Pollution and Other Anthropogenic Pressures Affecting Ecosystems

Alexandroupoli
& Samothraki scale,
Greece scale

ENI CBCMED
Cooperating across borders in the Mediterranean

Project funded by the EUROPEAN UNION

REGIONE AUTÒNOMA DE SARDIGNA
REGIONE AUTONOMA DELLA SARDEGNA

Co-Evolve4BG

Analysis of Threats and Enabling Factors for Sustainable Tourism at Pilot Scale

Pollution and other Anthropogenic Pressures Affecting Ecosystems Alexandroupoli & Samothraki scale,

Greece scale

REGION OF
EASTERN MACEDONIA & THRACE

Union for the Mediterranean
Union pour la Méditerranée
الاتحاد من أجل المتوسط

CPMR
CRPM

OVERVIEW

The present document was produced in the framework of **Co-Evolve4BG** project "*Co-evolution of coastal human activities & Med natural systems for sustainable tourism & Blue Growth in the Mediterranean*" in relation to Threats and Enabling Factors for maritime and coastal tourism development on a national scale" Co-funded by ENI CBC Med Program (Grant Agreement A_B.4.4_0075).

This document consists of the **Deliverable 3.1.1.19** (Pollution and other Anthropogenic Pressures Affecting Ecosystems – Alexandroupoli & Samothraki scale, Greece scale) of the **Activity 3.1.2** (Threats and Enabling Factors at local scale: Pilot Areas analysis) under the **Output 3.1** (Integrated analysis of Threats and Enabling Factors for sustainable tourism at MED scale) of the project.

REVIEW

Contributors

Eirini ARGYROPOULOU, Engineer

Region of Eastern Macedonia & Thrace (REMTH), Greece

Reviewers

Samah AKRICHE, PhD

University of Carthage, Faculty of Sciences of Bizerte, Tunisia

Dimitris KOKKINOS, PhD

Region of Eastern Macedonia & Thrace (REMTH), Greece

Maria CHAMITIDOU, Engineer

Region of Eastern Macedonia & Thrace (REMTH), Greece

Nahed MSAYLEB, PhD

Lebanese University, Faculty of Agriculture and Veterinary Sciences, Lebanon

Artemis TSOLAKI, ??

REMTH – Head of Department of Development Planning, Greece

Supervisors

Bechir BEJAOUI, PhD

National Institute of Marine Sciences and Technologies, Tunisia

Paraskevi CHOURIDOU, MSc

REMTH – Ex-Head of Department of Development Planning, Greece

Spyros ARSENION

REMTH – Head of Department of Development Planning, Greece

LAYOUT

Khouloud ATHIMEN, Engineer, Technical Coordinator

National Institute of Marine Sciences and Technologies, Tunisia

Houaida BOUALI, Engineer

National Institute of Marine Sciences and Technologies, Tunisia

Mohamed Ali BRIKI, Engineer

Coastal Protection and Planning Agency, Tunisia

Index

List of figures

List of tables

Abstract

The present deliverable aims at describing and studying the current situation taking into consideration pollution impact and all the predictable threats that are putting both environment and public health at stake. The focus will be put on the coastal zone of the 2 sub-areas of Pilot Area 2 of Co-Evolve4BG, namely Alexandropoulos and Samothraki located in the Region of Eastern Macedonia and Thrace, in Greece.

At the same time, the current report describes the best practices for pollution reduction and/or landscape restoration while examining the impacts of TOURIST flows within the framework of sustainable development and blue growth.

I. Introduction

Pollution has become today one of the most important global concerns. In fact, it represents a real threat menacing, directly or indirectly, all types of ecosystems and affects human activities as well. Sea water pollution for example may have negative effects on soil, on coastal/maritime areas with final recipient the residents. Pollution has severely impacted many other areas such as the economy, health, animals, and nature in general.

Sea water pollution is due to oil spills, tourism, erosion, and many other factors which may differ from region to region. In the Pilot Area of Alexandropoulos, the factors that can cause pollution to differ from that of the Pilot Area of Samothraki.

Nowadays, developing strategic tourism approaches and plans should necessarily consider economic, social, and environmental conditions as crucial interrelated components for the achievement of national objectives in containing pollution and developing tourism. In fact, Sustainable tourism development is accepted as a concept by most tourism planners. It must incorporate economic, sociological, cultural, and political aspects with environmental protection, the social and cultural identity, and the quality of life of the local community. Many different approaches have been developed over the years regarding tourism planning. Most of them rely on the idea/concept of sustainability. However, the sustainable approach to tourism planning depends on stakeholders' participation in the tourism planning process as well as the funding and implementation of the strategic planning[1].

Blue economy can help reduce infection and at the same time improve the standard of living.

Protection solutions are examined in the coastal areas of Pilot Areas of Alexandropoulos and Samothraki for different types of ecosystems.

1 Strategic Planning for Local Tourism Destinations: An Analysis of Tourism. Available from: https://www.researchgate.net/publication/37617335_Strategic_Planning_for_Local_Tourism_Destinations_An_Analysis_of_Tourism [accessed Jul 16 2021].

II. Environmental challenges and pollution impacts in Alexandropoulos and Samothraki,

II.1. Main causes of pollution

The most significant threats that are noted for Eastern Macedonia and Thrace – REMTH and especially the Pilot Areas of Alexandropoulos and Samothraki are mainly: flood risk, as well as health, safety risks, and coastal areas threats. Pollution is the most threatening factor which has an adverse effect on sustainable tourism. In fact, many different factors are involved such as: irresponsible human activities play a significant role in changing the environmental conditions through the natural resources over-exploitation and depletion, as well as various wastes and gasesemission (gases, liquids and solids) in the natural habitat (http://estia.hua.gr). Besides, the air pollution is mainly caused by the increasing road traffic, while the sea pollution is the outcome of waste and solid waste released from tourist boats in addition to the pollution emanating from the increasing solid waste quantities that are dumped both into the sea and land. Moreover, seaside saturation is caused chiefly by the overconcentration of buildings and mass human activities. Furthermore, there is also an emerging noise pollution due to mass networks and receptors installation in summer specifically because of Tourism seasonal aspect. It is also worth mentioning that there is an optical pollution due to landscapes alteration caused by the fact of responding to tourists' needs in terms of facilities and amenities by achieving several projects that generally contribute to natural views deterioration. Indeed, the radical land use changes, together with the settlement network deterioration bring about a decay at the old settlements, especially the traditional ones. In fact, the indirect damage of the natural and cultural inheritance caused by tourists' extravagant numbers, together with the frequent erosion resulting from the degradation of traditional activities have all entailed a devastating impact on the surrounding.

- The main causes of pollution in coastal zones are:
- Oil spillage from tankers (wastes of boats)
- Tourism
- Overgrazing (at Samothraki)
- Biomass
- Urban wastes
- Fertilizers from farming cultivation
- Air pollution
- Water pollution (urban solid waste, industrial liquid wastes, farming liquid waste, livestock liquid wastes, seawater intrusion, acid rain due to air pollution)
- The wastes of the port
- Over – pumping of water(salination)

At the pilot area of Alexandropoulos human activities have severely affected the environment due to unsustainable tourism, urban wastes, fertilizers and pesticides overuse and water irresponsible consumption, together with oil spills and wastes dumping into the sea, as well as the wastes produced by the local hospitals, which most of the time, end up into the sea, all the above have contributed devastatingly to worsening situation.

At Samothraki pilot area, the most serious issue is triggered by goats overgrazing while at the same time problems occur due to tankers and water pollution.

II.2. Sea water pollution

Marine pollution is considered as a direct and indirect human substance and energy disposal at the maritime environment, including the estuaries, which may as a result trigger harmful repercussions or damage biological resources and marine life. Hence, causing dangers to human health, the marine activities impairment, including fishing and other illegal sea use, downgrading sea water quality and deteriorating the coast.

II.2.1. Sea water pollution and oil spillages

Usually, during oil ship unloading, a possible equipment breakdown or malfunction, as well as human errors, or extreme natural events (such as earthquakes, typhoons, storms *etc.*) can create oil spillage that can pollute and spoil the whole marine environment. The consequences of these accidents on the environment are extremely serious and sometimes even fatal, when they occur near the coast, at shallow waters, or in territories with very poor renewable water.

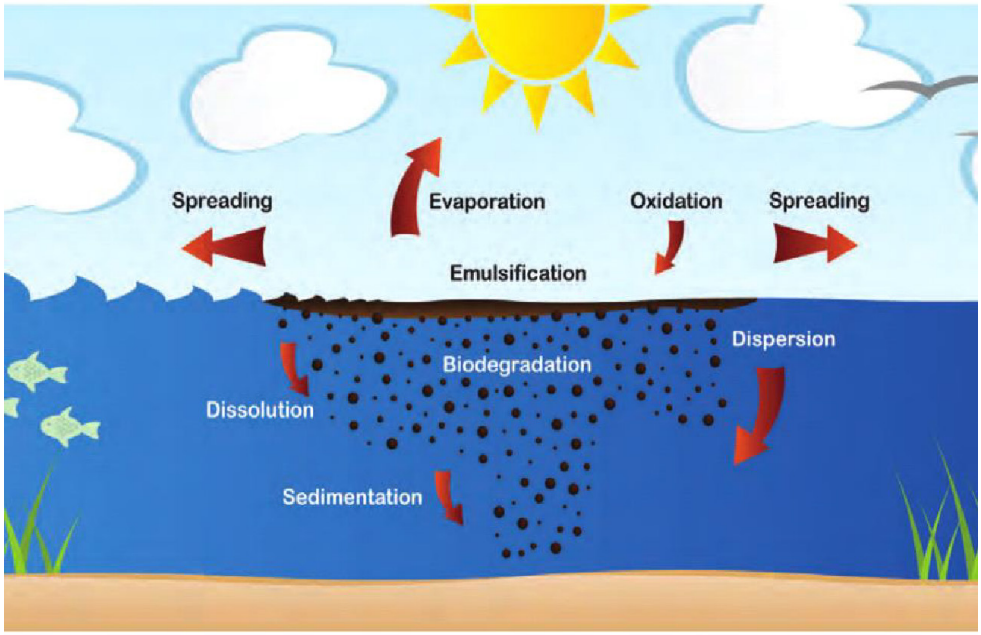


Figure 1. The behavior of oil at sea

Accidents during sea transport.

The main causes that lead to accidents due to the enormous oil spillage are the stranding of tankers at shallow waters, the crash of the tankers with other ships, fire, and explosions of the carrying load.

Figure 2. Cargo ship AbQaiq

Possible negative effects on the marine flora and fauna are related to:

- Oil waste from small amounts of oil leakage that occurs during the transportation and the cargo ships loading as well as from some processed liquid waste that comes from oil tankers residue and are in their turn released at the bay of Alexandropoulos (unless they are used only by double bottom ships).
- At the wider area it is expected to trace an increase of pollution related to the chemical compounds that derive from the paint of the ships such as PCB'S, EP and PUR.
- A probable oil leakage in the wider area will be very harmful to the marine flora and fauna and it is plausible that they will expand in the nearby area the nearby area the river Evros' delta, depending on the quantity, the type of oil and the conditions of the area.

