Pollution and Anthropogenic Pressures Affecting Ecosystems in Tourism Areas

Batroun, Lebanon

REGIONE LAZIO

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Co-Evolve4BG

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

Pollution and anthropogenic pressures affecting ecosystems in tourism areas

Batroun scale, Lebanon

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OVERVIEW

The present document was produced within the framework of **Co-Evolve4BG** project "*Co-Evolution of Coastal Human Activities & Med Natural Systems for Sustainable Tourism & Blue Growth in the Mediterranean*" with regards to the 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).

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REVIEW

Contributors

Talal DARWISH, PhD.
National Center for Remote Sensing – CNRS, Lebanon
Amin SHABAN, PhD.
National Center for Remote Sensing – CNRS, Lebanon

Reviewer

Faten GORSANE, PhD.
Faculty of Sciences of Bizerte, University of Carthage, Tunisia

Supervisors

Béchir BEJAOUI, PhD
National Institute of Marine Sciences and Technologies, Tunisia
Nahed MSAYLEB, PhD
Lebanese University, Faculty of Agriculture and Veterinary Sciences, Lebanon

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

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Acronyms

FAO	Food and Agriculture Organization of the United Nations
GDP	Gross domestic product
UNDP	United Nations Development Program
MoE	Ministry of Environment
ACAPS	The Assessment Capacities Project
MoI	Ministry of Industry
ALI	Association of Lebanese Industrialists
UNIDO	United Nations Industrial Development Organization
CDR	Council for Development and Reconstruction
MoEW	Ministry of Energy and Water
WPR	World Population Review
MSW	Municipal Solid Waste
RSI	Risk Sensitivity Index
CDW	Construction and Demolition Waste
EU	European Union
AUB	American University of Beirut
CNRS-L	National Council for Scientific Research-Lebanon
L.C.C.	Lebanon Chemicals Company

I. Introduction

Waste disposal represents a major concern in the coastal zones where there is a dense population earning their living through a diverse variety of activities. Obviously, in all developed countries, successful management approaches are taken to address any environmental threat that may result from these wastes. whereas this is not the case in the developing countries where management plans are totally absent. Indeed, Lebanon suffers from the lack of integrated strategy to manage the residues from anthropogenic and even the natural sources.

In fact, Lebanon liquid and solid materials are dumped directly/or indirectly into the sea. Dumping materials along the coast will necessarily reach the sea either through rivers or through their streams. Due to the lack of any governmental control, several thousands of tons of solid waste are dumped every day along the Lebanese coast. Besides, several hundred cubic meters of wastewater and polluted liquids are discharged daily into the sea. Consequently, in Lebanon, rarely a year goes by without a disastrous event resulting from seawater pollution impact. Indeed, accusations by local inhabitants are frequently raised, whilst governmental efforts remain insufficient and ineffective to mitigate the intensification of this problem.

Concerns are generally given to pollution in the terrestrial environment where human activities are more developed whereas the coastal and maritime environments are often given less attention. However, the marine environment has become under pollution stress along many coasts Worldwide. Lebanon Mediterranean coast represent a typical example of such a geo-environmental problem. Lebanon narrow coastal plain (< 5 km), as well as human activities density, have made it a place to deliver liquid and solid wastes which led ultimately to further complaints of the local citizens.

According to the Ministry of Environment (MoE, 2019), there is a rapid escalation of environmental damage in Lebanon, where estimates are classified into the following categories:

- Ambient air (household, vehicular, power plant and industrial emissions and dust, etc.).
- Water (water-borne diseases, surface water bodies contaminated or impacted mainly due to the release of untreated or partially, treated municipal and industrial effluents, waste leachate, agricultural runoff, water salinity, water scarcity due to irregular flow of perennial rivers, natural resource productivity, etc.).
- Land degradation, which is being exacerbated by desertification (*e.g.,* forest fire, wood logging, *etc*.) in certain areas and increased uncontrolled urbanization in others, affecting agricultural yields, livestock productivity and forest coverage that are compounded by unsustainable quarrying practices and poor solid waste management, especially since the 2015 Beirut and Mount Lebanon's crisis.

- Coastal zone artificialization and shoreline distortion.
- Marine environment degradation, unsustainable fish catch and ecosystem services disruption.
- Global environmental impact with an increasing carbon footprint per capita. Lebanon accomplishments in global environmental mitigation and adaptation are lagging due to the Lebanon's inherent political economy and governance which are negatively impacting natural, productive, cultural assets and wellbeing of the poor community as well.

Strikingly, environmental degradation in Lebanon is largely represented by the uncontrolled disposal of soil and liquid wastes which have recently become a national problem, leading often to political conflicts. Yet, national strategies and policies remain inefficient or inadequate to resolve this environmental issue.

