smart garbage systems developed by companies around the world (e.g. Enevo, Compology, Bigbelly, Sutera, etc. (Musulin 2015)). These systems are Cloud-based and use the smart bins, equipped with the wireless sensors that are able to detect the garbage. Weight sensors provide the information about waste weight, while the sensors that are able to measure the bin filling level (e.g. infrared sensor, ultrasonic sensor) are more efficient in the development of smart waste management systems. The flowchart of proposed smart waste management system is given in Fig. 4. The information from wireless fill-level sensors and the bin location are uploaded to the Cloud and other stakeholders (Fig. 4).

Figure 4. *The flowchart of a smart waste management system*



Separating bins for each category of waste (Fig. 1), the information of waste type is also available alongside information regarding bin waste levels (Aazam et al. 2016). After the receiving information from wireless sensors that measure bin filling level and other multiple sensors and information sources (e.g., GPS - Global Positioning System, smart devices, RFID - Radio Frequency Identification tags) that provides information on garbage track location, and traffic congestion, the decision about bin collection time and optimal route for waste collection are being generated (Fig. 4, Fig. 5). If garbage truck is full, the next step is to determine the optimal route for waste dumping. The accumulated waste can be dumped off to the landfill or to the incineration (Fig. 6). Pre-separation of waste simplifies the choice of an adequate method for the dumping of waste. The biological reprocessing or recycling of organic waste materials (food, plant, and paper products) results in forms (e.g. mulch or compost) that can be used for agricultural purposes. The waste gas, collected from this process can be used for the electricity production. The thermal treatment of waste materials can be used for the generation of energy as a fuel (Waste Management Resources n.d.).

Figure 5. *Determination of the optimal garbage truck route for waste collection*

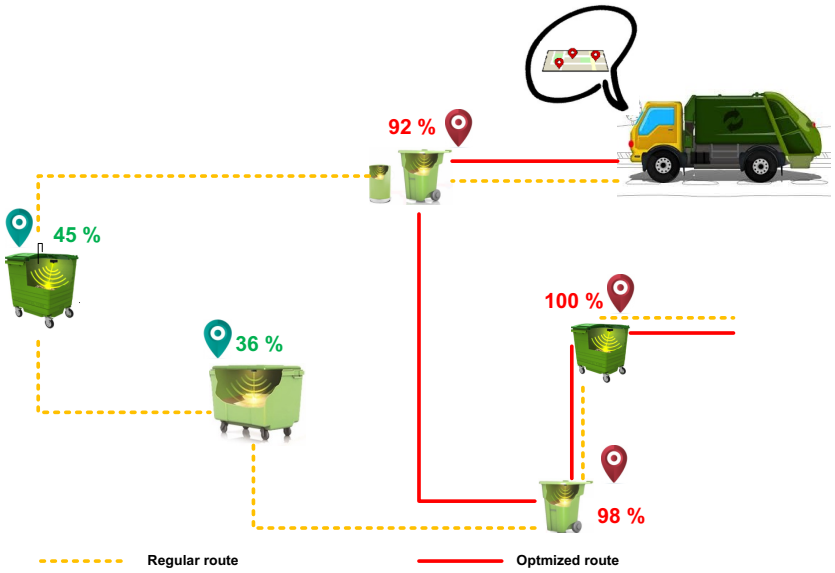
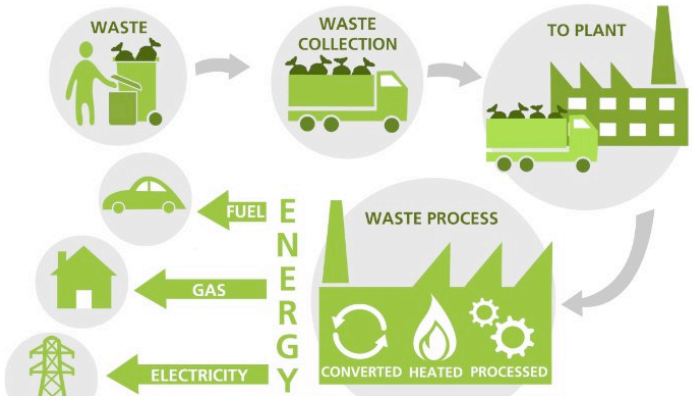


Figure 6. *Waste management process (Source: Tausif 2015)*



The development of smart bins and smart waste management systems can be found in numerous works (Sinha and Couderc 2013; Hong et al. 2014; Medvedev et al. 2015; Musulin 2015; Tausif 2015; Aazam et al. 2016; Boh 2016; Dhaya et al. 2016; Meghana and Nataraj 2016; Omar et al. 2016; Tracy 2016; Lundin et al. 2017, Shukla and Shukla 2017). The increased interest in this topic is the result of the numerous benefits that smart collecting, processing, and disposal of waste bring. The recent research has resulted in the development of solar-powered smart bins that act as Wi-Fi hotspots. Also, the bins can be equipped with a compactor that after crunching trash enable the increasing of smart bin capacity up to eight times (Boh 2016). It is important to highlight that implementation of the pre-separated waste method is of important significance in waste management systems. The stakeholders, based on information on the waste type and their collected quantities can perform more effective actions regarding specific waste type. Therefore, the optimization of the number and the placement of bins, as well as the better organization of bins for different types of waste, can be performed. Furthermore, the efficient and on-time waste collection contributes to better health, hygiene, and disposal (Aazam et al. 2016). Finding the optimal routes for waste collection (Fig. 5) contributes to significant cost savings. Hence, effective utilization of bins, real-time information of the waste volume, intelligent management of the city's services, cost-effectiveness and optimization of resource utilization, as well as enhanced environmental quality by minimizing potential harmful effects on the

environment and human health, are the main benefits IoT-based waste management systems bring. In other words, large quantities of data generated by IoT-based waste management systems enable obtaining valuable insights and making adequate decisions and activities towards the realization of smart, safe, and sustainable cities.

Conclusions

The performed study has shown the numerous benefits of IoT-powered waste management systems over traditional ones. The technology progress has enabled the omnipresence of the simple and low-cost solutions for wireless monitoring of bin filling level. Thanks to the IoT vision, numerous information regarding various aspects of the waste management are available at any moment from anywhere. This is of immense importance to all parties included in waste management and contributes to more successful waste management what is a precondition for the realization of smart, safe, and sustainable cities. This paper suggests the potential work schedule of an IoT-based waste management system. It enables the easier waste collection and optimizes the resource utilization. Waste management based on 3R's, reduce, reuse and recycle, thanks to the IoT has become more efficient than ever before. All of this leads to significant economic benefits. However, cleaner and safer environment is the most important advantage of IoT-based waste management systems. To the safer and sustainable place for a living contributes the utilization of green technologies, G-IoT particularly. Through the green design, production, utilization, and disposal, significant amounts of waste and greenhouse gas emissions can be reduced. With the help of technology advances, it can be expected that, despite the constantly increasing number of the city's residents and rapidly rising amounts of waste generated on a daily base, the society has a powerful tool for dealing with the challenges of modern society, such as successful waste management.

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PATTERNS AND ENVIRONMENTAL DETERMINANTS OF WOODY PLANT DIVERSITY AT A REGIONAL SCALE IN GREECE

Alexandra Solomou, Athanassios Sfougaris

Abstract

The aim of the present study was to determine the ecological characteristics of two types of ecosystems (maquis and abandoned olive groves) in terms of composition, diversity and environmental determinants of woody plant species in central Greece. The results of this study showed that woody plant species diversity indices had significant increasing values ($p<0.05$) in maquis compared to abandoned olive groves. According to Principal Component Analysis (PCA), woody plant diversity was positively correlated with soil organic matter, plant litter, N, P, K, slope and precipitation in maquis. Also, positive correlations among woody plant diversity and soil organic matter, and slope were detected in abandoned olive groves. It is noteworthy that woody plants serve a wide range of ecological functions. This study will be helpful for understanding ecosystem processes and for taking effective measures for management practices at abandoned olive groves and natural ecosystems different stages.

Keywords: *Environment; Olive groves; Distribution pattern; Maquis; Abandoned olive groves.*

Introduction

Biodiversity, the variety of life, is absolutely essential to the health of our planet's ecosystems. Biodiversity is a widely used term in ecology and natural resource management, and it is a key item in nature conservation (Do *et al.* 2015; Feroz*et al.* 2016). Woody plant species are among the most important components of terrestrial ecosystems (e.g. maquis and abandoned olive groves) and affect the overall composition of their communities and environment (Paganová and Jureková 2012; Solomou and Sfougaris 2015). Especially, they offer food such as leaves, flowers, pollen, nectar, seeds, and fruit which are important for the wildlife diets (Solomou and Sfougaris 2015). In addition, woody plant species diversity is fundamental to overall naturalecosystems biodiversity, because woody plants provide habitats for almost all other species (Feroz et al. 2016). Also, structural diversity measured as variation across a vertical stand profile also appears to be a good ecological indicator of the conservation of woody species diversity (Neumann and Starlinger, 2001; Feroz et al. 2016).

The main aim of the present study was to determine: a) the ecological characteristics of two types of ecosystems (maquis and abandoned olive groves) in terms of composition and diversity of woody plant species, and b) the relationships among woody plant species diversity and several environmental factors.

Materials and Methods

Study area

The study was conducted in 2009 on 10 maquis (M1-M10), a shrubland biome in the Mediterranean region, and 10 abandoned olive groves) (A1-A10) in western Magnesia Prefecture of Central Greece (Figure 1). The study area is included in the *Quercetalia ilicis* vegetation zone, and *Quercion ilicis* and *Oleo–Ceratonion subzones*. The climate is typical Mediterranean with dry and warm summers and mild winters with mean annual air temperature of 16.8°C and mean annual rainfall of 490 mm (Figure 2) (National Meteorological Service of Greece 2010).

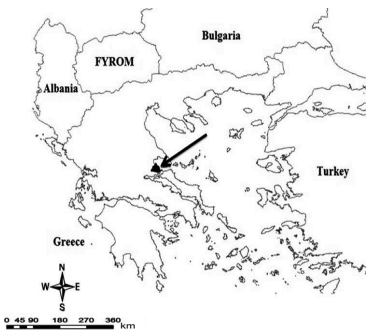

Figure 1*. Study area (western Magnesia, Central Greece).*

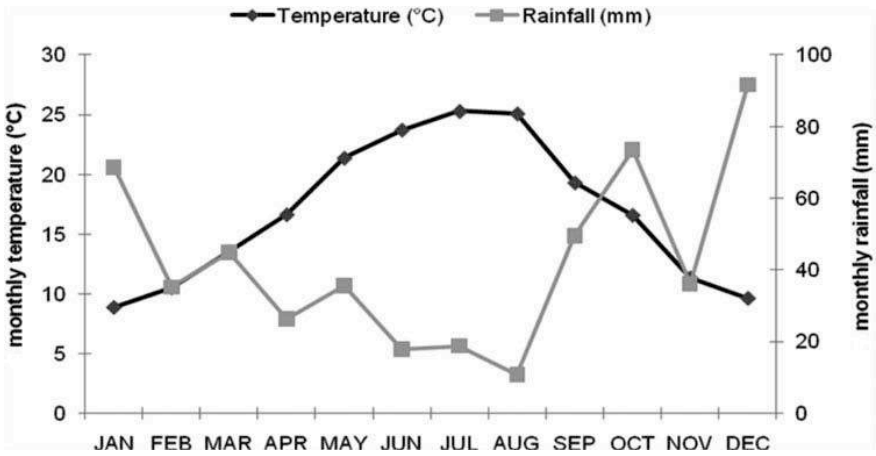

Figure 2. Ombrothermic diagram of the study area for the period 1956–2010 (data from National Meteorological Service of Greece 2010).

Sampling and Statistical analysis

Woody vegetation was surveyed in May 2009. Sampling was carried out in selected plots of 100 m^2 (10 m×10 m) (Koutsidou 1995) in 10 maquis and 10 abandoned olive groves (abandoned for about 12 years). Collins Tree Guide was used for the identification of woody plant species (Johnson and More 2004). Also, in each type of ecosystem (maquis and abandoned olive groves), five soil samples were randomly taken (0–30 cm deep) and mixed to obtain one representative sample (10 soil samples in maquis and 10 in abandoned olive groves). More specifically, soil samples thus prepared were analyzed for soil pH (SPH) (McLean 1982), organic matter (OM) (Nelson and Sommers 1982), N (Bremner and Mulvaney 1982), P (Olsen and Sommers 1982), and K (Thomas 1982). Additionally, soil plant litter (SPL) was recorded by visual estimation. Air humidity (AH) (%) and temperature (AT) (◦C), and precipitation (PR) (mm) were estimated by Hellenic National Meteorological Service. Finally, altitude (ALT) (m) and slope (SL) (%) were recorded using a global positioning system (GPS; e-Trex Vista, Garmin, Olathe Kansas) and a clinometer (Suunto Tandem), respectively.

Moreover, diversity indices such as species richness, Shannon Wiener, Simpsons D, Margalef D, McIntosh D, Brillouin D, Fisher's Alpha, Q Statistic and Evenness were calculated using Species Diversity and Richness IV software. Comparisons between the type of ecosystems were made with the randomization test of Solow (1993) (Seaby and Henderson 2006).

Furthermore, the relationships among woody plant species diversity (Shannon–Wiener index) and environmental variables (soil pH, N, P, K, plant litter and organic matter; precipitation; air temperature and humidity; altitude and slope) were analyzed using Principal Component Analysis (PCA) with the ordination software CANOCO (terBraak and Smilauer 2002).

Results

Woody Species Composition and Diversity

The overall species number of the woody plants sampled is 30, among these, 25 species are recorded in abandoned olive groves and 30 in maquis. The more frequently occurring woody species were: *Olea europaea* (19.85%) and *Olea europaea var. sylvestris* (9.01%) in abandoned olive groves, and *Pistacia lentiscus* (8.47%) and *Olea europaea var. sylvestris* (7.94%) in maquis (Figure 3).

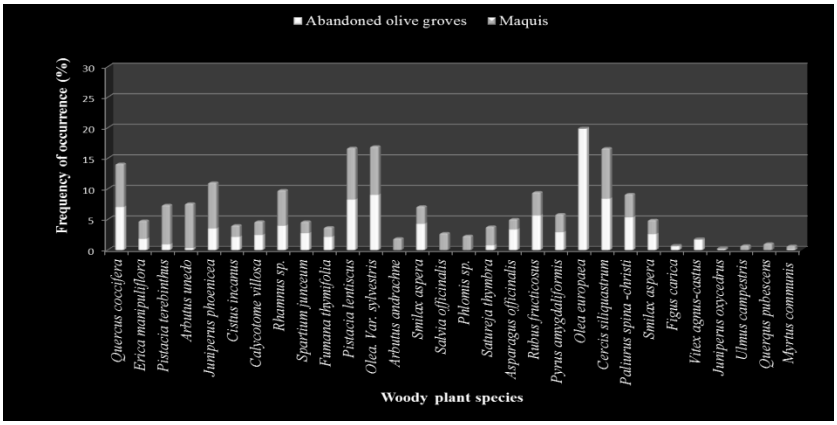

Figure 3. Frequency of occurrence (%) of woody plants in abandoned olive groves and maquis.

Diversity indices (Species richness, Shannon Wiener, Simpsons D, Margalef D, McIntosh D,Brillouin D, Fisher's Alpha, Q Statistic, Evenness) were computed from number of individuals of each species and they showed that maquis exhibited a significantly greater value of woody plant diversity compared to abandoned olive groves (Table 1).

Table 1. Woody plant species diversity indices in abandoned olive groves and maquis. Error! Not a valid link.<0.05: Statistical differences.*

Diversity indices	Abandoned olive groves	Maquis	P
Species richness	25	30	*
Shannon Wiener	2.69	2.98	*
Simpsons D	10.23	16.18	*
Margalef D	3.39	3.96	*
McIntosh D	0.70	0.76	*
Brillouin D	2.64	2.94	*
Fisher's Alpha	4.49	5.24	*
Q Statistic	7.70	8.40	*
Evenness	0.77	0.86	*

Environmental factors affecting woody plant diversity

According to PCA, the first two PCA ordination axes explained 90% of the data variation, where 77% is displayed on the first axis and 13% is displayed on the second axis (Table 2). According to Figure 4, in maquis woody plant diversity was positively correlated with soil organic matter and plant litter, N, P, K, slope and precipitation. Also, positive correlations among woody plant diversity and soil organic matter, and slope were detected in abandoned olive groves.

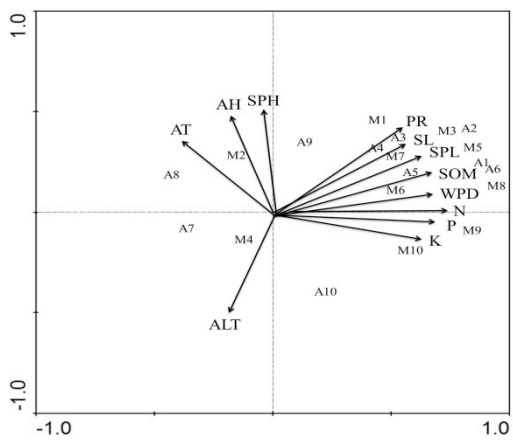

Figure 4. PCA.

Table 2. PCA summary of the relationship among woody plant species diversity and environmental variables.

