Lebanon's National ICZM Strategy, Legislation, and Plan Development

Integrated Diagnostic Analysis Report

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LEBANON'S NATIONAL ICZM STRATEGY, LEGISLATION, AND PLAN DEVELOPMENT

IN THE FRAME OF THE GEF MEDPROGRAMME CHILD PROJECT 2.1

Integrated Diagnostic Analysis Report

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3RF	Reform, Recovery and Reconstruction Framework
AAP	Ambient Air Pollution
ACNR	Abbassieh Coast Nature Reserve
AOC	Appellation d'Origine Contrôlée
AR	Artificial Reef
ARI	Acute Respiratory Infection
AUB	American University of Beirut
BDL	Banque du Liban
BMLWE	Beirut Mount Lebanon Water Establishment
BWE	Bekaa Water Establishment
CAMP	Coastal Area Management Programme
CAS	Central Administration of Statistics
CBD	Convention on Biological Diversity
CBNRM	Community Based Natural Resources Management
CC	Climate Change
CCI 25	Candidate Common Indicator 25
CDD	Consecutive Dry Days
CDR	Council for Development and Reconstruction
CDW	Construction and Demolition Waste
CEDRE	Conférence Economique pour le Développement par les Réformes et avec les Entreprises
CIP	Capital Investment Program
CNRS	National Council for Scientific Research
CO_2	Carbon Dioxide
CO_2 eq	Carbon Dioxide equivalent
COM	Council of Ministers
COPD	Chronic Obstructive Pulmonary Disease
CRI	Clinical Research Institute
CZ	Coastal Zone
CZM	Coastal Zone Management
DALY	Disability Adjusted Life Years
DGA	Department of Geographic Affairs
DPSIR	Drivers, Pressures, State, Impacts, Responses
EDL	Electricité du Liban
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ELCA	East Levantine Canyon Area
EPI	Environment Performance Index
EPDC	Education Policy Data Center
ERML	Environmental Monitoring Resources in Lebanon
ESA	European Space Agency
EU	European Union
FAO	Food and Agriculture Organization

FATF	Financial Action Task Force
FDI	Foreign Direct Investments
GBF	Global Biodiversity Framework
GDP	Gross Domestic Product
GDUP	General Directorate of Urban Planning
GEF	Global Environment Facility
GER	Gross Enrollement Rate
Gg	Gig grams
GHG	Greenhouse Gases
GII	Global Innovation Index
GOL	Government of Lebanon
GWP-Med	Global Water Partnership in the Mediterranean
HCUP	Higher Council for Urban Planning
IBA	Important Bird and Biodiversity Area
ICZM	Integrated Coastal Zone Management
IDAL	Investment Development Authority of Lebanon
IDP	Internally Displaced People
IFI	International Financial Institutions
IHS	Ischemic Heart Disease
ILO	International Labor Organization
IMAC	Integrated Management of East Mediterranean Coastline
IMF	International Monetary Fund
IMP - MED	Integrated Maritime Policy for the Mediterranean
IPM	Integrated Pest Management
IRFED	Institut de Recherche en Vue de Developpement
ISF	Internal Security Forces
ISWM	Integrated Solid Waste Management
IUCN	International Union for Conservation of Nature
LCEC	Lebanon Center for Energy Conservation
LCPS	Lebanese Center for Policy Studies
LCRP	Lebanon Crisis Response Plan
LEPAP	Lebanon Pollution Abatement Project
LEZ	Low Elevation Zone
LP	Lebanese Pound
MCBM-LB	Marine and Coastal Baseline Map
MCR-IOE-UOB	Marine and Coastal Resources Program – Institute of the Environment – University of Balamand
MED PROGRAMME	Mediterranean Sea Programme
MoA	Ministry of Agriculture
MoC	Ministry of Communications
MoD	Ministry of Defense
MoE	Ministry of Environment
MoET	Ministry of Economy and Trade
MoEW	Ministry of Energy and Water

MoF	Ministry of Finance
MoI	Ministry of Industry
MoIM	Ministry of Interior and Municipalities
MoPH	Ministry of Public Health
MoPWT	Ministry of Public Works and Transport
MPA	Marine Protected Area
MPD	Maritime Public Domain
MPI	Multidimensional Poverty Index
MSP	Marine Spatial Planning
MSW	Municipal Solid Waste
NAQMN	National Air Quality Monitoring Network
NBS	Nature Based Solution
NBSAP	National Biodiversity Strategy and Action Plan
NEEREA	National Energy Efficiency and Renewable Energy Action
NEET	Not in Employment, Education, or in Training
NEF	National Environmental Fund
NER	Net Enrollment Rate
NGO	Non-Governmental Organization
NIS	Non Indigenous Species
NLWE	North Lebanon Water Establishment
NM	Nautical Miles
NPMPLT	National Physical Master Plan for the Lebanese Territory
NSSF	National Social Security Fund
NWSS	National Water Sector Strategy
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
OMSAR	Office of the Minister of State for Administrative Reform
PAH	Polycyclic Aromatic Hydrocarbon
PAP/RAC	Priority Actions Programme/Regional Activity Centre
PINR	Palm Islands Nature Reserve
PPP$	Purchasing Power Parity dollar
PSU	Practical Salinity Unity
RCP	Representative Concentration Pathways
RWE	Regional Water Establishment
SDG	Sustainable Development Goal
SEA	Strategic Environmental Assessment
SLWE	South Lebanon Water Establishment
SME	Small and Medium Enterprises
SOER	State of the Environment Report
SSP-8.5	Shared Socioeconomic Pathways-8.5
SST	Sea Surface Temperature
TCNR	Tyre Coast Nature Reserve
UAS	Usable Agricultural Surface
UNCAC	United Nations Convention against Corruption

UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNHCR	United Nations High Commissioner for Refugees
UNESCO-IHP	UNESCO Intergovernmental Hydrological Programme
UNICEF	United Nations International Children's Emergency Fund
USAL	University of Sciences and Arts in Lebanon
US$	United States Dollar
VSL	Value of Statistical Life
WASH	Water, Sanitation and Hygiene
WP	Working Package
WWTP	Wastewater Treatment Plants

INTRODUCTION

PROJECT BACKGROUND

This project is part of the Mediterranean Sea Programme (MedProgramme): "Enhancing Environmental Security" and its Child Project (CP) 2.1 "Mediterranean Coastal Zones: Water Security, Climate Resilience and Habitat Protection". It falls under a five (5) year (2020-2025) multi-focal programme funded by the Global Environment Facility (GEF) aiming to start the implementation of priority actions to reduce the major transboundary environmental pressures affecting the Mediterranean Sea and its coastal areas while strengthening climate resilience, water security, and improving the health and livelihoods of coastal populations. This programme is implemented in several Mediterranean countries including Albania, Algeria, Bosnia and Herzegovina, Egypt, Lebanon, Libya, Montenegro, Morocco, Tunisia, and Turkey. The Priority Actions Programme/Regional Activity Centre (PAP/RAC) is an executing partner in CP 2.1 projects together with Plan Blue/RAC, Global Water Partnership in the Mediterranean (GWP-Med), UNESCO Intergovernmental Hydrological Programme (UNESCO-IHP) and UNEP/Mediterranean Action Plan (MAP), the latter being the leading executing agency.

The expected outcome for CP 2.1 is to ensure that coastal zone sustainability in beneficiary countries is enhanced through the expanded compliance with the Integrated Coastal Zone Management (ICZM) Protocol and the adoption of national ICZM Strategies, coastal plans and instruments, in addition to improving gender equality. Hence, the outputs of CP 2.1 comprise the following:

- Output 1.1: Multi-stakeholder consultations on ICZM Protocol ratification and implementation.

- Output 1.2: Inter-Ministerial Coordination mechanisms for coastal management in place

- Output 1.3: ICZM Strategies/plans developed and adopted.

- Output 1.4: A series of training events in ICZM, MSP and CVC adaptation developed and implemented.

- Output 1.5: Raised awareness on the approaches promoted by the project (with attention to the engagement of the private sector).

SCOPE AND OBJECTIVES OF THE PROJECT

This assignment is linked to outputs 1.2 and 1.3 of CP 2.1 of the MedProgramme:

- Output 1.2: Inter-Ministerial Coordination mechanisms for coastal management in place

- Output 1.3: ICZM Strategies/plans developed and adopted

The overall objective of this project is to update the Lebanese National ICZM Strategy, its Action Plan and the ICZM Law, and to contribute to the Integrated Management Plan (IMP) of the Damour river basin, aquifers and the coastal zone.

Accordingly, following are the expected results in the framework of this service:

- The update of the draft national ICZM Strategy with an Action Plan for its implementation.

- The update of the draft ICZM law supported with advocacy actions for its passage and enactment.

- The creation of an operational Coastal Platform.

- Ensuring the ideal environment for the adoption and implementation of the ICZM Strategy and the enactment of the ICZM Law created.

- Demonstration of the "Source to Sea" approach through participation in the preparation of the IMP for the Damour river basin.

The following four working packages (WP) are foreseen in the framework of this assignment:

- WP1: Analysis and assessments

- WP2: Stakeholder engagement

- WP3: Policy Integration

- WP4: Public Awareness and Advocacy

METHODOLOGY USED IN THE DIAGNOSIS ANALYSIS REPORT

Each expert, in order to develop his/her chapter(s) adopted the DPSIR (Drivers, Pressures, State, Impacts, and Responses) methodology based on the draft ICZM Strategy of 2015 and the most recent references in each sector.

The different sections provided by the experts were reviewed, commented on by PAP/RAC, The Marine and Coastal Resources Program – Institute of the Environment – University of Balamand (MCR-IOE-UOB) Team and the experts themselves, and compiled in one document by the MCR-IOE-UOB Team.

EXPECTED OUTCOMES

The Diagnostic Analysis Report will provide evidence for recommendations that will be addressed in the initial recommendations report and priorities which will be given in the national strategy. Additionally, a summarized DPSIR table is created to reflect the findings of the current diagnostic analysis (Annex I: DPSIR Summary Table).

DEFINING THE COASTAL ZONE

According to Article 2, Part 1 of the ICZM Protocol 2008 (UNEP/MAP/PAP 2008)[1], the Coastal Zone (CZ) refers to the geomorphologic area on either side of the seashore (marine and terrestrial) where complex ecological and resource systems consisting of biotic and abiotic components coexist and interact with relevant socioeconomic activities and human communities (Annex II: Map of the coastal strips in lebanon). The CZ includes:

- Inland areas, which affect the CZ mainly via rivers and non-point sources of pollution.

- Coastal lands, wetlands included.

- Coastal waters such as estuaries; lagoons; and shallow waters.

- Offshore water, mainly out to the edge of national jurisdiction (200 nautical miles (NM) offshore).

- High seas, beyond the limit of national jurisdiction.

In Lebanon, there is no clear definition of the CZ, but with the ascension of Lebanon to the ICZM Protocol in 2017, and based on its Article 3, the country is obligated to define its CZ boundaries. According to Decree 144 (1925), the landward limit of the Lebanese coast is determined by the highest waterline reached on land by the strongest winter storm, including for sand and gravel beaches.

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[1]Protocol On Integrated Coastal Zone Management in the Mediterranean. Priority Actions Programme. Split.

However, this flexible delineation of CZ boundaries resulted in continuous shifting of landward limits that are mostly dependent on different political and administrative considerations[2]. As for the seaward limits, the Lebanese CZ extends to the full of the territorial sea and up to 12NM from the coastline and is considered as part of Lebanon's maritime domain that consists of the sea, the seabed, and the coast[3].

The draft ICZM Law (2015) has adopted, in its Article 1, the definition of CZ as proposed in Article 2 of the ICZM Protocol (2008) mentioned previously [3]

Nevertheless, Article 3 of the ICZM Protocol tackles the issue of the geographical coverage of the CZ, dividing it between the "Seaward Limit", set as the external limit of the territorial sea of the countries (12 NM), and the "Landward Limit", set as the limit of the competent coastal units as defined by the countries. The competent units in Lebanon are made up of three main administrative divisions namely Municipalities being the smallest competent unit followed by Districts (Caza) and then Governorates (Muhafaza). Municipalities, numbering around 100 along the LCZ, represent a narrow strip along the coast with poor coverage for proper CZM. Districts, numbering 14 coastal Caza along the LCZ, have a larger area coverage than municipalities, nonetheless they extent much further inland reaching mountainous area in many cases. And finally, Lebanon has five coastal governorates all extending to reach the Lebanese mountainous area (Annex II: Map of the coastal strips in lebanon

Annex III: Map and List of coastal administrative units along the LCZ)[4]. Determining the appropriate competent unit or units for proper coastal zone management will be done through expert opinion, discussions and subsequent agreement with the project's Inter-Ministerial ICZM Working Group, the planned workshops, roundtables, and interviews in order to reach a final decision to be adopted for the ICZM draft law and strategy.

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[2] Policy/literature Review Relevant to Coastal Zone Management. (2023)
[3] Updated ICZM Strategy for the Lebanese Coastal Zone. (2015)

[4] https://www.lebanesearabicinstitute.com/administrative-divisions-lebanon/#External_Resources

CHAPTER I: LEGAL AND GOVERNANCE DIAGNOSIS

This chapter elaborates on the current legislative and regulatory state of the coastal zone (CZ) in Lebanon. It addresses the Maritime Public Domain (MPD), its delimitation, and its legal and illegal occupations. It also discusses the current legal protection tools for the CZ. Additionally, it tackles the challenges facing the CZ, their causes and impacts, as well as the key actions that need to be implemented. There are numerous studies on the legislation pertaining to the CZ, developed in the 2000s, upon which we will base this chapter. We will also highlight certain recently published texts related to CZM.

1. The current state of the Legislation and regulation related to the coastal zone in Lebanon

Lebanon acceded to the Protocol on ICZM on August 1, 2017. This accession came into force on August 31, 2017.Nevertheless, the transposition of this protocol into a specific text has yet to occur[5], although a draft Law on ICZM was prepared in 2003 and amended in 2015 following the publication of Decree No. 639 on 18/9/2014, which enabled the government to accede to the ICZM Protocol.

However, there are several texts directly and indirectly related to the delimitation and management of the Lebanese coastal zone, as well as multiple urban plans for coastal areas. Thus, "multiple texts govern the Lebanese coastline as a public domain; however, this legislation remains ambiguous and is not effectively applied."[6] It should be noted that some of the environmental legislation still in force in Lebanon dates back to the twenties.[7] Added to this is the delay in updating outdated laws and regulations related to CZM and in transposing the Protocol on ICZM in the Mediterranean (hereafter the ICZM protocol) since Lebanon's accession in 2017, as mentioned above.

1.1. Delimitation of the Maritime Public Domain

According to the final report of the National Physical Master Plan for the Lebanese Territory (NPMPLT), "the Lebanese coastal area, in the scientific sense of the term, encompasses nearly one-third of Lebanese territory, including the western slope of the Mount Lebanon range between 0 and 800m in altitude and extensive areas in North and South Lebanon"[8]. The absence of a clear legal definition of the CZ[9] leaves ambiguity regarding coastal boundaries and management responsibilities. However, the Decision of High Commissioner n°144/S, dated 10/06/1925 defines the public domain by stating that it includes first of all the maritime domains: The shore till the highest waterline reached on land in winter, and all sandy and pebble beaches, bays and salted lakes directly connected with the sea, navigation routes, marine and river dams, semaphores, lighting structures, ports, harbors, and roadsteads (article 2, § 1-2)[10].

An earlier decision n°1104, dating from 1921, concerning fishery regulation only defines the public domain on the seaside. According to this decision, the maritime littoral of the Lebanese coasts extends to six nautical miles from the coast or islands (article 1)[6].

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[5] Comparative Analysis of Coastal Zone Law in the Mediterranean. M. PRIEUR et al., PAP/RAC 2023
[6] Josiane Yazbeck. Pour un droit à un environnement sain au Liban. Droit. Université Côte d'Azur, 2023. Français. p.108
[7] IMAC-Assessment of the institutional & legal setting for CZM in Lebanon. Final Report, 2007. p. 4-2.
[8] National Physical Master Plan for the Lebanese Territory, Final Report. Dar-IAURIF May 2004, p. 30.
[9] According to the Article 2-e of the ICZM Protocol, "Coastal zone" means the geomorphologic area either side of the seashore in which the interaction between the marine and land parts occurs in the form of complex ecological and resource systems made up of biotic and abiotic components coexisting and interacting with human communities and relevant socio-economic activities.
[10] ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf, 2012 p. 56.

In 1974, Article 1 of Decree number 9132 assigned the seabed and depths of territorial waters to the maritime public domain. According to the same article, islands within territorial waters and lands acquired from the sea, whether through silting or landfill, may also be assigned to the maritime public domain by a decree issued by the Council of Ministers at the proposal of the Minister of Public Works and Transport (MoPWT).

The boundaries of marine properties are not immutable. They can change due to natural factors such as erosion, sand aspiration, or even because of human activities. Moreover, the maritime public domain is discontinuous and encounters the delimitation of private properties. Thus, while the entire coastline, according to the definition of the 1925 decree, is supposed to be part of the public domain, it is observed that certain plots are private properties. Furthermore, Article 3 of the same decision No. 144/S of June 10, 1925 states that "Persons who possess rights of ownership, enjoyment, or usufruct over the dependencies of the public domain, as defined in this decision, by virtue of established customs or definitive and regular titles anterior to the enforcement of this act, may not be dispossessed, if the public interest so requires, except upon payment of fair and prior compensation.[5]" However, since the publication of this text, no private property along the coastline has been dispossessed in favor of the State.

Moreover, Law n°163 dated 18/08/2011 defines the maritime zones according to the Montego Bay Convention of 1982 as: interior waters, territorial waters, contiguous zone, Exclusive Economic Zone (EEZ) and continental shelf. Article 2, § 2, of law n°163 states that the baseline of the Lebanese shore will be modified according to any change that occurs to it, either by accretion or by erosion. The law does not specify though in which case the baseline is to be changed: due to natural events, man-made structures, or both. It is clear though that the baseline is meant to change in the future[10].

Thus, despite the supposed public domain status of the entire littoral, private ownership claims, and ongoing development projects raise concerns about environmental degradation and biodiversity loss.

1.2. Occupations of the Maritime Public Domain

According to the article 1 of the decision number 144/S of 1925, the public domain cannot be sold and one cannot acquire property by prescription[10]. However, since the publication of this first text for organizing the Lebanese coastline published in 1925, legal exceptions to the prohibition of occupying the maritime public domain have emerged. Several occupancy regimes have emerged, leading to an indirect privatization of the coastline.

1.2.1. Legal Occupations of the Maritime Public Domain

Article 14 of the decision number 144/S of 1925 stipulates that the State or Municipalities may authorize private occupation on their public domain. "Two types of occupation are therefore provided for by this decree: the concession and the temporary occupation permit, which is granted subject to meeting the following three conditions: It must be temporary, precarious, and subject to a fee. Thus, 'There is a concession when the enterprise is established as a public service, and a temporary authorization in the opposite case... The concession is a public law contract entered into between the administration and the public or private body responsible for the public service mission"[11].

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[11]Le Littoral. MAJAL, Observatoire Académique Urbain. 2017, S. LAMY, C. BOU AOUN, ALBA.p.30.).

On 18/09/1964, decree n°17614 was promulgated to organize the exploitation of MPD not yet exploited. It determined the procedure to be followed for obtaining a permit to exploit the MPD. Then, in 1966, two decrees were promulgated, decree n°4809 dated 24/06/1966 relating to the planning of coastal areas that organizes the Lebanese shore and defines it as a MPD, and decree n°4810 dated 24/06/1966 relating to the regime of occupation of the MPD that organizes the occupancy conditions of the maritime public domain[10]. This latest decree has been promulgated with the aim of fostering the tourism and service sectors. Thus, a prohibition on occupying the MPD was imposed in the following cases: In sectors outside the tourist and industrial zones delineated in the plans attached to Decree No. 4809 of June 24, 1966, relating to the development of coastal areas; In Zone 10 of the city of Beirut[11].

The granting of this authorization is subject to the following conditions: The proposed project must be of public utility; This exploitation of the maritime public domain must not impede public access to the public domain nor infringe upon the principle of coastal continuity and building occupation should not exceed 5%.; The project must also comply with the zoning and urban planning regulations in force; the applicant for this authorization must possess a contiguous plot of land to the maritime public domain they wish to occupy.

"Several exemptions have been made to this latter condition. The first occurred in 1978 with Decree No. 1300, which amended the 1966 Decree, stipulating: 'A permit for the occupation of the MPD or territorial waters may be granted without the permit applicant being the owner of a contiguous plot of land to the part of the MPD to be occupied, provided that the permit application concerns a comprehensive tourist project aboard a large tourist cruise ship, including extensive tourist facilities that can be used as hotels, clubs, restaurants, and recreational spaces, on the condition that the area to be occupied is contiguous to a main road and is delimited in accordance with the plans, taking into account the needs of the project subject to the permit.' Another type of exemption to the conditions listed in Decree No. 4810/1966 was added by Decree No. 7464 of October 30, 1995. Under this new decree, the area of the MPD requested for occupation may now be larger than the authorized area if the area of the private property exceeds 20,000m² and the authorization request pertains to a Category A tourist project (Hotel, Beach Resort, etc.). In such cases, the Council of Ministers (CoM) grants an exemption by decree, upon the proposal of the Minister of Public Works and Transport"[5]. This decree also reactivated the possibility of occupying the MPD in Zone 10 of Beirut.

These outdated legislations have facilitated the implementation of investment projects that are gradually destroying the Lebanese coast[6].

The annual fees for the occupation of the MPD, as well as the payment modalities, were established in 1963 by Decree number 12841. In 1992, this decree was cancelled by Decree number 2522, which imposed new reference flat rates according to regions for the calculation of the fees, as well as the method for calculating these fees. This decree was amended in 2018 by Decree number 4127. In 2023, following the economic crisis, the price per square meter of the public maritime domain is adjusted by converting it into US dollars based on an exchange rate of 1,507.5 LP. The amount is then multiplied by the average market exchange rate of the day preceding the issuance or renewal of the temporary occupation permit for the public maritime domain.

Although it is possible to occupy the CZ, two fundamental conditions must be respected: the unity and continuity of the beach, as well as the right of free access. These conditions are mentioned in several laws and regulations. In 1963, although Decree number 12841 does not guarantee the rights of third parties, it symbolically increases (by only 0.1%) the fee in cases of infringement upon free access.

As mentioned above, according to Decree number 4810 of 1966, the exploitation of the MPD must not infringe upon the principle of the continuity of the coastline in cases where spaces are designated to remain accessible to the public.

In 2002, Article 33 of Law number 444 on the protection of the environment prohibits works on the marine or river public domain that obstruct free access to the coasts and sandy beaches.

This outdated legislation related to the public domain occupation is insufficient to protect the right to free access to the beach and equal enjoyment of MPD[6].

In 2017, among the regularization conditions set forth in paragraph 2 of the article 11 of Law No. 64`concerning the regularization of illegal occupations in the public maritime domain, public access to the beach must be ensured. The MoPWT reserves the right to create or maintain parts of the MPD as access routes to the beach and/or the sea in order to preserve the unity and continuity of the beach, as well as the right to create main and secondary roads leading to the beach and the sea.

Finally, according to the Article 45 of the Lebanese budget law 2024, Fines ranging from 10,000 US$ to 35,000 US$ are imposed on individuals violating the right to access to the sea and along the shore, and related decrees. The violator is required to promptly rectify the violation; the fine is doubled in case of recurrence. Unfortunately, these texts are not well enforced.

1.2.2. Illegal Occupations of the Maritime Public Domain

According to the 2012 report from the MoPWT, there are 73 legal occupations of the MPD, while illegal occupations amount to 1068. The total surface area of occupations legalized by decrees is 2,465,091m^2, whereas the total surface area of illegal occupations is 2,841,903m^2 [11].

Added to these 1068 infractions, according to the MoPWT, 61 recent infractions occurred in 2011 and 2012. The area illegally occupied during this period amounts to 15,559m^2, divided between landfills and other installations.

Since 2012, numerous new illegal projects affecting the Lebanese coastline have been emerged. A new assessment was conducted by the Lebanese army during the period 2023-2024. The report of this assessment has not yet been published.

In 1983, a first Decree-law number 144 was published with the aim of regularizing illegal exploitations of the CZ that took place during the Lebanese war. This decree was cancelled by the decree-law 34-1985 and the budgetary law no. 14 dated 20/8/1990 confirmed the annulment of sales, leasing and exploitation contracts of the public maritime or municipal domain which were not compliant with the applicable rules and regulations.

Article 11 of Law No. 64, published on October 20, 2017, concerning the regularization of illegal occupations in the area distinguishes between offenses that occurred before January 1, 1994, and those that occurred after January 1, 1994. The text does not provide for regularization of offenses that occurred since 1994; the occupied lands must be evacuated immediately. Only offenses that occurred before 1994 are eligible for regularization granted by decree. According to this Article, offenders were fully exempted from the payment of any fines for the period prior to 1994. Minor fines were established for the subsequent period. This was the case for the fees set for the period following regularization. Moreover, offenders had the option to either pay the fine immediately and benefit from a 20% reduction or request installment payments.

In 2019, paragraph 5 of Article 11 of Law No. 64/2017, which initially limited the grace period to only three months from the entry into force of this law, was amended by Law No. 132, extending the deadline so that it expired at the end of October 2019.

In 2020, the public prosecutor's office reached an agreement with the Ministry of Finance (MoF) and the MoPWT to establish terms and conditions under which auctions would be held to secure new bidding for beach resorts illegally located on the maritime public domain after 1994 instead of rehabilitating this area[6]. This demonstrates that the aim of these laws is to address only the financial aspect of the issue rather than protecting the environment.

Thus, legal and illegal occupations of the CZ, coupled with low license fees and fines, pose significant threats to coastal ecosystems and biodiversity.

1.3. The Current Coastal Zone Protection

The Ministry of Environment (MoE) plays a crucial role in the protection of the CZ and in the implementation of the ICZM Protocol. These powers are conferred upon it by virtue of multiple legal texts. Thus, Article 29 of the environment protection Law No. 444/2002 states that the MoE, in coordination with the MoPWT and the relevant departments and authorities, each within its jurisdiction, is responsible for achieving the following objectives: Protecting the beaches of the Lebanese Republic, its natural resources, and its ports from the risks of pollution in all its forms and types; Protecting the natural living and non-living territorial waters of Lebanon from the risks of pollution in all its forms and types.

According to Article 2 of Law No. 690/2005[12] outlining the current organizational framework of the MoE, the Ministry is responsible for determining the environmental conditions for protecting seashores, rivers, springs, lakes, swamps, and valleys in a manner that ensures environmental safety and the sustainability of natural resources. Also, article 20 of Decree No. 2275/2009, which regulates the units affiliated with the MoE and defines their tasks, staff, and special conditions for appointment to some of their positions, assigns the Natural Resources Protection Department the task of protecting the seashores.

Also, as per Law No. 690/2005, the ministry is tasked with formulating strategies. A first draft of the National Strategy for ICZM was developed in 2003 under the Coastal Area Management Program (CAMP) project. This first draft was updated in 2015. Nonetheless, the Strategy ICZM has not been published to date. However, Article 18 of the ICZM Protocol applied this obligation to the CZ, stating that State Members have to set National Coastal Strategies, plans and programs "for ICZM and coastal implementation plans and programs consistent with the common regional framework."[10, 13]

At international and regional level, in addition to the Barcelona Convention and its protocols, particularly the ICZM protocol, Lebanon has ratified several conventions and treaties pertaining to the protection of the coastal zone and sea water[7,14].

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[12] http://77.42.251.205/LawArticles.aspx?LawTreeSectionID=246883&LawID=245643&language=ar
[13] Art. 18 § 1 of the ICZM Protocol.
[14] For example, Convention on Preservation of Biological Diversity (Rio de Janeiro)-1992, International Convention for the Prevention of Pollution by Oil (London)-1954, international Convention for the Prevention of Pollution from Ships -1973, MARPOL Protocol of 1978 Related to the International Convention of 1973 for the Prevention of Pollution from Ships (London)-1978

At national level, it is evident that one of the most effective legal tools for the protection of the CZ in Lebanon is the ICZM Law. Unfortunately, this Law has yet to be promulgated. As previously mentioned, there is currently a draft Law on ICZM. This draft will be updated and submitted to the relevant authorities for publication.
However, there are several legal tools available to preserve the CZ. However, these tools are often poorly applied.

1.3.1. Sustainable Use of the Coastal Zone

There is no text in Lebanon imposing a 100m zone[15] where construction is not allowed according to Article 8-2-a of the ICZM protocol[16]. However, there are a few pockets of non-buildable zones, but at most these are only a few hectares generally unsuitable for construction due to the topography of the site. None of the urban planning plans of the agglomerations expressly delimit large non aedificandi zones.

The NPMPLT approved by the decree number 2366 published on June 20, 2009, identifies the CZ as the most ecologically rich and sensitive area in Lebanon. However, despite this recognition, the implementation of the NPMPLT remains inadequate and no detailed master planning for the CZ was conducted. This is particularly evident in the failure to implement the NPMPLT recommendations such as the publication of an Integrated Coast Management Law, the development of a specific master plan for the CZ, the updating of urban plans for coastal cities, and the classification of beaches.

However, the CZ can be protected by establishing coastal and marine protected areas. The article 48 of The Environment Protection Law 444/2002[17,] states that the management of natural resources and the protection of biodiversity includes the establishment of public parks, nature reserves and protected areas, and the proposal to protect sites and natural landscapes[18]. Furthermore, protected areas Law No. 130 enacted in 2019 aims at providing for the natural areas in Lebanon. It classifies protected areas into different categories and regulates their establishment and management requirements. However, the implementing decrees of this framework law are still not published.
There are currently three coastal and marine protected areas (MPA) in Lebanon established by laws: Palm Islands Nature Reserve[19] (PINR), Tyre Coast Nature Reserve[20] (TCNR), and the Abbassieh Coast Nature Reserve (ACNR)[21]. It should be noted that Lebanon's Marine Protected Areas (MPAs) Strategy was developed in 2012 for its importance in increasing the percentage of marine protected areas of particular importance for biodiversity in Lebanon[22].

Moreover, other coastal sites can be classified as non-buildable, pursuant to decree No. 166 L. R. /1933 on Antiquities and Historical Monuments[23]. For example, in the cities of Jbeil, Saida, and Tyre, certain sections of the coastline are designated as non-buildable due to the presence of classified ancient sites.

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[15] The 100 m non aedificandi zone is mentioned in article 11 of the ICZM draft law updated in 2015.
[16] "The parties Shall establish in coastal zones, as from the highest winter waterline, a zone where construction is not allowed. Taking into account, inter alia, the areas directly and negatively affected by climate change and natural risks, this zone may not be less than 100 meters in width, subject to the provisions of subparagraph (b) below. Stricter national measures determining this width shall continue to apply."
[17] http://77.42.251.205/Law.aspx?lawId=244662
[18] Lebanon national contribution to support the Post-2020 SAP BIO elaboration. 2020. p.41
[19] Law number 121/199,
[20] Law number 708/1998
[21] Law number 170/202.
[22] https://portals.iucn.org/library/sites/library/files/documents/2012-081.pdf
[23] http://77.42.251.205/Law.aspx?lawId=243812

Furthermore, according to Article 1-4 of the decree number 8803/2002[24] entitled "the organization of quarries and crushers. The exploitation of rock quarries for crushers and landfills, natural gravel pits, and quarries to produce soil is prohibited in natural sites, nature reserves, regional and national parks, and riverbeds. The exploitation of sand pits, decorative stone (block) quarries, building stone quarries, and rock quarries to produce mosaics is also prohibited in natural sites, nature reserves, and riverbeds.

"Each urban plan sets forth a set of rules and easements binding on landowners in the context of building permit or subdivision approval applications"[6]. There are several urban plans that cover the coastal localities of Lebanon (e.g., the urban plan for the northern CZ approved by Decree No. 3362/1972). A setback of 10m starting the limits of the MPD is generally provided for in urban planning for the CZ.

Furthermore, according to Article 17 of the Urban Planning Law promulgated by Decree-Law No. 69 of 1983[25], the exploitation factor of private lands located in the CZ can be reduced and certain regions may also be put under study for a period of one year, renewable for one year only, during which any construction or operating project is frozen pending the publication of an urban plan and a legal text specific to these areas (e.g., Decree No. 16431 of 25/05/1964) without any compensation. However, when the easement preventing construction (non aedificandi) has a final character that would make the plot of land unbuildable, it should be compensated.

Private territories can be expropriated for the benefit of the public domain in exchange for compensation[26] or through a land exchange[27] provided for by the Urban Planning Law.

The Construction Law No. 646/2004 and its implementing decree 15874/2005 impose specific easements, including environmental easements, in addition to the requirement to comply with the provisions of the Environmental Protection Law No. 444/2002 during the construction, operation, and demolition of buildings.

Finally, it should be noted that the governance of wetlands is addressed by the Convention on Wetlands of International Importance, particularly as waterfowl habitat, which was signed in Ramsar, Iran, on 2 February 1971. Additionally, it is incorporated into the ICZM Protocol under Article 10, § 1. Thus, and according to RAMSAR Convention, three maritime sites were designated wetlands in Lebanon: Deir el Nouriyeh cliffs of Ras Chekaa, 16/04/1999 in North Lebanon; PINR on 03/08/2001 in North Lebanon; TCNR on16/04/1999, in the South of Lebanon.

1.3.2. The Coastal Zone Protection Against Economic Activities Pollution

Article 9 of the ICZM Protocol tackles the issue of economic activities[28], "taking into account the relevant provisions of the Barcelona Convention and its Protocols".

The Environment Protection Law 444/2002, specifically Chapter II of the title V entitled "the protection of the coast and the marine environment against pollution", in its articles 29 to 34 stated the principle of "protection of the coast and aquatic environment from all sources of pollution in

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[24] Last amendement decree number 1735/2009
[25] http://77.42.251.205/Law.aspx?lawId=244511
[26] Art.18 of the Urban Planning Law promulgated by Decree-Law No. 69 of 1983
[27] Art.19 of the Urban Planning Law promulgated by Decree-Law No. 69 of 1983
[28] Article 9, § 2(f) of the ICZM Protocol sets a number of activities that have to be taken into consideration while organizing the management and protection of the coastal zone

respect of the provisions of regional and international conventions ratified by Lebanon[29]. However, this chapter has not been fully implemented. This failure includes the absence of a management and protection plan for the CZ, which should have been developed by the MoE in collaboration with the MoPWT as mentioned in Article 29.

Also, this chapter aims to protect marine habitats through prohibiting any discharge, submersion, or burning of harmful substances in Lebanese territorial waters. Nevertheless, these substances are still not specified. Furthermore, neither the required conditions to deliver permits for discharging, submersion, or burning of non-hazardous substances, nor the necessary measures to prevent any maritime pollution resulting from ships, maritime carriers, vessels, or facilities in the Lebanese territorial waters have been determined.

1.3.2.1. Waste Sector

In 1921, The High Commissioner issued Decision No. 1104, entitled "Determination of the Marine Coastline and Penalties for Violations of Marine Fishing," which prohibits, in its Article 6, the disposal of any materials that may pollute the waters or disturb, frighten, or poison fish along the entire coastline or in ports designated for marine fishing. This prohibition also applies to facilities located on the coast regarding the discharge of their waste, which may only be discharged into the sea in accordance with the conditions of a permit that they must obtain, without specifying the mechanism for obtaining prior permission[30].

It should be noted that the Decree No. 8735 of 1974, entitled "The Preservation of Public Cleanliness," stipulates in its Article 1 that it is prohibited to dispose of building debris, excavation soil, stones and other materials, agricultural and industrial waste, discarded vehicles and cars struck off from the vehicle registration authority, their debris, frames, and parts in watercourses, their banks, and on public maritime properties.
On the other hand, law No. 64/88, dated 12 August 1988, about protection of the environment from harmful wastes and dangerous substances, defines toxic and dangerous waste. According to Article 9 of this Law, a person commits the crime of pollution if she discharges into sea waters any chemicals, harmful wastes, or other materials that render the sea harmful for swimming or other uses, pose health risks, result in the death of fish or hinder their reproduction, compromise the suitability of fish as food for humans, or harm other marine animals and plants[30].

Other domestic laws and legal instruments contribute to the conservation and protection of marine and coastal zone from waste pollution. For example, the Integrated Solid Waste Management Law No. 80 promulgated in 2018 and the Law No. 192/2020 amending the water Law of 2018 prohibiting the disposal of waste in surface water which leads to the sea pollution. These laws include provisions prohibiting the dumping of waste into seawater. However, these legal texts lack implementation. In-land solid waste disposal contaminates underground water supplies, while the major ones are located on the seashore negatively affecting the whole coastal area of the nation as well as the marine environment[10].

Wastewater is one of the main pollutants affecting Lebanese coastal waters. Law No. 221 dated 29/05/2000 for the Organization of the Water Sector regulates domestic wastewater. It gives jurisdiction of the wastewater sector to the water public institutions that also exploit the drinking

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[29] Updated ICZM Strategy for the Lebanese Coastal Zone, 2015. P.12
[30] Legal Guide to Advocating for a Plastic-Free Sea, Lebanon Eco Movement, 2021, J. YAZBECK,. p.19

water sector[10]. The Law No. 192/2020 amending the water law of 2018 currently governs The Management of the Public Collective Sanitation Facility in its chapter 3, articles 68 to 73.

An updated National Water Sector Strategy for 2020-2035 has been recently drafted, which includes wastewater reuse and sludge management. However, this strategy has not yet been approved by the Council of Ministers and published by Decree. However, despite the recent legislation and strategy that have been issued, wastewater continues to pollute the sea of Lebanon.

1.3.2.2. Maritime Activities

The economic activities concentrated on the LCZ primarily involve port operations. The impact of maritime activities on life at sea has been extensively addressed by the Montego Bay Convention of 1982. The United Nations Convention on the Law of the Sea (UNCLOS) laid strict rules and regulations on the exploration and exploitation of the State's territorial waters and the continental shelf or the Economic Exclusive Zone (EEZ), with due respect to fishing and to the protection of the marine environment including the rights and duties of other States[10].

Lebanon acceded to this agreement pursuant to Law No. 295 of 22/02/1994. Moreover, on November 24, 1993, Lebanon acceded the 1973 International Convention for the Prevention of Pollution from Ships (MARPOL), the main international convention dealing with the prevention of marine environment pollution, whether the causes are related to exploitation or accidents. The convention includes rules to reduce pollution from ships—both accidental and routine—and currently includes six technical annexes, each of which regulates a specific topic. The annex that concerns us is Annex No. 5, which entered into force on January 31, 1988. This annex deals with several types of waste and specifies the distance from land and the method by which they are to be disposed of the most important condition in the annex is the complete prohibition of the dumping of plastic materials in any form[30].

At regional level, Lebanon acceded in 1977 to the Protocol for the Prevention of Pollution of the Mediterranean Sea by dumping from ships and aircraft adopted in 1976. However, it has still not acceded to the amendments to this Protocol entitled "Protocol for the prevention and elimination of pollution of the Mediterranean Sea by dumping from ships and aircraft or incineration at sea", adopted in 1995.

At national level, all Lebanese ports open to maritime commerce and fishing are subject to the Lebanese port regulations issued pursuant to Resolution No. 31 of 26/01/1966. According to the article 102 of this resolution, no person or associated institution may transport ship waste without obtaining a special authorization permitting such activities[31].

Moreover, Resolution No. 88/N, entitled 'Determining the Tariff for Receiving and Transporting Ship Waste in the Port of Beirut,' issued on 7/3/1997 (amended by Decision No. 8/N/1998 dated 01/13/1998), stipulated that all ships docking in the Port of Beirut, within its basins, at its berths, or outside it, or in the area attached to it, must deliver their waste upon arrival, during the period of their docking, and before their departure to the contractors responsible for receiving and transporting these materials. This is in implementation of the provisions of the applicable international agreements regarding the prevention of marine pollution and the preservation of the marine environment and the waters of ports and harbors and their vicinity[30].

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[31] http://77.42.251.205/LawView.aspx?opt=view&LawID=176668#Section_288903

Tourism, sporting, and recreational activities such as jet skiing and recreational boating are still not regulated by national law in respect of their interaction with coastal zone management and conservation, despite posing a threat to marine biodiversity. "In the sixties, due to the success of its touristic attraction, the Government of Lebanon (GoL) attempted to organize its littoral[32]. In the seventies, additional texts were necessary[33]. The relevant text related to the use of the shore for tourism and recreational activities is outdated and contains no mention of any obligation towards the natural environment"[10]. However, the ICZM Protocol has foreseen economic activities that can be extremely harmful to the environment. However, the ICZM Protocol has foreseen economic activities that can be extremely harmful to the environment[34].

1.3.2.3. Fisheries sector

The port operations include 44 fishing ports and landing sites that hosted 2,084 authorized fishing vessels in 2019. The current Fishing Laws and regulations date back to the French Mandate, such as the decision number 2775/1929 for coastal fishing monitoring. There is an attempt to organize the sector by the MoA. Currently, some fishing practices are regulated only by ministerial decisions that constantly change according to issues in the field. In 2010, Ministerial Decision No. 346/1 was issued, pertaining to the organization and specification of types and equipment of marine transportation[35]. However, the Lebanese legal framework lacks comprehensive legislation pertaining to fisheries. Fisheries and Aquaculture draft Law has been recently submitted to the parliament. Recently, a draft Fisheries and Aquaculture Law has been prepared and submitted to Parliament, but it has not yet been promulgated.

1.3.2.4. Energy sector

The Ministry of Energy and Water (MoEW) in Lebanon has initiated exploitation and extraction activities for offshore oil resources under Law No. 132/2010 on offshore petroleum resources. According to the MoE, "the introduction of this new sector in Lebanon will create new challenges and pressures on the surrounding marine and coastal environments."[36,37]. A series of domestic laws, decrees and decisions to regulate its development with special attention to possible impacts on marine and coastal resources such as: The mentioned Law No. 132/2010 stipulating the development of a Strategic Environmental Assessment (SEA) for the sector and Environmental Impact Assessments (EIAs) for all plans at all stages. This Law also gives the right to the MoE, in coordination with the MoEW to oversee activities that could disturb the environment; and Decree No. 43/2017 entitled Tender Protocol to Participate in Licensing Rounds and the Model Exploration and Production Agreement (Amended by Decree no. 4918/2019)[38] sets environmental requirements that should be respected by Right Holders[18].
Moreover, Lebanon acceded to the Protocol Concerning Cooperation in Preventing Pollution from Ships and, in Cases of Emergency, Combating Pollution of the Mediterranean Sea in 2017[39].

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[32] Decree n°17702/1964, Regulating Jounieh's shore; decree n°4809/1966, Regulating the Lebanese Littoral; decree n°5118/1969, Regulation of beaches and pools in the city of Beirut.

[33] Law n°5 dated 13/10/1970 and decree n°15598 dated 21/09/1970, decision of the Minister of Tourism n°1646 dated 26/06/1971, classifying the beaches.

[34] Art. 9, § 2 (d of the ICZM protocol.

[35] Also, Decision No. 8/1 issued in 2012 pertaining to: Regulating and specifying some types and equipment of marine fishing

[36] SOER-Lebanon 2020, MOE. 2021, p.196

[37] https://www.lpa.gov.lb/

[38] https://www.lpa.gov.lb/english/sector-governance/legislative-framework

[39] https://wedocs.unep.org/bitstream/handle/20.500.11822/2912/02ig14_final_act_alllangs_emergprotocol_eng.pdf

1.3.2.5. *Industrial sector*

Industry has a big impact on the CZ in Lebanon due to the large number of factories and plants located near the shore, particularly in terms of wastewater[40]. Gas emissions exacerbate the problem, especially when some plants remove their filters to accelerate production. Aesthetic pollution is also problematic due to the absence of any codes regulating their appearance[10].

Decree No. 8018-2002 (Determination of the procedure and conditions of permitting for industries) provided that the minimum distance of industries from the shore shall be 1000m at least for areas not regulated by decrees. The decree excluded industries which shall be established on the shore for purposes that are vital to the process in question[41]. In addition, the Ministry of industry (MoI) has classified industries according to their impact on their surrounding environment (five categories in accordance with ISIC III)[10,42]. Monitoring compliance with permit conditions during an industrial establishment's operation, as well as product quality; must be ensured according to the decree number 9765/2003. Control, measures and penalties related to industrial establishments.

1.3.2.6. *Ministry of Defense activities*

The Ministry of Defense (MoD) activities can have an impact on the coastal zone in case of exceptional circumstances leading to état d'alerte in application of the terms of The National Defense Law[43] or "State of Emergency" in virtue of article 65 of the Constitution which give the army full control over the country in times of threat[10].

The Chief of the army has the authority to make all decisions aimed at preserving peace, particularly concerning the control of ports and ships in territorial waters. The Army is also responsible for combating terrorism and has expanded the scope of its interventions. Currently, the army is tasked with controlling territorial waters, either in conjunction with or instead of the Internal Security Forces (ISF).

Given this broad jurisdiction during times of alert, the MoD is therefore involved in the CZ, and the army's activities should be integrated into the Strategy aimed at improving ICZM[10].

1.3.3. *The Environmental Impact Assessment*

The Law 444/2002 established the principles of EIA as a tool for planning and management in its article 4 and title 4[44]. According to the article 21 of this Law, "The relevant authorities in the public and private sectors are to conduct initial environmental impact assessments or environmental impact studies for projects that may pose a threat to the environment due to their size, nature, impact, or activities. The Ministry of Environment reviews and approves these studies after ensuring their compliance with environmental safety and sustainability of natural resources".

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[40] « 70% of industrial zones are located along the coast where they discharge raw chemical effluents without any pre-treatment to remove toxic compounds, which is negatively affecting the coastal zone and the efficient and sustainable use of coastal resources » (2007 -IMAC-Assessment of the institutional & legal setting for CZM in Lebanon. Final Report. p. 1-1).

[41] IMAC-Assessment of the institutional & legal setting for CZM in Lebanon. Final Report 2007 -. p. xvi

[42] Decrees n°5243/2001 Classification of industrial establishments and n°8018/2002Permitting conditions and procedures relating to the establishment and/or operation of industrial establishments.

[43] LD n°102 dated 16/09/1983.

[44] Art. 21 to 23 of the Environment Protection law No. 444 of 2002

Two implementing decrees of the mentioned title, published in 2012, are instrumental in the protection of the coastal zone in Lebanon. The SEA decree No. 8213 and the EIA Decree No. 8633. The enforcement of these decrees is crucial for preventing and mitigating environmental risks associated with programs and projects that have significant environmental impacts.

Thus, according to Annex 1 of Decree EIA number 8633/2012, the occupation of the MPD mandatorily requires an EIA. Additionally, according to Article 1 of the SEA Decree, any policy, plan, program, study, exploitation, or organization affecting an entire Lebanese region or sector is mandatorily subject to a strategic environmental assessment.

The current lack of implementation of these two decrees exacerbates environmental pressures on coastal and marine environments.

Moreover, the environment protection Law No. 444/2002 is outdated. It does not address contemporary issues such as climate change, erosion, or sea-level rise, contributing to policy deficiencies. Also, the low value of fines allows various environmental law violations, which prevents effective protection of natural areas, especially the coastal zone.

2. NON-CONFORMITY CAUSES (DRIVERS)

All legal studies assessing legal, policy and institutional gaps in Lebanon identified the main problem as being the lack of law enforcement without ignoring the need to update and/or enact new laws for the ICZM[10].
The challenges facing Lebanese CZM are multifaceted and deeply rooted in systemic issues that need urgent attention.

2.1. Lack of Political will

One of the critical issues is the absence of political will, exacerbated by the fact that most operators on the coastal zone are politicians. "The *main-mise* over the MPD by private companies, politicians, and individuals with political connections, and the privatization of the maritime public domain limits the capability of the GoL to force the implementation of laws and regulations"[10].

This lack of political will manifests in various ways, such as the slow updating of urban plans, especially for coastal cities, to align with recommendations of the NPMPLT. Unfortunately, these recommendations are not legally binding, leading to inconsistencies and gaps in coastal management.

2.2. Lack of Awareness and Education

Another significant concern is the lack of awareness and understanding regarding the importance of the coastal zone and the legislation governing it, including the ICZM protocol. According to this Protocol, Lebanon, like all other parties, undertakes to carry out, at the national, regional or local level, awareness-raising activities on ICZM and to develop education, training and public education programs on this subject[45]. "School programs do not consecrate enough time for environmental matters in general, and none to coastal matters in particular. The public opinion cannot, hence, constitute a serious pressure on the Government to adopt responsible environmental and coastal

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[45] Art. 15 § 1 of the ICZM Protocol.

policies"[10]. Also, the lack of environmental knowledge among public prosecutors and administrative judges further hinders legal enforcement.