Concerning pollution threats, there are numerous anthropogenic stresses caused by the adverse human activities, such as the chaotic construction due to the lack of proper urban planning, excavation for construction, quarrying, and marine backfilling, *etc*. All these activities led to severe repercussions on human health, negatively impacting the biodiversity quality and quantity and the entire ecosystem as well.

This report will highlight pollution temporal and spatial dimensions and the anthropogenic pressures affecting coastal ecosystems in tourism industry in Batroun City and its surrounding. This will include the terrestrial and marine environments, and the pressures that might result either from human or natural effects, or both.

II. Pollution factors

There are several polluting factors threatening both Lebanon terrestrial and marine environments. They are indeed the responsibility of several sectors and ministries. In fact, these polluting factors belong to/are caused by diverse sources and at different areas. These factors can be summarized as follows:

1. **Population growth:** Lebanon population size exceeds 6 million people, including foreign workers and refugees. Regarding the Lebanon's small surface area (10,452 km^2); population density is high, and it corresponds to 496 capita/km^2. According to ACAPS (2013), more than 90% of the population are residing in urban areas, being mostly concentrated in the biggest cities of the country, along the coastline.
2. **Geographic setting:** Lebanon's geography makes it vulnerable to stressed waste disposal. Indeed, Lebanon is a mountainous area with several streams draining into the sea. With regards to such a geography, several factors contribute significantly to pollution:
   - The coastal plain is narrow, being frequently less than 5 km.
   - The Mount-Lebanon chain is an elevated region that is cut by deep valleys, and it directly faces the sea.
   - The Bekaa Plain is a flat region with an average width of about 8 km.
3. **Climate change:** Lebanon has a Mediterranean climate characterized by hot, dry summers and cool, rainy winters. The average annual temperature is 15 ˚C. Due to climate change, Lebanon is facing increasing drought threats, spells alternating with torrential rain and a relevant increase of temperature by 1.6 °C over the last few decades (Shaban, 2020).
4. **Economic profile:** The current economic situation in Lebanon has caused adverse effects on waste disposal management as mainly reported from polluted landfills, wastewater outfalls, *etc.*
5. **Energy generation:** Energy shortages in Lebanon has resulted in frequent power cuts for several hours per day at the local level, with rationing hours unevenly distributed between cities. Moreover, energy is no longer supplied by public utilities, instead it is being provided by privately owned generators. Self-generation plays an essential role in electricity supply and demand and is estimated at 32-33% of total electricity demand (Osseiran, 2016).
6. **Transportation:** Lebanon transport sector consists only of road-motorized vehicles, since no appropriate infrastructure for non-motorized vehicles exists (*i.e.,* bicycle lanes, *etc.*). In fact, cars occupy about 85% of the transportation tools, followed by motorcycles, light and heavy-duty vehicles. Such a situation usually entails air pollution that reaches critical and intolerable level.

7. **Industrial activities:** Most industrial sectors in Lebanon are based on food products and beverages, metal processing products and non-metallic mineral products. These sectors represent 50% the economic industrial activities at the national level. Other industries include the chemical sector, furniture manufacturing and electrical machinery manufacturing (MoI/ALI/UNIDO, 2010). Besides, the largest part of the industrial activities is located either in the coastal zone or in dense urban settlements.

8. **Solid wastes:** solid waste amount is based on population and generation rate per capita regardless of the direct weighing and monitoring of collected solid waste from households and institutions. For each considered year, both surveys and assessments (El Fadel and Sbayti, 2000; CDR, 2006; MoE, 2010) gave generation rates, with a significant increase in quantity per capita throughout the whole period (Figure 1).

9. **Wastewater:** The Ministry of Energy and Water (MoEW) is in-charge of the wastewater management. Accordingly, the MoEW has developed the National Water Sector Strategy that sets targets in wastewater management, including the following:

   - Collection and treatment of generated wastewater up to 95%.
   - Pre-treatment of all industrial wastewater.
   - Reuse of 50% of treated wastewater.
   - Secondary treatment and reuse of the total inland wastewater and secondary treatment of coastal wastewater, where reuse is economically justified.

10. **Agriculture sector:** This sector is well developed, especially in both the Bekaa Plain and in the coastal plains. It contributes to about 4.6% of the country GDP. In comparison with neighboring countries, agriculture production in Lebanon is characterized by a higher added value per square kilometer, reflecting a production higher intensity and a greater focus on fruits and vegetables values (FAO, 2011).