Axes:	1	2	3	4	Total variance
Eigenvalues:	0.77	0.13	0.09	0.06	1
Cumulative percentage variance of data:	77.00	90.00	99.00	99.6	
Sum of all unconstrained eigenvalues:					1

Discussion-Conclusions

Biodiversity is globally used to evaluate ecosystem health because it affects key ecological processes of the ecosystems (Loreau*et al*. 2001; Hooper *et al*. 2005). Woody plant species are a key component of natural ecosystems; woody plants are responsible for their architecture (Stapanian*et al.* 1997) and influence the overall composition of the tree communities (Naidu and Kumar 2016). It is noteworthy that they provide food in the form of leaves, flowers, pollen, nectar, mast and fruit. Woody plants also provide cover, which protects fauna from predators and bad weather conditions. The type and percentage of cover required varies among wildlife species. More specifically, according to literature bird species population, habitat selection and foraging efficiency are influenced by vegetation structural diversity (Rais*et al.* 2010; Joshi *et al.* 2012;Gandiwa *et al.* 2013).

It is vital that floristic composition studies are essential in view of their value in understanding the extent of plant diversity in abandoned and natural ecosystems. The study of floristic composition and structure of abandoned and natural ecosystem reserves are also useful in identifying important elements of floristic diversity, protecting threatened species, and monitoring the status of these ecosystems (Akinyemi and Oke 2014).

Olea europaea var. sylvestris and *Pistacia lentiscus* constitute common species of woody plants in Mediterranean ecosystems and these species are abundant and widespread in the thermonediterranean part of the Mediterranean basin (Wilson 1993; Solomou and Sfougaris 2015). According to, Oliveira et al. (2011), woody plant species such as *Olea europaea var. sylvestris* and *Pistacia lentiscus* have high survival rates over the study period. As regard growth is concerned, these woody plant species also had the highest growth after eight years of study.

It is known that environmental factors influence the patterns of plant diversity, in turn; vegetation affects soil properties at different scales. More specifically, several environmental parameters such as nutrients, soil humus, rainfall and temperature may have favored the growth of these species in both abandoned olive groves and maquis (Peng *et al.* 2012; Solomou and Sfougaris 2015).

Greece is one of the richest countries in Europe in terms of floristic diversity. Though landscapes are dynamic and change continually under the influence of several driving forces, the rate of change can differ significantly (Sluis*et al.* 2014). Our study shows that woody plant species diversity was higher in the maquis than abandoned olive groves. These results can be explained by the Ecological Succession Hypothesis through which the abandoned olive groves tend to gradually develop into the natural Mediterranean type vegetation (Vokou 1988; Loumou and Giourga 2003).

It is remarkable that the examination of woody plant species richness as well as its interaction with its geographical variation and the environment at a national level, leads to the interpretation of plant diversity provenance and preservation in terms of geographical expansion in general and also of multidimensional woody plant diversity in particular at an international level.

According to the literature (Peng *et al.* 2011; Song *et al.* 2010) plant diversity has been shown to have a high degree of spatial variability that is controlled by both abiotic and biotic factors. Our results indicate that, according to PCA, soil organic matter and nutrients are the most dominant factors influencing the woody plant diversity of abandoned olive groves and natural ecosystems, followed by topography and climate. These results mean that soil organic matter and plant litter provide major nutrients such as magnesium, calcium, potassium, nitrogen, phosphorus, sulfur, and lime, from which plants use large amounts for their growth and survival (Smith 1999–2013). Also, topography (e.g. slope) and climate (e.g. precipitation), are widely used to explain the spatial distribution of plant communities (Hamilton 2010; Lowe *et al.* 2012). Coblentz and Keating (2008) refer to their study that topographic variability provides a wide range of microclimatic conditions and can support high woody

plant diversity and structure. Peng *et al.* (2012) and, Solomou and Sfougaris (2015) underline that slope has an important role in soil organic matter and available total N, P and K, which are important factors for the woody plant development and diversity.

Moreover, precipitation is critical for plant growth and plays a key role in determining the distribution and diversity of plants. The water availability for plant growth is affected by the amount and type of precipitation, as well as soil characteristics, temperature and wind (National Climate Assessment 2015).

Conclusively, this study is important as it will provides valuable information for ecological process and developing effective management practices at abandoned olive groves and natural ecosystems different stages. Furthermore, ethnobotanical studies should be conducted to harness the indigenous knowledge on the uses of plant resources contained in the above ecosystems.

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DEHYDRATION OF FIGS AS AN ALTERNATIVE OF SUN-DRYING TECHNIQUE AND EFFECT ON SOME QUALITY PARAMETERS

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Abstract

Dried figs are considered as prestigious snack food among other dried fruits, and have a great importance in nutrition. Sun drying is a traditional renewable, cheap and environmental friendly method applied also in Albania, but due to some disadvantages on the product quality and safety, there are other alternative drying systems used. This paper aims to present the evaluation of quality parameters of "Roshnik" a local fig variety, most common used as dried product in Albania, applied two drying methods: sun-drying and hot air dehydration. Application of pre-treatments such as bleaching and $K_2S_2O_5$ were used increasing quality of dried products. The results showed that hot air dehydration and pre-treatment applications offered better quality of dried fig fruits in terms of some quality parameters and should be taken under consideration for application to food processors for figs drying as an alternative of sun-drying.

Keywords: *Ficus carica, drying, pre-treatment, polyphenols, antioxidants*

Introduction

The fig (*Ficus carica L.*), one of the most important fruit species in the Mediterranean area, bears fruits that are highly perishable, due to its high moisture and sugar content even in refrigerated conditions (Hardenburg et al.1986, Piga et al. 1995), and thus nearly all the world production is preserved in the dried form.

Drying is one of the important preservation methods employed for storage of figs since the dawn of civilization. Fig fruit can be dried either by traditional methods (sun drying) or in conventional hot-air dryers (Babalis et al. 2006). As a drying alternative hot air dehydration has gained importance because it has many advantages over sun drying (Barbosa-Cánovas and Vega-Mercado 1996) including: (a) the process is under better sanitary conditions, because of a reduction in contamination by dust and other foreign matter; (b) drying parameters can be accurately set, controlled and changed over the entire processing time, thus a more consistently uniform product can be achieved with less quality degradation; (c) dehydration is not conditioned by rain or weather changes; (d) when a constant rate of dehydration is reached, increasing the air flow can result in shorter drying times; (e) labour costs are lower.

However, the research on drying figs is limited (Piga et al. 2004, Babalis and Belessiotis 2004, Doymaz 2005, Babalis et al. 2006, Xanthopoulos et al. 2007, 2009, 2010) even though in the last 30 years a number of research papers for other typical Mediterranean fruits like apricots and plums have been published (Bolin and Stafford 1974, El Halouat and Labuza 1987, Senhaji et al. 1991, Barbanti et al. 1994, Sabarez and Price 1999, Price et al. 2000).

Papoff et al. (1998) tried to dehydrate figs with an industrial dehydrator, and gained very good results in terms of drying times and microbial stability, but structure collapse occurred and figs have some problems with the sensorial properties (burnt taste).

Drying cause physical, chemical and biochemical changes in addition to some undesirable alterations such as textural and color changes (Krokida and Marinos-Kouris 2003, Doymaz 2005, Sharifian et al. 2012, Xanthopoulos et al. 2010). Such changes may be influenced by using pre-

treatment, causing a shorter drying time and a reduction in adverse changes that occur during drying compared to untreated fruits (Lewicki 2006). Several studies have tested various pre-treatment with the aim to reduce peel resistance of the final dried product or to weaken it (Demirel and Turhan 2003, Gonzalez-Fesler et al. 2008, Vega-Galvez et al. 2008, Perez and Schmalko 2009) and to water transfer from the inside of the product to the surface, increasing likewise the drying rate (Doymaz 2006, 2007a,b).

Dried figs are considered as prestigious snack food among other dried fruits. Figs have a great importance in nutrition due to being important sources of carbohydrates, essential amino acids, minerals and fibres. These beneficial effects are associated with the presence of phenolics, and some vitamins A, B1, B2 and C. Slatnar et al. (2011) compared for the first time the phenolic content between fresh and dried fruit. However, only a few studies have investigated the effect of drying on polyphenols of figs.

In Albania the conventional method of sun drying is still being used with prior sulfuring. The lack of a drying system applicable for figs in industrial level encouraged us to test the effect of different drying methods such as hot air dehydration and sun drying on the antioxidant potential of dried figs compared to fresh figs. Also, this work attempts to investigate the effect of pre-treatment prior to sun-drying and hot air dehydration.

Materials and Methods

Plant material

The local variety of *Ficus carica* named "Roshnik" (yellow skin colour and red pulp) was selected for this study. Its cultivation area is Roshnik village (40°42'51.56"N 19°58'48.02"E) in Berat region and sun-dried figs are traditional products of this region.

Fruits were harvested at the end of August 2016 at optimal maturity and immediately transported to the laboratory.

Sampling: The selection of fruits were done based on weight (fruit weight was 38.22 ± 1.28 g) in order to ensure a uniform size, appearance, maturity, and health conditions.

Pre-treatment

Before drying, fruits were pre-treated, in order to reduce non enzymatic browning and speed up the drying process. Pre-treatments were:

1. Blanching in boiling water with 1% NaCl for 1 min, cooling to 25±2°C using tap water (blanching water to fruit ratio was 12:1); (sample code BS)
2. Blanching in boiling water with 1% NaCl for 1 min, cooling to 25±2°C with tap water and dipping for 1 min in a 0.2 % $K_2S_2O_5$ solution (solution to fruit ratio was 12:1); (sample code BSKMS)
3. Dipping for 1 min in a 0.2 % $K_2S_2O_5$ solution (solution to fruit ratio was 12:1); (sample code KMS)
4. Untreated control; (sample code C)

Drying process

Sun drying

For sun-drying process the fruits were set on a tray in three repetitions per treatment, and exposed to direct sunlight during the day from 8 am to 20 pm. They were manually turned twice a day, while during the night they were covered in order to avoid absorbing air humidity. The average temperature during the day was 38°C, and the process last approximately 4-7 days.

Hot air drying

Fruits were dried in a laboratory dehydrator. Fruits were placed on three shelves per treatment (the drier can hold ten shelves). Hot air dehydrator was a closed cabinet with a fan inside to blow the air "horizontally" across the shelves (fruits were set on shelve inside the drying chamber). The ambient air temperature was 25°C, while drying air was heated electrically to a 60°C adjusted temperature, with air relative humidity approximately 40% (at the beginning) and 10% (at the end) and flowed to the fruits with a constant speed 1 m/s. Air recycling system allowed the mixing of exhaust air with

fresh air, which was then reheated and redirected to the product. The process last approximately 24-30 hours.

Dried fruits were packed in water impermeable plastic bags (coextruded polyethylene /polypropylene) and stored at ambient conditions until analysis.

Preparation of extracts

Methanol extracts were prepared by extracting 1 ± 0.001 g grinded fig samples with 10 ml of aqueous methanol 80% (v/v), homogenized for 1 minute using Ultra-Turrax T-25 (Ika-Labortechnik, GR), with speed set 11000 1/min, and centrifuged using centrifuge Eba 21 (Hettich, GR) for 15 min at 4500 rpm. This process was repeated three times and supernatants were collected and analyzed. Extracts of fresh and dried fig samples were prepared separately. All samples were analyzed in triplicate.

Assessments and determinations

Fresh and dried fruits were analyzed. Moisture content (%) was determined according to method AOAC (2000), pH value was determined using pH meter UB-10 (UltraBasic, Denver Instrument) (AOAC 2000), total acidity (expressed as % citric acid) was determined by titrating with 0.1N NaOH (AOAC 2000).

Total phenolic content of the extracts was determined according to the method of Singleton and Rossi's (1965) with some modification and results were expressed as *gallic acid equivalents* (mg GAE 100 g^{-1} DM^{-1} (dry matter of sample). The absorbance was measured at 760 nm using UV/Vis spectrophotometer Libra S22 (Bichrom, UK). Total flavonoid content was measured using $AlCl_3$, a colorimetric method (Zubair et al. 2013). The absorbance was measured at 510 nm using the spectrophotometer Libra S22 (Bichrom, UK), and results were expressed as *(+) catechin equivalents* (mg CE 100 g^{-1} DM^{-1} of sample). Total anthocyanin's content was measured according to the pH differential method (Cheng and Bren 1991). Absorbance of extracts was measured at 520 nm and 700 nm in buffers at pH 1.0 and pH 4.5 where absorbance was: $A=(A_{520}-A_{700})_{pH\ 1.0}-(A_{520}-A_{700})_{pH4.5}$, (with molar extinction coefficient of 26.900 and molecular weight of 449.2). Results were expressed as *cyanidin-3-glucoside equivalents* (mg C3G 100 g^{-1} DM^{-1} of sample).

Antioxidant activity of extracts was determined using ABTS radical scavenging assay (Re et al. 1999). ABTS and potassium persulfate mixture was kept in the dark at room temperature for 16 h before use. For the analysis, the stock solution was diluted in aqueous methanol 80% (v/v) until the absorption at 734 nm was 0.7± 0.02. 10 µl of extract was mixed with 990 µl of ABTS reagent. The absorption was measured after 6 min of incubation, and the result was expressed as *ascorbic acid equivalents* (mol AAE 100 g^{-1} DM^{-1} of sample).

Results

The results are given on Table 1-2 and Figures 1-3. The weight of pre-selected fig fruits was 38.22 ± 1.28 g, skin colour yellow and red pulp. The drying time took approximately 4-7 days for sun-drying, and 24-30 hours for hot air drying. The reduction of drying time for both drying methods applied was attributed the positive role of pre-treatment applied. This finding was in accordance with other studies (Piga et al. 2004, Lewicki 2006).

On the Table 1 are shown the codes of pre-treated samples and dried with two methods, and the drying time for each case.

Table 1. *Codification of pre-treated fig fruits and drying time for sun-dried and hot air dried samples*

Code of pre-treated samples	Code of sun-dried samples	Drying time for sun-dried samples (days)	Code of hot air dried samples	Drying time for hot air dried samples (hours)
C	C-SD	7	C-HAD	30
BS	BS-SD	5	BS-HAD	27
BSKMS	BSKMS-SD	4	BSKMS-HAD	24
KMS	KMS-SD	4	KMS-HAD	26

The two drying methods influenced the appearance of the final dried product. The browning resulted in untreated dried samples due to high amount of sugars in particular reducing sugars which have the ability to interact with amino acids (nonenzymatic browning reaction). Also, the long drying

time for C-SD affected more the color compared to C-HAD. The application of pre-treatment resulted to have a positive effect in retention of color, shape, and a soft structure for both SD and HAD samples according the order: BS < KMS < BSKMS.

Table 2: *Physico-chemical parameters of fresh and dried Roshnik fig variety*

Roshnik fig variety	Skin color	Pulp color	Weight[a] (g)	TSS	Acidity[a]	Ratio	Dry matter[a]	pH[a]
				(°Brix)	(% citric acid)	TSS/acidity	(%)	
fresh	yellow	red	38.22 ± 1.28	25±0.01	0.35±0.005	71.43	31.34±0.19	4.88±0.01
sun-dried					0.81±0.015		73.87±0.19	4.35±0.005
hot air dried					0.63±0.005		80.28±0.02	4.36±0.005

(a: mean value ± standard deviation)

Referring to Table 2 the dry matter was 31.34 % for fresh figs, while for dried figs was higher (73.87-80.28 %). The total soluble solids (TSS) of fresh fruit was 25°Brix, and the higher content of total soluble solids make it more suitable for drying. Titratable acidity expressed as citric acid, that is predominant organic acid in the fresh fig fruit was 0.35 % citric acid (CA), and for the dried figs it ranged 0.63-0.81% CA, showing that after drying process it was increased, this because the dried fig fruit samples contain less water, and organic acids are more concentrated in dried figs. The ratio between the analyzed sugars and organic acids in fresh figs is a common quality index and a good indicator of internal fruit quality. The optimal ratio differs between cultivars and it is crucial for a harmonious flavor (Slatnar et al. 2011). From literature and our results organic acids are present in lower concentrations in fig fruit than sugars, and their effect on the fruit flavor is considerable. The sugar/acid ratio for our selected variety was 71.43 value for fresh figs, so the higher the ratio, the sweeter are the fruits; the lower the ratio, the more sour tasting. Also, pH of fresh figs was 4.88, while in dried figs was lower and ranged between 4.35-4.36. Accordingly, after drying process the pH values were decreased with increscent of total acidity. The above data were in the range reported (Piga et al. 2004, Slatnar et al. 2011) for this fruit species.

Phenolic Compounds

A number of studies have shown that the presence of phenolic compounds in food and especially in fruit can be particularly important for consumers, because of their beneficial health properties. Besides antioxidant effects, phenolic compounds possess a wide spectrum of biochemical properties and can also have a beneficial effect in preventing the development of diseases such as cancer and cardiovascular diseases (Lattanzio 2003). Slatnar et al. (2011) identified groups of hydroxycinamic acids, flavan-3-ols, flavonols and anthocyanins, where the predominant phenolic compound were epichatechin.