It is crucial to note that, at national level, according to the Environment Protection Law No. 444/2002, academic institutions must include environmental education programs in their curricula. Furthermore, public and private institutions working in the fields of education, training, research, media, and culture must cooperate with the MoE and relevant ministries to develop media and awareness campaigns on the protection of the environment and natural resources, and to implement preventive techniques[46].

2.3. Political and Economic Situation

The lack of awareness is compounded by Lebanon's systemic economic and political crises which relegates environmental issues to a secondary priority. Consequently, legislative updates and advancements are slow, leading to the absence of promulgation of the Draft ICZM law and the transposition of the ICZM protocol. "The political situation in Lebanon is often unsettled and does not favor implementation of neither national nor international obligations. Indeed, Lebanon has been witnessing political tensions, armed conflicts, strikes and demonstrations since the 1970s, driving the Government away from environmental concerns and keeping it focused on security issues"[10].

2.4. Short-term remedies approach

The use of short-term remedies instead of adopting a comprehensive legal framework for CZM is prevalent. This approach, coupled with the absence of political will, leads to a lack of publication of implementing decrees and poor coordination between ministries and concerned institutions, further hindering effective coastal management.

2.5. Lack of law enforcement

The enforcement of environmental laws and regulations is weak, with sanctions and fines often being insufficient to deter violations. The Ministry of Interior and Municipalities (MoIM), through its security forces, is responsible for the application and enforcement of legislation in Lebanon including the environmental and coastal legislation (the Coastal Brigade Command and the Coastal Detachments affiliated to the security forces). Political interference in projects and decisions, and the limited number of security forces personnel and guards, coupled with a lack of knowledge of environmental laws among law enforcement agents (including ISF, forest and fishing guards, municipal police), and insufficient equipment for coastguards, contributes to enforcement challenges[7].

Furthermore, the MoE lacks employees enabling it to carry out research and monitoring of environmental issues, and to follow-up on the implementation of environmental strategies[10].

The environmental police, called also "inspectors", provided for by Law No. 251/2014 and established by Decree No. 3989/2016 have still not been recruited. The absence of an environmental police affects the effectiveness of environmental legislation and the monitoring power of the MOE.

2.6. Corruption

Degradation of the environment in general and the coastal zone in particular is closely linked to corruption[10]. At international level, Lebanon has acceded to the United Nations Convention against Corruption (UNCAC) on 22/04/2009. On the other hand, at national level, Law No. 175 on combating

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[46] Art. 16 & 17 of the Environment Protection law number 444/2002.

corruption in the public sector and establishing the National Anti-Corruption Authority has been promulgated on May 8, 2020. Lebanon has neither criminalized environmental degradation nor included it in the list of offenses considered as corruption, unlike several states such as Spain. However, the comprehensive definition of corruption, mentioned in Article 1 of this law, encompasses environmental corruption.

It should also be mentioned that in 2018, Law No. 84 was promulgated, enhancing transparency in the petroleum sector impacting the CZ. This specific law imposes transparency throughout the entire value chain, from exploration to decommissioning[47].

Despite these measures, violators, often protected by political parties, enjoy impunity. This phenomenon is spread all over the country and is not restricted to the coastal zone. "The warlords eventually became the leaders of the country themselves. They abuse their power to illegally exploit the public maritime domain for the benefit of those around them in exchange for royalties of a derisory amount"[6].

Furthermore, Law No. 28 on access to information was promulgated in 2017 to ensure that every citizen has the right to access information and documents available from the administration. It is important to note that, even before the promulgation of this law, the Environment Protection Law No. 444/2002 had already guaranteed access to information related to the environment[48]. Moreover, Decree No. 8633/2012 also guaranteed the right to access information related to environmental impact assessments conducted[49].

Access to information remains difficult in Lebanon at all levels and in all domains, including the environment.

2.7. Lack of funding

The amount allocated to environmental strategies, action plans and field activities is extremely small and does not allow major planning and progress[10]. It should be noted that the annual budget of the MoE is among the lowest compared to other Lebanese ministries, amounting to 8.9 billion LP in 2020, which represents less than 1 million US$ at the current market exchange rate[36].

"The funding for environmental protection is ensured by the establishment of a National Environmental Fund (NEF) provided for in Chapter Three of Title Two of the Environmental Protection Law. Article 11 of Law No. 444/2002 provides that the organization of the NEF and the implementation procedure of its missions will be determined by decree, issued by the Council of Ministers upon the proposal of the Ministers of Environment and Finance. However, this decree has not yet been published to date"[6].

2.8. Lack of NGOs' right to appeal and organization

Non Govenrmental Organizations (NGOs)' right to appeal before administrative courts is subject to discretionary powers. Also, lack of organization and education within civil society, including non-specialized NGOs and limited coalition-building, also contribute to the challenges in CZM.

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[47] https://www.lpa.gov.lb/english/sector-governance/legislative-framework
[48] Art. 4, O -1 & Art.14-1 of the Environment protection law number 444/2002
[49] Art. 12 of the EIA decree number 8633/2012

In conclusion, addressing these systemic challenges requires a holistic approach, including political commitment, public awareness and education, legal reforms especially the promulgation of the draft law on the ICZM transposing the ICZM Protocol., enhanced enforcement mechanisms, and strengthened collaboration between stakeholders and institutions.

Other challenges include overlap and contradictions in legislation[7], overlapping jurisdiction among ministries[10], lack of gender equality considerations in coastal zone laws, unclear accountability for law implementation, internal inconsistencies, and insufficient implementation mechanisms[7]. These factors collectively contribute to the ineffective management and protection of Lebanon's coastal and marine environments, necessitating urgent reforms and comprehensive policy revisions.

3. PRESSURES

The coastal areas are facing numerous challenges stemming from increasing urbanization, unregulated construction, and unsustainable exploitation of resources such as sand and fish etc. The discharge of untreated wastewater into the sea and the rise in pollution from human activities further exacerbate these issues.

Additionally, the significant lack of awareness about the importance of coastal zones and the regulations governing them leads to a low priority given to environmental concerns and weak enforcement of existing regulations. This weak law-enforcement extends to coastal regulations, with under-resourced authorities unable to effectively monitor coastal areas and limited legal avenues to challenge coastal violations. Insufficient penalties and political interference further contribute to a lack of deterrence and accountability.

The implementation of the Framework law number 444/2002 requires publication of implementing decrees that is one of the major gaps in terms of its enforcement. Most of the implementing decrees mentioned by this law are still not published. The publication of some of these decrees has been very slow. "Actually, it took ten years to issue two of its major application decrees: the EIA (Decree No. 8633/2012) and the SEA (Decree No. 8213/2012). EIAs and SEAs are intended to ensure the protection of the CZ (amongst other ecosystems) from possible pressures caused by new projects and plans"[18].

"Since the beginning of the civil war in Lebanon in 1975, illegal occupations of public domains, especially maritime ones, have increased significantly. The number of occupations and the area of encroachments along the Lebanese coast have risen. During this period, random authorizations were issued by successive MoPWT, thereby violating Decree No. 144/25, particularly its article 16 which stipulates that work permits must be issued by decision of the CoM, allowing for the occupation of state properties. With the end of the war, these violations reduced the unoccupied MPD to approximately 40km"[6].

One of the fundamental problems is the absence of a clear legal definition of the CZ, coupled with a slow legislative process for environmental matters and the politicization of environmental regulations. The coastal legislation is outdated and fragmented, lacking a comprehensive legal framework for ICZM and suffering from a lack of political prioritization for CZM, often focusing on short-term solutions instead of long-term strategies.

The existing coastal legislation also suffers from unclear definitions and procedure. Furthermore, there is a lack of political prioritization to address new environmental challenges, leading to legislative

and bureaucratic inertia and weak enforcement of environmental regulations due to under-resourced authorities and limited knowledge among enforcement agents.

Moreover, legal ambiguity regarding the status of coastal lands, exceptions allowing private property claims on the public domain, and limited oversight on development projects in sensitive areas create challenges. Private ownership within the CZ can restrict public access, create unequal distributions of benefits, and lead to conflicts between private landowners, public authorities, and environmental stakeholders regarding development plans and conservation efforts. These complexities make it difficult to implement comprehensive and integrated management plans for coastal areas.

It is also important to highlight the absence of development and updates to urban plans for coastal cities and regions, as mandated by the Urban Planning Law[50] and in accordance with the NPMPLT. Moreover, unregulated construction in violation of the Construction Law No. 646/2004 and its implementing decree number 15874/2005 further exacerbates the situation.

It is worth noting that the "Sectoral and inert-sectoral analysis" carried out under the MedProgramme Child Project 2.2 titled "Mediterranean Coastal Zones: Managing the Water-Energy-Food and Ecosystems Nexus" has identified a set of challenges on the governance sector that align with the findings of the current Legal and Governance diagnostic analysis (Figure 1).
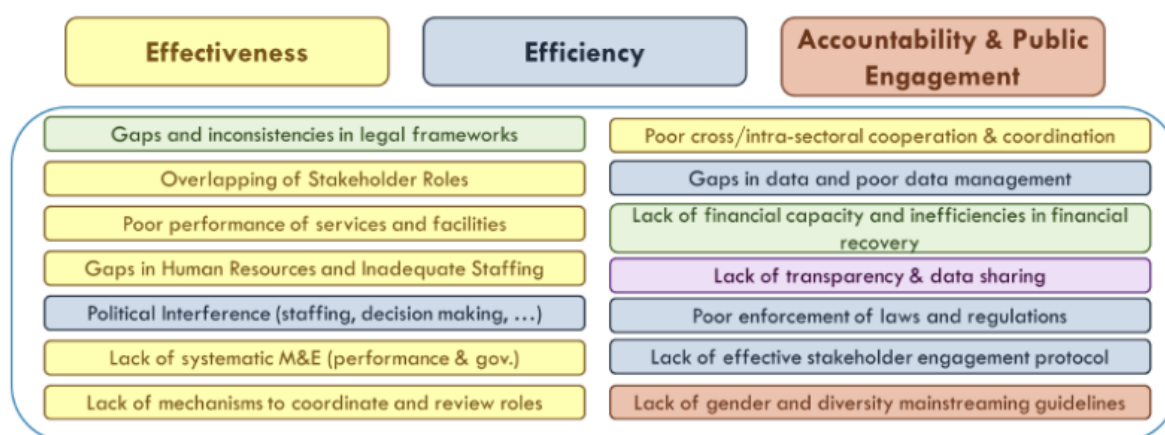
Figure 1: Summary of challenges in WEFE sectors governance.[51]

4. IMPACT

The degradation of sensitive coastal ecosystems, including beaches, dunes, seagrass beds, and terraces, has become a major concern. This degradation is aggravated by coastal erosion and increased shoreline retreat, resulting in the loss of critical habitats for marine biodiversity. Consequently, fishery resources are declining, and coastal water quality is deteriorating, endangering the livelihoods of coastal communities dependent on fishing and tourism.

Uncontrolled development activities along the coast, characterized by unsustainable resource exploitation practices, have devastating impacts on the coastal environment. Marine ecosystems

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[50] Decree – Law number 69 on September 9, 1983
[51] Preparation of an Assessment on the Water-Energy-Food-Ecosystems Nexus in Lebanon - 2023

degrade, biodiversity diminishes, and coastal landscapes are altered. Additionally, unregulated construction and human activities in fragile ecosystems exacerbate coastal biodiversity disturbance and degradation as well as reduce the protective capacity of the coastal zone against sea-storms and coastal flooding.

The degradation of coastal ecosystems and resources leads to significant economic losses for coastal communities and the country as a whole. The resilience of coastal infrastructure to extreme weather events is also compromised, increasing risks for coastal populations and ecosystems.

Furthermore, the absence of control and oversight of coastal development activities allows widespread illegal takeover of the public maritime domain by private interests, blocking public access to the coast. This situation creates frustration and a sense of impunity around environmental crimes, including illegal grabs of public coastal lands by private actors.

In conclusion, the degradation of coastal ecosystems and resources, coupled with unsustainable management practices and uncontrolled development, requires urgent measures to strengthen coastal protection, restore damaged habitats, engage local communities in sustainable management practices, and enhance control and oversight mechanisms to ensure comprehensive and sustainable coastal zone management.

5. Responses

In order to effectively manage the coastal zone and address the multitude of challenges it faces; several key actions and strategies need to be implemented:

- The Draft ICZM law should be updated and promulgated to ensure the transposition of the ICZM Protocol. It should address current environmental issues and ensure protection of coastal resources.

- The draft ICZM law must explicitly mention setbacks in line with the ICZM protocol. These setbacks must be established taking into account, inter alia, the areas directly and negatively affected by climate change and natural risks. In these areas, development is prohibited[10].

- The draft ICZM law should also provide for the development of a national strategy. The existing draft strategy should be updated, approved by GoL and published by decree.

- The legislative framework must be updated in line with scientific and technological progress to reflect contemporary challenges and best practices in coastal management.

- The draft Fisheries and Aquaculture law should be also promulgated.

- Advocacy campaigns, workshops, and roundtable discussions can be instrumental in garnering support and consensus for these legislative reforms among stakeholders, including Parliament and Government officials.

- The NPMPLT should be updated[52] and strengthened. Coastal municipalities should be encouraged and mandated to develop/update their urban plans in line with NPMPLT recommendations. This includes freezing the issuance of permits in coastal areas until updated urban plans are in place. Additionally, a comprehensive Master Plan specifically for the CZ should be developed and published. These plans must integrate considerations for climate change, erosion risks, and coastline management to ensure holistic and sustainable coastal management practices.

- An essential step in this process is to conduct an SEA for the whole CZ taking into considerations the needs of all sectors as well as for each drafted plan, as mandated by decree number 8213/2012 of the environment protection law number 444/2002. These assessments will provide crucial insights into the environmental impacts of proposed plans and guide decision-making towards sustainable outcomes. The EIA decree number 8633/2012 should be also strengthened and more binding especially for the public institutions.

- Capacity building sessions targeting public prosecutors, administrative judges and Internal Security Forces can improve their understanding and handling of environmental cases. Providing environmental courses to the school of magistracy is also helpful.

- Public awareness campaigns are vital to engage both public and private actors in coastal management efforts. Initiatives such as introducing chapters on coastal zones and legislation into school curriculums can help educate future generations about the importance of coastal conservation.

- Furthermore, the establishment of an ad hoc body, similar to France's "Conservatoire du littoral[53]," can enhance the visibility and effectiveness of CZM at national level and help recover marine lands. Other methods could be implemented based on the urban planning law published by Decree – Law No. 69 on September 9, 1983 such as reducing the exploitation rate, the exchanging lands.

- Laws stipulating the mandates of different public institutions must be revised in order to define the role of each institution in marine and coastal ecosystems and their proper management and avoid overlaps and conflicts.

- The GoL has ratified several international conventions and treaties related to the conservation and sustainable use of marine and coastal biodiversity and ecosystems that require commitment and obligation from Lebanon. Setting a clear plan for the implementation of international treaties and conventions, in which the corresponding focal ministries should be involved[7].

- Effective enforcement mechanisms are crucial for the success of any coastal management strategy.

- A master plan that includes a Marine Spatial Planning (MSP) for the protection of CZ, green spaces, and agricultural lands with taking into account recommendations of the NPMPLT.

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[52] The updated version of the NPMPLT must be approved by the government and published by Decree.
[53] https://www.conservatoire-du-littoral.fr/

- Coastal municipalities should be encouraged and mandated to develop/update their urban plans in line with NPMPLT recommendations and the new ICZM law when promulgated.

- Additionally, strengthening the NCE's resources and coordination abilities will enhance its role in overseeing coastal management activities.

- Furthermore, measures to address illegal occupancy of MPD and the prioritization of rehabilitation over re-exploitation of recovered lands are essential for sustainable coastal development. This should be done in harmony with the relevant legislation in force.

- Sanctions and fines for environmental offenses and illegal occupancy of MPD must be updated to be more dissuasive, with calculations based on the minimum wage to reflect the gravity of violations.

- Strengthening NGOs' rights to appeal and empowering local NGOs in advocacy roles will further support coastal conservation efforts. A new article can be added to the law 444/2002 or included in the draft ICZM law regarding the requests for annulment of administrative decisions related to the coast. Advocating for Lebanon's ratification of Aarhus convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters is essential to ensure this right done on June 25, 1998[54].

In conclusion, a comprehensive approach that integrates legislative reforms, awareness campaigns, strategic planning, and effective enforcement mechanisms is necessary to achieve integrated and sustainable management of the coastal zone in Lebanon. This includes the necessity of transposing the ICZM Protocol through the updating and promulgation of the Draft ICZM law, as well as the updating and publication of the Draft ICZM strategy. Collaboration and coordination among government agencies, private sector stakeholders, NGOs, and the public are key to overcoming the challenges and realizing the potential of Lebanon's coastal resources.

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[54] https://unece.org/DAM/env/pp/documents/cep43e.pdf

CHAPTER II: ENVIRONMENTAL, SOCIAL AND ECONOMIC DIAGNOSIS WITH THE EMPHASIS ON CHANGES SINCE THE ICZM DRAFT STRATEGY OF 2015

1. ENVIRONMENTAL CHANGES

1.1. *The Lebanese coastal and marine environments*

Lebanon, a country with an area equal to 10,452 square kilometers, is situated on the eastern-most part of the Mediterranean Sea, between the 33° and 35°N latitudes, and 35° and 37°E longitudes (Figure 2). It is commonly divided into four main geomorphological (physiographical) units[55]:

- A narrow coastal plain;
- Mount Lebanon;
- Anti-Lebanon;
- And the Bekaa valley

Driven by the geographical characteristics of these units two main "climate categories" can be seen in Lebanon. The coastal strip is subject to a "Mediterranean Climate" characterized by rainy winters with hot and sunny summers, while the interior (Anti-Lebanon and the Bekaa Valley) experiences a "Continental Climate" with drier cold winter and humid sunny summers (ANNEX IV: Characteristics of Lebanese Climate). In general, the country experiences four distinct seasons: summer, fall, winter, and spring.
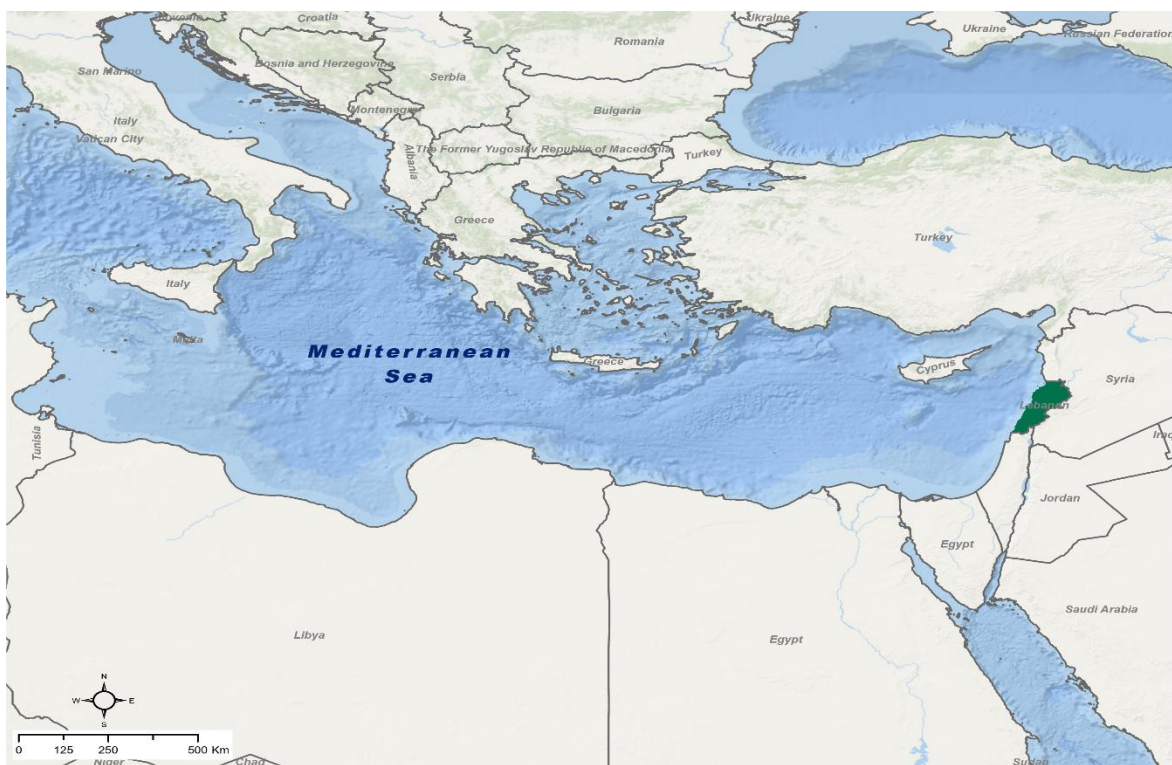
Figure 2: Mediterranean Sea and bordering countries

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[55] Vulnerability to Desertification in Lebanon Based on Geo-information and Socioeconomic Conditions. (2012)

The LCZ extends for 240km in length, from Nakoura in the south-west to Al-Arida in the north-east[56], overlooking the Levantine basin. However some studies relying on analyses of different varieties of satellite imagery have found the coastal area to stretch for 297.87km in 1962[57] and 370.92km in 2010[58]. This area represents one of the most economically active zones of the country and as such has been witnessing an increasing stream of migrants moving to the coast[59]. This has resulted in the accumulation of a high population on the LCZ with intense economic activities concentrating in a relatively small %age of the country[60,61].

Moreover, the Lebanese coast is narrow, 3-7km wide, characterized with interchanging rocky (~ 80%) and sandy (~ 20%) beaches, three bays with 12 prominent headlands, in addition to several river estuaries (Annex V: Map of Lebanon). The continental shelf stretches from 0m on shore to depths of 100-200m and is relatively wider in the north (18km) and south (7km) than in the center between Beirut and Enfeh (less than 3km) which is characterized with steep slopes dropping from 100 to 1,500m in less than 5km[62,63].

1.2. *Status of the Environment in the Lebanese Coast*

1.2.1. *Freshwater, Groundwater, and Aquifers*

Water scarcity in the Levant region is majorly attributed to temporal and spatial variations of hydrological parameters, most notably precipitation and evaporation[64]. Precipitation in Lebanon varies according to the units mentioned previously (The Lebanese coastal and marine environments) but averages between 8.6 billion m^3 and 9.7 billion m^3, of which around 1 billion m^3 consists of snow[65,66]. It was predicted that Lebanon is likely to gain 9 more days of drought per year by 2040[67,68] which is expected to increase the chance of accidental start and spread of larger fires across the vegetated landscape[69]. Moreover, precipitation patterns are expected to decrease by 45% by the year 2090 with damaging risks on various sectors[70].

Pumping ground water represents an additional source of freshwater in Lebanon which is mainly expended for anthropogenic purposes. Around 50% of water used for irrigation originates from underground wells and boreholes. As per the updated "National Water Sector Strategy" (NWSS), Lebanon has a documented total number of 2,000 springs with 275 ones in current usage for human needs[71]. An estimate of about 2,050Mm³ is recorded as the yearly average yield of these springs which

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[56] Review and Perspectives of Environmental Studies in Lebanon. (2012)

[57] Evolution of the coast of North Lebanon from 1962 – 2007: mapping changes for the identifications of hotspots and for future management interventions. (2013)

[58] Investigating the performance of sentinel-2A and Landsat 8 imagery in mapping shoreline changes. (2020)

[59] Holistic conservation of bio-cultural diversity in coastal Lebanon: A landscape approach. (2012)

[60] State and Trends of the Lebanese Environment. (2011)

[61] SOER Report 2020, "Lebanon, State of the Environment and Future Outlooks: TURNING THE CRISES INTO OPPORTUNITIES". (2021)

[62] Update of the Strategic Environmental Assessment (SEA) for Exploration and Production Activities Offshore Lebanon. (2020)

[63] The marine ichthyofauna of Lebanon: an annotated checklist, history, biogeography, and conservation status. (2020)

[64] Freshwater vulnerability in the Levant region. (2011)

[65] Assessment of Groundwater Resources of Lebanon. (2014)

[66] Determination of 48 pesticides in water by using DI-SPME coupled to GC/MS. (2017)

[67] Lebanon's third national communication to the UNFCCC. (2016)

[68] Droughts and agriculture in Lebanon: Causes, consequences, and risk management. (2018)

[69] Lebanon's Third Biennial Update Report (BUR) to the UNFCCC. Beirut, Lebanon. (2019)

[70] A Vision of Sustainable Design Concepts for Upgrading Vulnerable Coastal Areas in Light of Climate Change Impacts: A Case Study from Beirut, Lebanon. (2022)

[71] Updated National Water Sector Strategy 2020 – 2035. (2020)

is increasingly being threatened by the establishment of unlicensed wells thereby reducing the surface flow.

Lebanon possesses a shortage of perennial waterways, and as such experience a more severe water shortage during the drier summer season. This has resulted in the reliance on the country's highly aquiferous geology which store considerable volumes of fresh water. Driven by an increasing need for freshwater supply for human needs, aquifers in Lebanon have been increasingly overexploited which has resulted in multiple cases of wells drying up and prominent salinization of groundwater in coastal aquifers66[72]. Moreover, and due to the lack of proper treatment of domestic waste, the local population of various towns and villages in Lebanon have resorted to dumping their wastewater in cesspools and septic tanks posing serious risk to the quality of groundwater stored in these areas[73]. The lack of scientific evaluation of groundwater resources combined with the lack of adequate monitoring of this resource's use by the local population is expected to result in a water shortage threatening the water-security of the country[74].

1.2.2. Rivers and Estuaries

Lebanon has 2,000 springs and around 40 rivers and streams of which 16 are defined as perennial with continuous flow throughout the year77[75]. The country has five major waterway regions as follows[76]:

- El-Asi Basin flows from Lebanon into the Syrian Arab Republic in the northeast of the country;
- The Hasbani Basin in the southeast, flows into Palestine in the southeast and merges with the Jordan river;
- The Litany Basin, flows into the Levantine basin in the southwestern part of the country;
- Remaining major coastal river basins that flow into the Mediterranean Sea;
- Minor seasonal sub-catchments that flow between the major rivers in addition to isolated coastal pockets.

The LCZ receives freshwater, sediment, and nutrients from 15 coastal rivers that empty in the Levantine Basin60[77] (Figure 3). Referred to as "Coastal Rivers", these flowing bodies of water are mostly fed from the snowmelt of the Mount Lebanon area and are relatively short with the exception of the Litani River. An estimate of 75% of river water was thought to flow directly into the sea unexploited[78], but recent studies have shown that river discharge has went down by 60% due to a combination of natural (Climate Change (CC)) and anthropogenic drivers. Most of the waters flowing in these rivers or emerging from local springs are reportedly collected and redirected for usage by the local population for agricultural practices, domestic purposes, as well as for hydro-power generation (Annex VI: Freshwater of Lebanon). An estimate of 3,452 million m^3 of total annual discharge is recorded for Lebanon, 20% of it discharging in transboundary rivers flowing outside of the country's borders72 decreasing the actual total annual discharge to around 2,800 million m^3.

A 10-year plan developed by the MoEW and approved by the CoM in November 1999 intends to build 27 dams on Lebanese rivers as an approach to provide fresh water to various regions across Lebanon. Existing reservoirs and their respective storage capacities include (Figure 4): Ballout Lake (0.5 million m^3); Qaysamani Lake (1 million m^3); Yammouneh lake (1.45 million m^3); Kouachra lake (0.4 million m^3).

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[72] Strategic Environmental Impact Assessment for the New Water Sector Strategy in Lebanon. (2015)
[73] Citizen science in Lebanon— a case study for groundwater quality monitoring. (2019)
[74] Groundwater resources in Lebanon: a vulnerability assessment. (2004)
[75] Assessment of Groundwater Resources of Lebanon. (2014)
[76] FAO Country Profile – Lebanon. (2008) https://www.fao.org/3/ca0344en/CA0344EN.pdf
[77] Strategic Environmental and Social Assessment of the Updated National Water Sector Strategy. (2021)
[78] Rivers of Lebanon: significant water resources under threats. (2021)

Various other dams are in the process of being built which is expected to increase the county's total storage capacity from 232.5 million m^3 to 409 million m^3[79]. It is imperative to highlight the significance of coastal rivers in carrying sediment to replenish the LCZ as it is considered a primary source of sediment replenishment of the CZ aided by other sources such as disintegrating shells, and sediment carried through sea currents from the Nile River in Egypt. Diverting the flow of coastal rivers for anthropogenic use has resulted in a decrease in the sediment and organic load reaching the LCZ and an increase in coastal erosion[58,57].

Estuaries in Lebanon have relatively small sizes compared to that of their respective watersheds, nonetheless, they have been considered as special habitats with documented high productivity, hosting a diverse group of specialized species suited for the saltwater-freshwater interphase of these areas. As such, the 2012 "Lebanon's Marine Protected Area Strategy" has recommended the protection of five estuaries distributed along the LCZ[80]: Litani; Awally; Damour; Nahr Ibrahim; and Arida. Based on a recent evaluation, the designation of these estuaries as protected sites would greatly contribute to the establishment of an efficient MPA network across the LCZ[81]. Furthermore, the MoA,

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[79] Lebanon, State of the Environment and Future Outlooks: TURNING THE CRISES INTO OPPORTUNITIES. (2021)
[80] Lebanon's Marine Protected Area Strategy. (2012)
[81] Assessment of Lebanon's Marine Protected Areas against the creation of a "Marine Protected Area Network". (2022)

which oversees the management of fisheries in Lebanon, has banned fishing in estuaries since 1997 Decree No. 385/1[82], protecting the valuable ecosystem contained within these environments.

Figure 3: Rivers of Lebanon (Source: Fanack water)

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[82] http://77.42.251.205/Law.aspx?lawId=200645
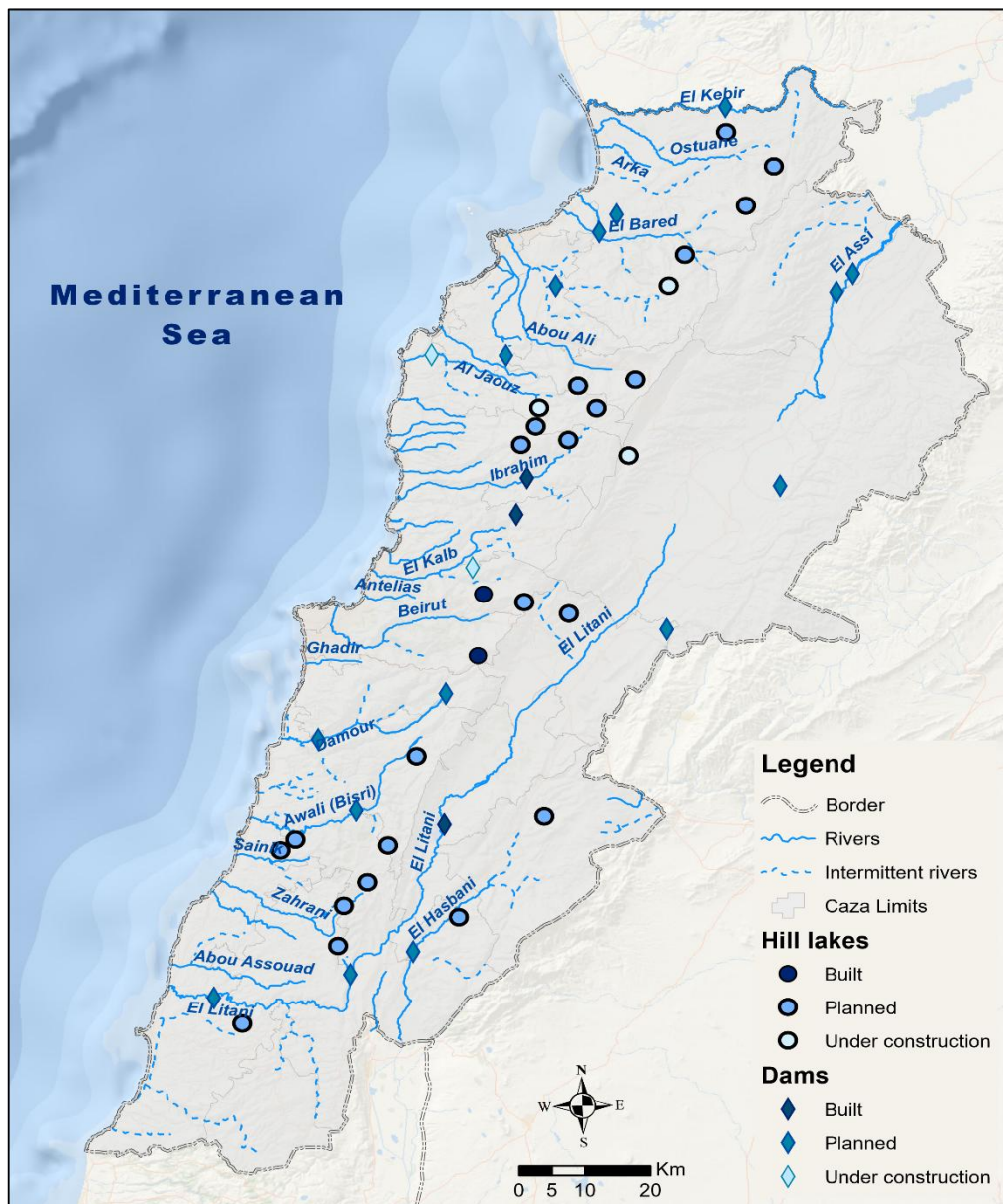
Figure 4: Dams and Reservoirs of Lebanon. (Source: Atlas of Lebanon: New Challenges. 2019)

1.2.3. Wetlands

Wetlands form in areas of defined geomorphology including lowlands and depressions, accompanied by water inflow mechanisms such as long rainy seasons and the existence of aquifers. A total of eight wetlands have been identified in Lebanon[83] with a total area of 16km^2, four of which are present on the CZ (Table 1). These valuable environments create special habitats for a variety of flora and fauna in addition to providing important resting areas for migratory birds and have been recognized internationally as Important Bird Areas (IBAs)[84]. Moreover, four out of the eight identified wetlands

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[83] Geomorphological and geological aspects of wetlands in Lebanon. (2013)
[84] Important Bird Areas-IBAs. https://www.spnl.org/ibas-kbas/

were designated in the RAMSAR List of 2014 (Table 1, ANNEX VII: Lebanon RAMSAR Sites). Few studies have been done to better understand the ecosystems present in the country's wetlands and have mainly focused on specific themes[85] and/or were included in regional projects with a larger scope[86]. One study done on the ecosystems of two of the mentioned wetlands, namely Ras El-Chekkaa and Tyre Coast, identified floral and faunal distributions shedding light on the importance of their conservation and proper management[87].

Wetlands in Lebanon are commonly used for tourism, agronomical production, and water supply in addition to constituting a valuable resource in the country's natural heritage83[,88]. This has placed wetlands under pressure from phenomena like urban expansion, change in rainfall pattern driven by the change in global climate, and reduced water saturation due to diverting river flow83[,87].

Table 1: Identified wetlands of Lebanon. Source: Important Bird Areas-IBAs. (Source: https://www.spnl.org/ibas-kbas/)

No.	Name	Area (km²)	Description	Location	RAMSAR Designation
1	Palm island	4.1	Three islands almost covered by saline water, notably among the karstic ponds.	Coastal	+
2	Cliffs of Ras El-Chekkaa	0.85	Jointed cliffs (~200 m) of carbonate rocks adjacent to the sea.	Coastal	+
3	Tyre Coast	3.8	Elongated watercourse from a number of artesian springs running to the coast.	Coastal	+
4	Abbassiyeh beach	0.54	Found in the Abbassiyeh Coast Nature Reserve (ACNR) (Tyre caza; South Lebanon)	Coastal	-
5	Ayoun Orghosh	0.47	Surface water in a depression in the land. It seeps from adjacent mountains and is fed mainly by snowmelt.	Internal	-
6	Aamiq	2.8	Several natural ponds of freshwater in the carbonate rocks.	Internal	+
7	Chamsine/Anjar	0.85	Watercourses of running water from Chamssine and Anjar spring that feed Litani River.	Internal	-
8	Aaiha	3.2	Lowlands where water seeps from the neighboring mountain chains.	Internal	-

1.2.4. Coastal Terrestrial Ecosystems

The LCZ is characterized by alternating rocky (~ 80%) and sandy (~ 20%) beaches with three main islands off of the northern coast facing Tripoli (Figure 5). Various types of natural and man-made environments can be found across the coastal area including wetlands (as discussed in section

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[85] Impacts of climate change on Lebanese wetlands and their migratory soaring birds/legislative framework. (2015)
[86] Aammiq Wetland Management Plan. (2006)
[87] Assessment of coastal wetlands in Lebanon. (2016)
[88] Conservation Needs for Mediterranean Wetlands (with a focus on the Aammiq Wetland). (2012)

1.2.3.Wetlands), sand dunes, coastal woodlands, as well as agricultural land (Annex VIII: Terrestrial coastal habitats along the LCZ). An assessment done in the context of the Environmental Resources Monitoring Project in Lebanon (ERML) identified different "biological" categories of the LCZ[89]:

- Marine turtles nesting sites
- Sites for endemic species: flora, fauna and micro-organisms
- Sites for threatened/rare species
- Critical habitats
- Migration routes
- Biodiversity rich sites
- Distinctive landscape
- Sites with unique biogeography

Within these categories, some habitats were identified as vulnerable Lebanese coastal habitats in need of conservation[90]:

- **Coastal terraces**, formed from the abrasive effect of the continuous action of waves on coastal formations, and represent a special ecosystem hosting a unique set of specialized organisms that have acclimated to the sudden changes in temperature and salinity.
- **Sandy beaches** which are formed by the deposition and concentration of broken-down minerals from living and non-living materials unique to the surrounding environment. This habitat is sparsely present on the LCZ yet hosts important organisms. Additionally, these beaches represent a very important environment for turtle nesting in Lebanon and as such require conservation.
- **Sand dunes** form on sandy beaches that have an important amount of deposited sand and sufficient wind to accumulate the sand at the back of the beach. These formations are rare across the LCZ where only one area can be characterized as an area of sand dune formation of significance, located at the Abbassieh Beach[91] (a declared nature reserve). They represent important ecosystems for a variety of plants that in-turn act as stabilizers for the dunes, an environment suitable for a unique set of coastal plants, insects and rodents, and as such, are in need for protection due to illegal land appropriation and coastal sand extraction for construction.
- **Estuaries** form when a flowing freshwater body meets sea water creating a partially enclosed body of brackish water. These ecosystems are highly productive due to the organic matter carried from the land and provide a habitat to a unique set of organisms with osmo-regulatory capacities. They are also considered biodiversity hotspots. Organisms such as the larvae, juvenile fish, in addition to various invertebrates use these environments for feeding, breeding, and the completion their life cycles. Additionally, estuaries act as filtration sites for pollutants carried by rivers from the land before entering marine water hence contributing to the mitigation of some effects of climate change.

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[89] Environmental Resources Monitoring in Lebanon (ERML) project: 'Improved Understanding, Management and Monitoring in the Coastal Zone'. (2013)
[90] Strategic Action Programme for the Conservation of Biological Diversity (SAP BIO). (2002)
[91] The Mediterranean coast of Lebanon: Habitat for endangered fauna and flora. (2004)

Moreover, an assessment done in 2012 was able to identify various sensitive areas along the LCZ based on several ecological and cultural criteria adopted89 (Figure 5).
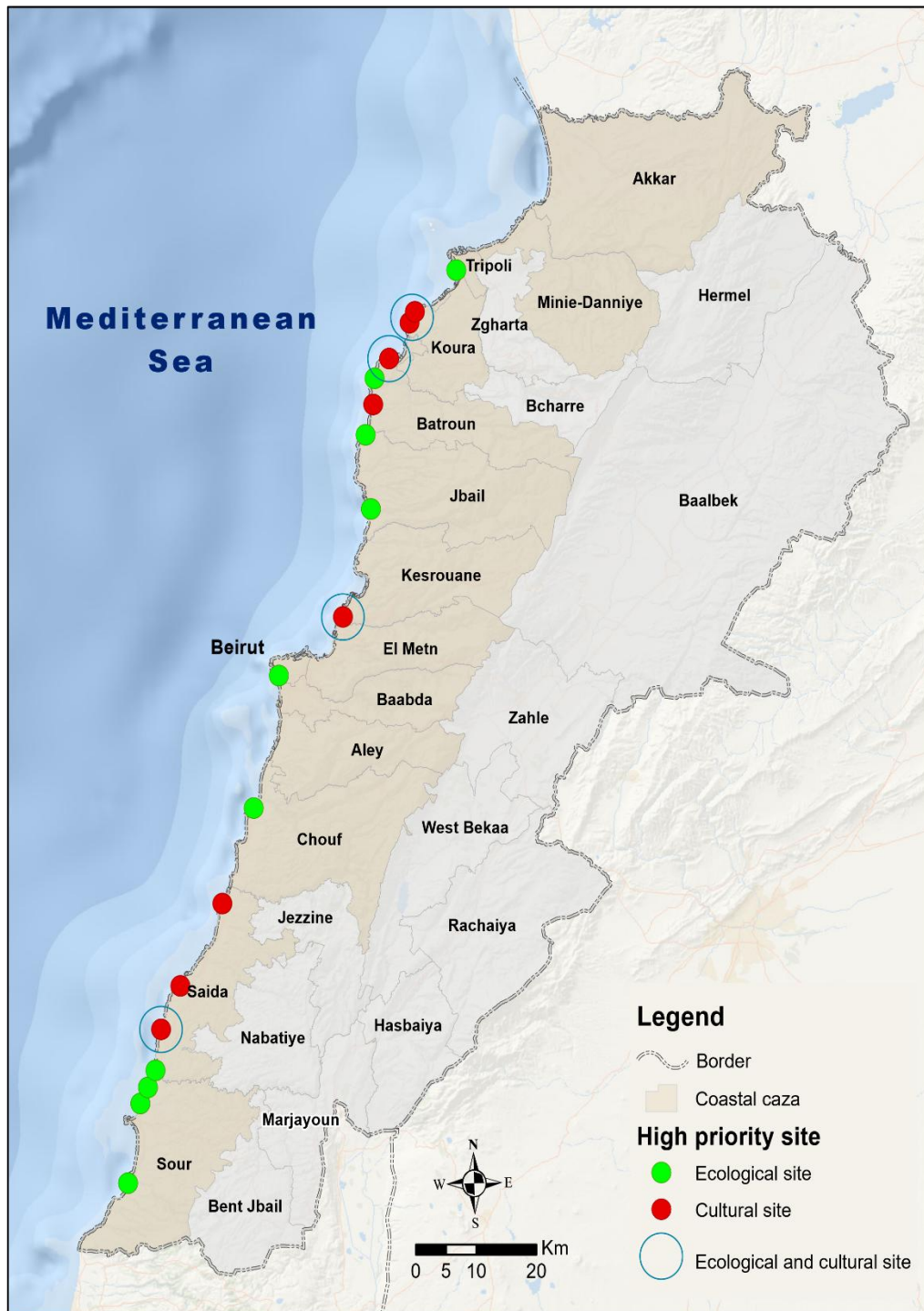
Figure 5: Ecologically and culturally sites of importance across the LCZ (Source: ERML 2013)

1.2.5. Marine Water Properties

Lebanese waters undergo two annual thermal phases, the cold phase in winter and the warm phase in summer, with two short inter-seasonal periods in spring and autumn. Sea Surface Temperature (SST) ranges from a minimum of 17°C in February (higher than the ambient air temperature) to a

maximum of 30°C in August (lower than the ambient air temperature) which allows the water to act as cooling body for the CZ during summer and vice versa during winter[92,93]. These temperature differences account for the well-mixing of water during winter and its stratification during the rest of the seasons. Moreover, Lebanese waters are characterized by an average salinity of 38.91 Practical Salinity Unit (PSU) which increases during the summer to reach 39.7PSU (offshore station) and decreases during winter to reach 38.5PSU (offshore station)56[,94,93]. Furthermore, measured salinity greatly fluctuates near shore due to terrestrial interference.

1.2.6. Tides, Waves, and Currents

Tides in Lebanon are generally documented to be weak, analogous to Mediterranean averages ranging between 30 to 40cm[95], whereby the movement of water along the LCZ is mostly attributed to the action of wind at the sea surface level. Studies that properly document wave and current patterns and strength across the LCZ are scarce, with no long-term time series data available for waves. The dominant wind in Lebanon has a South-Western direction pushing waters onto the coast, coupled with the existence of only a few protected bays, the coast is thus subject to direct action of waves and coastal storms. The maximum wave height recorded for Beirut and Tripoli (9m and 1.8m respectively) were documented during heavy winter storms between the months of November and March were winds are generally the strongest. Other data collected by deployed buoys and observatory stations (i.e. the Tripoli Environment and Development Observatory) record a maximum average monthly wave height of 1.41m off the shore of Beirut (no data available for near-shore environment for depth ranging between 10 to 20m)[96] and a maximal height of 1.1m wave during winter storms between 2012 and 2017 off the shore of Tripoli62. As for currents, they generally follow a North-Eastern direction in line with the counter-clockwise gyre of the Eastern Mediterranean which exhibits a relatively weak speed upon reaching the country (around 1knot during strong Western winds)62[,97]. Closer to the shore, currents form eddies that move in a clockwise direction creating more of a southern movement of waters which is the main driver for the constant accumulation of sand at the entrances of harbors[98,99].

1.2.7. Marine Ecosystems

Research on marine habitats along the LCZ is scarce making it difficult to identify the full extent of habitat types found on the Lebanese coast. This gap in the research along with the specificity of the habitats found along the Lebanese coast, the relative homogeneity of the infra-littoral fauna and flora, the drastic effect of Lessepsian species on local ecosystems, in addition to the pronounced seasonal changes in flora composition have made it difficult to use the Mediterranean habitat/biocenosis classification system in Lebanon[100]. As such, habitats were divided to hard and soft substrata[101] to allow analyses of associated communities. Hard substrates include100:

[92] Inter-annual variations of water and air temperatures in Lebanese coastal waters (2000-2012). (2013)

[93] The carbonate system of the Eastern-most Mediterranean Sea, Levantine Sub-basin: Variations and drivers. (2019)

[94] Temporal Variability of Zooplankton (2000-2013) in the Levantine Sea: Significant Changes Associated to the 2005-2010 EMT-like Event. (2016)

[95] Wind and wave data analysis for the Lebanese coastal area-preliminary results. (2005)

[96] Preliminary appraisal of wave power prospects in Lebanon. (2013)

[97] Sailing Directions (Enroute) – Eastern Mediterranean. (2017)

[98] Modelling surface currents in the Eastern Levantine Mediterranean using surface drifters and satellite altimetry. (2016)

[99] Environmental status of the Bay of Jounieh through the evaluation of its marine sediments' characteristics. (2018)

[100] National Monitoring Programme for Marine Biodiversity in Lebanon. (2018)

[101] Handbook for interpreting types of marine habitat for the selection of sites to be included in the national inventories of natural sites of conservation interest. (2015)

- **Littoral rock (supra and mid-littoral)**, made up of limestone and/or sandstone rocks with formations of interest, such as the vermetid reefs and their associated communities (*Sargassum vulgare, Cystoseira compressa, Cysotoseira amentacea* (uncommon) and *Palisada perforata*). These habitats are threatened by human trampling, shellfish and algae collection, wastewater pollution, urban expansion, climate change, and non-indigenous species (NIS).
- **Infra-littoral rock (upper, middle and lower horizons)**, made up of habitats that depend on a unique set of characteristics including nature and topography of the substratum, surface slope, wave exposure, illumination, sediment cover and scour, seasonal temperature changes, and thermocline depth among others. This habitat type follows the Littoral rock formations reaching depths of 2-8m and hosts a variety of species known for their conservational interest, namely species belonging to the genera *Sargassum* and *Cystoseira*. This habitat is threatened by wastewater pollution, urban expansion, sea filling, illegal fishing practices, in addition to the changes in environmental conditions brought upon by climate change.
- **Circa-littoral rocky bottoms**, made up of formations such as coralligenous infra-littoral claves, and caves which are considered as priority habitats under protection according to the Barcelona Convention for Biological Diversity. Additionally, these habitats can be made of flat rocky formations with coarse sand and gravel patches and channels ranging in depth from 28 to 42m. They are mainly threatened by anthropogenic activities such as interference from untrained scuba divers, boat anchorage, scraping from fixed nets, illegal fishing practices, and the collection of species for aesthetic value.

Additionally, a vast submarine canyon system can be found at the edges of the Lebanese continental shelf with an area of about 1,240km^2. These formations represent unique habitats that are considered vital to the equilibrium of marine environments61. They represent "super highway" for nutrients that allow high rate mixing optimal for local primary productivity and the functioning of the benthic and pelagic ecosystems. The Lebanese canyon system is part of the East Levantine Canyon Area (ELCA) which was subject to a primary analysis identifying several specific features of significance justifying the importance of the protection of said ELCA[102], those include several hydrothermal vents; submarine freshwater springs; particular habitats such as Rhodolith/Maerl beds, bathyal muds, and sandy bottom; in addition to hosting various species of ecological and commercial value. This has led to a request by the MoE for a deep-sea expedition to better understand these environments. This project, entitled "The Deep-Sea Lebanon Project" and funded by the MAVA Foundation, surveyed five canyons namely, Beirut Escarpment (Ouzai), Saint Georges Canyon, Jounieh Canyon, Sayniq (Saida) Canyon, and Chekka-Batroun Canyon (Figure 6).

