NATURAL RESOURCES MANAGEMENT IN THE CYCLADES ISLANDS IN GREECE AND EUROPEAN POLICIES

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Abstract - Cycladic islands sustain significant natural resources, which have attracted many human activities in both the land and marine environments. Today, these islands have a great tourist interest and some of them have been global destinations. This has a result in natural resources being under high pressure and threat of degradation. The present study initially refers to the natural resources of the Cycladic islands and then refers to the problems that are caused by human activities, at land uses, at infrastructure, at tourism development, at energy, at policies and measures that have been taken for protection and management of natural resources. The survey also, focuses on the role of European policies through the directives on the sustainable management of natural resources and the development of islands. To carry out the survey, statistical data, geographic data and law texts were used at national and European level. The survey has shown that the existing measures for the protection and management of natural resources are not sufficient, but new policies and measures are should be taken for a better marine spatial planning aimed at the sustainability of island areas.

Keywords - Natural Resources Management, European Union Policies, Cyclades Islands, Tourism, Coastal Area.

I. INTRODUCTION

The European Union has estimated the great importance of maritime areas and coasts for prosperity and economic growth. Marine areas are climate regulators and a source of energy and food, while the coasts are ideal for entertainment and housing. This accumulation of residents at coast areas from one point of view it has led to the tourist development of the areas, but on the other it has created land-use conflicts, resulting in the degradation of the environment in the coastal areas. To face these problems, the European Union has adopted various policies such as:

In 2002 the European Union implemented an integrated coastal management policy [1]. Then, in 2005, it adopted a Marine Strategy [2].

In 2007, the European Commission proposed an integrated maritime policy for the European Union within a framework of maritime governance. Thus, it called on Member States to develop integrated national coastal policies in cooperation with stakeholders. It emphasized that spatial planning is on land-based and does not address the impact of coastal development on the sea and vice versa. Thus, a maritime spatial planning that takes into account the maritime transport, the aquaculture, the fishing, recreational marine activities and the use of energy resources is required [3].

In 2008 the Commission of the European Communities issued a Roadmap for Maritime Spatial Planning and Common Principles in the EU which targets to the developing of one Integrated Maritime Policy [4].

In 2009, it adopted a Maritime Policy for better coastal zone governance [5].

In 2010, the EU adopts a Communication on 'Maritime Spatial Planning in the EU on achievements and future developments', which sets out guidelines for Member States that must follow in order to have a common approach to the themes [6].

In 2013, the EU adopts a directive on the "establishment of a framework for spatial planning and integrated coastal zone management". Accordingly, the objective is to promote the sustainable use of coastal resources and the sustainable development of coastal economies (land and sea) [7].

In 2014, the Member States were called to set up and implement the monitoring programs under the Marine Strategy Framework Directive. Monitoring activities focus on assessing of the environmental status of Member States' marine waters and the impact of human activities (eutrophication, marine litter, solid and liquid waste management, and other), because monitoring programs are not always sufficient to ensure monitoring of the state of EU marine waters, consequently a further coordination among Member States is needed, notably through actions at regional and local level [8].

In general, many policies are involved in managing the coastal environment of the islands. Such as urban policies, policies for water, solid waste and waste management, management of the cultural environment, agricultural production, tourism development, maritime transport, air spatial planning, the development of renewable energy sources, for the management of the marine ecosystem and others. In general, coastal management requires a multiscientific approach at local, regional, national and European level as it will be discussed below in the case study of the Cyclades.

II. METHODOLOGY

The survey initially refers to the European Union's effort to manage the coastal area through the development of various policies. Then it focuses on a complex of Greek islands, the Cyclades, where each

island has its own characteristics and physiognomy. It refers to the problems of degradation of natural resources due to human activities and to the interactions between land and sea. Thus, it focuses on land uses, tourism development, renewable natural resources and management measures. Statistical data, a survey in situ, geographic data and legislative texts have been used to carry out this survey.

III. CASE STUDY

A. Cycladic Islands

The Greek island coastal area has particular features, with the long coastline and many islands. The Cycladic islands are located in the southern Aegean Sea and present unique features in relation with the other islands (Fig. 1). The name was given because of the circular layout around the island of Delos. The island complex consists of about 220 islands. The most important islands are, Amorgos, Anafi, Andros, Antiparos, Delos, Ios, Kea, Kimolos, Kythnos, Milos, Mykonos, Naxos, Paros, Folegandros, Serifos, Sifnos, Sikinos, Syros, Tinos, and Thera or Santorini.

