

Littoralization and Urbanization in Batroun

North Lebanon, Lebanon





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

Littoralization and urbanization in Batroun

Batroun scale, Lebanon



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OVERVIEW

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List of abbreviations

CDR	Council of Development and Reconstruction - Lebanon
CBD	Convention on Biological Diversity
COD	Chemical Oxygen Demand
BOD	Biological Oxygen Demand
WW	Wastewater

Abstract

Relying on remote sensing, comparison, and old aerial photos, it has been estimated that urban sprawl annual average has increased from 220.32 km² in 1963 to 741.5 km² in 2005 and 1,658 km² of built-up areas in 2020. Indeed, the seashore public access has been hindered due to several factors: the unregulated ribbon development, the negatively affected and spoiled Batroun coast, as well as the coastline privatization by building beach resorts and other recreational facilities. In 2000, the land use in Batroun consisted mainly of forest and fruit trees (42.2%), followed respectively by urban areas (33.8%) that have become denser in 2020, and have replaced grassland, fruit trees and olives which decreased by 32-54%.

The multi temporal land use change analysis that was undertaken for this study revealed an alarming decrease in the rocky and sandy beaches proportion (44%). The remaining vacant ones in the northern and southern parts of the city represent natural components that are under a constant risk of artificialization, urbanization and expansion of Coastal/Maritime tourism complexes. The population in Batroun is 45,000 citizens. In fact, the net population density in Batroun is estimated at 6,816 capita/km² that is close to Lebanese average value. Yet, considering that the total municipality area of Batroun is equal to 278 km² this in its turn shows that built-up density is reduced to 5.76%, which significantly represents less density if compared to the Lebanese general average.

The recently studied city development contrasts the old city urban agglomerations that is obviously mirrored in the rapid high building rise in the central part of Batroun coastal strip. Based on the recent studies conducted between 2000 and 2020 in all over Lebanon, it has been revealed that North Lebanon and the latest urbanized Batroun City are predicted to witness a remarkable urban growth rate estimated at 7.03 ha (70,300m²) by 2040. This area can expand either towards the coast or towards the surrounding hills from the East, depending on several socioeconomic considerations, real estate business and city planning. Urban density brings pollution hazards due to solid waste landfilling and unmanaged sewage water. Batroun population generated 1.7 Mm³ in 2000, yet it is estimated to reach 5.2 Mm³ in 2040. The amount of corresponding chemical oxygen demand (COD) and biological oxygen demand (BOD) are significant and require permanent effective treatment plants functioning to avoid coastal water quality deterioration.

While the old Batroun city has developed in harmony with the surrounding landscape, recent urban development has been focusing on creating dense touristic complexes built on the southern coastal line. Artificial structures have been built on the sandy beaches. Thereby causing natural coastal lines defragmentation and the coastal waters integrity. Besides being famous for its facilities for windsurfing and bodyboarding, Batroun provides the opportunity for sea products, port and market, tourism complexes, restaurants and cafés and several authentic organic wine productions.

I. Introduction

Both the Population increase and tourism activities have been increasing worldwide putting more pressure on the poor sustainable coastal zone management and the limited natural resources, notably in the Eastern area of the Mediterranean. In fact, rapid chaotic urban growth is one of the principal causes of desertification (Eswaran and Reich, 1997). In fact, the coast has gone through several mass old settlements and shallow eroded Red Mediterranean soils on the nested mountains. The latter indeed represents an environmental proof of old soil erosion, a type of human-induced pressures that are particularly considered the most acute. This is really a fact in Lebanon where the total urbanized land covers a cumulative area of 646 km², or 6.3% of the Lebanese territory. The area between 0 and 400 meters above sea level represents 19.3% of the country. The most important urban agglomerations are concentrated on the coastal zone, which comprises 47% of the total urbanized area (CDR, 2002).

Concerning instability in the eastern and southern Mediterranean shores, the endorsement of soil protection long-term policies is not a choice but a prerogative to enhance sustainable development, food security and poverty alleviation (Zdruli *et al.*, 2010). In fact, more than half of the world's soils are affected by edaphic constraints (chemical, physical, biologic, or climatic in nature) and these factors have severe or prohibitive constraints on food production and agricultural sustainability because soils are either too dry or too shallow being on steep slopes (Friedrich *et al.*, 2008; Minhas *et al.*, 2017). Land use planning has been proved to be effective in safeguarding green spaces and protecting zones suitable for green and blue economy. This is notably relevant for rugged mountain coastal areas as the effectiveness of trees in controlling soil erosion was confirmed and reaffirmed (Safriel *et al.*, 2010). Thus, there is a need to incorporate economic growth perspectives with sustainable land use (Erk, 2010).