Moreover, artificial habitats commonly known as Artificial Reefs (ARs) have been deployed in Lebanese waters to help create a more sustainable environment in stressed, barren and/or unproductive areas. Substances used vary from derelict tanks, to abandoned vehicles, to more ecofriendly material such as concrete, clay pots and jars. These artificial environments were predicted to boost local ecotourism through the creation of attractive diving sites in tandem with the support of the establishment of a complex food web which would in the long term support the fisheries sector61. As such several initiatives were executed along the LCZ.

In June 2012, eight derelict tanks and vans donated by the Lebanese Army were deployed off the coast of Abdeh region through an initiative funded by the Lions & Rotary Clubs in collaboration with the MoE. An assessment of colonization of marine species on the deployed AR was performed in 2017 by the Marine and Coastal Resources Program – Institute of the Environment – University of Balamand

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[102] MPA Network proposal for the Mediterranean Sea. (2011)

(MCR-IoE-UoB) which documented a total of 93 species (16 fish species; 38 species of sessile macrofauna, macroalgae and sea-grasses; and 39 in-faunal species)[103].

In June 2018 another AR was deployed by the Friends of Al-Zireh Island Association in collaboration with the municipality. Six old army tanks and four other military vehicles donated by the Lebanese Army were deployed at depths of 14m, 17m and 18m within an area of about 150m^2. No documentation of biological colonization has been performed so far. Two more ARs were deployed through the "Protection and sustainable development of maritime resources in Lebanon" (ProMARE) Project implemented by the EU in partnership with the MOE, one by the MCR-IoE-UoB off the coast of Barbara, Jbeil, Mount Lebanon referred to as AR2020, and the other by "Friends of Nature" in Jounieh bay. Studies have been conducted to analyze the biodiversity of the area where AR2020 was deployed before and after deployment to assess the success of the initiative. A total of 66 species where identified in a follow up assessment done in 2022.

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[103] Artificial reef of Al-Abdeh-North Lebanon: biodiversity baseline assessment. (2017)
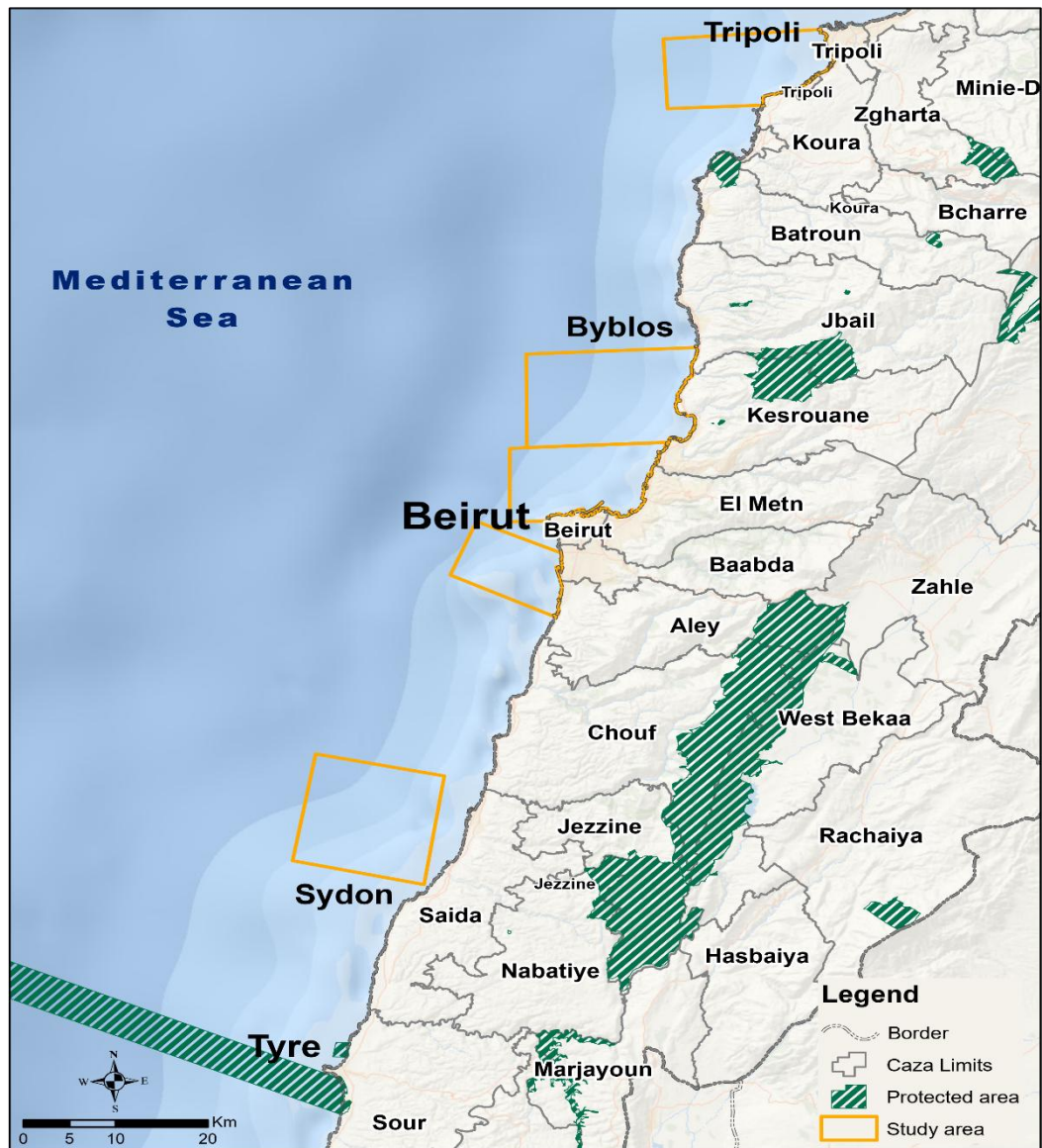
Figure 6: Surveyed submarine canyons in the OCEANA 2016 expedition (Source: 2016 Deep-sea Lebanon Expedition: Exploring Submarine Canyons. (2018)

Concerning marine biodiversity, no official list of species for Lebanon exists nonetheless, continuous studies have identified a total of 1,588 species across the LCZ100 that can be divided into100.[104,105,106,107]:

- Macrophytes - 243 species with 29 NIS
- Zooplankton – 783 species
- Phytoplankton – 385 species
- Zoobenthos (invertebrates) – 1,072 species, 156 considered exotic

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[104] Flore et faune marines du Liban (Méditerranée Orientale). (2013)
[105] Biodiversité Marine et Ressources Vivantes des Eaux Libanaises et du Bassin Levantin. (2018)
[106] Updating the 2002 SAP-BIO National Report for the Country of Lebanon. (2016)
[107] Ecological characterization of sites of interest for conservation in Lebanon: Enfeh Peninsula, Ras Chekaa cliffs, Raoucheh, Saida, Tyre and Nakoura. (2014)

- o Foraminifera;
- o Sponges;
- o Cnidarians;
- o Turbellariates;
- o Nemertes;
- o Nematodes;
- o Endoproctes;
- o Bryozoa;
- o Phoronidians;
- o Brachiopods;
- o Sipuncliens;
- o Polychaetes;
- o Mollusks;
- o Crustaceans;
- o Pycnogonides;
- o Echinoderms;
- o Enteropneustes;
- o Pterobranch;
- o Ascidians.

- Ichthyofauna – 367 species, 39 belonging to the class Chondrichthyes[108]
- Marine mammals – seven species100[,109]:
  - o Short-beaked common dolphin (*Delphinus delphis*)
  - o Common bottlenose dolphin (*Tursiops truncatus*)
  - o Fin whale (*Balaenoptera physalus*)
  - o Cuvier's beaked whale (*Ziphius cavirostris*)
  - o Risso's dolphin (*Grampus griseus*)
  - o Striped dolphin (*Stenella coeruleoalba*)
  - o Mediterranean monk seal (*Monachus monachus*)
  - o One sighting of Orcas (*Orcinus ocra*) was documented at the end of the year 2019 extending to 2020. Through the use of photographs and cross-checking marks, the individuals were traced to the Atlantic Ocean[110].
- Marine herpetofauna – four species with the most common being the Loggerhead turtle (*Caretta caretta*) and the Green sea turtle (*Chelonia mydas*) that can be found regularly nesting on sandy beaches along the LCZ. The Leatherback turtle (*Dermochelys coriacea*) and Olive ridley sea turtle (*Lepidochelys olivacea*) have also been recorded nevertheless they have not been observed to nest along the LCZ[41].
- Marine ornithofauna – 404 species in total (foreshore, coastal, and maritime)

Moreover, an important number of marine species in Lebanese waters were found to be Non-Indigenous Species (NIS) arriving to the Levantine basin through vectors that primarily rely on human intervention. These vectors can either be classified as direct through aquaculture or the aquarium industry, or indirect through fouling and ballast water from ships. The most significant factor accounting for the presence of NIS in Levantine waters was identified to be the opening and the subsequent enlargement of the Suez Canal which acted as a direct route for Lessepsian migration. A total of 215 NIS species were reported from Lebanese waters in 2018[111], such as the silver-cheeked toadfish (*Lagocephalus sceleratus*), lion fish (*Pterois sp.*), sea lettuce (*Ulva lactuca*), porcupine sea urchine (*Diadema setosum*), *Stypopodium schimperi*, amongst others, and more is expected to arrive due to the increase of temperature and salinity as an effect of climate change.

1.2.8. *Marine Protected Areas*

Lebanon has three officially declared MPAs, namely, Palm Island Nature Reserve (PINR); Tyre Coast Nature Reserve (TCNR); and Abbassieh Coast Nature Reserve (ACNR). Moreover, the MoE has

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[108] The marine ichthyofauna of Lebanon: an annotated checklist, history, biogeography, and conservation status. (2020)
[109] On the occurrence of the Mediterranean monk seal Monachus monachus (Hermann, 1779) in the Lebanese waters (Eastern Mediterranean Sea). (2020)
[110] Long-distance movements of North Atlantic killer whales (Orcinus orca) from Iceland via Spain and Italy to Lebanon. (2022)
[111] Action Plan Concerning Species Introductions and invasive species in Lebanon. (2018)

submitted two draft laws to the Lebanese Parliament for the declaration of two more protected areas, one in Anfe and the other in Jbeil. The MoE is currently working on increasing the protection along the Lebanese coast in hopes of protecting at least 30% of the country's terrestrial lands, inland waters, coastal areas and oceans, with emphasis on areas of particular importance for biodiversity and ecosystem functioning and services[112]. In this context the MoE in collaboration with the International Union for Conservation of Nature (IUCN) developed a strategy entitled "Lebanon's Marine Protected Area Strategy" which proposes a list of sites to be declared as MPAs, and recommends the establishment of an MPA network across the LCZ80. The list included nine coastal and marine sites (of which only Anfeh Peninsula is in the process of being declared as an MPA, five estuaries sites, and four deep water sites (Table 2, Annex IX: Map of the Protected Areas, existing and proposed, along the Lebanese Coast). A project, entitled "Conducting an evidence-based Non-State Actors Campaign on Marine Protected Areas Network", is currently being implemented by the Lebanese Environment Forum (LEF) in partnership with MCR-IOE-UOB to support the MoE in the execution of the Strategy. This project is to provide a review of legislative text to identify needs and approaches for the declaration of the MPA network.

Table 2: Proposed sites for protection according to the 2012 Lebanon's Marine Protected Area.

Proposed MPA coastal and marine sites	Proposed MPA estuary sites	Proposed MPA deep water sites
Nakoura	Litani estuary	Beirut Escarpment
Sidon rocks	Awally estuary	Saint Georges Canyon
Raoucheh cliffs and caves	Damour estuary	Junieh Canyon and
Beirout port outer platform	Nahr Ibrahim estuary	Sour Canyon
Byblos	Arida estuary	
Medfoun rocky area		
Batroun Phoenician wall		
Ras El Chekaa cliffs		
Enfeh Peninsula		

Concerning Lebanon's officially declared MPAs:

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[112] Convention of Biological Diversity (CBD) Post-2020 Framework. Conference of Parties 15 (COP15): Nations Adopt Four Goals, 23 Targets For 2030 In Landmark UN Biodiversity Agreement.

- PINR is the first MPA established in Lebanon under Law No. 121/1992[113], and is made up of three small islands, Palm Island; Sanani; and Ramkin (Figure 7) containing an internationally recognized RAMSAR site (Annex VII: Lebanon RAMSAR Sites). This nature reserve is located 5.5km off the coast of Tripoli, North Lebanon, with the Palm Island being the largest among the three. This Island is characterized by a rocky shoreline from the North-West to the South, and a sandy shoreline from the North to the East, whereas Sanani and Ramkin are smaller and are dominated by rocky shorelines. The PINR comprises both terrestrial and marine ecosystems under protection in addition to a 500m buffer zone at sea surrounding the area of protection. Being declared as one of Lebanon's IBAs, PINR is considered a resting place for 156 migratory bird species with nine nesting species[114]. Moreover, the reserve is rich with floral biodiversity which includes many important medicinal plants that have been diminishing across the country's mainland due to anthropogenic stress. The site provides an important location for marine biodiversity where it represents a habitat for 24 different species of fish, one species of seagrass (*Cymodocea nodosa*), 21 benthic species (divided between sponges, mollusks, gastropods, bivalves, polychaeta, crustaceans, echinoderms, and hydroids) as well as constituting a nesting site for one of Lebanon's herpetofauna the loggerhead sea turtle (*C. caretta*)[115]. Moreover, PINR displays signs of previous human occupation in the form of structures and ruins that have been identified to date back to the Crusaders' period, and late Roman and medieval eras. The site is subject to similar pressures as those that are faced on the main land including solid and liquid forms of pollution, in addition to human intervention especially in summer as the reserve is open to visitors which could affect the nesting season of marine turtles. Additionally, PINR is prone to incidents of accidental oil spill due to its proximity to an old oil pipeline in Akkar with a history of leakage (September of 2022)[81].

Figure 7: Palm Island Nature Reserve.

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[113] http://legallaw.ul.edu.lb/Law.aspx?lawId=167382
[114] State of Lebanon's Birds and IBAs. (2014)
[115] Physical-Chemical and Biological Characterization Of The Marine Ecosystem - Palm Islands Nature Reserve (Lebanon). (2009)

- TCNR, located in the city of Tyre south of Lebanon, was declared under Law No. 708/1998[116], and is the largest sandy beach on the LCZ (ANNEX VII: Lebanon RAMSAR Sites). It stretches over 3.8km^2 on land and covers 113km^2 offshore and is made up of two areas, a conservation zone and an agricultural zone, separated by the Rachidieh Camp (Figure 8). The reserve contains a wetland that has been internationally recognized as a RAMSAR site (ANNEX VII: Lebanon RAMSAR Sites), more specifically a "Wetland site of Importance". The level of protection varies from one region within the reserve to the other where it contains a recreational zone for beach-goers, accessible to the public; a high conservation zone containing Ras El-Ain springs dating back to the Phoenician times with access restricted to management teams and scientific researchers; in addition to the previously mentioned agricultural land. TCNR provides an important habitat for coastal and marine species such as sea birds, 13 known terrestrial mammals including the terrestrial Arabian spiny mouse (*Acomys dimidiatus*), 275 identified plant species of which four are considered endemic, 10 are rare, as well as 25 medicinal plants. Moreover, TCNR's sandy beach is an important nesting site for the loggerhead (*C. caretta*) and the green sea turtles (*C. mydas*) and represents a growth area for juvenile marine species especially those that are classified as vulnerable under the IUCN Red List.
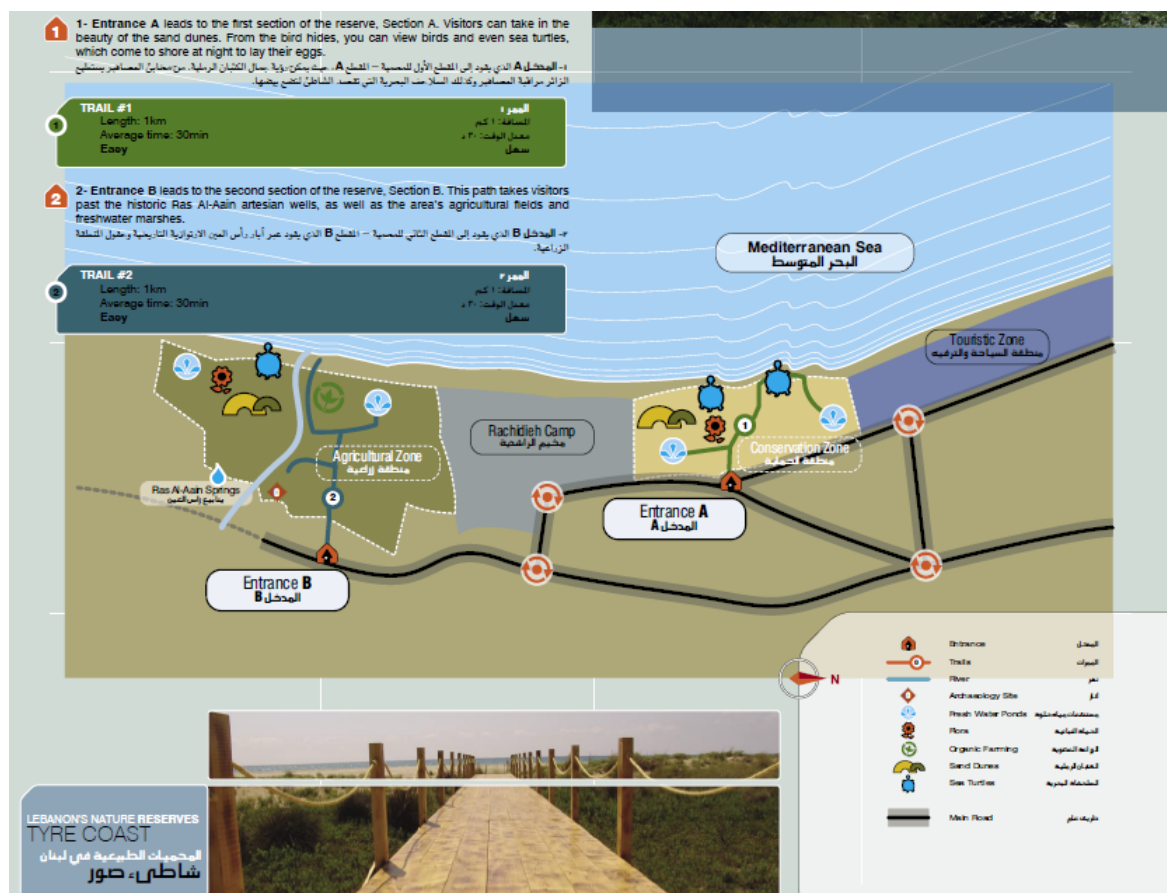
Figure 8: Zonation of TCNR.

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116 http://legallaw.ul.edu.lb/Law.aspx?lawId=198279

- ACNR is the most recently declared MPA under Law No. 170/2020[117]. It is located north of TCNR at the shore of Abbassieh town belonging to the Tyre Caza (South Lebanon) (Figure 9). It is mainly made up of a sandy beach with important dune formations (the only prominent dune formation in Lebanon)91. ACNR is characterized by a similar environment to the TCNR as per their proximity to each other and as such hosts an important diversity of marine and terrestrial species currently being assessed as part of the United Nations Development (UNDP) project "STEPping up Nature Reserves Capacity – STEP4Nature". This assessment has identified 10 habitat types that fall under the EUNIS classification[118] most of which are unique to the reserve. Moreover, the reserve is considered an important nesting site for the green sea turtle (*C. mydas*) and the loggerhead sea turtle (*C. caretta*). Solid and liquid waste pollution is considered among the main pressures threatening the reserve as the area was seen to accumulate solid waste carried by currents from different regions of the LCZ and dumped onto the reserve's shore. Moreover, the reserve is in close proximity to a sewage output system that dumps untreated waste into its marine zone.
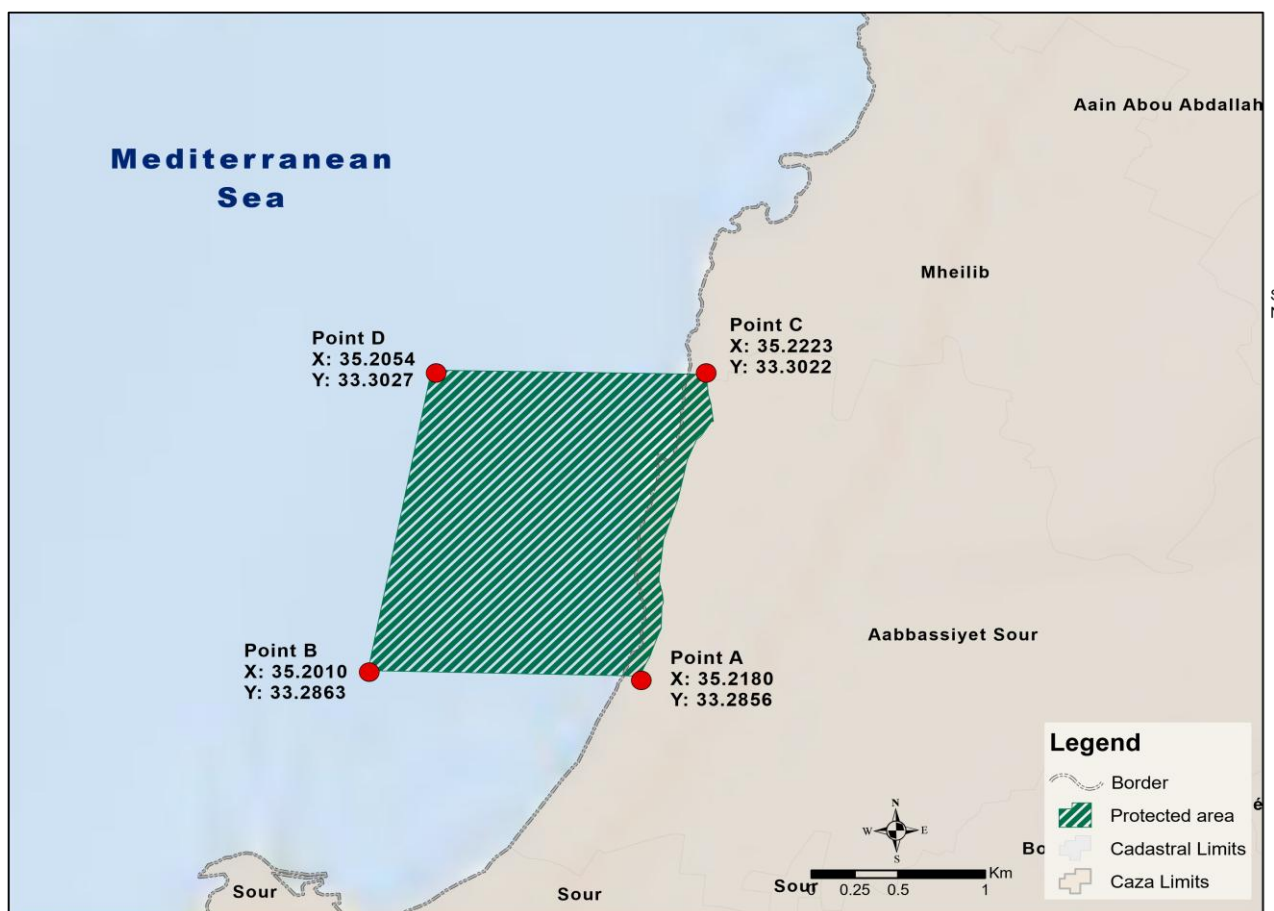
Figure 9: Abbassieh Coast Nature Reserve (Source: S. Termos, 2025)

1.3. *Main Drivers and Emerging Pressures*

The LCZ comprises the focus of the country's economic activities which is evident in analyses done for the spatial occupation of the area and its littoralization trend. As such, various studies have identified

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[117] http://legallaw.ul.edu.lb/Law.aspx?lawId=285496
[118] Aligning terrestrial habitat typology of Lebanon with EUNIS habitat classification. (2022)

urban sprawl as one of the main drivers interfering with the health of the coastal and marine ecosystems which in turn is a result of demographic growth and rural population migration towards the cities. This phenomenon comes in tandem with numerous issues that arise from the needs and behaviors of the expanding communities that get established along the coast. New industries are created, more investment is made for leisure activities, new settlements arise to surround these new economic hubs all of which lack proper management inevitably leading to harmful interactions with the surrounding environment. One main emerging issue is the privatization of the Maritime Public Domain (MPD) for tourism purposes, personal private use, the creation of landfills and dumpsites, all of which has led to the fragmentation and deterioration of the natural habitats present[119,120]. Additionally, natural phenomena, mainly due to Climate Change (CC), have contributed to the deterioration of the coastal and marine environments albeit to a lesser degree than that of the anthropogenic factor. As such, the following is a list of pressures that are affecting the health of the LCZ:

- Changes in Land-cover/Land Use
- Exploitation of Natural Resources
- Erosion and Sea-filling
- Pollution
- Climate Change

1.3.1. Changes in Land-cover/Land Use

The LCZ is witnessing a drastic shift in land division, where a study done in 2013 analyzing the evolution of the CZ between 1998 and 2010 identified a trend wherein natural land is being converted to bio-cultural land linked to traditional activities such as agriculture and fisheries which is in turn changed into urban environments (from grasslands, forests, agricultural lands, sea areas to artificial land)[58,119]. A more recent analysis of the Candidate Common indicator 25 (CC I25) for the LCZ between the years 2015 and 2020 identified a 3.08% increase of built-up area as opposed to an equivalent decrease of natural and semi-natural lands (i.e. agricultural areas, forests, semi-natural areas, and water bodies). This is mainly due to the creation of centralized economic hubs along the coastal area which, when coupled with weak law enforcement, has led to unregulated expansion of infrastructure. Furthermore, increased unregulated investment in touristic resorts, hotels, restaurants and country clubs along the Lebanese MPD has resulted in severe damage to the natural environment in the form of beach erosion, ecosystem fragmentation, in addition to biodiversity reduction[121]. Land allocation has also been changed for financial gain where it was noticed that multiple towns along the Lebanese coast have been abandoning agricultural plots converting them to residential areas which were able to provide increased revenues119. Urban sprawl, combined with intensive agricultural and industrial practices, have also contributed to the reduction in coastal woodland areas that have become restricted to Ras El-Shaqaa, El-Kelb, Damour and the Awally River valleys119.

1.3.2. Exploitation of Natural Resources

The LCZ provides various services that have been subject to overexploitation to meet the growing demands of the local population. This includes the fishery sector in Lebanon which is usually described as traditional, relying on artisanal practices and equipment. Nonetheless, the lack of law enforcement combined with the absence of legal regulations for seasonality and size of fish caught has resulted in

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[119] Environmental Resources Monitoring in Lebanon (ERML) project: 'Analysis of the Current Land Use and Socio-Economic Activities in the Coastal Zone'. (2013)
[120] Lebanon's national biodiversity strategy and action plan – NBSAP. (2016)
[121] Threatened biogenic formations of the Mediterranean: Current status and assessment of the vermetid reefs along the Lebanese coastline (Levant basin). (2019)

an unsustainable exploitation of this resource[122,123]. Moreover, fishermen regularly make use of illegal practices and equipment such as dynamite fishing, trawling nets, fishing of prohibited marine organisms (e.g. marine turtles, cetaceans and monk seals), in addition to the use of small mesh sizes[89,123,124]. Furthermore, the exploitation of coastal and marine resources for their aesthetic and recreational uses which includes unregulated recreational fishing in addition to over-frequentation by divers, jet skis and recreational boats, has exerted pressure on these natural ecosystems in the form of trampling, noise and light pollution, as well as littering[89]. This translates to severe degradation of the unique ecosystems and their inhabitants which is evident in the decreasing number of turtle nests and the destruction of valuable coastal and marine habitats such vermetid reefs[121,125], coastal wetlands, marine springs, and underwater caves along the coast[100].

1.3.3. Erosion and Sea-filling

Primarily the result of the Government's inability to monitor and enforce laws for the regulation of coastal development, especially during and after the civil war (1975-1990). Various locations across the LCZ are subject to illegal sand extraction in addition to chaotic sea-filling for the purpose of coastal development[57,58]. Moreover, the diversion of coastal dams for human consumption has resulted in the decrease in the sediment load reaching the CZ which is considered to be the main source of sediment replenishment across the LCZ[106]. This has resulted in a drastic change in the terrestrial and marine boundary where an 8km^2 increase in land was recorded by a study comparing the LCZ between 1962 and 2010[58] (Annex X: Map of the Coastal dynamics in Lebanon: Areas of accretion, erosion, sea-filling and excavation for port creation between years 2010 and 2023) Between 2010 and 2023, 2559.23m^2 were prone to erosion and around 38011m^2 were used for ports creation. According to the National Council for Scientific Research (CNRS), 45.24% of the Lebanese coastline is affected by significant erosion. Several low-lying coastal areas such as Tripoli, Chekka, Amchit, Jbeil, Jounieh, Damour, Jiyeh, Saida and Tyre are more prone to erosion since they are more exposed to tides and have less natural defense systems[126].

1.3.4. Pollution

Pollution on the LCZ is the result of a combination of various factors, including the lack of monitoring and enforcement of regulations, the absence of sufficiently functional waste water treatment plants, and mismanagement of certain anthropogenic activities (i.e. agricultural and industrial practices, in addition to residential areas). Sources of pollution on the CZ can be divided into land-based and sea-based and are not limited to the area itself but extend further inland where waste is transported naturally or through human intervention to coastal areas.

Rivers in Lebanon are considered to be one of the main contributors of pollution in the CZ[127] where they are responsible for transporting litter, domestic wastewater, plus agricultural and industrial runoffs to this area. Additionally, the LCZ hosts about 70% of the Lebanese population along with visiting tourists each year which have been reported to generate 65% of the country's total sewage load most of which is released untreated into the sea. The relatively recent influx of Syrian refugees has contributed to the rise of generated volume of wastewater by an estimate of 8%-12% in 2014[69]. Unregulated agricultural and industrial practices contribute greatly to the introduction on polluted,

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[122] Census of Lebanese fishing vessels and fishing facilities. (2005)

[123] Implementation of the ecosystem approach to fisheries for the purse seine fisheries in Lebanon – Baseline report. (2020)

[124] First Record of *Diadema setosum* (Leske, 1778) (Echinodermata, Echinoidea, Diadematidae) from Lebanon, Eastern Mediterranean. (2011)

[125] First assessment of the ecological status in the Levant Basin: Application of the CARLIT index along the Lebanese coastline. (2018)

[126] Detection of the Shoreline Changes Using DSAS Technique and Remote Sensing: A Case Study of Tyre Southern Lebanon. (2021)

[127] Water Quality Assessment of Lebanese Coastal Rivers During Dry Season and Pollution Load into the Mediterranean Sea. (2007)

and in some cases toxic, fluids into the CZ. Moreover, various landfills and dumpsites exit along the LCZ (particularly in Tripoli, Bourj Hammoud (Matn), Costa Brava (Baabda), Saida and Tyre), due to the lack of implementation of a solid waste management program which was hindered by public opposition to proposed landfill sites, the installation of incinerators, and to financial shortages. This has resulted in the pollution of the marine environment through direct introduction of litter, and through the release of leachate due to poor management. Precipitation has been reported to constitute another source of pollution introduction into the CZ, where the high levels of air pollution due to unregulated industrialized areas, the absence of an efficient public transport system, dense traffic, the use of community generators, and high population densities have resulted in dangerous emissions accumulating over cities of economic importance and their surrounding suburbs[128,129].

Pollution coming from sea-based sources can mainly be attributed to maritime activities. It has been observed that discharge of solid and liquid waste, accidental and intentional release of oil from engine waste, the use of antifouling chemicals, plus the discharge of ballast waters from day-to-day shipping operations have a severe impact on the marine environment[130]. This kind of toxic discharge is documented to cause the death of marine organisms or might affect their health and genetic diversity89. Moreover, the dependence of Lebanon on imported hydrocarbons for energy production might result in an increased chance of oil spills having a destructive effect on the coastal and marine environments.

1.3.5. Climate Change

CC greatly contributes to the deterioration of coastal and marine environments through altering their inherent characteristics. The rise in SST has been accredited to the loss of many vulnerable species, most notably, the vermetid platforms and their algal associations121. This rise is also expected to cause a change in precipitation patterns, which would alter the flow of freshwater and the carried nutrients into the CZ affecting the productivity of these areas and forcing the change of life cycles, symbiotic associations, desynchronization between periods of reproduction, dispersal, and migration[131,]94. Moreover, rising SST encourage the migration and establishment of NIS, especially of Lessepsian origin, that have been observed to compete with native species for habitat and resources100,111. Some of these new species, e.g. the silver-cheeked toadfish (*Lagocephalus sceleratus*)[132], striped catfish (*Plotosus lineatus*), the common lionfish (*Pterois miles*)111, some toxic microalgae[133] and the nomad jellyfish (*Rhopilema nomadica*), might represent health problems affecting the aesthetic value of the coast and in turn the touristic sector. Nonetheless, the introduction of some species (such as the lionfish (*Pterois miles*) has been viewed as beneficial in some cases, as they provide an untapped potential for the development of new fisheries for the area120.

The Lebanese coast is threatened, like all other coastal regions in the world, with the rising sea level as a result of mean temperature increase and higher melting of polar ice. This will have a drastic effect on coastal communities, specifically those dependent on light for food production. As such a loss of biodiversity is expected in the LCZ. Moreover, important coastal habitats, such as estuaries; vermetid platforms; caves; and sandy beaches; would be submerged changing their physical and chemical

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[128] Beirut Air Pollution and Health Effects-BAPHE study protocol and objectives. (2015)
[129] Modeling air pollution in Lebanon: evaluation at a suburban site in Beirut during summer. (2013)
[130] United Nations Environment Programme
[131] Lebanon's third national communication to the United Nations Framework Convention on Climate Change (UNFCCC). (2016)
[132] Biological characteristics of the lessepsian pufferfish Lagocephalus sceleratus (gmelin, 1789) off Lebanon. (2015)
[133] The introduced marine macroflora of Lebanon and its distribution on the Levantine coast. (2017)

characteristics and affecting the organisms depending on them (e.g. turtles and monk seal amongst others)[134,135].

Two additional effects of CC are the increase in the acidity of the water, commonly referred to as ocean acidification, and the reduction in the oxygen concentration of sea water, ocean de-oxygenation. The former causes the decrease in the net calcification and abundance of rocky intertidal and reef-associated species affecting important coastal habitats such as vermetid reefs and their associated communities121[,136,137]. As for ocean deoxygenation, it is expected to alter the ecosystem equilibrium, changing the characteristics and viability of many habitats including the spawning grounds of commercially and aesthetically important species. This would have great repercussions on the fisheries sector, food security in the country, in addition to the scuba diving sector131[,136].

1.4. *Proposed Mitigation Measures and Response*

Sustainable management of marine and coastal resources must begin at the legislative level, as such it is imperative to work on ensuring the implementation of adopted laws and associated decrees, as well as establishing needed decrees for the efficient activation of the articles of existing laws. Additionally, the GoL should strive to implement the ratified international conventions by issuing and enforcing applicable laws and decrees. Sufficient funds should be allocated for the implementation of national strategies, conservation plans, and monitoring programs. Moreover, scientific analyses should be financially and legally supported to allow the filling of existing gaps for better decision making.

Effort should be put to resolve existing pressures impacting the marine and coastal environments. Activities taking place on and around the LCZ must be regulated in an integrated manner to ensure a more sustainable approach. Additionally, specific plans for the management of solid and liquid waste generated by the LCZ must be made, and should be preceded by sufficient data collection of waste generation and disposal. Cooperation between the MoE and industrial, agricultural, and touristic sectors must be made to reduce levels of pollution (solid, liquid, gas, and aesthetic) produced. This could be aided by educational outreach initiatives within and outside the academic sector. Moreover, effort should be increased towards the active protection of ecosystems and biodiversity by reducing the pressure on the resources available on the coast and creating a sustainable approach to the extraction and use of said resources.

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[134] Impact of sea level rise on the coastal ecosystem. (2018)
[135] Coastal zones and climate change. (2010)
[136] Assessing climate change vulnerability in fisheries and aquaculture: Available methodologies and their relevance for the sector. (2015)
[137] IUCN - Ecosystem-Based Adaptation. (2017)

2. SOCIAL CHANGES

2.1. POPULATION

2.1.1. State:

Lebanon's total population increased from around 3.8 million in 2007 to approximately 4.9 million in 2022, of whom 79.8% are Lebanese and 20.2% non-Lebanese. With a population density of 669 inhabitants/km^2, Lebanon ranks in the top 20 list of the most populated countries (UNDP/ UNHCR/UNICEF/MoE, 2020).[138]

Nearly 60% of Lebanon's population lives along the coast where industrial, commercial and urban activities are concentrated.[139] For instance, the cazas of Beirut, Jbeil, Batroun, Koura, Tripoli, Sidon, and Tyre are home to 7.1%, 2.7%, 1.2%, 1.7%, 5%, 6.1%, and 5.3% of the country's population, respectively (EU/CAS/ILO, 2020). [140] The segregation of the Lebanese population per governorate and caza is presented in Table 3 with the coastal cazas colored in red (EU/CAS/ILO, 2020).[141]

Table 3: Population Distribution by Governorate and Caza

Governorate	Caza	Population per Caza	%age of Total Population
Akkar	Akkar	324,000	6.7
Baalbek-Hermel	Baabek	214,600	5.1
	Hermel	30,500	
Beirut	Beirut	341,700	7.1
Bekaa	Rachaya	33,800	6.1
	West Bekaa	86,400	
	Zahle	177,400	
Mount Lebanon	Aley	300,800	41.9
	Baabda	553,800	
	Chouf	277,000	
	Jbeil	129,500	
	Matn	511,000	
	Keserwan	260,500	
Nabatieh	Bint Jbeil	96,200	7.8
	Hasbaya	28,700	
	Marjaaoun	74,000	

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[138] UNDP/ UNHCR/UNICEF/MoE, 2020, SOER Report: Lebanon State of the Environment and Future Outlook: Turning the Crisis into Opportunities, SOER_Report_EN.pdf (unicef.org)

[139] European Union, 2020, Evaluation of the Lebanese Marine Environment: a multidisciplinary study (ELME) | EEAS

[140] LABOUR FORCE and HOUSEHOLD LIVING CONDITIONS SURVEY 2018-2019 for Beirut, Jbeil, Batroun, Koura, Tripoli, Sidon, and Tyre.

[141] EU/CAS/ILO, 2020, Labor Force and Household Living Condistions Survey 2018-2019, wcms_732567.pdf (ilo.org)

Governorate	Caza	Population per Caza	%age of Total Population
	Nabatieh	180,200	
North Lebanon	Batroun	58,900	13.2
	Bcharre	22,100	
	Koura	84,600	
	Minieh-Dannieh	140,800	
	Tripoli	243,800	
	Zgharta	87,700	
South Lebanon	Jezzine	32,100	12.1
	Sidon	296,600	
	Tyre	255,700	
Note: Excludes people living in non-residential units, such as army barracks, refugee camps and adjacent gatherings, and informal settlements.			

Source: EU/CAS/ILO, 2020

With the start of the Syrian war in 2011, many Syrians fled their home country and settled in different regions in Lebanon, which lead to the increase in the total number of population. Lebanon remains the country hosting the largest number of refugees per capita, with the Lebanon Crisis Response Plan (LCRP) estimation of 1.5 million Syrian displaced in addition to 11,778 refugees of other nationalities (UNHCR, 2023).[142] Nevertheless, the number of refugees represented in online data and statistics may not accurately reflect the true refugee population due to political reasons, and the figures are likely outdated and underestimated. In fact, real-time data of 2017[143] reveal that Palestinians refugees alone, constitute around 265,000 inhabitants, settled in 12 Palestinian camps across Lebanon. Syrian refugee population and distribution throughout Lebanon including the coastal areas, are illustrated in Figure 10.

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[142] UNHCR, 2023, Fact Sheet of Lebanon, UNHCR
[143] 2017 figures of Palestinian camps population data from previous project with United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA)
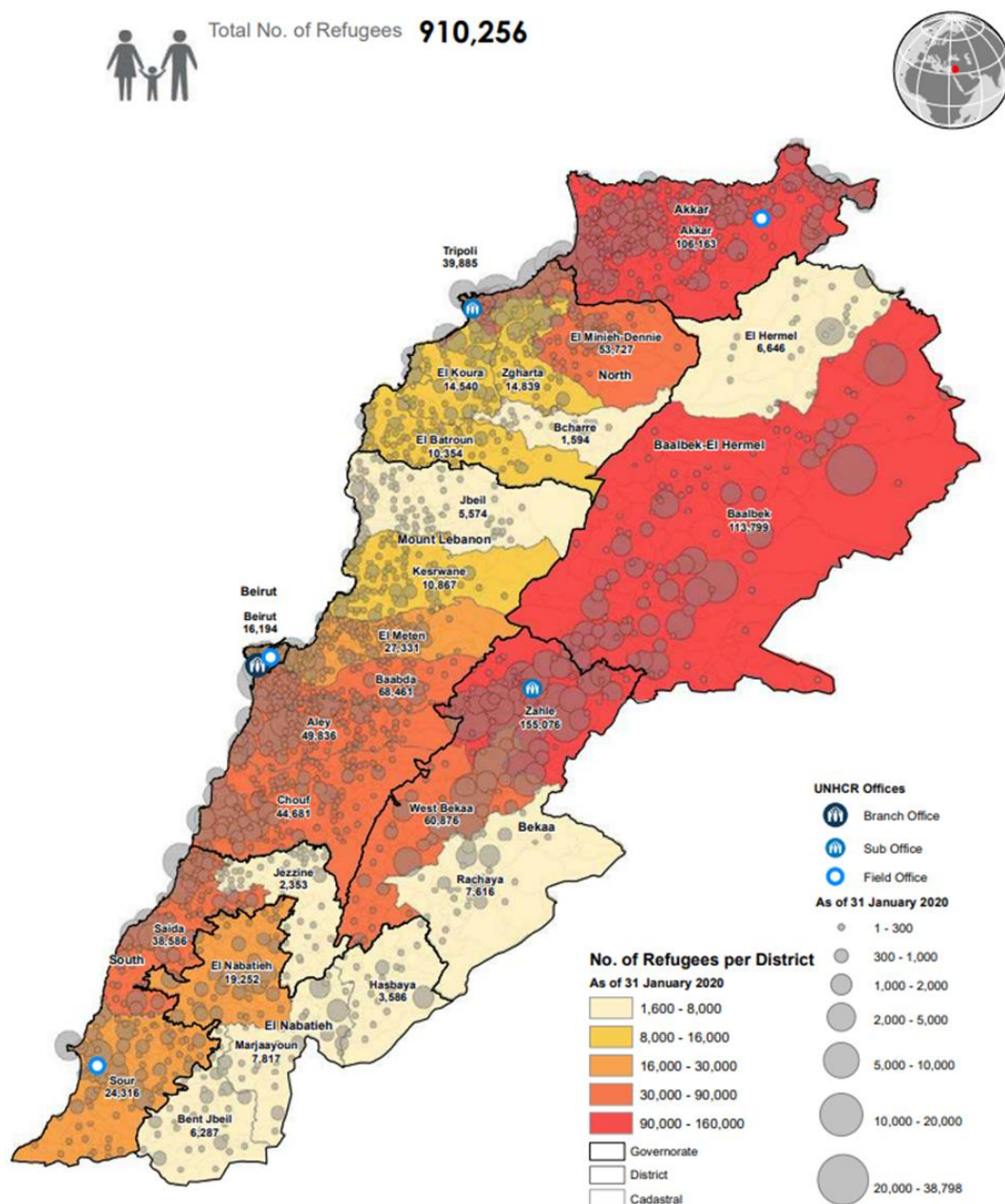
Figure 10: Syrian Refugee Population and Location Data

Source: UNDP/ UNHCR/UNICEF/MoE, 2020

In the Lebanese coastal areas, namely, Beirut, Jbeil, Batroun, Koura, Tripoli, Sidon, and Tyre, approximately, half of the population in Lebanon is between 15 and 64 years old (EU/CAS/ILO, 2020).

The overall average household size in the country has declined from 4.3 in 2004 to 3.8 individuals in 2018–19. Beirut had the lowest household size average among governorates with 3.4 individuals, while Akkar had the largest with 4.8 individuals. At the caza level, Jezzine (3.3), Batroun (3.4), Keserwan (3.4), Beirut (3.4), Rachaya (3.4) and Matn (3.5) have the smallest households, while Akkar (4.8), Minieh-Danniyeh (4.7) and Tripoli (4.4) have the largest (EU/CAS/ILO, 2020).

Urbanization offers various benefits including economic growth, social and cultural enrichment. Cities are centers for job creation and economic development, and they foster cultural diversity and social connections by bringing together people from different backgrounds, religions, and cultures. However, urbanization also presents several challenges such as ensuring equal economic opportunities and access to social services for everyone, maintaining safety, and promoting a healthy and sustainable urban environment. In Lebanon, cities showcase these opportunities and challenges. They provide economic prospects, jobs, and services while hosting a diverse population that mirrors the country's religious, cultural, and socioeconomic diversity. This diversity has enhanced Lebanon's cultural richness but has also led to urban divisions and conflicts, particularly highlighted by the Lebanese civil war from 1975 to 1990. Nowadays, the division within cities and major urban centers along religious and sectarian lines is evident, with certain areas developing informally to support less privileged groups like the poor, internally displaced persons, refugees, and migrant workers.

A 2016 study has indicated that the total urban areas have almost doubled from 1994 to 2010 (Table 4). Also, the EU Copernicus Program gave an estimation of approximately 1,004km^2 in 2019 for Lebanon's built-up area (UNDP/ UNHCR/UNICEF/MoE, 2020), reflecting that urban areas are in continuous increase since 1994.

Table 4: Urban Growth per Governorate from 1994 to 2013, with Coastal Areas Colored in Red

Agglomeration	Urban Land Area in Km2 and as a Percentage of the Total Area					
	1994		**2005**		**2010**	
Akkar	20	3%	44	6%	55	7%
North Lebanon	49	4%	89	7%	101	9%
Mount Lebanon	226	11%	281	14%	312	16%
Beirut	21	95%	21	98%	21	98%
South Lebanon	35	4%	68	7%	92	10%
Nabatiyeh	30	3%	76	7%	99	9%
Bekaa	46	3%	67	5%	83	6%
Baalback-Hermel	45	2%	73	94%	94	3%
Lebanon	**472**	**5%**	**719**	**7%**	**857**	**8%**

In fact, no significant changes in the Lebanese urban population share were noticed in 2022 in comparison to the previous year 2021 and the previous 10 years. The share remained at around 89.26% (Statista, 2024)[144]. Cross-checking this figure with several references from the UN-Habitat[145] and the World Bank[146] reveals that 87% to 89% of the Lebanese population lives in urban areas, with the majority, estimated at 64%, resides in large agglomerations mostly in the metropolitan areas of Beirut and Tripoli, which are major coastal cities.

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[144] Statista, 2024, Lebanon: Urbanization from 2012 to 2022, Lebanon - urbanization 2012-2022 | Statista
[145] UN-Habitat, 2011, Lebanon Urban Profile; A Desk Review Report, October 2011
[146] World Bank, 2022, Lebanon Urban Population (% of Total Population

Nevertheless, it is important to note that Beirut today is one of the least affordable cities on the globe in terms of housing (rated 327 out of 333 urban centers, in terms of affordability compared to median incomes). In fact, Lebanon has been assailed by the most severe, multi-prolonged crisis in its modern history for five three years. The ongoing economic and financial crisis, which began in October 2019, has been aggravated by the economic impact of the COVID-19 pandemic, the major Port of Beirut explosion in August 2020 and the current armed conflict with Israel that started in October 2023. The economic crisis though ranks among the worst economic crises globally since the mid-nineteenth century [147]. This has also made the value of the Lebanese pound (LBP) collapse and landlords to increasingly demand rent in United States Dollar (US$), making it dramatically more difficult for many LBP-earning renters to stay in their homes. This, as thousands of apartments lay empty around the city, causing artificial scarcity in the rental market (Crean, 2023).[148]

On another note, since October 8, 2023, one day after Hamas attacked Israel, which triggered the Palestine-Israel war; Israel and Hezbollah in Lebanon have been exchanging fire across Lebanon's southern border. Clashes have been constant since and have increased in breadth, with Israel evacuating citizens from towns near the border and some 600,000 people living along Lebanon's southern border remain in danger. There are more than 46,000 internally displaced people (IDP) in Lebanon who have moved to nearby shelters or to locations further north escaping the southern clashes (Relief Web, 2023).[149] These numbers have been in constant increase during the drafting of this report.