Among the total exploited agricultural lands, approximately only the half is irrigated. These areas have increased by 8% since 1998. 50% of irrigated lands lay on flood and furrow irrigation, while approximately 30% and 20% of water is supplied through drip and sprinkler irrigation, respectively. Therefore, the agricultural activities are often followed by unsustainable practices such as fertilizers and pesticides, which contribute to the water resources contamination.

11. **Land use change:** In Lebanon, land management plans absence and/or inadequate urban regulations have strongly affected both the natural and the urban environment. Thereby, increasing unplanned urban sprawl at the expense of natural landscapes. New roads and highways construction in mountainous areas has impacted landforms, vegetation cover, hydrologic system, and ecosystems.

12. **Effectiveness of environmental legislations:** The existing environmental laws and legislations in Lebanon aim to regulate the human behavior towards best practices. Nevertheless, policies remain ineffective and even the concerned ministries, as MoE, have dramatically failed to achieve goals.

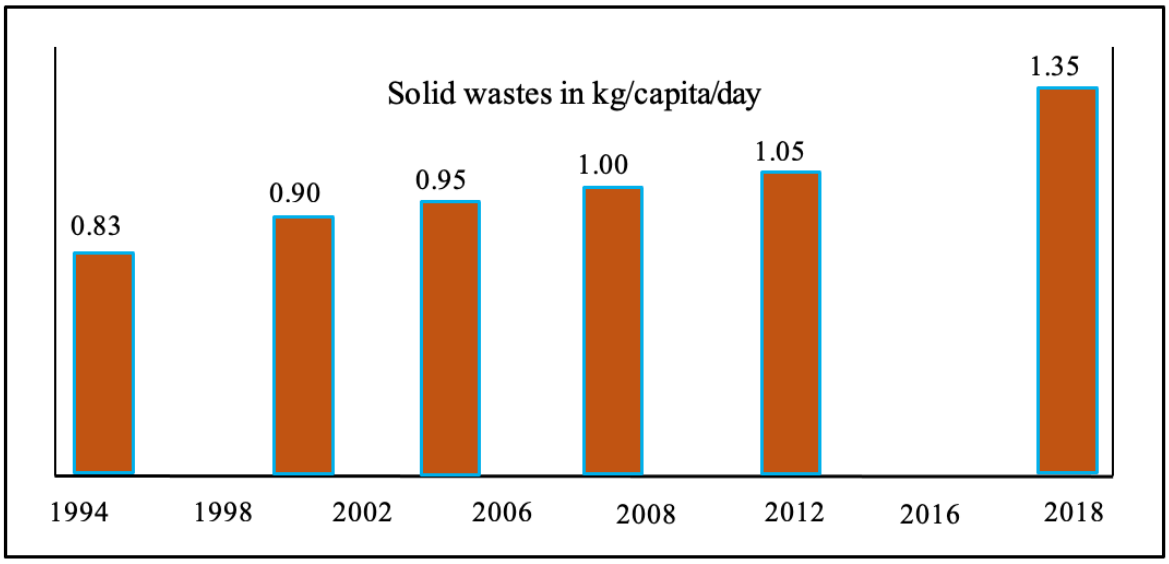

Figure 1. Municipal solid waste generation rates (per capita) for the 1994-2018 period in Lebanon (adapted from different sources).

The pollution factors in Lebanon are similar to those acting in other Lebanese regions, including Batroun City and its surrounding. The latter is facing pollution issues on-land and into the coastal/maritime region, as well.

III. On-Land pollution in Batroun City and its surroundings

The general situation in Lebanon, including political and financial crises, can be considered as the main reason behind the issue of wastes. Moreover, it has become obvious lately in all Lebanese cities. Similarly, Batroun City and its surroundings, corresponding to an area with dominant narrow coastal plain surrounded by green mountains, are highly vulnerable to pollution mainly with the poor waste disposal management plans.

III.1. Solid wastes and dumpsites

According to WPR (2021), the City of Batroun is occupied by about 10,852 people. Therefore, considering the solid waste per capita per day (Figure 1), the produced amount of solid waste from Batroun City will be as follows:

Population x produced solid waste/capita/day.

10,852 x 1.35 = 14.65 tons per day

14.65 x 365 = 5,347 tons per year

This annual amount (5,347 tons) of solid wastes is expected to be thrown every day in Batroun City itself, which requires environmentally secured place for dumping. In fact, studies have focused on the solid wastes, notably dumpsites (landfill), beyond the City of Batroun, to include the entire Batroun Caza. Knowing that the adverse effects of such wastes (*i.e.,* on the environment and health) can reach even the remotest areas surrounding them.

