CREATING A SYSTEM FOR SUPPORTING INTEGRATED SPATIAL PLANNING IN ISLAND AREAS

Lazoglou M.[1], Sourianos E.[2] and Kyriakou K.[3]

[1]*PhD Candidate, Division of Hydraulics and Environmental Engineering, School of Civil engineering, Aristotle University of Thessaloniki, GR 54124, Thessaloniki, Greece, mlazoglou@civil.auth.gr*

[2] *PhD Candidate, Division of Hydraulics and Environmental Engineering, School of Civil engineering, Aristotle University of Thessaloniki, GR 54124, Thessaloniki, Greece, esourian@civil.auth.gr*

[3] *PhD Candidate, Division of Geotechnical Engineering, School of Civil engineering, Aristotle University of Thessaloniki, GR 54124, Thessaloniki, Greece, kyriako@civil.auth.gr*

Abstract

Spatial planning, in both local and regional scale, is a crucial factor for the development of the Greek territory, although it's been hindered by significant weaknesses and controversies.. In order to confront the implications of the current multidimensional crisis it is necessary to utilize all its available resources and assets. One suggestion is the development of the Greek islands in accordance with the principles of sustainable development. Territorial planning, integrated coastal zone management and maritime spatial planning are critical factors of this process.

This paper aims in developing a tool for supporting islands' integrated spatial planning (territorial, coastal, marine), through the assessment of indicators. The indicators selected are grouped in categories with a view to cover all three pillars of sustainable development. However, it should be noted that each indicator affects to a different degree and in a different extend spatial planning and as a result the importance and the role of each indicator differs. In order to assess the degree that each indicator affects islands' integrated spatial planning, both Analytic Hierarchy Process and Expert Choice 11 software have been employed. Study area of this research is Rhodes Island.

Finally, in order to calculate the weight of each indicator according to its significance in integrated spatial planning, it was created a complex system. This tool is able to facilitate the islands' sustainable development in the decision making process. GIS software was used to adapt the system in accordance with the characteristics of the study area.

Keywords: Spatial Planning, ICZM, MSP, Analytic Hierarchy Process.

1. Introduction

Islands, coastal zones and seashore areas, despite their conceptual differences, form a triptych inextricably linked, presenting as common feature the immediate vicinity to the seas (Coccossis et. al., 1999).

European Union (EU) has adopted ambitious policy initiatives regarding oceans, seas and coasts, to be implemented within the next 10 to 20 years-the most important of which is the ambition to develop "Europe's Blue Economy". This initiative is considered to be the maritime's contribution in achieving the the "Europe 2020" strategy for smart, sustainable and inclusive growth. "Europe 2020" is the European Union's strategy for growth and employment, which began in 2010 to 2020. Its aspiration is creating the conditions for a smart, sustainable and inclusive development.

Seas and coastal zones are drivers of the European economy and present great potential for innovation and development while islands hold a key factor in this process. In European Union there are 450 islands that cover 4.5% of total surface, while Belgium, Luxemburg and Austria are the only member-states that do not have any island (Spilanis I., 1995).

Maritime Spatial Planning (MSP) constitutes an important component in achieving the above objectives. MSP is a science-based tool that assists in decreasing conflicts, improving planning and regulatory efficiencies, decreasing associated costs and delays, engaging communities and stakeholders during decision-making process, and preserving critical ecosystem functions and services (NOAA, 2014).

Coastal zones present a large proportion of resources and high biodiversity. These distinctive characteristics have turned them into popular settlement areas, transit points, important business zones and tourism destinations. This intensive concentration of population leads to excessive exploitation of coastal zones' natural resources and suppressesthe coastal ecosystems. As a result coastal zones present great concentration of environmental and developmental problems, such as pollution, biodiversity loss, conflicts between land uses, and space congestion issues. It should be also noted that these areas are among the most vulnerable to climate change and natural hazards (e.g. flooding, erosion, sea level rise as well as extreme weather conditions).

In this context, the importance of public policies aiming to tackle spatial, social and economic impacts at coastal zones and islands is continuously increasing (Papatheochari and Coccossis, 2009). Spatial planning has a significant role during this process as effective spatial planning and management of the above areas can enhance their economic, social and economic cohesion.

1.1 Islands and sustainable development policies

The European Spatial Planning Observation Network (ESPON) at the 5th Report on European Cohesion defined islands as*"Nuts 3 spatial units, where the majority of the population resides in one or more islands, without being permanently connected to the mainland (e.g. bridge or tunnel)"* (ESPON, 2011).

The first reference regarding policies with main focus on islands was at the seventeenth chapter of Agenda 21 (United Nations, 2011) where the islands were considered as *"discrete spatial units with specific economic, social and environmental characteristics"*. Until today there has not been established an EU policy exclusively for EU island areas, however there have been established policies which affect islands' sustainable development (e.g. policies on entrepreneurship, natural and cultural heritage, human resources and services, infrastructure).

Having recognized the need to protect and develop islands and island areas in a sustainable approach, the "Islands 2020" strategy was proposed, which classified the islands in three categories and defined a vision about the development of each category (Spilanis et. al, 2011):

- Quality islands: the development of which should be focused on quality-branded products and services that use local resources in a sustainable way. These products and services should be addressed to specific markets.

- Green islands: the development of which should gradually reduce the usage of their scarce resources and should promote strategies to increase their reuse (e.g. water, soil, energy).
- Island with equal opportunities: the development of which should provide islands with the same opportunities that exists businesses and residents of mainland areas.

It should be underlined that according to UNESCO[1] these guidelines are similar to goals of MSP.

At the following table (Table 1) are presented strategic proposals for sectors crucial to achieve sustainable island development.