2.1.2. Drivers:

The combination of cultural and societal norms, regional conflicts and refugee crisis, and the economic and ongoing political instability profoundly shaped the population dynamics on the level of population size, demographic composition, age structure, geographic distribution, resource allocation, etc.

2.1.3. Pressures:

The above drivers pushed refugee populations, whether integrated into host communities or residing in settlements, to increase demands for water and sanitation services, placing additional pressure on already strained infrastructure. Simultaneously, rapid urbanization, with urban areas hosting the majority of the population, intensified the pressure on urban infrastructure and services, exacerbating issues of overcrowding and inadequate living conditions. This urban concentration also fueled an increased demand for natural resources, particularly in coastal regions, escalating environmental challenges such as pollution, habitat destruction, and vulnerability to natural disasters. Moreover, high levels of unemployment, especially prevalent among youth and refugees, further burdened social services leading to poverty and inequality.

2.1.4. Impacts:

The back-to-back and overlapping crises Lebanon has been facing in the past five years have seen many impacts on the socio-economic levels that can be summarized in the following:

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[147] The World Bank, 2022, Lebanon Overview: Development news, research, data, Lebanon Overview: Development news, research, data | World Bank

[148] The Badil, Rosabel Crean, 2023, Houses Without Homes: Beirut's Affordable Housing Crisis, Houses Without Homes: Beirut's Affordable Housing Crisis - Badil (thebadil.com)

[149] Relief Web, 2023, Southern Lebanon's Unofficial War and Escalating Crisis, Southern Lebanon's Unofficial War and Escalating Crisis - Lebanon | ReliefWeb

- **Changes in Labor Markets and Unemployment:** The influx of refugees and rapid urbanization disrupted the labor markets by increasing competition for jobs and driving down wages, particularly in low-skilled sectors, which led to higher unemployment rates, especially impacting youth and refugees.

- **Environmental Pressures with Increased Use of Natural Resources:** The increased demand for natural resources, driven by population growth and urbanization, intensified environmental pressures such as deforestation, land degradation, and pollution, which contributed to biodiversity loss, habitat destruction, and climate change, exacerbating the vulnerability of ecosystems and communities to environmental hazards.

- **Urban Overcrowding Impacts Infrastructure and Industry Services which Will Hinder Economic Growth:** Rapid urbanization and population growth led to overcrowding in urban areas, placing immense strain on infrastructure on the level of transportation, water supply, waste management systems, etc. Inadequate investment in infrastructure hindered economic growth and productivity, and posed risks to public health and safety. Furthermore, overcrowding hindered the efficient functioning of industries, leading to congestion, delays, and increased costs of production.

- **Increased Public Health Issues with Inadequate Access to Essential Services:** Urban overcrowding and inadequate infrastructure contributed to public health challenges, including inadequate access to clean water, sanitation, electricity, and healthcare systems. Moreover, limited access to healthcare services exacerbated health disparities and reduced the resilience of communities to health emergencies and pandemics.

- **Housing Affordability Problems:** High housing prices can make it difficult for individuals and families to afford suitable accommodation, particularly for low and middle-income households, which led to housing insecurity, homelessness, overcrowding, or forced relocation to less desirable or distant areas with lower housing costs.

2.1.5. Responses:

- **Urban Planning Strategies:** Effective urban planning strategies are essential for managing urban growth and mitigating the impacts of urban overcrowding. This includes comprehensive land-use planning, zoning regulations, and infrastructure development to accommodate population growth while ensuring sustainable and livable urban environments.

- **Immigration Policies:** They can encompass all the measures by which Lebanon can regulate the influx of persons particularly those who want to establish residence in the Lebanese territory either temporarily or permanently.

- **Sustainability and Conservation Initiatives:** Sustainability and conservation initiatives are critical for managing natural resources and mitigating environmental degradation through promoting sustainable resource management practices to reduce environmental pressures and enhance resilience to climate change.

- **Affordable Housing Initiatives:** Affordable housing initiatives are essential for addressing housing shortages and reducing housing affordability barriers, particularly in rapidly growing urban areas. This includes implementing policies and programs to increase the supply of affordable housing, such as land-use incentives, public-private partnerships, and subsidies for low-income households.

2.2. Education and Labor Force

2.2.1. State:

Lebanon's crisis increasingly forced young people to drop out of learning and engage in ill-paid, irregular and informal work just to survive and help feed their families; more than 4 in 10 youth in Lebanon reduced spending on education to buy basic food, medicine and other essential items, and 3 in 10 stopped their education altogether. According to a UNICEF rapid assessment, enrolment in educational institutions dropped from 60% in 2020-2021 to 43% in 2022 (3 out of 10 students stopped their education) (UNICEF, 2022).[150]

At national level, the gross enrollment rate in primary education is 93% for both girls and boys combined. This decreases to 71% in lower secondary. As for literacy, compared to other countries, Lebanon ranks at the 36th percentile in access and at the 80th percentile in learning. The literacy rate is 99% among the Lebanese youth population, which is higher than the average youth literacy rate in other upper middle-income countries (EPDC, 2018).[151] The main inequality in education is between urban and rural areas where higher education is not always available (UNDP, 2021).[152]

At coastal level, the Gross Enrollment Rate (GER) and Net Enrollment Rate (NER) at the elementary level are relatively high but drop significantly at the secondary level. For instance, Beirut and Tripoli show GERs of 93.9% and 108.7% at the elementary level, but these figures fall to 71.6% and 70.4% at the secondary level. Similarly, NERs also decline, such as in Jbeil, where the elementary NER is 89.4%, dropping to 54.9% at the secondary level. This trend of decreasing enrollment rates from elementary to secondary education is consistent across coastal regions like Batroun, Koura, Sidon, and Tyre (EU/CAS/ILO, 2020). [153]

At national level, the Central Administration of Statistics (CAS) and the International Labor Organization (ILO) 2022 survey[154] reports that Lebanon's unemployment rate increased from 11.4% in 2018-2019 to 29.6% in January 2022, indicating that almost one-third of the active labour force was unemployed in January 2022. The labour force participation rate dropped from 48.8% in 2018-2019 to 43.4% in 2022; the labour force participation rate for both men and women decreased for all age groups between 2018-2019 and January 2022. In 2022, the female unemployment rate (32.7%) was somewhat higher than the male rate (28.4%) while the youth rate (47.8%) was almost twice the adult rate (25.6%). Almost one-third of the female youth population was not in employment, education, or in training (NEET) in January 2022 (32.1%), a net increase from 2018-2019, when the NEET rate for young women was 26.8%. A similar change may be observed in the case of the male youth population for whom the NEET rate increased from 16.7% in 2018-2019 to 26.1% in January 2022 (ILO/CAS, 2022).[154] Also, according to an article published by the UNDP in October 2022, youth migration rate has been increasing with a survey in 2020 showing that 77% of Lebanese youth aged between 18 and 24 wished to emigrate, a proportion higher than in war-torn Libya, Iraq, and Yemen.[155]

[150] UNICEF, 2022, Lebanese Crisis Forcing Youth out of Learning, Robbing them of their Futures: UNICEF Survey, Lebanese crisis forcing youth out of learning, robbing them of their futures: UNICEF survey

[151] EPDC, 2018, National Education Profile, 2018 Update, EPDC_NEP_2018_Lebanon.pdf

[152] UNDP/NCLW/MoE, 2021, Lebanon Gender Analysis, Executive Summary, Lebanon-Gender-Analysis-2020-Summary-A4_FINAL.pdf (undp.org)

[153] LABOUR FORCE and HOUSEHOLD LIVING CONDITIONS SURVEY 2018-2019 for Beirut, Jbeil, Batroun, Koura, Tripoli, Sidon, and Tyre.

[154] ILO/CAS, 2022, Lebanon Follow Up Labour Force Survey – January 2022, Fact Sheet, wcms_844837.pdf (ilo.org)

[155] UNDP, 2022, Lebanon's Youth: Barrier for Growth and Unfolding Opportunities, Lebanon's youth: Barriers for growth and unfolding opportunities | United Nations Development Programme

At coastal level, Beirut and Jbeil had higher labor participation rates (52.5% and 55.9%, respectively) than the national average in 2018-19(48.8%), while regions like Tyre had lower rates (41.8%). Gender disparities are observed across all coastal cazas, with men's participation rates generally much higher than women's. For instance, in Beirut, men's participation was 71.4% compared to women's 36.8%. Youth NEET rates also show regional variation, with Jbeil having a higher NEET rate (39.1%) compared to Beirut (22.2%) and Sidon (17.8%), with women's NEET rates typically higher than men's across the board.

Despite the abovementioned unemployment rates, the Lebanon Economic Vision 2025, has anticipated that the number of jobs by sector at the national level is likely to increase in the industrial sectors as such: approximately 50,000 jobs, 5,000 jobs in agriculture, and 100,000 jobs in tourism (McKinsey, n.d.).[156] It is worth noting that these figures have been set back in 2018 which may not exactly reflect the current socio-economic situation of the country.

2.2.2. Drivers:

Economic disparities such as unequal distribution of wealth and resources, can limit access to quality education and employment opportunities, particularly for marginalized communities. The socio-economic crisis also led to job losses, reduced household incomes, and increased poverty, making it difficult for individuals to afford education and training. Political instability and regional conflicts also disrupted education systems, displacing populations while also creating instability in labor markets.

Reductions in public funding for education has led to resource constraints in educational institutions, resulting in reduced access to quality education, limited learning opportunities, and overcrowded classrooms. Concurrently, reductions in incomes due to economic downturns make education financially inaccessible for many. Moreover, the widespread closure of businesses resulting from supply chain disruptions and currency devaluation further aggravated the challenges, leading to widespread unemployment, loss of livelihoods, and increased financial strain on households; Since 2020, of the total 363 sampled small-scale enterprises in Lebanon, 51% temporarily stopped operations, and of 1,987 interviewed workers, 84% were laid off and 94% saw their wages largely reduced (ILO, 2022). Additionally, the main obstacles facing young entrepreneurs have primarily been rooted in issues with policy/legislation and the education system. Key legislative and policy changes crucial for supporting youth entrepreneurship, such as updates to the Code of Commerce, the introduction of a new bankruptcy law, laws for private equity funds, and secured transactions, failed to materialize despite some advancements in 2019. Additionally, the education system has struggled to foster an entrepreneurial mindset, consistently failing to align its curriculum with the evolving needs of the market[157].

Finally, the COVID-19 pandemic has further exacerbated these challenges, leading to widespread job losses, disruptions to education systems, and aggravation of existing inequalities, particularly for vulnerable groups such as women, minorities, and low-income families.

2.2.3. Pressures:

The increase in unemployment rates among youth creates several pressures on both economic and social systems. Firstly, there's a heightened demand for social welfare programs as more young people rely on government support, straining public budgets and services. Concurrently, decreased disposable income among the unemployed leads to reduced consumer spending, negatively impacting

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[156] McKinsey, n.d. Lebanon Economic Vision, 20181022-1228full-report-en.pdf (economy.gov.lb)
[157] UNDP, 2022; Lebanon's youth: Barriers for growth and unfolding opportunities

local businesses and economic vitality. This economic downturn is accompanied by growing social discontent and instability, as high unemployment rates foster frustration and undermine societal cohesion. Furthermore, the discrepancy between the skills taught in educational institutions and those demanded by employers becomes more pronounced, highlighting inefficiencies in talent development and utilization.

2.2.4. Impacts:

- **Social Inequality Leading to Higher Levels of Poverty:** Social inequality, driven by disparities in access to education, employment opportunities, and resources, contributes to higher levels of poverty among marginalized communities. Limited access to quality education spreads poverty by hindering individuals' ability to acquire the skills and qualifications needed to secure stable and well-paying jobs.
- **Economic Stagnation and Decline in Education and Employment Negatively Impacting Economic Growth and Productivity:** Economic stagnation resulting from declines in education and employment levels can have far-reaching consequences for economic growth and productivity. A poorly educated workforce is less equipped to meet the demands of a rapidly evolving labor market, hindering innovation, technological advancement, and overall productivity gains. Furthermore, high levels of unemployment and underemployment reduce consumer spending and investment, reducing economic activity.
- **Increased Immigration to Countries with Higher Employment Rates and Better Job Opportunities:** Better employment opportunities and higher wages in countries with stronger economies often drives increased immigration, mainly of youth, from regions experiencing economic hardship

2.2.5. Responses:

- **Implementing Fiscal Reforms and Monetary Policy Adjustments:** Fiscal reforms and monetary policy adjustments can stimulate economic growth and create a conducive environment for job creation and investment. This may involve measures such as tax incentives for businesses, and monetary policy adjustments to stabilize inflation and exchange rates, promoting economic stability and investor confidence.
- **Pursuing Corruption Prosecutions to Rebuild Public Trust:** Combatting corruption is essential for restoring public trust in government institutions and promoting transparency and accountability. Prosecuting corrupt officials and implementing measures to prevent corruption can help rebuild public confidence, attract investment, and ensure that public resources are allocated efficiently and equitably, including towards education and employment initiatives.
- **Securing International Financial Assistance:** Securing international financial assistance can provide critical support for education and employment programs, especially in times of economic crisis or instability.
- **Developing a Sustainable Model for Economic Growth and Diversification:** Developing a sustainable model for economic growth and diversification is essential for creating long-term employment opportunities and reducing dependency on volatile industries. This may involve investing in renewable energy, sustainable agriculture, eco-tourism, and other sectors with growth potential, while also promoting innovation, entrepreneurship, and skills development to foster a resilient and inclusive economy.
- **Investment in Educational Infrastructure:** Investment in educational infrastructure, including schools, libraries, and vocational training centers, is crucial for improving access to quality education and enhancing workforce skills. This may involve upgrading facilities and providing resources for teachers and students.

- **Initiatives to Support Students:** Initiatives to support students, such as scholarships, grants, and student loan programs, can help reduce financial barriers to education and increase enrollment rates, especially among disadvantaged groups to facilitate their transition into the workforce.
- **Initiatives to Support Businesses and Startups:** Supporting businesses and startups through incentives, incubators, and access to financing can stimulate entrepreneurship, innovation, and job creation. This may involve providing technical assistance, mentorship, and access to markets.

2.3. HEALTHCARE

2.3.1. State:

There are some concerns regarding the healthcare system in Lebanon, especially with the influx of Syrian refugees that have added pressure on the system, leading to its fragmentation: growing demand and insufficient capacities/equipment, coupled with the recent crisis.

The latest data reveal that there are currently 163 hospitals distributed throughout the country. Figure 11 shows that the district of Mount Lebanon contains the highest number of hospitals and can fulfill the demand of almost 1.6 million of its residents. The district with the lowest number of hospitals is Nabatieh.[158]
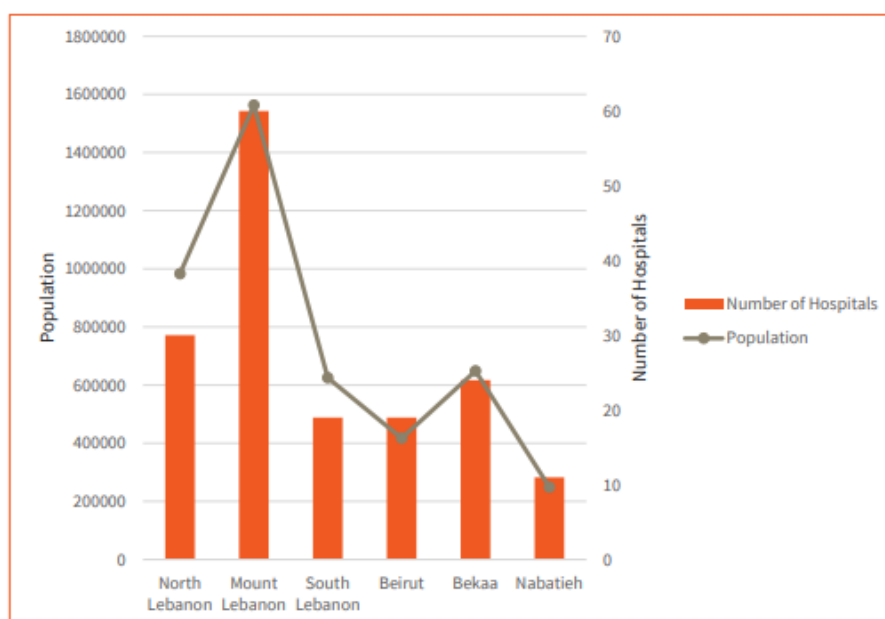
Figure 11: Number of Hospitals per District along with the
Population Size per District (Source: Isma'eel et al. 2020)

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[158] Isma'eel et al., 2020, Saving the Suffering Lebanese Healthcare Sector: Immediate Relief while Planning Reforms, Saving the Suffering Lebanese Healthcare Sector: Immediate Relief while Planning Reforms – Arab Reform Initiative (arab-reform.net)

The latest data on the number of pharmacies in Lebanon goes back to 2020. The Order of Pharmacists of Lebanon estimates that there are 2,614 pharmacies distributed across the country. Most of the pharmacies are also concentrated and localized in the governorate of Mount Lebanon (Isma'eel et al., 2020). In 2017 and for every 10,000 residents, there were 31.3 physicians, 36.4 nurses and mid-wives, 15.2 dentists and 18.9 pharmacists (MoPH, 2019).[159] However, a significant number of these have left the country since 2019 as a result of the socio-economic crisis and political instability of the country.

The government was able to finance the cost of healthcare goods and services for the country, through the Ministry of Public Health (MoPH) and military funds. Other funds were based on the employer contribution, for example, through the National Social Security Fund or the Civil Servant Cooperative. The National Social Security Fund (NSSF) provides employees with insurance that covers work-related incidents, maternity leaves, illnesses and diseases, and hospitalization. In 2018, 26% of citizens benefitted from the services of NSSF. There is also the Civil Servant Cooperative that covers civil servants, and 3% of the citizens benefitted from the Civil Servant Cooperative in 2018 (Ibrahim & Daneshvar, 2018; Isma'eel et al., 2020). The NSSF contributes the most for the employer-paid health expenditure. Other private insurance companies and NGOs have also contributed to covering healthcare expenditures. Today, the socio-economic crisis made the actual coverage of public funds become negligible due to the currency depreciation. The NSSF can cover only 10% of the cost of healthcare services, with the beneficiary paying the remaining 90%. Consequently, beneficiaries have resorted to private insurance companies or out-of-pocket payments, which increased from 33.1% in 2018 to more than 85% in 2022 (LCPS, 2023).[160]

Health insurance coverage varied significantly across the coastal cazas. Jbeil and Batroun had the highest coverage, with over 71% of residents insured. In contrast, Tripoli had the lowest coverage, with only 40.1%of residents insured. Beirut, Koura, Sidon, and Tyre showed moderate coverage. In most districts, women generally had slightly higher coverage than men, except in Koura and Tyre, where men's coverage was marginally higher (EU/CAS/ILO, 2020).[161]

2.3.2. Drivers:

The socio-economic crisis resulted in failures in the NSSF and drastic decreases in minimum wage for healthcare employees, similar to other sectors. (In some cases, salaries dropped from 585 US$ to 43 US$ in 2021, e.g., average nurse's salary became 75 US$ while they still work for 40 hours per week (WHO, 2023). [162]Moreover, difficulties in transportation due to fuel shortages hindered healthcare workers' ability to reach hospitals and clinics, further disrupting healthcare delivery. Additionally, the highly privatized healthcare system exacerbates disparities, with basic medications and services becoming increasingly inaccessible and unaffordable for many, worsening the overall health outcomes for the population.

2.3.3. Pressures:

With fewer healthcare workers available due to massive emigration seeking better opportunities abroad, the capacity to deliver essential healthcare services diminished, leaving healthcare facilities understaffed and overburdened.

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[159] MoPH, 2029, Statistics 2019, Statistics2019.pdf (moph.gov.lb)
[160] LCPS, 2023, Lebanon's Economic Crisis by Sector: Reforming the Healthcare System, 2023 (lcps-lebanon.org)
[161] LABOUR FORCE and HOUSEHOLD LIVING CONDITIONS SURVEY 2018-2019 for Beirut, Jbeil, Batroun, Koura, Tripoli, Sidon, and Tyre.
[162] WHO, 2023, Weakening of the Lebanese Health Sector, 1020-3397-2023-2903-168-169-eng.pdf (who.int)

2.3.4. Impacts:

- **Increased Health Burdens from Lack of Capacity to Provide Medical Services and Surge in Death Rates**: Patients started experiencing delays in receiving essential medical care, leading to the worsening of chronic conditions, preventable illnesses, and increased mortality rates.

- **Loss of Talented Healthcare Workforce:** The emigration of talented healthcare workers seeking better opportunities abroad resulted in a loss of valuable human capital and expertise within the healthcare sector, compromising the quality and efficiency of healthcare services.

- **Inequitable Medical Services Only to Patients Who Can Afford Them:** In highly privatized healthcare systems or contexts where medical services are primarily accessible to those who can afford them, inequities in access to healthcare emerge, leading to disparities in health outcomes based on socioeconomic status. Patients who can afford medical services may receive timely and comprehensive care, in contrary of those who cannot afford these services.

2.3.5. Responses:

- **Reforms to Restore Adequate Coverage by NSSF:** Implementing reforms to restore adequate coverage by the NSSF is essential for ensuring that all citizens have access to affordable healthcare services. This may involve expanding the scope of coverage, increasing funding for healthcare programs, and improving the efficiency and effectiveness of NSSF operations.

- **Subsidizing Drugs and Services Related to The Healthcare System:** Subsidizing drugs and services related to the healthcare system can help reduce the financial burden on healthcare facilities and patients. By providing financial support for essential medical supplies and utilities, the government can ensure that healthcare facilities have the resources they need to deliver quality care and that patients can access necessary medications and treatments without facing unaffordable costs.

- **Emergency Cash Assistance Program:** This program can offer financial aid to individuals and families facing unemployment or loss of income, enabling them to meet their basic needs and access essential healthcare services.

- **Raising Minimum Wages for Healthcare Workers:** Raising minimum wages for healthcare workers is essential for attracting and retaining skilled professionals within the healthcare sector. By offering competitive wages and benefits, the government can incentivize healthcare workers to remain in their roles and provide quality care to patients.

2.4. ELECTRICITY AND ALTERNATIVE SOURCES OF POWER

2.4.1. State:

Electricity in Lebanon is generated by the state's Electricité du Liban (EDL) that owns 7 thermal power generation plants and operates a total of 66 main substations distributed across different regions of the country. Most households are connected to the public electricity network (99.7%), around 84.0% of the households rely on privately generated electricity due to the fact that EDL is unable to provide

electricity 24/7 (EU/CAS/ILO, 2020).[163] With the latest electricity supply crisis in the country, diesel generators are scattered in the whole country for private use. According to the latest data in 2020, the approximate number of diesel generators across the country is accounted to be between 32,000 and 37,000 (AUB. 2020).[164]

In the coastal Cazas, nearly all households were connected to the public electricity network, with rates hovering around 99%. However, reliance on private electricity sources, such as subscriptions or private generators, varied across coastal regions. Tyre, Sidon, and Koura had the highest use of private electricity, exceeding 90%, while Beirut had the lowest at 54.1%. Overall, the public electricity network was universally accessible, but private electricity was widely used to compensate for gaps in supply across the districts (EU/CAS/ILO, 2020). [165]

The total installed renewable energy power capacity in Lebanon amounted to 350 megawatts (MW), including 57 MW from solar power, 286 MW from hydropower sources and 7 MW from landfills. It is estimated that renewable energy contributes between 4% to 6% of the total power production in Lebanon, mainly though hydropower (UNDP/ UNHCR/UNICEF/MoE, 2020).[166] However, following the worsening of the power crisis in 2021-2022, and the worldwide increase in the price of fossil fuels, the installation of solar photovolatic panels has been increasing significantly. A market for renewable energy exists in Lebanon as of 2020, at least 59 companies were found to be delivering services in the field of Renewable Energy and Electrical Equipment. This growth was concurrent with the launch of several UN-funded initiatives, the green loan support program offered by the Banque du Liban (BDL), in cooperation with the MoEW and the Lebanon Center for Energy Conservation (LCEC) solar water heaters support program, which is the National Energy Efficiency and Renewable Energy Action (NEEREA).

As for wind energy, which is yet to be used in Lebanon, the government signed 3 Power Purchase Agreements with private developers for the installation of 3 wind farms in the northern and mountainous district of Akkar with a total capacity of 227 MW. This project is on hold due to the current economic and political uncertainties in the country (UNDP/ UNHCR/UNICEF/MoE, 2020).

It's worth noting that the electricity sector in Lebanon is highly betting on the potential of oil and gas offshore exploration to bolster the economic situation; a consortium led by TotalEnergies started drilling for oil and gas off the coast of Lebanon (Reuters, 2023).[167]

2.4.2. Drivers:

The socio-economic crisis and the financial constraints affected the operations due to insufficient financial resources. Additionally, increasing demand resulting from population growth strains the aging infrastructure that has not kept pace with growing energy needs, leading to overburdened transmission and service disruptions, in addition to the lack of maintenance and investment in electricity infrastructure which increased the risk of equipment failures, breakdowns, and blackouts.

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[163] EU/CAS/ILO, 2020, Labor Force and Household Living Condistions Survey 2018-2019, wcms_732567.pdf (ilo.org)
[164] AUB, 2020, Unbundling Lebanon's Electricity Sector, 20211020_unbundling_lebanon_electricity_sector_research_paper_pdf.pdf (aub.edu.lb)
[165] LABOUR FORCE and HOUSEHOLD LIVING CONDITIONS SURVEY 2018-2019 for Beirut, Jbeil, Batroun, Koura, Tripoli, Sidon, and Tyre.
[166] UNDP/ UNHCR/UNICEF/MoE, 2020, SOER Report: Lebanon State of the Environment and Future Outlook: Turning the Crisis into Opportunities, SOER_Report_EN.pdf (unicef.org)
[167] Reuters, 2023, Total-led Consortium to Start Drilling Offshore Lebanon is September, Total-led consortium to start drilling offshore Lebanon in September | Reuters

2.4.3. Pressures:

Continuous blackouts resulting from system failure or overload represent a significant pressure in terms of electricity infrastructure and service delivery. These blackouts disrupt daily life, causing inconvenience and economic losses for businesses and households.

2.4.4. Impacts:

- **Dependency on Private Generators:** Reliance on private generators was the main solution to electricity shortages and blackouts. While private generators offer a temporary solution to power outages, they impose significant financial burdens on households and businesses, who must bear the costs of fuel and maintenance. Moreover, these generators contribute to environmental and noise pollution.

- **Adoption of Renewable Energy:** The decentralized nature of renewable energy infrastructure enabled greater energy independence and resilience to disruptions, empowering communities to generate their own electricity and reduce vulnerability to centralized grid failures.

2.4.5. Responses:

- **Awareness about Energy Efficiency Lifestyles:** Increasing awareness about energy efficiency lifestyles is essential for promoting responsible energy consumption habits among individuals and communities, empowering them to make informed choices that minimize their energy consumption and environmental footprint. This may involve implementing public awareness campaigns, providing educational resources, and offering incentives for energy-efficient behavior.

- **Investments in Expanding the Electrical Grids to Improve Reliability and Capacity:** Investing in expanding and upgrading electrical grids is crucial for enhancing reliability and capacity, particularly in regions experiencing electricity shortages and blackouts. This may involve upgrading transmission and distribution infrastructure, installing smart grid technologies to improve efficiency.

- **Diversifying Energy Sources by Integrating Renewable Energy to Reduce Dependence on Centralized Grids:** Diversifying energy sources by integrating renewable energy is a key strategy for reducing dependence on centralized grids and promoting energy security and sustainability. By harnessing abundant and clean energy sources such as solar, wind, and hydroelectric power, Lebanon can reduce reliance on fossil fuels, mitigate greenhouse gas emissions, and enhance energy resilience.

2.5. POTABLE WATER

2.5.1. State:

Water in Lebanon is managed by 4 Regional Water Establishments (RWEs): Beirut Mount Lebanon Water Establishment (BMLWE), North Lebanon Water Establishment (NLWE), Bekaa Water

Establishment (BWE) and South Lebanon Water Establishment (SLWE). It is estimated that around 79% of households are connected to the water supply system in Lebanon.

There are big regional differences in terms of the network coverage with the highest supply rate recorded in BMLWE at 92% against NLWE where only 33% of the total population receives water, while unknown water sources account for 67%.

In the coastal Cazas, non-piped water supply was the primary source of drinking water. Beirut had the highest reliance on non-piped water (91.9%), followed by Tyre (88.4%), while Tripoli had the lowest (66.2%). Piped water supply to residences was limited across all districts, with the highest in Tripoli (33.6%) and the lowest in Beirut (8.1%) (EU/CAS/ILO, 2020).[168]

In fact, unconnected households to the water grid bridge their water needs by looking for other alternative water sources, such as: tapping into artesian water wells, or purchasing water from water tankers or, water in gallons or bottles for drinking purposes. This also applies to households who are connected to the grid but suffer from continuous disruption in water supply and inadequate water quality.

In practice, most households pay for the water provided by the public network in addition to other sources of service water and drinking water. Most households therefore pay the following:

- Public network annual fee.

- Other sources of service water (water trucks, private wells).

- Other sources of drinking water (water gallons and bottles).

- Maintenance costs and/or investment costs.

- Pumping costs: Due the discontinued supply, subscribers need to install water tanks in basements or ground level as well as tanks at high level, typically on the roof, and interconnect these with a pumping system.

Although connection to the public network reaches 92% in BMLWE, mineral water (gallons and bottles) remains a significant source of drinking water for both connected and unconnected households: about 40% of households buy mineral water in gallons and 12%-15% of them buy mineral water in bottles (World Bank & CRI, 2009). Artesian wells and delivery trucks are the main source of service water for unconnected households.

UNICEF estimates that the price of water purchased from private water suppliers could increase by 200% a month, with more than 71% of people at immediate risk of losing access to safe water. As a result of the lack of sustainable water services and conservation of Lebanon's water resources, citizens

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[168] LABOUR FORCE and HOUSEHOLD LIVING CONDITIONS SURVEY 2018-2019 for Beirut, Jbeil, Batroun, Koura, Tripoli, Sidon, and Tyre.

lost trust in the governmental water authorities, resorting to unsustainable alternative private sources to secure potable water (CDR, 2022).[169]

2.5.2. Drivers:

Water mismanagement and overexploitation of aquifers depleted water resources, leading to shortages and degradation of water quality. Blackouts and intermittent power supplies compromise the water system's capacity to treat, pump, and distribute water, disrupting service delivery. Public water utility providers' inability to afford essential spare parts for maintenance or fuel for electricity generators due to currency devaluation further compounds the challenges. Additionally, the significant unaccounted-for water loss at the national level, primarily due to lack of maintenance and illegal connections, exacerbates water scarcity and compromises water supply.

2.5.3. Pressures:

The unsustainable use and waste of water resources contribute to the depletion of freshwater reserves, exacerbating water scarcity. Also, the lack of access to clean potable water undermines public health and quality of life for millions, spreading inequalities and vulnerabilities among marginalized communities. Additionally, overexploitation of aquifers is leading to an increase in seawater intrusion in coastal areas further straining water resources, risking groundwater availability, and exacerbating salinization of freshwater sources.

2.5.4. Impacts:

- **Looking for Other Alternative Potable Water Sources Such as Buying Bottled Water, Gallons, Tankers, etc.**: As traditional sources of potable water become increasingly unreliable or contaminated, residents are seeking alternative sources to meet their water needs. This often entails purchasing bottled water, using water gallons, or relying on water tanker deliveries, which is becoming more and more costly and unsustainable.

- **Additional Financial Burden:** The need to procure alternative potable water sources imposes an additional financial burden on households and communities, particularly those already facing economic challenges. The cost of purchasing bottled water and arranging tanker deliveries, can strain household budgets putting many at risk to access drinkable water.

- **Sanitary and Hygiene-Related Impacts Like Increased Sicknesses:** Inadequate access to safe and reliable potable water can have serious implications for public health and hygiene, increasing the risk of waterborne illnesses and communicable diseases.

- **Pressure on Groundwater Aquifers and Depletion in Quality and Volume:** The reliance on groundwater aquifers, can increase pressure on already stressed water resources, leading to depletion in both quality and volume. Over-extraction of groundwater for drinking water

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[169] CDR/Ecodit, 2022, Strategic Environmental and Social Assessment (SESA) of the Updated National Water Sector Strategy (NWSS) – Ministry of Energy and Water – Executive Summary, En-Executive-Summary-SESA-of-the-Updated-NWSS-MoEW-ECODIT-Liban.pdf.aspx (cdr.gov.lb)

purposes can lower water tables, increase salinity levels, and exacerbate seawater intrusion in coastal areas, compromising the long-term sustainability of aquifers.

2.5.5. Responses:

- **Enforcing Water Management Laws and Policies:** Enforcing existing water management laws and policies is crucial including reforms in water pricing based on updated National Water Sector Strategy (NWSS). Pricing reforms can help reflect the true value of water, encouraging conservation efforts and promoting sustainable water management practices. Also, updating and enforcing CZM policies to prevent unregulated development and protect natural coastal habitats that act as filters or buffer zones for pollutants is crucial in the context of Lebanon.

- **Strengthening Regulatory Frameworks:** Strengthening regulatory frameworks for water usage, pollution control, and allocation is crucial for ensuring sustainable usage and equitable distribution of water resources. This involves implementing stricter regulations to prevent water pollution and control excessive water extraction. For example, implement and enforce strict regulations on industrial and agricultural discharges into water bodies, with clear guidelines for waste treatment before discharge.

- **Investing in Infrastructure Upgrades:** Investing in upgrading aging water networks infrastructure is essential for reducing leakage and ensuring efficient distribution of potable water. By repairing and upgrading water infrastructure, Lebanon can minimize water losses, improve service reliability, and enhance water quality. Additionally. upgrading and expanding wastewater treatment facilities to ensure that urban and industrial wastewater is treated effectively before being discharged into the sea or rivers.

- **Strengthening Institutional Capacity:** Strengthening the capacity of water sector institutions, i.e., establishments through training, adequate staffing, and resource allocation is critical for improving service delivery and management.

- **Launching Public Awareness Campaigns:** Launching public awareness campaigns to educate citizens on water conservation techniques and the importance of protecting water resources can foster a culture of water stewardship and responsibility.

- **Implementing Environmental Protection Measures:** Implementing environmental protection measures to safeguard water resources from pollution and promote sustainable use, particularly in sectors heavily reliant on water is essential for ensuring long-term water security (e.g., encouraging the adoption of sustainable agricultural practices and implementing buffer zones). In terms of environmental measures relevant to coastal areas, it is important to look into promoting the use of green infrastructure (e.g., constructed wetlands or restoration of coastal ecosystems like seagrasses and enhance the marine protected areas network) to alleviate anthropogenic pollution particularly in coastal areas.

2.6. TELECOMMUNICATIONS

2.6.1. State:

Lebanon has two mobile operators which are government controlled under a monopolistic arrangement. The government pays a management fee to Alfa and MTC Touch who operate the mobile networks on behalf of the government. Fixed line telephony services are owned and operated by the government-owned operator, Ogero (log cluster, n.d.).[170]

Lebanon's telecom sector crisis is worsening as the quality of Internet services in most regions has deteriorated, coupled with the electricity crisis, the downturn of the central banks and the collapse of the lira exchange rate. Now, the telecommunications sector, which has been a steady source of revenue and profits, is also struggling and faces the absence of favorable solutions as well as heavy annual losses for the Lebanese State and the Ministry of Communications (MoC) (Telecom Review, 2023).[171]

2.6.2. Drivers:

Population growth, coupled with expanding urbanization and technological advancements, increased the demand for telecommunication services, including internet connectivity. Moreover, the socioeconomic crisis has worsened these issues, affecting telecommunication providers who struggle to cover the costs of maintaining and expanding infrastructure.

2.6.3. Pressures:

Population growth, expanding urbanization, and the proliferation of connected devices is putting more pressure on telecom services where the demand for connectivity is surpassing the capacity of the existing infrastructure.

2.6.4. Impacts:

- **Network failures**: The pressure on the telecommunications network is leading to increased instances of network failures, disruptions, and outages. As the demand for connectivity surpasses the capacity of the infrastructure, it becomes susceptible to technical malfunctions, equipment failures, and system overloads. Network failures can result in widespread service interruptions, affecting communication channels, internet access, and business operations.

- **Lack of access to good network:** The strain on the telecommunications network can exacerbate existing disparities in access to reliable and high-quality network services and slower speeds.

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[170] Logistics Cluster, n.d., Lebanon – Telecommunications, Lebanon - 3.4 Telecommunications | Digital Logistics Capacity Assessments (logcluster.org)

[171] Telecom Review, 2023, The Telecom Sector in Lebanon: From Pioneering to Collapse, The Telecom Sector in Lebanon: From Pioneering to Collapse - Telecom Review

- **Digital Divide**: A lack of connectivity exacerbates the digital divide, leaving certain communities, especially in rural or low-income areas, without access to digital resources. This can lead to inequalities in education, healthcare, and access to information.

- **Educational Disadvantages:** Students in areas with poor connectivity may struggle with accessing online learning resources, participating in remote learning, and acquiring digital skills crucial for the modern workforce.

- **Social Isolation:** In today's digital world, a significant portion of social interactions and community engagement occurs online. Lack of connectivity can lead to social isolation and hinder the formation of support networks.

- **Emergency Response and Public Safety:** Poor connectivity can impact the effectiveness of emergency response services by hindering communication during natural disasters, accidents, or public health emergencies, potentially leading to higher casualties and slower recovery.

- **Hindered Economic Growth**: Connectivity is a cornerstone for the digital economy. Poor telecommunication infrastructure limits the growth of digital businesses, e-commerce, and startups, directly impacting job creation and Gross Domestic Product (GDP) growth.

- **Inefficiency in Logistics and Transportation:** Modern logistics and transportation rely heavily on connectivity for efficient operations, including real-time tracking, route optimization, and communication. Lack of connectivity can lead to inefficiencies and increased costs.

2.6.5. *Responses:*

- **Telecommunication Infrastructure Investment:** Telecommunication infrastructure investments can address the growing demands and pressures on telecommunications networks. These investments involve allocating resources towards expanding, upgrading, and modernizing network infrastructure to enhance capacity, reliability, and coverage.

- **Moving from a Duopoly to a Competitive Telecommunication Model:** In Lebanon only two companies (Alfa and MTC) dominate the telecommunication services, limiting competition or barring other private telecom companies from operating. This has allowed a control on the market in terms of prices, limited choices for consumers, and slower innovative advandcement. Therefore, it would be economically and socially beneficial to decentralize the communication services in Lebanon.

2.7. TOURISM/ECOTOURISM

2.7.1. *State:*

Lebanon's tourism sector has always been an important contributor to the local economy, representing a major source of income and employment. In 2023, Lebanon received 700,000 expatriates and tourists in August, up by 22% to 26% when compared with the same period of 2022.

Tourism sector's revenues in 2023 were estimated to have reached 9 billion US$, up from about 6.5 billion US$ in 2022 (Xinhua, 2023).[172]

According to the latest Tourism Sector in Lebanon 2019 Factbook (IDAL, 2019), the direct contribution of travel and tourism to GDP reached 3.8 billion US$ in 2018, accounting for 7% of Lebanon's GDP, whereas the capital investments in the sector amounted to 1.3 billion US$ (10.5% of total investments). Tourism sector generated around 144,300 direct jobs in 2018, and 394,399 jobs in total including indirect/induced jobs (IDAL, 2019).[173]

Domestic and eco-tourism has gained popularity post-COVID19 pandemic. There has been a shift from traditional to more sustainable nature-based tourism options. People became more self-conscious in terms of their health and were looking at local nature escapes to unwind and improve their well-being (Sage Journals, 2022).[174] Lebanon's diverse landscapes from mountains to the Mediterranean coastlines have seen a growing interest in eco-tourism activities such as hiking, birdwatching, camping, small scale fisheries, and other outdoor activities. Guesthouses and eco-lodges have also gained noticeable popularity.

2.7.2. Drivers:

Lebanon's rich natural landscapes and cultural heritage serve as a major draw for tourists seeking authentic experiences and adventure. However, the lack of sustainable management practices, particularly in coastal tourism areas, poses significant threats to the environment and cultural sites. Despite global trends towards sustainable tourism, Lebanon struggles to implement integrated eco-tourism strategy and adopt eco-friendly practices to preserve its natural resources and cultural heritage.

2.7.3. Pressures:

Tourism increases the demand for natural resources like water and energy, straining local supplies and exacerbating environmental pressures. As eco-tourism grows, so does the need for infrastructure to support tourists, including transportation, lodging, and waste management facilities.

Lebanon has access to 240 km of Mediterranean shoreline; its beaches and favorable summer weather make it a perfect destination for "sun and beach" gateways. However, the lack of coastal tourism management and integrated wastewater management plan have led to a decrease in bathing water quality across the Lebanese coastal beaches. In fact, declining bathing water quality in Lebanese coastal beaches, as identified by the National Center for Marine Sciences (NCMS), highlights widespread contamination issues from untreated wastewater and chemical pollutants, threatening public health and damaging Lebanon's reputation as a tourist destination (The bacterial contamination at 31 beaches for the years 2019 and 2020 were assessed). The results show high bacteriological

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[172] Xinhua, 2023, Lebanon's Tourism Thrives Despite Political, Economic Challenges, Lebanon's tourism thrives despite political, economic challenges-Xinhua (news.cn)

[173] IDAL, 2019, Tourism Sector In Lebanon, 2019 Factbook, IDAL-Tourism_factbook_2019.pdf (opendatalebanon.org)

[174] Sage Journals, 2022, Post-COVID-19 Challenges for a Sustainable Community-Based Ecotourism, Post-COVID-19 Challenges for a Sustainable Community-Based Ecotourism: A Case Study of Rural Community in Sabah, North of Borneo - Jakaria Dasan, Fatimah Ahmedy, Shamezah Shamsul, Elia Godoong, Coswald Stephen Sipaut, Mohammad Saffree Jeffree, 2022 (sagepub.com)

contamination (from untreated wastewater and/or the presence of dumpsites) in selected locations. The assessment also reported the detection of chemical pollution at three beaches, namely Herri, Selaata, and Antelias) due to the presence of chemical and industrial plants on the coast.

2.7.4. Impacts:

- **Overcrowding and Overuse of Natural Resources, Pollution, and Habitat Destruction**: Which results from the influx of tourists, leading to environmental degradation and threats to biodiversity.

- **Pollution of Land and Waterways, Harming Wildlife and Detracting from the Natural Beauty of Eco-Tourism Sites:** Pollution from littering, improper waste disposal, and runoff contaminates natural habitats, harms wildlife populations, and weakens the scenic beauty of eco-tourism sites, diminishing visitor experiences and eroding the ecological value of these areas.

- **Increased Vulnerability of Communities Dependent on Eco-Tourism:** This vulnerability arises from their reliance on a single economic sector, leaving them susceptible to fluctuations in tourist numbers.

- **The Commercialization of Cultural Traditions and Potential Displacement of Local Communities Due to Tourism Development Can Undermine Social Cohesion and Cultural Identity:** These phenomena often prioritize economic gain over the preservation of cultural heritage, leading to the marginalization of indigenous populations and the commodification of their traditions, thereby threatening the integrity and continuity of local cultures.

- **Economic Dependency on the Tourism Sector Exposes Communities to Risks Associated with External Factors Such as Political Instability, Economic Downturns, and Global Crises**: Fluctuations in tourist arrivals, changes in travel patterns, and disruptions to tourism infrastructure can have profound economic impacts, leading to job losses, revenue declines, further exacerbating vulnerabilities and inequalities in eco-tourism-dependent regions.

2.7.5. Responses:

- **Effective Regulation and Enforcement:** Implementing robust regulations and enforcement mechanisms is crucial to ensure that tourism and eco-tourism operations adhere to sustainable practices. This involves establishing protected areas, imposing limits on visitor numbers to sensitive sites, and enforcing guidelines to minimize environmental impact.

- **Ensuring Financial Benefits for Local Communities:** It is imperative that local communities directly benefit from eco-tourism activities, both economically and socially. This can be achieved by implementing strategies to ensure that a portion of the revenue generated from tourism is reinvested into local conservation efforts, community development projects, and livelihood enhancement initiatives. An eco-tourism strategy for Lebanon can be seen as an effective tool to promote the tourism sector in the country while protecting the environment.

2.8. AGRICULTURE

2.8.1. State:

The agricultural land area in Lebanon is around 332,000ha. About 232,000ha are cultivated, with almost 113,000ha irrigated. Most fertile land is concentrated in Beqa'a and Baalbeck-Hermel governorates (with about 43% of the total cultivated area) along with the coastal strip. Akkar and North governorates represent 26% of the usable agricultural area, while South and Nabatieh has 22%and Mount Lebanon 9%.[175]

The fertile coastal plains account for substantial agricultural production (especially in intensive production of citrus, fruits, bananas, and vegetables) that, given the increased urbanization and the high cost of land, is mainly carried out in greenhouses[167].

Although very diversified, agriculture plays a relatively minor economic role in the country, contributing about 5% of the GDP. While 12% of the effective labor force works in agriculture on a full-time basis, an additional 13%, mostly unpaid family labor, is employed on a part-time or seasonal basis[167].

Employment in agriculture in the coastal Cazas is minimal. In Beirut, Tripoli, and Sidon, it was nearly absent for both men and women. In Jbeil and Koura, men participated slightly more than women, though overall engagement was still low. Batroun had the lowest agricultural employment for both genders. Tyre was the exception, where both men and women exceeded the national agricultural participation rates, though men were more involved (EU/CAS/ILO, 2020). [176]

Farmers, mainly engaged in part-time farming, confront the challenge of high input expenses and low market prices for their produce. The majority of inputs, such as seeds, fertilizers, pesticides, and animal feed, are imported by private agricultural businesses, contributing to the overall cost burden. With limited national agricultural support programs available, farmers often rely on seasonal credit and extension services provided by these private companies due to the absence of formal agricultural credit options. In response to prevailing macroeconomic conditions, importers and retailers of agricultural inputs have shifted towards cash-only transactions, departing from the previous practice of offering credit. Despite limitations imposed by topographic factors, the region's mild climate, fertile soil, and ample water resources suggest untapped agricultural potential beyond current levels of utilization.

2.8.2. Drivers:

The lack of financial support to farmers, coupled with heavy reliance on imports and inadequate enforcement of laws and monitoring of agricultural practices, exacerbates challenges within the agricultural sector. Insufficient funding hampers farmers' ability to invest in modern techniques and inputs, while dependence on imported goods escalates production costs, reducing profitability and

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[175] FAO, 2020, Special Report: FAO Mission to Assess the Impact of the Financial Crisis on Agriculture in the Republic of Lebanon, Special Report – FAO Mission to Assess the Impact of the Financial Crisis on Agriculture in the Republic of Lebanon
[176] LABOUR FORCE and HOUSEHOLD LIVING CONDITIONS SURVEY 2018-2019 for Beirut, Jbeil, Batroun, Koura, Tripoli, Sidon, and Tyre.

market competitiveness. Mismanagement of freshwater resources further compounds issues, leading to environmental degradation and diminishing agricultural productivity.

2.8.3. Pressures:

With increasing unsustainable land and soil exploitation, agricultural ecosystems face degradation and loss of fertility, threatening long-term productivity. Moreover, the escalating consumption of water for irrigation, split between surface water and groundwater sources, strains water resources and exacerbates water scarcity concerns. The demand for local products, driven by inflation and rising production costs, prompts farmers to seek cheaper irrigation sources, often resorting to untreated or contaminated water, posing risks to both crops and consumers. Additionally, heavy reliance on chemical pesticides, while aimed at boosting productivity, poses risks to ecosystem health, water quality, and human well-being.

2.8.4. Impacts:

- **Unlicensed wells and Depletion of Aquifers and Water Resources**: The proliferation of unlicensed wells exacerbates water scarcity and the uncontrolled extraction from aquifers can lead to overexploitation and depletion of groundwater reserves, exacerbating water stress and risking the availability of water for both agricultural and domestic use.

- **Reduced Soil Quality and Chemical Contamination:** The heavy reliance on chemical fertilizers and pesticides contributes to soil contamination, polluting groundwater, sea water, and surface water sources and posing risks to human health and ecosystem integrity.

- **Increase in Waterborne Diseases and Foodborne Illnesses Outbreaks:** Contamination of water sources with untreated wastewater, agricultural runoff, and chemical pollutants can lead to an increase in waterborne diseases and foodborne illnesses outbreaks. Consuming contaminated water or food grown with contaminated water can expose individuals to pathogens, toxins, and pollutants, leading to gastrointestinal infections, poisoning, and other health issues.