In Lebanon, 617 Municipal Solid Waste (MSW) dumpsites were identified in 2016, corresponding to 341 operational dumpsites (55%) and to 263 non-operational MSW dumpsites (43%). Out of the surveyed MSW dumpsites, 2% (13 dumpsites) were inaccessible. Meanwhile during 2016, surveys reported only three operational dumpsites in Batroun Caza (MoE/UNDP; 2017). Consequently, municipal solid wastes volume in dumpsites within the Batroun Caza has increased by 9,350 m^3 between 2011 and 2016 (Table 1).

The number of operational MSW dumpsites were 6 with a total volume of 17,350 m^3 in 2011, and they were reduced to 3 MSW in 2016 with a volume of about 59,000 m^3. In addition, there are several non-operational MSW dumpsites surveyed in 2011 and 2016 (Table 1).

Regarding the obtained Risk Sensitivity Index (RSI) for the 617 MSW dumpsites in Lebanon, Batroun City was ranked the 4th, displaying an RSI of 34.59, and a calculated capacity of the MSW dumpsites of 55,000 m^3. Tripoli was ranked first with 1,200,000 m^3 and RSI of 40.73, while Nabha (Bekaa) was at the 617th rank with 11.27 m^3. These data clearly stated and argued that Batroun City and its surrounding constitute an unfavorable and disabled environment.

Table 1. MSW dumpsites in 2011 and 2016 surveys for Batroun Caza (MoE/UNDP, 2017).

MSW		2011 Survey		2016 Survey	
		Cout	Volume(m^3)	Count	Volume(m^3)
Operational		6	17,350	3	59,000
Non-operational	Not rehabilitated	2	123,000	1	72,000
	Covered			-	-
	Removed			1	-
Total		**8**	**140,350**	**5**	**131,000**

With respect to construction and demolition waste (CDW) dumpsites, there are 166 identified dumpsites, among which 80% (132) were operational and 20% (34) were non-operational. Out of 324 CDW dumpsites identified in 2016, 55% (178) are operational and 45% (145) are non-operational. Overall, CDW (Volume and number) increased in dumpsites in Lebanon (MoE/UNDP, 2017).

All surveys conducted in 2016, in Batroun Caza, revealed seven operational CDW dumpsites (MoE/UNDP, 2017). Among them, four were operational since 2011. One dumpsite was non-operational in 2011 and has become operational in 2016. The total volume of wastes in these dumpsites is 22,240 m^3. Two dumpsites were identified as non-operational in the 2016 survey. While one was not rehabilitated, and another was rehabilitated-covered. One was non-operational CDW in 2011 survey and one was operational MSW in 2011 and was reclassified as CDW in 2016 survey. A detailed analysis on the changes between the 2011 and 2016 surveys in Batroun Caza are shown (Table 2).

Table 2. CDW dumpsites in 2011 and 2016 (for Batroun Caza; MoE/UNDP, 2017).

CDW		2011 Survey		2016 Survey	
		Count	Volume (m^3)	Count	Volume (m^3)
Operational		4	8,480	7	22,240
Non-operational	Not rehabilitated	2	8,800	1	600
	Covered			1	1,500
	Removed			-	-
Total		**6**	**17,280**	**9**	**24,340**

Regarding the obtained Risk Sensitivity Index (RSI) for the 324 CDW dumpsites in the entire Lebanon, Batroun City occupied the 21st rank with an RSI of 21.24, and a calculated capacity of the CDW dumpsites of 10,800 m^3. Compared to other cities in Lebanon, Morh Kfarsghab (Zghorta) ranked first, displaying an RSI of 23.53 and a total capacity of 15,200 m^3, whereas Aapoura (Jbeil) was in the bottom of the list with an RSI

of 8.016 and a capacity CDW dumpsites of about 8,016 m^3 (MoE/UNDP, 2017). Likewise, the MSW further underlined the unfavorable environmental situation in Batroun City and its surroundings.

Along with these known dumpsites, there are several temporary dumps found in many sites in Batroun City that are located near the coastline. Most of these dumps include construction debris materials and consist of a great controversy and conflicting debate when the Municipality of Batroun warns citizens to throw them away within a short time.

III.2. Wastewater

Waste disposal issue also includes liquid wastes with a special emphasis on wastewater and sewage water, which are observed as uncovered channels with different dimensions and forms in Batroun City and the neighboring regions (Figure 2). In this context, the Batroun City infrastructure is also a matter of concern, (*e.g.*, water and sewage networks, *etc.*) because it is often subjected to random digging and milling, especially by deteriorating road pavements. Due to the lack of prior investigation into the possible existence of an underground infrastructure, most of the infrastructure is not operational or still needs further maintenance.