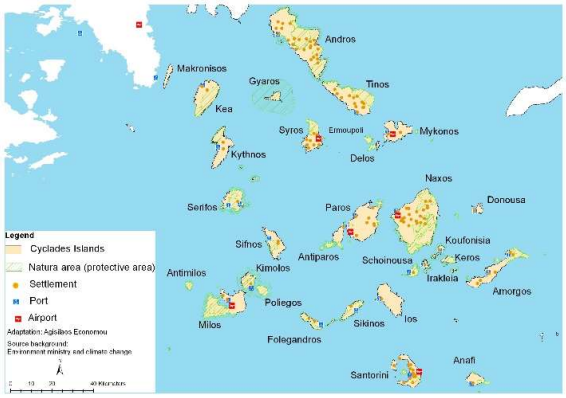


Fig. 1. Cyclades Islands.

B. Natural resources

The Cyclades area has remarkable natural resources for example, coasts, forest ecosystems, bare landscapes, areas of particular natural beauty, caves, marble quarries, remarkable benthic ecosystems (Fig 1.).

It also has renewable energy sources such as the high wind potential (Andros, Mykonos, Tinos, Naxos) (average annual wind speed 6-10 m/sec) [9], the great sunshine for all islands and geothermal fields (Milos, South of Santorini).

It also has valuable cultural resources such as historical monuments, archaeological sites and historical place.

C. Particular features of Cycladic islands

Cycladic islands have special characteristics such as traditional white settlements, variety of landscapes, coasts and good climatic conditions (In the area of Naxos, the minimum monthly temperature is 9.3 oC in January, the average maximum temperature reaches at 26.9 in July, the average monthly rainfall reaches 70.3 mm in February and the area has 266 days / year sunshine) [10].

Apart from the common features that the islands have, they also have particular local features which make them unique. For example, Delos is known for the archaeological site and the best place for space acoustics. Mykonos is known as the island of the winds, with the most beautiful beaches, the cycladic architecture and landscapes.

Santorini is known for the unique landscapes, the volcanic rocks, the amazing sunsets, the view and the traditional settlement. Naxos is known for the steep slopes and natural beauties (landscapes). Paros is characterized by many traditional settlements, beaches, marble quarries and landscapes (Fig.2a, 2d).

Ios is known as the island of Homer, for the traditional settlement and the beaches. Syros is known for the traditional settlement of Ano Syros and the unique neoclassical architectural heritage of Ermoupolis (Fig.2b). It is also the birthplace of Ferekidis (Teacher of Pythagora) and the capital of the periphery of Cyclades.

Tinos as one of the country's largest religious pilgrimages (Virgin Mary's Pilgrimage), and sculpture museums. Milos has beautiful beaches and beautiful landscapes of natural beauty (Fig.2f). Andros is known with its steep slopes (Fig.2c), its winds, rich vegetation and watering. Kythnos is known for the hot springs. Anafi for the natural beaches and the crystal clear waters.

Kimolos is a volcanic island with a variety of colors and beautiful beaches. Koufonisia are known for the huge caves. Kea or Tzia is famous for the landscapes, secluded beaches and many water springs. Amorgos has climbing landscapes, steep coasts, hills and mountain slopes with terraces.

Serifos has sandy beaches, landscapes and white villages. Antiparos has a Cave. The Sikinos has terraced landscape, stone walls and the beaches. While Sifnos, Iraklia, Schinoussa and Donousa are smaller islands with excellent beaches and small tourist activity.

The area of the Cycladic islands is ideal for recreation, relaxation, fun and cultural education. There are plenty of water activities such as water skiing, diving, fishing and more. Some islands are famous for their nightlife, such as Mykonos, the sunset enjoyment such as the Oia area of Santorini, the Caldera view of Santorini (Fig.2e), the volcanic scenery in the area of Santorini and others.

To sum up, every island has a special physiognomy, which makes it unique in relation with the other islands.

The beauty of the Cycladic islands is such that many Hollywood stars visit the islands and some of them have also acquired homes (Madonna and Tom Hanks in the Antiparos area).

The beauty and a specific characteristic of the islands is enhanced by the special culinary pleasures, the traditional products, the music, and the odorous landscape (the strong aromas of the aromatic plants

D. Tourism development

The areas that have presented great tourist development in the Cyclades are the areas of Mykono, Parikia of Paros, Caldera and Oia of Santorini. These islands are the most cosmopolitan [11]. In the summer months, the population exceeds the carrying capacity of the islands. The rest of the islands have lower tourist development (Table 1).



a.Paros (Kolymbithres) (Source: Personal file)



b. Siros (Source: Personal file)



c. Andros (Source: Personal file)



d. Paros (Naoussa) (Source: Personal file)



e. Santorini (Caldera) (Source: Personal file)



f. Milos (Sarakiniko) [15]

Fig.2. Cycladic islands

The most important islands are, Amorgos, Anafi, Andros, Antiparos, Delos, Ios, Kea, Kimolos, Kythnos, Milos, Mykonos, Naxos, Paros, Folegandros, Serifos, Sifnos, Sikinos, Syros, Tinos, and Thera or Santorini.

