



Co-Evolve4BG

Pollution and other anthropogenic pressures affecting ecosystems

- Mediterranean Scale -



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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 at a national scale” Co-funded by ENI CBC Med Program (Grant Agreement A_B.4.4_0075).

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Abstract

This document has been produced within the framework of the Co-Evolve4BG project “Coevolution of coastal human activities & Med Natural systems for sustainable tourism & Blue Growth in the Mediterranean” in relation to the threats and enabling factors for the development of marine and coastal tourism at the Mediterranean scale. This paper represents a geospatial analysis of factors related to anthropogenic activities (Pollution and other anthropogenic pressures affecting ecosystems - Tunisian scale, Threats and Enablers at the Mediterranean scale: Mediterranean scale analysis).

I. Introduction

The Mediterranean is also one of the most polluted semi-enclosed basins in the world.

Millions of tons of macro-waste litter the bottom (including in deep pools) or are in suspension. Thousands of tons of toxic waste are discharged directly into the sea by industry. Other threats include shipping, urban and agricultural pollution, and the effects of tourism.

Pollutants from heavy metals and persistent organic pollutants (POPs) pose irreversible risks to health and marine life. Sediments collected from “hot spots”, usually located in coastal areas receiving large amounts of effluent, solid waste and domestic sewage, contain high levels of mercury, cadmium, zinc and lead. These substances can travel thousands of kilometers across national borders, far from their points of origin.

Environmental problems on the Mediterranean scale have experienced an increasing trend since the geopolitical situation has become unstable because of pandemic and war. The majority of environmental degradation includes water pollution, air pollution, marine pollution, inadequate solid waste management and uncontrolled use of synthetic agrochemicals. In addition to pollution, other anthropogenic stresses are also encountered due to negative and irresponsible human activities, such as uncontrolled construction due to lack of proper urban planning, excavation, marine fill, quarrying, etc.

Although the problem continues to worsen, the reason for this unfavorable situation in the environmental sector is still a matter of weak institutional organization, with an unclear distribution of responsibilities among institutional parties. In addition, the problem is exacerbated by natural conditions, such as climate change, the country's geography, area and limited natural resources (SoED, 2020).

Pollution is considered one of the most important aspects of environmental degradation along the Mediterranean coast, which has serious repercussions on human health and affects the quality and quantity of a huge biodiversity and the whole ecosystem. It is well pronounced in the coastal area (UNEP/MAP, 2020).



II. Factors related to anthropogenic activities

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Many factors influence pollution in the Mediterranean, especially in densely populated areas such as the coastal strip, and where effective environmental measures and appropriate legislation are lacking or not enforced. These factors can be summarized as follows:

II.1. Natural Factors

These cover the geographical framework of the entire coastal area of Lebanon where the adjacent mountain ranges slope towards the sea. Along this area, which occupies more than 70% of the Lebanese population and is characterized by a high population density (> 700 people/km²). When large volumes of eroded soil and rock are transported by rivers and delivered to the sea, they form estuaries with huge plums extending several kilometers into the sea (tens of kilometers).

II.2. Institutional Factors

Since its establishment in 1992, the Ministry of Environment (MoE) in Lebanon has been trying to find an effective solution for waste disposal, but has never succeeded due to the conflict of competence between different institutions. In other words, the problem lies in the lack of coordination between governmental authorities, especially the fact that waste disposal (liquid and solid) falls under the competence of different ministries and authorities. Until recently, no effective solution has been adopted to properly dispose of the thousands of tons of solid waste generated daily, especially those belonging to coastal cities, including the capital Beirut.

In addition, the environmental legislations elaborated by the Ministry of Education have not yet entered into force and are yet to be adopted by other institutions at the national level. On the other hand, there are many plans and programs established by the Ministry of Education that have been supported mainly by foreign international agencies, such as UNDP, UNESCO, the World Bank, etc.

II.3. Anthropogenic factors

These are the most important factors in terms of pollution, especially in the marine environment. They involve many aspects, including the lack of formal controls and the unethical behavior of some citizens. These two factors, together with the lack of appropriate waste management solutions in the country, can probably explain why the Lebanese coastal strip is characterized by unfavorable environmental features, such as landfills, sewage, oil residues, etc.

II.3.1. Industrial

Industrial activities are a significant contributor to pollution in the Mediterranean sea and coast. The Mediterranean region is home to a large number of industries, including petrochemical, textile, and metallurgical plants. These industries produce large amounts of waste, including chemicals, heavy metals, and plastics, which are often dumped into the sea or discharged into coastal waters. This pollution can have severe consequences for marine life, causing harm to fish, birds, and other animals, as well as threatening human health through the consumption of contaminated seafood. In addition, pollution from industrial activities can have a significant impact on the tourism industry, which is an important source of income for many Mediterranean countries. Efforts are being made to reduce pollution from industrial activities in the Mediterranean, including stricter regulations and the promotion of more sustainable practices, but much remains to be done to protect the health of the sea and its coast.

An apparent pressure on the coastal areas of the promontory is the development, which manifests itself in private residences; this type of industry is well established in various regions of Tunisia. Indeed, as an example, high-density tourism development such as dense inland development near the boundary line occurs in various localities along the northern, central and southern coast of Tunisia. In Yasmine Hammamet, for example, an entire "city" has been erected along the seafront. The city center of Sousse has been able to combine various textile products with the tourism industry. In addition to the city of Monastir, tourism is greatly affected by the industrial discharges of the Hamdoun stream. In the south of Tunisia, from the city of Sfax to Gabes, the chemical industry affects mainly the coastal area of the region.

The environmental problem in Lebanon, which is largely represented by pollution, is significantly attributed to marine pollution. Moreover, the huge sources of pollution that spread along the coast are sometimes a geographical overlap of different pollution sources (i.e., more than one source in the same site). Indeed, the impact of marine pollution is very detrimental to the ecosystem and its environmental components.

Although sediments transported from the terrestrial environment as well as estuaries into the sea are often characterized by a large geographic extent, they have a slight impact on the marine ecosystem and encompass an opposite effect (negative or positive). For example, many organisms have adapted to fine sediments and high sedimentation rates, and use estuaries as habitat, where fine sediment beds are important for burrowing tube invertebrates and other burrowing species. In addition, species diversity and uniqueness decreases with increasing percentage of sediment and organic matter. In Lebanon, no studies have been conducted on the impact of transported sediments on the marine ecosystem, but it is generally accepted that transported sediments are almost harmful to coral reefs, especially those located at shallow depths in coastal sites.

III.

**Impact of marine
pollution and
anthropogenic
activities on the
environment**

III. Impact of marine pollution and anthropogenic activities on the environment

III.1. Impact of coastal landfills

There are several pieces of garbage (small dumps) along the coastal strip, all of which have reached their maximum capacity and often witness a load failure where large portions of waste fall into the sea.