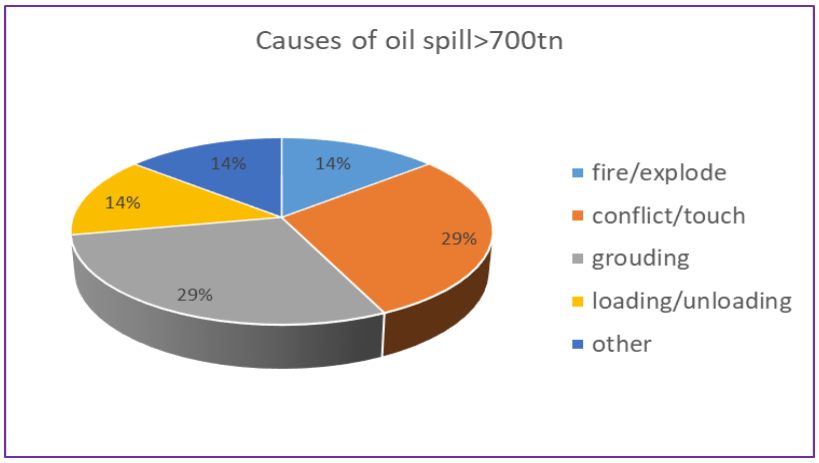


Figure 3. Causes of oil spillage at the Aegean Sea >700 t (1977-2003)

Alexandropoulos coastline is a low lying, long straight, shallow, sandy coastal zone. Especially the eastern side towards the river Evros' delta, is at its full length a low energy shoreline, because it is sheltered from large waves and long period waves, due to the presence of Imvros, Samothraki and Thassos islands. In such an environment any possible oil spillage could rapidly expand and pollute the coastal ecosystem. In the Pilot Areas, it would be very difficult to be limited or even eliminated.

Oil spillage and sea water pollution in the Pilot Alexandropoulos seaside regions (and the river Evros' delta) as well as in the Pilot Samothraki area, usually lead to a devastating situation that can be too difficult to overcome.

II.2.2. Sea water pollution from Tourism

Alexandropoulos and Samothraki are TOURIST locations. As it is known Tourism usually is regarded as an environmental pollution factor that can severely impact the surrounding if strategic and solid planning is not planned effectively. In the two Pilot Areas, various forms of tourism are developed such as religious, spa, leisure *etc.* If there is no legislation and control, all forms of tourism can lead to pollution in the areas where they are developed.

II.3. Erosion and desertification

One of the most serious issues that Samothrak is facing today is soil erosion. Erosion is defined as soil removal caused by the wind or the water (wind and water erosion) or due to irresponsible human activities. Erosion is related to the following: the superficial plant coverage amount, the type of vegetation, the ground inclination, the water amount absorbed by the soil and the tension as well as the rainfall duration. The area denuded from its vegetation and the progressive rainfall decrease contributes to the tread's formation on the ground. Therefore, a natural drainage system is created which leads to further soil degradation through sediments.

Apart from all the above reasons, irresponsible human activities have also triggered erosion. In fact, turning forests into cultivable land and fields into pastures has accelerated the natural erosion frequency (García-Ruiz, 2013).

Figure 4. Soil Erosion[2]

2 . Retrieved from http://econews.gr/

Besides, another important reason for erosion is related to overgrazing which represents a huge problem for the island by destroying both the valuable ecosystem biodiversity and its balance. The ancient forest does not regenerate because all plants that grow in the area are being destroyed by the non-controlled the overpopulated goats grazing. Some Other Factors That have intensified Soil erosion are the following: forest fires, water pollution, solid waste and illegal logging, and poor management.

Soil erosion causes the ground inability to restrain pollutants, which pass through streams and end up in the island coasts and its marine ecosystem. Hence, affecting and poisoning both Alexandropoulos and its coastal areas, especially Samothraki.

II.3.1. Overgrazing – Pilot area of Samothraki

Most Samothraki's residents are employed in the primary sector (stock – farming, agriculture, and fishery), with stock farming which is the most significant economic activity on the island.

Samothraki soil erosion is directly related to overgrazing, which is caused by the existence of a higher-than-normal ratio of animals per surface unit. As a result, the land of Samothraki does not have the capacity to restrain this extra ratio and to supply it in a sustainable way. Hence, leading to a deterioration of the soil. Overgrazing is considered as the most significant factor of erosion on all islands (García-Ruiz, 2013). Moreover, the local municipality cannot install hedges in different areas due to the property regimes.

Over the Last Years, a more natural resource sustainable use is being adopted, for the maintenance of Thailand indigenous vegetation quality. On Samothraki Island Stock farming is a very ample activity, yet currently there are 50 – 60 thousand goats, which are used to produce goat meat and dairy products.

The island is covered by pastures (municipals, communal and private) at a percentage of 35.7%, while forests cover 33.2% of the total surface of Samothraki.

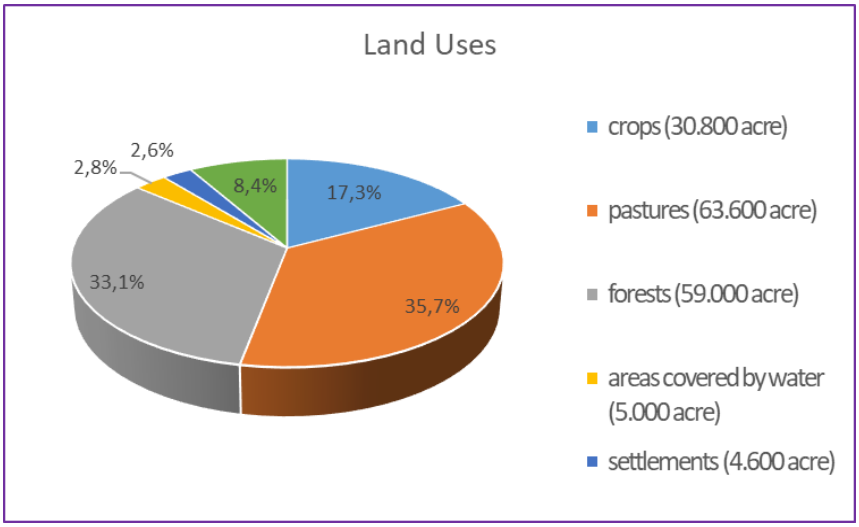


Figure 5. Percentage of land usage of Samothraki Island

Generally, 98% of the tree crops are olive tree products. In fact, olive trees cover an area of 9,000 acres. Besides, 88.37% of the arable land is covered by large crops, such as wheat, barley, maize, peas in livestock, vetch for hay, perennial cover, *etc.*, which are used as animal food with great demand in Samothraki.

Illegal logging and forest fires have also contributed to overgrazing in the Samothraki ecosystem forest.

According to the Network of Sustainable Islands "Dafni" and the Recognition Report, in 1997 by Forestry and Natural Environment School at Thessaloniki Aristotle University, a study was conducted on land usage which has been depicted in orthophoto maps. Moreover, the "pasture capacity study of the pastures of Samothraki", showed that in the Samothraki pastures the grazing pasture fraction capacity is 0.388 while the ideal result was near 1. Therefore, it is concluded there is intense pasture overgrazing.

II.3.2. Forest fires

Another significant issue in the wider area of Samothraki, is the phenomenon of forest fires, which has the maximum potential of moderating an ecosystem in a very small amount of time. Over the Last Decades, the number of forest fires has increased dramatically.

II.3.2.1. Forest fires – Pilot area of Samothraki

At Samothraki pilot area, the issue of forest fires is becoming more and more remarkable. Fortunately, these fires have not expanded largely thanks to the existence of torrents, broadleaved species and to the moist microclimates that are being created. However, overgrazing prevents their natural rebirth and ultimately prevents the woody vegetation restoration. At Samothraki, the fires occur mainly on the island's northern side. In fact, these fires destroy the broadleaves evergreens (especially *Arbutus* and *Calluna vulgaris*) and occur frequently in August and September. During these months, rapid fire spreading is highly possible due to the strong winds that blow regularly along with the increased summer temperatures. For instance, in the summer of 1999 there was a rapid fire spreading that took place in the area between Kamariotisa and Alonia where in 10 minutes an area of 5 km length and 2 km width reaped wheat, was burned[3].

II.3.2.2. Forest fires – Pilot area of Alexandropoulos

In Alexandropoulos the pilot area, fire outbreaks are a very frequent phenomenon, especially during the summer season. The winds that blow in combination with the existence of thick vegetation and the dry bushes branches create the ideal conditions for a fire outbreak. Furthermore, due to the wide area spread, a rapid and effective way of response is difficult. For that reason, to prevent fire outburst and its widespread, precautions should be taken annually such as cleaning private and public areas.

3 Retrieved from www.samothraki.com

II.3.3. Water pollution

Water pollution is also considered a very important environmental issue. In fact, it is defined as any physical or chemical characteristics alteration, which can lead to a significant disbalance of the natural habitat and consequently threaten the living species. Water pollution may derive from natural processes like volcanic activities, soil erosion *etc.* as well as from irresponsible human activities (households, farming or industrial). Moreover, the absence of a sewage disposal system, in addition to the inappropriate techniques that are being applied in agriculture and forestry are also among the major causes of water pollution.

II.3.3.1. Water pollution –Pilot area of Samothraki

The Hellenic Center of Marine Research (HCMR) in cooperation with the municipality of Samothraki, received several samples of water that were analyzed by a group of researchers from the Institution of Marine Biological Resources and Internal Waters (IMBRIW) of HCMR (2013 and 2014), the team has found that there is a medium ecological quality of the rivers in Ksiropotamos, Katsampas, Lakoma, Tsibdogiannis because of the non-processed household wastes that end up dumped in these waters. It has also been proved that stock – farming intensifies the applied pressures that the ecosystem must face due to the goats grazing.

With respect to the sewage disposal system, Samothraki uses cesspits to cover its needs. In fact, inside the island, the household sewage disposals are linked to the rainwater torrents which cause pollution and bad smelling. All the solid waste goes to Katsampa torrent and then, they travel long distances until they finally end up into the sea, so they get cleaned not only because of the long path they cross but also because of the liquid waste filtration to the inhabitant and the strong sea currents, which remove the solid waste from the shores.

II.3.3.2. Water pollution – Pilot area of Alexandropoulos

Quality checks are being performed in the pilot area of Alexandropoulos. Most of the households are connected to the wastewater treatment city plant, and then, they undergo the necessary process. The main remarkable issue of water pollution in the Alexandropoulos pilot area and especially in the Makri sub area is the salination caused by over pumping.

II.3.4. Management of the solid waste

Generally, the islands should overcome the issue of solid waste increasing production level as well as the economic and ecological problems. In fact, disposal sustainable management is time consuming, and it requires hard work.

Samothraki comes across with serious issues at the gathering and management of the solid waste, especially during the summer months when the mass increases due to tourist flows.

The solid waste area at Samothraki is located between Kamariotisa and the Monastery of St Athanasius. There was also a second solid waste disposal area operating in that region until 2009. When it was shut down, an uncontrollable solid waste dumping happened in torrents and in other areas. As a result, the island's environmental degradation worsened more and more, as well as the underground torrents and sea aquifer pollution. As a temporary solution, solid waste extraction and transfer towards the mainland took place. In fact, they are transferred to the disposal areas of Komotini and Alexandropoulos. The municipality of Samothraki has already launched preliminary research about the relocation of the island's dumping area.

At the pilot area of Alexandropoulos wastes tend to stack up at the solid waste dumping areas and thus, there is far more solid waste than it can be absorbed.

III. Identification of the most vulnerable coastal areas

The categories of Greek land's uses (45 in total) are described through the program Corine Land Cover (CLC). The basic classes of land usage in Greece are natural sites, artificial surfaces, agricultural areas, forest, and semi natural areas, burnt areas, wetlands, and water bodies.