Islands	2010	2011	2012	2013	2014	2015	2016	2017	2018
Mykonos	649145	691375	625153	739479	867431	860295	1020448	1254054	127751
Thera or Santorini and Anafis	398751	454779	395544	510705	595387	657281	584424	622726	74776
Paros	315488	298043	224628	259761	324221	305650	300954	359066	39512
Naxos and small cyclades	66614	79605	72824	90109	133717	162028	156713	175906	17403
Siros	79014	76473	55025	72847	78482	91986	99263	107199	10972
Tinos	114874	96517	92056	101304	103188	112388	87159	100230	11063
Ios	64984	65832	58100	59169	68346	84814	84025	85652	7837
Andros	58711	54897	43423	47180	57287	59506	73813	86426	8495
Milos and Kimolos	37464	43031	35484	41936	46950	46817	53571	38033	3875
Sifnos	21969	21602	17425	19449	23458	26229	30540	27148	818
Folegandros and Sikinos	18074	16285	13772	15166	16780	16554	16525	14511	1877
Kythnos and Kea	10397	8288	6054	6239	6763	7232	13937	15184	1525
Serifos	7621	8608	7059	7870	9032	9932	10772	9020	818
Antiparos	9330	9176	7074	8021	9030	8824	8424	9798	1007
Amorgos	3577	3949	4277	5957	6631	7242	7917	9281	937
Total	**1856013**	**1928460**	**1657898**	**1985192**	**2346703**	**2456778**	**2548485**	**2914234**	**308675**

Table 1. Number of overnights in the area of Cyclades [13].

Generally, in all islands of the Cyclades, tourist activities are the main activity of the residents, which contributes to the economic development of the area.
Tourism development is expected to be further enhanced by the new spatial framework for tourism development, where it encourages coastal development [14].
The transport of tourists and residents is carried out by ports and airports. The islands that have an airport are Mykonos, Syros, Paros, Naxos, Milos and Santorini (Fig. 1). The rest of the islands use sea transport.

IV. RESULTS AND DISCUSSION

A. Pollution problems in the island area.

This valuable natural and cultural environment attracts human activities that press natural resources (aquifer, forests, mineral wealth, agricultural land, and other) and threaten them with degradation.
The most important impact of human activities is the pollution of coastal area in the marine environment, water recipients and protected areas.
The pressures on the island are:
Natural resources

- Marine pollution from uncontrolled and semi-controlled disposal of waste and from sewage from settlements and hotel units due to the lack of sewerage networks and sewage treatment plants [15].
- Coastal waters are further degraded due to the pollution of ships' liquid wastes (oil, gasoline, and other) when the safety rules under the Common Fisheries Policy for the use of fishing vessels are not applied [15].
- The great movement of maritime transport causes air pollution in the marine area.
- Protected areas (coasts, wetlands, lakes, forests) are under pressure from the construction of coastal roads, harbors and holiday homes along the beaches.
- The depletion of water resources (aquifer). In many areas, over-pumping of groundwater to cover local human needs and irrigation needs has resulted to a drop of the aquifer and an increase the risk of degradation of water quality and soil productivity by salinisation, such as example in the area of Santorini.
- The areas of Cycladic islands with mining activity (aggregate quarries and marble quarries) are Milos, Kimolos, Paros, Naxos and Tinos. This activity creates problems of pollution and degradation of the coastal area and requires the restoration of the affected area [15].

B. Other effects

On some islands, tourism development has been monoculture, which has led to a degradation of productive sectors in agriculture. Also, the great tourist activity during the summer months on some islands exceeds the island's carrying capacity. As a result, natural resources are insufficient to maintain a great number of tourists.
This great tourist movement must be accompanied by equal sewage treatment plants. Some areas do not have biological treatment plants, resulting to a burden on the marine environment.
Also, many areas have been affected by chlorine pools when there is no good management and protection, and many marine organisms are threatened.
The islands of Mykonos and Santorini have great tourist development, as a result the impact of tourism is more visible. This revenue source has increased employment in the Tertiary sector and has contributed to the housing development of the areas. Thus, new tourist units have been developed in order to receive tourists. Tourism demand increases the need for natural resources and housing. This results to a great pressure for further building.
Some islands have not sufficient specializing of land uses, so many spatial problems have appeared.
In many islands, there are local spatial plans to regulate land uses that cover only a small part of the area and not the entire island.
On the contrary, the island of Ios, has developed an spatial plan for land uses for the whole island, which, apart from the regulation of land uses and protection of the environment, focuses on protecting the island's physiognomy (historical place, archaeological sites, settlements, cultural monuments) as well as the regulations for the protection of the marine environment
Generally, in the islands, there is not a general framework for maritime spatial planning.