2.8.5. Responses:

- **Provide Liquidity to Farmers:** Offering financial support to farmers, particularly those heavily reliant on agriculture for their livelihoods, ensures their resilience during economic downturns and safeguards the sector's production potential.

- **Revise Agricultural Strategy:** Developing a new agricultural strategy tailored to the current context and setting realistic targets enables farmers to enhance productivity and adapt to evolving market demands.

- **Subsidize Eco-friendly Practices:** Providing subsidies for eco-friendly farming methods and investing in research and development fosters sustainable agricultural practices, such as organic farming, which contribute to environmental conservation and long-term viability.

- **Water Management Regulations:** Implementing water management regulations and promoting water-saving irrigation techniques help mitigate water scarcity and ensure efficient use of water resources in agriculture.

- **Integrated Pest Management (IPM):** Encouraging IPM practices minimizes reliance on chemical pesticides, reduces environmental pollution, and promotes biodiversity conservation.

- **Market Access Support:** Supporting farmers to access local and international markets, particularly for sustainably produced agricultural products, enhances their income opportunities and incentivizes sustainable practices.

- **Agricultural Insurance:** Introducing agricultural insurance schemes protects farmers against losses from extreme weather events or pest infestations, providing financial security and risk management.

- **Capacity Building and Knowledge Sharing:** Offering training and knowledge-sharing programs equips farmers with the skills and information necessary to adopt modern techniques and address emerging challenges.

- **Climate Change Adaptation Measures:** Developing and implementing adaptation measures, such as drought-resistant crop varieties and early warning systems, helps reduce the vulnerability of the agriculture sector to climate change impacts and ensures its long-term resilience.

2.9. FISHERIES

2.9.1. State:

A briefing note prepared by FAO[177] about fisheries and aquaculture in Lebanon, reveals the following key findings:

- The Lebanese coast hosts 44 fishing ports and landing sites that harbor around 3,000 all-artisanal, small-scale fishing vessels.
- The fisheries of Lebanon are traditionally based on trammel nets, longlines and purse seine nets that capture roughly 3,000 – 3,500 tons annually (2,800 tons in 2018).
- More than 4,000 families in Lebanon rely on fisheries for their livelihood.
- All-artisanal predominantly wooden fishing fleet (average length is 7m) can only practice coastal fishing, due to its questionable navigation and safety capabilities, making fishing area to 3 nautical miles from the shoreline.
- Since the production of the fisheries sector cannot cover the national demand, Lebanon has been dependent on fish imports, which averaged 35,000 tons in recent years, but dropped to 12,800 tons in 2020.

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[177] FAO, 2021, Briefing Note, Fisheries and Aquaculture in Lebanon, English Fisheries Briefing note - 08Apr2021 (fao.org)

- Most production, from the 300 farms, was rainbow trout (1 000 tons in 2018), which are grown in semi-intensive growing systems, mainly along Assi River, that were introduced in 1958. Moreover, the only onshore marine farm in Aabdeh, Akkar produces annually 15 tons of shrimps.
- Most of the fishermen still use illegal fishing methods like the small mesh sized fishing nets (less than the mandated 2x2cm).
- The per capita fish consumption (mainly from imports) was about 8.9kg (2017) as compared to global per capita consumption of 20.3kg.
- The fish import market is controlled by a limited number of players.
- Fishermen work through the perceived cartel of the traders/importers/auctioneers at Beirut (Quarantina) Central Fish Market.
- The fishing sector is unappealing for the young generation given that the average age of skippers is 51 years.
- Limited knowledge of market and fish consumption patterns, together with the lack of a strategic vision to define priorities, hamper the creation of job opportunities.

2.9.2. Drivers:

As fishermen in Lebanon rely on fishing activities as their primary source of livelihood; this has created an increasing pressure on marine resources. Also, the lack of monitoring and enforcement mechanisms exacerbates issues such as illegal, unreported, and unregulated fishing, threatening fish stocks and ecosystem health.

Furthermore, the absence of effective enforcement of fisheries management and conservation regulations allows unsustainable fishing practices to persist unchecked. Political instability further compounds these challenges by creating an uncertain investment climate, discouraging investments in the seafood sector and hindering efforts to implement effective management measures.

2.9.3. Pressures:

The overexploitation of coastal fish stocks poses a significant pressure on marine ecosystems and biodiversity. Intensive fishing activities, driven by high demand for seafood and limited regulatory oversight, lead to the depletion of fish populations and disruption of ecological balance.

2.9.4. Impacts:

- **Reduced Fish Stock:** The depletion of fish stocks directly affects fish populations, leading to diminished biodiversity (e.g., changes in the species composition within ecosystems) and ecosystem health in coastal waters.
- **Loss of Livelihood and Increased Poverty:** The decline in fish abundance and decreased fishery productivity translates into economic hardship for fishermen and coastal communities, resulting in a loss of livelihoods and increased poverty levels.
- **Food Security:** As in many parts of the world, fish in Lebanon is a crucial source of food (protein and nutrients) for the communities. Overfishing can jeopardize food security, especially in coastal regions where people heavily depend on fish for their diet.

2.9.5. Responses:

- **Establish MPAs:** Designate MPAs with clearly defined buffer zones and implement regulations that permit seasonal fishing, ensuring sustainable use of marine resources while protecting ecosystems.

- **Develop and Enforce Sustainable Fishing Practices Regulations:** Implementing and enforcing regulations that promote sustainable fishing practices helps to conserve fish stocks and protect marine ecosystems from overexploitation.
- **Habitat Restoration, Especially Efforts to Restore Depleted Coastal Fisheries:** Investing in habitat restoration initiatives, contributes to the recovery of depleted coastal fisheries by restoring critical habitats and enhancing marine biodiversity.
- **Promote Seasonal Fishing with No-Fishing Marine Zones:** Promoting seasonal fishing practices, coupled with the establishment of no-fishing marine zones during critical periods of fish reproduction and growth, helps to replenish fish stocks, maintain healthy ecosystems, and sustain long-term fishing yields.
- **Develop a Fishing Strategy Defining Priorities and Targets:** Developing a comprehensive fishing strategy that outlines priorities and targets for sustainable fisheries management ensures the provision of decent working and living conditions for fishermen while minimizing environmental pressures.

3. ECONOMIC CHANGES

3.1. BACKGROUND

Lebanon is facing an existential crisis that has been brewing since before 2011 which has affected the demographic, economic and financial landscape. Endogenous factors such as the multifaceted social-economic-financial-political crisis that finally broke out in October 2019 when huge demonstrations triggered after the introduction of a WhatsApp call fee led to the resignation of the Government .The Beirut Port double-explosion on August 4, 2020 further aggravated an already fragile and volatile situation. Simultaneously, exogenous factors, such as the growing influx of displaced Syrians triggered by the Syrian internal conflict that broke out in March 2011, has intensified this multifaceted crisis. In addition, the COVID-19 pandemic as of March 2020, the economic effects on international staple food and fossil fuel prices due to the Russia-Ukraine conflict since February 2021 and more recently the Israel-Palestine conflict since October 2023 have worsened the situation. In October 2024, the Financial Action Task Force has put Lebanon on the Grey list which is meant to increase the monitoring of financial transactions. The chapter is divided into five main sections, categorized following the DPSIR method: drivers, pressure, state, impacts and responses regarding Lebanon's overall demographic, economic and financial situation, and prospects which are mainly prevalent along the coastal zone. Therefore, the chapter is more focused at the national level than the CZ *per se*.

3.2. DRIVERS (SECTOR/CATEGORY)

The drivers of the economy will include three threads:
1. Although covered in-depth in ((Chapter on Social), the population is briefly analyzed from the perspective of **demographic changes, poverty and employment** in Lebanon due to the multifaceted crisis in terms of hemorrhaging emigration vs. influx of displaced Syrians and seasonal workers;
2. Through mainly the GDP released by the CAS,[178] which is acknowledged to be skewed towards growth instead of sustainable development and progress, the economy is analyzed by sector, provider, and expenditure to have a better understanding of the determinants of GDP over the 2004=2020 period that are considered in 2010 constant terms and economic drivers; and
3. The **pervasive financing architecture fueling the Lebanese economy** since the end of the 1975-90 Civil War.

While the coastal zone houses most of the Lebanese population, a sizable number of displaced Syrians and seasonal workers, and the economic activity, the GoL neither aggregates the GDP by governorate nor by economic zones such as the CZ.

3.2.1. Demographic Change:

Lebanon's population is facing a fundamental demographic change where the coastal urbanization's positive trend over the last decades has been maintained. Nevertheless**,** the start of the 2019 multifaceted crisis has contributed to raising the total number of Lebanese individuals falling below the poverty line and significantly increased the emigration of Lebanese skilled and unskilled laborers. In addition, there is a quasi-unrestricted influx of displaced Syrians to Lebanon seeking better livelihoods and opportunities since the start of the internal Syrian conflict in 2011. These displaced

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[178] CAS_Lebanon_National_Accounts_2020.pdf

Syrians and seasonal workers, who live in formal and informal settlements, are gradually and informally replacing Lebanese workers in most sectors.

3.2.2. Economy: GDP by Sector:

The tertiary sector is the largest sector in Lebanon with 72.7% of the GDP on average over the 2004-2020 period and 74.4% relative employment in 2018. Within the tertiary sector, real estate (14.1%), wholesale and trade (13.3%), financial services and information and communication (10.1%) and public administration (9.6%) take preeminence over education (6.7%), transport management and maintenance (4.2 %), health and social care (3.0%), hotels and restaurants (2.5%) and other services (9.2 %) (Figure 12). Yet, following the financial crisis of 2019, the financial services and information and communication faced further contraction after 2020. Following a peak in 2009 at 3 %, the tourism sector contribution to the GDP remains relatively small with an average of 2.5% over the 2004-2020 period and a significant downfall in 2020 to reach 0.8%. Conversely, the start-up ecosystem remains very dynamic after the 2019 multifaceted crisis[179] but is not recognized and ranked by the Global Innovation Index (GII)[180] which measures the level of innovation of a country. The secondary productive sector (manufacturing: 7.2%; and construction: 3.2%) ranks second with an average of 10.5% and 18.7% relative employment in 2018. After reaching a peak of 12.0% in 2007 and 2008, the relative GDP share of the manufacturing and construction sectors fell to 5.0% in 2020. Contrary to all the other sectors, the relative GDP share of the primary sector (agriculture and forestry with 2.8%; livestock and fishing with 1.8%; and mining and quarrying) peaked in 2020 at 7.9% (3.6% relative employment in 2018) against a 5.0 % on average over the period and was driven by the agriculture sector with 5.2% in 2020. Yet, the mining sector reached its peak in 2009, 2011 and 2013 with a relative GDP share of 0.5% and fell to 0.2% in 2020 after the multifaceted crisis and the moratorium on quarrying decided by the MoE that came into force at the end of June 2021.[181] The secondary utilities' sector (electricity, water, wastewater, and waste) with 2.3% (0.7 % relative employment in 2018) that is highly inefficient and partly responsible for air, water and land pollution and disruption of ecosystem services, especially along the coastal zone. Finally, taxes on products account for 13.3% net of 3.5% subsidies that are poorly targeted.
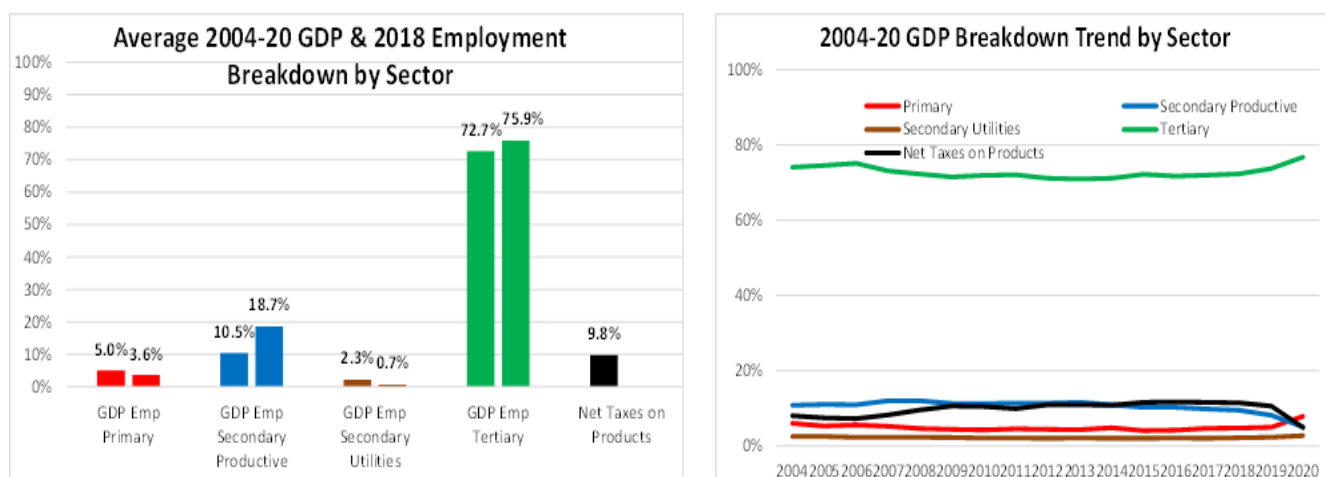
Figure 12: GDP Breakdown Average and Trend by Sector, 2004-2020

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[179] Berytech — Powering Potential

[180] Global Innovation Index 2022: What is the future of innovation–driven growth? (wipo.int)

[181] Environmental Crimes in Lebanon: Unlawful Enrichment That Kills - Legal Agenda (legal-agenda.com)

It is worthy to note that mixed Sectors include utilities, education, health and social care and community services as provider disaggregation is difficult to consider due to complementary provision. Construction is considered secondary productive and not under secondary utilities. %ages reflect 2010 constant prices. Totals may not add up due to rounding.

3.2.3. Economy: GDP by Provider:

The private sector is the largest provider of goods and services in Lebanon with 65.9% of the GDP on average over the 2004-2020 period in 2010 constant terms (85.05 relative employment in 2018) and is followed by the public sector with 9.6% (13.7% relative employment in 2018). A third category with 14.9% (relative employment was included under private and public sector with a residual 1.3% that could not be aggregated by sector above) includes both the public and private sectors as the subcategories could not be disaggregated and include utilities, education, health and social care, and community services, e.g., both private and public sectors provide electricity, water, healthcare, education, etc. that are differentiated by the price, quality, and effectiveness of the service. A fourth category already mentioned above includes the 9.8% of net taxes on products (Figure 13).
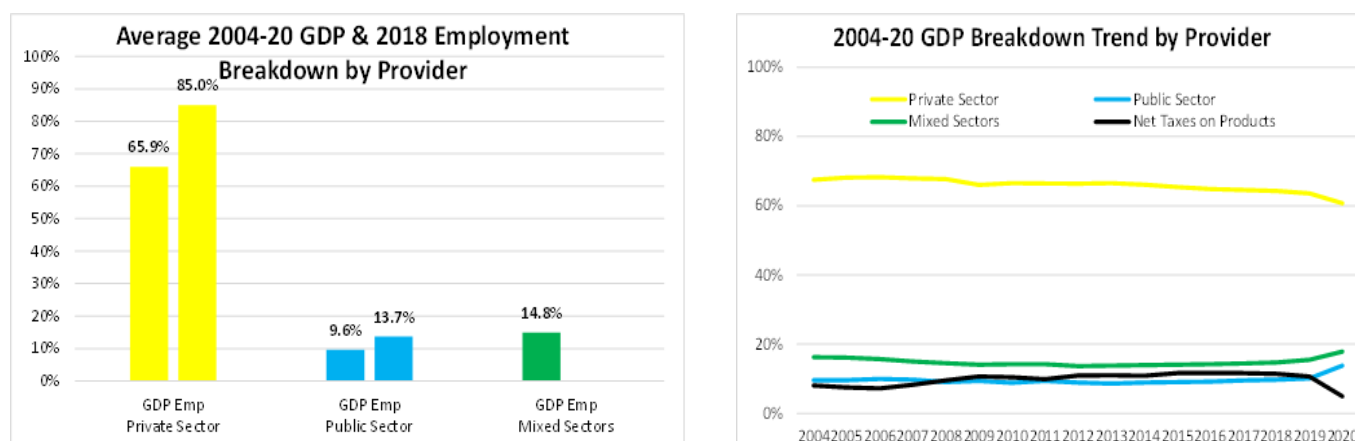
Figure 13: GDP Breakdown Average and Trend by Provider, 2004-2020

Note: Mixed Sectors include utilities, education, health and social care and community services as provider disaggregation is difficult to consider due to complementary provision. Construction is considered secondary productive and not under secondary utilities. Percentages reflect 2010 constant prices. Totals may not add up due to rounding[182,183].

3.2.4. Economy: GDP by Expenditure:

Lebanon is increasingly becoming a consumer driven economy where household consumption reached 89.3% of the GDP on average over the 2004-2020 period in 2010 constant terms followed by the government consumption with 16.4% where the lack of responsible consumption and circular economy policies increases the burden on air, water, land, and ecosystem services. The growing consumption demand required a steady increase in imports of goods and services to fulfill the demand

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[182] CAS Lebanon National Accounts. 2020
[183] *LFHLCS_2018_2019_Labor force.xls (live.com)*

equivalent to 60.3% that is not balanced by exports with 31.6% leaving a net trade deficit of 28.7%. Similarly, the private sector is Lebanon's largest investor with 20.7% followed far behind by government investments with 1.9% (Figure 14) although private investments dramatically fell three-fold to reach 6.6% in 2020 when compared to the period average.
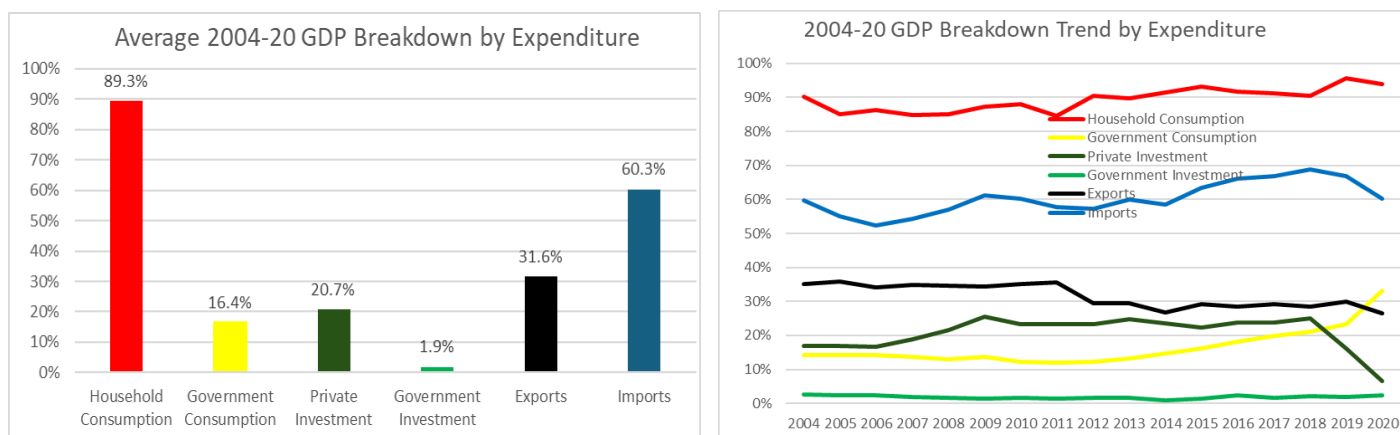
Figure 14: GDP Breakdown Average by Expenditure, 2004-2020

It is worthy to note that the mixed Sectors include utilities, education, health and social care and community services as provider disaggregation is difficult to consider due to complementary provision. Construction is considered secondary productive and not under secondary utilities. Percentages reflect 2010 constant prices. Totals may not add up due to rounding[184,185].

3.2.5. Financing:

Since the end of the 1975-90 Civil War, the Lebanese economy has been financially "fueled" thanks to ungrounded and attractive interest rates on deposits, Treasury Bills and Eurobonds in Lebanese Pound (LP) or US$. Indeed, the BDL designed a monetary policy to attract investors for the reconstruction. Still, over the years, the BDL maintained the same monetary policy by providing financial yields above international market rates while maintaining the LP afloat and pegged to the US dollar. These distortionary incentives attracted all sorts of investors such as institutional investors as well as investors from the MENA region notably the Gulf countries and the Lebanese diaspora. Compounded to the loans and grants provided by the International Financial Institutions (IFI or multilateral) and Official Development Assistance (ODA or bilateral), most of these foreign deposits mainly served to finance the public and private cyclical (re)construction boom, notably after the 2006 conflict with Israel, the expanding consumer economy, the real estate development, and the growing public and utility (e.g., the ailing Electricité du Liban) deficits. The latter was termed by the former Prime Minister, Selim el Hoss, as the "infernal cycle of deficit and debt". Locally, most Lebanese banks and to a lesser extent joint Lebanese and foreign banks considered subscribing to Treasury Bills and Eurobonds as these were considered safe investments and almost risk free as these were sovereign debt obligations guaranteed by the GoL. As a result, they accumulated huge profits on capital deposits over the 1990-2019 period with an average yield reaching 5.6% against a 0.7% benchmark in 14 Organization for Economic Cooperation and Development (OECD) countries banks for the same period.[186] The BDL was able to maintain this stratagem until 2019 where the interest rates to be paid on the LP and US$ deposits exceeded the

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[184] CAS Lebanon National Accounts. 2020
[185] *LFHLCS_2018_2019_Labor force.xls (live.com)*
[186] شربل نحاس شاهداً | عودة إلى1997: المصارف بدّدت الودائع عمداً (al-akhbar.com)

foreign direct investments net inflows to the country and where the debt service significantly increased with an accumulated public debt over the years hitting an all-time high and reaching 87.65 billion US$ in 2019.[187] The deficit between net outflows and net inflows averaged 1.85 billion US$ over the 2004-2022 period, reached 88.6% (3.8 billion US$) in 2009 and peaked at 99.4% in 2020 (1.6 billion US$) when Lebanon defaulted on the payment of the Eurobond debt (Figure 15). Moreover, the BDL embarked on dubious financial engineering operations[188] such as the bankroll of the largest Lebanese banks in 2016 that made poor investments and incurred large losses abroad. The repatriation of these banks' foreign investments resulted in reducing the deficit to 50% (1.2 billion US$) in 2017 and allowed these banks to offer higher yields on US$ deposits[189].
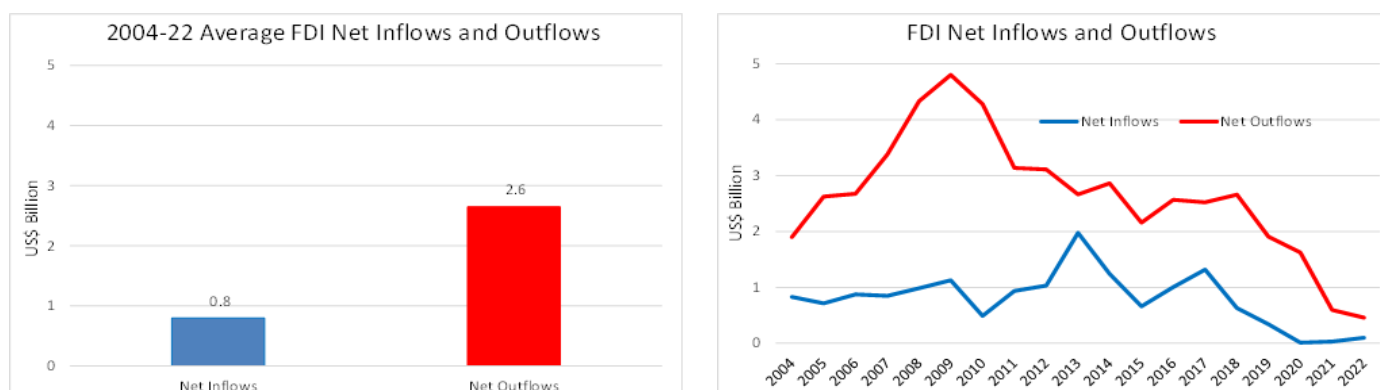
Figure 15: Foreign Direct Investment Net Inflows and Outflows, US$ Billion (*Source: adapted from World Bank. 2024. World Development Indicators. Washington, D.C.*)

3.3. PRESSURES

3.3.1. Demographic Change

Further to the severe 2019 multifaceted crisis, the reduction of the real salaries across the board has increased the poverty rates and triggered a Lebanese brain drain since the 2020 which is affecting all sectors such as the financial, health, and education, public and private administrations. Conversely, for most middle level to unskilled jobs, Lebanese micro, small, medium, and large enterprises are increasingly offering them illegally to displaced Syrians and seasonal workers as their competitive salaries are lower than the market rate and are also net of taxes as well as health coverage and social security contributions. Incidentally, some displaced Syrians are benefiting from the donor aid while also cumulating other jobs.

3.3.2. Economy

Reeling under the pressure of the severe 2019 multifaceted crisis, Lebanon faced a growing pauperization of its population, alarming inflation rates, financial bankruptcy, and drastic cuts in residents' purchasing power and government expenditures that disrupted and distorted the demand and supply of goods and services that were exacerbated during the COVID-19 pandemic and after the Beirut Port double explosion. All the determinants of running a prosperous economy were under pressure when looking at the GDP through the sector, provider, and expenditure prism (see State Section).

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[187] Lebanon National Debt 2019 | countryeconomy.com
[188] Alvarez and Marsal of the Middle East Limited. 2023. Preliminary Forensic Audi Report Banque du Liban.
[189] Adapted from World Bank. 2024. World Development Indicators. Washington, D

3.3.3. Financing

The liquidity crisis led to a lack of confidence in the economy by investors, shareholders, private and IFI lenders alike. The original deposits in LP, US dollar and other currencies were quasi wiped out from the Lebanese banking system where the US dollar is discounted at its face value and only new transfers after October 2019 onward are deemed "fresh" money considered at the US$ nominal value and could be used for transactions. The balance of payments' deficit has been a significant economic challenge where it reached 3.2 billion US$ in 2022. At the height of the multifaceted crisis, the BDL foreign exchange reserves were further strained by subsidizing mainly non-basic 300 items[190] instead of importing essential products to secure food safety (seeds, agriculture inputs, staple food, etc.), pharmaceutical products and equipment to maintain essential industrial production, etc.

3.4. STATE

Before October 17, 2019, Lebanon was already facing serious social, economic, and financial challenges in 2018:

3.4.1. Demographic change

Lebanese employment breakdown between private and public sector reached 85.0% and 13.7% respectively with 1.4% being undetermined in 2018;[191] Lebanese unemployment reached 10.4%[192] whereas ILO sets the informal employment rate at 55 percent in 2019 without specifying whether they include the displaced Syrians and the seasonal workers;[193] the Multidimensional Poverty Index (MPI) based on the survey conducted between April 2018 and March 2019 revealed that 53.1% of residents in Lebanon were multidimensionally poor;[194] the country was hosting around one million registered displaced Syrian (equivalent to about a quarter of the population), who when[195] combined to a growing number of Syrian seasonal workers, significantly increased the pressure on already failing infrastructures and public services.

3.4.2. Economy

The private tertiary sector, which is driven by a consumer economy, makes the largest contribution to Lebanon's GDP and employment; GDP growth went down from 8% in 2010 to -1.89% in 2018; external balance deficit on goods and services increased from 9.6 billion US$ in 2010 to 14.7 billion US$ in 2018 probably to cater to the displaced Syrians and seasonal workers' growing needs; inflation was hovering around 6% in 2018 against 4% in 2010.[196]

3.4.3. Financing

Total public debt reached an all-time high with 85.13 billion US$ representing more than 148% of the GDP; budget deficit exceeded 10%; funding needs were growing whereas net foreign direct

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[190] Lebanon's BDL to subsidize 300 Items, including red meat – Ya Libnan
[191] LFHLCS_2018_2019_Labor force.xls (live.com)
[192] Lebanon FLFS Jan 2022 EN.pdf (cas.gov.lb)
[193] ILOSTAT Data Explorer
[194] Lebanon MPI 2019 Report EN.pdf (cas.gov.lb)
[195] UNHCR Lebanon
[196] World Bank. 2024. World Development Indicators. Washington, D.C.

investments decreased from 3.8 billion US$ in 2010 to 2.0 billion US$ in 2018; the balance of payments' deficit reached 4.82 billion US$ in 2018.[197]

The social, economic, and financial challenges were exacerbated after October 2019:

3.4.4. Demographic change

Lebanese employment breakdown between private and public sector showed a relative private sector reduction compensated by the a relative public sector increase reaching 81.0% and 16.7% respectively with 2.9% being undetermined in 2022;[198] Lebanese unemployment reached 29.6% in 2022[199] while Syrian employment reached 32% in 2023;[200] the national poverty rate stands at 27.4 in 2021, the MPI based on the survey conducted in 2021 stands at 82% of residents[201] while around 60% of households considered themselves to be poor or very poor according to the preliminary results of the CAS 2022-23 survey.[202] Moreover, Lebanon is hosting 2.08 million displaced Syrians and seasonal worker equivalent to about 36% of the total population where the Syrian presence in certain villages sometimes exceeds the natives.[203]

3.4.5. Economy

The GDP and employment determinants remain the same after the multifaceted crisis albeit weaker; the GDP has contracted by one third from 54 billion US$ in 2018 to an estimate of 18 billion US$ in 2022;[204] inflation has been at triple-digits and averaged 171.2% in 2022 and is projected to reach about 231% in 2023.[205]

3.4.6. Financing

The banking system is bankrupt and insolvent while the depositor savings in LP and US$ were almost wiped out with the US dollar being discounted at less than 10% of its nominal value. The country credit rating set by Moody's at C in 2023 which means that Lebanon is credit unworthy.[206] The LP lost almost 60 times its initial value and increased from 1,507.5 LP in 2018 to 89,000 LP to the US$ in March 2024 and several rates were adopted which triggered speculations on the LP through a platform, Sayrafa, introduced and then abandoned by the BDL after introducing one single rate in early 2024 that was used in preparing the 2024 budget. The market capitalization of the stock market stood at 18 billion US$ in February 2024 although, similar to the banking sector, the US$ is discounted at its face value.[207] The GoL defaulted on Lebanon debt service in March 2020, notably on the EuroBonds as the BDL lost two thirds of its foreign exchange reserves from 53.2 US$ billion in August 2019 to 12.7 billion US$ in February 2023. Present value of external debt reached 38.85 billion US$ in 2022 thanks notably to the "hair cut" borne by the depositors although the public gross debt was equivalent to 282.6% of GDP in 2022 and estimated to reach 509.3% in 2023 because the BDL was still using the pre-October 2019

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[197] www.bdl.gov
[198] 3.Labour force 2022.xlsx (live.com)
[199] Lebanon FLFS Jan 2022 EN.pdf (cas.gov.lb)
[200] Most data gathered from: World Bank. 2023. Lebanon Economic Monitor: In the Grip of a New Crisis. Washington, D.C.; and IMF. 2023. Lebanon: Staff Concluding Statement of the 2023 Article IV Mission.
[201] 21-00634-_multidimentional_poverty_in_lebanon_-policy_brief_-_en_0.pdf (un.org)
[202] LEBANON MPO (worldbank.org)
[203] CAS. 2018-19. Lebanon Crisis Response Plan adjusted by Official figures, notably, Sameer el Daher, Advisor to the Prime Minister (Al Hadath TV interview, 2 2013).
[204] Lebanon Economic Monitor (worldbank.org)
[205] LEBANON MPO (worldbank.org)
[206] Moody's website: Lebanon, Government of Credit Rating - Moody's (moodys.com)
[207] Welcome to Beirut Stock Exchange (bse.com.lb)

pegged exchange rate to account for some of the local debt denominated in LP and US$.[208] The budget deficit reached 25% in 2020 while the draft budget for 2024 is balanced with utterly unrealistic revenues. Funding needs were still growing whereas net foreign direct investment inflows reached an all-time low of 0.1 billion US$ in 2022 while the balance of payments' deficit reached 3.2 billion US$ in 2022 after a record deficit of 10.2 billion US$ in 2020.[209] The external balance deficit on goods and services fell to 6.2 billion US$ in 2021 although imports returned to their pre-crisis levels in 2022 to reach 19.1 billion US$.

3.5. IMPACT

3.5.1. Demographic Change

Worldwide, Lebanon is second only to the island of Aruba in the ratio of refugees to the native population.[210] The coastal urban and rural dynamic is being altered and the demographic pressure on the coastal zone is increasing. Moreover, the economy is losing its competitive edge due to the brain drain and the poverty trap that is affecting a growing segment of the Lebanese population. Within the micro, small, medium, and large enterprises, there is a gradual transition from a regular Lebanese labor force to an informal Syrian labor force where positive economic benefits are accruing to employers due to cost savings and the negative costs are accruing to Lebanese workers, fiscal revenues, and social compensation. This departure of the highly trained and skilled laborers will be difficult to replace in the short to medium terms and will affect the overall performance of the economy. The private and public sector resignation rates have been steadily increasing as these workers found or are seeking new opportunities abroad as 70% of people wanted to leave Lebanon in 2021 according to Gallup.[211] Except for the displaced Syrians until 2015 –as Lebanon stopped allowing UNHCR to register Syrians in 2015 although UNCHR found a loophole and is still "recording" them instead—and the Syrian sponsored and seasonal workers, an undisclosed number of the estimated 2.08 million Syrian living in Lebanon in 2023 lack legal residency. To become legal, unregistered Syrians need to be sponsored by a Lebanese, then get the approval of the authorities.[212] Hence, there is an economic trade-off where hiring this informal cohort of laborers has a fiscal and social impact that affects Lebanese employment, GoL revenues and Lebanese future retirees but reduces the present overall running cost of all these enterprises facing the multifaceted crisis. Socially, the change of the demographic footprint is also taking its toll in municipalities where the MoIM surveyed 925 out of 1,050 municipalities to gauge the relationships between host communities and displaced Syrians, the results reveal that a positive relationship is reaching an all-time low of 20% in 2022 against 41% in 2021[213] where the tensions between host communities and displaced Syrians are worsening negative perceptions such as the accusations of: stealing jobs from natives; committing crimes;[163] most registered and recorded displaced Syrians traveling back and forth through alternative routes between the two countries; receiving more aid packages than natives that help them contribute to the livelihood of their families back home; putting pressure on all the municipality utilities, infrastructures and social services; etc.

[208] Lebanon: 2023 Article IV Consultation-Press Release; Staff Report; and Statement by the Executive Director for Lebanon (imf.org)
[209] www.bdl.gov
[210] GlobalTrends_2023_v16.pdf (unhcr.org)
[211] Leaving Lebanon: Crisis Has Most People Looking for Exit (gallup.com)
[212] https://www.brookings.edu/articles/why-syrian-refugees-in-lebanon-are-a-crisis-within-a-crisis/
[213] MOIM. 2023. Impact of Syrian Displaced on Lebanon, 2022. Beirut

3.5.2. Economy

The World Bank has described the multifaceted crisis faced by Lebanon as one of the worst the world has witnessed in more than 150 years. The deliberate depression is the result of mismanagement by Lebanese leaders and a lack of effective policy actions.[214] The factors of production in terms of labor, capital, capital goods and technology to run, maintain and increase the efficiency of most productive and services' sectors were disrupted despite the creation of BDL of the 200 million US$ platform for industries to have access to capital that was never truly operational. The disruption of the transport infrastructure, especially after the Beirut Port double explosion, utility services (wastewater and waste) resulted in higher pressures on natural resources as water resources were affected with higher pollution loads and new dumps mushroomed near municipalities due to the lack of waste transportation and treatment. On a positive environmental note, the construction sector-freeze due to the liquidity crisis also contributed to stopping quarrying while the fossil fuel shortages reduced daily air pollution. Education, health, social services were all disrupted and had to cater to the displaced Syrians. Most public services were dysfunctional, public servants rarely joined their duty stations, public revenues and investments shrunk to unprecedented low levels.

3.5.3. Financing

The liquidity crisis worsened as the sudden stop of capital inflows precipitated systemic failures across banking, debt, and the exchange rate[215] leading to suspicious capital flight via wire transfers and cash money ranging between 1 US$ to more than 10 billion US$ according to unreported and unsubstantiated claims during the multifaceted crisis (Figure 13). The depreciation of the LP did not have the expected boast to revive the export-oriented industries due to the capital investment crunch and the growing risk encountered by entrepreneurs. The balance of payments and trade balance were in the red and reached new deficit levels. Savings and pension funds deposited in the banking system were quasi wiped out, fragilized retirees and curtailed private consumption and public and private investments as payout on bills and bonds also stopped. The banking system is bankrupt with no perspective to compensate depositors. Until it is bankrolled, it is an ineffective intermediation mechanism as only a few banks can barely offer loans, credit cards, letter of credits, etc. Although some IFIs and ODAs are still transferring hard currency to implement their programs and projects, these inflows of foreign currencies reduce, albeit marginally, the stress on the foreign exchange market. This narrow market, where the demand is much higher than the supply of US$, contributed to the free fall of the LP vis-à-vis the US$ which led to the dollarization of the economy where the cash economy represents 45% of the transactions in 2022. Also, 300-items subsidized by the BDL meager foreign reserves contributed to interrupting the import of basic commodities that led to sporadic shortages of bread and gasoline, and disrupted the value chains, etc. However, after 4 years since the 2019 multifaceted crisis, all the prices of goods, services and estates were gradually adjusted upwards to almost pre-crisis levels or current international market levels whereas the GDP shrunk 3 times when compared to 2018 (see State Section). The BDL has reconstituted a small portion of its initial foreign exchange reserves and has momentarily stabilized the LP early 2024 to 89,000 LP to the US dollar. Moreover, the Lebanese economy is increasingly becoming a cash economy where foreign exchange money transfers are becoming the common practice through national and international peer-to-peer payments and money transfer mechanisms. In October 2024, the Financial Action Task Force (FATF) has put Lebanon on the Grey list which is meant to increase the monitoring of financial transactions. Lebanon was given until 2026 to address the issues that led to its grey-listing, including

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[214] documents1.worldbank.org/curated/en/394741622469174252/pdf/Lebanon-Economic-Monitor-Lebanon-Sinking-to-the-Top-3.pdf
[215] documents1.worldbank.org/curated/en/474551606779642981/pdf/Lebanon-Economic-Monitor-The-Deliberate-Depression.pdf

concerns over terrorism financing and a lack of judicial independence.[216] Fortunate households are increasingly dependent on inflows of foreign currency from the diaspora that currently uses these mechanisms. To the less fortunate households, the GoL started implementing World Bank emergency assistance to extremely poor Lebanese households. Cash transfers also using these money transfer mechanisms started in March 2022 to 150,000 extreme poor Lebanese households providing approximately 680,000 individuals with a monthly transfer of 20 US$ per household member (maximum 6 members per household), in addition to a flat amount of 25 US$ per household and direct costs of schooling for 87,000 children.[217]

3.6. RESPONSE

3.6.1. Review of Recent Major Economy wide Agreements and Programs

The Syrian internal conflict leading to the influx of displaced Syrians and seasonal workers since 2011 had a multi-partner response: the *Lebanon Crisis Response Plan* was launched in 2015 under the aegis of UNDP and UNCHR where Lebanon has received over 9.3 billion US$ until mid-2022 in support for 3.2 million displaced Syrians, vulnerable Lebanese and Palestinian refugees as well as public institutions, notably host communities.[218] Operational response plans showed tangible results for the host population and displaced persons and covered all sectors and all governorates from basic, social and utility services to supporting and promoting livelihood opportunities. The Government, UN and partners appealed for 3.2 billion US$ to cover the 2022-23 period although firm pledges are still not officially reported.[219]

Before October 17, 2019, given the challenging economic situation, the cabinet headed by Saad Hariri hedged its bet by speeding up the endorsement and implementation of the *Vision for Stabilization, Growth and Employment* program for 2017-2020 that was presented by the GoL to the donors' community in Paris, on 6 April 2018, during the Conférence Economique pour le Développement par les Réformes et avec les Entreprises (CEDRE) gathering or Paris IV, the fourth in its kind to bailing out the country since the end of the 1975-90 Civil War. The program was based on four pillars:

  i) Boosting public and private investments where the ambitious phased Capital Investment Program (CIP) covering the electricity, water, wastewater, waste, tourism, industry and culture sectors was presented at CEDRE and endorsed by the development partners where 10.2 billion US$ loans have been pledged (9.9 billion US$ in concessional terms and 0.86 billion US$ grants including grants to subsidize loans);
  ii) Ensuring economic and financial stability through fiscal consolidation;
  iii) Undertaking essential sectoral and cross-sectoral reforms including the fight against corruption, strengthening fiscal governance, modernization and restructuring of the public sector including the e-government, judicial reforms and improving the business environment;
  iv) Developing and diversifying the productive sector that was articulated in the *Lebanon Economic Vision*[220] which was released by the MoET on October 2018 after being requested by the CoM (Decree 13669/2017), highlighted a five-year National Economic Plan aimed to

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[216] https://www.reuters.com/world/middle-east/lebanon-grey-listed-by-financial-watchdog-fatf-two-sources-say-2024-10-25/
[217] Lebanon Announces Payment of Cash Transfers to Extreme Poor Lebanese households under AMAN (worldbank.org)
[218] Lebanon Crisis Response Plan 2023_0.pdf (un.org)
[219] Launch of the 2022 Lebanon Crisis Response Plan (LCRP): Government, UN and partners appeal for US $3.2 billion | United Nations Development Programme (undp.org)
[220] Lebanon economic vision (fes.de)

boost the country's stagnant economy and create jobs through diversification and modernization of potentially competitive productive sectors.

Vision for Stabilization, Growth and Employment Pillars 2 and 3 were acknowledged as essential ingredients to implement the CIP, attract private investors and support the diversification drive. However, the CEDRE overall fiscal and sectoral reforms did not include specific responsibilities, actionable plans, quantifiable targets, and concrete outputs and therefore, deflected the Government accountability to implement these reforms.

Both Visions included "growth" and "economic development" although neither explicitly considered "sustainable development" or "ICZM" as a priority. However, they implicitly fell within the overall framework of CEDRE's CIP (water, wastewater, and waste investments would have benefited the coastal and marine environment) and reforms that included: ratification of draft laws; introduction of new formal institutions; improvement or amendment of existing policies or institutions; evaluation of existing policies and procedures; and development of plans or strategies. Under the CIP Phase I, solid waste and wastewater represented 14 and 13% of total allocations, respectively. Unlike for the wastewater sector, the breakdown by waste segment or service area was not mentioned for solid waste although the pressing issue of waste management received a passing reference under CEDRE as the planned decentralization of waste processing to municipalities. Conversely, in the *Lebanon Economic Vision,* sectors such as agriculture, industry, tourism, financial services, etc. were considered, that allowed cross cutting issues such as air pollution, greenhouse gases and solid waste generation to only be benchmarked. Finally, neither Visions addressed the contentious offshore oil and gas dossier.

After October 17, 2019, a new cabinet headed by Hassan Diab was formed in January 2020 and presented the *Lebanese Government's Financial Recovery Plan*[221] in April 2020 followed by the draft GOL *3-Year Development Priorities* in May 2020. The reform program proposed to: implement a comprehensive reform program including some that were considered by the CEDRE reforms; contain the COVID-19 pandemic; introduce safety nets for the growing population falling into poverty; put public finance on a sustainable footing and curb the depreciation of the LP; restore the confidence in and recapitalization of the banking sector; and jump start the economy. One of the nine interrelated pillars supported an *environmental reform and a national sustainable development strategy to preserve the environmental identity of the country and sustainably use it as a socioeconomic engine*. Subsequently, several environmental reforms were spelled out in the reform program. Conversely, the 3-Year Development Priorities included four priority areas: development planning framework; productive sectors development; social policies; and environment. The latter was partially costed (1.23 billion US$ for the immediate term) and notably focused on governance, waste management, Litani depollution, quarrying, air quality and climate change. Unlike CEDRE overall reforms, the 3-Year priority program had specific responsibilities, a timetable (immediate and medium terms) but lacked quantifiable targets, concrete outputs, and development partners' pledges. However, the cabinet resigned on August 10, 2020 after the Beirut Port double explosion of August 4, 2020 and while none of the 3-Year priority program started to be implemented, the World Bank set up a multi-donor Lebanon Financing Facility Trust Fund to co-finance the Reform, Recovery and Reconstruction Framework (3RF) goals elaborated conjointly with the EU and the UN:[222] (i) provide a roadmap for recovery and the reconstruction of the Beirut damaged areas; and (ii) set ground for comprehensive reform, recovery and reconstruction program based on a Lebanon-wide approach. The preliminary environmental sector interventions amounted to 20 million US$ and covered: reforms and policy change (greening the reconstruction of Beirut); investment and programs (waste stream assessment

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[221] http://finance.gov.lb/en-us/EventPdfs/English/The%20Lebanese%20Goverment%20Financial%20Recovery%20Plan.pdf
[222] Lebanon Reform, Recovery & Reconstruction Framework (3RF) (worldbank.org)

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and waste treatment and disposal reconstruction); and institutional strengthening (environmental and health safety, air monitoring and establishing a platform for stakeholder engagement). Whereas the reconstruction component is well underway, the reform component, however, is stalled.[223]

A new cabinet headed by Najib Mikati was formed on September 21, 2021, 13 months after the resignation of the previous cabinet, and remains in office in 2024 in a caretaker capacity since October 30, 2022, after the end of the president six-year term. After fruitful discussions with the International Monetary Fund (IMF), an agreement on comprehensive economic policies subject to reforms and backed by about 3 billion US$ over 46 months was not reached with the GOL in April 2022. Five key pillars were to be implemented, including restructuring the financial sector and implementing fiscal reforms, along with the proposed restructuring of external public debt. They also include reforming state-owned enterprises, particularly in the electricity sector, and strengthening governance, anti-corruption, and anti-money laundering efforts.

3.6.2. The Way Forward

Since CEDRE in 2018, all the attempts to reform the Lebanese system and take actionable measures and introduce judicious policies failed to materialize. The whole political, governance, judicial, parliamentarian, executive, notably monetary, fiscal, and prudential, etc. system introduced reactive, unsound, or pervasive policies when the system was under pressure instead of tackling the macroeconomic fundamentals, e.g., preemptively adopting capital control, controlling inflation, adopting fiscal prudence, stabilizing the exchange rate that was finally temporarily achieved in January 2024, etc.

Lebanon has reached an unprecedent vulnerability level since its independence to foreign influence and foreign financing and needs to be "under new management." After the election of a new president, a new government operating like a task force needs to be formed and based on its proven competence, record and representativity instead of political allegiance to formulate a vision, strategy and phased overall planning as the challenging reality is changing its demographics, depressing its economy, and restricting its financing. Prior to CEDRE, Lebanon developed NPMPLT[224] that was approved (Presidential Decree 2366/2009) but never implemented. This Strategy needs to be updated and adjusted to become a Physical Orientation Plan of the Lebanese Territory to include the participation of the private sector and communities in the process. Combined with Climate Actions, the ICZM should be an integral part of the updated strategy where the ICZM framework will be based on coherent legislative and regulatory texts, clear horizontal and vertical institutional roles and responsibilities, judicious policies, and governance principles.

3.6.3. Demographic change

Through a well thought strategy, the new government needs to curtail the brain drain and create an enabling environment to attract this human capital contrary to the *Lebanon Economic Vision*[225] that considers this growing diaspora as a long-term human capital investment which will bear dividends to be repatriated. Safety nets must be adjusted and maintained to shield the poor and vulnerable during the restructuring period. Moreover, there is an urgent need to formulate a joint Lebanese-Syrian strategy to phase the return of the displaced Syrians and seasonal workers in the short term where

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[223] Lebanon Reform, Recovery and Reconstruction Framework (3RF) - News, stories, progress and information about the Lebanon 3RF
[224] The National Physical Master Plan of the Lebanese (NPMPLT). 2004. Conseil du Développement et de la Reconstruction in collaboration with the Directorate General of Urban Planning and the contribution of Dar-al-Handasah (Shair & Partners) and the Institut d'Aménagement et d'Urbanisme de la Région Ile-de-France (IAURIF). Beirut.
[225] Lebanon economic vision (fes.de)

the donor funding policy targeting displaced Syrians needs to be switched from an incentive to stay in Lebanon to an incentive (pre-conditioned cash in hand) to recreate new livelihoods in Syria.

3.6.4. Economy

The World Bank considers that macroeconomic framework remains severely precarious at the end of 2013 and that the multifaceted crisis cannot be overcome without a comprehensive crisis resolution plan.[226] A firm commitment by the new government is needed to embark on a fundamental and comprehensive restructuring, reform, and investment program where ICZM is to be firmly anchored in this drive. Therefore, an agreement needs to be initially reached with the international community including the Lebanese diaspora where the political system, the economic system and governance practices should be reformed and transitioned in phases to put them on a sustainable footing. These reforms should build on some elements in the proposed agreements and programs that were not executed.