Damage to the infrastructure may lead to several detrimental impacts, such as cutting off sewage, water pipes, generation of bad smells, attraction of water-borne diseases and vectors due to contaminated water accumulation *etc.* There is a great likelihood of this negative impact to occur, even though it is of a medium consequence and hence of a minor significance (CDR, 2020).

The streams and the tributaries of Al-Jawz River are often subjected to severe forms of pollution. Indeed, in January 2018, media reported that Al-Jawz River has become the river of wastewater and litter, due to years of recklessly dumping wastes in the river's tributaries (Figure 2). Lately, water pollution level in the river has increased significantly, mainly because of the numerous refugees' tents situated around the river's course, particularly in the villages of Beit Chlela and Kfarhelda.

Figure 2. Examples of wastewater pollution in Al-Jawz River.

There are two wastewater treatment plants in Batroun Caza, described as follows:

- **Batroun, Northern Lebanon:**

This wastewater treatment plant is in the coastal village of Sel'aata, at the geographic coordinates: 34°17'19" N and 35°45'05" E.

This plant has a design capacity of 3,200 m^3/day, but it is currently receiving around 2,000 m^3/day. The influent arrives both by gravity (from Hamat, an adjacent mountainous village) and through pumping from the rest of the villages. In fact, the process includes two lines with primary and secondary treatment, although only one is currently operational. Tertiary treatment (UV disinfection) is performed *via* a flow detector, then sludge is treated (thickening and dewatering in centrifuge) and kept at the station. The plant generates around 500 kg of sludge per day, and it severs Batroun City, Sela'ata, Kouba, Hamat, Wajh El Hajar, Abrine, Kfaraabida, and Jdabra (EU/AUB/MoEW, 2021).

- **Kfarhelda, Batroun:**

This treatment plant was built in 1967 and renovated in 1990. Lately, it has been supplied with new booster pumps in 2018. This station treats and supplies 15,000-16,000 m^3/day. In fact, its main source of water is a spring called Nabeh El Delleh and Ghawawit. The treatment process consists of chlorination, followed by decantation (three decanters), and finally filtration (eight filters). Next, water is stored in a reservoir and then pumped via booster pumps to regional reservoirs. It serves villages of Mar Yaacoub, Kfahelda, and Beit Chelala (EU/AUB/MoEW, 2021).

IV. Marine pollution in the coast of Batroun City

Marine pollution implies the presence of pollutants either on the coastline or in the maritime region where both can be derived from the same source of pollution. This form of marine pollution is usually exacerbated in case if urban areas are located on/nearby the coastline or if there is no control on the marine activities. Therefore, studying marine pollution for a coastal city is imperative and it must include, in addition to its shoreline, the surrounding marine environment where collateral dimensions are also of an important interest. This is due to the seawater which may transfer along the coastline/or into maritime water.

IV.1. Types and sources of marine pollution along Batroun Coastline

The pollution along the coastline of Batroun City is typical for the entire Lebanese coast where several pollution sources are derived from land into the sea. Many are permanent, while other pollution sources are sporadic and occasional. Furthermore, accidental pollution sources may occur mainly in the maritime region.

Likewise, in other parts of the Lebanese coast, pollution sources along the selected coastal stretch of the Batroun City are:

1. On-land/coast pollution corresponds to many forms of liquid and solid wastes located along the coastline, especially close to the urban areas. Here, the source of pollution can be located at several tens of kilometers away from the coast, as follows:
   - Many forms of wastewater, grey water, and sewer outfalls into the sea either as sewage pipes, open canals, or along streams. They are derived from the urbanized areas and touristic resorts, close to the coast.
   - Municipal solid wastes are usually transported by vehicles to the coast and dumped into coastal landfills. Solid waste is sometimes thrown along the coast by visitors and therefore large amounts of garbage are collected.
   - Turbid water with sediments plumes along rivers courses and streams; especially after raining periods.
   - Oily water and chemically polluted water from the different industrial utilities, refineries and factories situated close to the coast.
   - Warm water from electric power plants.
2. Maritime sources: found in seawater because of deliberate or accidental events, such as:
   - Oil spills released from ships and oil tankers.

- Unknown sources of pollution, such as chemicals and toxic materials. When identified, these sources are often mentioned by the media or directly observed.

The identification of marine pollution along the selected coastal stretch of Batroun City was performed using high-resolution satellite images. This includes mainly:

- Sentinel-2 satellite images (10 m spatial resolution, and 13 spectral bands).
- IKONOS satellite images (0.82 m spatial resolution, and 5 spectral bands).

These images were analyzed using ERDAS-Imagine software (version 10) which enables applying digital advantages and enhancement processes (*e.g.,* band combination, filtering, color slicing, edge detection, *etc.*). Therefore, all coastal features can be determined along the studied shoreline. The digital identification of these features on seawater was performed depending on color, texture, patterns, and thermal differentiation (Shaban, 2008).