Urban sprawl encroached on agricultural land near coastal cities (Tripoli, Batroun, Sidon, Tyre) and invaded the forested mountain slopes overlooking coastal plains (*e.g.*, Jounieh bay). The urban sprawl annual average encroached on natural and agricultural land is 10 km² per year. This phenomenon has considerably grown in scale, increasing the total urbanized land cover by five times from 49 km² in 1963 to 251 km² in 1998, with considerable area of agricultural and natural land destroyed by urban sprawl (SDATL, 2002). At the same time, the built-up areas rose from 220.32 km² in 1963 to 741.5 km² in 2005 and 1,658 km² in 2020. Unregulated ribbon development expanded along coastal access roads and through traffic arteries, filling remaining gaps between urban centers from Beirut to Tripoli, passing by Batroun. Linear urbanization was further reinforced by the privatization of the coastline due to the building of beach resorts and other recreational facilities, hindering public access to the seashore.

II. Urbanization and littoralization in Batroun

II.1. Land use change in Batroun between 2000 and 2020

The administrative area of Batroun city was 466.8 ha (Figure 1) in 2000, but with the construction of artificial structures along the northern shores, the area of Batroun city rose to reach 467.8 ha (Figure 2).

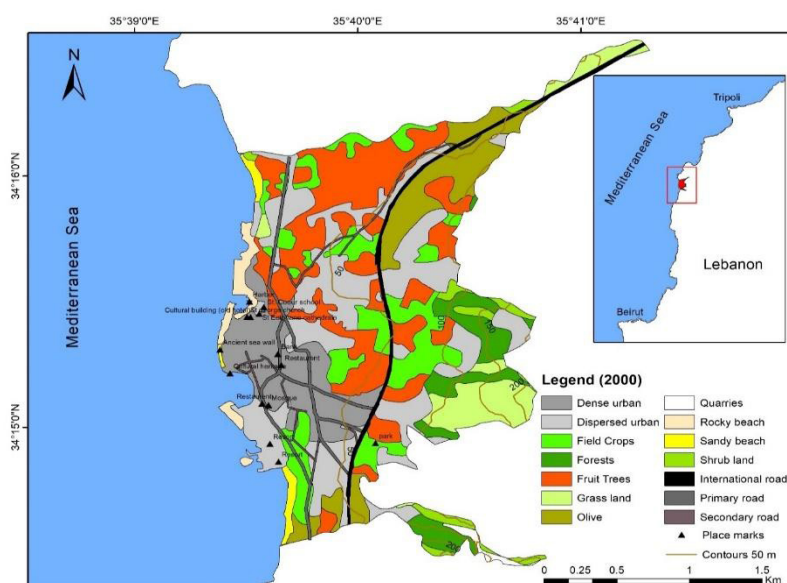


Figure 1. Land cover land use of Batroun city in 2000.

In 2000, the land use and land cover consisted mainly of forest and fruit trees (42.2%), at the western and central parts of the city, followed by urban (33.8%) along the eastern and northern parts of the city.

The East Levantine Canyons (ELCA) are considered by the CBD of the Parties as ecologically or biologically significant Marine Areas (EBSAs), requiring management for sustainability (UNEP/MAP and Plan Bleu, 2020) This is based on criteria such as (i) uniqueness or rarity, (ii) special importance for life history stages of species, (iii) importance for threatened, endangered or declining species and/or habitats, (iv) vulnerability, fragility, sensitivity, or slow recovery, (v) biological productivity, (vi) biological diversity, and (vii) naturalness.