Table 1. Proposal per sector from various European policies[2]

Sector	Proposal
Transportation	Territorial connectivity
	Reduced travel fees for residents and exported goods
	Mandatory provision for public services
	Ensure employments of indigenous personnel
	Participation of island authorities and stakeholders in decision-making process
VAT	0% VAT in transportation
	Reduced VAT up to 50%
	Reduced VAT regarding petrol and diesel
Agriculture – Fishing	Implementation of biological agriculture
	Protection of fishing areas
	Policies regarding high quality products
	Policies regarding the conservation of traditional cultivations
	Policies to reinforce local agricultural production
Environment	Observation centers for monitoring environmental issues
	Exemption from tax environment for fuel
	Exemption from the law on recycling waste

1.2 Integrated Coastal Zone Management

Bruntland Report (WCED, 1987) as well as the 1992 Earth Summit in Rio de Janeiro (United Nations, 2011) identified the need for sustainable development of the coastal zones throught the multidimensional process named "Integrated Coastal Zone Management" which is considered the means to achieve it.

ICZM is based on the concept of coordinating actions in all administrative and institutional levels in coastal areas of interest. The European Commission (EC) describes the term Integrated Coastal Zone Management as a *''dynamic, multi-disciplinary and iterative process that seeks to balance economic development and use of the coastal region, protection and preservation of coastal areas, minimization of loss of human life and property, and public access to the coastal zone''* (EC, 2002a).

ICZM suggests a new pattern of coastal management through which an effective integration among social structures, economic patterns and policy issues should realize and maintain a sustainable use of coastal resources (Gopnik et al., 2012). ICZM is a process that brings together all those involved in the development and management of the coastal zones,

[1] UNESCO, Marine Spatial Planning, Guideline.

within a framework that facilitates the integration of interests and responsibilities (Cantasano and Pellicone, 2014).

The ICZM objectives are ensuring the sustainable management of all natural resources and rationalizing human activities of coastal, territorial and the marine areas, a goal that can only be achieved through integrating spatial planning policies (Ritchie and Ellis, 2010).

ICZM is one of the primary mechanisms of environmental policy geared towards sustainable development of European coastal areas. Further evaluations have led to the awareness of the need for an updated ICZM initiative (Breen and Hynes, 2014).

Integrated coastal management aims to coordinate the application of different policies affecting the coastal zones and all the related to activities (e.g. nature protection, industry, tourism).

1.3 Integrated Coastal Management Policy-Milestones

In 1973 the Council of Europe concluded a Resolution on the Protection of the Coastline. Few years later, in 1983, the Conference of Ministers responsible for Spatial/Regional Planning (CEMAT) led to the adoption of the European Regional-Spatial Planning Charter. From 1973 to 1981 the first European Community action programmes on the environment were launched and they led in 1981 to the European Coastal Charter which underscored the need for integrated planning of coastal areas (EC, 2014a).

Starting point of the EU policy on ICZM is the UN Earth Summit of Rio de Janeiro in 1992. The conclusions of the summit called on coastal states to set up ICZM strategies in Chapter 17 of the Agenda 21. In 1992 and in 1994 the Council adopted resolutions on ICZM.

In 2000 the European Commission adopted:

- A Communication from the Commission to the Council and the European Parliament on "Integrated Coastal Zone Management: A Strategy for Europe" (COM/2000a).
- A proposal for a European Parliament and Council recommendation regarding the implementation of ICZM in Europe (COM/2000/545) (COM, 2000b). This recommendation was adopted on 30 May 2002 (EC, 2002b) and listed eight principles defining the essential characteristics of ICZM. The recommendation outlined steps which the Member States should follow to develop national strategies for ICZM (EC, 2014a).

The 6th Environment Action Programme of the European Community, 2002-2012 (EC, 2002c) confirmed ICZM among the action priorities.

A milestone in the development of international legislation on ICZM was achieved by the adoption of the ICZM to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention), which was entered into force 12 February 1978. In 2008, a Protocol was developed to provide a common framework for the Contracting Parties to promote and implement ICZM. On 13 September 2010, the Council adopted the decision to ratify the ICZM Protocol to the Barcelona Convention (EU, 2010). The Protocol entered into action the 24th of March 2011.

1.4 Maritime Spatial Planning: Framework and Priorities

On 12 March 2013, the Commission adopted a proposal for a Directive establishing a framework for maritime spatial planning and integrated coastal management, with a view to promote both the sustainable development of maritime and coastal activities, and the sustainable use of coastal and marine resources. The proposal required Member States to *"map human activities at sea and identify their most effective future spatial development in maritime spatial plans and to coordinate relevant policies affecting coastal areas in integrated coastal management strategies"*. Through this approach, plans and strategies concerning coastal areas will be assessed using the provisions of Directive 2001/42/EC about strategic environmental assessment (EC, 2001; EC, 2014a).

The above proposal directive required Member States to establish maritime spatial plans that map existing human activities in member states' marine waters and to identify their most

effective future development. Member States should take into consideration land-sea interactions, as well as environmental, economic, social and safety aspects (EC, 2014b). They will also have to cooperate with the aim to ensure that maritime spatial plans are coherent and coordinated across the marine region concerned (COD, 2014).

The competition that prevails in the maritime area, among different activities (e.g. renewable energy installations, aquaculture) shows that effective management is needed in order to avoid potential conflicts and to create synergies between different activities. MSP is a process through which the relevant authorities analyse and organise human activities in marine areas to achieve ecological, economic and social objectives. Basic parameters of MSP are time and place of each activity in order to ensure both efficiency and sustainability to the most possible extent. During this process, all the stakeholders involved should cooperate with transparency, to avoid conflicts among neighboring maritime activities (COD, 2014). Apart from the implementation of the above, it is vital to monitor, evaluate, research and enhance public participation.

The main objectives of MSP are to (COD, 2014):

- encourage investments by ensuring predictability, transparency and clearer rules. This approach will boost the development of renewable energy sources and networks, establish marine protected areas and facilitate investments regarding oil and natural gas.
- strengthen the coordination among national administrations, through applying a single mechanism aiming to balance the development of various maritime activities. In this way MSP will simplify procedures and reduce costs.
- increase cross-border cooperation between EU countries regarding infrastructure (cables, pipelines, wind power plants, etc).
- protect the environment through assessment of the impacts of the potential activities.

1.5 Characteristics of the Greek coastal zone

Greece has an area of 132.000 sq.kms. while the total length of the Greek coastline is about 15,000 km (7,300 miles on the mainland and 7,700 km on islands). More than 30% of the coastline is sedimentary and 70% are corrosion products. Sand formations occupy 3000 ha (Coccossis et. al., 1999).