Figure 1. *Total polyphenolic content in fresh and dried figs of two drying methods and different pre-treatment*

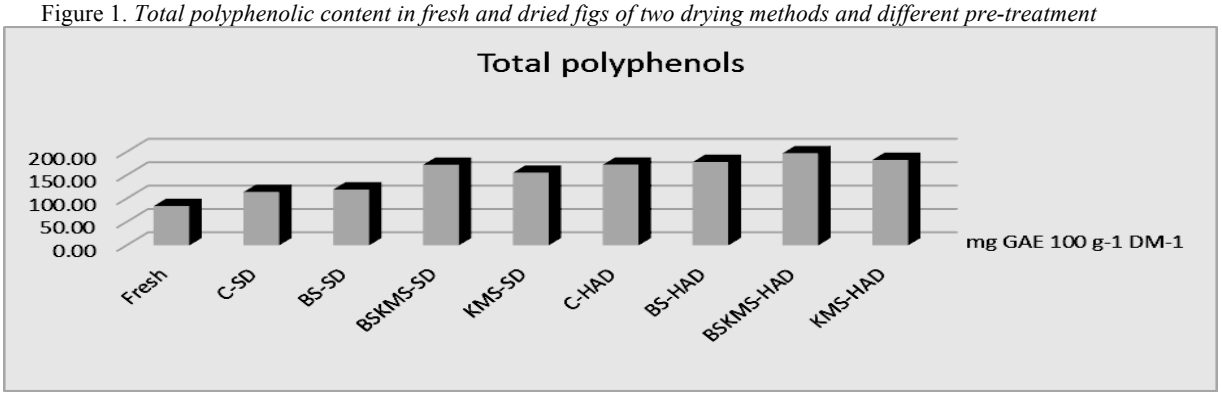


Figure 1 shows the total polyphenolic (TP) content of fresh and dried figs before and after pre-treatment. The TP in fresh figs was 83.92 ± 0.76 GAE 100 g^{-1} FW^{-1} (fresh weight) and in dried fruits ranged between 114.03-196.97 mg GAE 100 g^{-1} DM^{-1}. These results showed that the two drying

methods have had different impacts in total phenolic content. It was also noticed that after hot air dehydration fruits had higher TP content compared to sun-drying (TP after HAD ranged 172.45-196.97 mg GAE 100 g^{-1} DM^{-1}, while after SD ranged 114.03-172.24 mg GAE 100 g^{-1} DM^{-1} of sample). Furthermore, the pre-treatment have different effect on phenolic content. In both drying methods bleaching plus KMS had a positive effect on content of polyphenols, showing a greater phenolic content than other dried samples (sample BSKMS-HAD had 196.97 GAE 100 g^{-1} DM^{-1} and sample BSKMS-SD had 172.24 GAE 100 g^{-1} DM^{-1}). The effect of pre-treatment BSKMS were more notable at sun-dried samples, while at hot air dried samples there were not a significant difference between three pre-treatment applied (Figure 1).

Total anthocyanins (TA) content ranged 0.0-10.35 mg C3G 100 g^{-1} FW^{-1} of sample. Anthocyanins were detected only in fresh figs, while in dried figs were depleted. The two drying methods applied had the same effect on depleting anthocyanins content. The pre-treatment applied did not affect the content of anthocyanins in the dried fruits.

Figure 2. *Total flavonoid content in fresh and dried figs of two drying methods and different pre-treatment*

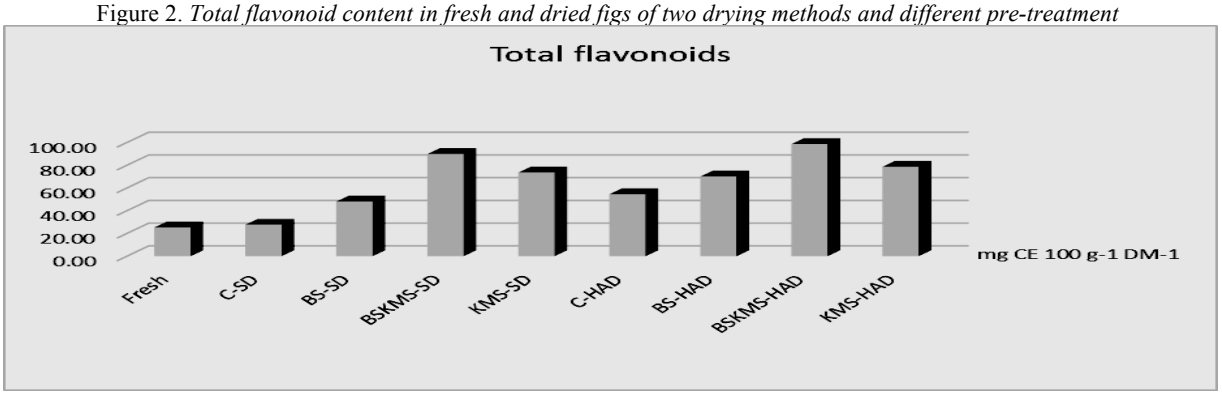
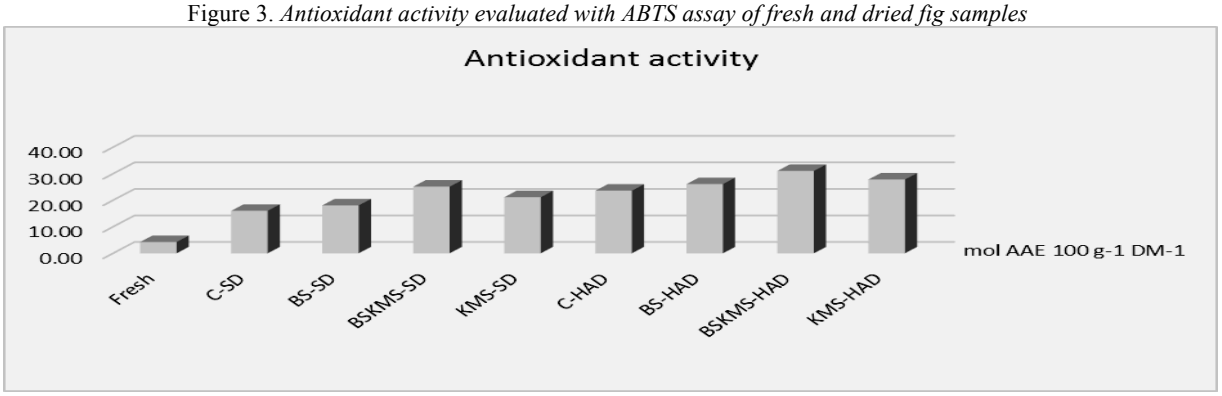


Figure 2 gives the total flavonoid content (TF) content of fresh and dried figs before and after pre-treatment. In fresh figs was 25.27± 0.242 mg CE 100 g^{-1} FW^{-1}, of sample. In dried fruit TF after sun-drying ranged 27.68-89.87 mg CE 100 g^{-1} DM^{-1} of sample, and after HAD ranged 54.53-98.63 mg CE 100 g^{-1} DM^{-1} of sample. It is obvious that the two drying methods had different effect on the content of total flavonoids, where hot air drying had a positive effect on the content of flavonoids. Pre-treatments had a positive impact in total flavonoid content in the order bleaching plus KMS (89.87-98.63 mg CE 100 g^{-1} DM^{-1} of sample), potassium metabisulfite (KMS) (73.58-78.64 mg CE 100 g^{-1} DM^{-1} of sample) and the last bleaching (48.14-70.14 mg CE 100 g^{-1} DM^{-1} of sample).

Antioxidant activity was determined using ABTS radical scavenging assay. The results are given in Figure 3. The highest antioxidant activity resulted in hot air dried samples and the values ranged between 23.67-31.12 mol AAE 100 g^{-1} DM^{-1}, while in sun dried samples values ranged between 16.07-25.18 mol AAE 100 g^{-1} DM^{-1}.

Figure 3. *Antioxidant activity evaluated with ABTS assay of fresh and dried fig samples*



In accordance to the results shown in Figure 3, pre-treatment had a positive impact in total antioxidant activity. Many studies showed a good correlation between polyphenolic compounds and

antioxidant activity. Antioxidant activity was higher at all dried figs varieties compared to fresh figs. Also, it was noted that antioxidant activity of hot air dried samples was higher compared to sun dried samples.

Discussion-Conclusions

Comparing the influence of the two drying methods applied it was obvious that hot air dried products achieved lower moisture content than sun-dried products and a shorter drying time. Also, application of the hot air dehydration had a higher effect on total acidity for "*Roshnik*" variety. Anthocyanins were depleted after the application of both drying methods and was find that pre-treatment did not play any role. The hot air dehydration processes influenced differently on the phenolic content and showed an increased effect about 25-35% on phenolic content compared to sun-drying.

Application of pre-treatments, was found to be beneficial for dried figs, speeding up the drying process and better quality of dried fig fruits in terms of phenolic compounds and antioxidant activity for both SD and HAD samples according the order: BS < KMS < BSKMS.

Based on evaluated quality parameters of dried figs dried with two methods, such as the traditional sun-drying and the hot air dehydration, we can recommend the hot air drying as an effective method for figs drying. Hot air dehydration allowed better process parameters control and hygienic conditions. Also, application of pre-treatment has a beneficial effect in terms of quality of dried product and the drying process. Furthermore, this study showed that the selected Albanian fig variety showed high potential to be processed as dried products.

The results of this work showed that hot air dehydration and pre-treatment applications offered better quality of dried fig fruits in terms of some quality parameters and should be taken under consideration for application to food processors for figs drying as an alternative of sun-drying in Albania.

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FISHERY COMPOSITION AND PRODUCTION OF COASTAL WETLANDS 'LAFRI', 'LAFROUDA & 'OLD RIVERBED NESTOS', AIMING TO THEIR SUSTAINABLE MANAGEMENT

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Abstract
The coastal wetlands (lakes or lagoons) 'Lafri' and 'Lafrouda' and the a wetland channel ecosystem 'Old Riverbed Nestos', are situated in northern Greece, in the region of Thrace, east of the river Nestos estuarine, about 30km far from the city of Xanthi. The two lagoon systems mentioned first, communicate with each other and are separated from the sea by a sandblast reef. Their waters are brackish, muddy and shallow, with a mean depth of around 0,35m. The wetland of 'Old Riverbed Nestos' is comprised of shallow canals with brackish water and it is southern nearby of Erasmio village. The fishery of lagoons Lafri and Lafrouda are managed from a local Fishery Cooperative named 'Agios Nicolaos', whereas the 'Old Riverbed Nestos' is managed from the 'Poseidon Fishery Cooperative'. The lagoons Lafri and Lafrouda provide yearly a rather low fishery production (about 4.217 kg), due to silting and the shallow nature of the two wetlands. The fishery management of 'Old Riverbed Nestos' is quite intense since the mid of the decade of 2000, and have done technical projects that have presented excellent fishery results with an average annual production reaches 17.562 kg.

Keywords: Lafri, Lafrouda, 'Old Riverbed Nestos', fishery production, fishery composition, fishery management.

Introduction

The coastal lake (or lagoon) Lafri is located east of the river Nestos estuarine, 30 km from the city of Xanthi. The lagoon connects in west with the lagoon Lafrouda, while in north and east both of the lagoons are restricted by an arable land and pastures. Both of the lagoons are separated from the Thracian Sea in south from a sandblast. The lagoon Lafri covers an area of about 1.200 acres and is roughly oval in shape. It is shallow and muddy, with an average depth of 0,4 m and a maximum of 0,7 m. The water of the lagoon is brackish, due to the communication with the sea. This communication is permanent all over the year and achieved with a channel of 300 m long in length. In the southeastern part of the lagoons has been constructed an artificial islet for the protection of aquatic avifauna, from the sludge that derived from the construction of the dredging trenches from the surrounding lagoons. (Koutrakis 2000, Pesca 2000, Kokkinakis 2004, Koutrakis et al. 2005, Kokkinakis et al. 2007)

Lafrouda lagoon is located at a distance of 30 km from the city of Xanthi, eastern of Nestos river, between of Porto Lagos and Avdira vilages, in west of Lafri lagoon and in southwest of Vistonis Lake. It covers an area of 750 acres, and has an average depth of 0,3m. It is a shallow and muddy lagoon, with brackish water as it is in permanent contact with the sea through a connective channel of 300 meters long. For the better water circulation of this coastal lake has formed a V shape artificial channels in the bottom (Arabatzis and Kokkinakis 2005, Kokkinakis et al. 2005, Kokkinakis and Andreopoulou 2006).

The fishery management on both coastal lakes (lagoons) becomes from the Fishery Cooperative called 'Agios Nikolaos'. The undersized fish that are caught letting to enter in a 'wintering trench', built in 1985 in Lafri lagoon and in 1990 in Lafrouda lagoon. The fishery traps are constructed in modern type and consist of concrete and aluminum alloy. They arranged in 3 rows, the two of them are including simple 'doors' ('fish-bars') and the third one, which is in the middle, is including the fish traps. (Koutrakis 2000, Pesca 2000, Kokkinakis and Psaltopoulou 1997)

The cluster of wetland channels called 'Old Riverbed Nestos', formed East of Nestos River at a distance of 30 km from the city of Xanthi, South of the village Erasmion. It consists of a grid of water channels that are left after the settlement projects of the Nestos River, from 1954 onwards. These channels accept fresh waters from the surrounding area as also sea waters, since they communicate with the Thracian sea, from which is separated with a wide sand-islet. Their total area is about 650 acres while their water area covers 280 acres. The water in the ditches of the ecosystem is shallow. The mean depth of this ecosystem is 1 m and the maximum 2 m, whereas this deeper area covers 10% of the total water surface. The water of the channels communicating with the sea with an inlet channel of about 60 m long, which one has a width of 4 m and a depth a of about 1 m approximately. Until 1999, the fishery production data refer only to fishes from Mugilidae family and eels. From September to December 1999, was made a restocking of these channels with Sea bass, within the framework of PESCA project, and was made an intensive 'pre-fattening' period of the small fishes up to 35–50 gr (Pesca 2000). In January 2000 were released in the channel system the above fishes, aiming to the increase the production. The wetland 'channel system' of the 'Old Riverbed Nestos' belongs to the Greek State and has been rented in a 'direct process' to a Fishery Cooperative called 'Poseidon' from 1983, while till then it was exploited from other privet companies. The 'undersized' fish for fishing, let to enter in a 'wintering ditch', throw a small channel located exactly after the inlet channel of sea water (Kokkinakis and Andreopoulou 2009a, b, Kokkinakis et al 2009, Kokkinakis and Zournatzidis 2014).

Materials and Methods

Fishery data were collected from the Fishery Department of Xanthi, and are mentioning for the years 1995-2010. In the fishery recording system, the separate fish species of the family Mugilidae – 'grey mullets' (*Mugil cephalus Liza aurata, Liza saliens, Liza ramada, Chelon labeo and Chelon labrosus*) grouped as a common sum named 'grey mullets', (Mugilidae) (Koutrakis 2000). Concerning the Lafri and Lafrouda lakes, for the years 1995-1999 data arises only for 'grey mullets', while for the 'Old Riverbed Nestos' no data was kept for the years 2000-2003. During the years 1995-2000 the 'Old Riverbed Nestos' doesn't manage in an intensive way, which was followed since 2004 and the production of those years is insignificant.

Fishery production data recorded using the Microsoft Excel program. Total fishery production data presented in linear annual charts in comparison with that of separated for each fish species. It presented also the percentage of each species production in the % composition of total fishery production.

Results

The Lafri and Lafrouda lagoon ecosystems

Fishery production in the mid of 1990s begins from very high levels, around 9.748 kg/year in 1995, which is following from a general decline with fluctuations, leading to a 'zero' production in 2001. This instant change is due to an intense storm that occurred in January in both of the above ecosystems of Lafri and Lafrouda in 2001 and 2000, that caused mass deaths of fish due to very low temperatures and finally the total frost of the waters in both of the lakes (Fig. 1a,b,c). The recovery of the production which follow and the relative stability of the fishery yields, succeeded higher prices in 2005 (3.171 kg) and 2008 (3.283 kg). In 2007 occurred a decline of production due to a flooding caused from the very heavy rainfalls of this year.

The main fished species for both of these two lakes are the gray mullets with a rate of 83%, while following the sea breams with 13%, the sea basses with 2% and the soles with 1% (Fig 1d). The participation of crabs and eels are very small and opportunistic. As it is expected, the specific fishery production of grey mullets specifies the total fishery production and the amount of consistent with the corresponding fishery changes. Very high yields presented also in 1995 (9.748 kg), 1998 (8.448 kg), where they received the 100% of the fishery production, while in 2005 was 3.171 kg and in 2008, 3.283 kg.

The composition of the fishery production presents changes and most indicative is after the introduction of sea bream in the yield. The sea bream starts fished since 2002, and the maximum

production appears in 2004, with 2.030 kg and in 2005 with 1.989 kg. The fishery composition of 2004 is characteristic (Figure 1a,c), and it presented there the combination of the rise of sea bream production, with the falling of grey mullets production.

The same also occurs and for the production of sea bass during the same years (Fig. 1a,b), where the yield were of around of 391 kg and 334 kg, respectively for each lagoon. We can note here, that as also the same happens and in the 'Old Riverbed Nestos', where the production of sea bass and sea bream have an inverse relationship and when the first species reaching higher productions when the other one shows smaller ones.