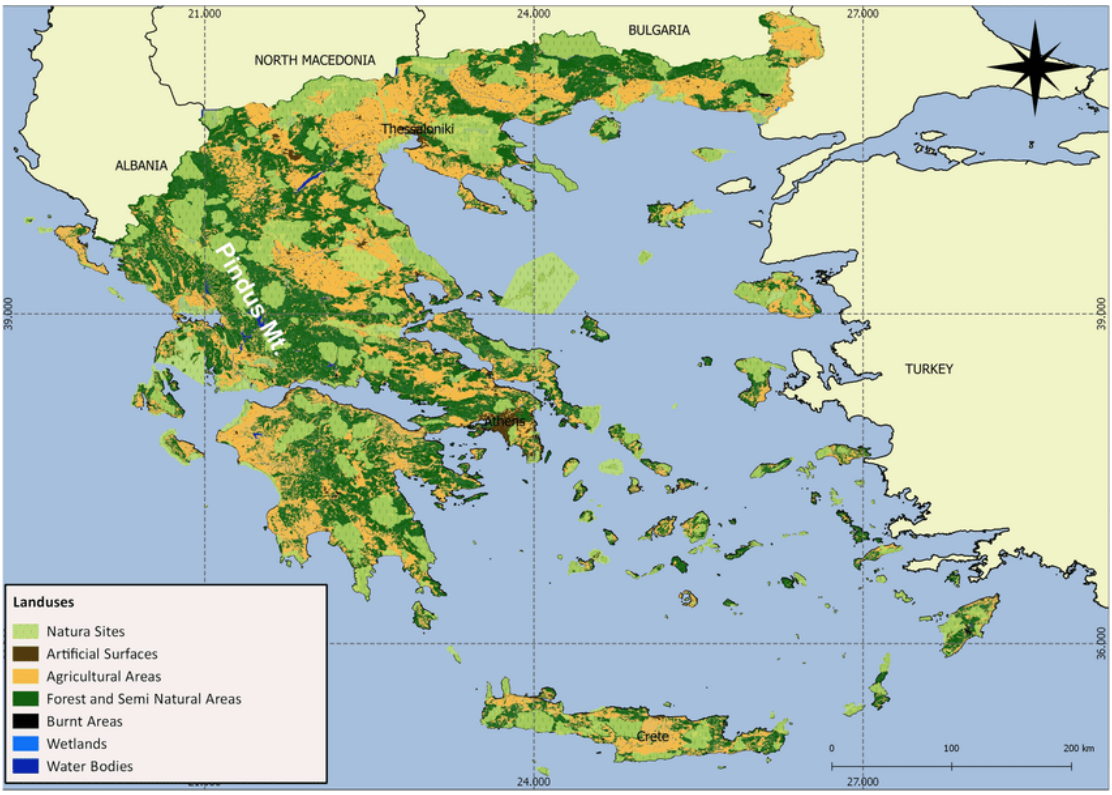


Figure 6. Land uses in Greece (Gemitzi A. *et al.* 2019)

III.1. Pilot Area of Alexandropoulos

The land usage of the municipality of Alexandropoulos is presented in Figure 7 and explained in its corresponding legend. The gates of entrance/exit of Alexandropoulos are the port, the Fishing Port of Makri and the State Airport of Alexandropoulos "Democritus" (7 km on the east side from the city). These gates and Evros' delta form the most vulnerable coastal areas.

According to the Urban Planning Alexandropoulos Municipality in July 2015, there was a boundary definition of the coasts and beaches at thirty-two (32) areas, across the coast side, inside the Municipality boundaries.

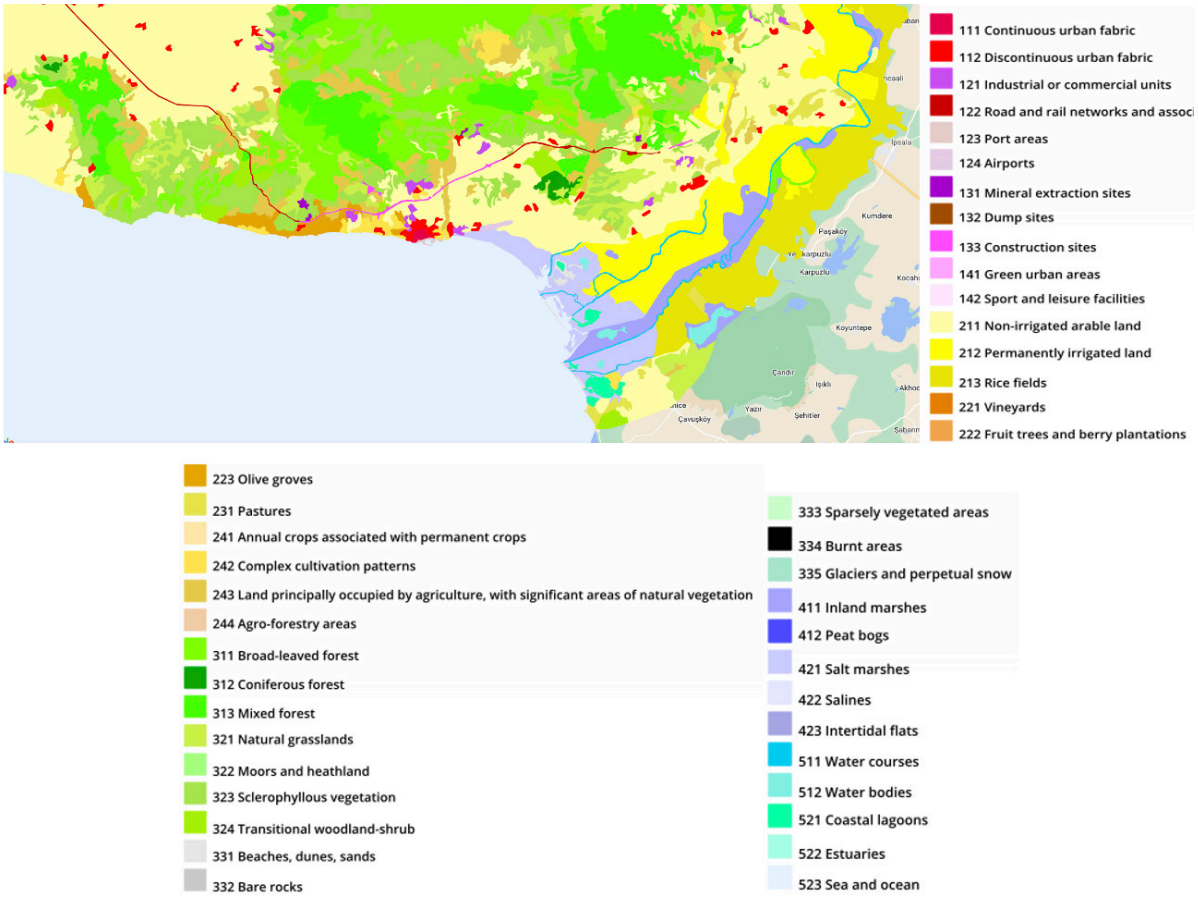


Figure 7. Land Uses via Corine 2000[4]

4 Retrieved from www.oikoskopio.gr

III.2. Pilot Area of Samothraki

Samothraki Municipality land usage can be seen in Figure 8, which is explained by the following legend.

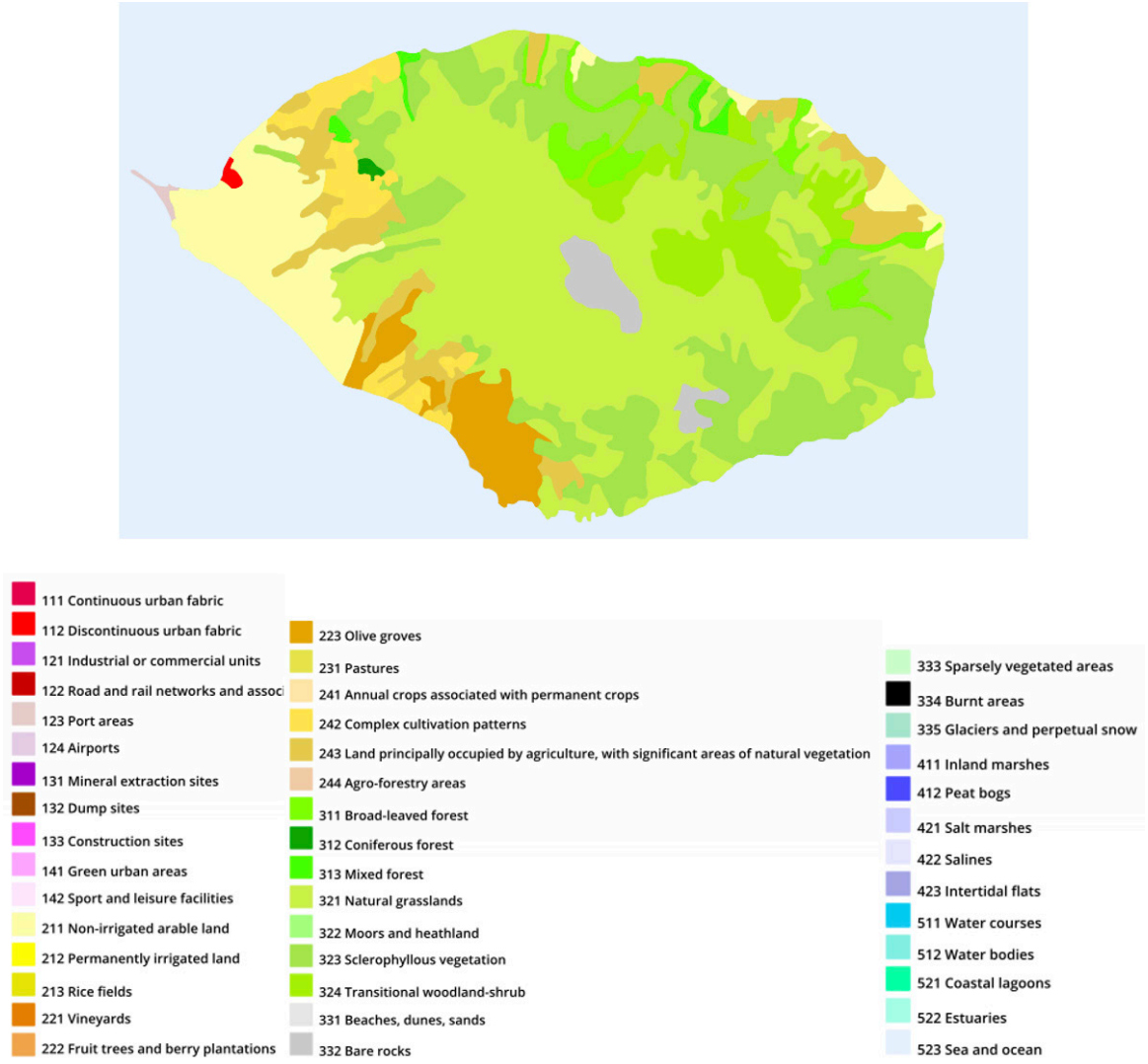


Figure 8. Land Uses via Corine 2000 (Samothraki) [4]

IV. Impacts of pollution at the ecosystems

IV.1. Types of ecosystems

An ecosystem is the basic ecological unit which consists of the natural habitat and the species that live in it. There are many types of ecosystems. The broad category of the ecosystem is mainly composed of two types – Terrestrial and Aquatic.

IV.2. Pilot Area of Alexandropoulos

The degradation threats to the natural resources at the targeted area could be either natural or human related.