Greek coastal zone presents a wide variety of coastal landscapes and ecosystems. It simultaneously attracts various activities which result in conflicting land exploitation between tourism, agriculture, mining, fisheries, housing development and protected areas (e.g. Natura 2000).

Key features of the Greek coastal zone are the sharp seasonal concentration of various activities (e.g. tourism) and also the strong competition that has been developed among users of water, land and services. The outcome is the continuous degradation of natural resources due to the intensification of human activities and the depletion of natural resources. Remarkable levels of also been observed pollution have also been observed due to urban sewage, fertilizers, pesticides, industrial waste, mining and transport (Angelides, 2000). The above situation is becoming gradually intense due to the weak institutional framework implemented on land use planning and spatial planning in general.

1.6 Characteristics of the Greek islands

Insular prefectures are defined as *"the prefectures that have either numerous islands or one large island and as a result its socio-economical characteristics differ significantly from other prefectures"*. Main disadvantages of all insular prefectures are connectivity issues, long distances between the main cities of the prefecture and geographical isolation (Spilanis, 1995).

Twelve of the thirteen Greek prefectures have islands, but only four of them (North Aegean, South Aegean, Ionian Islands and Crete) are regarded as insular prefectures. The above prefectures cover 14, 97% of total Greek territory, and their population is 12.06% of Greece's total population (Table 2) (Spilanis et. al., 2011).

Table 2. Profile of insular prefectures3

Insular prefectures	Surface (km^2)	Prefecture surface/total surface (%)	Population 2011 (permanent)	Population 2001 (permanent)	Population change (%)	Population participation (%)
North Aegean	3.836	2,91	197.810	205.235	-3,62%	1,88
South Aegean	5.286	4,00	308.975	298.462	+3,40%	2,76
Ionian islands	8.336	6,32	207.855	209.608	-1,50%	5,48
Insular prefectures	19.765	14,97	1.339.126	1.190.500	+1,08%	12,06
Greece	131.957	100,00	10.815.197	10.934.097	-1.34%	100,00

Insufficient infrastructures, inadequate public services and unemployment are the most significant issues that Greek islands are facing. . Tourism development has been augmented too much in few islands and as a result great threats are getting more and more crucial for their sustainable development.

Different levels of development are recorded amongst the Greek islands. Few of them have begun to decline and get deserted, other rely too much on tourism industry and the rest struggle to maintain their traditional characteristics intact. According to Hellenic Agency for Local Development and Local Government (Spilanis et. al, 2011), islands are categorized according to their characteristics as following (Table 3).

Table 3. Types of Greek islands

Island types	Tends-Needs
1st type	Significant touristic activities at prefectural, national and international level
	Increasing environmental pressures
	Raise of population and high density
	Immediate need to control the type of development followed
2nd type	Augmenting tourism development
	Many natural resources
	Important productive activities apart from tourism
	Land-use conflicts
	Reducing reliance on tourism development
3rd type	Small islands
	Crucial development problems
	Shrinking population
	Insufficient infrastructure
	Geographical isolation

[3] National Statistical Service of Greece.

4th type	Small islets
	Few residents
	Geographical isolation
	Absence of any infrastructure and services
	Need to ameliorate life conditions and connectivity issues

2. Materials and Methods

Islands' sustainable development requires the implementation of policies and tools which aid integrated management of coastal zones and marine spatial planning. Aim of this study is to develop a tool to support islands' decision-making process, concerning integrated spatial planning (territorial planning, ICZM and MSP), through indicators assessment.

2.1 Selection of indicators

In order to choose among the vast number of indicators that have already been suggested worldwide, the criteria below were followed:

I. to be compatible with both the European Strategy for Sustainable Development (Wolff, 2003) and the Greek National Strategy towards Sustainable Development (Hellenic Republic, 2002),
II. to consider methodologies and frameworks suggested by United Bodies and International Organizations (OECD, UNEP),
III. to consider indicators provided by EUROSTAT,
IV. to comply with international commitments,
V. to promote the principles of sustainable development,
VI. to be adaptable to future developments,
VII. to be reliable, so as to provide trustworthy information.

2.2 Methodology

All the indicators selected are separated into categories, and sub–categories, according to the pillars of sustainable development (environment, society, economy), while special attention is given to MSP indicators and indicators which are related to tourism activity.

It should be underlined though that each indicator affects to a different degree and in a different extend the process of spatial planning and as a result the importance and role of each indicator differs. In order to assess the degree that each indicator affects spatial planning, a different weight was calculated for each indicator. This procedure was carried out using Analytic Hierarchy Process (AHP) and Expert Choice 11 software, a user friendly software, which incorporates intuitive graphical user interfaces and is used to calculate, organize and analyze complex decisions. This process is implemented when qualitative, quantitative conflicting factors should be taken under consideration (Melvin, 2012). AHP uses a ratio scale, which contrary to other methodologies, uses interval scales and does not require any units in the comparison process. In the next phase an objective is defined and related to nodes. Each node may include numerous sub-nodes. At every node of the hierarchy, a matrix collects the pairwise comparisons performed (Karanikolas et. al., 2011).

Main disadvantages of AHP are the inherent subjectivity of assigning preference values between criteria and its complexity in the computation of the criteria weights. Nevertheless, it should not be forgotten that spatial planning decisions are made by managers or stakeholders, a fact that implies a certain level of subjectivity (Lamelas, 2007).

Finally, the indicators selected are presented in maps using ArcGIS software. The benefits of using a systemized spatially-referenced multi-knowledge GIS database are: effectiveness in data management, the identification of information gaps and the promotion of increased spatial thinking and understanding and the definition of existing areas of important conservation, human activity, threats and opportunities (Baldwin et. al., 2011)

The analysis performed was based to the data available.