The applied remote sensing (*i.e.,* satellite images processing) was accompanied with field verification to ensure the retrieved data reliability from Sentinel-2 and IKONOS satellite images. In addition, previously mentioned sources of marine pollution in the investigated coastal stretch of Batroun City, were verified from previous studies (*e.g.,* CNRS-L, 2018; Faour and Shaban, 2002; Nassif *et al.,* 2016; Shaban, 2008).

IV.2. Fixed-source marine pollution

There are several marine pollution fixed sources, characterized by known sources and sites of effluence along the coastline. They can be along pipelines, canals, or streams' outlets as is the case of Batroun City. Yet, these sources may sometimes display a very low effluence into the marine environment, always within a determined site. Thus, the treatment of such sources can be easily achieved unless they present a fixed source, combined with application of management.

Table 3 and Figure 3 show the recognized sources of marine pollution along Batroun City coast (between Al-Jawz River in the north and Dawrat in the south). It is obvious that marine pollution along the coast of Batroun City is minimal if compared to other coasts in Lebanon. There were many more sources, as already proven by locals, in the past two decades. Fortunately, the implements undertaken by the Municipality of Batroun have reduced the number of these pollution sources, notably because the coast of Batroun City is a touristic coastal stretch. Therefore, only 5 major sources of pollution along the investigated coast were identified. They are attributed to wastewater effluents, water along canals and transported sediments.

Table 3. Recognized sources/types of marine pollution along Batroun City coast.

#	Coordinates		Pollution type/ description
1	N 34° 15’ 22”	E 35° 39’ 21”	Wastewater effluent with a limited discharge from few adjacent homes.
2	N 34° 15’ 12”	E 35° 39’ 24”	A concrete canal transporting surface water, sometimes mixed with wastewater, to the sea and discharge near Maqaad El-Meer Bay. It is a part of an ancient stream.
3	N 34° 15’ 06”	E 35° 39’ 28”	Wastewater in Maqaad El-Meer Bay (near the Marine Science Center). It has a moderate discharge along a pipeline.
4	N 34° 14’ 49”	E 35° 39’ 35”	Wastewater from the adjacent touristic resorts.
5	N 34° 14’ 22”	E 35° 39’ 35”	Transported sediments along Wadi Eddeh, an intermittent stream that loads sediments during wet seasons.

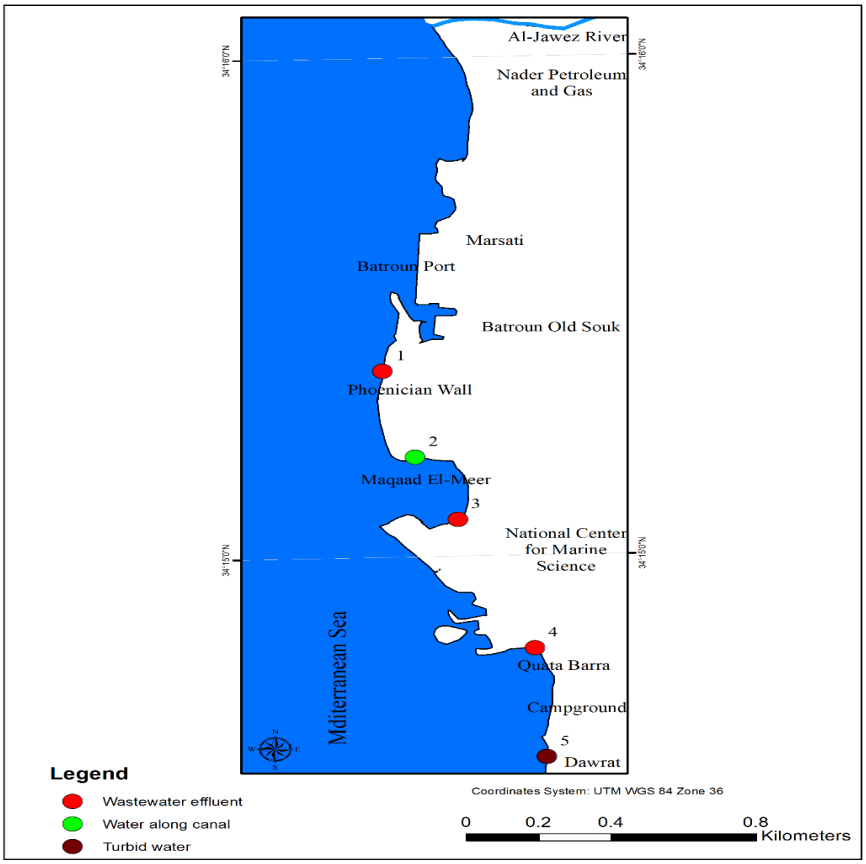

Figure 3. Identified marine pollution sources along Batroun City coast.