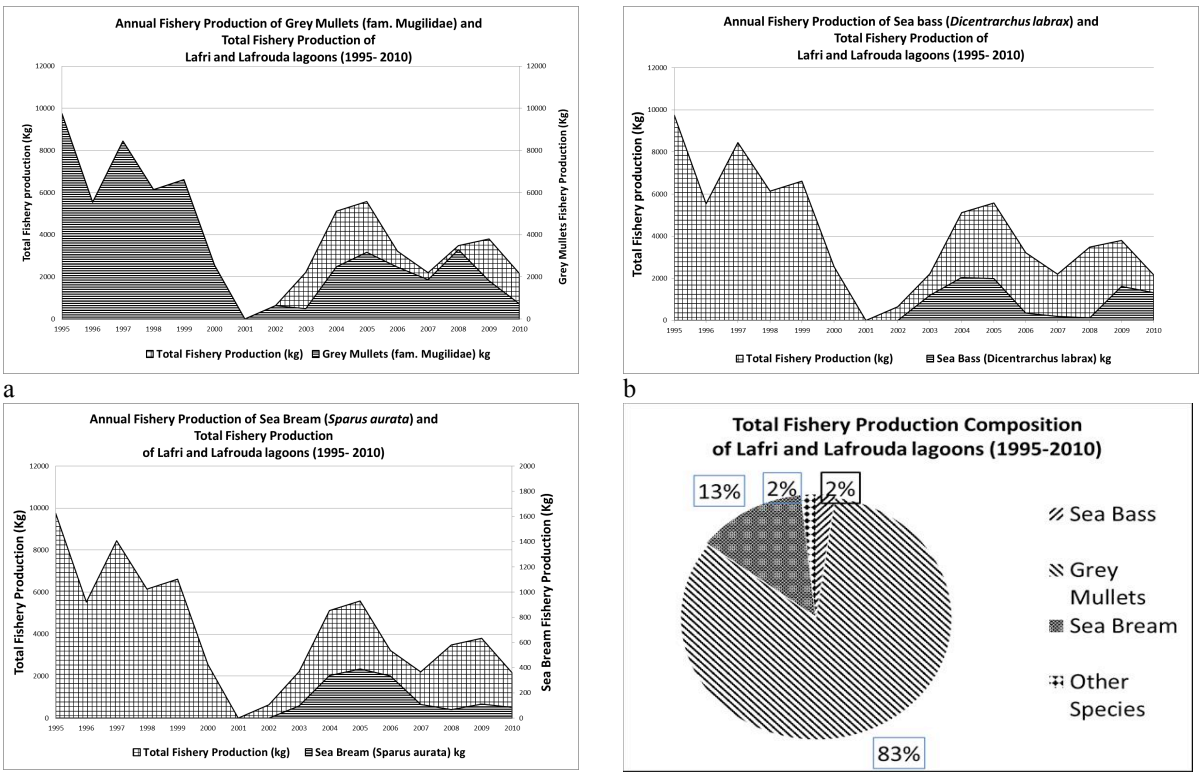

Figure 1. *Comparison of the Total Fishery Production with the partial fishery production of a) Grey mullets, b) Sea bass, c) Sea bream and d) Fishery Composition of the Total Fishery Production of the lagoons Lafri and Lafruda for the years 1995-2010.*

The 'Old Riverbed Nestos' wetland channel ecosystem

Fishery data are recorded for the period of years 2004-2010. Fishery data exist also and for the years 1995-1999, but they are including only data for gray mullets, so we used them only for making comparisons. The fishery production of the 'Old Riverbed Nestos' presents sequential changes per year, even if it is including extreme values of the total fishery production.

The highest value of the annual fishery yield is 32.443 kg in 2004 and the lowest immediately afterward, in 2005 is 10.225 kg, while during this year occurred a strong heatwave in the wider area. The comparison of the values of total fishery production with the corresponding values that prevailed during the 1990s is very interesting (Fig. 2). The higher fishery production was recorded is that of 1996, with 760 kg, while the next year was reached to zero, while the previous year were just 134 kg. Even and in this case we can observe years with higher and lower production, alternately. The dominant fish species in the fishery production for the period 2004 - 2010 are the sea breams (Fig. 2a,c,), with 69% rate and a total annual production of 97.619 kg (Fig.2d), the sea basses, with a rate of 26% and a yearly production of 36.011 kg (Fig.2b,d) and the grey mullets with a rate of 3% and a yearly production of 3.558 kg (Fig.2a,d). The fish species 'chiona' -'sharp-snout seabream' [*Diplodus puntazzo* (Walbaum, 1792)] and the species 'sargos' – 'white seabream' [*Diplodus sargus sargus* (Linnaeus, 1758)], contribute only with 1% in the annual yield. During the same time period

was not recorded any production of eels, that contrasts with the data of the decade of 90's, when the 1996 caught 250 kg of eels and 100 kg in 1998. In 2004 impressive fishery yield came from grey mullets (2.023 kg), but this subsequently fell, ranging in levels corresponding to those showing the decade of 90s. In 2005 observed also a strong heatwave, which lowered the total fishery production.

The sea breams, is the most important species in terms of fishery production, and has its highest values at the beginning, from the year 2004 and at the end in 2010, while in the intermediate period their prices fall significantly lower, with alternating years of higher and lower production, affecting its succession to the total production in these intermediate years. The grey mullets follow a similar course, but them pointing out a significant difference in 2010, when their production fell almost in 'zero', in comparison to the dynamic repetition of the production of sea breams.

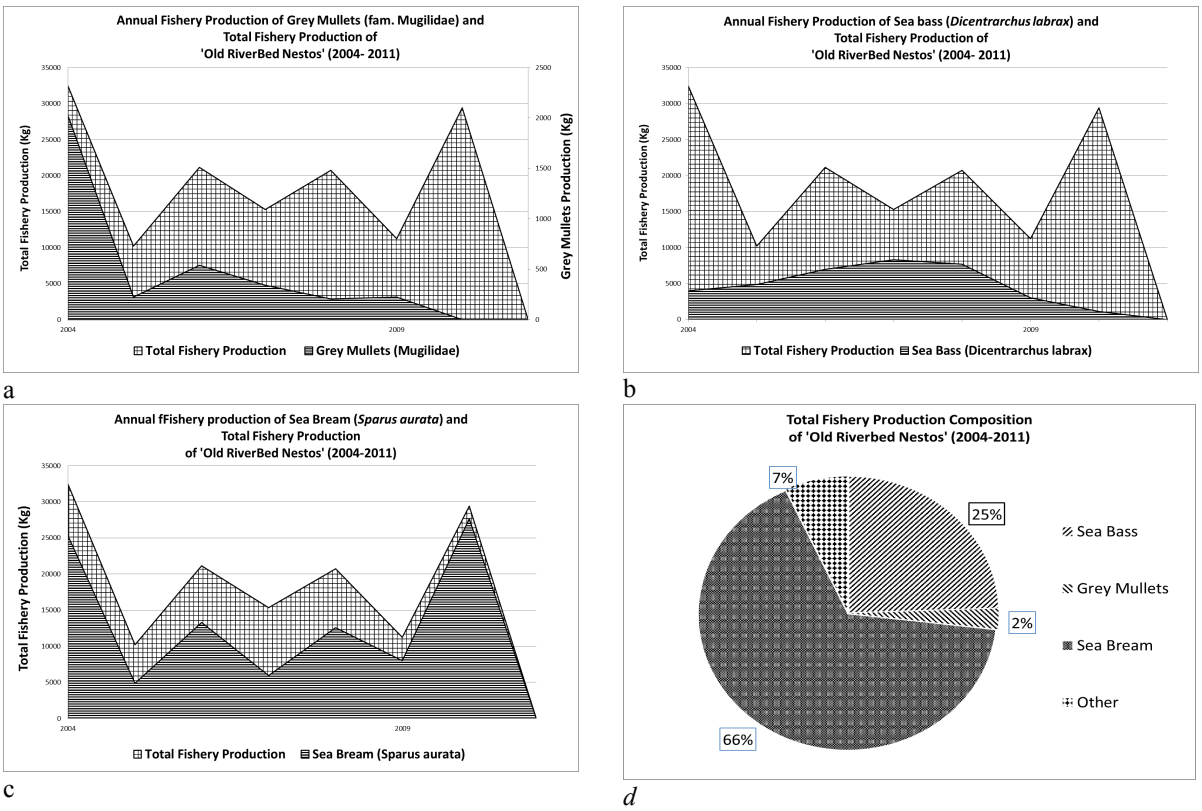

Figure 2. *Comparison of the Total Fishery Production with the partial fishery production of a) Grey mullets, b) Sea bass, c) Sea bream and d) Fishery Composition of the Total Fishery Production of the 'Old Riverbed Nestos', for the years 2004-2011.*

Detecting the progression of the production of sea bass, we can see exactly an opposite course, with this of sea bream (Fig. 2b,c). The production starts with 3.985 kg 2004 and indicates a gradual increase, resulting in 2007 the sea bream as the prevalent species and becoming the species with the main production (8.310 kg vs. 5.950 kg of sea bream). But with the reappearance of the sea bream, sea bass production is gradually falling, reaching at 1.131 kg in 2010 (Fig. 2c,d).

Discussion - Conclusions

The total fishery production starts at high levels in the above ecosystems in 1995, which is following by a downward trend, up to zero in 2001, due to successive frosts. There is a recovery after this, but that is still bent due to extended floods. Extreme weather conditions prevailing in these ecosystems cause severe killing phenomena of fish production due to the low depth of the lakes, both in summer and winter periods. Another important problem is the invasion of materials that block the entrance of water channels and consequently the water communication of the sea with the coastal lake (Pearce and Crivelli 1995, Crivelli and Maitland 1995, Kevrekidis et al. 1995).. Gray mullets are by far the main catch, with their fishery course starting at very high levels in the five-year period of 1995-

1999, but exactly after they declining downwards, reaching very low prices, which continues until the last years. From 2003 onwards, the production of sea bream, plays an important role in the fishery management of the above ecosystem, which has a lot of fluctuations. The downward trends of the yield continue till today.

In the Lafri and Lafruda lagoons, during the years that seabream reaches lower production, we can notice that the production of the seabass is in the opposite site, but we are having available data only for few years to take a safe conclusions. Finally, the fishery production in both of lagoon systems includes and other important fish species, such as the soles, the eels and the crabs.

Before 1999, in the channels that structure the 'Old Reverbed Nestos', the intensity of fishery was too small. Since 1999, the Cooperative received the fishery management, has proceeded in main technical structure projects, such as the construction of wintering channels, use of geothermal energy and enrichment with fish fry. Then, the fishery production raised rapidly. While until then, mainly grey mullets were fished there, from 2004 to 2010 the main catch is the sea breams, followed by the sea basses and then following the grey mullets. It is obvious that both in the 90s and in 2004-2010 period are alternating yearly yields, which including very low and also very high productions.

The course of the production of grey mullets and sea breams is almost similar, showing a general reduction in mid of the time period examined, due to a heatwave recorded in 2005, dissimilar even if the population of sea breams recovered, the population of grey mullets reach to zero. In this ecosystem, as also and in the lagoons Lafri and Lafrouda, the fact that sea bream and sea bass have opposite fluctuations is very interesting, with one species prevailing in production when the other one is in decline. But also and for this ecosystem of channels, the fishery data covers only a very short period of time to lead to any kind of safe conclusions.

In general we can conclude that the present fishery management is not appropriate as it is directed selectively mainly to fish species with commercial value and ignores the rest. That way, the negative influence is doubled, since a great part of the commercial species is subtracted from their populations and it remains in the lake all the population of the non-caught species that finally acts in competition to the commercial species (Kokkinakis and Andreopoulou 2011). Fishery production variations in these neighbouring ecosystems imply that is necessary to apply the appropriate management strategy for each lake in parallel to the improvement of the fishery techniques and infrastructure. Decision support is enhanced through the examination of the yields for total and partial annual productions while it implies an effective model for fishery management, well adapted with the natural environmental conditions of the ecosystem, also aiming in the upgrade of fisheries production for local profit and environmental protection (Andreopoulou et al. 2004). Furthermore, the description of the fisheries production in a quantitative and qualitative level represents an important indicator for the evaluation of the fisheries ability of these systems, while simultaneously it is also suggestive of the designing of a rational model of fisheries methods used, in harmony both with the natural habitat and the needs of those managing the coastal lakes. This model will not only target at the improvement of the fisheries production, but also at the preservation and protection of the biological resources and the ecological balance of these ecosystems. Additionally, it specifies the impact from the environmental disturbances on the fisheries production that have taken place in these vulnerable ecosystems. The results can be an effective tool for the authorities within the management, environmental protection, research and the sustainable development of coastal wetland systems; nevertheless, the organized information can support decision-making in planning and development projects.

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REVIEW ON IMPORTANCE OF PROTOZOAN PARASITES FOR FISH IN FYRO MACEDONIA

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Abstract

Protozoa cause significant problems in aquaculture. The main groups include the ciliates, flagellates, microsporidians and myxozoans. These can build up to very high numbers when fish are crowded, causing weight loss, debilitation and mortality. The ciliates and the flagellates have direct life cycles and affect especially the pond reared fish populations.

In FYRO Macedonia, nearly 100 parasites species in fish were found, of which more than 10 belong to the protozoa. The most frequent are: *Chilodonella piscicola, Ichthyophthirius multifiliis, Goussia sp., Myxobolus cyprini, M. dispar, M. muelleri, M. encephalicus, Thelohanellus nikolskii, T. hovorkai, Chloromyxum legeri* and more types of ciliates of the genus Trichodina.

Keywords: *protozoa, fish*

Introduction

Protozoa represent a vast assemblage of essential unicellular organisms, in which a single cell is capable of all life functions executed in higher organisms by specialized organs. Discovered by Leeuwenhoek in the late 17th century, protozoa number about 50000 species, living in water and soil habitats and also as parasites of animals; some cause dangerous diseases. The first mention of fish protozoans dates from the Sung Dynasty in China (964 – 126 AD) when a scholar, Su-Shi, mentioned in his book "On the relations between organisms" a white-spot disease of cultured fish, undoubtedly ichthyophthiriasis. Much later, in 1825, myxosporeans were discovered.

Protozoa are grouped into several phyla, as following: Flagellates, Opalines, Amoebae, Apicomplexans, Microsporidia, Myxosporidia and Ciliates. Classification of Protozoa is based on the widely accepted taxonomic scheme proposed by the Committee on Systematics and Evolution of the Society of Protozoologists, published in the Journal of Protozoology in 1980, with some modifications.

Most of them live in commensalism with their hosts, while certain species are adapted onto parasitic relations toward fish. The majority of them reproduce asexually, by means of simple cell division, but in some of them sexual reproduction might be possible. A greater number of them appear as ectoparasites.

Parasites in fish occur as a direct cause of the disease or as factors that lead to disorders and reduction of resistance of fish. Fish can also occur as vectors or intermediate hosts of certain types of parasites that attack human, i.e. appear as reservoirs and sources of zoonosis. In addition to health aspect, parasites are also important economic problem in intensive fish culture, because their presence can cause great economic losses, mainly through slow growth.

Parasites usually attack young fish, or the fish with reduced condition and resistance, typically due to the action of adverse influences of the environment. Adult fish usually do not get sick, but transmitted infestation.

In terms of the intensive fish farming there is a very high density of susceptible fish in a limited space, and their physiological and health status is not always satisfactory, so there are a large number of susceptible individuals, with excellent conditions for the spread of mass parasitic infections. On the

other hand, the fish in open waters regularly has a large number of species of parasites, especially with complex life cycle, as animals that occur as intermediate hosts of parasites (snails, worms and crabs) are present in the wild.

Preventive measures to eliminate parasitic diseases consist in the destruction of the parasites themselves or destroying those aquatic organisms that appear as their transitory hosts. In this regard, permanent ichthyoparasitological controls of the fish health status should be made. In open waters fight against parasitoses is more complex, because it is a large surface of water, but must take into account the economic effects of measures.

In most of the parasitic diseases, if stressful moments are avoided and optimal conditions of the water environment are ensured, as well as adequate health and physiological status, the fish may tolerate invasion of parasites. Severe forms of parasitic infections are often resulting of the adverse influence of the environment, to timely identify and correct.

Material and methods

Fish material is partially examined on the field, and the other part in the laboratory. A special protocol on completed dissections is opened for each fish. The protocols included the following information: 1. biometric data: species of fish, total length, weight and sex; 2. Findings obtained by external examination (mouth, eyes, skin, scales, fins, gill and gill covers); 3. Findings obtained by examination of internal organs: body cavity, heart, urinary bladder, gall bladder, air bladder, stomach, intestines, liver, spleen, sexual organs, kidneys, muscles, eyes and brain). Protozoa were determined in the native smear or have been prepared for the determination by appropriate techniques. In doing so, we used the key of Lom & Dykova (1992).

Results

Within investigations mainly of Hristovski & Stojanovski in our country almost a hundred of parasite species are found, and more than ten of them belong to Protozoa. They are: *Chilodonella piscicola, Ichthyophthirius multifiliis, Goussia sp., Myxobolus cyprini, M. dispar, M. muelleri, M. encephalicus, Thelohanellus nikolskii, T. hovorkai, Chloromyxum legeri* and some ciliate species from the genus *Trichodina*.

Due to the great number of protozoan diseases of fish, we will discuss in our paper only those presented in our country or potentially harmful.

Trypanosomiasis and **Tripanoplasmosis**

These diseases are caused by flagellates of the class Dinoflagellida and they are manifested by symptoms of anemia. Pleomorphism exists in the blood of fish with most of these causative agents, where it is difficult to determine the species taxonomy. Pathogenic species from the genus *Trypanosoma* are: *T. carassii, T. abramidis, T. remake* and *T. percae*. Pathogenic species from the genus *Trypanoplasma* are: *T. borelli* and *T. tincae*. *Tripanoplasmae* are highly pathogenic and more often lead to a lethal outcome. As intermediate hosts occur leeches that infest by sucking the blood of infested fish. In the digestive tract of leeches they develop and finally reach the proboscis.

Hexamitiasis (Octomitiasis)

Causative agent is a flagellate *Hexamita salmonis*. It is actually a "double" flagellate, formed by the fusion of two individuals. The parasite is widespread in the world, and was registered on the territory of the ex Yugoslavia. Fingerling of salmonid fish suffers. The parasite is a commensal, i.e. it is an integral part of the intestinal microflora. Its pathogenic effect comes into play in adverse conditions. Hexamitiasis often occurs as a secondary infestation of fish with VHS. But this protozoa has expressed pathogenic effect as well. Primary sites of infestations are stomach and intestine, where it can move into the gall bladder, air bladder and other organs. Hexamitiasis might be a systemic disease, often leads to a lethal outcome.

Coccidiosis

Causative agents are sporozoa from family Eimeridae. The most widespread and with the highest pathogenicity are *Goussia carpelli* and *G. subepithelialis.* Mainly cyprinid fish species are diseased. Oocysts are very resistant, and they live for at least 3 weeks outside. Coccidian development goes through 3 stages: merogony (asexual reproduction), gametogonia (sexual reproduction) and sporogonia (forming of infectious oocysts). Parasites induce regressive changes in intestinal epithelial

cells. Anterior part of intestines is mainly affected, but in certain cases, coccidian may enter the liver, spleen, pancreas, kidney or gills, which lead to the destruction of parenchyma and the inflammatory process, typically a proliferative type.