2.3 Study area

Study area of this research is Rhodes Island. Rhodes is the largest island in the Dodecanese complex and one of the most popular touristic destinations of Greece in international level. It has a total surface of 1401 sq.km and a coastline of 253 km. Since 2000, Rhodes presents a significant increase of its seasonal population while signs of exceeding its carrying capacity have been recorded (Vagiona et. al., 2013). This should be regarded as a logical consequence since its carrying capacity cannot forever withstands the excessive growth of tourism in the island of Rhodes. Moreover, Rhodes' economy is highly depended on tourism, while its agricultural sector has started to be abandoned – a fact that sets in danger the island's sustainable development prospects. On the other hand, Rhodes's old town is of outstanding beauty and currently is under UNESCO's protection. However, the island is undergoing numerous critical issues that are related with technical and social infrastructure (Kyriakou et. al., 2011).

However, in Rhodes island important differences are noted. North part of Rhodes Island is more developed than south part of island. Tourism pressure is intense at north part and environmental degradation is noted mainly at north part. In the following figure it is presented the number of luxurious and 'A' category hotels, as it is obvious in north Rhodes there are numerous.

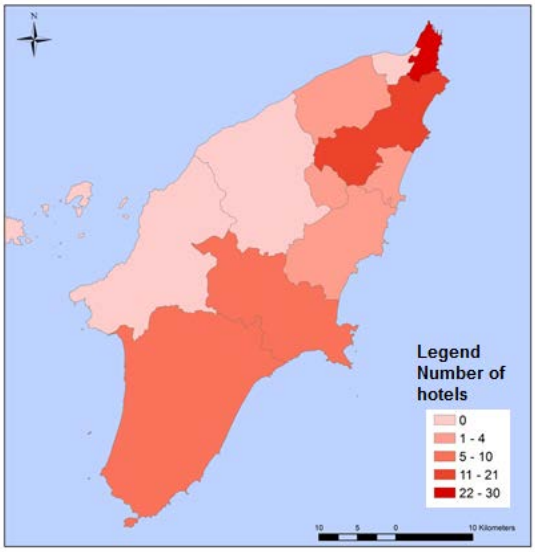

Figure 1, Number of hotels (luxurious and A category) in Rhodes Island

In addition, according to a questionnaire survey that was performed by the authors during December 2010 and January 2011, declared that Faliraki (38%), Elli (16%) and Ialysos (6%) beaches are degraded. These beaches are at north part of Rhodes, this proves that north Rhodes have significant tourism pressures while at south part there aren't any.

In the following figures (Figure 1, Figure 2), significant characteristics of Rhodes are presented; such as island's population and few of its land uses (e.g. artificial surfaces, forests and water resources). Figure 1 shows that forests predominate at Rhodes which is a factor of primary importance for its future development. Many artificial areas have also been noted, while the vast majority of the population is concentrated mainly in the city of Rhodes or in the nearby urban areas.

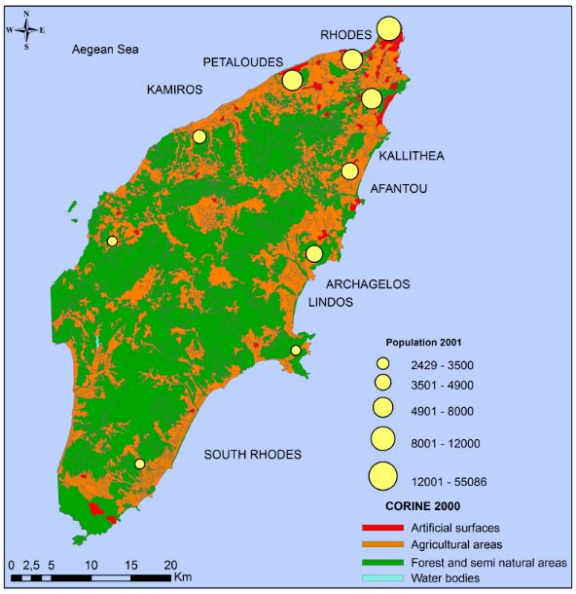

Figure 2, Categorized surface and population in Rhodes Island

Figure 2, presents the protected areas of the island, including the areas which belong to Natura 2000 network, in combination with land elevation. It should be noted that the most significant protected areas in Rhodes are sited around Rhodes' marine area. From the above observations it can be clearly indicated that Rhodes holds remarkable natural resources. Finally, Figure 2 shows the most important infrastructure of the island, for example, its port and airport.

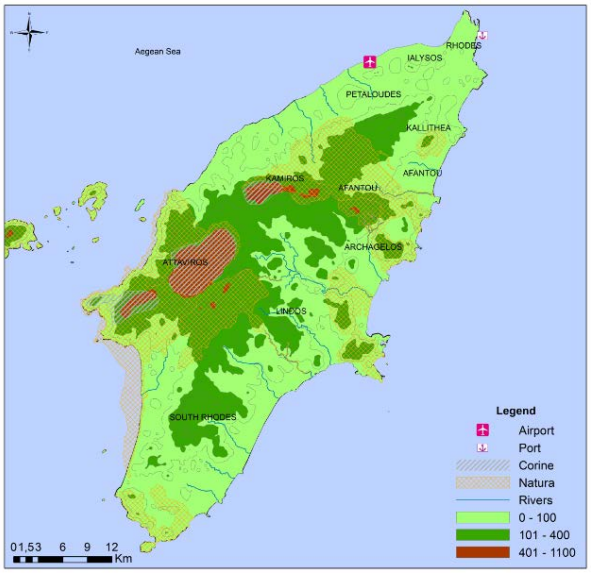

Figure 3, Protected areas in Rhodes Island

Both figures were created using ArcGIS Software. Firstly, a geodatabase including all the data available was created for Rhodes and then all data were analyzed and visualized.

3. Results and discussion

Environment includes indicators related to land uses (2), water resources (3), energy–climate change (2), waste (2), soil (1) biodiversity (1) and built environment (3). Society includes indicators related to demographic dynamics (2), education (2) and unemployment (2). Economy includes indicators related to GDP (1). Tourism includes indicators related to saturation (3) and capacity (1). Thus, a database including 35 indicators has been developed. The selected set of indicators is presented in Table 1.