3.6.5. Financing

The new government still needs to seek the most appropriate advisory and financial support to reshape the Lebanese financial sector, restructure the accumulated public debt, curtail the balance of payments' deficit, rebuild the investor confidence, reach a fair agreement on compensating depositors and harness and secure future sources of financing notably towards implementing the ICZM strategy from, but not limited to the: IFIs, notably green finance and new development banks, ODAs, Development Financial Institutions, institutional investors, venture capitalists, private equity firms, sovereign wealth funds, foundations, Donor-Advised Funds, and Lebanese diaspora.

4. WASTE MANAGEMENT

4.1. State of Waste Management

4.1.1. State of Solid Waste Management

As of 18 October 2018, Law No. 80[227], titled the Integrated Solid Waste Management (ISWM) Law, which contains 38 articles has been enacted. This law makes use of an integrated approach covering the stages from source reduction, reuse, source and plant sorting to recycling, composting, energy recovery to final disposal of residual waste. Moreover, the law was accompanied by Decree No. 5605/2019[228] relating to sorting of household solid waste from the source, Decree No. 5606/2019[229] relating to Identification of the Fundamentals of Hazardous Waste Management, and MoE Decision No. 108/1 of 2019[230] establishing an ISWM committee. Still, the Law needs more decrees for all its provisions to be implemented as intended.

No specific accounting of solid waste generation has been done for the population of the LCZ, nonetheless, Lebanon as a whole generates around 2,700,000 tons of Municipal Solid Waste (MSW) per year (Annex XI: MSW Generation Rates per Governorate) of which 20% are diverted from disposal, 44% is transported to landfills, and 36% to dumpsites61 (Annex XII: Lebanon Municipal Solid Waste Facilities). The collection and transportation of domestic solid waste to designated facilities falls under

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[226]https://documents1.worldbank.org/curated/en/099518112202340074/pdf/IDU1cbb9a9271d02b14f6a18d8c1cd99718adaaf.pdf
[227] http://www.legiliban.ul.edu.lb/LawView.aspx?opt=view&LawID=278572
[228] http://www.legiliban.ul.edu.lb/LawView.aspx?opt=view&LawID=284307
[229] http://www.legiliban.ul.edu.lb/LawView.aspx?opt=view&LawID=284309
[230] http://www.legiliban.ul.edu.lb/LawView.aspx?opt=view&LawID=280596

the responsibilities of municipalities as per the mentioned Law (No. 80/2018 (Article 20)). This activity is regulated by standards and conditions set by the MoE to ensure that no harm is inflicted on the natural environment. Accordingly, the MoE, through the financial support of international partners, developed two guides (Practical Guide for Municipalities to Enhance Environmental Management – 2017[231]; Environmental Guide for Municipal Police) intended for municipalities that focus on the reduction of environmental degradation from activities such as solid waste management. Domestic waste generation in Lebanon is mainly dominated by organic materials[232].

Moreover, according to a study done in 2014, Lebanon generates 14 tons/day (of healthcare waste[233] which can be divided into hazardous (20%) and non-hazardous (80%)[234]. The latter is usually disposed of with other types of solid waste, while the former needs to undergo proper sterilization by autoclaving or microwave technology to be later disposed of with the rest of the waste[235]. Two main organizations are responsible for dealing with hazardous healthcare waste, namely Arcenciel (local NGO) which handles 12 tons of infectious material per day, and the Abbassieh plant managed by the local authority which handles 1 ton/day.

Industrial waste in Lebanon follows the same division used for healthcare waste, which falls into two categories, namely hazardous and non-hazardous. The latter is handled with the same criteria of MSW, while no proper handling procedure exists for the treatment and disposal of hazardous industrial wastes which end up being discharged into the environment (by open dumping, open burning and disposal in water streams and the sea)[236]. An estimate of 71,800 tons of hazardous industrial waste were recorded in the year 2019 which was further analyzed by sector to determine sectoral contributions (Table 5).

Other types of solid waste produced in Lebanon include electronic and electric waste; construction and demolition waste; wastewater sludge; slaughterhouse waste; in addition to persistent organic pollutants all of which are not sufficiently managed to limit their environmental impact.

Table 5: Hazardous waste quantities per sector in 2019. Source: Hazardous Waste Preliminary Inventory Study. (2019)

Sector	Weight (t)
Chemicals, petroleum, coal, gas	33,916
Transport equipment	28,346
Textile, clothing and footwear	5,631
Paper products and printing	2,489
Non-metallic products	850
Metal products	546

Marine litter, being of special concern to the LCZ, can be divided into two categories, those originating from the sea such as fishing gear and ghost nets in addition to land-based litter considered to be the dominant category[237]. Due to the lack of adequate infrastructure waste generated from a variety of sectors and coming from all over Lebanon is transported via rivers and ends up being thrown into the

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[231] https://citesunies.s3.amazonaws.com/pages/5f4fc06c7bac7.pdf
[232] Environmental Governance (STREG): Assessment of Solid Waste Management Practices in Lebanon in 2015. (2017)
[233] Health Care Waste generation rates and patterns: The case of Lebanon. (2015)
[234] Pre-feasibility Study Guidelines for PPP Projects. (2018)
[235] Lebanon Health Resilience Project in Collaboration with The World Bank: Social and Environmental Safeguards Framework. (2019)
[236] Hazardous Waste Preliminary Inventory Study. (2019)
[237] Marine Litter Assessment in the Mediterranean. (2015)

sea[238,89]. Another source of marine litter is the unofficial open dumpsites created along the coast that have been regularly used for burning waste with no consideration for the impacts on the surrounding environment. Studies found that plastic waste was the most common form of marine litter, where it was even recorded in alarming amounts within marine animals that constitute an important part of the local human food chain238[,239].

4.1.2. State of Liquid Waste Management

According to the NWSS developed by the MoEW in 2010, Lebanon produced around 310 million m^3 of wastewater, of which 250 million m^3 were domestic and 60 million m^3 were industrial[240]. Of the generated wastewater, only about 8% undergoes treatment while the rest is generally discharged untreated into rivers and the coastal areas[241]. This has been attributed to the lack of proper infrastructure to efficiently connect the existing sewage networks and the operational treatment plants[242]. As a response, the MoEW has developed in 2012 and later updated in 2020 an update to the 2010 strategy which proposed the construction of new wastewater treatment plants across the country in addition to the expansion of the exiting collection network. Nonetheless, this as been a challenging undertaking due to problems related to procurement, expropriation, operational, financial, judicial and political constraints. However, in the NWSS 2020-2035, this value dropped to 248 million m^3 and it is estimated that the influx of refugees and displaced increased the wastewater generation rate by 8 to 14%[243].

Lebanon has 78 Wastewater Treatment Plants (WWTP) across its area most of which are small in scale and were constructed by private effort with the support of international funding, as such no data is available to assess their performance level. Large scale coastal WWTPs, with the exception of the Al Ghadir plant, were developed to provide capacity for secondary treatment of wastewater, but have not been able to fulfil this role and have been functioning as preliminary treatment facilities. The country has 11 new WWTPs under construction and an additional 181 WWTPs have been planned for construction according to the latest update of the NWSS (2020) (Table 6, Annex XIII: Status of WWTPs in Lebanon across Water Establishments). The current estimated wastewater generation rate in the country is equal to 310 million m^3 /year, and if all the current and future construction projects proceeded successfully the total national capacity of WWTPs would reach 673.7 million m^3 /year, more than double the current estimated wastewater generation rate. Moreover, industries generate around 20% of the total amount of wastewater generated in the country[244], yet are not equipped with appropriate infrastructure to properly treat their discharge and comply with the national standards[245].

Table 6: List of WWTPs with Design Capacity > 10,000 m3/day (PT=Primary Treatment; AS= Activated Sludge; MBBR= Moving Bed Biofilm Reactor). Source: National Water Sector Strategy Update. Volume IV: Water sector current situation. (2019)

Existing

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[238] Lebanese civil society combating for a plastic free Mediterranean Sea. (2019)

[239] Microplastics pollution along the Lebanese coast (Eastern Mediterranean Basin): Occurrence in surface water, sediments and biota samples. (2019)

[240] National Water Sector Strategy. (2010)

[241] National Strategy for the Wastewater Sector. (2012)

[242] Lebanon Crisis Response Plan 2017- 2020. (2019 updated)

[243] Brief overview of Strategic and Decision-Making frameworks in The Policy/Thematic Areas of Priority *Under the* Preparation of an Assessment on the Water-Energy-Food-Ecosystems Nexus in Lebanon. (2023)

[244] Sustainable consumption and production action plan for the industrial sector in Lebanon. (2015)

[245] Second National Action Plan for the implementation of the LBS protocol and its regional plans in the framework of sap med to achieve good environmental status for pollution related ECAP ecological objectives. (2016)

RWEa	Caza	WWTP Name	Capacity(m3/day)	Process
BMLWE	Baabda	Al Ghadir	306,430	PT
BMLWE	Chouf	Nabi Younes	38,000	AS
BMLWE	Jbeil	Jbayl	10,000	AS
BWE	Baalbek	Iaat	20,300	AS
BWE	West Bekaa	Joub Janine	10,000	AS
BWE	Zahle	Zahle	40,000	AS
NLWE	Tripoli	Tripoli	256,000	AS
SLWE	Nabatieh	Charqiye	20,400	AS
SLWE	Sidon	Sidon	50,000	PT
SLWE	Tyre	Chabriha	55,000	AS
Under Construction				
BWE	Zahle	Majdel Anjar/El Marj	45,000	RB
NLWE	Akkar	El Aabde	39,010	RB
SLWE	Marjaayoun	El Khiam	16,000	RB
Proposed				
BMLWE	Aley	Bchtfine	10,200	Unknown
BMLWE	Baabda	El Halaliyeh	17400	RB
BMLWE	Baabda	El-Kneisse	13,900	RB
BMLWE	Chouf	Chourit	13,000	RB
BMLWE	Chouf	Sirjbal	10,780	BF
BMLWE	Matn	Burj Hammoud	325,000	MBBR
BMLWE	Kaserwan	Ghazir/Adma	48,000	RB
BMLWE	Kaserwan	Makhada	42,000	RB
BWE	Baalbek	Chaat	11,893	RB
BWE	Baalbek	Tamnine	50,000	AS
BWE	Baalbek	Ras Baalbek	17,296	RB
NLWE	Akkar	Jebrayel	17,275	RB
NLWE	Minieh-Danniyeh	Bakhaoun	15,680	AS
SLWE	Bint Jbeil	Froun	10,000	RB
SLWE	Bint Jbeil	Ouadi Houjair	26,093	RB
SLWE	Bint Jbeil	Salhani	11,000	RB

4.2. *Main Drivers and Mitigation Measures*

4.2.1. *Solid Waste*

The emergence of solid waste as an environmental and health issue in Lebanon has been attributed to two categories of drivers, those that are considered traditional in nature and those that have recently emerged. The collection of these drivers has been exerting a tremendous pressure on the coastal and marine environments which was clearly reflected in the deteriorated state of these zones previously describe (1.2. Status of the Environment in the Lebanese Coast).

4.2.1.1. **Traditional Drivers**

Solid waste generation has a direct link to the growth of the population, both of which have witnessed an increase in the last couple of years. As such waste received at waste facilities reflects an increasing trend in yearly rates with a peak in the summer of every year attributed to touristic activities and the return of immigrants for summer break. This was further complicated by the poor political handling of the solid waste sector combined with poor financial and human resource accessibility, poor data availability for proper decision making, in addition to the lack of implementation of relevant laws (Law No. 444/2002[246] and Law No. 80/2018) all of which resulted in a crisis in the years 2015 and 2016 and the continuous mismanagement of waste disposal. This has brought about the loss of trust of the public in the government's capacity and will to manage the solid waste sector further exacerbating the issue. Moreover, Lebanon's topographic and geological characteristics make it difficult to find suitable areas for waste treatment and disposal, made harder with the continuous public opposition of proposed sites due to fear of mismanagement and predicted health problems.

4.2.1.2. **Emerging Drivers**

Other drivers that affect the proper management of solid waste in Lebanon can be attributed to unforeseeable events that change the waste production rate and the capacity of collection, treatment, and disposal of the country. A 16% increase in waste production was recorded by facilities for waste management of the Lebanese Council for Development and Reconstruction (CDR) in 2011, which were attributed to the influx of Syrian refugees due to the Syrian War[247]. Similarly, the Beirut Port explosion of August 2020 resulted in an unexpected increase of demolition waste where it was estimated to be

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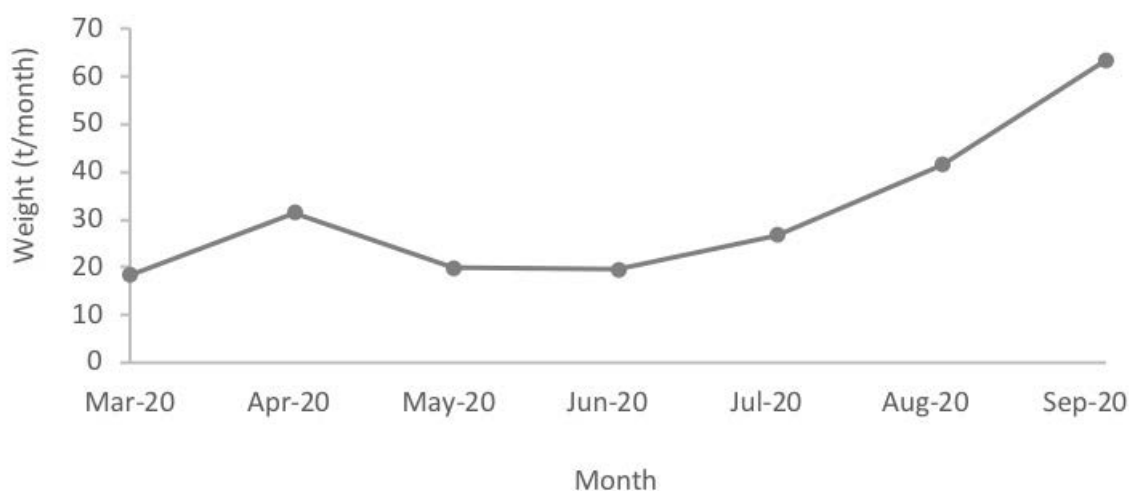
[246] http://www.legiliban.ul.edu.lb/LawView.aspx?opt=view&LawID=244662
[247] LACECO data

equal to 800,000 – 1,000,000 tons[248]. On the other hand, some events, such as the economic crisis of the country and the successive Covid-19 lockdowns, contribute to a reduction of generated domestic solid waste due to lowered purchasing capacity. Nonetheless, the Covid-19 pandemic caused an increase in healthcare management waste from 18.3 tons/month to 63.5 tons/month[249] (Figure 16).

4.2.2. Liquid Waste

The primary drivers for the mismanagement of wastewater in Lebanon are the lack of adequate infrastructure for the treatment of all generated waste, and the poor connectivity between the producers of this waste and the existing treatment facilities. This is greatly exacerbated for the industrial and agricultural sectors as they are responsible for producing toxic runoff that either gets carried to the CZ via surface running water or leaches to pollute groundwater aquifers. Furthermore, industries are usually constructed in areas outside the designated industrial zones, most commonly in residential zones and the MPD for the reduction of production and transportation costs245. This complicates the planning for a national or even regional management of produced waste runoff. In addition, the haphazard urbanization and lack of a proper land-use planning that takes into account natural capital and prioritizes protection of water and geological resources. The lack of a proper

Figure 16: Covid-19 Infectious Waste Generation. Source: Arcenciel data

operation and maintenance procedure for water facilities, in addition to the Syrian war have contributed to the deterioration of the water sector especially with more than 1,500,000 displaced persons[186].

Plans have been made by the Lebanese government to upgrade existing WWTPs, rehabilitate and/or install sewer networks and collectors, and construct new WWTPs, nonetheless these projects have been slow and hindered by procurement, expropriation, operational, financial, judicial and political constraints. If all plans are executed successfully, the issue of the sustainability of their operation, i.e. continuously generating funds to cover operation costs and being able to hire qualified personnel, remains uncertain which would create more environmental and healthcare issues in the future.

4.3. Proposed Mitigation Measures and Responses

As is the case for all other sectors in Lebanon, the proper management of waste production, whether solid or liquid, starts at the legislative level. As such, it is important to properly implement relevant laws (including Law No. 444/2002 and Law No. 80/2018) through the issuance of appropriate decrees. Additionally, a monitoring system of waste disposal is needed in order to efficiently activate these laws and reduce the waste improperly disposed of. The infrastructure of facilities needs to be upgraded to withstand the production rate of the population, in addition to banning the establishment of sanitary landfill in coastal areas as they pose a very high risk of accidental release and leaching into the environment with severe repercussions.

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[248] UNDP data
[249] Arcenciel data

CHAPTER III: CLIMATE CHANGE IMPACTS ON THE COASTAL ZONE

1. INTRODUCTION

Over last decades, coastal risk assessment has become the first step in all strategic planning and management activities. Coastal areas are particularly exposed to risk drivers and are subject to a gradual weakening of the environmental asset, affecting also economic development and coastal community lifestyle. Hence, to support decision-makers in managing and prioritizing the interventions, the basic principles of the ICZM have to be followed through the definition of a coastal Risk Index. Climate change which refers to long-term shift in temperature and weather patterns can affect coastal areas in a variety of ways and is considered one of the threreat to environmental degradation. Coasts are sensitive to SLR, change in the frequency and intensity of storms, increase in precipitations and warmer ocean temperatures. For instance, warmer marine waters can lead to deoxygenation of marine ecosystems impacting biological organisms as oxygen become less soluble in water as temperatures rises. As many marine organisms rely on dissolved oxygen for survival, reduced levels of oxygen stress these ecosystems. In addition, rising atmospheric carbon dioxide (CO_2) cause the sea to absorb more of the gas and become more acidic and therefore impact coastal and marine ecosystems (Figure 17).
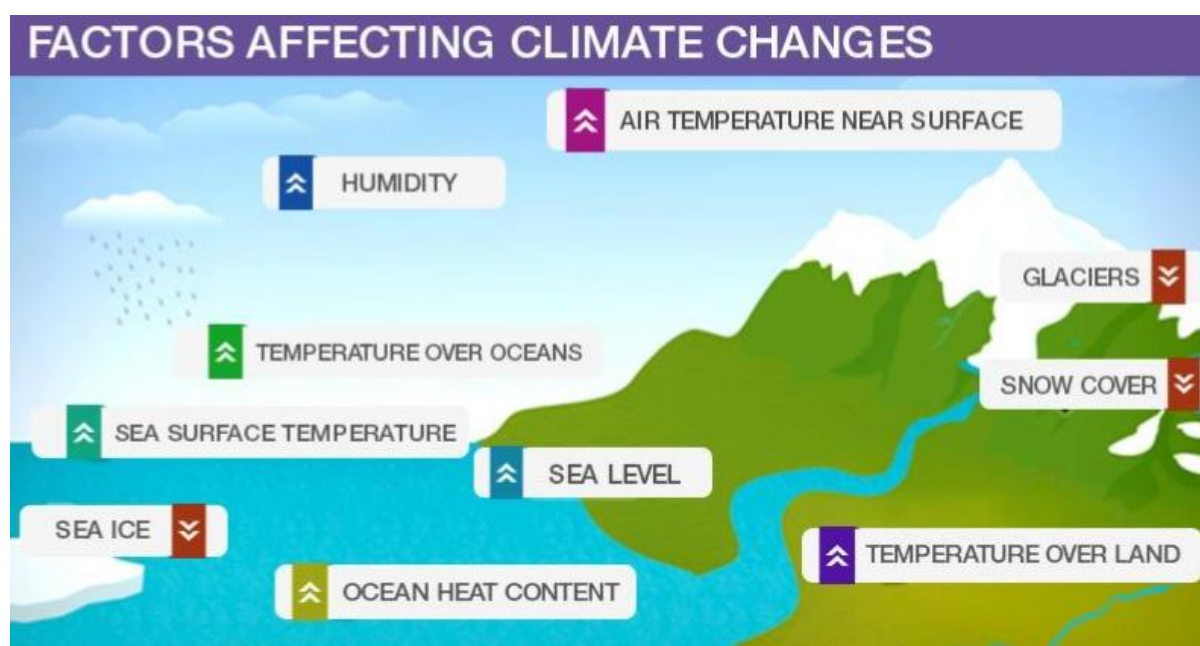
Figure 17: Factors Affecting Climate Changes (Source: Byjus, 2024 :
https://byjus.com/biology/climate-factor-changes/Last accesses November 2024)

In Lebanon, the CZ is vulnerable to CC, as it hosts Lebanon's major activities and contributes to more than 74% of the country's GDP[250]. These activities include commercial and financial activities, large industrial zones, important agricultural lands, and sectors such as fishing and tourism, all of which are affected by CC because of their location in this vulnerable CZ. The shoreline extends about 240km in length from the northwest border at Aarida to the southwest border at Naqoura. If a 500m-wide

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[250] MOE/UNDP, 2011 : Lebanon Second National Communication to the UNFCCC

corridor along the coastline, is to be considered as the CZ then the CZ represents 8% of the total Lebanese surface area which is approximately 840km^2 of the Lebanese territories where almost 90% of the population resides[251].

The Lebanese coastline is marked with a series of promontories such as Ras Beirut, sandy beaches - around 20 in Chekka, Batroun, Jbeil, Maameltein, Ramlet el Bayda, Jnah, Damour, Tyre, etc., cliffs such as the cliff of Ras el Chaqaa and of Bayada at Naqoura, rocky capes such as Ras Es Saadiyat, Nabi-Younes, Sarafand, and bays as present in Jounieh, at the Pigeon Rock in Beirut and in Naqoura. The coastline is well-known for housing natural habitats for endangered fauna and flora. Moreover, the majority of industrial, commercial and financial activities as well as the largest cities are situated in the CZ due to the wide range of services provided by coastal ecosystems (Figure 18).

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[251] MOE/UNDP, 2011 : Lebanon Second National Communication to the UNFCCC

Figure 18: Land use along the Lebanese coast (Source: Smeets E & Weterings R. (1999): Environmental Indicators: Typology and Overview. Report No. 25, Copenhagen: European Environment Agency.)

As a result, an in order to understand the main drivers, pressures and climate impacts on the CZ in Lebanon and responses, a DPSIR framework (Figure 19) was adopted for the analysis and the mains outcomes are summarized in the following subsections.
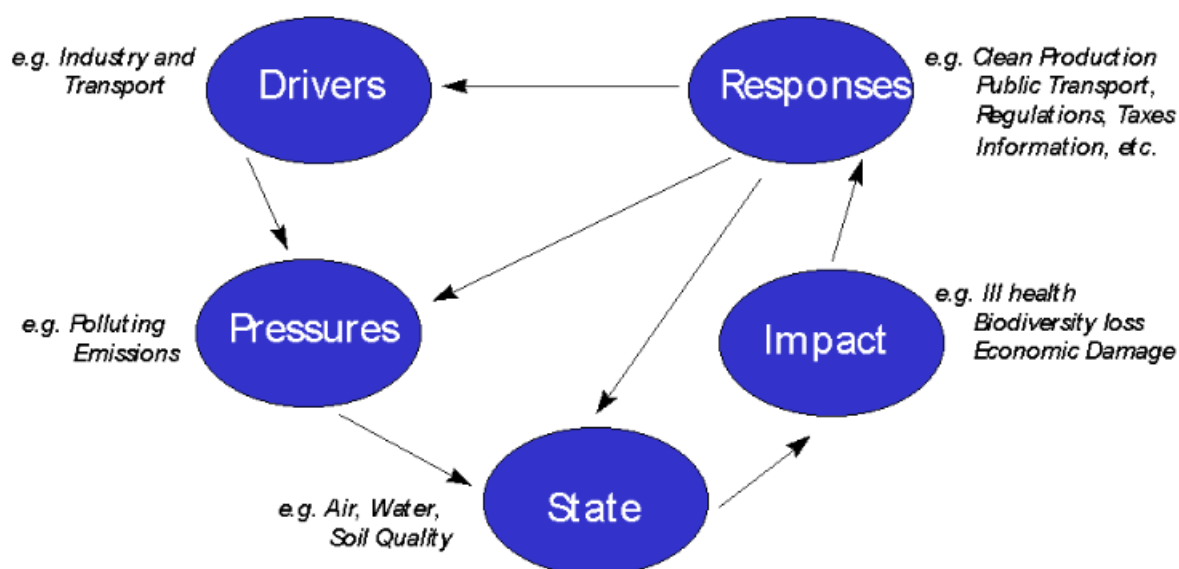
Figure 19: DPSIR Framework

2. STATE

CC impacts in Lebanon are multifaceted and significant, affecting various aspects of life and the environment. Lebanon, already grappling with challenges like economic crises, armed conflicts and environmental disasters, views climate change as a threat multiplier that exacerbates existing problems and introduces new ones. Economically, it's projected that climate change could cause Lebanon's GDP to fall by 14% by 2040 and further to 32% by 2080.[252] According to Lebanon's fourth national communication report of 2023, the direct economic loss from damage caused by climate change and/or related disaster to the agricultural sector (including fishing and forestry) was estimated at 605 million US$ in 2018. Floods are considered the most damaging disaster on the sector, with high annual financial losses (estimated at 330 million US$), followed by cold waves (estimated at 241 US$ million), winter storms (estimated at 212 million US$), heavy rainfall (estimated at 177 million US$), heatwaves (estimated at 149 million US$), wildfires (estimated at 125 million US$), strong wind (estimated at 93 million US$) and landslides/land erosion (74 million US$).[253]

In terms of CC impacts on coastal tourism, an assessment of Lebanon's CZ showed that their vulnerability to climate change varied between 'moderate' to 'very high', rendering these units as areas of concern. The coastal cities of Batroun and Tyre were selected for a vulnerability assessment based on a set of indicators. The tourism sector was identified as the most vulnerable sector in both coastal cities, which are popular destinations for both foreign and Lebanese tourists. Potential impacts are mainly affected by daily and monthly (mean, max and min) temperatures, heat waves and extreme precipitation events. Furthermore, warmer temperatures will increase heat stress for tourists as well as the cooling costs. Extreme precipitation events will contribute to the destruction of the tourism infrastructure, blocking roads and changing the hydrologic cycle. Extreme precipitation events will also contribute to beach erosion, lost sand, destruction of reef and sediment plumes. The increase in acidification of marine water will have the strongest effect on the tourism destination. In fact, the

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[252] UN, 2021; Climate Change in Lebanon: a Threat Multiplier
[253] MoE/UNDP/GEF, 2022 Lebanon's 4th National Communication on Climate Change | United Nations Development Programme (undp.org)

acidification can change the marine ecosystem, decrease natural shoreline protection and increase the risk of inundation and erosion of the low-lying coastal areas.[254]

The impacts of CC on marine resources in the Mediterranean Basin are expected to be severe in the coming decades. Increasing ocean temperatures, acidification, and pollution are likely to decrease marine productivity, alter species distribution, and could lead to the local extinction of over 20% of exploited fish and marine invertebrates by 2050. Both CC and human activities are disrupting marine ecosystems, affecting plankton dynamics, reducing fish populations, and causing changes in the physiology, growth, reproduction, and behavior of marine species. [255]

2.1. Atmospheric GHG Concentrations

The largest contribution to global warming comes from the increase in atmospheric concentrations of CO_2 since the 1870s due to industrialization. Concentrations of CO_2 at world scale in the atmosphere are higher now than at any time during the past 650,000 years[256]. In Lebanon and according to the Fourth National Communication report to the UNFCCC, the country was responsible for emitting a total of 30,089 Gigagrams (Gg) of Carbon dioxide Equivalent (CO2eq) in 2019 where the main contributor remains the energy sector (including transport) with 80% of GHG emissions, directly followed by the industrial sector[257] (11%; Figure 20).
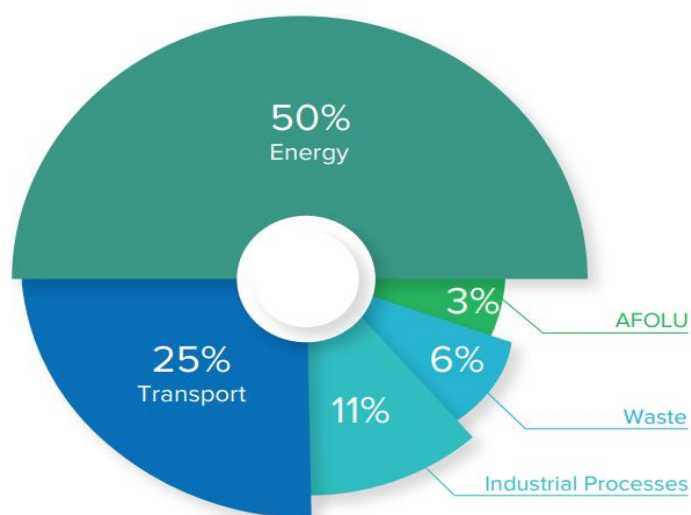
Figure 20: Lebanon national GHG by category in 2019 (Source: MOE/UNDP, 2022: Lebanon Fourth National Communication to the UNFCCC)

Since 1994, total Greenhouse Gases (GHG) emissions in Lebanon increased by approximately 3-fold with an average yearly increase of 6%. The trend of increase in total GHG emissions closely follows the trend of emissions from the energy sector, reflecting the growing demand for fuel and electricity (Figure 21).

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[254] MoE/UNDP/GEF, 2022 Lebanon's 4th National Communication on Climate Change | United Nations Development Programme (undp.org)
[255] MoE/UNDP/GEF, 2022 Lebanon's 4th National Communication on Climate Change | United Nations Development Programme (undp.org)
[256] https://news.mongabay.com/2005/11/carbon-dioxide-at-highest-level-in-650000-years/
[257] MOE/UNDP, 2022 : Lebanon Fourth National Communication to the UNFCCC
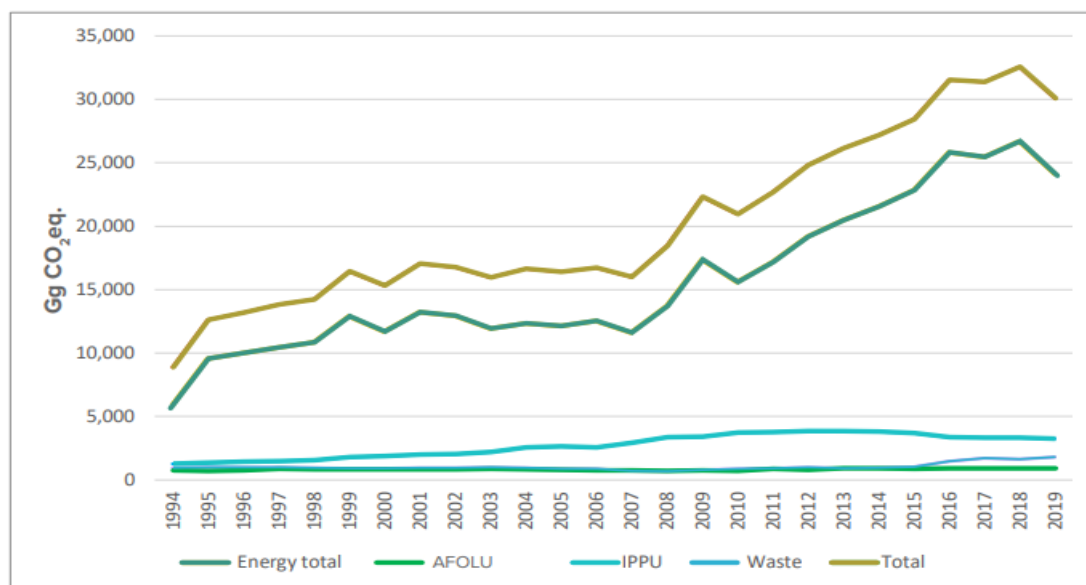
Figure 21: Trend in total and sectorial GHG emissions 1994 – 2019 (Source: MOE/UNDP, 2022 : Lebanon Fourth National Communication to the UNFCCC)

2.2. Atmospheric and Sea Surface Temperature for Lebanon

Lebanon is characterized by hot dry summers (June to September) and cool rainy winters (December to mid-March) with an average annual atmospheric temperature of 15°C and highs of 30- 40°C in July and August[256]. The mean climatology of Lebanon from 1991- 2020 shows large variation of temperature with an increase of 1.6 °C for the period of 1950-2020 with the trend of increase being steeper for the period 1991-2020 (Figure 22).
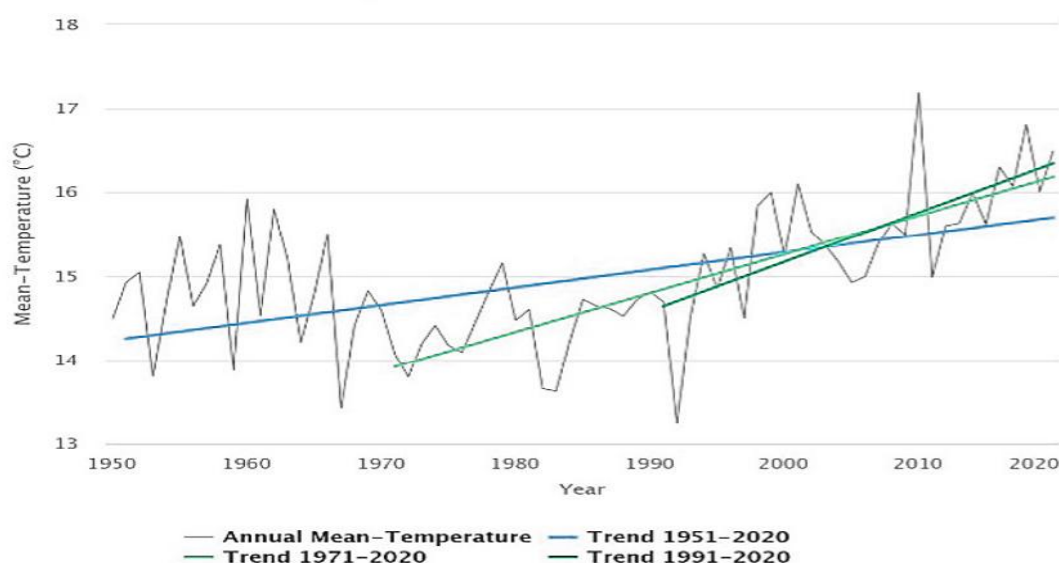
Figure 22: Mean temperature trends for Lebanon over the years (Source: MOE/UNDP, 2022: Lebanon Fourth National Communication to the UNFCCC)

As for future projected changes for 2050-2100, the results show an increase in the average temperature of 1.6°C to 2.2°C when compared to the reference period 1986-2005 depending the RCP scenario (4.5°C or 8.5°C) by mid-century according to the most recent projections (2022). The increase is seasonally dependant being more pronounced in summer and autumn. The Bekaa valley and most coastal areas will suffer the most from such increase (Figure 23).
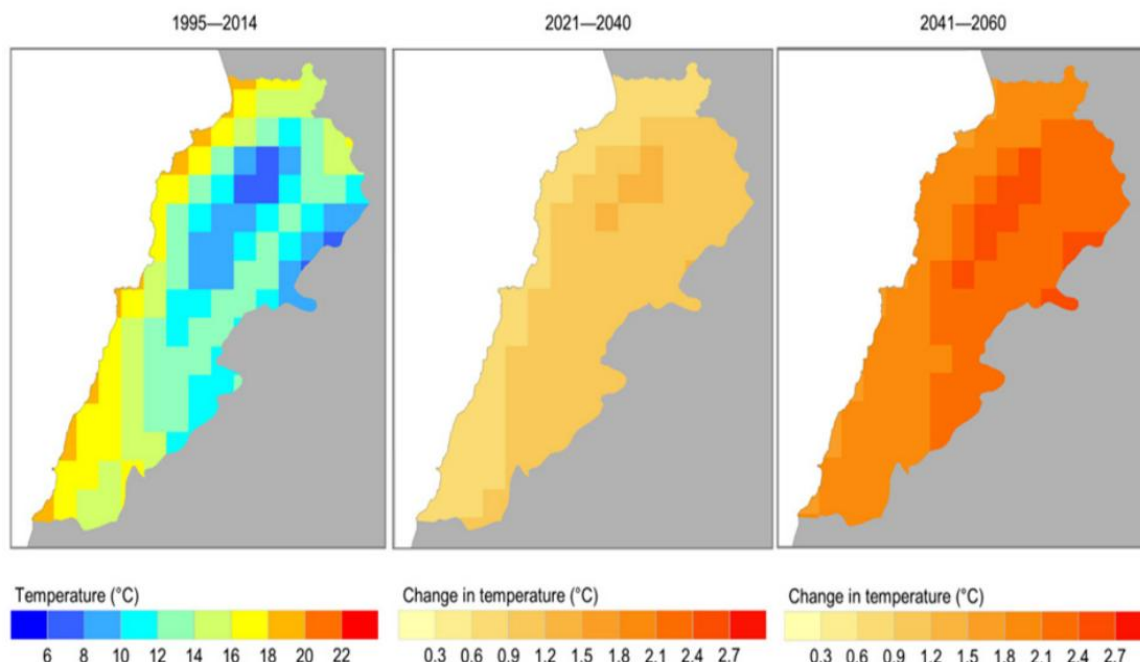
Figure 23: Climate projections for temperature for the reference period 1995 - 2014 as well as changes in temperature between the periods 2021 - 2040 and 2041 – 2060 (Source: MOE/UNDP, 2022: Lebanon Fourth National Communication to the UNFCCC)

As for the SST the results show that Mediterranean SSTs have increased throughout the basin, but with large sub-regional differences ranging between +0.29 and +0.44°C per decade[258]; furthermore, marine heat waves have become longer and more intense sea surface warming will continue in the 21st century by 1 to 4°C[259] depending on the scenario (low or high greenhouse gas emissions), and deep waters in the Mediterranean will likely warm more than in other oceans around the world. Over the Levantine basin, SST showed a consistent warming trend, with rates averaging approximately 0.35°C to 0.4°C per decade. Studies examining long-term SST data indicate that this trend is part of a broader regional warming across the Mediterranean, which is widely regarded as a CC hotspot. Specifically, warming is noted to be more intense during summer months, likely exacerbating the impact on marine ecosystems, as higher temperatures stress native species and promote the spread of invasive ones. This warming pattern is influenced by a combination of atmospheric and oceanic factors, including changes in atmospheric circulation, increased summer heatwaves, and reduced precipitation, which impact water stratification and salinity. The eastern Mediterranean, including the

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[258] 2020 - Climate and Environmental Change in the Mediterranean Basin – Current Situation and Risks for the Future. First Mediterranean Assessment Report. Cramer, W., Guiot, J., Marini, K. (eds.) MedECC. Union for the Mediterranean, Plan Bleu, UNEP/MAP, Marseille, France, 632pp, ISBN 978-2-9577416-0-1, doi: 10.5281/zenodo.4768833.

[259] 2019 - Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)] - IPCC. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3–35. https://doi.org/10.1017/9781009157964.001.

Levantine Basin, has experienced some of the fastest warming rates in the region, underlining the urgency for climate adaptation strategies in the area[260].

2.3. Rainfall

In Lebanon, precipitation shows a decreasing trend for the period 1950-2020 (0.53mm per decade), although less pronounced for the period 1990-2020 (0.35mm per decade; Figure 24). The rainfall distribution reflects a South-to-North gradient, leading to the northern, mountainous parts of the country receiving the most precipitation.
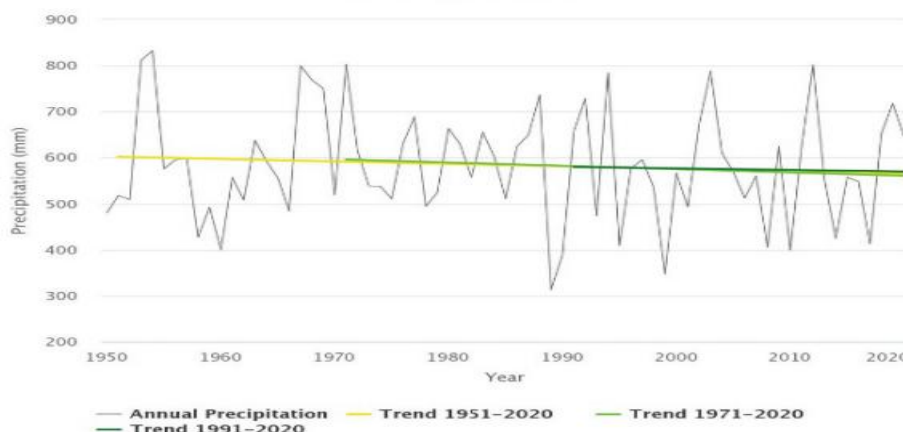
Figure 24: Precipitation trend for Lebanon (Source: MOE/UNDP, 2022: Lebanon Fourth National Communication to the UNFCCC)

As for future projected changes, precipitation is expected to decrease by 6.5% to 9% by mid-century and by 9% to 22% by end-century based on RCP scenarios' most recent projections (4.5 and 8.5 respectively). According to the same projections, a change in the spatial distribution of precipitation is expected for the RCP4.5 and RCP8.5 scenarios, with a -20% decline in rainfall in the Bekaa valley and southern Lebanon, which are important agricultural areas that already feel water stress due to urbanization and limited infrastructure (Figure 25).

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[260] 2021 - Long-term changes in sea surface temperature (SST) within the southern Levantine Basin. El-Geziry, T.M.. *Acta Oceanol. Sin.* **40**, 27–33 (). https://doi.org/10.1007/s13131-021-1709.
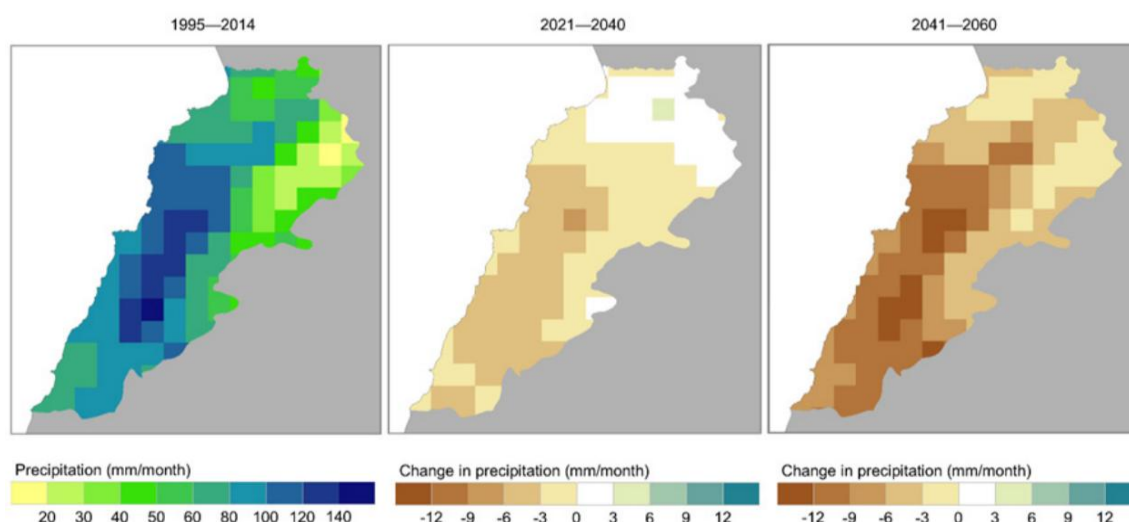
Figure 25: Mean change in precipitation (mm/month) for near-term (2021 - 2040) and mid-term (2041 - 2060) for an ensemble of six SSP -8.5 projections compared to the reference period (1995-2014) (Source: MOE/UNDP, 2022: Lebanon Fourth National Communication to the UNFCCC) .

In addition, it was shown that the amount of Consecutive Dry Days (CDD) when daily precipitation is less than 1mm have a south to north gradient of the annual mean of CDD (in days) with considerably higher values for CDD in the southern part of Lebanon. Future projections show that CDD will increase across all regions during the periods 2021-2040 and 2041- 2060 under the SSP5-8.5 scenario, with the most pronounced increases expected in the southern regions and along the coast. Consequently, drought risk is expected to increase towards 2050 under all scenarios. For instance, events of heatwaves and droughts are expected to increase almost fivefold for the period 2041-2060 as compared to the reference period 1986-2005. The increase will reflect up to 15 more incidents for inland Lebanon, and 20+ incidents for the northeast and southeast regions (Figure 26).
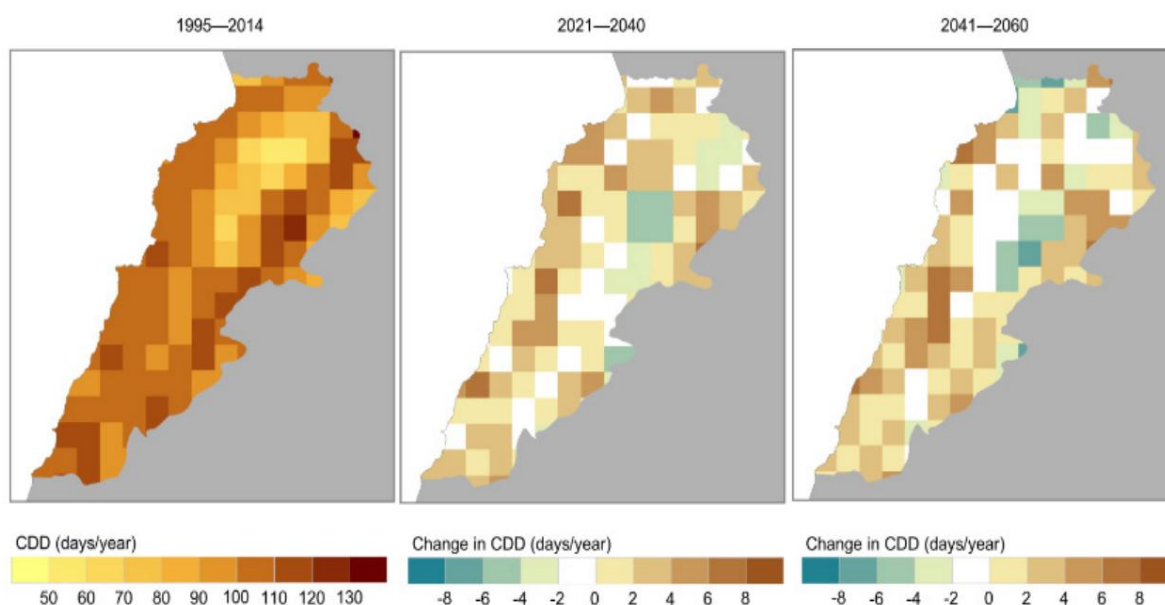
Figure 26: Mean change in maximum length of the consecutive dry days (CDD) for the periods 2021 - 2040 and 2041 - 2060 compared to the reference period 1995 – 2014 for ensemble of six Shared

Socioeconomic Pathways-8.5 (SSP-8.5) (Source: MOE/UNDP, 2022: Lebanon Fourth National Communication to the UNFCCC)

2.4. Sea Level Rise

As for the SLR, averaged across the Mediterranean Basin, mean sea level has risen by 1.4mm/year during the 20th century (Figure 27) and has accelerated to 2.8mm/year recently (1993–2018) (high confidence) mostly due to global ocean and ice sheet dynamics. There is high confidence that Mediterranean mean SLR will accelerate further throughout the 21st century. In particular, around 2100 and depending on the scenario, the basin mean sea level will likely be 37-90cm higher than at the end of the 20th century, with a small probability of being over 110cm. Studies performed for Lebanon show that the SLR is likely to increase by 30-60 cm by 2040[261].
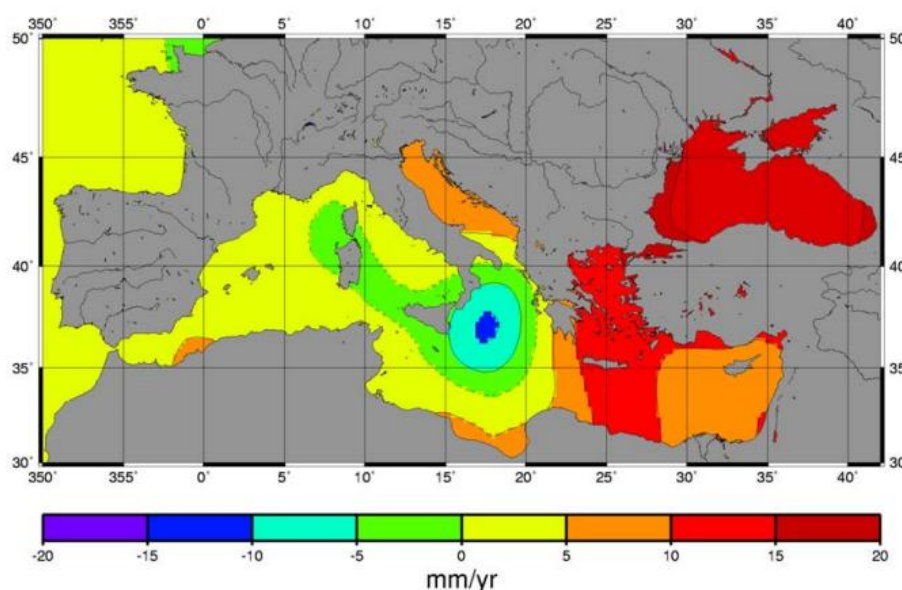
Figure 27: Mediterranean sea level changes as observed during the period between 1993 and 1999 (Source: https://www.aviso.altimetry.fr/en/news/image-of-the-month/2001/mar-2001-mean-rise-in-sea-level-is-only-part-of-the-story.html)

2.5. Water Resources

Lebanon's surface flows and groundwater sources are increasingly stressed by CC along with high population growth, increased demand from agriculture and industry, inadequate water storage capacity, increased water pollution and inefficient utilization. Renewable water resources per capita are below the scarcity threshold, with further decreases projected. Of particular concern is the changing nature of mountain snow cover, which is projected to decrease by 40% (70% under a 4°C warming scenario). The snow line, which constitutes a vital water source in Lebanon, is also projected to shift from an elevation of 1500m to 1700m by 2050. Changes in snow levels will negatively impact retention, and therefore water supply, particularly from April to June (a period of high demand for water for irrigation), reducing river flows. Reduced precipitation (both snow and rain) is likely to increase the incidence of drought, while higher temperatures will amplify the effect of drought. Already dry regions such as the Bekaa, Hermel and the south will be the most sharply affected by

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[261] USAID 2016 : Climate Change Risk Profile for Lebanon

longer drought periods. Reduced precipitation affect sediment and nutrient loading from rivers and would impact beach stability (With less sediment reaching coastal areas due to reduced river flow, Lebanese beaches are more susceptible to erosion, especially in areas like the northern coast, where rivers such as the Nahr el-Kalb play a key role in sediment transport) and marine biological productivity (In Lebanon, the lower nutrient input from rivers like the Litani and Nahr Ibrahim affects coastal biodiversity, harming fishery resources that are vital for local communities) along the Lebanese coast. Saltwater intrusion into limited coastal aquifers, is already a problem and will continue with rising seas.