Myxosporidioses

Myxosporidioses are parasitic diseases caused by protozoa belonging to the type Myxozoa. There are over 1330 myxosporean species, however only a small part of them are pathogenic for fish. These are representatives of the genera: *Myxidium, Zchokkella, Sphaerospora, Chloromyxum, Myxobolus, Henneguya* and *Thelohanellus.* Spores have polar capsules (one or more), which are important for the determination of a species. Spores extracted from the fish are to be ingested by oligochaetes, in which to form the so-called "triactinomyxon spores". Then, they actively penetrate through the skin, gills and fins into the fish organism, but might enter orally as well. Myxosporidia migrate through the intestinal wall into circulation, and through it comes to a definitive place of localization, where they develop to sporogenic trophozoits. Spores develop inside them. Myxosporidian spores are very resistant to the external environment. Pathogenic effect depends on the species of parasite and its localization.

Pathomorphological changes on the gills are caused by *Sphaerospora molnari, Myxobolus pavlovskii, M. dispar* and *Henneguya psorospermica;* on the gills and skin by *Myxobolus müelleri* and *M. exiguus;* on the kidneys by *Myxidium lieberküehni, M. giardi, Sphaerospora renicola, S. tincae* and *S. pectinacea;* on the liver and gall bladder *Zchokkella nova* and *Chloromyxum truttae.*

Myxobolus cyprini are found in carp, but also in many other cyprinid fish species. It forms intracellular plasmodia in muscle cells. Pathological changes can cause in the kidneys as well, spleen and liver. *M. cyprini* causes so-called "pernicious" anemia of carp.

Thelohanellus nikolskii is found in carp. In our region the disease is registered in the beginning of 80's, and is spread very rapidly. Deformations of fin rays appear and thickening in their epithelium. In severe cases occur as a drop off fins and secondary infections, and often these fish die.

Because of its importance, from the group myxosporidioses we could stand out the following diseases: Whirling disease, Inflammation of air bladder in carp and Proliferative kidney disease.

Whirling disease (Myxosomiasis; Blacktail)

The disease manifests by nervous symptoms in acute form, and skeletal deformities in chronic form. It is present in almost all European countries and beyond, as well as in our neighborhood. Causative agent is *Myxobolus cerebralis.* In fish cartilage plasmodia and spores are formed, which lead to its erosion and colliquationis necrosis. Their toxins lead to reflex irritation over the vegetative nervous system. Disorders in ossification occur, accompanied by deformation of the skeleton. Due to the erosion of the cartilage around the auditory organs occurs rapidly swimming in a circle, and damage to the cartilage of the spine causes cause dark pigmentation of rear of the body. Only juvenile fish are diseased, before the start of ossification of the skeleton.

Much like disease with whirling disease of salmonids is disease of carp caused by *Myxobolus encephalicus.* Its plasmodium develops in the blood vessels of the brain, causing a decrease in cerebral circulation. Hardly affected fish show locomotory disorders, loss of balance and circling.

Inflammation of the bladder (Aerocystitis infectiosa cyprini)

It is a highly contagious disease, which is characterized by imposing changes in fish bladder. It is widespread in all European countries and in our waters, where there is an intensive culture of carp and in the summer in an acute form can cause great damage. In recent years, has proven to be the cause of disease very pathogenic *Sphaerospora renicola.* Sporogonic stages in the renal tubules are accompanied by serious disturbances of excretory and hematopoietic kidney function. The appearance of blood proliferative stages causes changes in the blood picture. Development of "SBI" stages in air bladder leads to exudative-proliferative inflammation in one-year old carp. The primary changes are complicated by secondary bacterial purulent infections, resulting in huge losses to the fingerling.

Proliferative Kidney Disease (PKD)

PKD is a disease of young salmonids, caused by extrasporogenic stage of *Tetracapsuloides bryosalmonae,* so-called. "PKX- organism" - trophozoit. It is widespread in European countries and North America. The development is probably similar to that of *Sphaerospora* species. Trophozoits causes intense inflammatory response of kidney and other vascularized organs, which can destroy large portions of tissue. Parasites also attack blood vessels. All functions of the kidneys are impaired.

Ectoparasites caused by protozoa

Causative agents of this group of diseases are different classes of protozoa, however their pathology is similar. Because of its importance, ichthyobodosis, chilodonelosis, ichthyophtiriosis and trichodiniasis are stand out. Parasites have a cosmopolitan distribution.

The cause of ***ichthyobodosis (costiasis)*** is *Ichtyobodo necator,* flagellate from class Dinoflagellida. All freshwater fish are susceptible, particularly salmonids, even some marine fish and larval amphibians. There is no intermediate host. There are two developmental forms: free-living and attached.

The causes of ***chilodonelosis*** are 2 types of ciliates: *Chilodonella piscicola* and *C. hexasticha,* some of the most dangerous ectoparasites. They are encysted at unfavorable conditions. They may infect all species of freshwater fish, mainly carp. *C. piscicola* mostly occurs in younger fish, while *C. hexasticha* are seen in older ones.

The cause of ***ichthyophtiriasis (white spot disease)*** is ciliate *Ichthyophthirius multifiliis*, big infusoria with round or oval shape. Macronucleus is characteristic by crescent shape, located in the middle of the body. The parasite attacks all species of freshwater fish. The development cycle is a complex, by multi-stage development.

Six types of infusoria occur as causes of ***trichodiniasis***: *Trichodina domerguei; T. pediculus; T. nigra; T. reticulata; Trichodinella episootica* and *Tripartiela buldosa.* Trichodinae adhere to the body of the fish by means of an adhesive disc, which is very important in determining the type of species. Trichodinae are commensals and they use their hosts as the transitional hosts, and feed by the particles from the water, bacteria and debris from the surface of fish. Rarely endanger the health of the host. The parasite attacks all species of freshwater fish, as well as many species of arthropods, mollusks etc.

Influence of unfavorable environmental factors is important for occurrence and outbreak of these diseases. Parasites attack the whole surface of the fish, and *Ichtyobodo necator* even fish eggs. Pathogenic role is reflected through damage to the epithelium of the skin and gills. *I. necator* and *I. multifiliis* secrete some digestive enzymes or toxins. Dystrophic changes develop due to epithelial cell hyperplasia. Fish show symptoms of oxygen deficiency. They are upset, scratch, and due to excessive secretion of mucus – they are coated in gray-blue layers. Gills are pale or dark-red due to bleeding and necrosis. In ichthyophtiriasis, it can be detected grayish-white granules which look like semolina on the surface of the fish body. There may be a secondary infection. In more severe stages of the disease, the affected parts of the skin fall in patches, the fish are apathetic and quickly loss their weight, and often comes to their lethality.

Discussion and conclusions

Within investigations in FYRO Macedonia more than ten Protozoa are found: *Chilodonella piscicola, Ichthyophthirius multifiliis, Goussia sp., Myxobolus cyprini, M. dispar, M. muelleri, M. encephalicus, Thelohanellus nikolskii, T. hovorkai, Chloromyxum legeri* and some ciliate species from the genus *Trichodina*.

Only those presented in our country or potentially harmful are discussed in our paper.

Some of them have direct life cycle (such as *Hexamita salmonis*, *Goussia spp., Ichtyobodo necator, Chilodonella spp., Ichthyophthirius multifiliis* and *Trichodina spp.),* but some of them include transitional hosts (such as *Trypanosoma spp., Trypanoplasma spp.* and myxospiridians.

Significant pathogenic effects are associated in the infestation with: *Chilodonella piscicola, Ichthyophthirius multifiliis, Goussia sp., Myxobolus cyprini, M. dispar, M. muelleri, M. encephalicus, Thelohanellus nikolskii, T. hovorkai, Chloromyxum legeri.*

Protozoan from the fish in FYRO Macedonia is in common with that of the fishes of the corresponding families of fish. They are with wide area of distribution and wide specter of hosts (Cakić, 1992; Ćirković 1986; Hristovski et al. 2007; Hristovski, 1983; Hristovski et al. 2006; Stojanovski, 1997; Stojanovski et al. 2008.

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ANALYTICAL METHODS FOR THE EXAMINATION OF SOME ALBANIAN OLIVE OILS AUTHENTICITY

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Abstract

In order to organize greater awareness of food safety and quality, especially for olive oils produced in our country, consumers are increasingly demanding reassurance regarding the origin and content of olive oil, while producers need to be able to confirm the authenticity of components of olive oil and comply with government legislation. Prevention of fraudulent or deceptive practices and the adulteration of olive oil is an important and challenging issue facing the food industry, and has been one of our most important objective for the research work recently. The analytical techniques for characterization and identification, were considered to be used for the determination of some Albanian olive oils authenticity, include various spectroscopic techniques, methods based on isotopic analysis and chromatography, and other techniques based on DNA, as well. The assessment of quality parameters in olive oil authenticity will show us a safer perspective using conventional standard methods in Albanian case.

***Key Words**: authentication, analytical techniques, olive oil, adulterants, spectroscopic techniques*

Introduction

The olive oil varieties consumed in the Mediterranean basin retain virtually all their natural nutritional properties because they are usually obtained from their respective plant sources through either physical crushing or pressing.

The aim of the paper is to make a review of the analytical methods for the examination of the olive oil samples, which are widely recommended from the control bodies of the country and to show the priority of the most specific for the Albanian conditions.

The definition of traceability according to the European Council Regulation EEC 178/2002 is the ability to identify and trace a product or a batch of products at all stages of production and marketing. Olive oils command a premium price in the market, leading to great temptation to adulterate them with vegetable seed oils (Rayda Ben-Ayed et al. 2013).

Biochemical techniques, also have been employed for the classification and authenticity of olive oils using a high number of variables such as triacylglycerides (TAGs) composition, phenolic fraction, and unsaponifiable components monitoring by statistical and mathematical analyses in order to facilitate the evaluation of the results . More recently, the suitability of DNA markers in providing unequivocal identification for authentication and traceability of foods has been a subject of great interest. In fact, many researchers have applied bio-molecular methodologies for olive/olive oil genetic characterization, identification, and

authentication. Molecular markers allow the detection of DNA polymorphism and enable to effectively distinguish different cultivars in an effective way, without any environmental influence (Busconi et als. 2003).

Olive oil is often adulterated with seed oils and olive residue oil. Oils having a similar composition (hazelnut oil and high oleic sunflower oil) or lower price (palm, avocado, and canola oils) have been used as common olive oil adulterants Aparicio, R., et al. (2012).

Food fraud is the protection of food products from intentional contamination or adulteration by biological, chemical, physical, or radiological agents. It addresses additional concerns including physical, personnel and operational security Harwood, J., & Aparicio, R. (2013), Guiziérrez, F., Fernandez,J (2002), Guillaume,C., et als.(2013). This is in contrast to food safety, which is based on accidental or environmental contamination, and food security, which deals with individuals having access to enough food for an active, healthy life. These three terms are often conflated. Food protection is the umbrella term encompassing both food defense and food safety Guillaume,C., et al. (2013).

In the last few years, spectroscopic approaches associated with multivariate analysis have been used to detect adulteration of virgin olive oil.

Materials and Methods

The authenticity of Olive Oil is guaranteed by strict guidelines laid down by the responsible national authorities that include official sensory evaluation, chemical analyses.

According to special recommendation (Angela Sheridan, et als, 2013) there are some analytical protocols for special analysis with Olive Oils such as:

- ✓ Trans fatty acid content
- o Sterol composition (including total sterol content)
- o Erythrodiol and uvaol content
- o Wax content
- o ECN42 difference
- o Stigmastadiene
- o 2-glyceryl monopalmitate
- o Aliphatic alcohol
- o Free fatty acidity
- o Peroxide value
- o Absorbency in ultra-violet
- o Fatty acid methyl esters(FAMEs) and Fatty acid ethyl
- ✓ esters (FAEEs)

Meanwhile from Aparicio R and Aparicio-Ruiz R.(2000) it was showed that the characteristics of olive oil and olive-residue oil and on the relevant methods of analysis are applied with its all subsequent amendments in regard to certain procedures related to the organoleptic assessment of virgin olive oils, the sampling procedures if lots and analytical methods to be used by the official control laboratories. It is easy to adulterate olive with low-grade olive oils or foreign oils such that physical and chemical properties still fall within the limits of the European standard of olive oils.From the same source Aparicio, R., et als. (2012) we found the selected analytical criteria which are*:* sensory properties, quality of harvesting and treatment before pressing (gmp); (Free fatty acids (Titration) and 1,2-Diglycerides (GC)]; Age of the Oil [1,2-Diglycerides (GC) Pyropheophytin (HPLC), K232 (Spectrometry)]; *Oxidation* [K232 (Spectrometry), Peroxid Value (Titration)]; Adulteration (Refining) [K270 (Spectrometry), Pyropheophytine (HPLC)]; Authenticity (Origin, Identity) Fatty acid composition (GC) Triacylglycerol Composition (GC)]. As it comes up from the

literature (Aparicio R and Aparicio-Ruiz R. 2000; Cert A, Moreda W, Perez-Camino MC. 2000; Garcia-Gonzalez DL, et als.(2008), García-González, D.L., et als. Aparicio, R. (2010), Christopoulou, E., et als. (2004), the quality and uniqueness of specific extra virgin olive oils (EVOOs) is the result of different factors such as cultivar, environment and cultural practices. Consumers are also more and more oriented towards purchasing food products of a certified genuineness and geographical origin. In recent years, several attempts have been made in order to verify the declared geographical origin of olive oils by means of suitable chemical parameters, such as triglyceride and fatty acid profiles. Spectroscopy techniques usually require time-consuming measurements, sample preparation and a qualified staff. The official methodologies for checking Olive Oil Genuineness include measurements of some chemical and physical constants, such as iodine value, refractive index determination, and specific color reactions, which may be useful in revealing adulteration with seed oils. Nowadays, these methods have been completely replaced by modern chromatographic and spectrometric determinations that provide more information and may lead to more conclusive results. At the moment Codex Alimentarius, European Commission (EC), and International Olive Oil Council (IOOC) generally give the same limits for the olive oil identity characteristics. These characteristics can be different from those of European Union countries because of different cultivars and climate conditions. The evaluation of quality and the checking genuineness of olive oils is made on the basis of analytical data of a number of parameters which must be within limit values established by the European Commission (EC Reg No 2568/1991), the Codex Alimentarius Norm and the IOOC Trade Standards.

Results

Some practical methods for determining Olive Oil Quality Parameters have been mentioned in the following text, using as reference a specialized nowadays laboratory protocols and relevant literature. Parameters used by the different international organizations to check olive oil quality have been also were reported in the literature. Indicator for Checking Olive Oil Genuineness is firstly Oil's Fatty Acid Composition. Wide ranges of percentages are seen for the more abundant fatty acids (Kamm W., et al. 2001), whereas limit values are fixed for the minor ones (myristic acid, linolenic acid, arachidic acid, eicosenoic acid, behenic acid, and lignoceric acid). The oleic acid, the most representative fatty acid of olive oil, ranges from 55% to 83% Juan Ramón Izquierdo et als (2013)., Roca M, et als., (2003), Psomiadou E. et als. (2003), Rayda Ben-Ayed et. als., (2013), Harwood, J. et als. (2013). The level of other minor fatty acids is useful to reveal seed oil adulteration. High amounts of eicosenoic and behenic acids are characteristic of soybean and rape seed oils, erucic acid of rapeseed oils, and lignoceric acid of peanut oil. The limits fixed for fatty acids are not useful for detection of frauds if the addition of seed oil is of about 5% (Christopoulou et al.~~,~~ 2004), Tasioula-Margari M, Okogeri O. 2001.

It can be seen clearly that the Common Adulteration Practices are as follows Angela Sheridan,(2013)**:** • Blending EVOO with low quality and cheaper olive oils that have Sensory Defects: • To remove undesirable flavor volatiles derived from lipid oxidation, these oils are generally subjected to mild deodorization at lower temperatures, • The quality of stored commercial EVOOs can vary widely, • Interactions between minor constituents in EVOO and trace metals can produce pro-oxidant effects, • The choice of methods and conditions to evaluate oxidative stability and antioxidants is therefore critical as in the Table 1.

Table 1 *Quality criteria established for EVOOs*

Parameter	EU limit	Explanation of quality criteria
Free acidity	≤ 0.8 g % w/wa	The higher the value, the worse the olive quality. The processing of unhealthy olives increases free acidity
Peroxide value	≤ 20 meq O2/kg oil	After extraction from olives, oil undergoes oxidation depending on several external variables. Management of olive oil storage should be checked
K_{232}	≤ 2.50	Oxidation products absorb at this wavelength. The higher the oxidative status, the higher the value
K_{270}	≤ 0.22	Oxidation products absorb at this wavelength. The higher the oxidative status, the higher the value
ΔK	≤ 0.01	The higher the oxidative status, the higher the value
Panel test	Me (sensory defects) = 0	Sensory defects induce rejection of VOO by consumers
	Me (fruity attribute) > 0	EVOOs must have a fragrant fruity odor. A low value does not fit with extra-virgin designation
Alkyl esters	([b])	EVOOs should have no ethyl esters or at trace level. High values characterize lampante olive oils

M*e* median value, FAME fatty acid methyl esters, FAEE fatty acid ethyl esters
[a]As oleic acid; [b]Σ(FAME + FAEE) ≤ 75 mg/kg or [75 mg/kg < Σ(FAME + FAEE) ≤ 150 mg/kg and (FAEE/FAME) ≤ 1.5]

Discussion - Conclusions

In recent years, the olive and olive processing sector has been a priority in agricultural policy. The Albanian government has undertaken the initiative to plant 20 million olive trees, in order to increase the olive production for consumption and olive oil. The development of Olive Oil and the Oil Processing Industry is dedicated to the high nutritional value of olive and olive oil produced by it, as well as the economic and commercial interest in the entire world market. Along with the increase in production, olive oil adulteration by Food Business Operators is undertaken. In order to provide a quality product to the consumer market, are made some achievement to update the rules and standards for the production and marketing of olive oil, aligning it with European legislation.