Table 1. System of selected indicators and theirs weights through AHP

Category	Sub - category	Indicator	Weight	Value
Environment	Land use	surface area of forests (ha % total area)	0,8	39,60%
		arable land per capita (ha/capita)	0,2	19%
	Water Resources	annual irrigation consumption of water per capita (hm^3/capita)	0,614	0,104
		annual household consumption of water per capita (hm^3/capita)	0,117	0,14
		blue flags (number) 2014	0,286	24
	Energy - Climate Change	annual consumption of energy per capita (100Mwh/capita)	0,333	0,657
		% energy production from RES/energy production from fuel resources	0,667	4.12%
	Waste	recycling centers	0,5	5
		annual waste production per capita (kg/capita)	0,5	458
	Soil	area affected by fire (ha)	-	104.442
	Biodiversity	protected areas (ha) as % of total land area	-	22,75%
	Built environment	% urban area (ha) / forest area (ha)	0,297	0,04
		% urban area (ha) / water area (ha)	0,163	1,2
		% natural coastline	0,540	87,1%
MSP	Zoning of areas for specific uses	wind farms (yes / no)	0,123	Yes
		military operations (yes / no)	0,040	Yes
		waste disposal (yes / no)	0,436	No
		marine transportation (yes / no)	0,222	Yes
		offshore aquaculture (yes / no)	0,179	Yes
	Zoning of areas by objective	development areas (yes / no)	0,121	No
		conservation areas (yes / no)	0,575	Yes
		multiple use areas (yes / no)	0.304	Yes
Society	Demographic dynamics	population growth rate (%)	0,500	17,5%
		population density (persons/km^2)	0,500	39,28
	Education	number of post-graduate studies per 1000 inhabitants	0,667	150
		number of under-graduate studies per 1000 inhabitants	0,333	270
	Unemployment	unemployment rate (%)	0,500	18%
		thousands of economic active population	0,500	82.541
Economy		GDP per capita (euro)		20.900
Tourism	Saturation	number of tourists per capita	0,405	13,57
		number of tourists per km^2	0,114	1.276
		number of tourists / coastline length (no/km)	0,481	7.945
	Capacity	number of hotel rooms per 1000 inhabitants	-	282
Institutional	Decision - making structures	main telephone lines per 100 inhabitants (no)	0,143	13,26
		Sustainable development strategies (yes/no)	0,857	Yes

Through Expert Choice software a pairwise comparison was implemented for each sub-category and all weights were calculated. Graphs as the following (Figure 4) were created regarding the significance of each indicator. Below is being presented a dynamic sensitivity graph. It can be undoubtedly noted that the sector of environment and economy (GDP per capita) are the most significant issues regarding integrated spatial planning approach.

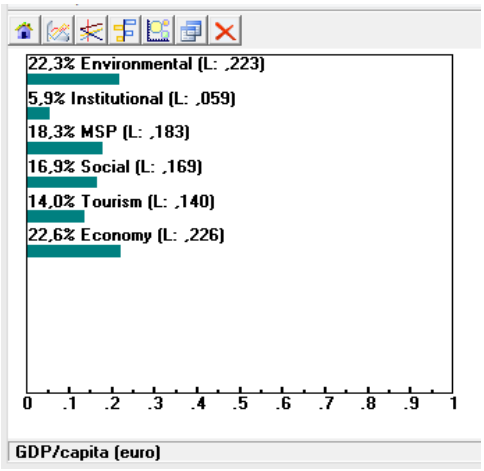

Figure 4, Dynamic sensitivity of categories

According to Figure 4, the most significant indicators for Rhodes' spatial planning regarding the sector of environment are waste and energy issues. Indeed, waste is a crucial problem for Rhodes Island as there are not adequate infrastructures. Authorities have already carry out a study for installation of new infrastructures but it hasn't be implemented because of lack of space (Kyriakou et al., 2011). Energy issue is almost significant as the residents of Rhodes Island recognize the need to construct Renewable Energy sources infrastructures however they do not agree with the sited that have been selecting. Landscape degradation is considered as the most important reason (Kyriakou et al., 2011).

The above evaluation combined with a further evaluation of indicators leads to the following (Figure 4) indicators' shortlist, which presents in a descending order the most crucial indicators related to the sector of environment. The most significant indicators turn out to be the number of recycling centers and the amount of annual waste production per capita. On the contrary, arable land per capita and urban areas comparing to water areas are the least crucial indicators for this sector. Arable land has minor importance because of irrigation problems. Residents have abandoned agriculture as they weren't able to irrigate their cultivations (Kyriakou and Sourianos, 2011).

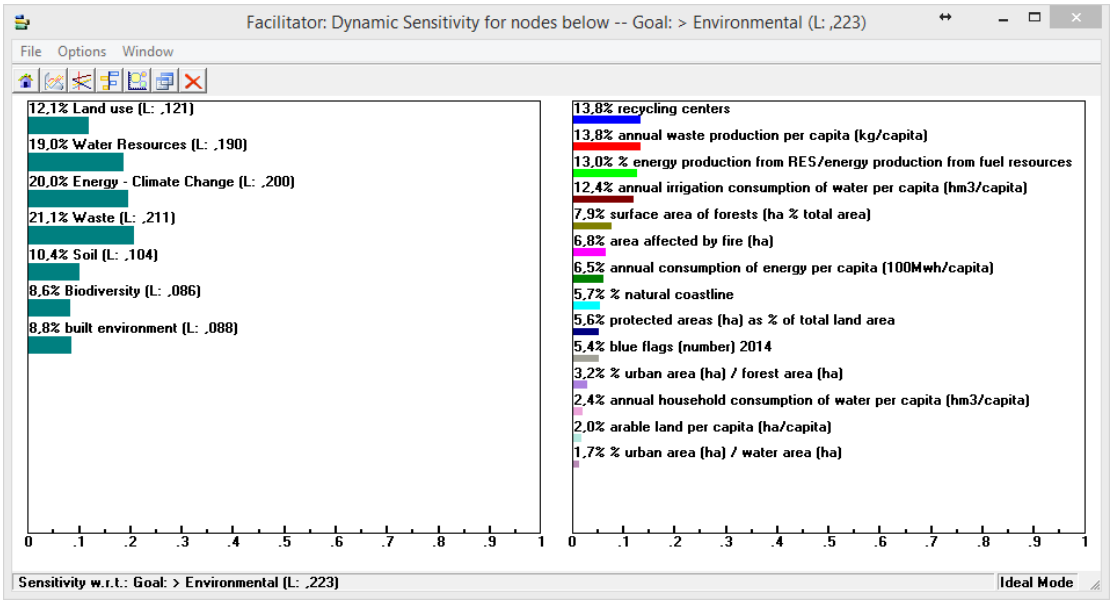

Figure 5, Dynamic sensitivity of sub-categories and indicators for the sector of environment

The following figure (Figure 6) presents a dynamic sensitivity graph for the sector of tourism. The most vital indicator is the number of tourists per length of coastline. On the other hand, the least crucial indicator regarding tourism sector in Rhodes is the number of hotel rooms per habitants.