The decomposed toxic materials from the solid waste, which are mostly in a liquid state, slowly leach into the sea water, resulting in intensive marine pollution that impacts the surrounding ecosystems. In addition, burning of coastal landfills is an aspect of air pollution where the smoke affects humans, vegetation, etc., located near these communities.

Pollutants from municipal sewage and wastewater discharges are one of the greatest threats to the marine ecosystem. For example, the lack of infrastructure in Lebanon has resulted in the direct discharge of untreated (or partially treated) wastewater from urban areas into the sea. This has resulted in a huge risk to public health and serious geo-environmental problems affecting coastal marine ecosystems.

The majority of municipal wastewater pollution involves the presence of bacteria and other microorganisms that use oxygen to metabolize the wastewater they accompany. While breaking down sewage in seawater, these microorganisms can cause hypoxic (oxygen-depleted) dead zones, which lack the oxygen that fish and other native organisms need to survive.

III.2. Impact of chemical and hospital waste

Usually, chemical and hospital wastes (including industrial) are hidden or dumped in storage facilities along the coastal zone, or in abandoned mines and valleys that are also connected to channels to the coast.

Resulting in pollution that is extremely harmful to the marine ecosystem. These suspicious and toxic wastes seep into the groundwater, killing livestock and causing cancer in humans.

These types of marine pollution are also considered sporadic in that they are dumped suspiciously at different times, almost in various locations near the coast. Thus, they are usually found as lumps in relatively small localities.

III.3. Impact of tailings and oil spills

There are some localities where oil residues are found permanently at known industrial sites and refineries along the coast, while a large number of oil spills exist temporarily, either along the shoreline or at a range off the coast. These oil materials are highly toxic and therefore have serious implications for human health, biodiversity, fisheries and tourism, which in turn have serious implications for Lebanon's livelihoods and economy.

The most accidental marine pollution event that occurred in Lebanon was the 2006 war, when the Jieh power plant was hit; Because of this, a huge oil spill appeared in front of the Lebanese coast with an area of about 3,100 km². The oil spill that occurred intensely affected coastal and marine ecosystems, such as the vermetid terraces, coral and reef communities of Sheikh Zennad, the coastline of Al Mina, the Palm Islands, the marine area of Batroun, Jbeil in Amshit and the rocks of Wata Slim. In addition, a significant impact on the seabed was detected, especially on the seagrass beds of Aarida, Amshit, Jbeil and the wave breakers of Beirut airport.

There are four power plants along the Lebanese coastal strip that produce electricity for the entire coastal area, and then release hot and waste water that is injected into the sea, causing pollution hotspots, called "thermal pollution". The warm sea water from power plants spreads as plumes into the sea and reaches a few kilometers offshore.

IV. Pollution and tourism

IV. Pollution and tourism

The Mediterranean Sea is one of the most polluted semi-enclosed basins in the world. Thousands of tons of toxic waste are discharged directly into the sea by industry. Shipping, urban and agricultural pollution and the effects of tourism are other threatening factors.

IV.1. Maritime transport

Some of the world's busiest transport routes are in the Mediterranean. It is estimated that about 220,000 ships over 100 tons sail in the Mediterranean each year - about one third of the world's maritime traffic. Many ships carry hazardous cargoes that pose potential dangers to the marine environment. Approximately 370 million tons of oil transit the Mediterranean each year (more than 20% of the world total), and approximately 250 to 300 oil tankers pass through it each day.

The spillage of tank cleaning chemicals and oil discharges are a major source of marine pollution. The Mediterranean Sea represents 0.7% of the surface area of the seas, but it concentrates in this modest area significant traffic and risks, out of all proportion to its size. It is estimated that 100,000 to 150,000 tons of crude oil are spilled each year due to maritime transport activities.

The Mediterranean receives 17% of the oil discharged into the world's oceans (even without oil spills). A major spill could occur with disastrous consequences for the environment and ecosystems.

IV.2. Tourism in the Mediterranean

The Mediterranean concentrates one third of the world's tourism. Tourism is one of the most important sources of income for many Mediterranean countries. It allows small communities in coastal areas and islands to subsist far from urban centers. There is no question of denying the economic benefits that it represents for the region. However, it has played a major role in the degradation of the marine and coastal environment. The rapid development and construction of infrastructure has been encouraged by the governments of Mediterranean countries to meet the demand. This development and overcrowding has led to serious erosion and pollution problems in many parts of the Mediterranean.

Tourism is often concentrated in areas where nature offers the greatest wealth and constitutes a serious threat to the habitats of endangered Mediterranean species.

V.
**Analysis of
factors related
to anthropogenic
activities at the
MED scale** (Tunisia, Italy,
Spain, Greece ad Lebanon)

V. Analysis of factors related to anthropogenic activities at the MED scale (Tunisia, Italy, Spain, Greece ad Lebanon)

V.1. Analysis of factors related to anthropogenic activities In Tunisia

Tunisia currently has 152 industrial zones distributed throughout the country. The most important remark is that most of these industrial zones are stationed on all the coast of Tunisia at the seaside which will create a big problem with tourism facing the absence of industrial zones in the interior of the country.

New industrial zones are regularly planned in order to face the increasing demand for industrial land.

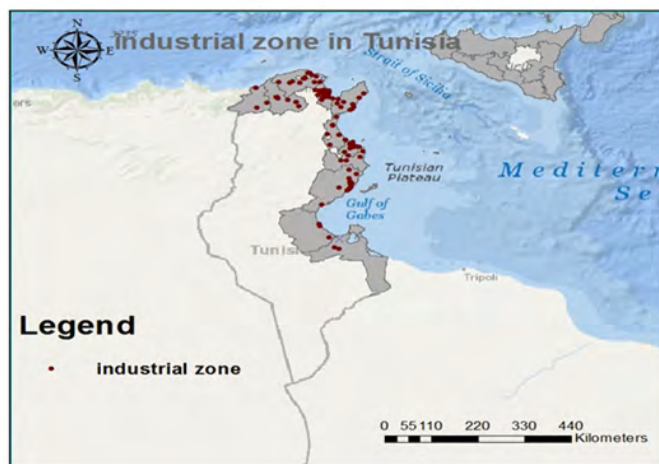


Figure 1. Industrial zones in Tunisia

New industrial zones are regularly planned to meet the growing demand for industrial land.