- **Natural pressure – Dangers:**
- Natural disasters from fire outbreaks
- Natural disasters from floods at the local regions of Evros' river
- Coastal erosion
- Superficial, ground, and underground waters salinations.
- **Human related pressures – Dangers:**
- Pollution caused by stock – farming units' waste.
- Water over pumping at the seaside leads to salinization and it restricts the preservation of the flora and fauna due to less clean water.
- Evros' river pollution from urban and industrial wastes produced by Bulgaria, without being previously processed appropriately.
- Agricultural extension at the expanse of forestall areas and regions that are being protected.
- Overgrazing, or grazing at areas that are prohibited.
- Illegal hunting and logging.
- Renewable energy repercussions: Even though the consequences are less harmful than the conventional methods of producing energy, it is still remarkable that there is much more pressure towards the natural habitat and its species, such as the wind turbines, where most of the time, birds can crash.
- Fishes Scarcity due to overfishing.
- Fishing methods development has intensified the activity. Hence, speeding up the disappearance of some fishing areas.

IV.2.1. Wetland of Alexandropoulos

At Alexandropoulos Municipality there is an important wetland on a national, European, and international level: Evros' Delta which covers a region of 188 km^2. in this area exists more than 350 species of plants, 40 species of mammals, 28 amphibious and reptile species, 46 species of fishes and 324 bird species find shelter. In fact, for many years it has been declared as a protected area thanks to its diverse wildlife and human one, too. In Evros' Delta hundreds and thousands of birds find shelter and food all year round, while it represents a limited natural resource for the local community, because of its value for fishing, stock breeding, agriculture, climate, flood protection, education, recreation, science.

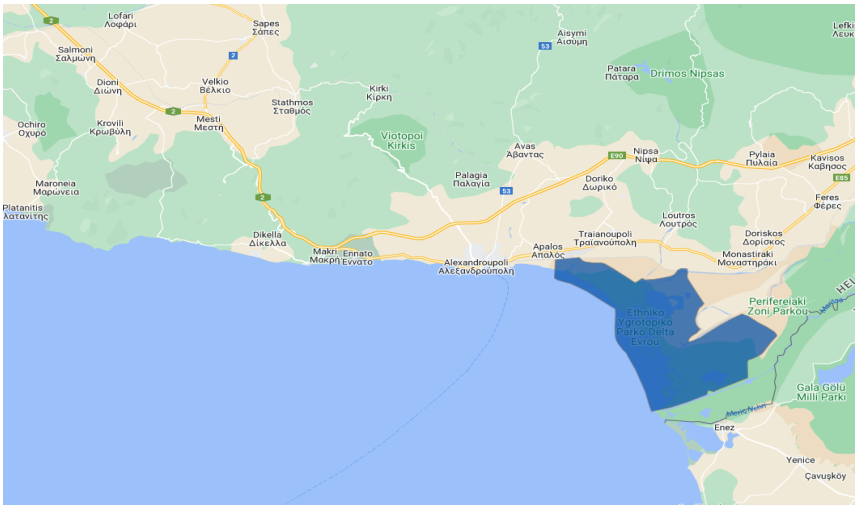


Figure 9. Alexandropoulos' wetland (Ramsar treaty)

The seaside is covered mainly by agricultural and meadow areas, while a small part of the above has been replaced by tree cultivation through a program of forest planting on land which belongs to the Board of Forest, in the Region of Evros. Besides, the geographic location of the area (Mediterranean – Black Sea) affects not only the climate but also the area planting, creating a very rare and ample species variety (flora and fauna).

The role of the plantation (bushes, trees, etc.), and the one that is near to the river and seashore, is very important for both the natural habitat and the ecosystem preservation. In fact, the plantation creates not only a shelter for the fauna species, but also prevents soil erosion caused by floods, as well as the decomposition of the ground from the rushing waters of the rivers and the torrents. It plays the role of a filter which withholds the nutritious salts and nitric substances, and as a result minimizes the burden for the wetland. It is also capable of absorbing a significant water quantity; hence the wetland can renew itself.

The Evros' Delta flora consists of reptiles, Passeriformes, and raptors, some of which are very rare in the whole region of Europe. Sometimes, the area often warms with migratory herons, birds, swans etc., non-raptors that live in cultivated lands (e.g., black storks, Isabelline Wheatear etc.) and it is the area of hunting for the raptors (which find shelter at the forest of Dadia). At the wetland of the river Evros' delta, there have been up to 307 species of birds, and thus it is the most significant wetland in the Eastern Mediterranean and one of the greatest Ramsar treaties in Europe.

The pilot area of Alexandropoulos includes protected areas as well, such as the National Park of the river Evros' Wetland area and the area SPA (Special Protection Areas) «South Forestall Simplex of Evros» (GR1 110 009). There are two wildlife shelters, Evros and Kirkiaswell.

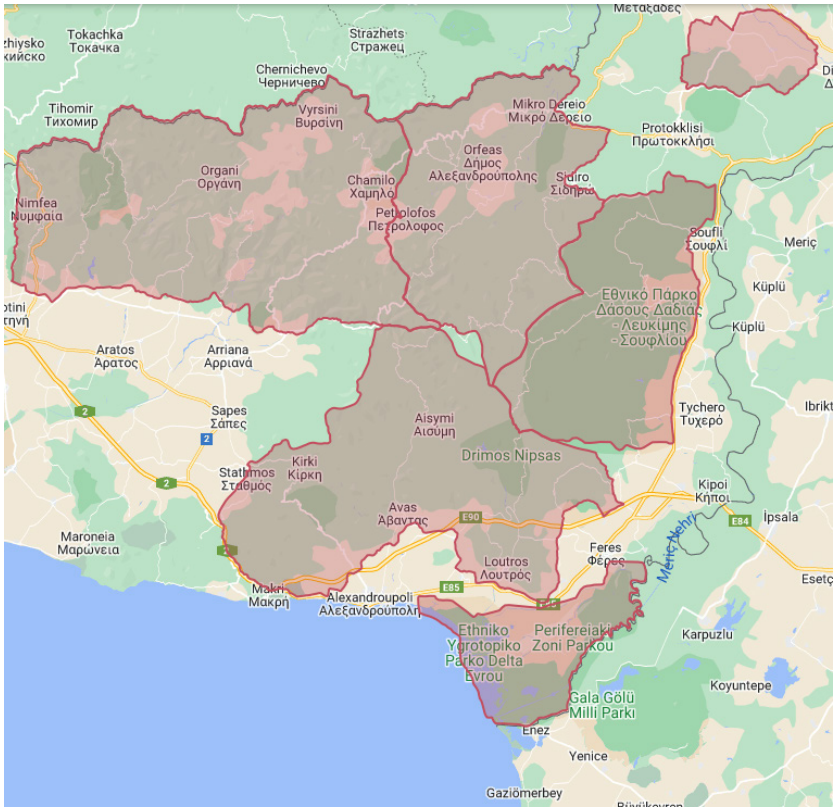


Figure 10. Important Bird Areas

IV.2.2. Marine ecosystem of Alexandropoulos

Alexandropoulos marine flora is very ample, due to the wetland of Evros' delta since it is the natural shelter and the place both for reproduction and growth for many marine species that live across the Mediterranean Sea. The perpetual pollution has led to the fishing production reduction. The small spillages that come from the processed oil residue that is rejected at the Bay of Alexandropoulos is estimated to vary from 20% to 60% of every boat's carriage that is equal to 80,000 – 150,000 t. Tanker boats that pass through the marine species and marine

flora areas of reproduction and alimentation are probably going to affect their population and the fishing of these species. There is a threat to the reproduction and thus the shrimp production which consists in 1/3 of the fishes of Alexandropoulos' Bay.

IV.2.3. Forestall Ecosystem of Alexandropoulos

The National Park of Dadia's Forest – Lefkimi – Soufli is one of the most significant areas on the natural, European, and international level. At the National Park plenty of flora and fauna species of the Balkan Peninsula, Europe and Asia live together. Pine trees, forests, and oak, which are intercepted by clearings, pastures and cultivated lands are the ideal environment for the raptors. At the National Park more than three out of four species of Europe's raptors (Black vulture, Vulture and Asproparis) were found, while at the same time it hosts the only settlement of the Black Vulture in the whole area of Balkans.

IV.3. Pilot Area of Samothraki

IV.3.1. Samothraki's wetlands

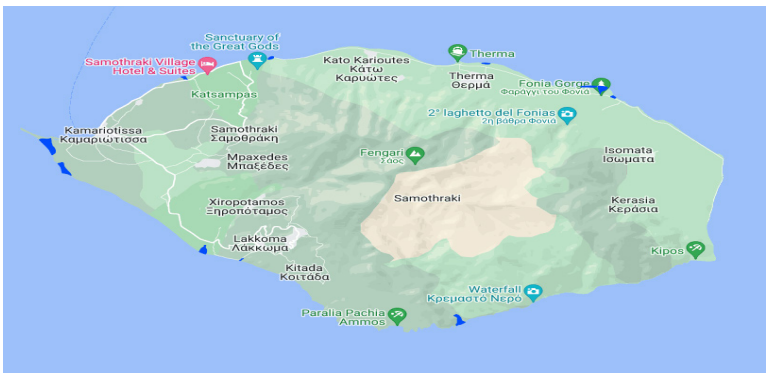


Figure 11. Samothraki's wetlands

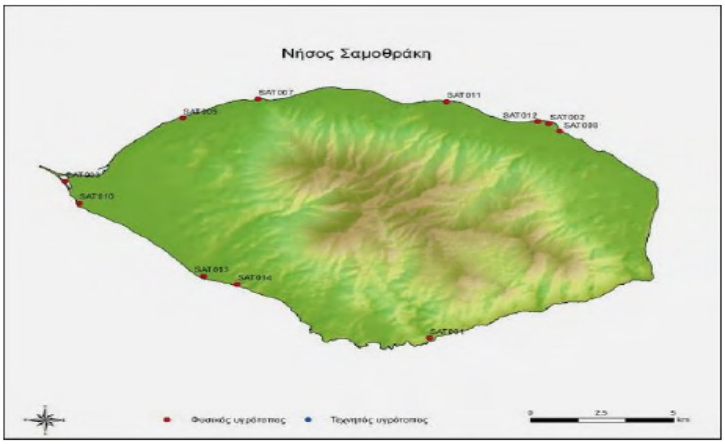


Figure 12. Samothraki's wetlands[5]

5 Retrieved from www. ydrokritis.blogspot.gr

At Samothraki's municipality area plenty of wetlands can be found:

- **SAT001 –Outflow of Batos' river**

This Torrent Outflow is not accessible by land; it can only be accessed by boat about 17 km from Kamariotisa port. The wetland is within the limits of the Special Protection Zone (GR 1 110 012) and the Significant Area for Birds. It is also protected by the Presidential Regulation of the small wetlands at the Greek Islands (Government Gazette229/AAP/2012).

- **SAT002 –Outflow of the Fonia's small river**

Fonia, a small river and its outflow are located at about 11.3 km E – NA inside Samothraki. There are two outflows that are only a few meters far from each other. Both outflows have very little purely wetland vegetation on rocky soil. The seaside zone is full of Platanus orientalis and Pteridium aquilinum. Besides, the wetland value is mainly seen as wild animals and plants habitat as well as the main water supply for the farming animals stock needs. At the other side of the outflow there is an organized recreation area and across the river there exists a walking path. The wetland is located within the limits of the Special Zone of Preservation (GR 1 110 004), the Special Protection Zone (GR 11 100 012) and the Significant Region for the Birds. It is also protected by the Presidential Regulation of the small wetlands at the Greek Islands (Government Gazette229/AAP/2012). Apart from all that, a small sector of this outflow is located inside the archeological site of Fonia (Government Gazette 355/B/1994).