3. DRIVERS AND PRESSURES

Concentration of populations (resident and non-resident) and human activities around the coastal areas present considerable threats to coastal ecosystems and resources in four major areas:

- On the structure and function of natural ecosystems as a result of the construction and operation of facilities for human activities and the associated urbanization and activities development;

- On the quality and quantity of natural resources (forests, soils, water, fisheries, beaches, etc.) as a result of increasing concentrations of people and activities adding to the demand for their use and exploitation and subsequent disposal of wastes;

- The CZ as a consequence of the development of different human activities and associated facilities as well as on the competition among conflicting users;

- The natural and man-made landscape as a result of the changes of activities, and of size and scale of related facilities and associated development.

In the future, coastal areas are likely to face increasing pressures, particularly on habitats, natural resources (land, fresh/marine waters and energy) and growth of demand for infrastructures (ports/marinas, transport, wastewater treatment facilities, etc.). Urbanization, tourism, agriculture, fishing, transport and industry are the major forces of change.

3.1. Urbanization

Lebanon is a highly urbanized country with more than 87% of its population living in urban areas and 64% living in large urban agglomerations (Beirut and its suburbs, Tripoli, Sidon, Zahle and Tyre). In the last fifty years, rates of urbanization have increased dramatically, primarily due to rural exodus, suburbanization, war displacements and the influx of refugees and displaced. Future projections of urbanization have predicted that urban areas will continue to increase and will cover 884km^2 of the country by 2030.

In coastal areas the population growth and the high demand for coastal lands as a result of their economic attractiveness coupled with poor enforcement of legislation, especially during the civil war period, has led to uncontrolled and illegal development along the coastline. Moreover, the coast is littered with illegal occupation of recreational projects, breakwaters and marinas (land reclamation projects) that prevent public access to the seafront. All these changes are major causes of coastal hydrodynamic modifications, coast degradation, soil erosion and loss of biodiversity.

3.2. Population Growth

The population of Lebanon is estimated to have exceeded 4.84 million people back in 2018 Population growth rates have been reported to range between 1% and 2.5% per year. As of October 2017, the GoL estimated that the country was hosting 1.5 million Syrians, who have fled conflict in Syria, along with 34,000 Palestinian refugees and displaced from Syria, 35,000 Lebanese returnees and a pre-existing population of more than 277,985 Palestinian refugees in Lebanon. Currently, refugees and displaced constitute around 30% of the Lebanese population, representing the world's highest number of refugees and displaced per inhabitant.

3.3. Economic Growth

Over the past 20 years, Lebanon's economy has been very volatile. While the country witnessed a period of moderate economic growth between 2006 and 2010 (9.2% GDP growth), that growth stagnated between 2010 and 2017, with an average GDP growth of 1.3%. Since then, the economy has started to contract, experiencing a decline of 6.7% in 2019. In 2018, the GoL had put together an ambitious national economic plan that prioritized growth across the different economic sector both in terms of GDP and job market. The plan projected that the annual GDP growth in the industrial sector will be between 4.6% and 14.8% per year, while the agricultural sector was expected to grow annually between 4.5% and 7.5%. These growth rates far exceed the projected population growth rate.
The LCZ is densely populated where coastal slums exist around major cities such as the coastal slums between Khaldeh and Ouzaï in the southern suburbs of Beirut. Such urban settlements that lack sewage networks and public services are vulnerable to changes in climatic factors due to haphazard urbanization with poor infrastructure and poverty conditions.

3.4. Agriculture

Despite the fact that the Lebanese coastal zone is narrow, agricultural zones are not absent in this area. The largest agricultural areas are located in Akkar, Abou Ali valley in the north, Damour and the southern plain, e.g. in Qasmiyeh and Ras el Ain. Cultivations in the coastal zone include subtropical crops (bananas, oranges, avocado, etc.) that are concentrated in the south along with wheat and a variety of irrigated crops and vegetables that are however mostly grown in the northern coastal plain of Akkar. Agriculture on the coast is considered as one of the activities offering environmental opportunities for green areas and has the additional benefit of reducing CO_2 enrichment of the atmosphere.

3.5. Shipping and Fishing

Lebanon has four main commercial ports in Beirut, Tripoli, Sidon (Saida), and Tyre, and a number of small ports along the coastline which are primarily used for fishing and leisure purposes. The Port of Beirut, one of the largest ports on the Eastern Mediterranean coastline, occupies a total area of $1.2km^2$ and has four basins, 16 quays and a newly built container terminal. The traffic at the Port of Beirut has reached around 5 million tons per year; while in Tripoli it is around 0.7 million tons per year.

Regarding the fisheries sector, fishing ports are traditional as the fisheries sector in Lebanon is largely artisanal. The Lebanese fishing fleet is composed of 2,662 vessels operating along the coast from 44 fishing ports and landing sites. The marine fishing sector employs 6,500 persons who annually capture, on average, 3,646 tons of fish and 200 tons of mollusks and crustaceans. The busiest fishing ports are

in Tripoli, Beirut and Saida. Trammel nets, longlines and purse seine nets are the most used fishing gears in Lebanon and capture roughly 3 000 - 3 500 tons per year (2 800 tons in 2018)[262].

3.6. Tourism

Tourism on the coast is expressed through different forms:

- Beach resorts and marinas projects for leisure and recreational activities that both occupy 8.5% of the coastline

- Archaeological monuments such as in Tripoli, Jbeil, Saida and Tyre.

- Natural landscape such as Ras Chaqaa, Enfeh, Pigeon Rock and Ras Naqoura.

- Natural reserves such as PINR, TCNR and ACNR.

  - Tyre beach is the only remaining stretch of sandy beach located to the south of the southern city of Tyre. It owes its specificity to the presence of artesian springs with high flows at Ras el Ain and for the breeding sites of Mediterranean Sea turtles

  - The Palm Islands Nature Reserve is of important natural heritage. It attracts nesting, migrating and wintering bird populations of global concern. The number of bird species that were recorded at the tiny Palm Islands Nature Reserve makes 40% of the total national avifauna

3.7. Industry

The main industrial activity is located in the vicinity of the coastal cities of Beirut, Tripoli, Chekka, Selaata, Sibline and Zouk. In fact, 65% of industries are situated on the coastline for a better supply of raw materials through the extensive coastal road network and faster export of products through the port. Large industrial or commercial units occupy about 24km of the coast which is equal to 10% of its total length.

3.8. Solid Waste Disposal

Inefficient solid waste management and illegal dumping practices have transformed the seafront of many coastal locations into dumpsites. Prime examples are the dumpsites at the coastal fronts of Saida, Tyre, Tripoli and Bourj Hammoud in Beirut. Generated solid waste is dumped along the coast or reaches the sea through rivers and streams. Some beaches are littered with garbage aggravating marine pollution. Uncontrolled dumpsites are sources of heavy metals and other priority pollutants that leach into marine waters.

3.9. Marine Pollution

Raw sewage generated from residential and industrial areas is directly discharged to the sea or nearby rivers. There are approximately 53 outfalls along the coast, 16 of which are located in the Greater Beirut Area between Dbayeh and Ghadir. Lebanon annually generates an estimated 249 million m³ of wastewater. Many of the Lebanese industries are located along the shoreline (65% of industries) and

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[262]https://openknowledge.fao.org/server/api/core/bitstreams/0459695a-90c2-4bff-8e52-f1b361639d58/content#:~:text=The%20Lebanese%20coast%20hosts%2044,2%20800%20tons%20in%202018).

discharge their untreated effluents directly into the sea. As a result, sea water is contaminated with industrial effluents, and domestic wastewater which have increased marine water pollution levels.

3.10. Beach Quarrying and Sand Extraction

Historical sand dredging operations and their aftermath are one of the main problems facing the Lebanese coast. Natural sand dunes have been exploited with an estimate of 1.5 million m^3 of sand being annually extracted for construction. This has contributed to destabilizing the coastline, while leading to coastal erosion and coastal hydrodynamic modifications.

3.11. Salt Water Intrusion

Legal and illegal drilling of groundwater wells across the CZ and the excessive, uncontrolled withdrawal of groundwater have led to the lowering of the water table in coastal aquifers. This has ultimately increased the mix between fresh and salt water which raised saline and chloride levels in coastal wells. Seawater intrusion is a direct consequence of water mismanagement and poses a serious threat to the quality of fresh water in the CZ. It is understood that the salinity levels in wells across Greater Beirut is at least five-fold the accepted scientific threshold for public use.

3.12. Coastal Set Backs

Coastal setbacks are poorly enforced in Lebanon which has led over the years to maritime violations along the coast. These violations date back to the civil war period and remain unresolved. Their existence bans public access to beaches which are a public domain and of public interest.

4. IMPACTS

CC impacts CZ over the Mediterranean basin and includes drought, floods, changed soil erosion and desertification processes, storms, coastal erosion, seawater temperature and salinity currents together with SLR and biodiversity reduction. Major potential impacts identified by the UNEP/MAP[263] studies are summarized in in Table 7.

SLR poses a direct threat to coastal ecosystems and human settlements by increasing the risk of flooding, erosion, and saltwater intrusion. Coastal habitats are particularly vulnerable, facing inundation and loss of biodiversity and subsequently reduction in the quantity of extractable biological resources. Human settlements located in low-lying coastal areas are at risk of displacement and damage to infrastructure, homes, and livelihoods. Critical infrastructure along the coast, including ports, power plants, transportation networks, industries and waste treatment facilities, is at risk from climate-induced SLR, erosion and extreme weather events. This can lead to disruptions in services, economic losses, and challenges in disaster response and recovery effort as well as the need for coastal communities to spend on protection, relocation and/or accommodation.

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[263] UNEP/MAP 2000 : State and Pressures of the Marine and Coastal Mediterranean Environment.

Table 7: Major Potential Impacts Identified Along the Mediterranean Basin[264]

Area	Potential Impacts
Delta of Ebro, Spain	increased coastal erosion; reshaping of coastline; loss and flooding of wetlands; reduced fisheries yield
Delta of Rhône, France	erosion of unstable or threatened parts of coastline; reduction of wetlands and agricultural land; increased impact of waves; increased salinization of coastal lakes; destabilization of dunes; intensified tourism
Delta of Po, Italy	increased flooding and high-water events; increased coastal erosion; retreat of dunes; damage to coastal infrastructure; salinisation of soils; alteration to seasonal water discharge regimes; reduced near-shore water mixing and primary production; increased bottom water anoxia
Delta of Nile, Egypt	Increased coastal erosion; overtopping of coastal defenses and increased flooding; damage to port and city infrastructure; retreat of barrier dunes; decreased soil moisture; increased soil and lagoon water salinity; decreased fisheries production
Ichkeul-Bizerte, Tunisia	Increased evapotranspiration leading to decreased soil moisture, reduced lake fertility and enhanced salinity; increased salinity of the lakes and shift to marine fish fauna; reduced extent of wetlands and loss of waterfowl habitat
Thermaikos Gulf, Greece	Inundation of coastal lowlands; saline water penetration in rivers; drowning of marshland; increased sea water stratification and bottom anoxia; decreased river runoff; salinization of ground water; decreased soil fertility; damage to coastal protective structures; extension of tourist season
Island of Rhodes, Greece	Increased coastal erosion; salinization of aquifers; increased soil erosion
Maltese Islands, Malta	Salinization of aquifers; increased soil erosion; loss of fresh-water habitats; increased risk for human health, livestock and crops from pathogens and pests
Kaštela Bay, Croatia	Inundation of Pantana spring and Zrnovica estuary; increased salinization of estuaries and groundwater; negative impact on coastal services and infrastructure; accelerated deterioration of historic buildings; increase in domestic, industrial and agricultural water requirements
Syrian coast	Increased soil erosion; modification of vegetation cover due to increased aridity; increased salinization of aquifers; erosion of beaches and damage to coastal structures and human settlements due to exceptional storm surges
Cres-Lolinj, Croatia	Increased salinization of lake Vrana; extension of tourist season; increased risk from forest fires
Albanian coast, Albania	salinization of coastal aquifers and shortage of adequate quality of drinking water; soil erosion (physical); extension of summer drought; extension of tourist season
Fuka-Matrouh, Egypt	increased evapotranspiration and decreased rainfall; extension of summer aridity; increased coastal erosion; flooding in eastern part; decreased soil fertility
Sfax coastal area, Tunisia	salinization of ground water; increased rainfall; possible flooding

As for the LCZ, the absence of proper land use planning, high population density along the Lebanese coast, large contribution of coastal economic activities to the national GDP, weak regard of the environment as well as the lack of legislation, weak enforcement capacity and existence of unresolved threats that undermine the natural coastal environment increase the vulnerability of the different coastal units along the LCZ to climatic factors. Main identified coastal hotspots can be summarized in

Table **8**.

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[264] It should be noted that these are examples that may also apply to the Lebanese Coast

Table 8: Threatened or degraded areas surrounding the Lebanese coast

Area	Rationale
1. Akkar beach and dunes	Beach degradation and erosion
2. Akkar agricultural plain	Potential loss of agricultural area due to urbanization and establishment of a free trade zone
3. Coastal stretch from the IPC refinery (Beddawi) to El-Mina port	Site of future wastewater plant. Possible site of future solid waste landfill on land reclaimed from the sea. Calls for re-classifying existing coastal tourism zone as an industrial zone
4. Ras en Natour & Enfeh	Characteristic landscape (Salinas, historic port) threatened by mass scale tourism development
5. Ras el Chaquaa, with Chekka and Selaata industries (from Chekka to Batroun)	Outstanding natural beauty and biotope of rich biodiversity, threatened by industrial growth and quarries (Chekka and Selaata). De-classified stretch of coast (previously industrial) offers opportunity for sound management
6. Nahr el-Jawz valley and Msaylha fortress	Cultural, archaeological and natural landscape requiring protection. Visual impacts of illegal quarry behind Msaylha fortress
7. Batroun marine reserve	Declared reserve is ill-defined with no management or conservation plan
8. Amsheet-Jbail coastal area	Tourism development pressures could hinder public access to the beach and spoil landscape. Rocky mountain (with garrigues) and green area could serve as urbanisation buffer zone
9. Nahr Ibrahim valley	Unique ecology and legendary landscape devastated by quarrying and currently still threatened by industry and urbanisation
10. Jounieh City and surrounding mountains	Characteristic landscape and quality of life degraded by uncontrolled urban growth
11. Nahr el-Kalb valley and river mouth	Geology, paleontology, biodiversity and history of this unique site are threatened by infrastructure (highway and power plants) and rampant urbanization. Jeita spring source threatened by increased pollution
12. North Metn	Beaches either lost or privatised. Opportunity for planned urban development of reclaimed land. High environmental impacts of supplying required aggregates and sand
13. Beirut, with Pigeon Rock	Several hotspots (port, Normandy landfill) and sensitive areas
14. Airport and ELISSAR	Beaches either lost (if land reclamation options selected) or privatized. Delicate relocation of industries and people
15. Damour plain	Agricultural plain/green space threatened by tourism development pressures
16. Nahr Hammam valley	Pristine valley with interesting ecological habitat needing legal protection
17. Saida coastal area	Northern beaches threatened by urbanization and tourism development pressures. Coastal highway project would separate old city from fishing port and Sea Castle. Environmental and socioeconomic impacts of SIDON port. The Saida coastal dumpsite remains a threat to the local marine environment, surrounding human settlements and tourism infrastructure
18. Rmeileh beach	Sandy coast to be protected

Area	Rationale
19. Zahrani area	Old refinery site and industrial area requiring rehabilitation
20. Litani seashore and valley & Qasmieh plain	Ecological and economic importance of river warrants special protection. Sandy coast and scenic valley to be protected. Agricultural plain threatened by ribbon urbanization along new highway
21. Mhaylib coastal area	Publicly-owned beach reserve, currently partially occupied by illegal housing
22. Tyre to Rashidieh camp	Unique historic and cultural sites. Access to the sandy beach north and south beach threatened by tourism development projects
23. Rashidieh to Ras el-Ain	Competing interests of conservation, agriculture and tourism require an integrated planning and management approach
24. Iskandarouna beach	Sandy coast to be protected
25. Ras en-Naqoura	Distinctive landscape and ecological importance threatened by rushed development in the event of regional peace. Opportunity to reroute inland the southern stretch of coastal expressway before expropriation and building activities take place

Expected impacts due to climatic factors are further detailed in this chapter.

4.1. Land Use and Coastal Erosion

Coastal erosion is an environmental threat, related to a combination of human activities such as damming and coastal development, the abandonment of agriculture, and global CC. Habitat erosion has also occurred mainly due to the competitive use of the CZ.

Beaches in Lebanon are extremely vulnerable to shoreline erosion or the permanent loss of sand, gravel and rocky shores as 80% of the shoreline is rocky[265]. For instance, the loss of rocky shores; 1. Affect biodiversity as these areas provide habitats for various marine species and 2. Impact coastal communities affecting tourism, fishing and local economies that rely on the coast.

Severe erosion is a result of high water level and wind-driven waves that can result in storm surges. Sandy beaches cover a length of 49 km and represent 20% of the shoreline. In a study conducted by the MCR-IOE-UOB, the results showed that sand and pebble beaches have retreated due to extensive erosion while more than 10km^2 of land was added along the Lebanese shores by sea filling and these impacts are expected to intensify due to climate change. In another study on shore erosion between 1963 and 2003, it was noted that sandy beaches were the most eroded with a 45.2% of coastal erosion while gravel beaches are less eroded with 24% of coastal erosion[266].

An increase in the frequency and intensity of episodic weather events, sea level rise, and/or an alteration of coastal circulation patterns due to CC could exacerbate natural coastal erosion. Coastal erosion could lead to a loss of beaches especially in locations where sandy beach stretches are narrow and buildings are close to the shoreline. Illegal construction that has exceeded the coastline setbacks can contribute to erosion by altering the movement of sediment along the coast; as they block the

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[265] 2021 - Impact of Climate Change on the Coast of Lebanon. Nader, M., Bou Nassar, M., El Indary, S., Bou Dagher, M. 2021. IUCN: An Awareness handbook.
[266] 2005 - Evolution du Trait de Cote Libanais entre 1962-2003 Abi Rizk (Master Thesis)

process of natural migration of sand[267]. Some changes in sediment deposit may be amplified by CC such as loss of sediments in storm events.

4.2. Coastal Flooding and Inundation

Agricultural plains in Akkar, Damour, Saida and Tyre are vulnerable to coastal flooding and inundation due to sea level rise combined with extreme storms events. Furthermore, the productivity of these areas is threatened by the reduction in the availability of irrigation water that is mainly sourced from groundwater wells due to saltwater intrusion into these coastal aquifers driven by the excessive pumping of groundwater from coastal aquifers for the supply of potable water to the rapidly growing coastal urban areas.

The mount Lebanon areas are also vulnerable to coastal flooding due to torrential rains where all pollutants and solid wastes are washed into coastal waters extensively polluting ecosystems and where coastal infrastructure is usually damaged (roads, bridges (Nahr Al Kalb, Nahr Beirut, etc...).

Moreover, coastal plains and shores that suffer from erosion and experience periodic inundation during high sea level conditions (e.g. storms) are the most vulnerable under such conditions. Any increase in the mean sea level, or in the frequency and intensity of episodic events affecting that level, would worsen the present situation. Coastal inundation degrades coastal ecosystem services, limits coastal use and damages infrastructures, which would lead to negative effects particularly in heavily populated areas and agricultural plains.

4.3. Sea Water Intrusion

One of the most serious impacts of sea level rise in Lebanon would be the salinization of coastal aquifers as they are one of the major components of Lebanon's water resources. Groundwater aquifers are utilized as a main source of drinking, service and irrigation water. For instance, in a study conducted between 1999 to 2004, to assess pressure on coastal zone, the salinity of water fluctuated around $3dS.m^{-1}$ and the Simpson index (Cl/HCO_3) indicated levels of moderate to injurious contamination. The Na/Cl ratios remained < 1, suggesting a seawater intrusion rather than an anthropogenic origin[268]. In another study conducted in 2022, for the Chekaa area, the coastline salinity ranged between 37-39 PSU[269] and it passed the normal average. This putted the coastline under threat of high percentage of corrosion and changes of marine environment in Chekka. The increasing of salinity affects the dynamic of sediment of the seabed and around the underwater sites, in addition it changes the type of marine biological life and support different algae and invertebrates where all of them are threaten and disturbed the submerged features and structures. The sea water intrusion impact of SLR can be exacerbated by increased groundwater withdrawal due to increasing urbanization. For instance, it was observed that the impact on saltwater intrusion of a 65cm rise of sea level (by 2032) is comparable to only a 2% increase in abstraction rates under the baseline scenario[270] In Lebanese coastal regions, the uncontrolled exploitation of groundwater resources intended for domestic, industrial and agricultural purposes, imbalances the dynamic equilibrium between sea water and the flowing groundwater. The combination of the two occurrences, groundwater exploitation and sea level rise compound the repercussions of sea water intrusion.

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[267] It should be noted that data are not available and these are referred as potential impacts

[268] 2013 - Seawater Intrusion and Crop Response to Salinity in Coastal Lebanon. El-Moujabber et al.,:

[269] 2024 - Climate Change Impacts on Maritime Resources in Lebanon Using Satellite Imagery, chekka case study. Sirine Saad El Dine Ghiyye:. Journal of Water Resources and Ocean Science

[270] 2018 - Synergy of climate change and local pressures on saltwater intrusion in coastal urban areas: effective adaptation for policy planning. A. Safi, G. Rachid, M. El-Fadel, J. Doummar, M. Abou Najm & I. Alameddine., Water International, 43:2, 145-164, DOI: 10.1080/02508060.2018.1434957

Saltwater intrusion poses a serious threat to the quality of freshwater, particularly that in some locations seawater has actually intruded several kilometers inland into coastal aquifers. The coastal area of Choueifat-Rmeileh region is one of many districts in Lebanon that are threatened by the penetration of seawater into the aquifers[271].

4.4. Impact on Coastal and Marine Economic Activities

SLR, acidification, de-oxygenation and extreme climatic events would afflict coastal and marine economic activities. Losses in tourism, agriculture, fisheries, transportation and other essential services are expected to occur due to CC. Moreover, an influx of non-native species due to warmer temperatures, shipping routes and climate change has been observed for Lebanese waters. These species often compete with native marine life, altering food webs and impacting local biodiversity. One major pathway for these NIS is the Suez Canal, which has facilitated the migration of species from the Red Sea into the Mediterranean—a phenomenon known as Lessepsian migration. Notable invasive species, such as the lionfish (*Pterois miles*) and rabbitfish (*Siganus spp.*), have disrupted native populations, especially herbivorous fish that are critical for maintaining the balance of algae in coastal ecosystems. Additionally, rising sea temperatures in Lebanon create favorable conditions for tropical and subtropical NIS, allowing them to establish and thrive in the Mediterranean environment, which used to be too cold for these species[264]. Overall, the main repercussions will be on the fishery sector as marine species will be affected by the change in temperature, due to thermal tolerance thresholds, low pH and oxygen concentrations. Coastal communities relying on ecosystem services, especially those relying on the fishing industry for livelihoods will bear the impacts of CC as extractable biological resources are more likely to decrease and marine biodiversity to decline. CC will have adverse impacts on coastal agriculture due to coastal flooding and saltwater intrusion into groundwater aquifers. Beaches might lose their attractiveness for a longer period during the summer with the predominance of jellyfish and algal blooms in coastal waters; potentially affecting beach tourism negatively. On the other hand, the length of summer season, due to global warming might be profitable for businesses that cater to beach and summer tourism.

For instance, the tourism sector was identified as the most vulnerable sector in coastal cities in Lebanon, which are popular destinations for both foreign and Lebanese tourists. Both potential impacts (destination and operational) are mainly affected by daily and monthly (mean, max and min) temperatures, heat waves and extreme precipitation events. Furthermore, warmer temperatures will increase heat stress for tourists as well as the cooling costs. Extreme precipitation events will contribute to the destruction of the tourism infrastructure, blocking roads and changing the hydrologic cycle. These events will also contribute to beach erosion, lost sand, destruction of reefs, and sediment plumes. The increase in acidification[272] of marine water will have the strongest effect on the tourism destination. In fact, the acidification can change the marine ecosystem, decrease natural shoreline protection and increase the risk of inundation and erosion of the low-lying coastal areas.

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[271] MOE/UNDP, 2022 : Lebanon Fourth National Communication to the UNFCCC

[272] Refers to the ongoing decrease in the pH of the ocean, caused primarily by the absorption of carbon dioxide (CO_2) from the atmosphere. As CO_2 levels increase in the atmosphere, a significant portion is absorbed by seawater, where it reacts with water molecules to form carbonic acid. This acid dissociates into hydrogen ions and bicarbonate ions, lowering the pH and increasing ocean acidity. This acidification process disrupts the balance of carbonate ions in the water, which are crucial for marine organisms like corals, shellfish, and some plankton species to build their calcium carbonate shells and skeletons. The reduction in available carbonate ions makes it more difficult for these organisms to survive and affects the overall marine ecosystem's health and biodiversity.

4.5. Biodiversity and Ecosystem Changes

The Mediterranean and in particular the Lebanese marine ecosystem is a high-diversity ecosystem. As such, it is highly vulnerable to environmental perturbation and the impact of pressures due to CC is expected to be more significant. Such perturbations in marine and coastal environments include pollution, over-exploitation of marine living resources, habitat erosion, climatic changes (e.g. through the greenhouse effect), introduction of NIS and other human activities leading to environmental degradation.

Mediterranean fisheries resources are in a state of over exploitation driven by anthropogenic impacts, dwindling resources, and by rising prices and demand in the past decades;

- Over-fishing and fishing practices have largely contributed to SLR in the Mediterranean region over the past 10 000 years

- Demersal fish stocks (close to the sea bottom) are usually fully exploited, if not over-exploited, with a general trend towards smaller individual sizes;

- Small pelagic fish stocks are highly variable in abundance (depending on environmental conditions) and probably not fully exploited except perhaps, for the anchovy resources;

- Large pelagic fish stocks (tuna and swordfish) are overexploited also by international industrial fleets, especially the red tuna for which the Mediterranean is an important spawning area;

- Habitats of high biological significance are frequently destroyed by trawl-nets operating close to the shore.

4.6. Water Scarcity

CC is expected to make water resources scarcer in Lebanon, negatively affecting agricultural output. This is particularly crucial for coastal areas where agriculture, including the cultivation of crops such as citrus and bananas, plays a significant role in the local economy. Water scarcity can also impact drinking water supplies and sanitation services, exacerbating health risks.

4.7. Displacement of Coastal Communities

As coastal areas become increasingly uninhabitable due to SLR and other environmental pressures, communities may face the need for relocation or displacement. This displacement can occur either gradually, as communities migrate away from vulnerable areas, or immediately, in the aftermath of extreme weather events such as storms and flooding. Displacement often leads to social disruption, loss of cultural identity, and challenges in accessing basic services and resources.

4.8. Increased Risk of Waterborne Diseases and Heat-Related Illnesses Due To Changing Environmental Conditions

Changing environmental conditions, including rising temperatures and altered precipitation patterns, can create favorable conditions for the proliferation of waterborne diseases such as cholera and hepatitis A. Additionally, heatwaves and extreme weather events can increase the risk of heat-related illnesses such as heatstroke and dehydration, particularly among vulnerable populations living in coastal areas.

5. RESPONSES

Adaptation Strategies in CZ vary from abandoning the coast to their natural evolution to adopting proactive measures to manage and react to the main impacts to be induced by CC. CC is but one of many interacting stresses in Lebanon's CZ. An overarching adaptation and management option to relieve pressures on the coastal zones can be the adoption of ICZM. Those adaptation Strategies will be summarized in the below subsections.

5.1. Retreat Adaptation Measures

- Including in land use plans a sufficiently wide buffer zone where no development near the shoreline is allowed. The construction should be restricted on a minimum width of 100m of the shore band.

- Creating an MPA network through the rehabilitation and preservation of more than 30 remarkable sites (sandy beaches, a certain number of rocks and cliffs, fresh water springs, bays, etc.) along the coastal front. This measure will strengthen the ability of coastal habitats and species to adapt on their own. It will also strengthen the ability of coastal habitats and species to adapt on their own and increase ecosystem resilience.

- Including a sufficiently wide buffer zone in land-use plans where sufficient setbacks are introduced and no development is allowed. These setbacks should be based on the worst predicted SLR scenario for the region.

- Relocation of Infrastructure which involves moving critical infrastructure away from vulnerable coastal or flood-prone areas to minimize the risks posed by climate change, such as SLR, flooding, and storm surges. This Strategy, known as managed retreat, is a proactive approach aimed at reducing the exposure of communities and assets to climate impacts.

- Land Use Planning in CZ as an essential strategy to manage the impacts of CC, particularly in areas vulnerable to SLR, increased flooding, and extreme weather events.

- Engaging communities in understanding climate risks empowers them to adopt local adaptation actions, like sustainable fishing practices or water conservation.

- Supporting alternative income sources for communities that rely on fishing or tourism can reduce economic vulnerability to changes in the marine environment and seasonal tourism shifts.

5.2. Accommodation Adaptation Measures

- Reducing or moving sources of occasional pollution (urban and industrial pollution) and diffuse pollution (agriculture) to restore environmental balance, natural resilience and adaptability.
- Introducing effective Early Warning Systems along the coast for coastal hazards such as storm surges and coastal inundations.
- Mangrove restoration where mangroves act as natural buffers, reducing the impact of storm surges and erosion while providing essential habitats for wildlife.

- Wetland restoration as coastal wetlands can absorb floodwaters, filter pollutants, and protect coastal areas from storm impacts.
- Coral Reef protection and restoration as Coral reefs act as natural barriers against waves and storms. Their preservation is critical for maintaining biodiversity and protecting coastal areas from erosion.
- Dune and Beach restoration as sand dunes help protect coastal areas from wind and water erosion.
- Coastal defenses such as sea walls, levees, and storm surge barriers designed to protect against flooding and erosion.
- Elevating Infrastructure such as raising buildings, roads, and other infrastructure to higher ground to prevent damage from rising sea levels and storm surges.
- Flood control systems such as constructing flood retention ponds, reservoirs, and drainage systems to manage storm water more effectively.
- Zoning Regulations by restricting or regulating development in high-risk areas (e.g., flood zones or coastal cliffs) to minimize exposure to climate hazards.
- Building Codes by enforcing climate-resilient building standards that ensure new developments are designed to withstand extreme weather and flooding.
- Insurance Schemes by providing risk insurance to coastal communities to help them recover after extreme weather events.
- Climate-Resilient Livelihoods by promoting alternative livelihoods (e.g., eco-tourism, sustainable agriculture) to reduce dependency on vulnerable sectors like fishing.
- Public Awareness Campaigns by educating communities about climate risks and adaptation strategies, fostering collective action.
- Financial Incentives by offering subsidies or tax incentives for businesses and individuals to adopt climate-resilient practices, such as energy-efficient technologies or sustainable farming methods.

5.3. Protection Adaptation Measures

- Hard engineering techniques refer to the coastal structures such as sea walls, dykes, and embankments in order to protect the coast from more frequent high water and sea storms. However, a major downside to hard defense structures is that they do not stop beach erosion as they transfer this problem to another part of the coast. Moreover, they are generally found unattractive and are known to contribute negatively to coastal water quality. They are usually adopted on active economic environments that cannot be moved as well as on highly urbanized areas to protect expensive properties or infrastructures.

- Soft engineering techniques are adopted to restore the natural dynamism of the shoreline and include beach nourishment and sand dune stabilization. Beach nourishment consists of feeding a beach periodically with material brought from elsewhere to remedy erosion and increase beach area and sand dune stabilization involves the planting of vegetation such as beach grass that retains sand and creates natural habitats for animals and plants.

5.4. ICZM Coping with Climate Change

Lebanon would need to ratify and implement the ICZM Protocol to adopt it as a tool of adaptation of coastal zones. Most of the suggested adaptation measures for CZ and the ICZM share the same general sustainable development objectives like preserving CZs, ensuring the preservation and integrity of coastal ecosystems and preventing and reducing the effects of natural hazards, in particular those associated with CC.

6. CONCLUSION

In this report, the impact of CC on CZ in Lebanon was assessed which showed that the coastline is highly vulnerable as it hosts 90% of the population and is responsible for around 74% of Lebanon's GDP, it lacks proper urban planning and is affected by marine and waste pollution. The main identified impacts include increase in saltwater intrusion which affects the access to safe water, SLR and storm surges responsible for increased flooding events and inundation and increase of coastal erosion of sandy beach. This said, data and information are absent on acidification and de-oxygenation, but are assumed to also negatively impact the CZ and its associated resources. As a result, all main economic activities such as tourism, agriculture, fisheries are affected. Therefore, there is an essential need to translate the ICZM protocol into law supported by an integrated Strategy that will address all possible measures that will increase the resilience of the Lebanese CZ for both coastal residents and biological communities.

CHAPTER IV: TRENDS OF LAND USE CHANGE

This chapter focuses on the dynamics of coastal land use including trends, causes, drivers and consequences in and of the changes in coastal land use. The provided information discusses, but is not limited to, erosion, land degradation, land conversion (from agricultural and natural areas to urban areas), quarries and urban development, built - up area in the coastal strip and the extent of the coast, as well as the development and encroachment on the maritime public domain. It also discusses specific strategies, methodologies, land use policies, and instruments for inclusion in the National ICZM Strategy and the ICZM Law of Lebanon in addition to mitigation measures. The chapter is divided into five main sections, categorized following the DPSIR method: state, pressures, impacts, drivers and responses towards the different trends of land use change. It is in response to the following articles within the ICZM Protocol:

- Article 2-e, f;
- Article 5-a, b, c, d;
- Article 6;
- Article 8.2 and 8.3,
- Article 9.2-b, c, d, e;
- Article 10.2 and 10.3,
- Article 11.1;
- Article 18.1; and
- Article 20.1.

1. THE CURRENT STATE OF LAND USE PLANNING:

Urbanization in Lebanon reflects a complex and rapidly evolving phenomenon, marked by significant growth and challenges that mirror global trends. With one of the highest urbanization rates in both the Arab region and the world, approximately 89% of Lebanon's population resides in urban areas. This urban growth has been rapid and largely uncontrolled, leading to urban sprawl and significant disparities within cities. Limited planning regulations, coupled with a lack of enforcement, have resulted in expanding built-up areas, putting a strain on urban infrastructure, and exacerbating social, economic, environmental, and demographic challenges.

In 2023, urban population for Lebanon was 89.4 %. It increased from 65.5 % in 1974 to 89.4 % in 2023 growing at an average annual rate of 0.64%[273] with the majority - estimated at 64% - residing in large agglomerations mostly in the metropolitan areas of Beirut and Tripoli which are both coastal cities. Urbanization is estimated to consume an additional 10km² of natural areas every year in Lebanon, according to the NPMPLT.[274]

The pattern of urbanization in Lebanon has been largely characterized by chaotic and unplanned development, leading to significant urban sprawl and the lack of a comprehensive physical infrastructure system. The centralization of services and inadequate transportation systems have compelled people to settle near urban centers in search of better living conditions, contributing to urban agglomerations. Although urbanization can foster socio-cultural diversity, innovation, and economic development, the unplanned nature of urban growth in Lebanon has resulted in negative impacts such as increased real estate prices, the development of urban slums, environmental degradation, and heightened social inequalities.[275]

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[273] Knoema, n.d., Lebanon Urban population, 1960-2023 - knoema.com
[274] UN-Habitat, 2011, Lebanon Urban Profile.pdf (unhabitat.org)
[275] Khamis, 2018; Urbanization in Lebanon: A problematic local issue, reflecting global trends

The Governorates of Beirut and Mount Lebanon together comprise around half of the Lebanese population. They are largely urban and peri-urban, although Mount Lebanon also contains some rural and remote areas.[276]

According to World Bank, around 56% of the world's population – 4.4 billion inhabitants – live in cities. This trend is expected to continue, with the urban population more than doubling its current size by 2050, at which point nearly 7 of 10 people will live in cities.[277] In 30 years from 2021, it will be required to add 4 new cities the size of present-day Tripoli[278] to accommodate the Lebanese population.

Lebanon's built-up area and its main cities are geographically concentrated in the coastal areas, with a limited number of major inland poles as seen in the figure below.[279] It is worth noting that the MPD in Lebanon faces extensive exploitation, much of it occurring illegally or in violation of established regulations. This encroachment is well-documented by government authorities, yet it is often tolerated and, at times, even supported by certain state entities, despite contradicting legal principles.[280]

1.1. Current land use practices, existing services, artificialization and land conversion of the coast and natural lands

Several sectors occupy the 240km coastline, ranging from highly concentrated urban centers, industries, tourism, ports and marinas, fisheries, commercial transport and naval base, and agriculture. This zone is also extremely sensitive and diverse in both ecological resources and requires special management approaches. With displaced and refugee populations totaling roughly 669 people per km², Lebanon has a high population density. More than half of the population, estimated at 88%, lives in urban areas, which are concentrated along the coast[281]. Within 500-meters landward into the coastal area, urban structures occupy between 33% and 40% of the land, whereas 41% of the land is occupied by agriculture, and natural areas like beaches and dunes form 19% of the coast[282] (Annex XIV: Land use - Land cover map of Lebanon and Figure 28).

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[276] ReliefWeb, 2018, Lebanon: Beirut & Mount Lebanon Governorates Profile (October 2018) - Lebanon | ReliefWeb
[277] WB, 2023, Urban Development Overview (worldbank.org)
[278] UN-Habitat/ESCWA, 2021, un-habitat_escwa_state_of_the_lebanese_cities_2021_web.pdf (unescwa.org)
[279] UN-Habitat/ESCWA, 2021, un-habitat_escwa_state_of_the_lebanese_cities_2021_web.pdf (unescwa.org)
[280] Atlas of Lebanon - Disputes over the Maritime Public Domain - Presses de l'Ifpo
[281] World Bank, 2020. World Bank Database. Retrieved from: https://data.worldbank.org/country/LB
[282] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf p. 11
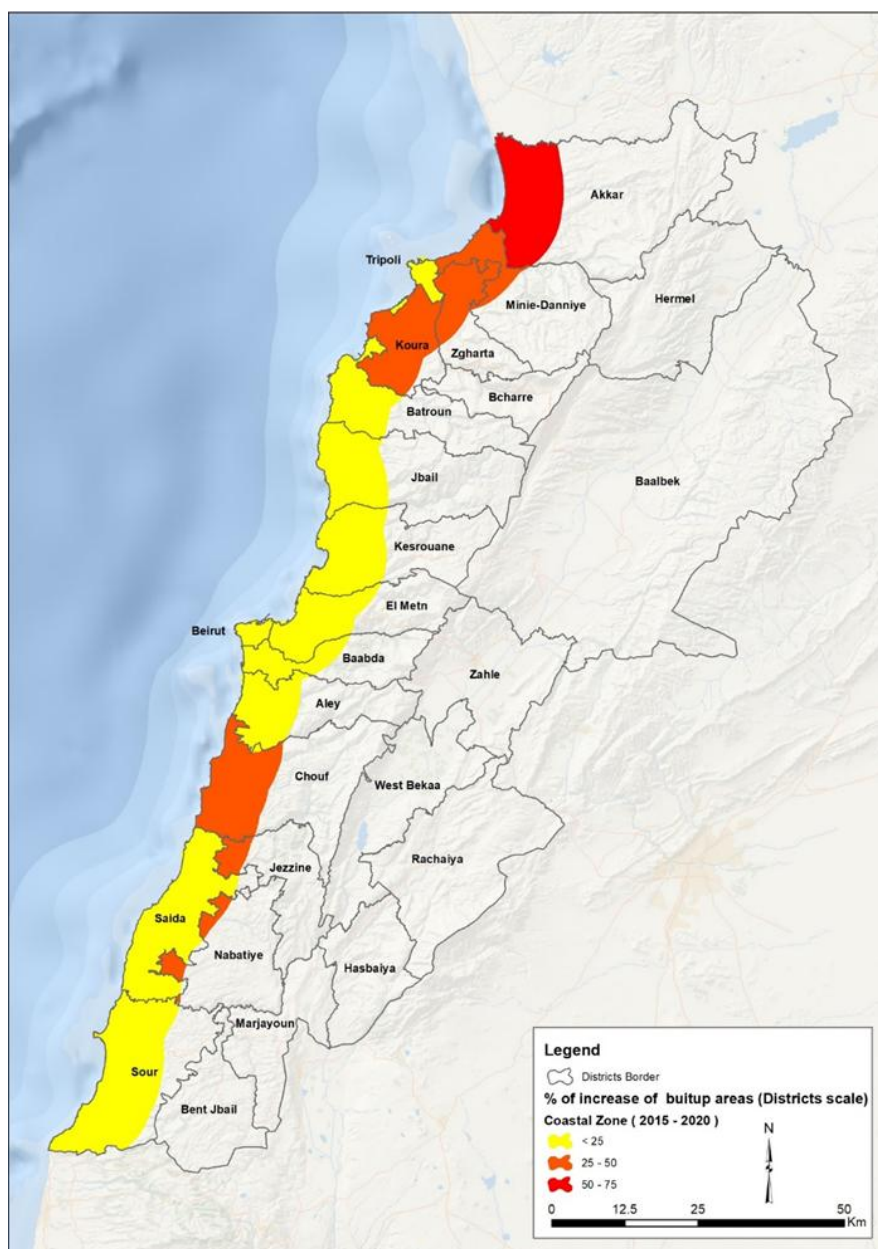
Figure 28: Spatial distribution map showing the percentage increase in built-up area across the coastal zone at district level (Source: S. Termos, 2023)

Furthermore, as a source of interest for all socio-economic sectors within the country, the land-use distribution along the LCZ varies, where large-scale industries and classical tourism coexist, as they denote huge economic opportunities in these areas such as marine transport, cooling of power generation and machinery, road networks etc (Annex XV: Map of Lebanon's coastal infrastructure, highlighting sea ports, rivers, airports and diving centers). Meanwhile, the agricultural and fishery sectors use the natural resources base available along the coast. Similarly, real estate is prevalent along the coast, and tourism relies on large seaside constructions such as resorts and hotels that occupy wide-spread areas and depend on sea-filling and construction of artificial beaches and marinas that eventually degrade coastal environments[283]. Based on the CCI25, "Land Cover Change", the study

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[283] SOER Report 2021- Chapter 6, Land Resources, p. 270

of the land use cover in the CZ indicates that natural areas account for over 50% of the CZ including wooded land, sandy beaches, bare rocks and bare soil. Agriculture also plays a main role in providing sources of income to coastal communities, with crops being cultivated along large areas throughout the coast[284] (Figure 29 and Figure 30).

Percentage of LC classes (year: 2015)
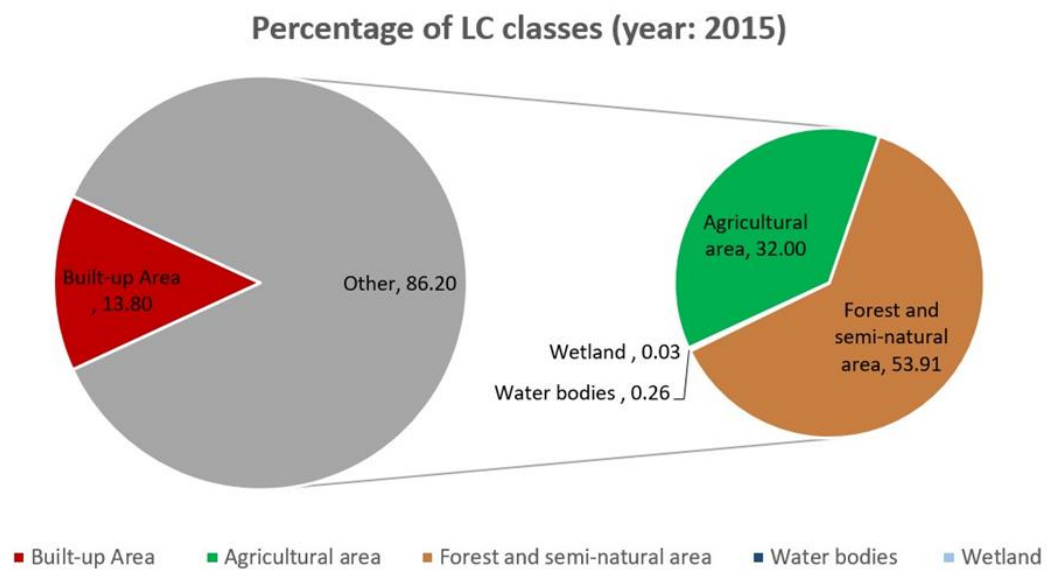
Figure 29: Percentage of distribution of land cover classes (LCC) within the coastal zone (0-10km) for the year 2015 (Source: S. Termos, 2023)

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[284] Candidate Common Indicator 25, "Land cover change" Assessment for Lebanon (Termos S., 2023), p. 24
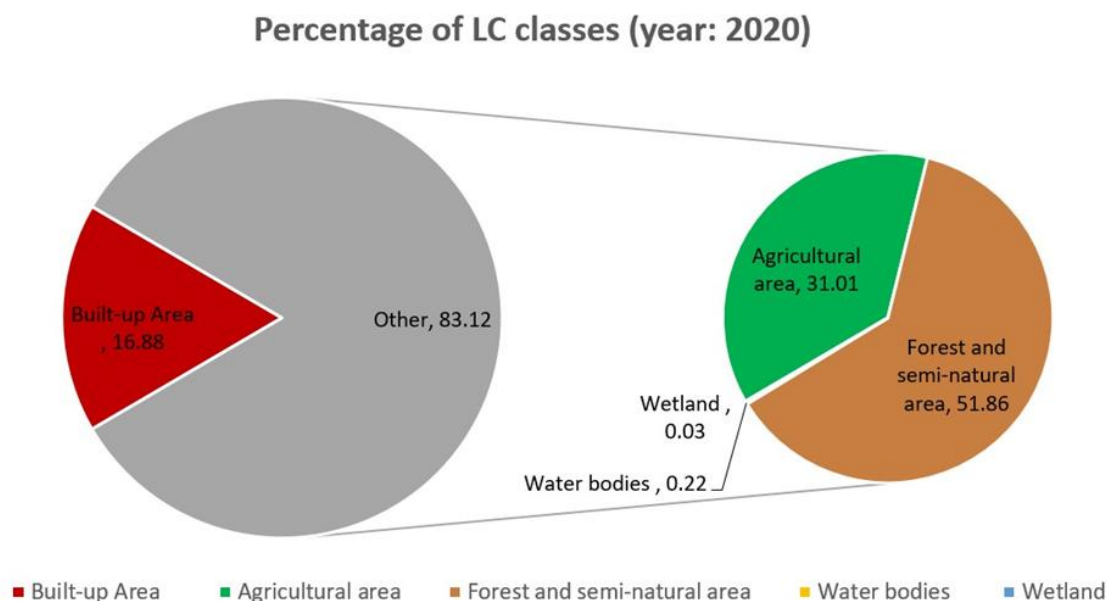
Figure 30: Percentage of distribution of land cover classes (LCC) within the coastal zone (0-10km) for the year 2020 (Source: S. Termos, 2023**)**

According to the studies present within the "Situational Analysis of the current land use of the coastal zone, particularly in terms of socio-economic activities" report under the ERMIL project (UNEP/MOE,2013b), a 1998 map showed the presence of 42% of the areas being agricultural and 31% being artificialized land, which includes road networks and infrastructure, as well as residential and industrial areas, whereas 17% was forested land, and the remaining were natural land with little vegetation and all types of water bodies and wetlands[285]. This, in comparison with an image of 2010, shows the coastal transformation where 39% of artificialization affected grasslands, 30% affected forests, 20% affected agricultural areas, and 7% of sea-filling affected sea water[286]. In 2015, almost 14% of the CZ was classified as built-up areas, which is relatively high. Most of this is concentrated in Beirut, Tripoli, and Baabda district[287] (Figure 31).