These regulations and standards are approximated in the National Legislation, respectively Law No. 87/2013 "*On the Categorization of Olive Oil Production, Naming and Trading Olive Oil and Pomace Olive Oil*", VKM No.235, dated21.3.2017, on the approval of Regulation "*On the Quality Characteristics and Criteria of the Naturalness of Olive Oil and Pomace Olive Oil*" and Draft-Regulation "*On the Establishment and Functioning of the Organoleptic Panel Test for Olive Oil*".

In recent years some studies have been carried out on the characterization of olive oil produced from autochthonous varieties in different areas of Albania. Studies have been focused on the physical and chemical analysis of the quality parameters, studies have also been carried on the naturalness and authenticity of olive oil, determining the number of iodine, the value of delta K and the use of instrumental techniques for determining the profile of fatty acids, level of sterols. Given the current studies on the characterization of olive oil produced from the autochthonous varieties and in areas known for high quality production, it

can be judged whether an olive oil is forged / blended with olive oil produced from other areas, enabling the traceability of the product

The aim of our work was to evaluate effectiveness and correctness of the analytical techniques, adapted in the Albanian environment, and possibly to analyze and carry out further studies on olive oil quality and adulteration, using instrumental techniques as mentioned in this paper.

Through this work, we wanted to influence to the national control authority, to adapt and create a database on characteristic of autochthonous olive oil production varieties, in such way to determine PDO. On the other hand, these work should serve to public awareness, in that way to be conscious for the quality of product and its origin. As a conclusion referred from other authors (Edwin Frankel (2013), several potential problems become apparent from the extensive literature published in the past several decades on different kinds of olive oils. Many studies on the adulteration of EVOO with cheaper vegetable oils were based on advanced sophisticated statistical methods that require the analyses of large numbers of samples. Powerful analytical methods are now available to provide more precise and accurate chemical information on olive oils.

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ENVIRONMENT, HEALTH AND FOOD CONSUMPTION'S MODELS.

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Abstract

Health and Environment constitute strategic Goals to be pursued in Agenda 2030, in order to guarantee Global Society and Sustainable Development. Furthermore, the Agenda 2030 put in evidence as new Consumption's Models can play a strategic role as for Sustainable Development. In one word, the Global Society's Quality of Life also depends on individual and collective capacity to have an integrated approach to these three Agenda 2030 goals. In this paper we want to investigate this issue, analyzing it from the perspective of consumers.
In other words, we will try to speculate on how the new food Consumption's Models, taking into account relationships between food, health and environment, can improve the quality of life in the Global Society.

***Keywords**:* Environment, Health, Food's Styles, Sustainability, Food Consumption's Models

Introduction

Traditionally, the concept of "Quality of Life" is defined as *"the good combination of material resources and not, of objective and subjective aspects that characterize the human condition* (Allardt 1976).

In the last twenty years this concept has undergone tremendous changes.

In particular, Amartya Sen was the economist that gave a new interpretation of the concept of quality of life. He was the proponent of a new approach to the subject that emphasizes the *"relationship between the Quality of Life and capabilities (choice) subjects* (Sen. 1970)

It has identified some conceptual categories, responsible for a new definition of the theme of "Quality of Life". Of course, the Health of a Population and the Quality of the Environment experienced by it.

These areas are being by now, more than ever, also strongly conditioned by the *Food Consumption Patterns* (Malassis 1979). Where, they are an expression of lifestyles, capable of "approaching" or less, the consumer of goods and food services towards purchasing choices and compatible consumption at the same time with Health and Environment.

To fully understand what it means by a Healthy and Environment-friendly Food Consumption Model, it is necessary to step back. Therefore, a suggestion first proposed in this paper, attempts to address the concept of Model Food Consumption by today's *"criteria"* that have profoundly changed the meaning.

Hence, a timely analysis of current food styles must necessarily overcome the traditional mode of the same, mainly referring to the nature and quantity of consumed foods. In fact, *the consumption being an extremely complex phenomenon,* it is necessary to take into consideration some variables useful to reread the current eating habits in the interests of Health and Environment.

Today, the "criteria" that can set these styles are varied and *"must necessarily be extended to those" socio-economic units of consumption which constitutes "the way men are socially organized, as part of small ensembles, to consume"* . (Malassis e Padilla 1986,) This leads to important considerations underlying a new Approach to Food Consumption.

This consideration refers to a *systemic vision of the concept of consumption,* which should be read, not as a single action, But as an entire process of human action consisting of several phases.

It is therefore stating that a new **Integrated Approach** (CESARETTI G.P 2015**) to Food Consumption** can no longer be confined to a single phase, but must necessarily be extended to all

phases of *the Consumption Process.* From this process emerges a new consumer interested in *how-what-where* you buy, and *what-how - where* food is taken.

This is useful in identifying many of those variables or criteria, affecting current trends in Food Consumption, including attention to Health, Quality and Environment.

In particular, when designing new food styles are compatible with Health and Environment, must also involve those *variables related to the socio-cultural sphere* of consumers. (Fauzia Saleem Alvi, 2014)

Today, individuals look at Food Consumption in an increasingly differentiated way. Paradoxically, product standardization is opposed to a "search for individuality" in the way it consumes. This scenario makes it increasingly difficult to systematize the Consumption Process in a unique way.

It follows that *the adoption of several food lifestyles,* has led to a profound change in consumption's models that carried consumers in acting more frequently on the basis of *"beliefs and policies"* increasingly heterogeneous.

Material and method

The current "criteria" that can guide the consumer towards new eating styles are many. Indeed, by addressing many of the variables relating to the socio-cultural sphere of consumers, they have changed the depths of the values underlying the Traditional Food Consumption.

In particular, in the current eating habits, are emerging a growing attention to "Future": **Health, Environmental Issues** and **Protection Territorial Identity.**

From this it follows that consumers "reorganize" their way of eating according to compatible choices both with their individual and collective well-being. In other words, it is arguing that these consumers are more aware of environmental, social and cultural impacts of their dietary habits.

Such behavior of Sustainable Consumption is the expression of a greater "awareness" of individual who feels responsible not only for himself but also for others and their community.

Therefore, the growing focus detected in the current food consumption trend toward the three **"determinants of the Future"** mentioned above, requires a paradigm shift. In other words, consideration to Future, needs an **Integrated Approach to Food able to read the entire consumption process in its current complexity.**

From here, **assuming an Integrated Approach to Food implies the adoption of new consumption models that take into account the strong interconnections among the three determinants of the Future.**

This statement leads to new *integrated food styles,* compatible with Health, Environment and Territorial Identity.

In essence, it is possible to say that greater attention to the determinants able to express environmental, social and territorial values of Food Consumption perfectly responds to new instances of individuals who intend to pursue, through Food, the attainment and protection of Material and immaterial components of Sustainable Well-being.

From here, looking at the current trends in Food Consumption is generally seen as "greater awareness". It certainly derives from this new "conscience" that can guide consumers towards Sustainability.

In order to better understand the issues discussed, a classification of some Food Consumable models has been reported, complying with the three "Future determinants" described above:

HEALTH: More than ever, food styles are generally more health-conscious. This consideration derives from the now universally shared consideration that the Western Food Consumption Model has had strong responsibilities in the occurrence of certain diseases (cardiovascular disease, obesity, cancer).

" *This Food Consumption Model, which for a long time has awarded the highly processed industrial product, has created serious problems not only in the administration but in the very perception of the Food itself"* (John D. Floros. Et.al. 2007)

In fact, in recent years, the strong interconnection between Food and Health has literally "overwhelmed" the logic associated with Consumption.

This meant that people were getting closer to healthier, safe, and nutritional nutrition styles. Consequently, purchasing choices and food consumption have come close to products and production

processes that are more compatible with health. Consider the **Model vegetarian or vegan,** or the growing demand for **light products,** low calories, poor or totally free from sugars.

Therefore, a careful health food style will certainly be characterized by demand **for products without traces or residues of substances that are harmful to the same (preservatives, dyes, pesticides).** (Belletti G)

Furthermore , the demand for health mainly rewards **the fresh product** at the expense of processed products as well as others whose production processes are careful to keep the characteristics and initial properties of the raw materials as unaltered as possible.

ENVIRONMENT: the adoption of sustainable eating habits on the environmental plan is one of the current relative to the consumption trend. Today, consumers are more aware of the environmental impacts generated by their own eating patterns. Therefore, in all dietary habits compatible with Environmental Sustainability, it is possible to capture a strong ecological component. Overall, this component reverberates in the adoption by the consumer of attitudes aware of the impacts generated by production and consumption activities in terms of pollution of natural resources.

The interest in protecting their environmental context drives these consumers to "internalize the costs of scarcity", focusing more and more on consumer actions aimed at reducing energy and reducing waste.

These environmentally friendly food styles are characterized through an **application, more and more widespread of agro-food products made with organic production systems or *integrated pest management.***

From here, pursuing environmental sustainability in power implies the choice of so-called **green products, environmentally friendly, low-energy impact.**

In addition, these shopping patterns show purchasing orientation towards productions Agro-alimentary **"green",** characterized by production processes that do not attack the soil and do not compromise in any way the three Environment function.

Territory: the current criteria related to food consumption, more than ever, tend to be more related to, social, environmental and cultural in which they are expressed.

Overall, this unprecedented attention to the Territory and its needs pushes the consumer towards purchasing choices and consumption of food capable of expressing, through the same, a certain place and its history.

In practice this involves purchasing and consumption decisions that reward **identity-local product,** finding the latter in a "symbolic value" that expresses membership in the reference area.

In addition, such food styles, within the various territorial systems, tend to reward agro-food products available through the Short Range.

This commercial organization in fact, implemented mainly through the so-called **"Markets Proximity",** most closely to the consumer identity productions. In the context of an increasing differentiation of consumption, the *Spatial Model* is part of the new demand for food, also expressed by the so-called *Ethical Consumer.*

He, by asking the maker of the product to respect particular moral principles, is slowly but constantly conditioning the market.

Overall, the demand for food Food System asks to go *"beyond"* the product with a view to greater sustainability and transparency.

Main results

From a careful reading of the above mentioned Food Consumption Models, it emerges that none of them is compatible with an Integrated Food Approach.

Such food styles do not, at the same time, satisfy the various facets of the three "future determinants": Health, Environment and Territory.

In other words, it is emphasized that the current tendency of dominant models does not give a partial, segmented response satisfying only for the individual determinants.

Therefore, no food style now mentioned is able to read the complexity of the Food Consumption Process that is responsive to an Integrated Approach.

Consequently, this Approach to Food Consumption needs new styles, capable of meeting simultaneously the three "Future determinants" mentioned above.

Hence, new Food Consumption Models will have to be able to incorporate purchasing choices and the use of food-oriented, at the same time, to meet new consumer, health and consumer demands.

Therefore, new eating habits that are compatible with a Nutrition Integrated Approach should firstly be strongly connected with the territory, and therefore mainly oriented towards purchasing choices and the use of local products in a Logic of Short Range, but where such products are implemented in the respect of the environment and in the interests of health protection.

To this end, food styles "built" on the consumption of local products, whose production processes are made through intensive or greenhouse farming and contain traces of pesticides and herbicides (considered to be toxic to health), are not entirely compatible with the Approach Integrated with Food.

By the same logic, even in the context of environmental sustainability, purchasing choices and the use of predominantly green or environmentally friendly food, not accompanied by consequent "responsible" food consumption attitudes, are not sufficient to fully express the "value of sustainability Environmental in food ".

These predominantly green consumer patterns should therefore "internalize the costs of scarcity", trying to "contain" and not pour into the territorial context of reference, the "environmental costs" they generate.

Conclusion

From this review it is therefore possible to state that eating habits compatible with a Nutrition Integrated Approach should at the same time meet the growing demand for consumer health as well as maintaining and protecting the conditions of the factors expressed by Environmental, Cultural and Environmental Quality Social, of the territories in which they live on a daily basis.

To this end, the search for a product: safe, fresh, light, nutritious enough, green and possibly an expression of a certain local food culture should always be accompanied by more conscious eating habits: for the individual, for The Community and for Territory at the same time.

Only in this way will Consumers be able to orient themselves towards an Integrated Food Approach and, at the same time, contribute to the Food System, pursuing the Sustainability of Wellness on a global scale.

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SUSTAINABLE DEVELOPMENT IN EUROPEAN UNION: THE CONTRIBUTION OF ICT IN THE ENVIRONMENTAL AND FOREST POLICY

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Abstract

Sustainable development stands for meeting human development goals while maintaining the ability of natural systems to continue to provide the ecosystem services and the natural resources upon which the society and the economy depend. Information and Communications Technologies (ICTs) is a potentially powerful tool for sustainable development and environmental protection. This paper aims to present the current use and trends in the use of ICTs for dealing with environmental and forest issues in the European Union (EU) in an attempt to enhance sustainable development. The acts of the EU concerning these issues in a broad range are studied according to their ICT adoption. EU environmental and forest policies are classified according to the four ICT application categories, which are the following: observation, analysis, planning, management and protection. Furthermore, the current situation is presented according to the e-Environment ICT application map.

***Keywords**: Sustainable development, Information and Communication Technologies, environmental and forest policy, European Union, e-Environment*

Introduction

Sustainable Development stands for meeting the needs of present generations without jeopardizing the ability of futures generations to meet their own needs – in other words, a better quality of life for everyone, now and for generations to come (European Union, 2015). Sustainable Development is a global concern; therefore, its principles need to be implemented more widely in international cooperation and development policy (European Union, 2015). It offers a vision of progress that integrates immediate and longer-term objectives, local and global action, and regards social, economic and environmental issues as inseparable and interdependent components of human progress (Andreopoulou, 2012; European Union, 2015). The phenomenon sustainability encompassing three dimensions: economic, social and environmental. On the one hand these three dimensions of sustainability are complementary and to some extent overlapping. On the other hand, there are also trade-offs (Pascucci et al., 2011). The "mosaic concept" (three dimensions) of sustainability is related to the capacity of human activity (e.g. land management) to maintain ecological processes (ecological dimension), to be feasible (economic dimension) and to be acceptable by society (social dimension) (Tisdell, 1997; Perman et al. 2003; Pascucci et al., 2011). Sustainability has (a) a "people-centered" dimension; and (b) its concept is normative; it embodies standards of judgment and behaviour to be respected as the human society seeks to satisfy its needs of survival and well-being (Lutteken and Hagedorn, 1999). Sustainable development is by necessity a dynamic process; new advances will change the way business is done, completed projects will influence new projects, social, economic and natural landscapes and resources will change daily (Ehlinger et al., 2011).

Bringing about transitions to sustainability has emerged as one of the key organizing global challenges over the past four decades (United Nations, 2012). ICTs are a key part of government strategies for a sustainable economic recovery (OECD, 2009). The document of the European Union (EU) "A Green Knowledge Society" strongly emphasizes sustainability, ecological aspects of information system innovation and their impact on sustainability (Forge et al., 2009; Alena and Libor, 2012).

Information and Communications Technologies (ICT) should be seen as a key positive element, empowering EU citizens, growing businesses, and helping us build an open, innovative, secure and sustainable knowledge economy (Forge et al., 2009). ICT are now a major part of Europe's economic

growth strategy (European Union, 2013). Conservation management has been greatly enhanced by capabilities for improved spatial analysis and simulation brought about by advances in ICT (Reynolds et al., 2005).

ICT are the actual platforms where different socioeconomic forces of Humanity have the opportunity to interact, without geographical barriers (Briz et al., 2013). The widespread penetration of ICT will only bring good news to the communities struggling to revitalize their local economies by exploiting natural resources. The potential for economic growth through new ICT have barely been tapped. These new possibilities exist largely as a result of two converging forces, the first one being the quantity of information available around the world, exponentially greater than that available only a few years ago and growing at an accelerating pace and the second one being the advances in global communications and technological infrastructure (Louca, 2013).

ICT such as Internet provide various advantages and benefits by offering a rich, dynamic environment for the exchange of information and resources (Andreopoulou et al. 2014; Andreopoulou et al., 2015). Positive impacts can come from dematerialization and online delivery, transport and travel substitution, a host of monitoring and management applications, greater energy efficiency in production and use, and product stewardship and recycling (Houghton, 2010). These modern technologies present very substantial opportunities for us to advance in all areas (Koliouska et al., 2015). Informatization refers to the transformation of an economy and society through the effective deployment of information and communication technologies in business, social, and public functions (Obidike, 2011; Guo, 2011; Zhang et al., 2016).

In recent years, the role of ICT in the protection of the environment has received significant attention (Andreopoulou, 2012; Koliouska and Andreopoulou, 2013). New ICT has improved the quality and utility of data used in sustainable forest management. According to Hansen, Panwar and Vlosky (2013), ICT has a defining impact on forest sector as it is used to automate processes, improve efficiency and productivity and support decision making. The implementation of most new EU legislation is supported by ICT systems (EC, 2010). ICT Implications are defined as the consequences a legislative act can have in relation to the use of ICT for the implementation thereof (European Commission, 2010). The use of ICT in the implementation might entail the development of new ICT solutions or the adaptation of existing ones and is likely to impact on existing processes and IT systems of the Commission and the Member States (European Commission, 2010). Implementation of legislation will impact in almost every case the processes, the data which needs to be stored, the data exchange between businesses, citizens and governmental organizations or the applications which are used to execute the processes (European Commission, 2010).