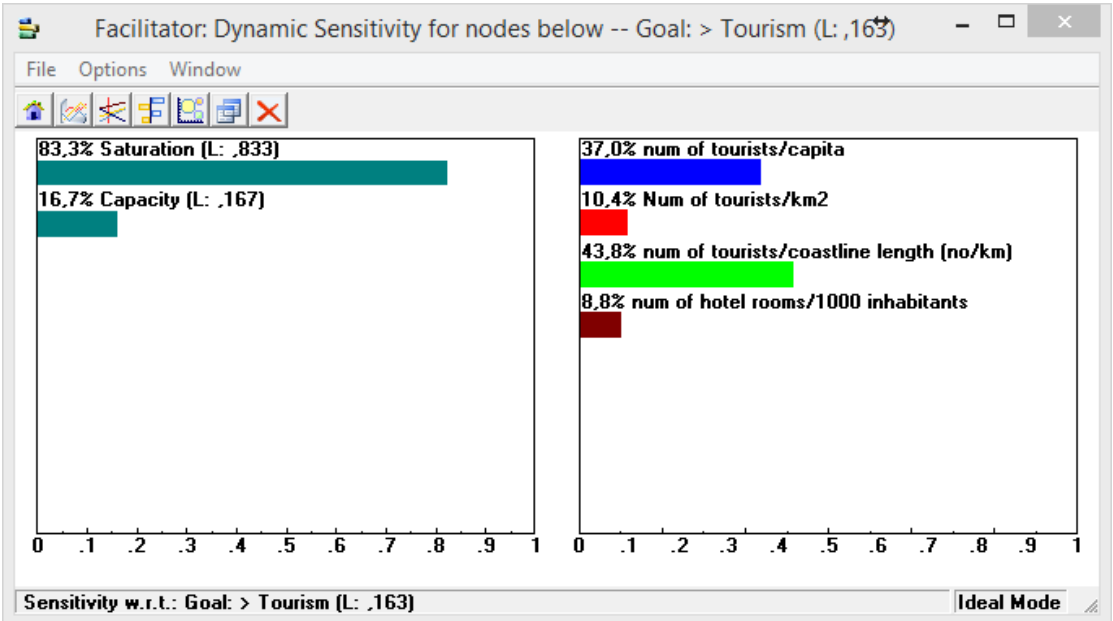

Figure 6, Dynamic Sensitivity graph of evaluation of Tourism indicators

In Figure 7, is presented a dynamic sensitivity graph concerning Rhodes' social indicators. It is obvious that unemployment is an issue of primary importance (0,584) while demographic issues are not crucial enough (0,281). This is absolutely normal as population of Rhodes is trending upward, last decade has a 17% augmentation. So demographic issues do not consist a problem for Rhodes Island and as a result is of minor importance.

It is observed that the rate of unemployment and number of economic active population predominate (30,2%). Moreover, population growth rate (14,5%) and population density (14,5%) are also significant parameters regarding integrated spatial planning in Rhodes. On the contrary, the indicators number of post-graduate and under-graduate students per 1000

habitants are the least important social indicators, although they are not negligible (7% and 3,5% respectively).

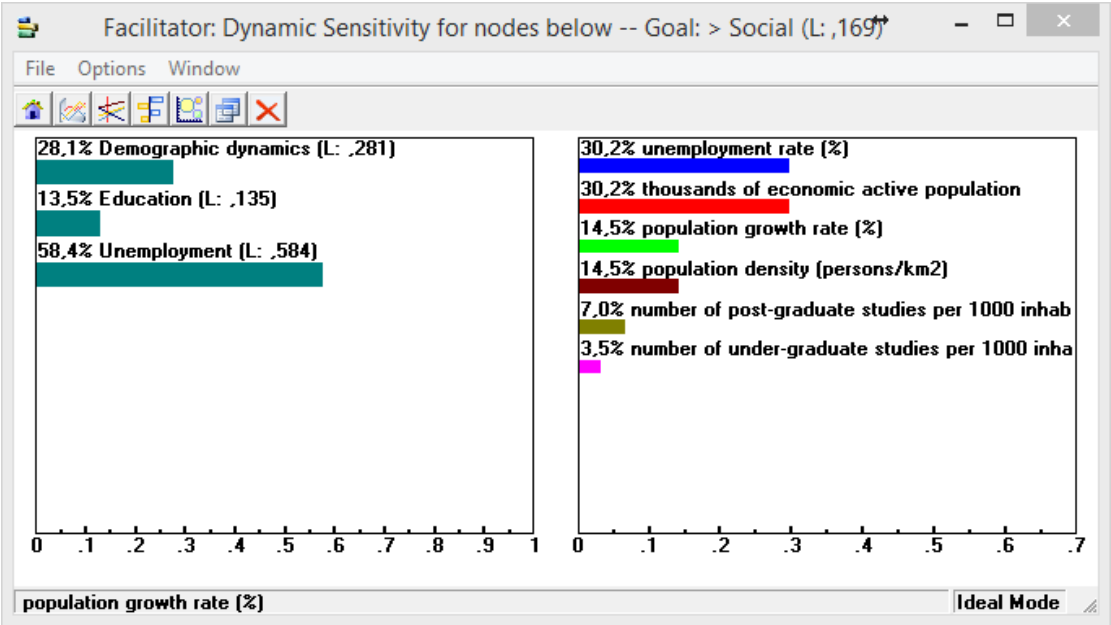

Figure 7, Dynamic Sensitivity graph of evaluation of Social indicators

Figure 8 presents a list in which every indicator was sorted according to its significance regarding Rhodes' integrated spatial planning. The analysis performed showed that the five most important indicators are: GDP per capita (14,2%), number of tourists per coastline length (7,3%), rate of unemployment (6,2%), economic active population (6,2%) and number of tourists per capita (6,2%). On the contrary, indicators such as existence of military operations (0,5%), annual household consumption of water per capita (0,5%) and arable area per capita (0,4%) are the least crucial parameters concerning Rhodes' integrated spatial planning.