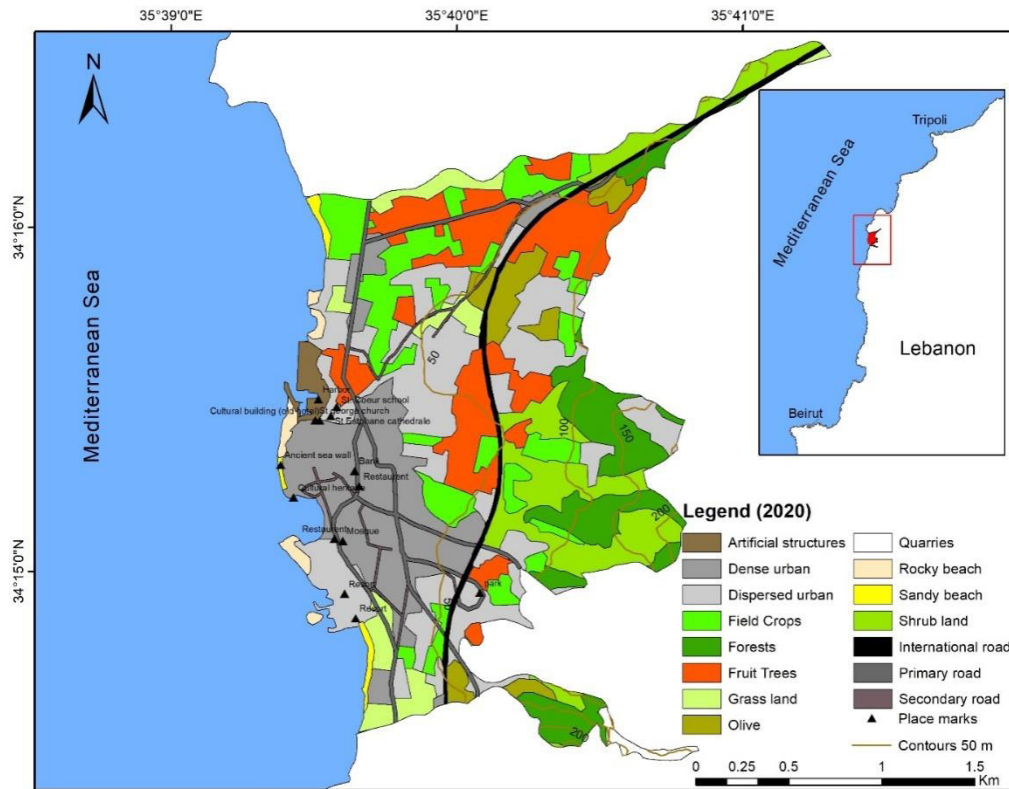


Figure 2. Land cover land use of Batroun in 2020.

In 2020, urban sprawl became denser, and expanded by more than 30% at the account of grassland, fruit trees and olives, which decreased by 32-54%. Artificial structures expanded from the heart of the city port and invaded the sandy beaches (Primary data of the authors).

For the twenty-year span, the dense urban area expanded in 2020 by more than 41% with a significant decrease of dispersed urban area by 11.7% (Figure 3). The ratio of urbanized areas became 35.28% of the city area (Table 1). While forest area expanded by 64%, the area of olive and fruit trees decreased by 54% and 33%, with the field crops areas remaining practically unchanged. While international roads remained stable, the secondary roads decreased by 10% while the primary roads expanded by 44%, indicating additional expansion and artificialization of the coast of Batroun. Shrubland's expansion by 348% clearly reflects agricultural land abandonment and expansion of vacant land for further littoralization (Primary data of the authors).

Table 1. Dynamic change of land cover and land use in Batroun city between 2000 and 2020.

Class	Area (ha)		percentage from total city area (%)		Relative change for 20 years (%)	Increase/Decrease, (%)
	2000	2020	2000	2020		
Artificial structures	0	5.16	0	1.10	1.10	+515.55
Dense urban	47.91	67.65	10.26	14.46	4.20	+41.22
Dispersed urban	110.34	97.40	23.63	20.82	-2.82	-11.73
Field Crops	56.04	56.38	12.00	12.05	0.05	+0.60
Forests	27.74	45.56	5.94	9.74	3.80	+64.24
Fruit Trees	99.77	66.17	21.37	14.14	-7.23	-33.67
Grass land	29.74	20.20	6.37	4.32	-2.05	-32.08
International road	10.69	10.67	2.29	2.28	-0.01	-0.25
Olive	41.10	18.75	8.80	4.01	-4.80	-54.38
Primary road	10.56	15.25	2.26	3.26	1.00	+44.39
Quarries	2.65	3.34	0.57	0.71	0.15	+25.89
Rock beach	8.92	4.76	1.91	1.02	-0.89	-46.63
Sand beach	5.42	3.13	1.16	0.67	-0.49	-42.30
Secondary road	5.10	4.59	1.09	0.98	-0.11	-10.03
Shrub land	10.90	48.87	2.33	10.45	8.11	+348.47
Total	466.88	467.87	100	100	0	+0.21