IV.3. Sporadic marine pollution

In addition to the few fixed-sources of marine pollution (number and discharge) along the coast of Batroun City, there are sporadic pollution sources on the coastal and maritime environments. These accidental sources are much harmful, and they are highly frequent. Moreover, they often extend over vast surface area. These sources have been detected from satellite images (*i.e.*, Sentinel-2 and IKONOS satellites) and from field surveys, as well. They correspond to:

– Chemical residues released from the Lebanon Chemicals Company S.A.L. (L.C.C.) which is in Sela'ata at 600 to the north of Al-Jawz River (the northern border of Batroun City). L.C.C. produces mainly phosphoric and sulfuric acids, superphosphate, aluminum sulphate, and calcium phosphate.

Most chemical pollutants imply phosphoric materials residues and other undetermined chemicals. They are spread by the impact of subsea currents that divert seawater loads from north to south, opposing the sea surface currents which are inversely directed. This has been identified also by the processed thermal Sentinel-2 satellite images as shown in Figure 4. Therefore, chemical pollutants from L.C.C. reach primarily Batroun City coast where most of these pollutants are captured by the coastal platforms and vermetid reefs.

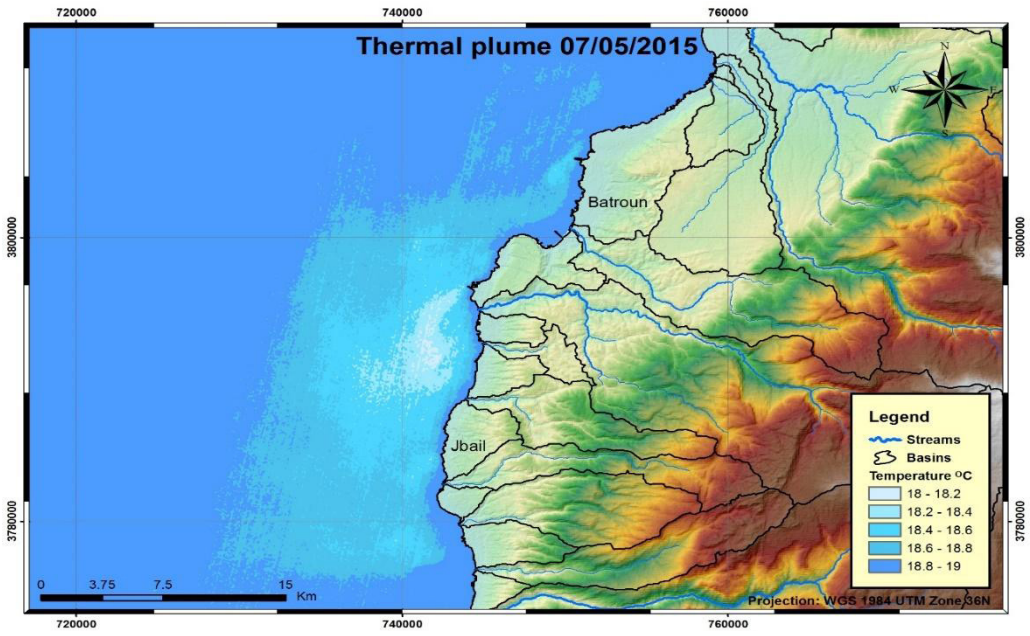

Figure 4. Subsea plum extends more than 7 km from the Lebanon Chemicals Company L.C.C. (Sel'aata) southward (Detected from Sentinel-2 satellite image of May 2021).

- Oily slicks constitute also frequent sporadic pollutants in the coastal and maritime environment of Batroun City, derived mainly from ships and oil tankers' anchor at L.C.C., Tripoli Port and even in Batroun Port. These slicks sporadically appear at different times. Since oily water and slicks are light enough to float on sea surface, they are usually affected by sea surface currents, which often flow from south to north along the Lebanese coast (Figure 5).
- Floating pollutants correspond to another form of marine pollution which also occur sporadically, float on seawater surface, and move according to wind direction and current mechanisms. The largest part of these pollution sources is delivered from ships and tankers that anchor into the sea. It is considered a major form of marine pollution, rather than liquid and solid (leachate) substances (Figure 6).