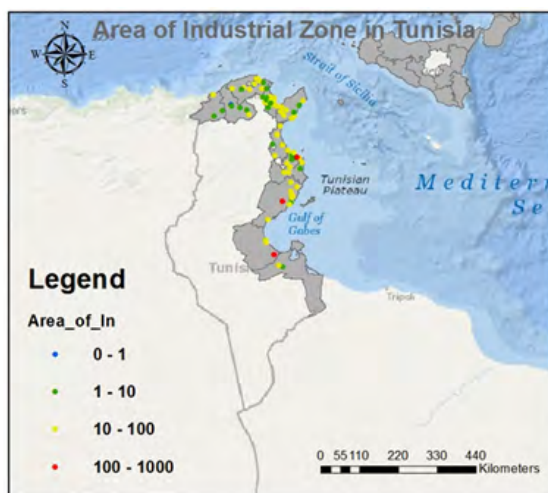


Figure 2. The surfaces of industrial zones in Tunisia

Table 1. Distribution of industrial zones in the Grand Tunis

Gouvernorat	Nombre de zones ¹⁶	Superficie en (ha)
Tunis	7	335
Ben Arous	22	1068
Ariana	7	203
Mannouba	8	102
Total Gran Tunis	44	1708

In Tunisia, the infrastructure is one of the largest parts of the territory that can offer a satisfactory attractiveness, development projects affect urban areas unevenly. Under these conditions, rebalancing is impossible. The trend towards the concentration of economic, political-administrative and cultural powers in the large coastal cities is confirmed. There is an important link between tourism and industrial units, but not always direct. There is another economic aspect to their establishment. But in some agri-food and chemical industries, tourism is the first direct local market. In the same context, oil platforms are installed in front of or near an important tourist area such as Djerba, Hammamet, Sousse.

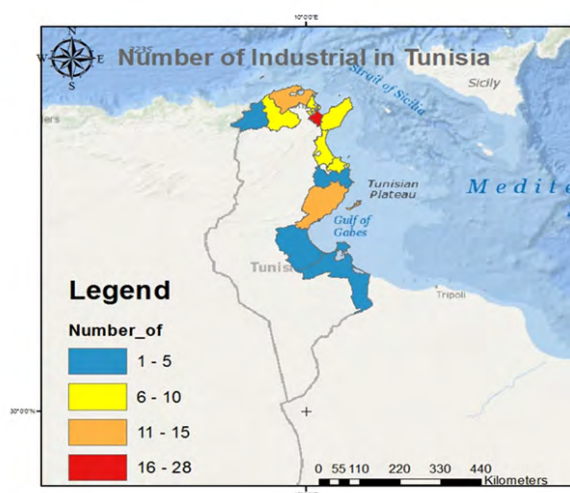


Figure 3. Number of industrial zones by region In Tunisia

Their effect on the environment should be associated with other activities to distinguish the source of the threats.

We notice that the number of industrial zones is strong in the coast of Tunisia (16-28 in Tunis) more precise in the capital of Tunis

The development of industrial zones must also take into consideration the needs of employees through the enhancement of the social dimension in the planning and design of these areas, especially in the interior regions.

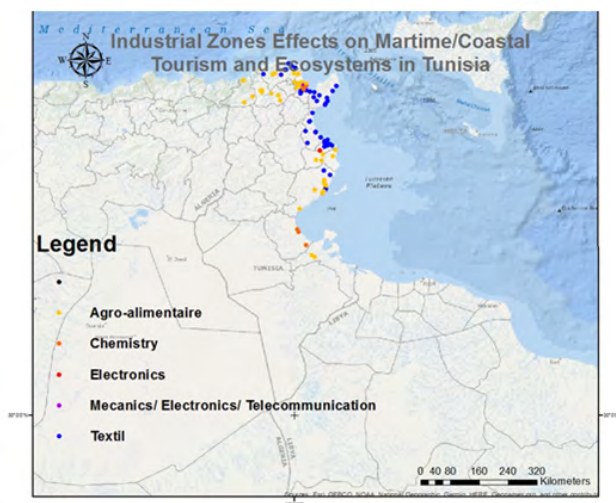


Figure 4. Type of production of industrial zones In Tunisia

Food industries : including in particular the milk and derivatives industries, grain and flour processing, canning and semi-canning, drying, dehydration, freeze-drying, sugar production, chocolate and derivatives, beverages, alcoholic liquids and vinegars, refrigeration industries, compound foodstuffs, packaging of agricultural and fishery food products.

Textile and clothing industries including fraying, finishing, milling and texturing, dyeing, ouaterie, embroidery, manufacture of synthetic and artificial fibers, - Leather and footwear industries including tanning and tannery, leather goods, manufacture of leather clothing,

The industries of building materials, ceramics and glass : of which in particular the industries of marble, lime, concrete, tiles, cements, bricks, tiles pipes in terra cotta, sanitary articles, crockery, earthenware, insulators for buildings, glass and crystalware,

Chemical industries : including in particular the transformation of phosphates, the production of nitrogen and fertilizers, the production of sulphur, fluorine, soda, mineral acids, petroleum derivatives, solvents and thinners, coloring materials, polymerization,

polyaddition and polycondensation, the rubber industry and pneumatic, the manufacture of coatings, sealants, gas for industrial and medical use, aromatic compounds, tonic extracts, products for pharmaceutical or veterinary use, pesticides, cleaning products, inks, paints, glues, lubricants and greases.

Mechanical, metallic, metallurgical and electrical industries: including in particular the manufacture of primary steel products, metallurgical, metallic and electrical products, electronic equipment and components, telecommunication devices, etc.

Miscellaneous industries : including in particular wood and furniture industries, cork processing, basketry and strawberry making, paper and graphic arts industries, plastic industries.

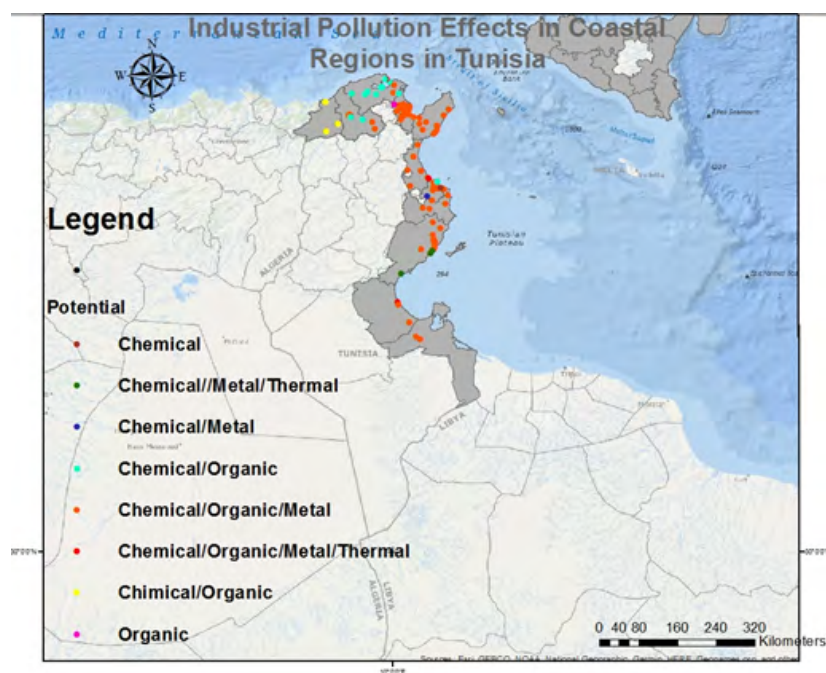


Figure 5. Potential pollution by industrial zones in Tunisia

With growth proportional to environmental deterioration, industry is largely responsible for the increased pressure on ecosystems and their degradation. And results in a strong urbanization and overexploitation of natural resources. This could reflect the environmental awareness of the Tunisian state vis-à-vis the ecological situation.