The most alarming indicator is the rocky and sandy beaches area recession at an average of 44% (Figure 3). The remaining vacant rocky beaches in the central western part and sandy beaches in the north-west and south-western parts of the city are the future natural components under risk of artificialization, urbanization and expansion of Coastal/Maritime tourism complexes.

II.2. Future trends of Urbanization and Littoralization in Batroun

Lebanon is a very highly densely populated country with an average national population of 667 capita/km² (<https://www.worldometers.info/world-population/lebanon-population/>), and an average net density (number of population in built up area) of 6,686 capita/km², unequally distributed on the territory with 78.4% of population residing in

urban areas. Like the national case, the built-up area and open space area in Batroun is following increased artificialization and reduced open space, but in larger magnitude (Table 2).

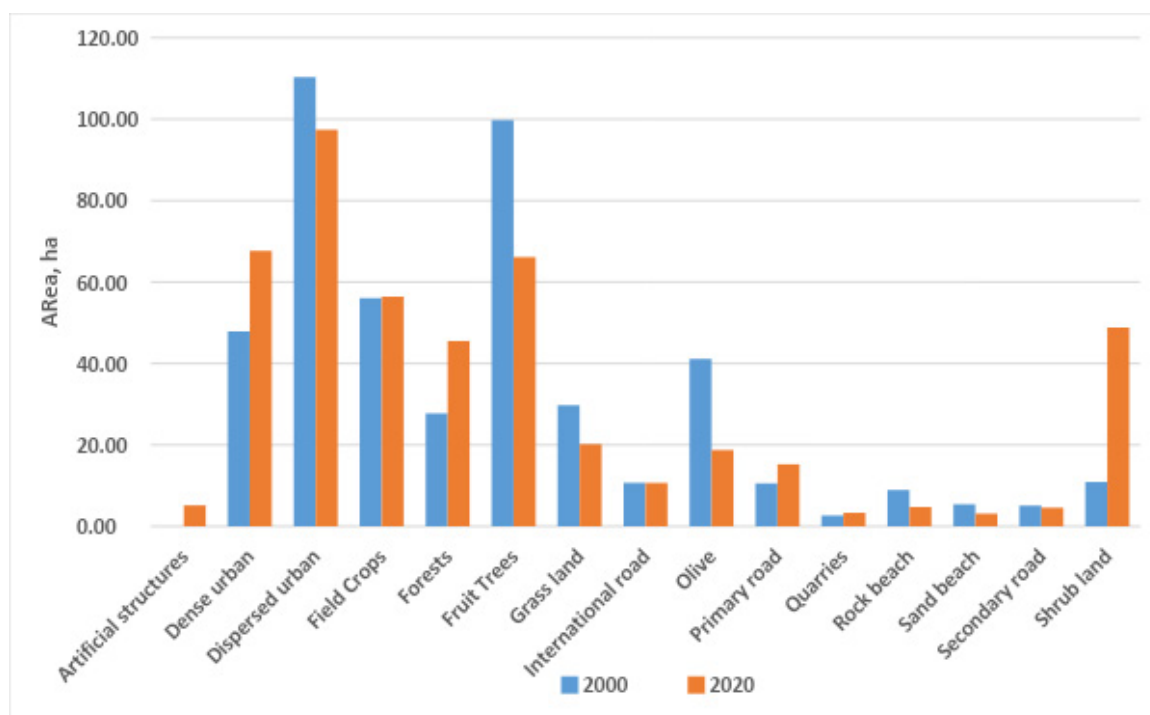


Figure 3. Land use changes in Batroun between 2000 and 2020.