- **SAT003 –Sea Lake of St Andrew**

St. Andrew sea lake is located at about 1.8 km W – SW of Kamariotisa. The locals call it as: "(n) taliani ''. In fact, it is a natural wetland that consists of habitat of priority 1 150* - Seaside Seas of 92/43. It is a public land area which was leased by the municipality to the fishing corporation until 1990. At the south borders there is evidence that fresh water is coming to the area through the underground aquifer. Moreover, there is no fishing activity spotted anymore and probably the fishing species have run out since the connection with the sea has been lost. No activities take place in the wetland while at the same time the absorption basin is covered by crop cultivations, pastures and very thin construction and roads. The wetland is located within the limits of the Special Protection Zone (GR 11 100 012) and the Significant Region for the Birds. It has been threatened not only by the abundance and the illegal disposal of solid waste and solid waste but also from the new road construction.

Figure 13. Sea Lake of St Andrew[6]

- **SAT005 –Anonymous swamp**
- **SAT006 –Anonymous Sea Lake**
- **SAT007 –Palaiopolis' swamp**

Palaiopolis swamp is located at 6.3 km E – NE Kamariotisa settlement. It's about a swamp that is formed under a big rock. In fact, there were the Gattellusi towers' ruins which are considered as part of the already existent archeological site. Water supply is being made through underground unloading (karst source). The swamp is plenty of wetland vegetation where the wickers *Vitex agnus castus* and some *Juncus* sp. and thick land vegetation (*Inula*, *Urtica*, *etc*.). The basin has run off from the wetland and has been covered by natural forestall and bush vegetation. All the Archeological Site of Palaiopolis (Government Gazette 527/B/1967) is under the regime of Special Zone Protection (GR 111 012) while at the same time the wetland is protected by the Presidential Regulation of the Greek wetlands of small islands.

Figure 14. Palaiopolis' swamp [6]

6 Retrieved from www. oikoskopio.gr

- **SAT008 –Fonias' swamp**

Fonias swamp is in the east side of the Fonias' Tower at about 300 meters straight away from the outflow of Fonias' small river (SAT002) and at 11.3 km E – NA of the inside area of Samothraki. It's a seaside swamp that supplies itself with sweat water through the underground, while in spring season a small superficial flow is noticed. For a larger period throughout the year, it practically gets drier, but some parts of the swamp continue to be saturated with water. It is full of *Juncus*, *Carex* and wickers *Vitex agnus – castus*. In addition, there are small surfaces covered by *Phragmites australis* stubbles and *Typha* sp. straws. The main activity both in the wetland and the runoff basin is the graze of small stock – farming animals. In fact, in this habitat live several species such as *Mauremys rivulata* lined sea turtles, *Pelophylax* sp. frogs and some emigrating aquatic birds. The wetland is located within the limits of the Special Preservation Zone (GR 1 110 004), Special Protection Zone (GR 1 110 012) and the Significant Area for the Birds (Portolou *et al.* 2009). It is also being protected by the Presidential Regulation of the Greek wetlands of small islands (Government Gazette 229/AAP/2012) (Data collection: 6/2005. Enumerator: G. Katsadorakis).

Figure 15. Fonias' swamp[7]

7 Retrieved from www. oikoskopioKatsadorakis/WWF Greece

- **SAT009 –Outflow of Katsampa small river**

The Kastampa's outflow is located at 3.4 km E – NE of Kamariotisa. It's about a small outflow of the Katsampa torrent which is supplied by superficial water and underground discharges as well. The main habitat is the 72A0 which mainly consists of *Phragmites australis*, while on the upper side there are a few *Platanus orientalis* plane trees and *Vitex agnus* – castus wickers. It is considered as a shelter for wild animals and plants. Its runoff basin is dominated by natural arboreal and bush vegetation as well as extensive dry wheat vegetation. As long as superficial waters exist in the area some marine fishes exist as well as plenty of coleopteran Gyrinidae, lots of dentin anisoptera, *Mauremys rivulata* lined sea turtles and *Pelophylax* sp. figs. A part of the outflow is considered to be included at a Wildlife Shelter (Government Gazette 841/B/2001), while as a whole it is being protected by the Presidential Regulation of the Greek wetlands of small islands (Government Gazette 229/AAP/2012) (Data collection: 6/2005. Enumerator: G. Katsadorakis).

Figure 16. Katsampa outflow

- **SAT010 –Koufki's sea lake**

Koufki sea lake is located about 2 km NE of Kamariotisa settlement. Due to the salty sea water impact, there are small lands with straws from *Schoenoplectus littoralis* and *Phragmites australis* and there are many moisturizing *Ruppia maritime* and *Chara* sp. During spring and autumn many migratory birds, especially Charadiomorphs, remain there. At the runoff basin there is cultivated wheat, therefore the wetland is being polluted by fertilizers. It is under the regime of the Special Protection Zone (GR 1 110 012) and the Significant Area for Birds.

Figure 17. Koufki's sea lake

- **SAT011 –At Maris' or swamp of Filakio**

The At Mari's or Filakio's swamp is in At Mari's, at 8.1 km E – NA on the North coast of Samothraki. It is a seasonal swamp in a natural-formed cavity. In addition, it's about a wetland of high aesthetics and naturalness, as it remains intact from any human activity. When it dries, it is used as a grazing area for small stock – farming animals. There are almost 2,260 main habitats, as well as bush vegetation with hard leaves dunes (Cisto – Lavenduletalia), mainly *Myrtus communis* myrtles and *Vitex agnus* – castus at completely stoned soil, 3,260 – Floating vegetation are water friendly plants (batrachia) with *Ranunculus* sp., 72A0 – straws and 72B0 – Societies of tall rushes with *Bolboschoenus maritimus* and the habitat of priority 91E0 – residual alluvial forests and forests of *Alnus glutinosa* hardwoods. Its runoff basin is covered by natural bush and wooded vegetation. It is located within the limits of the Special Protection Zone (GR 1 110 012), and it is being protected by the Presidential Regulation of the Greek small islands' wetlands.

Figure 18. Mari's or swamp of Filakio[6]

- **SAT012 –Leech Lake**

The Leech Lake is 10.2 km E – NA in Samothraki on the north beach of the island, nearly next to the outflow of the Fonias' torrent (SAT002). It's a natural wetland and it is supplied by the unloading of the alluvial underground aquifer. It is very similar to the swamp of At Mari's (SAT011). In summer it dries completely yet, it has a very wide variety of high aesthetics, and it remains still untouched by human related activities. The main values that the Leech Lake provides are several strategies such as setting an underground water disposal point, for the coastline stabilization, to support the food chains, and to keep it as a shelter for wild animals and plants Besides, setting an area where rare and interested species of migratory birds may find shelter is one of its primary objectives. Yet, when it dries it is used as grazing for small stock and farming animals. The main habitants that comprise are: 1,260, 2,260, 3,260, 72A0, 72B0, and the habitat of priority 91E0. It is well known for its vast vegetation of charoidal, floating rhizophytes such as *Ranunculus* spp. and *Elatinealsi nastrum*, super hydrous with Scripus and Typha as well as wetland vegetation. The runoff basin is covered with natural bush and wooded vegetation. The wetland is located within the limits of the Special Preservation Zone (GR 1 110 004), the Special Protection Zone (GR 1 110 012) and one part belongs to the Significant Area of Birds as well (Portolou *et al.* 2009). It is also protected by the Presidential Regulation of the Greek wetlands of small islands (Government Gazette229/AAP/2012) and one part is located within the archeological site of Fonias (Government Gazette 355/B/1994).

Figure 19. Leech Lake

- **SAT013 –Ksiropotamos' outflow**

The Ksiropotamos' outflow is about 5.4 km S – SW far from the settlement of Samothraki. It is a seasonal small river which receives water from a relatively large runoff basin in the southwest of mountain Saos. In this area there are olive trees. The outflow is within the limits of the Special Protection Zone (GR 1 110 012) and the Wildlife shelter (Government Gazette841/B/2001). It is also protected by the Presidential Regulation of the Greek wetlands of small islands (Government Gazette 229/AAP/2012).

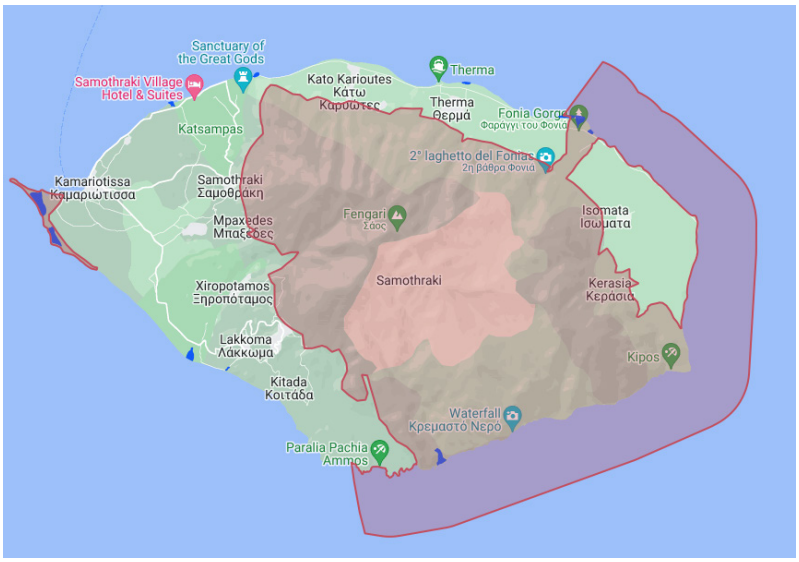


Figure 20. Important Bird Areas [6]

Samothraki's wetlands are small, seaside areas and they endure the tough human related pressures that are linked to the island's limited water resources, ineffective management as well as the negative impact of rapid tourist development. The most common and significant issue is mainly pollution that is chiefly caused by solid wastes (constructional materials, public constructions wastes, liquid disposals (households) which leads ultimately to eutrophication and intense micro biotic activities due to the dairy industry wastes.

Figure 21. Samothraki's wetlands[6]

IV.3.2. Samothraki Marine ecosystem

The seas that surround Samothraki Island still maintain a large amount of biodiversity, including many marine mammals that are threatened by extinction, as well as species of fish with a commercial point of interest. The uncontrollable seaside activities on the island, especially during summer period, cause a significant pressure to the marine and

seaside ecosystems. All these circumstances have resulted in the over-pumping and degradation of the resources. Furthermore, there is a shortage of fishing boats and a unit of processing fishing pirates. Apart from that, a significant decrease of the reserve of the fishes is also noticed due to the illegal and exaggerating fishing activities Network of Sustainable Islands[8].

Figure 22. Image from Kamariotisa port[9]

Samothraki island is mainly characterized by a traditional center of fishing activities with a manpower of about 60 families. In fact, the non-sustainable fishing has had significant repercussions not only on the marine life, but also on the flora and fauna in the area. This has ultimately led to a decrease in both the natural reserves and marine environment. To tackle this issue, an effort is required to be made for further sustainable management, aiming at the marine environment protection.

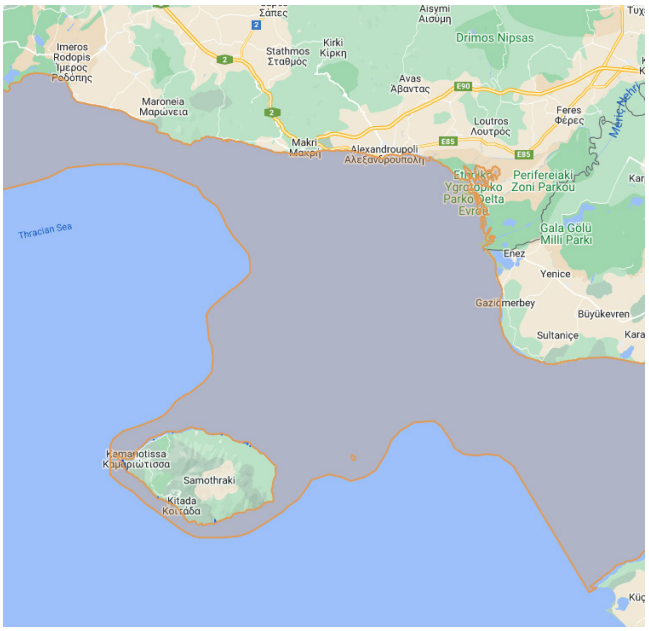


Figure 23. Important Mammal Areas[6]

8 Retrieved from http://www.dafni.net.gr/gr/members/files/samothraki/samothraki-report.pdf

9 Retrieved from http://www.shipfriends.gr

IV.3.3. Forestall ecosystem of Samothraki

A forest is described as an ecosystem involving plants and animals and a large tree density. At Samothraki the forestall ecosystem (Mountain Saos) comes across with important issues due to the overgrazing effect caused by goats, while at the same time fire outbreaks contribute to worsening the situation. Soil removal due to wind or water (wind and water erosion) or due to irresponsible human activities is called soil erosion. The overgrazing effect on the island impedes natural rebirth, and as a result the restoration of forestall vegetation can never be ensured.