Indeed, an urgent intervention is required in front of the accumulation of waste and chemical industrial residues very toxic for nature and human health.

Solid waste : The final waste is generally rejected in public dumps. Packaging is stored on site, sold or reused. Special waste is made up of treatment sludge and by-products of industrial activities. These wastes contain polluting substances, generally dangerous for the environment and public health, which require appropriate management methods. This waste is generally stored on site or disposed of in municipal landfills.

V.2. Analysis of factors related to anthropogenic activities In Italy

There are 53 industrial districts located in the Italian coastal provinces. Among these districts, the main productions are: textiles and clothing (16), household goods (10), leather and footwear (9), food industries (8) and mechanical industries (7). The locations of the industrial units listed in the table have been defined using the centroids of the cities where the industrial districts are located.

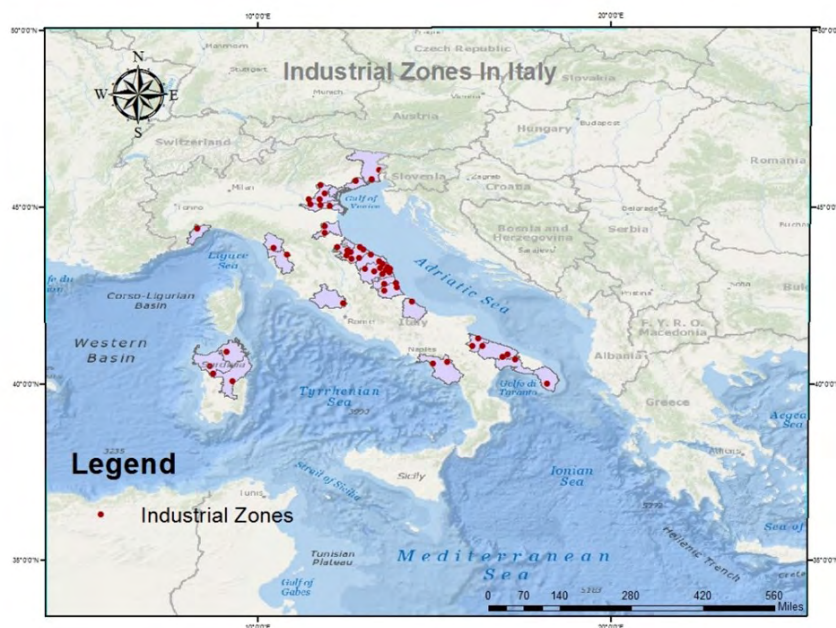


Figure 6. Industrial areas in Italy

In Italy, there are no specific studies on coastal industrial areas, but the Italian National Institute of Statistics conducts a periodic census of national production activities. The last of these was the ninth census of Italian industry and services. At the national level, based on local labor systems, ISTAT identified 141 industrial districts and classified them according to their production specialization.

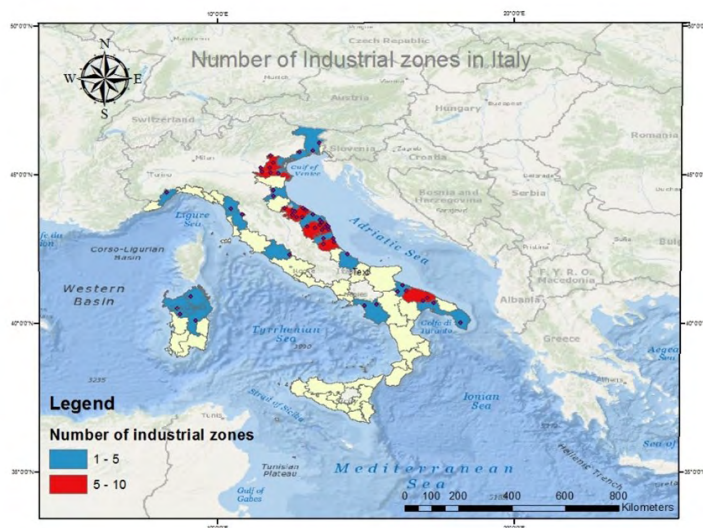


Figure 7. The number of industrial zones by region in Italy

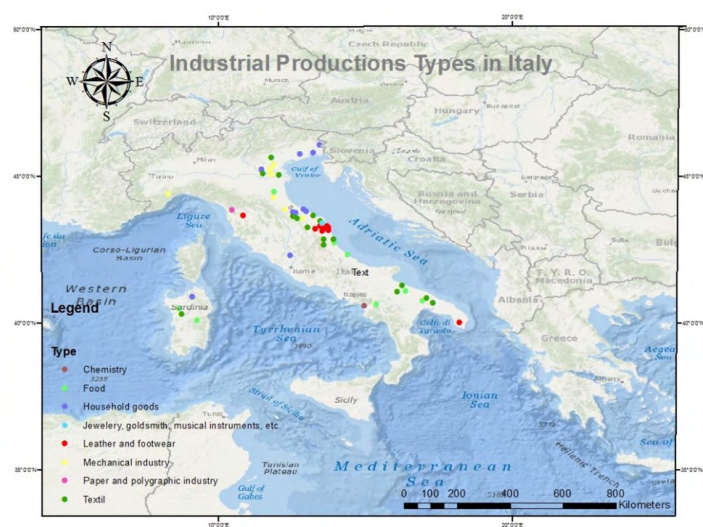


Figure 8. Type of Production of Industrial Areas In Italy

The industrial production in Italy is multiple we can notice that the chemical production is not deflated.

The Italian legislation foresees that the regions send to the competent provincial structures information on pollution from industrial sources. The information to be provided includes compliance with authorizations for discharges, but not data on pollution loads. Chemical plants, representing 50% of total chemical production, had already significantly reduced pollutant discharges (COD, nitrogen, phosphorus, suspended solids, heavy metals) in 2002.

V.3. Analysis of factors related to anthropogenic activities In Spain

Gross domestic product (GDP) expresses the total value of goods and services produced in a country over a given period of time, usually one year. The volume of GDP, expressed in millions of euros, establishes the size of an economy, and its evolution is indicative of its stages of expansion or decline. In Spain, the manufacturing industry has experienced a negative evolution if we compare the beginning and end of the fifteen years between 2000 and 2015, going from 16.2% to 12.9% of total GDP. In turn, the contribution to GDP of manufacturing industry expresses the importance of this branch of the economy.