Beirut, the capital, has a density reaching more than 19,000 capita/km². Greater Beirut and Tripoli agglomeration are characterized by high net density, respectively around 15,000 and 18,500 capita/urbanized km². The population in Batroun is 45,000 citizens. That is to say, the net population density in Batroun is estimated at 6,816 capita/km² which is close to Lebanese average value. Yet, considering Batroun total municipality area is equal to 278 km² while the built-up density is reduced to 5.76%, which is significantly less dense than the Lebanese average.

Table 2. Urban expansion and its impact on green and open space in Batroun versus Lebanon.

Year	Lebanon					Batroun
	1963	1994	2005	2010	2020	2020
Population density (Inhabitants/km ²)	189.95	325.68	449.64	473.98	667.00	157.00
Built up density (%)	2.16	4.55	7.27	10.26	16.26	5.76
Open space density (%)	97.84	95.45	92.73	89.74	83.74	64.72

The development of cities is not always predicted with high precision, nor has it been subject to strict laws and regulations when it concerns chaotic urban expansion. City expansion does not always follow the land use planning rules and in most cases, it is driven by economic motives.

The new city development trends are contrasting the old city urban agglomerations (Figure 4) and they are clearly mirrored in the expansion of the building rise in the central part of Batroun coastal strip (Figure 5).

Based on the recent urban growth rate between 2000 and 2020 all over Lebanon, North Lebanon and Batroun city as well as the current state of urbanization in Batroun, a simple extrapolation of predicted city urban expansion by 2040 is estimated at 7.03 ha or 70,300 m² (Table 3). This area can expand either towards the northern and southern coastal area or towards the surrounding hills from the east with wood stands. All depends on real estate business, city planning policy and the trade-off between urban development and other economic and social priorities.

II.3. Impacts of Urbanization and Littoralization on Coastal /Maritime environment in Batroun

The current state and maintenance development of the city sewerage treatment plant can be unpredictable in the context of the socio-economic harsh crisis that is hitting the central government and local authorities. Therefore, the city planning must preview the zones for future urban expansion, the free coastal areas, and the green zones. A land use planning project targeting the land capability and suitability modeling is recommended to identify the suitable areas for future land use.



Figure 4. Old city is integrated well with the sea.

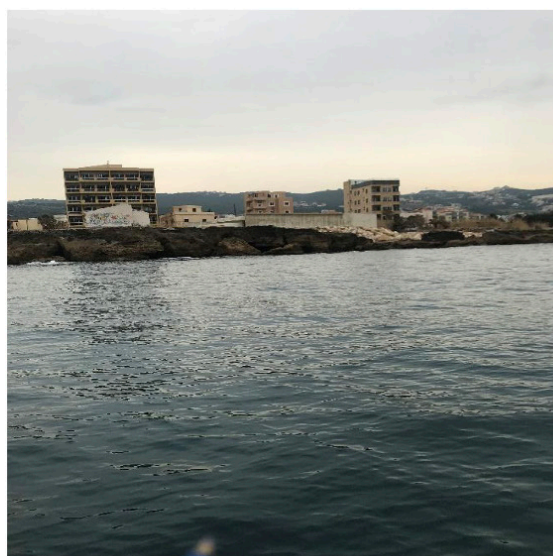


Figure 5. Tall building rise on the waterfront.

Consultation with the stakeholders in Batroun showed their definite decision to conserve the green areas and avoid the concrete, new sandy and rocky beaches expansion as well as to preserve the people's rights for free access to the sea. This is important since the urbanization rates extrapolation and the expected sealed land areas indicate potential alarming loss of prime natural and agricultural lands in additional areas.

Table 3. Urbanization status and perspectives until 2040.

Area	% from total area (%)		Relative change for 20 years (%)	Increase/decrease (%)	Expected urbanization (%)	Total Area of Land consumed to urban (ha)	Additional area taken by urban (ha)
Year	2000	2020	2000	2020	2040	2040	
Batroun	33.89	35.28	1.38	4.10	36.66	171.52	7.03
North Lebanon	5.91	15	9.09	153.81	24.09	29,799.33	11,244.33
Lebanon	17.7	24.4	6.7	37.85	31.1	324,995.00	70,015.00

As to the issue of sewage water, Recent estimates indicated that 35 to 50% of the untreated Lebanon urban sewage water is infiltrated to the aquifers due to the lack of discharge networks and wastewater treatment plants and then pumped for both irrigation and domestic use (Karam *et al.*, 2013). In fact, most towns and villages lack wastewater infrastructure except for the traditional household septic tanks or the method of draining wastewater into boreholes in bedrock which ends up in the groundwater (MoE, 2004).