Figure 24. Destruction of the flora from the overgrazing effect at Samothraki[10]

10 Retrieved from http://www.samothraki.com/

Figure 25. Fire outbreak at Samothraki's Therma[10]

Samothraki has been integrated within the Natura network (GR 111 004) from 2002, while the Regional Council of Evros and Samothraki Municipality Council after a proposition of the local Forestry Service and the proposal of the Ecological Company of Evros have unanimously decided the introduction of a new National Park Saos – Martini at Samothraki.

Figure 26. Natura network (GR 111 004)[6]

V. Effect of coastal/maritime tourism in pilot areas

In Greece, tourism is the most important source of income with a very rapid growth rate. The combination of natural habitat, sea, sun, mild climate, and the inhabitants' hospitality have all contributed to a further importance allocated to tourism. Yet, during the country's economic recession, and despite the reduction of GDP, tourism is the only productive sector which is currently increasing. For instance, between 2016 and 2017 tourism (the indirect and direct economic effect of tourism in the GDP) shows an increase of 9.3% while in the same year the increase of the Greek GDP was just 2.03%.

Table 1. Total effect of tourism at the Greek GDP (in million euros; Prokopiou G-D, 2019)

Category of Expenditure	2016	2017	Variation	Variation (%)
Incoming tourists' income	12.749	14.202	1.453	11.40%
Cruise tourists' expense	457	462	5	1.09%
Cruise companies cost	169	171	2	1.18%
Air transport	1.326	1.432	106	7.99%
Shipping	133	90	-43	-32.33%
Domestic tourism	1.287	1.323	36	2.80%
Investments	615	615	0	0.00%
Tourism direct impact	16.736	18.295	1.559	9.32%
Gross national product (%)	0	0	3.118	
Gross national product (%)	**174.199**	**177.735**	**3.536**	**2.03%**

Tourism is an economic activity which hasn't been well developed due to the lack of effective planning and management. This indeed has led to negative repercussions not only for the natural environment but also on the economic and social environment of the touristic area. For that reason, it is essential to develop a rational plan for more sustainable tourism. This will ultimately entail to the natural habitat preservation, which will in its turn attract and expand more tourism, to secure longer stays duration and further productivity and income from Tourism (Arabatzis and Polyzos, 2008).

The volume of tourism in the Mediterranean Sea, Greece, and the Pilot area of Samothraki as well, are responsible for incidents like (Kokkosis *et al.* 2011; Logothetis, 2001):

- Inflammatory actions.
- Perpetual interferences in the landscape with the direct aim of deforestation permit the construction of hyper luxurious hotel units.
- Air pollution due to traffic jams.
- Noise pollution of the aerial and the marine area because of noises (motorized means of transport and others).

- Water pollution that is caused by cruise boats.
- Aesthetic pollution incidents (cleanliness of beaches, water quality at swimming areas).
- Increase of illegal construction activities.

The wider effects of tourism:

Tourism has started as a fiscal activity without having any environmental effects. However, this is currently incorrect. The environment, natural, cultural, and structure represent the main components of tourism. Areas with ideal climate conditions, extensive beaches, clean seas, as well as significant historical and archeological sites. In addition, rich flora and fauna, breathtaking landscapes, and a structured, aesthetic, and historical environment and finally, responding to the people's functional and cultural needs, are all among the most significant tourists' preferences. The main incentives of selecting a destination in the Mediterranean Sea reveal that environmental aspects such as climate, sun, sea, beaches and of course the quality of the offered services have a dominant place at the preferences' list of the possible visitors of the place (Logothetis, 2001).

Tourism is plausible to provoke both positive and negative environmental consequences, which are related not only to the development policies that are being planned (Lickorish and Jenkins, 1997), but also to the evaluation of the ongoing – applied models of growth. Apart from the natural habitat, the repercussions of the TOURIST activities are visible to the economic, social, and cultural sector as well.

The positive impact of tourism (Akrivos and Salesiotis, 2007):

A. Economic related:

- It offers more job opportunities.
- It is a source of currency income (limited funds due to euro).
- It boosts the individual income of the residents.
- It boosts the GDP of the country.
- It operates at the existing facilities.
- It gives incentives for public investments in facilities.
- It develops facilities that enhance the local trade and industrial activities.
- It develops itself in parallel with the local products and wealth resources.
- It is linked to many sectors of the economy.
- It enhances and broadens fiscal growth thanks to its tight relation with the different economic sectors.
- It increases the income of the state and the local government as well.

B. Social:

It broadens People economic horizons.

- It improves the quality of life thanks to income increase.
- It confirms and reassures the necessity of environmental protection.
- It provides more opportunities for the residents for recreation and entertainment.

C. Cultural:

- It empowers the protection of cultural inheritance and traditions.
- It bridges the gap between people with different religious, linguistic, social, and cultural backgrounds.
- It advertises the area as an attractive destination worldwide.
- It promotes the formation of a worldwide community.
- It empowers international communication and peace.

Tourism growth consists in preserving resources, providing the most significant aspects for an ideal tourist destination, and emphasizing emerging tourist areas development. Besides, tourist resources do not only include the natural components such as habitat and climate but also the cultural ones like traditions and local customs. Apart from these, all facilities and services that contribute to tourism development such as hotels, tourist agencies and all the companies related directly or indirectly to tourism as well as the transportation facilities such as ports, airports and all the other means of public transport are highly important in Tourism growth and productivity. Finally, the institutions and the funding of the tourist-related enterprises are considered as part of the tourist resources as well (Kokkosis and Tsartas, 2001).

The most significant tourist resources are:

1. Nature and natural habitat
2. Climate
3. Culture
4. Traditions and traditional events
5. History and archeology
6. Local customs
7. Museums (archeological, historical, folkloric, art galleries)
8. Accommodations
9. Companies that offer tourist services
10. Transportation and communication services
11. Ports
12. Airports
13. Taxi cabs
14. Car rental companies
15. Tourist institutions

The environmental impacts of tourism:

Tourism contribution to the National economic growth requires mainly safe nature friendly Tourism that is harmless to the natural inhabitant and respectful to the local communities' culture and beliefs. In fact, Boosting Tourism along with its tourist

resources as well as encouraging both the alternative tourism development and the conventional model can ultimately turn tourism into a source of general sustainable economic growth. Indeed, Sustainable tourism has the potential to make all forms of tourism friendlier towards the environment and society.

Negative impacts of tourism:

- Traditional settlements Partial abundance.
- Noise pollution in certain areas.
- Noticeable water resources salinization.
- Fire outbreaks.
- Scattered construction across the coast.
- Heavier traffic jam.
- Aesthetic degradation of the landscape and the architectural character in highly tourist populated areas.
- Village's architectural aspects degradation.
- Degeneration of the mountainous areas' population.
- Overpopulated tourist areas.
- Rural communities Marginalization.
- Abundance of mountainous areas.
- Over exploitation of tourist growth resources.
- Low quality tourist services in certain areas.
- Excessive dependence of the economy on seaside tourism.
- Development Discrimination.
- Lack of support for development in the mountainous and rural regions.
- Tourism limited liaison with the first and the secondary economic sectors.
- Seaside environmental pressure due to the conventional seaside tourism standard.
- Lack of general political plans in promoting alternative tourism.
- Lack of political protection for the environment.

The positive impact of tourism:

- Concern about nature's protection issues.
- Preservation of the natural habitat in touristic destinations.
- Service quality improvement thanks to tourism enhancement.
- Better public health and a more pleasant environment for the residents.
- Economic profits.
- Harmony between nature and humans.
- Improvement in cities and urban environments.
- Maintenance of monuments and archeological sites.

- Increase in job opportunities.
- Region's history promotion.
- Raising awareness of society.

According to PhD research of Mr G. – D. Prokopiou, according to the existing capability measurement, it has become possible to calculate the correlation between tourism and the environment. At this research, 16 variables whose prices vary from 0 to 100 were used, with respect to the equivalent gravity indices.

The indexes used are the following:

urban wastes coverage, buildings legal authorization, noise pollution, the solid waste coverage, use of pesticides, non-over pumping effects, drinkable water resources sufficiency, lack of fire outbreaks, clearings, landscape's maintenance, green areas sufficiency, beds per km of beach area, beds per km^2, beds per permanent resident and light blue flags per km of beach. The complicated indexes used are beds per km of beach area, beds per km^2, beds per permanent resident, and light blue flags per km of beach.

The analysis of the indices regarding Greece as a total has revealed the following conclusions:

V1: The urban waste management level on the island is low. The median is 27.94 and the standard deviation is 38.94.

V2: The legally authorized buildings level in the island is low. The median is 54.64 and the standard deviation is 46.61.

V3: The noise pollution level on the island is low. The median is 89.4 and the standard deviation is 22.3.

V4: The solid waste's coverage level on the island is low. The median is 57.05 and the standard deviation is 34.93.

V5: The solid waste prevention level on the island is low. The median is 65.64 and the standard deviation is 45.38.

V6: The level of non-over pumping effects on the island is low. The median is 77.49 and the standard deviation is 37.95.

V7: The level of sufficiency of the water resources at the island is medium. The median is 66.77 and the standard deviation is 44.15.

V8: The level of drinking water quality on the island is medium. The median is 75.15 and the standard deviation is 50.45.

V9: The lack of fire outbreaks level in the island is medium. The median is 71.83 and the standard deviation is 40.77.

V10: The lack of land clearings level in the island is medium. The median is 80.68 and the standard deviation is 36.9.

V11: The island level of the preserved areas is decent. The median is 71.79 and the standard deviation is 33.41.

V12: green areas sufficiency level in the island is medium. The median is 66.51 and the standard deviation is 45.76.

V13: The median bed per km of beach at the island is 763 and the standard deviation is 134.7.

V14: The median of beds per km^2 is 55.6 and the standard deviation is 121.11.

V15: The median of beds per resident is 6.1 and the standard deviation is 83.83.

V16: The median of light blue flags per km of beaches is 0.03 and the standard deviation is 0.73.

The results of the above indexes are presented at the Pilot Area of Samothraki, while there is no equivalent data collected for the Pilot Area of Alexandropoulos.

V.1. Pilot Area of Alexandropoulos

The seaside zone of Alexandropoulos' Municipality is in a remote area, within the biggest urban center of the REMTH. It has one of the most popular wetlands in Europe, an olive grove with famous products and some even more remarkable natural and cultural aspects. All these characteristics are responsible for the concentration of various competitive activities which are threatening the environment and creating conflicts among them.

V.2. Pilot Area of Samothraki

The Pilot Area of Samothraki represents the total of indexes that estimate the current tourist regions capabilities.