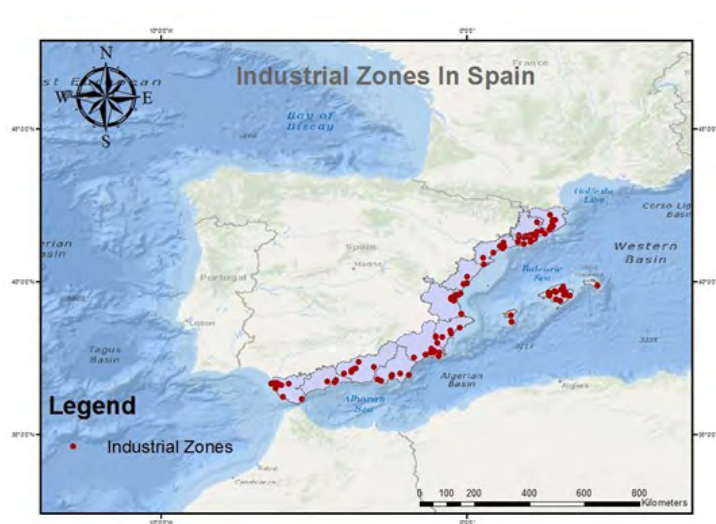


Figure 9. Industrial areas in Spain

Production in relation to the primary sector, the rest of the secondary sector and services.

The territorial contrasts are evident, currently highlighting the weight of the GDP of industry in Burgos, Navarra, Álava and Gipuzkoa compared to its relative weakness in Extremadura, Madrid, the Balearic Islands and southern Andalusia.

Spanish industry is characterized by a concentration in certain branches of activity, with agriculture and food accounting for approximately 23.6% of overall sales. Secondly, there is the chemical and pharmaceutical industry and industrial activities related to transport equipment. Spanish industry is highly concentrated both geographically and by industry. This trend also occurs both in terms of production and sales and in terms of employment and business. The Mediterranean autonomous communities with the most relevant industrial fabric are Catalonia, Andalusia and the Valencian Community.

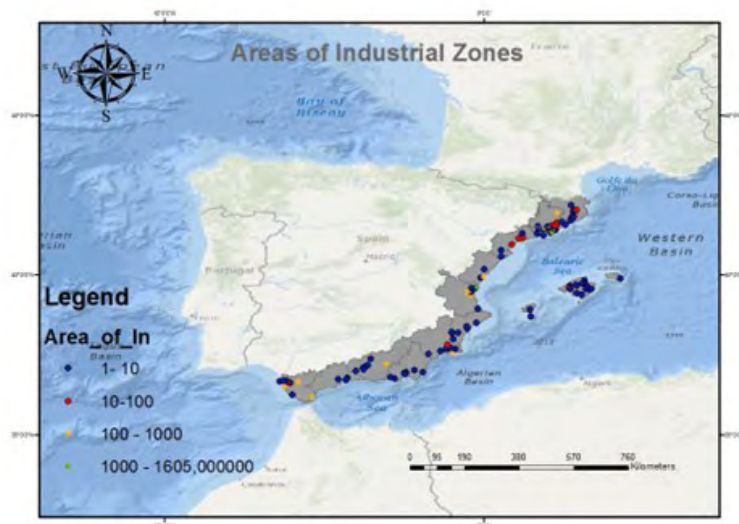


Figure 10. The surfaces of the industrial zones in Spain

The industrial specialization of the Spanish economy is mainly oriented towards agro-food activities, chemical and pharmaceutical production and transport equipment.

The Flix water reservoir in Tarragona has received the impacts of the toxic chemical industry for more than a century. More than 700,000 cubic meters of toxic waste containing substances such as mercury, cadmium and other toxic organochlorine components (such as hexachlorobenzene, PCBs or DDT) have been dumped by the company ECROS to the river Ebro from Flix. The beaches of the Spanish Mediterranean coast suffer from significant pollution due to local industries and agriculture.

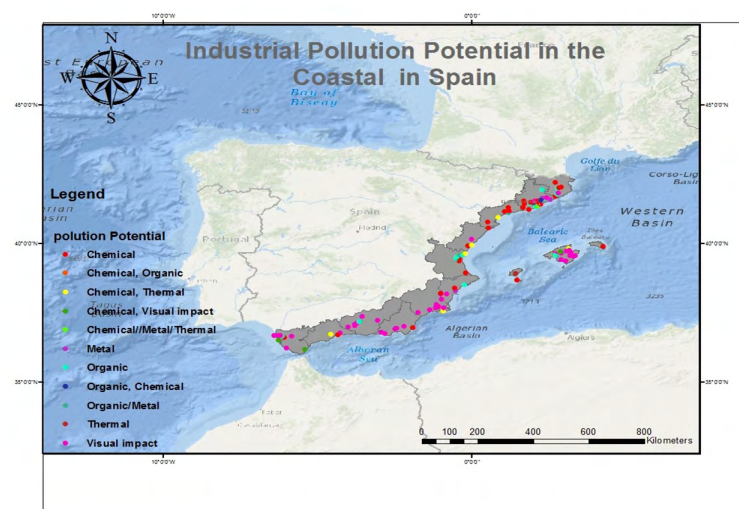


Figure 11. Pollution Potential of industrial areas in Spain

The pollution of our oceans is one of the biggest concerns of our time. The cause is the production of plastic on a global scale, the overwhelming majority of which is not recycled. The 8,000 kilometers of Spanish beaches are contaminated. The coastline of Barcelona would be the second most affected by the dumping of plastic in the Mediterranean

The beach of the province of Tarragona in Catalonia, the beach of La Pineda, designated as the most polluted in Europe in microplastics. At the end of 2021 a group of volunteers carried out a cleaning of this beach during which they collected more than 790,000 small pieces of plastic. Of the 6,000 cleanups carried out as part of the global microplastic collection operation, Tarragona proved to be the most contaminated. This is the largest amount collected in such a short time.

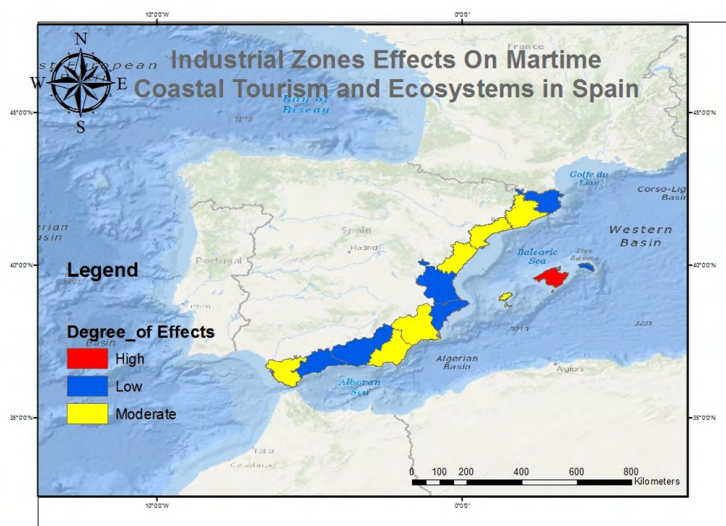


Figure 12. The effect of industrial zones on tourism and the ecosystem in Spain

The weight of pollution in this area is explained by the local industry: Catalan companies alone account for nearly 70% of the production of plastic in Spain. The industrial areas of Tarragona and Barcelona are affected. Microparticles of plastic are lost (due to their size) during the production and distribution processes. These particles, too small to be recovered, end up in the sea and in the sand of the beaches.