In the absence of treatment plants, greywater could be another potential non- traditional water source generated by households from kitchen sinks, washing machines, dishwashers, hand washing basins, and showers. If collected and treated by simple sedimentation, it can be used for watering gardens and municipal trees. In Lebanon gray water is ejected in mixture with sewage water (Table 4).

Table 4. Total quantity of wastewater (WW) generated by Batroun inhabitants.

Year	Lebanon				Batroun			
	population	WW	BOD	COD	population	WW	BOD	COD
	Inhabitant	Mm ³	tons		Inhabitant	Mm ³	tons	
2000	4,000,000	206	26,400	130,000	33,000	1.7	220	1,070
2020	5,500,000	329	42,100	207,600	45,000	2.7	345	1,700
2040	7,400,000	643	82,300	405,700	60,000	5.2	665	3,280

However, along the Lebanese coast, 88 sewers reach the sea, of these 58 are domestic effluents and 29 industrials (CDR, 2002). Fortunately, a total of six pretreatment plants have been completed along the Lebanese coastal area. However, ten years ago, less than 66% of the population was connected to an improved sewer network (World Bank, 2011). The Lebanese population generated 206 Mm³ of WW, which was expected to reach 643 Mm³ in 2040 (CDR, 2001).

The population of Batroun generated 1.7 Mm³ in 2000 that can be estimated to reach 5.2 Mm³ in 2040. The amount of corresponding COD and BOD is significant in both national and local level and it then requires permanent effective treatment plants functioning so as to avoid the coastal waters deterioration and the green economy degradation in such a tourist city. In this approach, we did not cover the wastewater generated by internal and foreign tourism, knowing that Batroun has already turned into the most attractive and most preferred destination for both Lebanese and foreign tourists.

II.4. Impacts of Urbanization and Littoralization on Coastal /Maritime tourism in Batroun

Built-up area and population density, referred to as Essential Societal Variables, were used to model human activities and the impact of climate induced hazards on society and social activities (Ehrlich *et al.*, 2017).

While the old urban area has been well integrated within the surroundings (Figure 6), the new tourist trends development has been focusing on creating dense touristic complexes built on the southern coastal line (Figure 7). Human-nature interference and interaction, the use of mineral resources and production of byproducts, greatly affect the biogeochemical cycles that usually modulate the climatic processes changes by affecting the type and dimensions of. Demands for climate-related hazards, energy and materials, associated with the urban settlements' expansion, affect the marine and land mass biosphere.



Figure 6. Part of the old city Batroun with part of the Phoenician wall.



Figure 7. Littoralization of the southern coast by dense touristic complexes and sea resorts.

Moreover, the resulting emissions related to human activities affect the climate variables and the climate -related hazards like flood, erosion, landslides, and sea level rise. The marine tourism infrastructure can be affected as well by these natural hazards, as the interaction between land and sea is dynamic and reciprocal (Figure 8).

II.5. Impacts of Coastal/Maritime tourism on Urbanization and Littoralization in Batroun

Both coastal and maritime activities require the land-based infrastructure availability that aims at providing the services to the local community and the marine resorts and transport. More artificial infrastructure has been built on the coastal Batroun equivalent to 5.6 ha (Table 1). As a result, artificial structures have been built on the sandy beaches and thereby causing natural coastal lines defragmentation and coastal waters integrity.