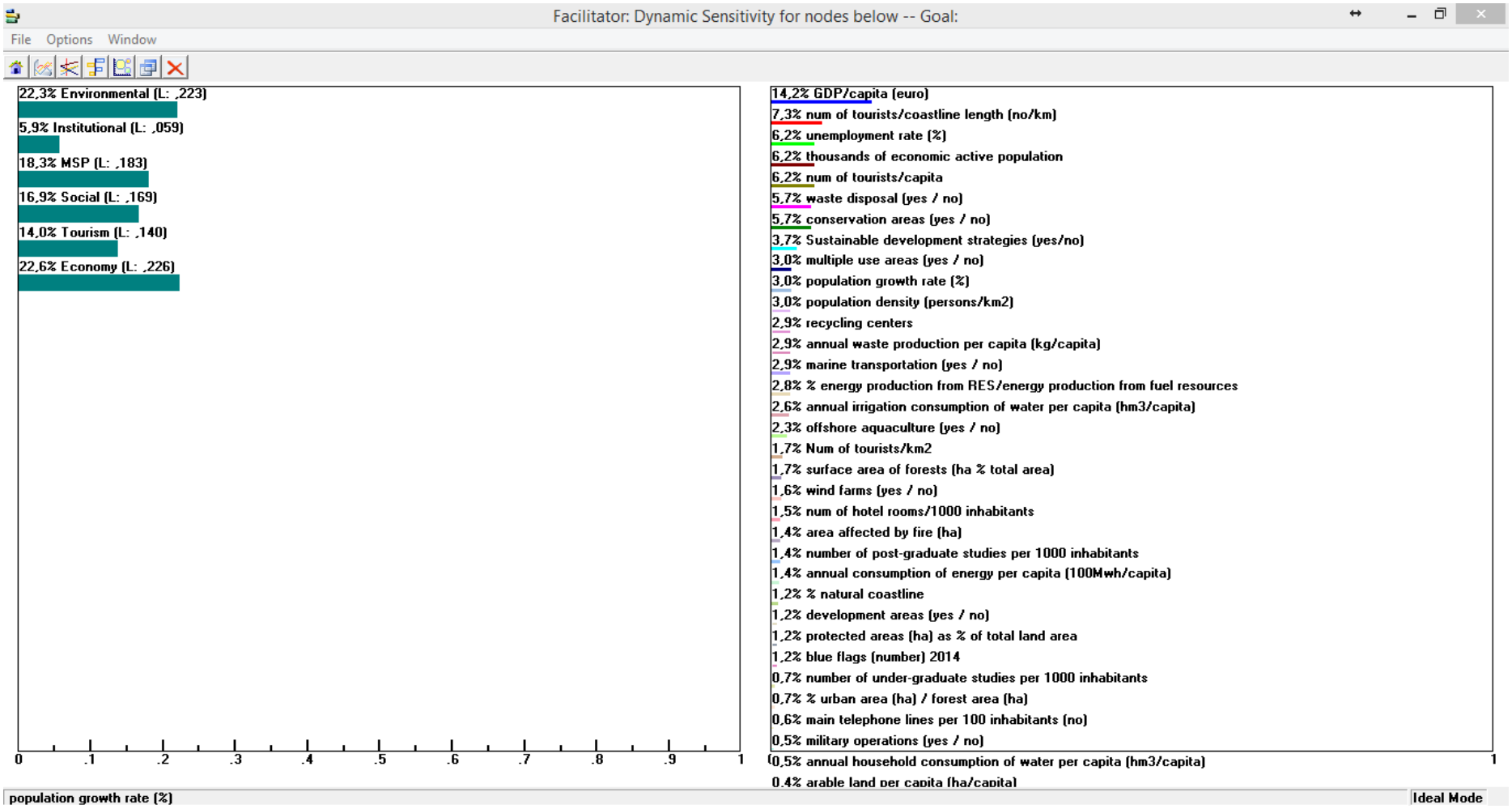

Figure 8, Dynamic Sensitivity Graph with all indicators sorted by significant (weight)

4. Conclusions

Creating a tool to for support island integrated spatial planning decision-making process through the assessment of indicators is a complicated endeavor since spatial planning is a multidimensional issue. The methodology followed was based on Analytic Hierarchy Process, Expert Choice 11 software and ArcGis Software.

According to the analysis performed, environmental and economic issues affect significantly Rhodes' integrated spatial planning, while MSP issues follow. Waste treatment and energy issues turn out to be the most crucial indicators regarding Rhodes' environment. On the contrary, urban areas comparing to water areas and arable land per capita are the least crucial indicators concerning this set of indicators.

Concerning the economic sector, GDP per capita is another significant parameter regarding Rhodes' future integrated spatial planning.

Tourism industry is also significant regarding Rhodes' future integrated spatial planning. Specifically the indicator concerning the number of tourists per length of coastline turns out to be the most vital issue for achieving sustainable tourism development in Rhodes. On the other hand, the number of hotel rooms per habitant is the less vital indicator regarding tourism sector in Rhodes.

Among social indicators unemployment is of primary importance while economically active population is also an extremely crucial parameter. The number of post-graduate students and the number of under-graduate students per 1000 habitants are the least important indicators, although they are not negligible.

The methodology proposed has already implemented for small Greek islands such as Sikino and Nisiros. Now, it is trying to adapt this methodology to different study-cases, while particular interesting would be to compare the results among different islands, calculating even more indicators. This would contribute to the creation of a methodology that would be possible to be implemented for bigger islands. In future work this methodology will be also implemented taking north part and south part of Rhodes as two different cases.

5. Acknowledgements

This research was generously supported by IKY Fellowships of excellence for postgraduate studies in Greece – Siemens Program.