Samothraki does not have urban waste coverage (0%), there are plenty of illegal constructions (100%) and there is no noise pollution (100%). There is a sanitary solid waste disposal area (80%) and a very high percentage of pesticides (0%). Furthermore, there is not over salted water pumping (100%), the water resources are insufficient (0%) while the water from the pipe network is potable everywhere (100%). There are also fire outbreaks (50%), landing clearing to construct buildings (0%). Fortunately, the area remains partially preserved (50%) and the green areas are ample in the urban area (100%).

Regarding the compound indexes, the index I13 (beds per km of beach) has a medium evaluation of 44.50% which means that there is still a margin for tourist development and marine tourism. It's about the development of alternative tourism. The index I14 (beds per km^2) has a value of 18.60% and a low evaluation which means that there is still a slight margin for tourist growth. Furthermore, the index I15 (beds per permanent resident) has a value of 40.20% and a medium evaluation, meaning that the economy is not strongly dependent on Tourism. The index I16 (number of blue flags per km of beach) has a price of 19.45% and a low evaluation, showing that there is already a wide number of certified beaches, regarding the big area that the island covers.

Taking into consideration that the country has a value of 57.07%, Samothraki has a general index value of 45%, which is lower for 12.07%. The index of Samothraki land situation scores a value of 0%, while at the same time the total value of the country is 43.37%. Concerning the water's management, Samothraki has a value of 70%, same with the value of the country in total. Finally, Samothraki's index of the natural habitat's management has a value of 45%, while the country in total scores 62.67%.

VI. Political efforts for pollution's management

Air pollution due to the increased vehicle circulation, marine pollution caused by the solid waste from tourist boats, pollution triggered by the burry of an increased amount of solid waste at sea and land, the saturation of seaside areas caused by the over concentration of buildings and activities, the unwilling disturbance, the overload of facilities' network during the summer period due to tourism, the optical pollution which is caused by the deterioration of the landscape from tourist facilities and infrastructure projects, the radical alterations of the use of land, the deterioration of the settlement's network, the direct harm to the natural and cultural inheritance due to the overwhelming amount of visitors and, last but not least the soil erosion are the main issues that need to be tackled.

Mainly in Samothraki, there is a lack of basic infrastructure resulting in serious environmental problems. The State acts to eliminate these problems that occurred and created pollution.

VI.1. Wetlands' protection

Evros' and Samothraki's wetlands, as well as the species that found shelter in them, need protection from the different types of pollution that threatens them.

For the protection of the wetlands, it is proposed:

- The prevention of illegal camping and other tourist activities both at the area inside the wetlands and the nearby area.
- The preservation and designation of the wetlands' areas and functions and the sustainable management of their natural resources.
- The creation of small facilities for the protection and the preservation of the wetlands, as well as access to them, whenever it is required.
- The scientific research at the corresponding sectors and the notice of the visitors.

Alexandropoulos and Samothraki wetlands and its ecosystem should be urgently treated since it is under stake through effective direct and indirect actions and through the appropriate institutional framework. If no action is taken, that will have indirect repercussions, such as water scarcity, cultivable land decrease, increase in tourist resources level and serious harm to the biodiversity, with the extinction of the species that live or depend on them.

VI.2. Protection of the coastal and marine environment

For the improvement of the water's quality a long-term program of managerial actions and a supplementary analysis for the risk of danger are required (http://www.palo.gr/).

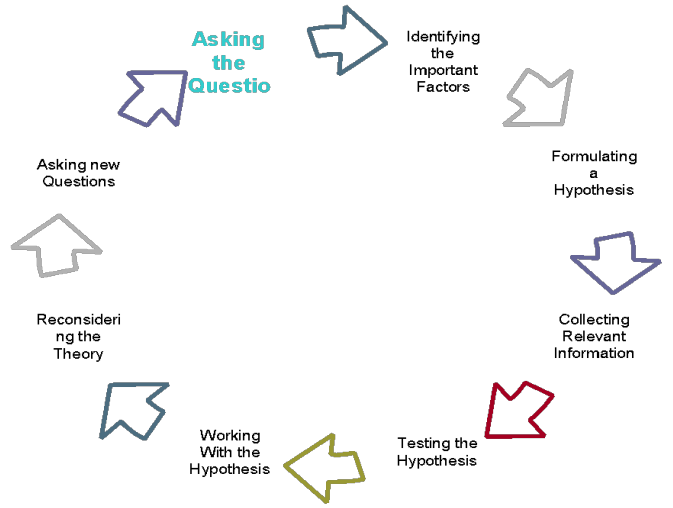


Figure 1 Η ρύπανση ως κίνδυνος των θα λάσσιων μεταφορών στο χώρο του Αιγαίου

Figure 27. Pollution as a menace for the marine transfers at the Aegean territory

VI.2.1. Pilot Area of Alexandropoulos

Concerning the Pilot Area of Alexandropoulos, essential measures need to be taken to protect the marine environment from oil repercussions. The port of Alexandropoulos is about to be renovated to become an oil terminal. The offshore and port facilities have to support, providing the highest possible safety and quality, the oil distribution and the natural habitat as well as the related activities that will be developed in the area (oil refineries, facilities of storage for the oil products, facilities for supplying the ships, facilities for prevention and confrontation of sea accidents *etc.*).

VI.2.2. Pilot Area of Samothraki

Generally, within the sea surrounding Samothraki Island lies a diverse biodiversity, including many marine mammals under the extinction threat, as well as some fishing species that have a commercial interest. For the sea and the offshore ecosystems protection it is suggested:

- The creation of zones at the marine territories
- Fishing limitations measures
- Cleaning of the spoiled shores due to random free camping

With these measures the island marine ecosystems will prosper and become more resilient and richer. Thanks to sustainable fishing, special fishing tools have become highly promoted, legal fish quantity as well has been regulated together with the fishing areas determination.

VI.3. Soil Protection from Overgrazing

The overgrazing problem has become remarkable in Samothraki Island, which is not the case in Alexandropoulos.

Based on research on the grazing ability of Samothraki's stock farming areas, which was conducted in 2004, several measures were proposed so as to increase productivity without causing problems to the stock farmers:

- Removal of at least 61% of the goats
- Signage of all the goats at the island and their exact enumeration
- Removal of the inappropriate animals as well as their exaggerated number until the desiring aim of about 23,000 goats
- Stabilization of the grazing days at the maximum annual limit of 240
- Reassurance for the existence of a local Institution for Management of the stock farming areas
- Application of a completed program for managing the grazing areas of Samothraki
- Regulation of the grazing, gradually, in accordance with the limited capacity of grazing activities

VI.4. Protection of the forestall ecosystem

VI.4.1. Pilot Area of Alexandropoulos

The Pilot area of Alexandropoulos encompasses a vast amount of forestall areas, which are highly valuable for the region. Many of these include recreation areas mainly for hikers in Spring. The Forestry Service, in cooperation with the Fire Department, is responsible for maintaining the local forests, which are vital for the area.

VI.4.2. Pilot Area of Samothraki

Regarding the island of Samothraki, there is a wide variety of different and rare species that are more than a century old and comprise a unique natural inheritance. Their designation and promotion are essential, through their enumeration, definition of their age and mapping of their location (http://www.sustain-eu.net/). Moreover, it is crucial that forests enjoy regular management and protection. In fact, Alder seaside forest, Maritime oak forest and the other ones as well, the riverside units of east plane tree, are all considered unique ecosystems. That is why they need to be properly and effectively managed to preserve their high ecological contribution and biodiversity.

For forests preservation and protection many recommendations have been suggested:

- Grazing control in the highest mountainous areas and the oak forests.
- Forestry services reinforcement, to preserve sufficiently the forestall characteristics of the burnt areas.
- The modernization of the means and methods of prevention and the updating of measures to tackle forest fires.
- The construction of barriers for the protection against soil erosion and the prevention of landslides due to rainfall.
- The checks for illegal logging and trafficking of forestall products.
- The intensification and the patrols in the forests with the contribution of volunteers.
- Rational design management of forestall resources (prohibition of extended logging, actions related to the prevention of intended fire outbreaks) to prevent of the lands' denudation and their desertification.
- Construction of anti-erosion constructions in the canyons and the torrents of the vulnerable areas, for the deceleration of the flooding waters' flow.

VI.5. Management of liquid disposals

VI.5.1. Pilot Area of Alexandropoulos

At the Pilot Area of Alexandropoulos there is a significant issue triggered by the water disposals derived from the Industrial Zone and the local Hospital. However, the trouble has been overcome thanks to the fact that both the Industrial Zone and the Hospital possess their own biological cleaning system.

VI.5.2. Pilot Area of Samothraki

Regarding the main sewage disposal system in both the Country and in Lakoma, liquid waste ends up at sea through sewage, while for the rest of the settlements each house has its own cesspit. For the rational management of liquid disposals, it is recommended that the focus on constructing a biological cleaning system should be planned and urgently completed. Furthermore, it is suggested that an essential network of filthy disposals for the settlements with more than 100 residents should be created[8].

VI.6. Management of Solid wastes

VI.6.1. PilotArea of Alexandropoulos

At the Pilot Area of Alexandropoulos, the recent turn towards recycling recyclable products has contributed a lot to the solid waste amount decrease that is being buried within the sanitary area for disposal. However, there has been a saturation of the Sanitary Solid Waste Disposal Area and Hence, founding a new area is necessary.

VI.6.2. Pilot Area of Samothraki

Soi far, the island solid waste is being transported by containers through the sea at the Sanitary Disposal Area of Komotini and Alexandropoulos, which is a costly method. Within the Regional Planning framework due to the area insular character, and to accomplish appropriate and effective solid waste management, it is estimated that building a Sanitary Area to bury the residues seems to be a supplementary facility. In fact, "Recognizing Paper for Samothraki" has already conducted complete research for solid waste management. It is vital that there is not only a Study for the location of the solid waste Sanitary Area but also the installation of a Sanitary Area for Residue's bury is needed, to eliminate the amount of solid waste. Finally, the establishment of a Residue's Sanitary Area on the island will increase the capability to producing more biogas, which can be exploited in covering the local needs for energy supply[8].

VII. Environmental practices at tourist sector for eliminating pollution

A SWOT analysis has been conducted (Strengths, Weaknesses, Opportunities and Threats Analysis; Molla, 2014), regarding the pros and cons, the perspectives and the dangers that may occur in Samothraki's environment:

Strengths/Advantages

- High quality of the environment
- Highly enriched natural resources and diversity of ecosystems
- Rich flora and fauna
- Natura and SPA regions
- Existence of papers for creating units of solid waste process
- Environmental protection and sustainable growth of the environmentally vulnerable regions
- Historical – Cultural inheritance
- Contribution and sensitivity of the dwellings for the improvement of Municipality's cleaning and forests' protection

Weaknesses

- Fragile natural habitat
- Unexploited natural resources
- Degradation of the environment due to human related and natural conditions
- Further degradation of the burnt forestall lands
- The perpetual increase of the quantity of producing solid waste especially during the summer season and the vast amount of money needed for its transportation away from the island
- Insufficient water supply and irrigation network
- Lack of protection and rational management of the forestall wealth

Opportunities

- Geothermic – thermal springs
- Existence of funding from the National Strategic Reference Framework and innovative actions for the complete management of the solid waste
- Funding of projects for the management of solid waste
- Information and sensitivity of the dwellings for the ecological value of the vulnerable areas for the growth of the region
- Existence of perspectives for the area to be characterized as Worldwide Park of Biosphere from UNESCO

Threats

- Overgrazing
- Overfishing
- Forest fires
- Illegal logging
- Deterioration of the island's habitat due to intervention mainly from the settlement areas and tourist activities
- The burden of the water horizon by liquid wastes that have serious repercussions for the environmental and public health.