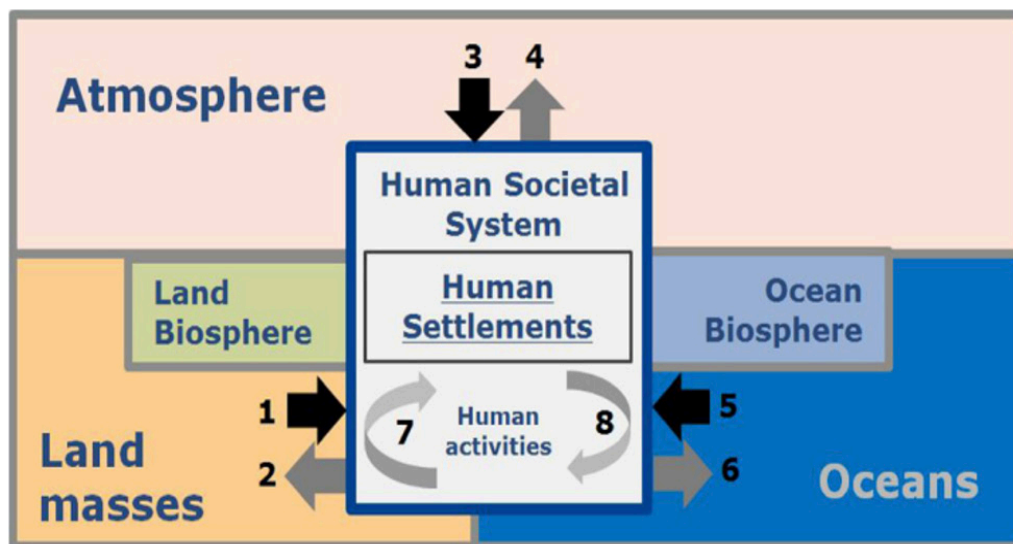


Figure 8. Interaction between human settlements and land/ocean biosphere and atmosphere.

Grey arrows indicate human activities impacting climate subsystems. Black arrows are the climatic hazards affecting back human settlements (Ehrlich *et al.*, 2017)

II.6. Blue Economy in the context of sustainable Coastal/ Maritime Tourism development in Batroun

In addition to being famous for its wind surfing and bodyboarding facilities, Batroun provides the opportunity for sea products, port and market, tourism complexes, restaurants, and cafés. The main street is enlightened by dozens of hotels, restaurants, and nightclubs where both local and international tourists can enjoy easy access to all means of leisure and joy. Batroun is neither an industrial nor an agricultural city. Yet, it is a touristic city with a large choice of pubs and nightclubs offering diverse cuisines. In fact, several wineries exist in the mountains surrounding the city from the East. These wineries are: IXSIR, Adyar, Atibaia, Aurora, Coteaux de Botrys, Domaine S. Najm, Chateau Sanctus, and Clos du Phoenix. Some of these enterprises are well known for their complete green industry, like IXSIR's winery, Seigniorial House, located on the hills of Batroun that won the CNN Green award for its completely sustainable facility.

III. Conclusions

To sum up, population increase, urban expansion and tourism have clearly added more pressure on sustainable coastal zone management and limited natural resources in the Lebanon-East Mediterranean Batroun city. Indeed, it is obvious through the urban sprawl encroached on the coastal strip of Batroun in addition to the unregulated ribbon development which expanded along coastal access roads and through traffic arteries, filling remaining gaps between urban centers from Beirut to Tripoli, passing through Batroun. Linear urbanization was further reinforced by the coastal line privatization through the mass building of beach resorts and other recreational facilities. Thereby hindering public access to the seashore. In 2000, the land use and land cover consisted mainly of forest and fruit trees (42.2%), at the western and central parts of the city, followed by urban (33.8%) along the eastern and northern parts of the city. In 2020, urban areas became denser, and expanded by more than 30% at the expense of grassland, fruit trees and olives, which decreased by 32-54%.

Moreover, the artificial structures have greatly expanded from the heart of the city port to invade a large part of sandy beaches. Based on the recent urban growth rate between 2000 and 2020 all over Lebanon, North Lebanon and Batroun city as well as the current state of urbanization in Batroun, a simple extrapolation of predicted urban expansion by 2040 is estimated at 7.03 ha (70,300 m²). Hence, the urban expansion impact should be controlled and be subjected to modern regulations that comply with the updated sustainable city planning. Thereby limiting the detrimental impact on both marine environment and coastal tourism. Thereby, protecting the dominant business activity in Batroun and preserving mountain tourism in several wineries. In fact, recent consultations with the stakeholders in Batroun have shown their definite decision to conserve the green areas, avoid concrete to new sandy and rocky beaches expansion as well as to preserve people's rights for free access to the sea. It is worth mentioning that to protect blue development, and to plan effectively for the treated water reuse, efforts must be deployed not only to protect the green zone in and around the city but also to minimize the human effect on marine biosphere. Thereby reducing the risks related to climatic hazards.

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