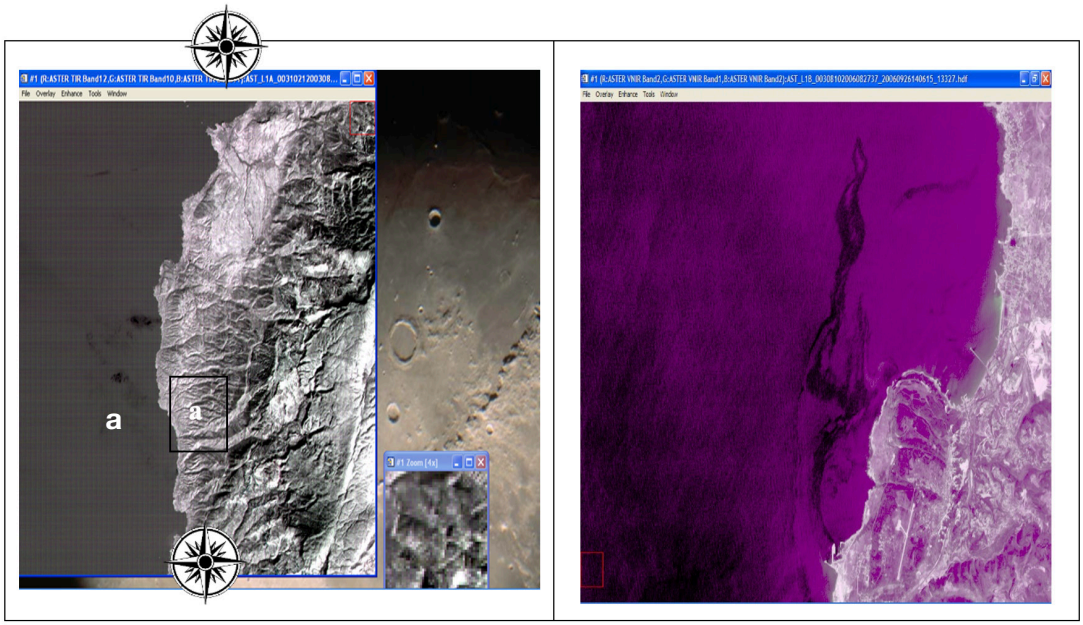

Figure 5. Examples of oil slicks: a) nearby Batroun coast, and b) from L.C.C. (Detected from Aster satellite image of May 2015).

Figure 6. Example showing floating pollutants, a common phenomenon adjacent to the coast of Batroun City (Photo by the authors).

V. Conclusions

Marine pollution is one of the most challenging factors that affect Lebanon tourism along coastal cities. In fact, its impact is often anticipated to be higher because of the dense irresponsible human activities including tourism industry itself. In addition, it is worth mentioning that a rapid and uncontrolled economic development in the coastal and maritime regions will necessarily lead to substantial risks for both population and maritime environment (Bennett *et al.,* 2021). Therefore, waste disposal management plans are usually implemented in the coastal zones to secure both blue growth and clean environmental aspects that might support favorable touristic conditions. Hence, waste management plans are adopted either within the context of a national strategy, or at a smaller scale at the municipal level, as in the case of Batroun City, one of the most important coastal tourist attractions in Lebanon.

According to Shaban (2008), there is a major source of marine pollution occurring each 3 km along the Lebanese coast. Yet, this ratio is much higher within the coast of Batroun City, reaching a frequency of occurrence of 1 km. However, this estimation was accounted for by number and not by the impact of marine pollution. In fact, both pollution type and the pollutants volume are significant to appraise the marine pollution effect. Therefore, the five existing pollution sources along the coast of Batroun City are almost all attributed to wastewater and grey water, where the degree of physicochemical and biological contamination is low. To this extent, marine pollution along Batroun coast is considered low if compared to other coastal stretches in Lebanon.

Nonetheless, coastal protection from pollution must be considered at two levels: First, the human activities' interaction between land and sea, and second the neighboring coastal stretches and the maritime region. This is exactly the case of Batroun City where the coast is still clean although several pollution forms exist and affect the coast either from the adjacent sides/or from the maritime region. Thus, the coast of Batroun City and the blue growth of its maritime region are still under pollution threat. This can be obviously attributed to the presence of the chemical residues released from the Lebanon Chemicals Company (L.C.C.) located in Sel'aata. In fact, it is not the only marine pollution source. Indeed, the ships and tankers belonging to this industrial locality, often release chemical residues and oily water at a small range (few kilometers) from the coast.

These pollutants are harmful to the marine ecosystem, as they threaten food safety and human health as well. Adverse impact also extends to the touristic industry in Batroun City, which depends mainly on the tourism sector. Based on the discussion, there must be precautionary implements to protect both Batroun coast together with its maritime region, and consequently, the relevant economic aspects and the sought blue growth.

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