V.4. Analysis of factors related to anthropogenic activities In Greece

Greece has undergone significant economic and social developments as a full member of the European Union (EU), particularly over the past 30 years. But Greece's notable efforts toward economic and social convergence with other European countries have been accompanied in part by environmental control of various forms of pollution and improvements in quality of life. In recent years, Greece has made much progress in environmental legislation and regulation. However, bureaucratic incompetence, corruption, and inactivity of local authorities in taking action for the enforcement of environmental law have caused problems in policy implementation.

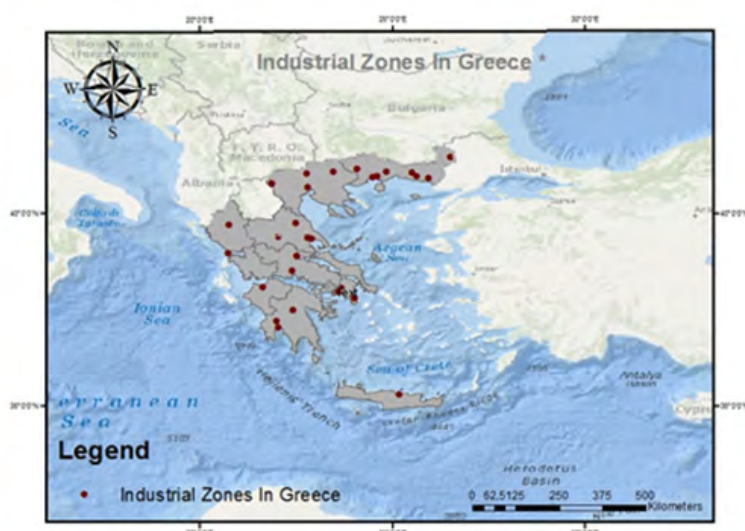


Figure 13. Industrial areas in Greece

With more than 16,000 km of coastline, Greece has the longest coastline of any country in the Mediterranean. But, mainly due to a very complex legislation, and the number of institutions involved in environmental protection and conservation at the national level, there is no real network of coastal and marine protected areas in the country. Eight coastal protected areas cover about 29,000 ha but include mainly terrestrial areas. Biodiversity and coastal area legislation is sufficient, but its application is hampered by various difficulties that slow down its implementation.

The main sources of impact listed by the national report are: - untreated wastewater discharges from hotels, although the law requires treatment, - anchoring of pleasure boats in Posidonia meadows, - construction of marinas and ports in the immediate vicinity of lagoons, and more generally the construction of infrastructure, - overcrowding of beaches, - introduction of predators, - uncontrolled sightseeing in the middle of schools of cetaceans,

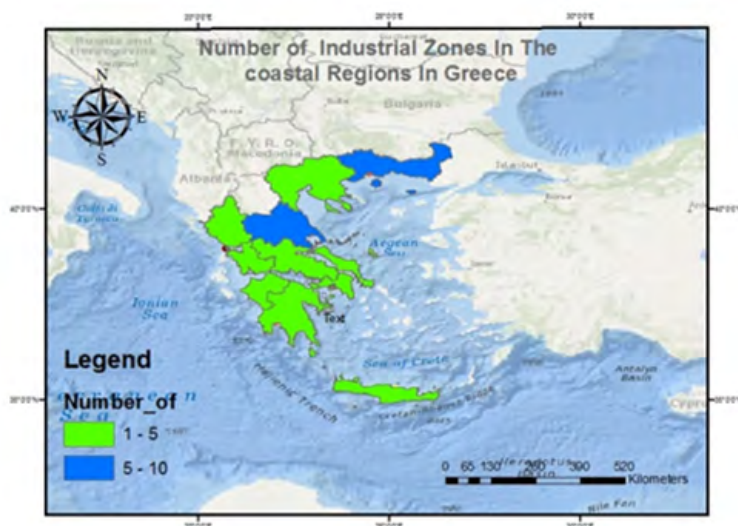


Figure 14. Number of industrial zones per region

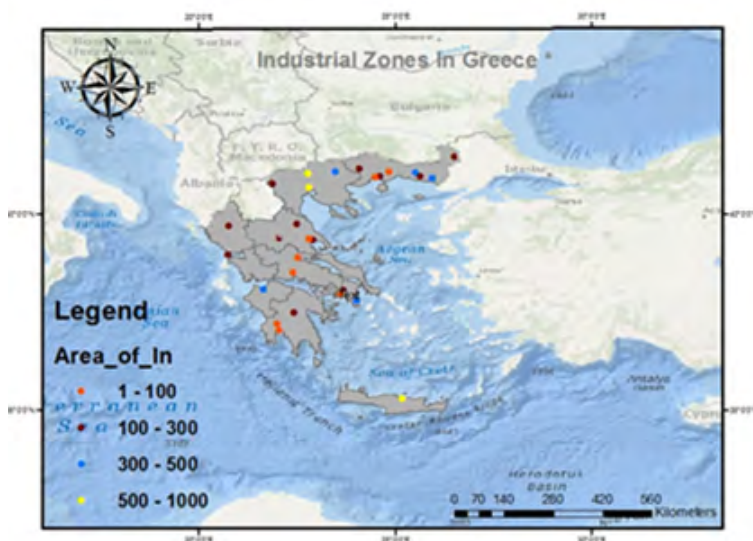


Figure 15. Areas of Industrial Zones in Greece

The Athens region accounts for almost half of the country's industrial activity, the other main centers being Thessaloniki, Patras and the port of Vólos, in Thessaly. Light processing industries (food, textiles, leather) are present throughout the country, while heavy industries are concentrated in Athens (chemicals, mechanical and electrical engineering, aeronautics), Piraeus (shipyards), Thessaloniki (metallurgy, chemicals), Patras (chemicals) and Vólos (metallurgy).