6. References

- Angelides M., 2000. Spatial planning and sustainable development, 1st edition, Athens, Symmetry.
- Baldwin, K., R. Mahon. 2011. A geospatial framework to support ecosystem based management and marine spatial planning for the transboundary Grenadine Islands. CoastGIS, Oostende, Belgium
- Breen, B., Hynes, S., 2014. Shortcomings in the European principles of Integrated Coastal Zone Management (ICZM): Assessing the implications for locally orientated coastal management using Biome Portfolio Analysis (BPA). *Marine Policy*, 44, pp.406–418.
- Cantasano, N., Pellicone, G., 2014. Marine and river environments: A pattern of Integrated Coastal Zone Management (ICZM) in Calabria (Southern Italy). *Ocean & Coastal Management*, 89, pp.71–78.
- Coccossis C., Dimitriou K., Konstantoglou M., 1999. Creation of GIS for coastal locations. 1st Panhellenic Conference on Geographic Information Systems - Features and Applications, Prospects and Challenges.
- COD, 2013. Proposal for a directive of the european parliament and of the council establishing a framework for maritime spatial planning and integrated coastal management, COD/2013/0074.

- COM, 2000a. Final Communication from the Commission to the Council and the European parliament on integrated coastal zone management: A strategy for Europe COM/2000/547 final.
- COM, 2000b. Amended Proposal for a European Parliament and Council recommendation concerning the implementation of Integrated Coastal Zone Management in Europe COM/2000/545.
- EC, 2001. Commission Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment.
- EC, 2002a. Recommendation 2002/413/EC of the European Parliament and of the Council concerning the implementation of Integrated Coastal Zone Management in Europe [Official Journal L 148 of 06.06.2002].
- EC, 2002b. Recommendation of the European Parliament and of the Council of 30 May 2002 concerning the implementation of integrated coastal zone management in Europe (2002/413/EC).
- EC, 2002c. Decision no 1600/2002/EC of the European Parliament and of the Council of 22 july 2002 laying down the sixth community environment action programme
- EU, 2010. Council Decision of 13 September 2010 2010/631/EU: concerning the conclusion, on behalf of the European Union, of the Protocol on Integrated Coastal Zone Management in the Mediterranean to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean.
- EC, 2014a. Integrated Coastal Management- What is it about?, http://ec.europa.eu/environment/iczm/home.htm (11/7/2014).
- EC, 2014b. Council confirms deal on maritime spatial planning, press release, http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/EN/genaff/141450.pdf (15/7/2014).
- ESPON (2011α), European Perspective on Specific Types of Territories, Interim Report, ESPON & University of Geneva, http://www.espon.eu/export/sites/default/Documents/Projects/AppliedResearch/GEOSPECS/2013-1-12_-_Inception_Report_xGEOSPECSx.pdf (25/2/2014).
- Hellenic Republic, 2002. Ministry for the Environment, Physical Planning and Public Works, "National Strategy for Sustainable Development, Greece", found at http://www.minenv.gr/4/41/g4110/00/NSSD-english-final.pdf (18/7/2014).
- Gopnik M., Fieseler C., Cantral, L., McClellan K., Pendleton L., Crowder L., 2012. Coming to the table: Early stakeholder engagement in marine spatial planning. *Marine Policy*, 36(5), pp.1139–1149.
- Karanikolas N., Kyriakou, K., Sourianos, E., Vagiona, D. (2011). Offshore Wind Power in Europe: Perspectives of development in Greece. 12th International Conference on Environmental Science and Technology(CEST), Rhodes island, p.851-858
- Kyriakou, K. and Sourianos, E., (2011). Perspectives and possibilities of sustainable development: The case-study of Rhodes Island. Diploma Thesis. School of Spatial Planning and Development, Faculty of Engineering, Aristotle University of Thessaloniki
- Kyriakou, K., Sourianos, E., Vagiona, D. (2011). Perspectives of sustainable development in Rhodes Island, Greece. 3rd International Conference on Environmental Management, Engineering, Planning and Economics (Cemepe) 2011. Skiathos.
- Kyriakou, K., Sourianos, E., Vagiona, D. (2011). Tourism development and carrying capacity in the Rhodes Island, Greece. 3rd International Conference on Environmental Management, Engineering, Planning and Economics (Cemepe) 2011. Skiathos.
- Lamelas M.T., Marinoni O., Hoppe A., Riva J. (2007). Suitability analysis for sand and gravel extraction site location in the context of a sustainable development in the surroundings of Zaragoza (Spain). *Environmental Geology*, 55(8), pp.1673–1686.

- Melvin Al. (2012). Decision-Making using the Analytic Hierarchy Process (AHP) and SAS/IML. SouthEast SAS Users Group (SESUG), Baltimore
- National Statistical Service of Greece
- National Oceanic and Atmospheric Administration (NOAA), 2014. What is Coastal and Marine Spatial Planning?, http://www.cmsp.noaa.gov/ (18/7/2014).
- Papatheochari I, Coccossis C., 2009. Reformation beachfront in Mediterranean cities compared to the integrated management of coastal zones, proceedings of the 2nd National Conference of Urban Planning & Regional Development, 1st Edition University of Thessaly, Volos.
- Parlement Europeen, Resolution sur les problemes des regions insulaires de l' Union Europeenne, A4-0118/98
- Ritchie H, Ellis G. 2010. A system that works for the sea? Exploring stake-holder engagement in marine spatial planning, Journal of Environmental Planning and Management, 53, pp.701–23.
- Spilanis I. (1995) Tourism development in Lesbos exploiting cultural and natural resourse. In conference of Tourism and environment in insular prefectures" Cyprus
- Spilanis I., Akrivopoulou I., Gakis K., Michailidis G. and Niarxos Ath., 2011. Kallikratis at islands, Hellenic Agency for local development and local government Islands.
- United Nations, 2011. Review of United Nations system support to Small Island Developing States, http://www.un.org/esa/dsd/dsd_aofw_sids/sids_documents.shtml (13/03/2014).
- World Commission on Environment and Development, 1987.Our Common Future, Report of the World Commission on Environment and Development.
- Wolff P., 2003. EU Member State experiences with sustainable development indicators, Eurostat.