EU's commitment to leading a response to the environmental challenges has resulted in a high level of legislative activity related to environmental policy (Gabaldon-Estevan et al., 2016). The EU has taken a leadership role in the international negotiations on a number of environmental issues, with its role in the development of an effective and comprehensive regime on climate change naturally standing out and having received almost universal praise in the literature, as well as in the media (Afionis, 2011; Afionis and Stringer, 2012). Apart from its active and high profile role in the climate regime, Europe's environmental policies are among the most advanced and progressive worldwide in a wide range of other areas, from greenhouse gas emissions trading to recycling, waste management, biosafety and eco-labelling (Falkner, 2007; Kelemen, 2010; Afionis and Stringer, 2012). Europa 2020 is the strategy of the global EU development over 2011–2020, taking into account recent theories of economic growth, with emphasis on the new economic growth theory, underlying importance of research and development along with innovations (Kedaitis and Kedaitene, 2014).

This paper aims to present the current use and trends in the use of ICT for dealing with environmental and forest issues in EU in an attempt to enhance sustainable development. The acts of EU such as regulations, directives, decisions and communications concerning these issues in a broad range such as the environment and the climate change, the regional policy, the maritime affairs and fisheries, the development and the energy concerning environmental issues in a broad range are studied according to their ICT adoption. The EU environmental policies are classified according to the four ICT application categories, which are the following: observation, analysis, planning, management and protection. Furthermore, the current situation is presented according to the e-Environment ICT application map.

Materials and Methods

The data was collected from the official website of the European Union (www.europa.eu). The themes of the EU policies about the forest and the environment are the following: the environment and climate change, the regional policy, the maritime affairs and fisheries, the development and the energy. The first step was to record the acts such as the regulations, the directives, the decisions and the communications regarding environmental and forest issues.

Then, the above policies were studied in order to define whether ICT tools are adopted. In case there was ICT adoption, the ICT tools were recorded. As ICT tools, we consider: Satellite monitoring systems, Web portals, Traceability systems, Early Warning Systems, Lifelong learning systems, Computer simulation software, E-freight, Electronic tax payment systems, Web-based databases, Telematic systems, Electronic dissemination of information, Geographic Information System, Electronic media, Automatic measurement systems, Systems of electronic reporting, Internet / Broadband networks, Automatic Identification Systems, Systems of Integrated Pollution Prevention and Control, Online shopping, Electronic submission systems, E-navigation, E-government, E-commerce, e-business, Smart grids.

The classification of ICT in the EU environmental and forest strategies is based on the four application categories as they have been defined by the International Telecommunication Union (ITU) in 2008 (Labelle, 2008). The four categories are briefly reviewed below:

- Observation: terrestrial (earth, land, soil, water), ocean, climate and atmospheric monitoring and data recording technologies and systems (remote sensing, data collection and storage tools, telemetric systems, meteorological and climate related recording and monitoring system), as well as geographic information systems (GIS) as it applies to data recording and georeferenced data formats;
- Analysis: land, soil, water and atmospheric quality assessment tools, including technologies for analysis of atmospheric conditions including Greenhouse Gas (GHG) emissions and pollutants, and the tracking of both water quality and availability;
- Planning: planning proceeds from environmental analysis in order to forecast short-term and long-term environmental conditions and objectives. The planning activity may include classification of various environmental conditions for use in agriculture and forestry and other applied environmental sectors. Planning is often focused on specific issues such as protected areas, biodiversity, industrial pollution or GHG emissions. In addition to improving environmental conditions, planning may also include the anticipation of environmental conditions and emergency scenarios, such as climate change, man-made and natural disasters;
- Management and protection: environmental policy and strategic direction set during planning must reach the implementation phase in order to have a direct impact on the environment. In the area of climate change, management and protection deals with issues related to mitigating the impacts of climate change as well as adaptation to climate change.

Furthermore, the current situation is presented according to the e-Environment ICT application map which was developed by ITU in 2008 (Labelle, 2008) (Figure 1). This template is based on the four environmental application categories described above as well as the perceived relevance and usefulness of the applications themselves. Figure 1 presents the application categories that connect environmental observation with implementation at global and local level.

Figure 1. e-Environment ICT application map (Labelle, 2008)

Results

The research in the EU website resulted in the retrieval of 595 policies (regulations, directives, communications and other acts) concerning environmental and forest issues in a broad range such as environment and climate change, regional policy, maritime affairs and fisheries, development and energy. There are 263 policies about the environment and the climate change, 125 policies about the development, 96 policies regarding the energy sector, and 51 policies regarding regional policy and 60 policies about the maritime affairs.

Regarding the category of observation (Fig. 2), most environmental and forest policies (41,7%) use archival data, while 19,5% of them use satellite observation, 16,8% of the policies use direct sensing tools and only 3,9% of the policies use human observers to collect data. As for the analysis (Fig. 3), most environmental and forest policies (51,4%) use computational grid, 27,6% of the policies use GIS and 19,3% of the policies use models to conceptualize and construct systems in business and IT development.

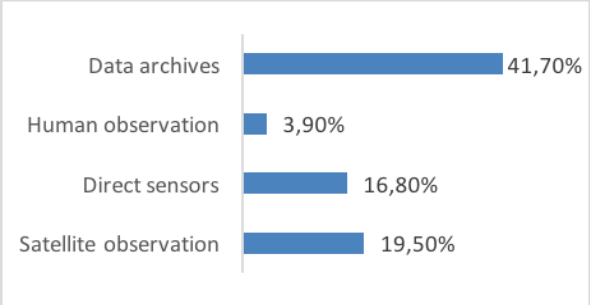

Figure 2. Observation

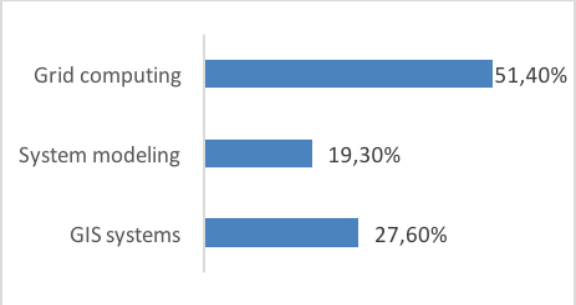

Figure 3. Analysis

Regarding the category of planning (Fig. 4), most environmental and forest policies (43,2%) apply data correlation methods, while 24,4% of them forecast environmental conditions and objectives, and 17,5% of the policies contribute directly to policy formation. As for the management and protection (Fig. 5), most policies (39%) refer to the planning of mitigating the impacts of the climate change and the adaptation to climate change, while 37% of them are enforcement strategies to climate change.

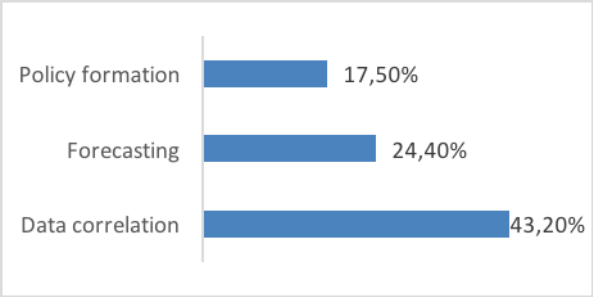

Figure 4. Planning

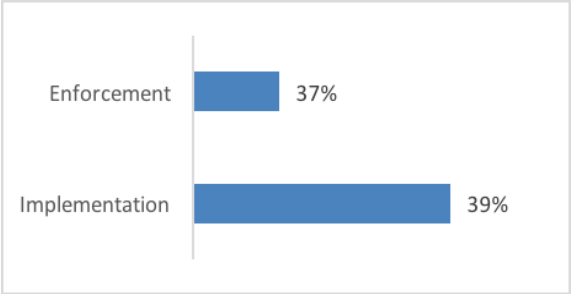

Figure 5. Management and protection

Figure 6 presents the current trend based on the e-Environment ICT application map. The 279 environmental and forest policies deal with the observation and the management plans at global level, 347 policies are about management plans at both global and local level, 480 environmental and forest policies concern the observation and management plans at local level and 412 policies deal with the observation at global and local level.

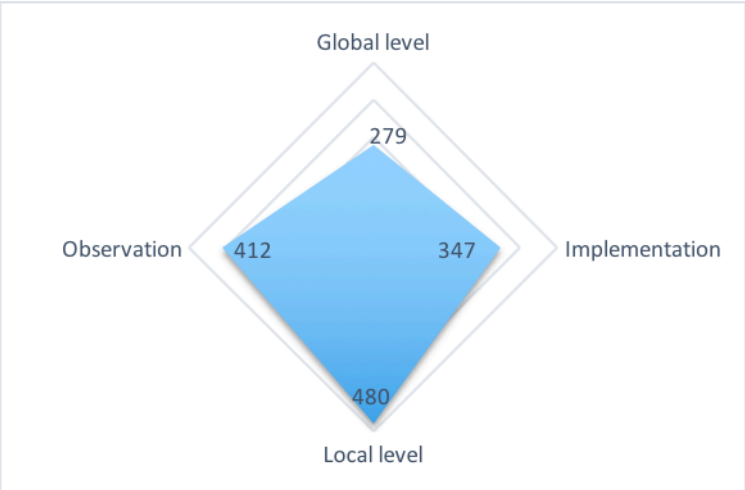

Figure 6. Current trend based on the e-Environment ICT application map

Discussion-Conclusions

ICT is an umbrella term that include any communication device or system encompassing, inter alia, radio, television, mobile phones, computer and networking hardware and software, satellite systems, as well as the various services and applications associated with them (Labelle, 2008). ICT have changed many traditional types of community, but also enabled the appearance of new ones (Connery and Hasan, 2005; Andreopoulou, 2009). At EU level a set of Acts affects the impact of ICTs on sustainable development and environmental protection.

The results reveal that the EU environmental and forest policies have not reached high rates of ICT adoption. Most policies use data archives for observation, grid computing for analysis, data correlation for planning and implementation for environmental and forest management and protection. However, the ICT adoption of the half of the EU environmental and forest policies constitutes a first and very important step for the transition to eEurope. eEurope Action Plan aims to ensure the EU fully benefits from the changes the Information Society is bringing and plans to create a digitally literate Europe. Nevertheless, the results reveal the necessity of introduction of new ICT tools, concerning network connection and services. That was expected since the method for assessing ICT adoption of the EU policies was introduced in 2010.

This rate should be augmented within the context of e-innovation society. To prepare for and to take account of the ICT aspects of the EU policies, stakeholders involved in the drafting and the implementation of legislative proposals must be more aware of the ICT adoption of such proposals. Within that aspect, e-readiness of member states of the EU should be improved in order to participate in the Information Age (networked world).

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Short presentations

COMMUNICATION AND COOPERATION – MAJOR CHALLENGES OF GREEN INFRASTRUCTURE CONCEPT

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Abstract

In recent years "Green Infrastructure" has become synonymous of "ecological networks" and a buzzword in European biodiversity policies. Building up of a Green Infrastructure needs smart and integrated approaches to spatial planning and ensuring that natural resources are utilized and land is turned into areas capable of providing multiple other functions for nature and society. However, it should be born in mind that, there is no clear definition for "Green" and no set criteria for "How Green is Green". In this regard, ensuring a harmony between the physical infrastructure needs and the existing environmental/cultural values has been a major challenge in land-use planning. In doing so, communicating the good deeds of man-made interventions on land becomes a main task of the "ecological networks" or "Green Infrastructures".

CO_2 EMISSIONS FROM STUBBLE BURNING IN THE SKOPJE VALLEY

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Abstract

In this article a general information about the air pollution in the Skopje valley, its geographical, climatic and meteorological conditions, that contribute to high concentrations of PM_{10} and $PM_{2,5}$ in the city, especially during the heating season. The measuring network shows that PM10 concentrations in all measuring point in the city of Skopje is drastically above the limit of 50µg/m^3, with accident reaching value up to 1000µg/m^3. Part of this research is done by conducting a survey on 5044 households in 17 municipalities of the Skopje plan region and additional analysis of the practice for stubble burning in the Skopje plan Region. It is illegal but it seems to be a common practice. CO_2 emission from the process is given in the article.

**This research was developed in the frame of Macedonia's Second Biennial Update Report, UNDP Office in Skopje.*

INNOVATION FOR SUSTAINABILITY IN RURAL AREAS: BARRIERS AND OPPORTUNITIES.

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University of Basilicata – Italy

Abstract

The poster reports a preliminary research activity conducted in Sothern Italy concerning the adoption of innovation in the rural sector. The aim is to assess the main barriers facing the farms when decide to introduce innovations. A farm sample of 100 units based in Campania region and beneficiary of measure 124 of the rural development program have been inquired using a questionnaire focused on the degree of adoption of different innovations in their farms.

Results show a wide range of barriers, from technical to financial, facing the farms according to their size structure and socio-demographic characteristics of the family running the farm. These results offer a series of interesting insights for policy efficacy. Even when the innovation are co-generated at farm level, their fully adoption meet some technical and non-technical barriers than need to be removed when innovation is the key for competitiveness.

Key words: *Innovation, rural development, sustainability*

THE EUROPEAN GREEN BELT – INITIATIVE FOR THE PAN-EUROPEAN ECOLOGICAL NETWORK

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Abstract

The European Green Belt forms a pan-European ecological network extending along the former Iron Curtain from the Arctic Ocean in the north to the Mediterranean, the Adriatic and the Black Sea in the south. Today the Green Belt is of global significance and of vital importance for the long-term preservation of Europe's unique ecosystems and biodiversity.Transnational and cross-border projects play a particularly important role in protecting this unique corridor as well as in building and strengthening the network of stakeholders.Initial findings of studies demonstrate that the Green Belt is capable of making a significant contribution to green infrastructure in Europe. Since 2014 the European Green Belt Association e.V. is coordinating the manifold activities of the initiative that spans 24 states and involves governmental and non-governmental organisations.

Keywords: *Ecological network, Iron Curtain, Green Infrastructure, Cross-border cooperation, Political support*

Introduction

The Green Belt is an ecological network spanning the whole of Europe; it runs the length of the former Iron Curtain from the Arctic Ocean in the far north to the Mediterranean, the Adriatic and the Black Sea in the south. In many regions, the European Green Belt features extraordinary biodiversity and also serves as a unique memorial landscape to the end of the Cold War. Of the 24 neighbouring states, 20 have already pledged their commitment to protecting and further developing this important corridor through political declarations of intent. The long-term coordination of the European Green Belt Initiative, which has been in existence since 2004 and encompasses all neighbouring states as well as governmental and non-governmental organisations, poses a challenge that has been tackled systematically in recent years; further major challenges still lie ahead. Transnational and cross-border projects play a particularly important role in building and strengthening the network of participants and engaging further organisations in the initiative; several projects of this kind have already been conducted. Initial findings of studies into the networking of protected areas along the European Green Belt demonstrate that this ecological corridoris capable of making a significant contribution to the creation of so-called Green Infrastructure in Europe.

Material and Methods

The European Green Belt – European ecological network and transnational initiative

The area along the former Iron Curtain, which divided Europe over a period of almost four decades, was for a long time virtually untouched by human hand. Consequently, many habitats and near-natural landscapes were preserved in numerous regions along today's Green Belt. The European Green Belt covers a distance of 12,500 kilometres, running through the European continent from the Norwegian-Russian to the Bulgarian-Turkish border. It connects 24 European states, runs through virtually all the biogeographic regions of the continent, links

climatic and vegetation zones and provides an important refuge and migration corridor for numerous animal and plant species.

In May 2013, the EU Commission cited the European Green Belt Initiative as one of the few examples of green infrastructure realised at European level (EU Commission 2013). The purpose of the "Green Infrastructure Concept" is to preserve the diverse services provided by nature (ecosystem services) and hence make them usable for human beings on a long-term basis. This concept includes everything from the prevention of air and ground pollution, to flood protection and the preservation of habitats and migration corridors for animals and plants. "Green infrastructure" is the term used to describe a network of protected areas as well as the landscape between them and also includes green urban spaces (parks, planted areas, green roofs and planting around buildings) (cf. Geidezis and Wessel 2014). The "Federal Concept for Green Infrastructure" published by the German Federal Government in March 2017 picks up on the EU Commission's green infrastructure initiative and serves primarily as a means of evaluating all German Federal Government planning schemes from a nature conservation perspective (German Federal Agency for Nature Conservation – Bundesamtfür Naturschutz 2017). In this document, the Green Belt is explicitly referred to as a backbone of green infrastructure in Germany.

There are as many as 47 national parks alone directly on the Green Belt, 19 of which are cross-border protected areas. Today the Green Belt is an ecological network of global significance and of vital importance for the long-term preservation of Europe's unique ecosystems and biodiversity. Moreover, it is a living memorial landscape linking nature, culture and recent European history in a unique way (Geidezis and Kreutz 2006).

Figure 1.Course of the European Green Belt, its four main regions and the respective regional coordinators (Source: European Green Belt Initiative).