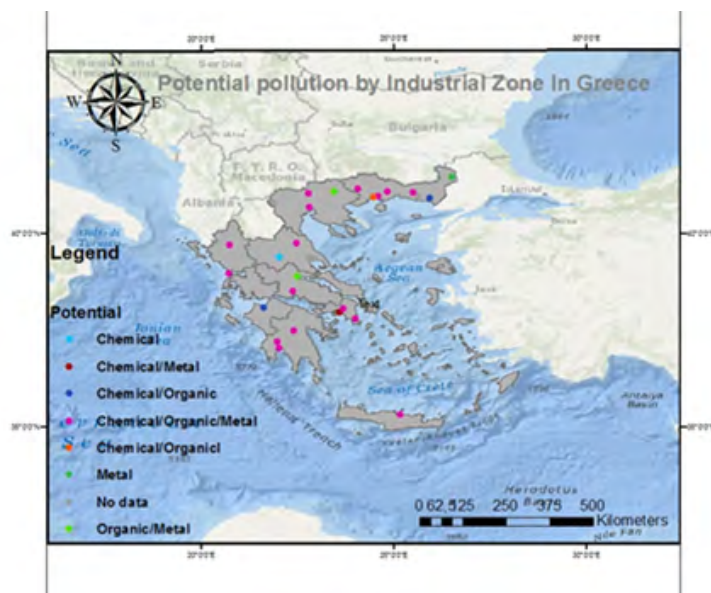


Figure 16. Pollution Potential of industrial areas in Greece

The main facilities of the “Larko” metallurgical plant are located in Larymna (Phtiotide nome), Greece. The waste produced during the processing of ores by this plant is disposed of in the Gulf of Evia. According to a survey conducted by the Greek Maritime Research Center, this industry pollutes the gulf by dumping nearly one million tons of rust, which contains toxic heavy metals such as nickel, chromium, cadmium and mercury, into the gulf each year. A study published by Greenpeace reveals that the level of toxic heavy metals in the region’s fish products is so high that long-term consumption of these fish poses serious public health risks. Despite complaints from citizens’ organizations and political bodies, the Greek government still defiantly refuses to solve this problem and thus protect the health of the inhabitants and the fragile marine environment of this region. Instead, it is permissive towards this company, which already has an extremely heavy record of environmental pollution and occupational safety.

The Greek Ministry of the Environment and Energy has fined some 20 companies 700,000 euros for repeatedly polluting Lake Koronia in the north of the country.

Twenty Greek companies have been fined 700,000 euros for repeated pollution of Lake Koronia, in northern Greece.

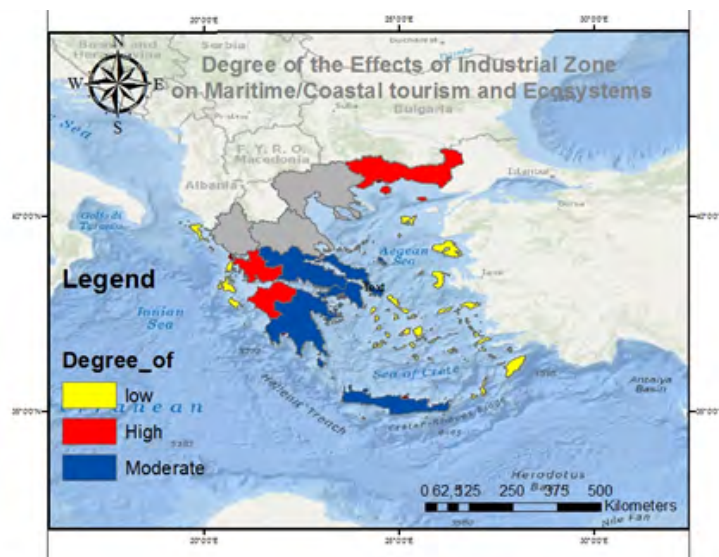


Figure 17. Degree of effect of industrial zones on tourism and the ecosystem

The waters with their infinite variations of blue are the delight of tourists. With its 15,000 km of coastline and beaches, Greece offers a palette of unique landscapes in the Mediterranean. But under the crystal clear waters, the show is quite different. Thousands of plastic bags cling to the rocks and form artificial corals. Georgios is one of the last small fishermen of the island of Salamina, one hour from Athens. Until a few years ago, there were about a hundred of them exploiting these very fishy waters. Today, there are only about fifteen of them.

Environmental Impacts

- Loss of biodiversity (wild animals, agro-ecological diversity)
- Food insecurity (damage to crops),
- Loss of landscape / aesthetic degradation
- Pollution of surface water / Decrease in water quality (physico-chemical, biological)
- Genetic contamination
- Overflow of waste storage sites

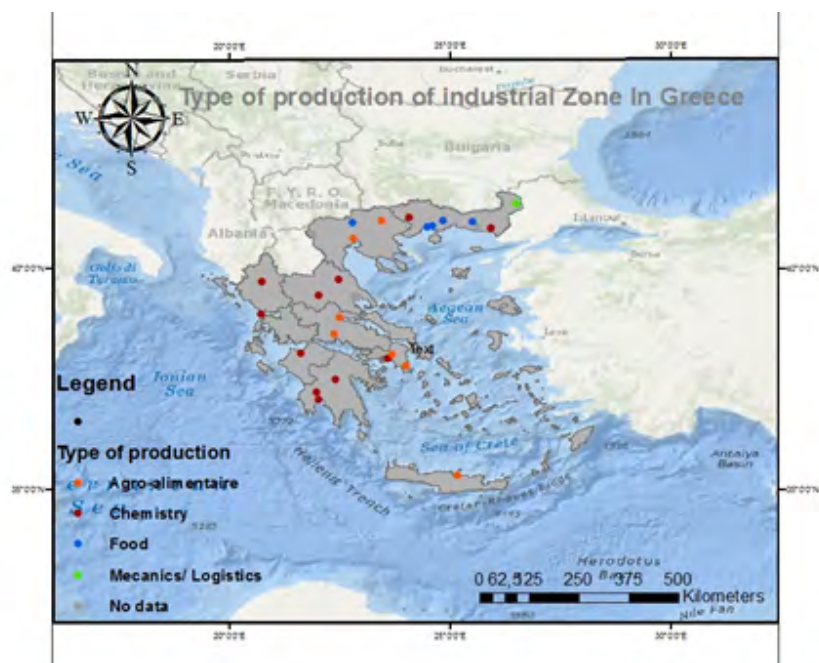


Figure 18. Degree of effect of industrial zones on tourism and the ecosystem

The table shows the shares of industrial branches in the four Mediterranean countries, in Germany and in the EU 27. In a simplified mode, we have grouped these four countries, Germany and the EU27 for the AFIs (Food processing industries), chemicals (plus plastics and pharmaceuticals) and “heavy” industry. It seems to us that the four Mediterranean countries share characteristics that are clearly different from those of Germany. The weight of the AFIs is common to them, and even if Italy stands out, its “food regime” remains well characterized. Traditional” industries such as textiles, wood, paper and construction materials are generally of particular importance (Spain and Greece have a real estate sector in full collapse). Italy, which is closer to Germany, is clearly different in terms of “traditional” industries, which account for 15% of its production, compared with 10% in Germany, indicating the importance of the Third Italy. Conversely, “heavy” industries are exceptionally important in Germany. Finally, chemicals and their derivatives, except in Italy, have a similar weight, which shows that the Mediterranean does not exclude this type of activity by nature.

Table 2. Type of productions of the industrial areas in Greece compared to other countries by %.