C. Fishing

Coastal fishing is an important activity in the coastal area. In the islands with a small tourist period and small farming and livestock farming, the financial support of the areas is largely based on the development of the fisheries sector.
However, there are a number of factors that create problems for the development of the fishing industry, such as the lack of delimited fishing grounds, the slow pace of fleet modernization, overfishing of many areas and the use of illegal methods. All this, has a result into the degradation of the fauna of the marine ecosystems [15].
Coastal fishing is also degraded by the degradation of coastal waters of various factors that have been mentioned above (urban waste water, agro-livestock units, matter that are transfer by torrents and end up in the coastal area).

D. Response measures

Many areas of the Cyclades are today under a protection status, such as, natura areas, areas of particular natural beauty, areas with remarkable benthic ecosystems, marine fauna and other.
To address the above problems, various measures have been taken, such as:

- Creation of biological treatment units for the treatment of sewage from settlements.
- Construction of landfill sites on the Paros area for

the picking and burial of solid waste.
- Defining protection zones for areas with significant natural ecosystems.
- Defining protection zones for archaeological sites and cultural monuments.
- Defining the rules of building and regulation of land use for the protection of architectural heritage and traditional settlements.

From the survey in situ found that:
- All settlements have not biological treatment plants, this results to a source of pollution for the marine environment.
- Many areas of the islands although present remarkable terrestrial and marine ecosystems, do not belong to any protective status.
- There is a conflict of land use between tourism activity and the development of renewable energy sources (aeolian parks).
- There are problems with the specializing of landfills on the islands due to their small size and many of them carry their waste to landfill sites in Attica, thus increasing management costs.
- Many areas do not have land use plans at all, resulting in increasing human activity intensity and land uses conflict. This leads to the degradation of the environment and the quality of life of residents and tourists.

Areas have different impacts depending on the culture of tourists. For example, on the island of Ios there are tourists both form Italy and Scandinavian countries, on Mykonos foreign tourism is prevailed while on Paros, Syros and Tinos domestic tourism prevails, lately there is an increase in the tourist traffic of Asian tourists in the area of Santorini.

E. Proposal
- The Cyclades' islands are in need of new policies for coastal area management. Specifically:
- Integration of areas with significant ecosystems into a protected status.
- Spatial planning for all areas, taking into account the specific characteristics of each area and the carrying capacity.
- Construction of new biological treatment plants for waste treatment for settlements that have no one.
- New measures to avoid increasing building.
- New measures for fisheries and the protection of marine biodiversity.
- New measures for the exploitation of mineral resources and the exploitation of renewable energy sources.

V. CONCLUSION

The European Union has issued many Directives concerning the protection of the environment and its sustainable development.

The European policy for islands, has a target and the development of other activities as well as tourism.

In recent years, the European Union has been promoting the design of maritime spatial planning, while have been conceited of great interest to the protection of natural and man-made resources, and their preservation and exploitation.

The Cycladic area has remarkable natural and cultural resources, which are currently threatened by degradation due to the intensity of human activities and conflicts of land use.

Major tourism development has brought significant benefits to the local community, while it has degraded natural resources to some extent.

The protection of natural resources is essential to preserve not only tourism but also businesses that support tourism businesses.

The region has significant wind potential and great sunshine, which fosters the development of renewable energy sources. Many benefits can also be derived from the proper exploitation of energy potential both island of Milos and Santorini.

In general, the policies implemented so far have contributed to the development of the islands, but in many areas the non-implementation of urban and spatial plans has increased the problems.

The new guidelines of the European Directives constitute the preparation of a new framework for maritime spatial planning and the protection of natural resources, which is necessary for the sustainability of areas and the further protection of natural resources.

New projects and policies must include measures, which have to do with the specific characteristics of each area, carrying capacity, growth potential as well as the prospects for their apply.

According to the above, it is found that coastal area governance has many components and its management demands the involvement of many scientific areas as well as the active participation of both local authorities and residents

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