Actions need to be taken at the Pilot Areas of Alexandropoulos and Samothraki. In fact, the most significant are overgrazing restriction (Samothraki), forest wealth rational planning management (Alexandropoulos & Samothraki), water resources protection (Alexandropoulos & Samothraki), fishing activities restrictions (Alexandropoulos & Samothraki), wetlands preservation and promotion (Alexandropoulos &Samothraki) and the sustainable management of their natural resources, the state – of – the art and completed management and their disposals (Alexandropoulos & Samothraki). Besides, there are many other problems due to the tourists' number in the area, mainly in small areas (for instance the area of Therma at Samothraki) around free and organized camping activities, which requires both wise approaches and effective planning as well. Moreover, it is essential that a strict control is applied at the implementation of the regulations related to the necessary processing and liquid wastes disposal to protect the coasts from the tourist units that exist in the area (Alexandropoulos & Samothraki).

For the protection of Alexandropoulos' and Samothraki's soil it is strongly recommended that:

- Perpetual monitoring of the erosions and indirect application of emergent actions for protection
- Restrain of the uncontrolled grazing with plans that are sufficiently adapted to the conditions of the island
- Restrain of the animals based on the ability for grazing on the island in order to facilitate the growth of the indigenous vegetation, which will protect the soil from erosion
- Implementation of regulations for a sustainable management of the stock – farming areas
- Preservation and growth of the olive forests at the agricultural areas as:
    - They are very resilient against dryness
    - Ensure that the ground has sufficient vegetation
    - Have low sensitivity against fire outbreaks
    - Contribute to a very wide biodiversity
- Construction of many small barriers (logs or dry stones) for the limitation of flooding and erosion effects.

VIII. Blue economy within the sustainable coastal management framework

VIII.1. Pilot Area of Alexandropoulos

Over the last years, there has always been a significant effort, in Alexandropoulos pilot area, to achieve renewable energy cleaner resources. For instance, several with wind parks have been established on the mountainous area the planning for new ones. besides, further exploitation the geothermic field of Alexandropoulos Aristino, which is one of the most significant within the Greek territory, with high temperatures that involve the most significant energy production.

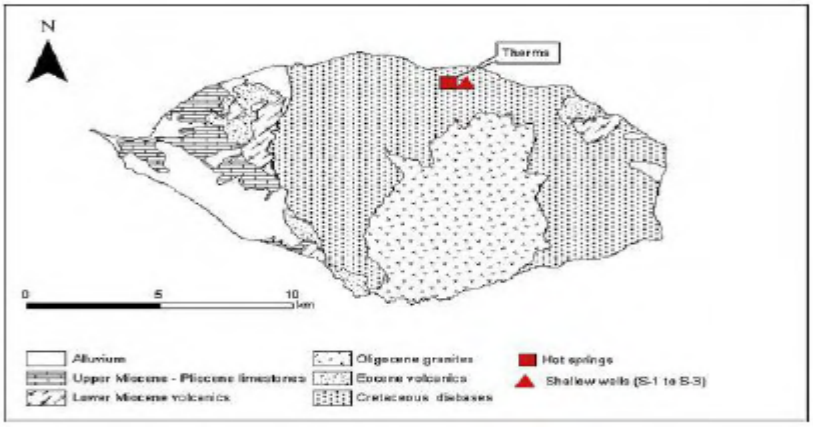
The geothermic field at Alexandropoulos Aristino is also responsible for the creation of thermal springs and thus, thermal tourism.

Thermal spring of Trainoupoli – Region of Evros: The area where the springs are 14 km east of Alexandropoulos, next to the archeological site of ancient Trainoupoli. Besides, the hot thermal springs which has been always a famous attraction for the population since ages. Today, they are considered as one of the most significant thermal springs in Greece thanks to the facilities and services offered by the hydrotherapy center (20 individual bath tabs, 6 double sized bath tabs, whirlpool, inhalation therapy, posttherapy, *etc*.) along with accommodation provided by C grade hotel facilities. Water is characterized by overheated (51 °C) hydrochloric sodium. The heating facilities is accomplished thanks to the heated – thermal water. The management is handled by the Inter Municipal Company of Alexandropoulos 's Springs. Its aim is to combine thermal – therapeutic tourism with the contemporary tendency of thermalism for both mental and physical wellness, and other mild – alternative forms of tourism that the wider area can offer.

VIII.2. Pilot Area of Samothraki

Energy production is wholly related to the island's growth. Samothraki has a significant force of energy renewable sources (wind, sun, water) as well as an active geothermic field. It is one of the few Greek territories that has an average annual wind speed of more than 6 m/s, while the boreholes at its geothermic fields contribute to the high temperatures of the water. Based on these data, Samothraki can be a Pilot Island with a multi energetic system that can exploit all its renewable sources.

Εικόνα 4.4: Γεωλογικός Χάρτης της Σαμοθράκης



Πηγή: www.sciencedirect.com

Figure 28. Geology map of Samothraki[11]

VIII.2.1. Recycle

According to the Sustainable Islands Network, research for promoting a recycling plan has already been conducted. In fact, this plan would be useful in positioning a Sanitary Area for Disposal's Burry, to convince the dwellings that a complete plan of recycle can reduce the amount of solid waste at a great scale and to remove dangerous organic solid waste via the "composting "method. This would result in the fact that a new Sanitary Area could be cleaner and longer lasting.

VIII.2.2. Wind Energy

Samothraki is known for its wind force and strength as well as its significant capabilities for developing wind farms. In fact, on the island there were 4 wind turbines which were withdrawn due to their age.

VIII.2.3. Geothermal Energy

For the geothermic force exploitation research will be conducted by the government. At Samothraki, based on the research "Broadening the geothermic field of Thermes" (2006), three shallow drillings are known for the area of Thermes (Loutra), while another possible geothermic field is the Field of Kamariotisa. According to the research conducted in 2006 to study the use of the geothermic fluids at Samothraki, the following guidelines are suggested:

- Broadening the therapeutic units with an outside pool and heating of the facilities
- Constructing geothermic greenhouse to cover the local necessities of vegetables during winter and spring.

11 Retrieved from http://www.sciencedirect.com/science/article/pii/S0375650509000704

- Constructing dryness unit of fruits and vegetables for the biological stock – farming
- Developing marine cultivation

At Samothraki, thermal tourism has been developed.

Thermal spring of Samothraki's Psarotherma – Region of Evros: In the northern part of the island, at about 93 km far from Kamariotisa, the port of Samothraki, the Therma (or Loutra) are located whose warm sulfurous springs were known for their curative capabilities since the age of Byzantine.In fact, five springs cover the hydrotherapeutic center needs with their degree varying from 30°C to 100°C. The hydrotherapeutic center has two grouped and five individual bath tabs which operate during Summer. The management is being handled by the municipal Enterprise of Growth at Samothraki.

VIII.2.4. Biomass

There was a paper from the "Bureau of Anergy of the Aegean Sea" in 2011 dealing with the biomass's capabilities exploitation in Samothraki Island, either with energy crops (Cynara cardunculus) or with the exploitation of the residues that derive from other cultivations (branches of olive trees, corps, stock – farming residues), for electricity and heating production, as well as for inexpensive energy production. The cheap biomass energy production, if made in a consistent and targeted way, it can entail huge fiscal and environmental benefits. Samothraki has many possibilities, which are not being appropriately exploited.

- Pomace wood can be used as a solution for the energy issues that the island has (vast amount of olive trees).
- Promotion of energetic cultivations.
- Recycling of solid waste.
- Forestall biomass.

VIII.2.5. Hydroelectric power

The rational exploitation of the water resources of the island can contribute to the production of electric energy.

VIII.2.6. Energy

Samothraki is being supplied by underground routes from Alexandropoulos Mesimvria. Its total supply during Winter is up to 2 Mw, while in summer can be up to 4 Mw.

At Samothraki, while the environmental opportunities of clean renewable sources, with low or zero emissions during the production of electricity, seem to be very important, they are not being properly used. Even though the demand for power supplies is increasing, the main domain of the island's electricity is being accomplished through

underground supply cables. There is a small possibility for the island to become partly independent. In fact, a system of energy in the island will completely rely on renewable energy sources, is also able to become a prototype for a developing plan that will fulfill both sustainable goals and restrain climate change (Network of Sustainable Islands "Dafni", 2011, http://sustainable-samothraki.net).

IX. Conclusions

Coastal and estuarine ecosystems have always been, and they are still heavily influenced by human activities through pollution and habitat loss worldwide. Over 80% of all marine pollution originates from land-based sources which are primarily industrial, agricultural, and urban, while the chemical and biological characteristics of coastal waters are susceptible to the addition of soil biodegradable and stable compounds.

This deliverable is focusing on pollution problems due to the irresponsible human activity in the coastal areas of Alexandropoulos and Samothraki. It tries to describe in a scientific and solid way the current situation by collecting and studying the relevant literature or existing academic studies.

Within this context, the main threats emerging from pollution problems regarding environmental sustainability (coastal and marine) and public health, have been identified and described on regional and pilot area scale. Additionally, these threats were studied and analyzed to examine how tourist flows aggravate the existing problems and how these threats affect tourist sustainability.

Moreover, the legal and administrative framework for coastal zone protection is presented, along with proposals for the coastal ecosystem's protection and restoration, considering the best practices from different sources and applications.

The results highlight the main coastal pollution impacts on Tourism and its development at a pilot area scale. Pollution in all its forms mainly results in freshwater quality degradation, coastal waters' eutrophication, soil degradation, noise, aesthetic and light pollution and drastic declines in overall abundance and diversity of marine organisms.

Like all forms of pollution, coastal and marine pollution can be controlled by deploying data-driven strategies based on law, policy, technology, and enforcement that target priority pollution sources.

The coastal ecosystems' complexities along with the interactions of stressors in the coastal zone realm at interfaces with atmosphere, land and freshwater are of multidisciplinary interest. Coastal pollution prevention has many benefits on both the environment and humans. In fact, it boosts economies, increases tourism, helps restore fisheries, and improves human health and well-being. Besides, it advances the Sustainable Development Goals (SDG) that are crucially needed for the whole globe wellness.

X. Reference

Akrivos C., Salesiotis M., 2007. Tourism: Introductory concepts. Interbooks Publishing, Athens.

García-Ruiz J.M., Nadal-Romero E., Lana-Renault N., Beguería S., 2013. Erosion in Mediterranean landscapes: Changes and future challenges. Geomorphology. 198: 20-36.

Gemitzi A., Banti M., Lakshmi V., 2019. Vegetation greening trends in different land use types: natural variability versus human-induced impacts in Greece. Environmental Earth Sciences. 78:172.

Kokkosis C., Tsartas P., 2011. Sustainable TOURIST development and environment, Kritiki Publishing S.A.

Lickorish L., Jenkins C., 1997. An introduction in tourism. Oxford, UK: Heinenmann.

Logothetis M., 2001. Tourism industry law. Sakkoulas Publishing, Athens.

Molla F., 2014. Island environmental problems. Case study of Samothraki. Diploma Thesis, University of Thessaly, Engineering Department of Spatial Planning, Urban Planning and Regional Development, Volos.

Prokopiou G., 2019. Management of coastal environmental tourism. Doctoral Thesis, University of Piraeus, School of Shipping and Industry of University of Piraeus, Department of Maritime Studies, Piraeus.

Arabatzis and Polyzos, 2008

Portolou *et al.* 2009

DISCLAIMER

The present document has been produced with the European Union financial assistance under the ENI CBC Med Program. The contents of this document are the sole *Region of Eastern Macedonia & Thrace (REMTH)* responsibility and can under no circumstances be regarded as reflecting the position of the program management structures.

PARTNERS

ASSOCIATES PARTNERS