The activities carried out by the BUND (*Bund für Umwelt und Naturschutz Deutschland* – Friends of the Earth Germany) since 1989, aimed at preserving and developing the German Green Belt (Frobel et al. 2009), coupled with the initiatives launched in the 1990s for the protection of valuable landscapes in the Balkans (Schneider-Jacoby et al. 2006) and the "Fennoscandian Green Belt" on the Finnish-Russian border (Karivalo andButorin 2006), led to the founding of the European Green Belt Initiative (Geidezis and Kreutz 2012). This development was prompted by the current chairman of the BUND, Hubert Weiger, who first spoke publicly of a Green Belt through the whole of Europe in 2002 at the opening of the Land Art Project "*WestÖstliches Tor* – WestEastern Gateway" on the Green Belt Germany, and called for transnational efforts to protect it. Guest of honour at this event was Mikhail Gorbachev, the former president of the Soviet Union, who instantly agreed to become patron of the European Green Belt. Shortly after, in 2003 and 2004, the idea was taken further by theGerman Federal Agency for Nature Conservation (*Bundesamtfür Naturschutz* – BfN) and the IUCN (International Union for the Conservation of Nature), and two preliminary international conferences were held on the subject of the Green Belt (cf. Schwaderer et al. 2016). This led to the founding of a European initiative in which around 150 governmental and non-governmentalorganisations now work together on a cross-border and interdisciplinary basis.

The European Green Belt is divided into four main regions (see Figure 1) managed by regional coordinators, whose main aim is to promote the cross-border exchange of information and initiate projects:

- Fennoscandian Green Belt, Baltic Fund for Nature
- Baltic Green Belt, BUND Mecklenburg-Western Pomerania
- Central European Green Belt, BUND Project Office Green Belt
- Balkan Green Belt, EuroNatur Foundation

Regional conferences and regular pan-European congresses facilitate transnational collaboration. At the beginning of November 2016, the 9th pan-European Green Belt Conference took place in Koli National Park in Finland; it was attended by 125 delegates from all participating states(see Figure 2; for congress documents, go to www.europeangreenbelt.org).

The initiative gained widespread political support thanks to the "Declaration of Intent on the European Green Belt", an official pledge to support the European Green Belt Initiative. This declaration was signed by environment ministers, ambassadors and envoys from 11 states at the ceremony held in May 2013 in Berlin to mark the 10th anniversary of the European Green Belt Initiative. Since then a further nine countries have signed the declaration or submitted equivalent letters of support, with the result that in total 20 of the 24 states have now committed themselves to further developing this important network of natural habitats through Europe (cf. Schwaderer et al. 2016).

Figure 2.Participants of the 9th pan-European Green Belt conference in Koli National Park in Finland in November 2016 (Source: Ministry of the Environment Finland).

Overall coordination of the initiative – European Green Belt Association e.V.

Up until 2010, the IUCN was responsible for the overall coordination of the European Green Belt Initiative via its office for South-east Europe based in Belgrade (Serbia). However, owing to lack of funds and extensive restructuring of the European IUCN secretariats, the IUCN was no longer able to fulfil this role. Consequently, a new organisation had to be found for coordinating the initiative – a task undertaken by the BUND and EuroNatur within the framework of a BfN-funded research and development project entitled "Further Development of the European Green Belt Initiative". The project prompted a discussion process about forming a new, efficient grassroots organisation for coordinating activities and culminated in the founding of the European Green Belt Association e.V. on 24 September 2014 during the 8th pan-European Green Belt Conference in the Czech city of Slavonice (cf.Schwaderer et al. 2016). The founding members of the association were 23 governmental and non-governmentalorganisations from 14 countries; today the association has 31 members from 16 countries.

The association is currently chaired by EuroNatur and vice-chair is the BUND. In order to achieve the broadest possible acceptance and put the initiative on a firm footing in Europe, the association pursues the following objectives and tasks: coordinating transnational activities, strengthening the strategic and content-based orientation of the initiative, further developing communication strategies, and legitimising resolutions by means of transparent decision-making processes. The coordination of the initiative is extremely time-consuming and cost-intensive, not least due to the extensiveness of the geographic territory. The founding of the association represents an important milestone in safeguarding continuity with respect to content and funding. It is nevertheless evident that secure long-term funding will have to draw on multiple sources of income. Hence, considerable work still needs to be done with respect to establishing stable funding sources (cf. Schwaderer et al. 2016).

Results

Implementing transnational and cross-border cooperation

In order to expand the participant network, engage new organisations, and implement activities on a cross-border and transnational basis, the European Green Belt Initiative requires funding that does not stop at national borders. Despite the complicated and lengthy application procedures, the various EU funding programmes offer numerous options for financing these kinds of activities. It has already been possible, for example, to implement

three large-scale transnational projects along the European Green Belt with the help of various EU Interreg funding programmes.

The Interreg IIIB CADSES Project GREEN BELT (2006-2008) was the first scheme of this kind; it was largely initiated by the BUND, with the Association for Rural Development in Thuringia (*ThüringerLandgesellschaft*– ThLG), Germany, acting as lead partner. Eighteen partners from eight countries (Germany, the Czech Republic, Austria, Slovakia, Hungary, Slovenia, Croatia and Bulgaria) collaborated on the project. Among other things, it involved a "gap analysis" of the Green Belt in Central Europe and Bulgaria using aerial photographs and uniform methodology. Based on this analysis, it was possible to establish the protection status of the natural habitat network, identify non-protected areas within the network that were valuable from a conservation perspective, and propose appropriate measures for safeguarding them (Schlumprecht et al. 2009). The project also generated the first flyer and the first travelling exhibition on the subject of the European Green Belt, both of which were translated into the languages of all the participating countries. This facilitated the building and strengthening of important networks in the individual countries as well as the initiation of further cross-border implementation activities.

From 2008 to 2011, 22 partners from six countries (Estonia, Latvia, Lithuania, Poland, Russia and Germany) worked together on the Interreg Project "Baltic Green Belt" (Baltic Sea Region Programme), with the University of Kiel acting as lead partner. For the first time, this project made it possible to build an extensive network of active organisations along the Baltic coast. In addition, the partners jointly formulated issues of special importance for the Baltic Sea region. These include, in particular, the handling of marine and coastal habitats, the special historical development of the Baltic states during the Cold War and their cultural and military legacy that has survived in the isolation of the numerous restricted military zones along the Baltic coast. Another important outcome of the project was that the Baltic became recognised as one of the four main regions of the European Green Belt owing to the special conditions prevailing there (Sterret al. 2012).

From 2011 to 2014, the Interreg Project GreenNet (Central Europe Programme) was implemented along the Central European Green Belt, once again with the ThLG acting as lead partner. Twenty-two partners from six countries (Germany, the Czech Republic, Austria, Slovakia, Slovenia, Italy) collaborated on the project. For the first time, it was possible to engage participants from Italy, such as the government of the autonomous region of Giulia Friuli Venezia and the Julian Alps Nature Park, on a long-term basis. Thanks to the founding of the non-government organisation Rete Italiana European Green Belt ("Friends of the Italian Green Belt"), there has been a local organisation dedicated exclusively to the further development of the Green Belt on the Italian-Slovenian border since 2016. Over the course of the project, it was also possible for the first time to carry out political lobbying for the European Green Belt at EU level. Under the leadership of the BUND Project Office Green Belt, a presentation about the European Green Belt was given to members of the European Parliament in Brussels in October 2011; two months later, the BUND gave a similar presentation to the EU Environment Committee. This helped considerably in raising awareness of the Green Belt in Brussels. The staging of three international scientific conferences also made a valuable contribution to the exchange of expertise about the European Green Belt (Marschallet al. 2012, Marschalland Gather 2015).

Other important cornerstones in the preservation and development of the European Green Belt are local or regional cross-border projects. As far as the Balkan Green Belt is concerned, transboundary schemes are helping to protect the rare and severely endangered Balkan lynx as well as safeguarding landscapes such as the Jablanica-Shebenik mountain range in the Albanian-FYR Macedonian Green Belt; this has been partially achieved by designating the area a national park on the Albanian side (cf. www.euronatur.org/unsere-

themen/projektgebiete/projektgebiete-a-z/jablanica-shebenik/).
Numerous cross-border projects and activities in the fields of nature and species conservation, tourism and sustainable regional development are taking place along the Finnish-Russian and Norwegian-Russian Green Belt. This work is based on a legally binding Memorandum of Understanding adopted in 2010 by all three states to protect and develop their Green Belt on a permanent basis and provide the necessary financial framework. Further information about activities along the Fennoscandian Green Belt can be found at www.ym.fi/greenbelt.

Contribution to the creation of Green Infrastructure

The contribution made by the Green Belt to green infrastructure is being examined as part of an ongoing BfN-funded research and development project – "The European Green Belt as Part of Green Infrastructure" – which is being conducted by the BUND in cooperation with EuroNatur.The project has led to the identification of 1,060 protected areas covering 44% of a 1-km-wide corridor along the borderline and 6,389 protected areas covering 25% of a 50-km-wide corridor. The protected areas featured in the study are Natura 2000 sites,national parks and biosphere reserves as well as IUCN sites of categories I-IV (and partly V and VI), which have been recorded within a 150-km corridor (75-km buffer zone on either side of the border) in the course of an extensive Geographic Information System (GIS) project.Initial findings of analyses concerning the connectivity of protected areas in corridors of various widths along the Central European section confirm that the Green Belt is making a positive contribution:With increasing proximity to the border, the proportion of land covered by protected areas increases and the distance between protected areas decreases. This indicates that the Green Belt is capable of making a significant contribution to the connectivity of the protected area network in Europe and hence to the creation of green infrastructure (see Figure 3 and 4). It is planned to carry out further analyses of the zones between the protected areas (the "gaps" in the protected area network) in order to establish how to improve connectivity between the existing protected areas.

Discussion-Conclusions

The founding of the European Green Belt Association e.V. represents a major step towards coordinating and steering the European Green Belt Initiative on a long-term basis. However, further funding tools will have to be found in future in order to ensure long-term financial security for overall coordination.The IUCN cites the European Green Belt as a model for a Europe-wide initiative with an innovative management structure (Vasilijević et al. 2015). EU funding programmes will continue to play a major role in the implementation of cross-border and transnational activities and measures.

The pan-European conference in the Finnish national park of Koli resulted in a key demand being made by the European Green Belt Initiative, namely that the EU set up its own programme for funding the creation of green infrastructure. Incorporating the topic in existing EU funding programmes such as LIFE, aimed at implementing specific measures, does not appear worthwhile given the limited resources available to these schemes. Moreover, as part of green infrastructure, the Green Belt must be taken into consideration in the spatial planning policies of the European countries involved and be viewed in the context of the "Trans-European Network for Green Infrastructure" (TEN-G) that the EU endeavours to achieve. This is something the European Green Belt Association is campaigning for via the EU Green Infrastructure Implementation and Restoration Working Group.

Figure 3 and 4. The Green Belt – a network of near-natural linear corridors and core areas – makes a significant contribution to the preservation of green infrastructure, be it in the form of an expansive near-natural landscape such as that found on the River Kitka in the Finnish-Russian Green Belt (above) or the last remaining near-natural structure in an intensively cultivated landscape as seen in many areas of the inner-German Green Belt (below)(Sources: Kari Lahti/Metsähallitus, Klaus Leidorf/BUND Project Office Green Belt).

As far as mitigating the effects of climate change is concerned, the fact that the Green Belt runs along Europe's north-south axis means it will be particularly important as a migration corridor in future. Furthermore, there are numerous points of contact with other (cross-border) ecological network axes. This is another reason why increased efforts should be undertaken to map out the Green Belt as the backbone of a European-wide green infrastructure and make adequate funds available for its preservation and development.

Owing to the special way in which it links nature, culture and history, the European Green Belt can act as:

- an initiator and catalyst for more intensive cross-border cooperation for protected areas of various categories,
- an aid to closer cooperation between governmental and non-governmental organisations in the cross-border context,

- a basis for EU-funded projects due to the fact that it is a model area for the protection of biological diversity and the preservation and development of an ecological network that incorporates the economic (e.g. nature tourism) and socio-cultural demands of local communities (joint heritage and memorial landscape), and
- a flagship project for pan-European cooperation, as it facilitates transnational cooperation between 24 states.

The European Green Belt is a cooperation model and networking system not only for animal and plant species, but also for nations, regions, public authorities, universities, government and non-government institutions, associations and individuals. It is firmly rooted in individual regions that together form an international network. Designating the Green Belt a UNESCO world natural and cultural heritage site would also be a great opportunity for promoting peaceful European cohesion and putting political boundaries into perspective.

Acknowledgements

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NGO CO-OPERATION FOR THE CONSERVATION AND SUSTAINABLE DEVELOPMENT OF THE TRANSBOUNDARY PRESPA BASIN: "PRESPANET"

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Abstract

Long delays in the development of formal co-operation between the littoral states of the Prespa basin, despite the best efforts of collaborating NGOs from the three countries, led to the decision to establish a permanent network of environmental NGOs, PrespaNet, in 2013. The network, consisting of the SPP, based in Agios Germanos, PPNEA in Tirana and MES in Skopje, aims to fill part of the gap left by the states, by synergising activities and enhancing co-operation between environmental NGOs working in and around the Prespa region, enabling a better flow of information on conservation and sustainable development issues, and influencing environmental policies concerning Prespa. Since its establishment, PrespaNet has undertaken a series of activities on all three sides of the basin on wildlife monitoring, particularly of waterbirds, as well as environmental education, communication and policy activities, especially on water management issues. Its future plans also include work on large carnivores and participatory projects for wild plants using local volunteers. One significant activity, which was critically needed in the absence of official state co-operation, was the elaboration of a common strategic framework for conservation in the basin, which guides joint activities and was prepared with the participation of other international NGOs active in the region. PrespaNet has also been instrumental in the early years and initial establishment of a trust fund for the wider region, the Prespa Ohrid Nature Trust (PONT), a financial instrument that is expected to support conservation and sustainable development efforts in the region in the long run, filling in the substantial funding gaps that have been left by official state policies. Lastly, note should be made of the future role of PrespaNet in the new era of implementation of the quadrilateral international agreement for the Prespa Park, which has just recently entered into force and is expected to establish innovatory institutions for permanent transboundary co-operation with the participation of civil society organisations.

***Keywords**:* conservation, transboundary co-operation, NGO, PrespaNet, PONT

THE INTERNATIONAL AGREEMENT FOR THE TRANSBOUNDARY PRESPA PARK AND ITS FUTURE IMPLEMENTATION

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Abstract

In 2000, after a decade of turmoil in the Balkans, "green diplomacy", up to then unknown in the country, was put in the test by the Greek Government in a small and secluded but highly symbolic spot in the border map of the region, the Prespa basin. The transboundary "Prespa Park" was thus established by the prime ministers of the 3 littoral countries and an informal institutional set up was put in place and produced fruit for the next 10 years. In 2010 the process showed signs of maturation, as the ministers of environment of the 3 countries and the EU commissioner for the environment came together on the coast of Lesser Prespa to sign an international agreement for the protection and sustainable development of the Prespa Park area. However, seven years passed without any further progress due to the fact that the Greek state/ government did not complete its internal process for the ratification of the agreement. This long period of the 'freezing' of formal transboundary cooperation in the Prespa basin recently came to an end with the ratification by a wide majority of the Greek Parliament of the 2010 agreement. This meant that it has now entered into force and can and must henceforth be implemented. The agreement sets the ground for the implementation of common action plans and programs for the protection and the sustainable development of the transboundary "Prespa Park". In order to accomplish this, the agreement foresees the establishment of permanent structures; the Prespa Park Management Committee, its Secretariat and the Working Group on Water Management. On the Greek side this daunting task is entrusted by the ministry of environment to the management body of the Prespa National Park, with seed funding from the Green Fund. The management body is currently planning how to best meet this challenge together with other local stakeholders that are committed in transboundary cooperation in Prespa. In this context the management body is eager to create yet another innovatory paradigm for conservation and sustainable development of a border protected area in Greece.

***Keywords**:* Prespa Park, conservation, sustainable development, international agreement

THE LINK OF NATURE CONSERVATION AND REGIONAL DEVELOPMENT – CASE STUDY EUROPEAN GREEN BELT INITIATIVE IN PELLA

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Abstract

In the face of climate change, globalization and the need for sustainable development, landscapes have to fulfill an increasingly multifunctional role for the delivery of ecosystem services for the human well-being. In this regard, the conservation of nature is a challenging but not impossible issue. The European Green Belt Initiative has been set off with the aim to contribute to the preservation of ecosystems along the former borderline of the Soviet Union, which have been spared of human interference in some regions to some extent.

In order to shed some light on how this initiative may connect nature conservation and regional development, a study has been conducted in the prefecture Pella, Greece, as part of the Green Belt and possessing a high grade of biodiversity and a dominantly rural character. At the same time the area shows major lacks in nature conservation and suffers from the border area status.

To find out about the potential economic and social benefit of the initiative for Pella, surveys were conducted with local stakeholders and experts. This way information about the protected areas' role for the regions' development, current problems and needs for change and improvements was collected. The results showed that nature conservation is indeed integrated in regional development approaches. In practice, however, the protected areas play a passive role: Illegal activities like logging and hunting by the inhabitants obstruct the achievement of the conservation goals and alternative tourism potential as additional income is not fully used. Furthermore the cooperation with FYROM is inefficient if not lacking. In order to improve the effectiveness of the initiative, some recommendations are the increase of law enforcement, an enhanced marketing of the initiative and the tourism sector including also a better cooperation with the Former Yugoslav Republic of Macedonia (FYROM) as well as a reconsideration of the protected areas' legal status.

***Keywords**: Pella, regional development, nature conservation, European Green Belt Initiative, protected areas*

IMPACT OF ANIONIC DETERGENT CONCENTRATION ON SOIL AND PLANT

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Abstract

Detergents are increasingly and widely used all over the world. Cleaning in the home, in commercial laundries, at car washes and in a wide variety of industrial procedures represent major sources of detergents. Surface active agents reduce the surface tension of water and oil. Surfactants in detergents are toxic for freshwater environment. The reduced surface tension of water also makes it easier to absorb pesticides, phenols and other pollutants. In this paper is present some analitycal aspects about anionic detergent determination in soil sample and different concentration impact on physical and chemical properties of soil and plants. For this reason was made experiments in green house with different anionic detergents concentrations and different commercial type of detergents.