	Greece	Spain	Italy	France	Germany	UE 27
Food and beverage industries	47,53	32,03	17,58	28,45	14,20	19,32
Textile clothing leather	3,56	3,30	6,81	1,61	0,97	2,64
Wood and furniture	1,47	2,31	4,06	2,61	2,98	3,20
Paper and printing	5,41	4,53	4,75	4,05	3,69	4,21
Chemicals, pharmaceuticals, plastics	15,84	14,91	13,04	17,21	16,86	16,56
Non-metallic products	5,18	3,63	3,88	3,70	2,39	3,06
Basic metallurgy	10,90	5,71	7,57	2,58	6,99	6,99
Electron. prod. Transp. equipment	7,35	29,23	36,78	31,54	46,43	38,44
Installation repair	0,90	3,00	2,96	6,09	3,38	2,98

Since the end of the Second World War, Greek industry, while remaining highly concentrated on agri-food and textiles, had built up a significant energy and metallurgical base. It had also developed a housing construction activity, as an outlet for the products and materials it needs, and as a driver of household equipment. By the turn of the century, many companies had been created in the field of electronics, computing and ICT. The country's industrial base had thus diversified considerably, although it did not extend to mechanical engineering activities comparable to those in EU countries (except for shipyards and some armaments).

The most important industry in Greece is the maritime industry. Geography has made the country a major player in maritime affairs since ancient times. The Greek maritime industry has been one of the brightest spots of the modern Greek economy during the nineteenth century.

V.5. Analysis of factors related to anthropogenic activities In Lebanon

Lebanon already has some 130 industrial zones, but they lack adequate infrastructure. Many are located in the middle of cities and on the coast of Lebanon

Many factors influence pollution in Lebanon, especially in densely populated areas such as the coastal strip, where effective environmental measures and appropriate legislation are lacking or not enforced



Figure 19. Industrial zones in Lebanon



Figure 20. Type of production of the Industrial zones in Lebanon

Human activities directly on the marine area (in seawater), including: oil spills from ships and industrial areas. Unspecified sources of pollution, such as chemicals and toxic materials, that are frequently mentioned in the news media or by witnesses

Lebanon has always been trade-oriented. This choice has left its mark on the industrial sector, which is essentially characterized as a light industry targeting everyday consumer products such as food and beverages, the wood and furniture industry, textiles and ready-to-wear, machinery and equipment, leather and footwear, jewelry, paper, cardboard, and major minerals.

Exports are mainly of seeds and oils, food industry products, beverages, mineral products, hides, leather, woodwork, textiles, tobacco and handicrafts.

About 15 sub-sectors currently make up the Lebanese industry. The food and beverage industry contributes the highest share of production with about 26% of total industrial production, followed by metals and metal products with 12%, other non-metallic mineral products with 11.7%, machinery and electrical appliances with 11%, and furniture.

The plastics industry occupies a prominent place. It is based on the manufacture of containers, tubes, domestic objects or advertising material.

Unfortunately, the Lebanese coast is witnessing all types of marine pollution, including physiochemical and biological types, as well as huge oily sludge and oil spills occurring randomly, with a harmful environmental impact. In general, the Lebanese coast is severely polluted by liquid and solid wastes, while the pollutants are located either directly on the shore or at a distance off the coast.

In addition to their types and quantities, the liquid and solid wastes found along the coastline have different characteristics and follow a non-unified pattern of waste discharge (disposal) into the sea, which has been noticed in different coastal localities.

There is a remarkable diversity in the sources of pollution (i.e. the geographical locations where pollutants are generated) that reach the Lebanese coast, and this is often reflected on the mechanism and flow of the transport and volume of pollutants. Most of these sources are continuous, while other sources are intermittent or appear occasionally in the sea water.



Figure 21. Potential Pollution from Industrial Areas in Lebanon

Table 3. Main types of pollution in Lebanon

Typical pollution	Major sources	Description
Sediment and turbid water	Sediment and eroded material from the earth	Sediment from long distances along rivers and streams due to human activities (mainly excavation)
	Fragmented, eroded sand and lost sediments	Almost referred to these debris resulted from rocky trees due to the effect of torrential rains.
Coastal landfills	Solid waste	Coastal landfills that accumulate various solid wastes from areas far from the coast
	Coastal fill	Sediments and rocks that buried the coastline to increase the land area for different purposes
Sewage effluents	Outfalls	Wastewater from urban settlements through pipes to the sea
	Sewage seepage	Sewage without uniform flow, but seeping through porous rocks and alluvial deposits
	Grey water along streams	Wastewater discharged from urban areas at a distance from the coast along waterways and

Chemical and medical products	Chemicals from factories	Plants producing industrial or chemical products and various residues resulting from them
	Medical equipment from hospitals	Medical waste from hospitals on the coast
Oil residues	Oil spills	Intermittent slicks were mainly the result of ships and tankers, as well as marine accidents
	Oil from refineries	Petroleum liquids and slugs from coastal oil refineries
	Oil from power plants	Oil leaks from generators and pipes in coastal power plants
	Maintenance and workshop operations	A variety of oily liquids result from maintenance tools in workshops on the coast
	Oil from ships	Oil leakage from ships
Thermal water	Coastal power plants	Hot and polluted water from coastal power plant generators



Figure 22. Degree of effect of industrial zones on tourism and the ecosystem

There are several localities with pollution sources along the Lebanese coast, which may exist in small sections. However, there are huge sources of pollution of small dimensions (i.e. extension into the sea) or occur only in limited periods of time. These sources are spread along the coast. Nevertheless, the study developed by Shaban (2008, and with updates) showed that there are 47 major pollution localities where most of them are related to continuous pollution discharges (e.g., sediments along estuaries and sewers), either permanently or temporarily. Thus, the majority of pollution sources originate from land.

VII.

Conclusions

VI. Conclusions

The Mediterranean Sea is a highly fragmented physical space. It is also a border zone between two worlds whose political, cultural and economic differences are very marked. From Spain to Lebanon through Tunisia, who says industries, says discharges, in rivers but also in the atmosphere, in fine all these contaminations are found in the sea constantly testing the biodiversity and marine ecosystems. The Mediterranean is a victim of all types of industrial pollution.

The use of integrated solutions through the construction of resilient infrastructures, the promotion of an inclusive and sustainable industrialization and the encouragement of innovation are curious determinants that provide a tangible response to this problem.

- The answer also goes through the integration of key success factors in the design of a sustainable industrial zone model, namely
- The encouragement of the green economy and the circular economy (by integrating renewable solar or wind energy)
- The valorization of waste through recycling, treatment and transformation
- The implementation of a wastewater and rainwater management system The development of green spaces
- The use of the eco-transportation concept
- Identification of potential climate risks
- Improving governance ;
- The development of a benchmark study to learn about the best practices and models in the development of sustainable industrial zones, in vogue in the world, models adopted by many countries such as Germany, China, Korea.
- Encourage the creation of industrial zones in the interior of countries so as not to harm tourism.

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