Within the comparison of land use cover among the coastal strip, the built-up area ratio increases the closer it approaches the coastal line. This is attributed to several factors: the first being that the coastal strip, identified by the CCI25 as the area ranging from the coastline to 300 meters inland, contains the highest built-up ratio, presumably due to the presence of ports, resorts and coastal infrastructure, as these areas are regarded as hubs for concentrated human activities, urbanization and tourism. Meanwhile, the Low Elevation Zone (LEZ), the coastal area depicted by CCI25 as having an elevation below 5m, though narrow, showed that the land cover distribution is similar to that of the first strip (between 0 and 300m inland), with an approximate of 28% built-up area, 27% agricultural land cover, and 31% semi-natural and forest land[288].

However, in terms of governorates, Beirut has the highest percentage of built-up area, which aligns with the reality of its heavy urbanization and dense infrastructure that leave little room for green areas such as agriculture and natural landscapes[289].

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[285] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf p. 22
[286] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf p. 22
[287] Candidate Common Indicator 25, "Land cover change" Assessment for Lebanon (Termos S., 2023), p. 22
[288] Candidate Common Indicator 25, "Land cover change" Assessment for Lebanon (Termos S., 2023), p. 41
[289] Candidate Common Indicator 25, "Land cover change" Assessment for Lebanon (Termos S., 2023), p. 43-44
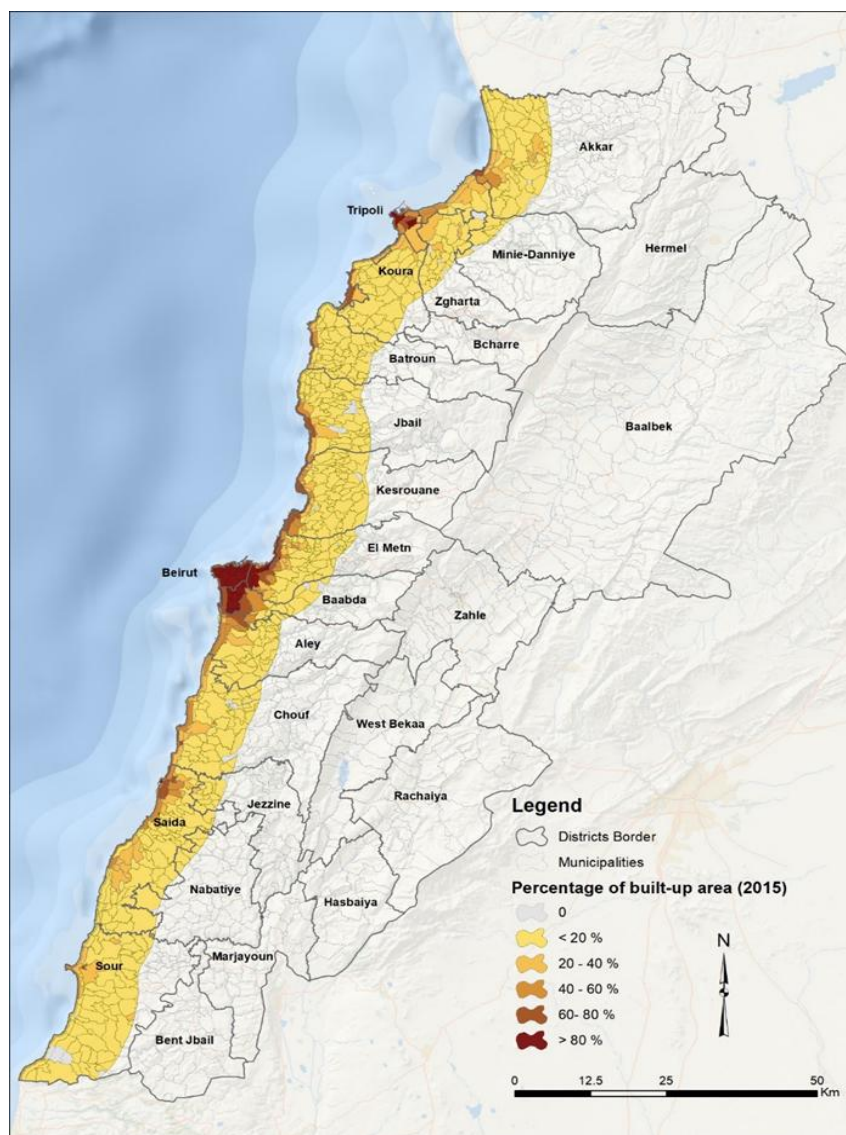
Figure 31: Percentage of built-up area in 2015 (Source: S. Termos, 2023)

Examining this change in land cover offers important information on how urbanization affects coastal development. The built-up area increase could account for urban growth and infrastructure development, which could thus imply negative outcomes for natural habitats and the present ecological environments. Evidently, the data has indicated a decrease in other types of land-cover with the increase in the built-up areas, thus suggesting that the expansion of urban areas is trespassing on other land cover classes, which is commonly present with rapid urbanization of regions as a result of population growth. On the other hand, a decrease in agriculture is also linked to periods of crises or conflicts, which could interrupt agricultural activities, obstruct farmers' livelihoods and reduce agricultural production overall, especially since people may prioritize urban development over agricultural land in such circumstances[290].

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[290] Candidate Common Indicator 25, "Land cover change" Assessment for Lebanon (Termos S., 2023), p. 36

1.2. Fragmentation and loss of coastal ecosystems

Increased urbanization and development projects along the coastline result in the harm of valuable natural resources and ecological habitats. These sites are transforming into urban areas and tourist services that disturb the existing balance of natural ecosystems (Figure 32)[291].
Though forests and woods along the coast in the ICZM Protocol's Article 10, Section 3 are safeguarded as "Specific Coastal Ecosystems", Lebanon lacks woodlands and forests that reach the shoreline since that region has long since been densely urbanized. Its coastal portions are partially covered in garrigue, but no particular legislation governs this ecology, whereas, the mountains fall into coastal waters in several parts of the coastline, making them eligible to be included in the coastal area, but that is location-specific[292].

Ecosystem fragmentation is caused by habitat loss, conversion, and degradation of certain environments, and this is exacerbated with the increase in haphazard urbanization along the coastline. Sometimes these alterations are so drastic that regeneration is no longer possible. If certain natural habitats have not been completely extinguished or altered, they are reduced to sub-optimal states[293].

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[291] 2023 - Candidate Common Indicator 25, "Land cover change" Assessment for Lebanon (Termos S., 2023), p. 8
[292] 2012 - ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf, Page 72
[293] 2015 - CBD 5th national report for Lebanon, p. 34
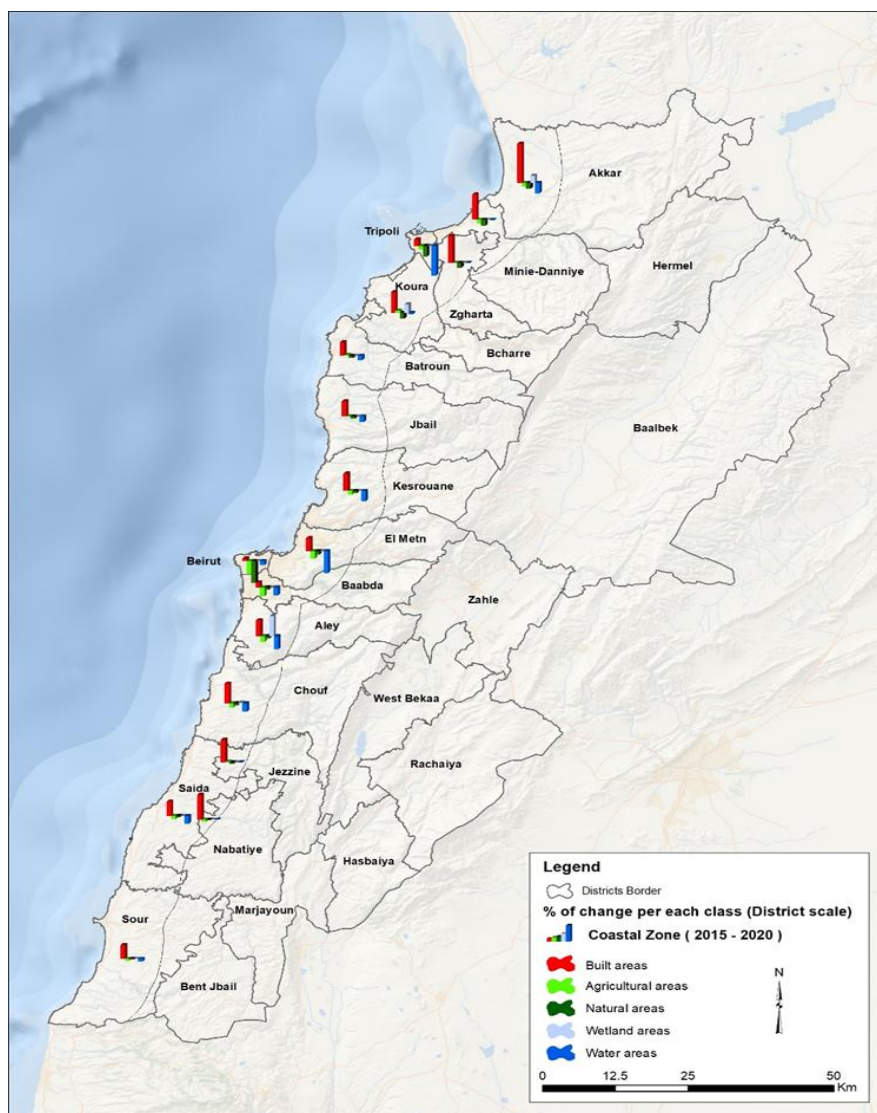
Figure 32: The percentage of change for each land class in different districts between the years 2015 and 2020 (Source: S. Termos, 2023)

On the other hand, there are preservation efforts of biodiversity present in the form of Protected Areas. Approximately 2.7% of Lebanon is made up of nature reserves, which are home to a rich biodiversity that includes 2,000 different species of plants and wildflowers, many of which are endemic, and over 370 different species of birds. Yet, a large number of other potential natural sites have not received national preservation initiatives, and even out of the eighteen established nature reserves in Lebanon, only six currently have management plans[294].

1.3. State of the current urban management plans of the coast

According to decision 144 of 1925, the LCZ is defined by the highest waterline in wintertime, containing sand and gravel beaches. The Lebanese MPD also includes the territorial sea up to 12NM (Nautical Miles) from the coastline and entails the sea, sea bed, and coast. In 1974, Article 1 of Decree Number 9132 connected the bed and depths of territorial waters to the MPD (Annex II: Map of the

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[294] 2015 - CBD 5th national report for Lebanon, p. 18

coastal strips in lebanon). According to the same article, islands within territorial waters and lands acquired from the sea and the MPD, either through siltation or landfill, can also be affiliated with the MPD through a decree issued by the CoM, following the proposal of the MoPWT[6]. However, Lebanese law does not clearly define the CZ, which would thus make it difficult to delineate a clear comprehensive strategy for the coast.

Currently, there are no comprehensive management plans for the CZ and marine waters or a clear national strategy that is applicable to conserve and sustain the Lebanese coast. However, there are several rules, regulations, and proposals put forward or currently being implemented that facilitate the process for the future. First of all, there is complete independence of specific institutions. Since the Government decided on the need for a public institution to manage the massive reconstruction necessary in Lebanon during the Civil War, the CDR was created in 1977. It is an independent body that has jurisdiction and answers directly to the CoM through the Prime Minister, which allows it to surpass the usual administrative bureaucracy to accelerate reconstruction processes. It has authority over the necessary planning and reconstruction supervision in Lebanon, overlapping with municipality and MoPWT jurisdictions, and has thus realized several projects related to the CZ[295].

There are also several instruments of institutional coordination between marine and terrestrial areas of the coast, ones that are created between different services and organizations found at the same administrative or geographical level. The Higher Council for Urban Planning (HCUP) is one of the main coordination mechanisms available, as it rearranges representatives from the relevant public institutions in CZM and issues permits for coastal developments. The CDR and the National Council of Environment also contribute to the coordination with concerned parties and supervise the management of the CZ. Meanwhile, the MoE coordinates with the responsible institutions to conduct laboratory investigations and analysis and propose mitigation methods to relevant groups. However, without the suitable resources, implementing such methodologies remains ineffective. Furthermore, two separate bodies, one under the Directorate General of Land and Maritime Transportation that is responsible for sanctions of violations regarding ports and harbors, and another linked to the ISF that manages the residual spaces of the coast that lay between municipal boundaries and these ports or harbors, coordinate through joint instructions by the ministers involved, but the body linked to the MoPWT has yet to be formed[296].

Regarding existing national legislations for integrated coastal management strategies, Decree No. 639 dated 18/09/2014 states the adhesion to the ICZM protocol. The current draft of the ICZM Law is still under study before being approved, and in parallel, a National ICZM strategy is awaiting official authority approval. There are also several laws and time-limited decisions at a local level that manage temporary coastal problems.

In general, the Law of Urban Planning (loit de l'urbanisme) in Lebanon is promulgated by Decree-Law n°69/83 through three parts: the first part is in the form of urban planning, in terms of plans and local regulations, the second part discusses urban operations, in the form of how the administration would implement a project blueprint, and the third part dictates urban licenses and authorizations, in the form of permits and land subdivision. Directly involved actors regarding the law of Urban Planning are mainly the HCUP and the Directorate General of Urban Planning (DGUP), whereas indirect actors are the CDR and municipalities[297].

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[295] 2012 - ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf p. 30
[296] 2023 - ICZM Questionnaire - Updated report 2023
[297] 2012 - ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf p. 57

All zoning and urban planning regulations in Lebanon apply to the coastal zone. The legal procedure begins by placing a zone under study to launch an Orientation Plan based on the scheme put in place by the MoPWT's minister, after he requests the opinion of the HCUP and the municipality or union of municipalities involved. When the zone is placed under study, it is verified by decree, so provisional measures need to be ensured so there are no future complications between land owners. Consequently, when the decree (renewable once) is published, construction, division or merger licenses cannot be issued in that zone. However, approval to licenses can be exempted by the HCUP, as well as embankment licenses can be granted after DGUP approval, thus undermining the law. The public administration can only stop works if the decree has been published, and it can only stop the works within a period of two years, and since the law does not have fixed dates for the study periods, construction licenses can be arranged three years after the study, which proves that provisional measures put in place have limited outcomes. The Code of Urban Planning amended this procedure through the DGUP[298]. Private companies are actually involved through decree n°9333/2002 that amends public contract procedures at the expense of the State if a municipality cannot afford to do it. Approvals or refusals of such plans, even on a municipal level, are considered at the CoM, thus local issues become part of national deliberations. Plans can be blocked if municipal councils conflict with land owners, so the declaration of urban plans requires a sequence of implementation measures. Nevertheless, the Construction Code still includes several exceptions, especially with regards to touristic resorts, that weaken the existing urban planning regulations. Violations are punishable according to article 36 of the Urban Planning Law: the first level of sanctions is administrative, where a fine would need to be paid if any demolition violates the law. This is done after a warning is sent to the violator, designating a time limit for the works to conform to the urban plans, which is then followed by demolition or rehabilitation orders once the deadline has passed. Usually, rehabilitation is the overarching rule, but this adds to the weakened state of the law[299].

Attaining private land for public use through the Lebanese Law of expropriation is possible through providing compensation before acquiring expropriated lands and facilitating fees for the imposed restrictions. The law also allows for partial expropriation of land for public interest[300]. Furthermore, with the aim of preserving the CZ, "the exploitation factor of private land can be reduced to 1%. In this case, the owner should be compensated for half of the value of the land"[301].

Certain laws and decrees established as short-term solutions to long-withstanding problems have harbored negative impacts on urban development along the coastal zone, creating a vicious cycle that has been going on for decades: "legislating" violations at one point and "settling" them at a later time. The purpose of Circular 33 of 2013 was to compel the Minister of Municipalities and the Interior to revoke circulars that permitted the issuance of building permits violating the law. Circular 483 was then published, which restored the authority of governors and mayors to grant residential building permits in rural regions, provided that the built area is not larger than 150 m² and that certain other prerequisites are met. Following this strategy, MoIM released Circular 613 in 2014, which effectively superseded the role of DGUP and OEA and gave municipalities the power to issue construction permits using the same building laws in effect for a year. This circular was a response to the high number of building permits issued without first consulting engineering or architectural offices, multiple violations of the construction law, and the exodus of young people from rural areas. The new decision seeks to address these issues by facilitating the building permit application process. Therefore, on agricultural and natural lands that were originally intended to be devoid of any buildings, all kinds of construction (from small utility shacks to larger residential units) were built, endangering food security, the

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[298] 2012 - ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf p. 58
[299] 2012 - ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf p. 59
[300]2023 - ICZM Questionnaire - Updated report 2023
[301] J. Yazbeck, towards a right to a healthy environment in Lebanon, PhD. Thesis, University of Côte d'Azur, December 2023. p.124

preservation of natural resources, and, consequently, the nation's environmental identity. New circulars were released to extend the duration of this circular and permit the addition of another level (Circular 352), in spite of intense objections from organizations including the MoE, OEA, and activists. The most recent circular's effects ran out in March 2020, but the MoIM gave a one-month extension in June 2020 so that incomplete work may be completed[302].

Meanwhile, internal instruments before the 2002 Urbanism Law included the law No. 69/1983 that limited urban planning jurisdiction of municipalities and contradicted the 1977 decree-law that empowered them. Similarly, Law No. 444/2002 pertains to land use issues: it dictates that land and sub-soil protection situations will be handled through decrees. Thus, the Government appointed the CDR in 2002 to initiate studies that elaborate on the NPMPLT presented in 2004. It is a strategic development plan that binds all public authorities in Lebanon. It outlines the development principles for various areas, clarifying the general land use of all areas, and proposes sites and projects for specific activities, their objectives, dimensions, and locations. It includes market policies and legislative procedures to incorporate sustainability management of marine and coastal ecosystems, and developed recommendations and guidelines within a strategy that anticipated growth through the year 2030[303].

This NPMPLT considers biodiversity through developing blue and green networks, proposing regional and national park concepts, and defining the coastal areas, mountains, and valleys that require national protection[304]. The proposed land use plan outlines development values for various regions in the country whilst proposing solutions through a master plan. By 2009, decree No. 2366/2009 adopted the master plan, yet this decree is highly dependent on the Government properly ensuring that the NPMPLT is imposed during urban planning decisions throughout these areas. To date, it is the only document that has such a thorough and in-depth national strategic territorial development. Still, many gaps in the Plan were identified, such as norms relating to urban forms (setbacks, dimensions of retaining walls) placed in the Construction Code that need to be modified in accordance to the NPMPLT plan, as well as the lack of a legally binding framework for local actors involved in the creation of comprehensive urban plans, nor its application at municipal or regional levels. The NPMPLT does not directly address guidelines and recommendations on regional and local levels, thus creating gaps in the legal framework that connects it to the local actors developing the detailed urban plans[305]. If these points are not ensured, then the NPMPLT remains as a soft law acting as recommendations rather than a required document. It is also issued by decree, whereas the Construction Code is law, which means that the masterplan cannot be modified and can be overruled by the Code when points are contradictory. Moreover, these rules become less relevant until they are out of date the longer they are delayed in being implemented. Since the majority of the NPMPLT data is already out of date, current occurrences—most notably the economic collapse and the Syrian refugee crisis—must be taken into account. CDR detailed in its 2017 Progress Report how it intends to work with the DGUP to modernize the NPMPLT. But as of right now, no action has been taken to implement this upgrade[306].

Generally, master plans in Lebanon are prepared at two levels. While detailed master plans address specifics like land use, road networks, and construction ratios, general master plans outline the fundamental development concepts of the designated zone (Law 69/1983). Even though the legislation mandates that master plans must take into account all stakeholders while preserving a balanced development, including social and environmental issues, there are currently no clear legal

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[302] 2020 - SOER Report - Chapter 7, Haphazard Urbanization, p. 332
[303] 2020 - SOER Report - Chapter 7, Haphazard Urbanization, p. 334
[304] 2015 - CBD 5th national report for Lebanon, p. 82
[305] [305] 2020 - SOER Report- Chapter 6, Land Resources, p. 290
[306] 2018 - CDR Progress Report for the year 2017.

objectives or aims to them[307]. There is still much to be done for the masterplans in Lebanon to have a proper framework, and that is due to significant deficiencies at the organization level: there remains an absence of comprehensive land surveys, no consolidated land use classifications or zoning methods throughout, and a deficiency in updated data[308].

With regards to available National Strategies for CZM, a national draft strategy for coastal areas was produced in parallel to the draft coastal zone law and submitted to the Ministry of Environment. The Integrated Management of East Mediterranean Coastline (IMAC) project of 2007 has also produced a strategy for the Northern Region of Lebanon that will be referenced when developing a national strategy. The Coastal Area Management Programme (CAMP) strategy at the MoE also acts as a starting point that can be easily modified and implemented in short time-frames. This strategy highlights the implementation of ICZM values to reach sustainable development of the coast, and incorporates the economy, environment and society. Meanwhile, the Environmental Resources Monitoring in Lebanon project, also known as the ERML project (2011-2013) that was implemented by the MOE and supervised by UNDP and UNEP, provided surveillance of the coastal area, identified priorities, and outlined legal information linked to the coastal zone project in order to support marine ecosystems and environments with the intention to form "Lebanon's MPA Strategy"[309].

Additionally, Decree 8213/2012 mandates that environmental concerns be taken into consideration throughout the preparatory stage of any plan, including urban master plans, by means of a SEA. Since its introduction, SEA has only sometimes been used; no assessment has been carried out to determine how it may affect the processes of planning and executing plans[310].

Other than the abovementioned, there are a few legal innovative tools present within the Lebanese law that are set in place for land management, such as land pooling or readjustment, but those tools have rarely been utilized due to their need for strong institutions that are able to manage and control the long and slow necessary procedures of land evaluation, expropriation and assessment[311].

1.4. Quarries versus sea-filling along the coast

Lebanon's quarrying industry is ill-organized, as seen by the lack of official statistics or accurate count of quarries that are currently in operation. Quarrying has been a prevalent factor necessary for the construction sector in Lebanon, but these activities have led to the infringement on forests and agro-ecosystems. In the past, quarries were allowed, but the majority of these quarries are still illegal, harming the Lebanese landscape. Many are left unattended without the damaged area being restored. A survey conducted in 2018 found that roughly 56km² of land were used for quarrying, primarily outside of the designated suitable areas mentioned in the 2009 NPMPLT[312].

Several initiatives endeavored to locate quarries and to ban such activities in favor of relying on imports, but these attempts failed. There are approximately 1,300 quarries of different scales in

[307] Basbous M, Saksouk A and Bekdache N. (2018). The Legislative Framework for Urban Planning: No Voice for the People Public Works Studio. The Legal Agenda, https://english.legalagenda.com/the-legislative-framework-for-urban-planning-no-voice-for-the-people/
[308] 2020 - SOER Report - Chapter 7, Haphazard Urbanization, p. 318
[309] 2023 - ICZM Questionnaire - Updated report 2023
[310] 2020 - SOER Report - Chapter 6, Land Resources, p. 274
[311] 2022. Beirut Urban Lab, The Lincoln Institute of Land Policy, and The Policy Initiative Land Policy Dialogue: Final Synthesis Report Expanding Betterment Contribution in Lebanon
[312] 2018. Quarries in Lebanon based on remote sensing. Atallah A (unpublished). Map coordinates and costing were introduced by Elias Sebastian Azzi, Fadi Doumani and Nakhle Hachem for the Ministry of Environment. Beirut

Lebanon that support the cement and construction industries. Between 1989 and 2005, 738ha of grasslands, 676ha of arable lands, and 137ha of forests were degraded due to quarrying practices. The reason for the need for these quarrying activities was due to lack of awareness, improper law enforcement, political corruption, and the need for rocks for construction due to the increase in housing demand from urbanization and socio-economic profits[313]. However, following the severe decrease in construction in 2019 and 2020, quarrying activities were reduced[314].

1.5. Privatization of public spaces by the sea

The privatization of the public beaches in Lebanon is a common phenomenon, exacerbated by recreational pressures and, most prominently, lack of adequate plans to tackle these pressures. Recreational activities are prominent along the Lebanese coast, and these are leisure activities that can sometimes harm the environment and marine ecosystems when practiced. Some of these activities that could contribute to such issues include significant construction pressures such as beach resorts and hotel construction on the coast, sea-filling to build restaurants, outdoor event spaces and chalets, as well as more domestic pressures such as littering and fire burning[315]. A recent example is the 2018 opening of the Eden Bay Resort in Beirut, which was successful despite demonstrations and public opposition to its development. Many opponents criticize the anomalies and violations that allowed the hotel to be built on the public beach in Ramlet el Bayda. The majority of the 1,026–1,068 violations of the MPD, as reported by the MoPWT, date from the conflict that lasted from 1975 to 1990[316].

There are certain laws and legal instruments that exist in Lebanon that are intended to restrict coastal construction, but have been rendered inadequate. Urban Planning along the CZ still follows outdated regulations. Decree No. 17614 of 1964 that accounts for exploitation with regards to the MPD, along with decree No. 4810 of 1966 that regulates occupation of the said domain, have produced the road map to control the exploitation of this coastal public domain. Decree No. 17614/1964 decided on the protocol for obtaining permits to utilize the MPD, whereas the Law/Decrees No. 4809 and No. 4810 from 1966 specify that the leisurely use of the public maritime domain returns to the public, thus ensuring that privatization of the public domain cannot be authorized. Since the MPD falls under decree No. 4810/1966, the territory cannot be under private ownership, but exemptions were done for the benefit of touristic projects, industrial use when necessary, and private seafront residences. These exceptions are under the jurisdiction of the DGUP[317]. Legally, zones over 100m in width from the highest winter waterline are still allowed to host coastal construction. A law or decree to rectify this has not yet been established[318]. Thus, other decrees have weakened the 1966 decree, where decree 169/1989 (which as later annulled in 1990) allowed landowners who have over 20000m^2 of land in Beirut's Zone 10 near the sea to use the public domain for private purposes. In 1995, the occupation of the public domain of the Beirut zone became possible by Decree No. 7464. Such exceptions, along with other laws that set up additional exceptions, have destabilized the existing law, rendering it mostly useless[319].

Furthermore, proper strategies to monitor resort developments are not available, and paired with lack awareness and lack of control of construction regulations and implementation of the EIA decree, this

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[313] 2015 - CBD 5th national report for Lebanon, p. 36
[314]2020 - Construction sector faces severe contraction in Lebanon. Arab News. Retrieved from: https://www.arabnews.com/node/1686776/middle-east , Houssari N.
[315] 2015 - CBD 5th national report for Lebanon, p. 36
[316] 2020 - SOER Report - Chapter 7, Haphazard Urbanization, p.331
[317] 2012 - ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf p. 59
[318] 2023 - ICZM Questionnaire - Updated report 2023
[319] 2023 - ICZM Questionnaire - Updated report 2023

leads to similar practices along the shoreline[320]. Approximately 73% of violations are non-residential buildings on public land that are utilized for commercial or tourism purposes and, as such, are not eligible for compensation. The MoPWT requested in May 2020 that the Attorney General implements Law 64/2017 and its amendment Law 132/2019 to recover the remaining lands linked to infringement cases[321].

Having stated that, the legalization of building violations on public maritime property does not solve neither the public rights dispute nor the environmental harm. Instead of restricting itself to charging fees, it ought to guarantee environmental preservation and make the shoreline open to the general public. Law 139 of 2019 established the settlement for building code violations that happened between 1971 and 2018. It lists the fines that are imposed based on the kind of infraction, but as long as the infraction takes place on the violator's land, it permits the settlement of any infringement. This law removes any possibility of reclamation by legitimizing any infringement, provided it occurs on private property. Rather than focusing on interventions or demolitions, the law concentrates on collecting fees for the municipalities, the Treasury, and the Public Corporation for Housing. This is justified by the fact that the majority of the violating structures are too old to be removed[285].

1.6. Sea-filling

The shore regulations in the Lebanese Legislation system are over 50 years old. There are some disjointed texts that introduce regulations to certain coastal areas such as Jounieh and Jbeil, whereas the Tyre beach has been turned into a nature reserve.

Rising land values drive efforts to appropriate seaside lands and backfill the sea with materials. Rapid urban construction and consumption generate waste and excavated material flows, with intensified consumerist consumption that has been generating more waste in recent years, and rejection of materials (the production of rubble) correlated to capital circulation. In Lebanon, capital from foreign investments feeds consumption and real estate. Ad hoc solutions to the waste crisis have led to landfill construction, posing future land closures[322]. Certain parts of the coast have been subject to – or intended to be subjected to – sea-filling to create new land, such as in northern Beirut, Dbayeh, Solidère's Beirut Central District, and the Elissar project[323]. The most recently planned sea filling is for Saida beach.

As an alleged temporary solution, municipal waste is deposited in the coastal landfills of Borj Hammoud, Jdeideh, and Costa Brava since the waste crisis in the greater Beirut area first surfaced in 2015. This approach is just a reiteration of choices made during the Civil War, where urban plans from the 1950s and 1960s that were never carried out, are transformed into reclaimed lands that are frequently applied to areas designated for development[324]. As an example, the most well-known embankment in Beirut's present city center is called BIEL and covers more than 60ha of parcelled land with a conference and exhibition center. This beachfront extension is the outcome of several schemes and initiatives that began in the 1960s, one of which was to acquire land by the sea. The fifteen years of civil war and the metabolic disturbance it brought about for the disposal of household trash gave rise to the possibility of filling in Normandy Bay, which was turned into a landfill in 1978,

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[320] 2015 - CBD 5th national report for Lebanon, p. 37

[321] 2020 - SOER Report - Chapter 7, Haphazard Urbanization, p 332

[322] 2021 - Seafront Reclamations, Rubble, and Waste: A Metabolic Reading of Lebanese Urbanization. Verdeil, E., https://thederivative.org/for-rubble-%D8%B1-%D8%AF-%D9%85/. ffhalshs-03381308f

[323] 2012 - ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf p. 12

[324] 2021 - Seafront Reclamations, Rubble, and Waste: A Metabolic Reading of Lebanese Urbanization. Verdeil, E., https://thederivative.org/for-rubble-%D8%B1-%D8%AF-%D9%85/. ffhalshs-03381308f

which in turn grew and was transformed into BIEL. The city center embankment illustrates how sea reclamation plans led to unexpected waste and rubble influx, leading developers to exploit the landfill as a profit opportunity, extending embankment area and imposing reinforcement works. Similarly, land reclamation plans for the North Metn coast since the 1960s, including an eight-kilometer stretch from Borj Hammoud to Dbayeh, were never realized, but the study was revived in the 80s and where the Borj Hammoud region became a waste material dump, while the Dbayeh area was prioritized and then revived once again in the 1990s to now form The Waterfront City, a marina and luxury residential complex(Figure 34 and Figure 33)[325].

Figure 34: Satellite Image of the Beirut coast in 1985

Figure 33: Satellite image of the Beirut coast in 2022

1.7. Transportation networks and infrastructure

Air, sea, and land transportation are all included in the transportation sector. Due to inadequacies in the legal system and law enforcement, Lebanon's road transportation industry has numerous issues. The following are a few, non-exhaustive explanations, all of which have an effect on the coastal zone: in regards to road conditions, road networks are unsuitable and not safe for driving; they lack of lighting and proper lanes, and are poorly maintained. There is an improper upkeep of the dual drainage/sewage system, disorganized urban planning, inadequate signalization by drivers, lack of bike/bus lanes and pedestrian sidewalks, an abundance of stores (pharmacies, bakeries, etc.) and intersections all along the highway, to mention a few examples[326]. The growing number of people utilizing cars for transportation is also causing traffic congestion and increased strain on roadways due to urban expansion. It also calls for increased spending on public infrastructure, something the government is unable to regulate[327]. There are many reasons for this, but one is that Lebanon lacks a true expressway, and the traffic congestion is also primarily caused by poor road planning and design. The street networks of major coastal cities are frequently very old and do not accommodate the modern demands of efficient traffic flow[328].

Similarly, because of its location on the coast, the Rafic Hariri International Airport in Beirut raises serious concerns about the protection and management of coastal zones. The runway's landing end begins in the sea, where there have been no reports of environmental harm from the construction, particularly since the EIA decree was not in place when the runway was constructed[329].

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[325] 2021 - Seafront Reclamations, Rubble, and Waste: A Metabolic Reading of Lebanese Urbanization. Verdeil, E., https://thederivative.org/for-rubble-%D8%B1-%D8%AF-%D9%85/. ffhalshs-03381308f
[326] 2012 - ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf, p. 60
[327] SOER Report 2021- Chapter 6, Land Resources, p. 267
[328] 2012 - ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf, p. 61
[329] 2012 - ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf, p. 62

There are currently no requirements in the tenders for maintenance-related works on the transportation network. In fact, Lebanon experiences nearly nonexistent maintenance for projects in this industry. Lebanon is required under a number of international and regional treaties to implement guidelines and take action to safeguard the environment from the effects of the transportation industry. However, there are no laws that control this industry in this way, which leaves a gap when it comes to Lebanon's ability to fulfill its international duties.

1.8. Pollution

There are various sources of pollution present along the coastline, but ones that are mostly directly linked to land-use and spatial planning are the presence of landfills. Pollution from several sources can affect terrestrial, marine, and coastal ecologies and networks[330]. Most of these land-based sources of pollution will eventually reach coastal waters due to inadequate infrastructure and improper management of industrial, agricultural, and household wastewater. River discharges are regarded as the primary land-based source of pollution affecting Lebanon's marine and coastal environments due to the country's twelve major coastal rivers. However, solid waste disposal impacts are acknowledged as additional land-based pollution sources[331] (Figure 35).

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[330] 2015 - CBD 5th national report for Lebanon, figure 7, p. 40
[331] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf, p. 20

Figure 35: Map showing the road concentration along the coast (Source: S.Termos, 2023)

1.8.1. Urban/Domestic Pollution:

In addition to hundreds of thousands of tourists, over 70% of Lebanon's population lives along the shore, where this mostly untreated sewage burden is then dumped into coastal seas due to insufficient functional sewage treatment facilities currently operating. Apart from untreated wastewater originating from major cities and towns, massive seaside dumpsites located mostly in Tripoli, Bourj-Hammound, Naameh, Saida, and Tyre also have an impact on coastal waters[332].

1.8.2. Industrial discharge:

Coastal waters are becoming more and more contaminated as a result of the heavy industries' overwhelming presence along the shore. Seawater near industrial sites has been shown to have high concentrations of heavy metals, where ecosystems and biota are known to be affected by these

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[332] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf, p. 20

industrial contaminants. There have been reports of wastewater discharges from industries and other sources into a number of coastal locations[296].

1.8.3. Agricultural run-offs:

The agricultural plains of Akkar and Damour are the primary locations for agriculture on the Lebanese coast, however some smaller-scale farming operations are also present in a number of other places, including the TCNR. However, the majority of agricultural practices are conventional, unsustainable, and ignore the effects they have on the environment, particularly the soil, in addition to fresh and marine water bodies. This industry's excessive use of chemicals like pesticides and fertilizers leads to pollution, where chemicals seep into aquifers and contaminate groundwater, and thus fertile soils can degrade. Delicate coastal ecosystems are also threatened by the contaminated runoff from agricultural areas that enters coastal waters through rivers and streams[333].

1.8.4. Noise and visual pollution:

Both noise and visual pollution contribute to coastal pollution. Noise pollution originates from coastal highways running parallel to shorelines as well as the coastal international airport south of Beirut, while visual pollution is the result of haphazard construction of tourist complexes and human settlements that obscure the sea view and have the least amount of aesthetic standards[334].

2. Drivers:

This section discusses the human needs and pressures in regards to the survival and thriving of urban, economic, ecological and anthropogenic systems that result in the states and current conditions mentioned above.

2.1. Urbanization and demographic shifts

According to calculations and visualizations made using Global Land Cover - Fine Classification 30 dataset for the initial monitoring of the CCI25, Lebanon's coastal zone is under a great deal of anthropogenic densification, mostly from urbanization (Figure 36). The concentration of population can be explained by the concentration of refugee communities, attractive beach resorts, ports, and significant businesses situated in close proximity to the shore[335], thus increasing the artificialization of the CZ.

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[333] FAO. (2020). FAOSTAT. Retrieved from: http://www.fao.org/faostat/en/#data
[334] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf, p. 21
[335] Candidate Common Indicator 25, "Land cover change" Assessment for Lebanon (Termos S., 2023), p. 23
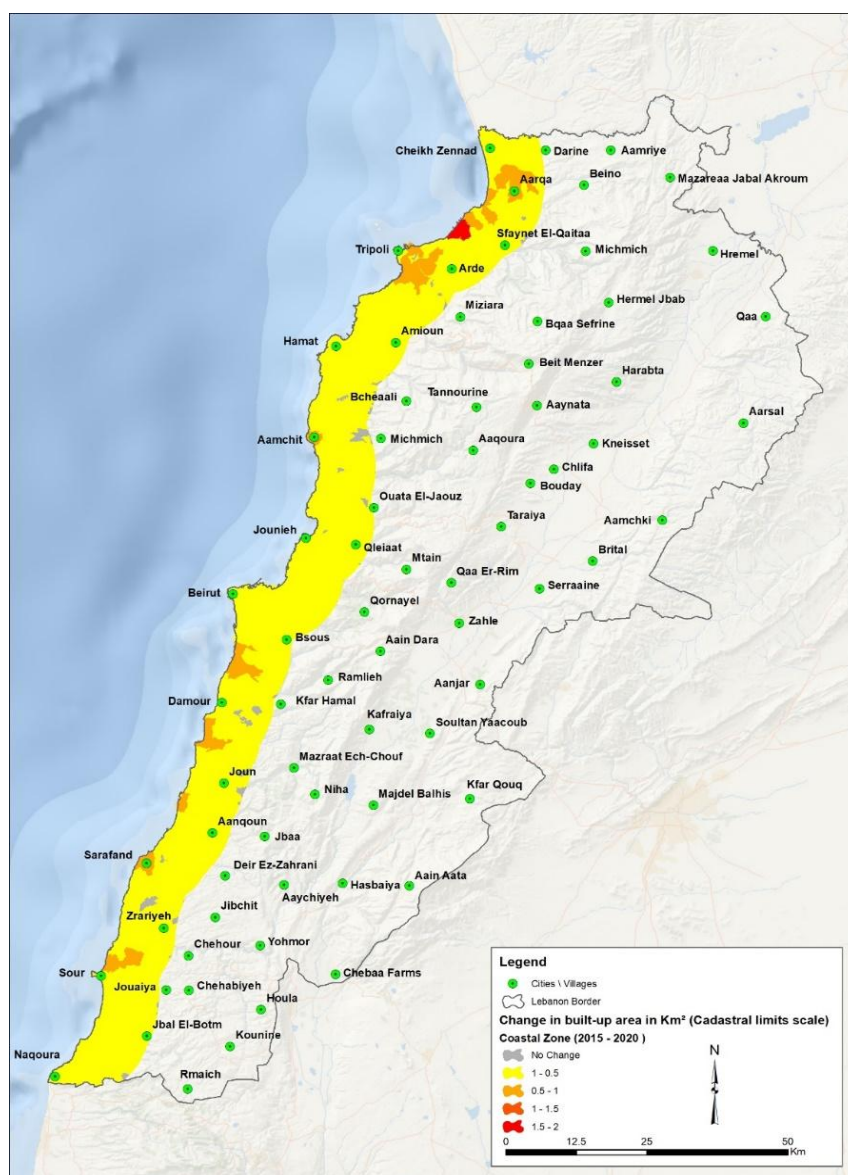
Figure 36: The change in built-up area between the years 2015 and 2020 along the coast (Source: S. Termos, 2023)

2.2. Legal regulations and the stakeholders involved

Ultimately, land use change and evolution is encouraged by the lack of law enforcement that allowed the undertaking of illegal actions along the coast such as building without permits, encroaching on the MPD and large scale sea-filling which have resulted in the current urban transformations along the coast that we see today[336]. Moreover, unsuitable inheritance law, lack of suitable implementation of the construction law, and real estate speculations in parallel to a lack of awareness increase these risks onto the existing natural habitats[337].

Furthermore, the lack of clear consensus in regards to coordination of stakeholders and monitoring of necessary urban services leads to neglect or mismanagement of certain necessary sectors. In between

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[336] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf p. 11
[337] 2015 - CBD 5th national report for Lebanon, p. 34

municipalities and the MoPWT, decree No. 13379/1998 states that the Directorate General of Roads and Buildings within the MoPWT is not in charge of internal roads, roads under municipal jurisdiction (i.e., roads not used for national transportation), or buildings owned by the Lebanese army, security forces, post, or telecommunications, and are therefore under the responsibility of the municipalities. Nevertheless, it might be difficult to distinguish between "internal roads" and "roads of national use," which results in neglect of some roads caused by a lack of accountability. This also happens with practically every public project that needs to be done. The Security Forces and the towns share responsibilities for law enforcement when it comes to highways, bridges, walls, water channels, and public buildings. The MoPWT's DGUP is only permitted to become involved in matters when complaints are made; after building construction is completed, its only responsibility is to inspect the work to ensure that it complies with license requirements. The refusal of accountability by all parties may possibly be the cause of the absence of law enforcement in this case. Another example of this overlap is the construction of seaside resorts on private property that falls under municipal jurisdiction, whereas sea filling and marinas obtain permits from the MoPWT without any requirement for municipalities to supervise the building process

2.3. Provision of economic services

The LCZ has been responsible for providing so many resources, but the accelerated population growth along the coastline is causing faster depletion of these resources and thus harming the available ecosystems. Agriculture was regarded as the second most important sector for the country's economy, behind services and tourism. The coastal plains of Lebanon, despite their narrowness, have been used to meet domestic needs and facilitate certain exports. This sector was severely impacted by the conversion of agricultural fields to other uses, the absence of government support, and the massive immigration of rural communities during and after the Civil War (1975–1990)[338]. Land tenure is also a major barrier to sustainable agriculture. Implementing comprehensive and unified soil management for a given geographic zone is challenging since most farmers work on extremely small parcels: 75% of them operate on less than 1 ha of Usable Agricultural Surface (UAS) and 95% on less than 4ha[339]. In addition, the design of the parcel may present challenges, such as with long land parcels, deterring farmers from farming it.

The economy and society both depend on marine water bodies. They are a type of natural capital that adds value to the stocks and flows of products and services, directly as in the case of seafood, medications, oils and additives, small-scale drinkable water, building materials[340], as well as tourist and leisure services that are very beneficial to the country's economy[341].

2.4. Wars

Wars and conflicts cause different types of chaotic urbanization that lead to future irreversible consequences. Since the 1970s, political unrest, armed conflicts, strikes, and protests have occurred in Lebanon; as a result, the government has shifted its attention from environmental issues to security-related ones. From 1975 to 1990, the Civil War entirely disregarded the regulations pertaining to shorelines and beaches, resulting in many and occasionally irreversible violations. The Israeli War on Lebanon in 2006 caused extensive environmental damage, especially from the oil spill that

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[338] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf
[339] Darwish, T. (2015). National priorities for Sustainable Soil Management in Lebanon, CNRS, Centre for Remote Sensing in Lebanon, 2015.
[340] 2015 - CBD 5th national report for Lebanon, p. 53
[341] 2015 - CBD 5th national report for Lebanon, p. 56

contaminated over 150km of coastline. Due to the 15-year Civil War, there was no law enforcement at all, and abuses were encouraged, causing irreparable harm to the ecosystem.

Till this day, the conflicts rage on, primarily at the political level with battles taking place on the ground. So, progress is sluggish since environmental problems can quickly turn into political ones. The primary goal is being lost as a result, and the natural environment usually suffers first[342].

2.5. Real estate and construction

Large-scale public works are not adequately integrated due to the demographic growth, weak urban planning, crises and wars, and political instability, which could consequently affect ecosystems. Sand extracted from shores for the purpose of construction threatens these habitats. Moreover, political pressure and the high profit from gravel, sand and stone and the lack of law enforcement and awareness encourage such practices and exacerbate these available resources, since biodiversity and ecosystem services are not given much intrinsic value outside of the construction sector[343].

New construction is ultimately driven by the real estate market. Between 2006 and 2014, there was an exponential increase in demand for real estate, as foreigners, expats, and locals invested at record levels in Lebanon's real estate market. Since then, the ensuing economic crisis has made the real estate industry's shortcomings worse. Following the political unrest and the Syrian crisis, Foreign Direct Investments (FDI) fell drastically. In spite of this, real estate accounted for 70% of FDI in 2018 and 16% of foreign projects, much of which were focused on Syria's rehabilitation. With 13% of acquisitions credited to each, Saudi Arabians and Syrians continued to be by far the leading real estate investors, where nearly all of these transactions took place in Mount Lebanon (47%) or Beirut (45%)[344].

In recent years, the real estate market has slowed down significantly between 2011 and 2019, and that is partially due to oversupply in luxurious residential structures that do not cater to the majority of the current market demand of the population[345], whereas the addition of displaced Syrians oversaturated the affordable housing market that led to new haphazard construction. A reliable measure showed the amount of construction permits issued, which decreased from about 16 million in 2011 to roughly 6 million m² in 2019[346]. But since late 2019, when local banking institutions have come under more scrutiny, real estate transactions have rebounded, albeit mostly restricted to finished structures and financially indebted developers[347]. Depositors found refuge in investing in real estate during those times, opting out of relying on banks as much. Since then, the situation has remained incredibly volatile[311].

3. PRESSURES:

This section emphasizes the direct results of these drivers on an urban scale, resulting in physical and morphological transformations along the coast, as well as economic and environmental changes at different scales.

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[342] 2012 - ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf, p. 82
[343] 2015 - CBD 5th national report for Lebanon, p. 36
[344] 2019- IDAL. FDI Data. Retrieved from:
https://investinlebanon.gov.lb/en/lebanon_at_a_glance/foreign_direct_investments/foreign_investment_structure
[345] 2018 -. "Lebanon's real estate market: The worst is yet to come", Azar, G. Annahar. https://www.annahar.com/english/article/824021-lebanon-real-estate-market-the-worst-is-yet-to-come
[346] Banque du Liban, Statistics and Research. Retrieved from: https://www.bdl.gov.lb/statistics-and-research.html
[347] 2020 - "Lebanese buy up property as government defaults", Cornish, C. Financial Times. https:// www.ft.com/content/eb735370-5a14-11ea-abe5-8e03987b7b20

3.1. Transformation in built-up areas and habitat fragmentations

According to the Global Land Cover - Fine Classification 30 dataset, a noteworthy increase in the built-up area between 2015 and 2020 was observed, particularly in the North and Akkar regions. This increase is the result of the establishment of refugee camps, even if they are currently not a permanent feature in the area[348]. These anthropogenic pressures are some of the main causes for the identified major stresses along the LCZ. Several factors have threatened the marine and coastal ecosystems, which are linked to urban sprawl, industrialization, unmonitored agriculture, unregulated waste management, tourism, sand extraction and dredging, water pollution and toxic fishing practices. These issues are caused by the lack of coordination among the various sectors accountable for the management of the marine and CZ, as well as the lack of consolidated data in regards to the existing biodiversity[349].

Similarly, the escalation of sand suction and gravel extraction activities can be attributed to the absence of environmental regulations. The extraction of gravel and sand from the public maritime domain and seabed was prohibited by decree 10121/1962, which was later modified by decree 15649/1970. However, this prohibition was subject to an exception, determined by the Minister of Public Works and Transport, in the event that such activities are intended to clean ports and harbors or if the extracted material is required for natural defense purposes for water filters. While most construction materials are mainly imported, cement, stone tiles, and quarrying products are produced locally at sites like Tartij and Chekka. This has significant environmental impacts and distorts the cement market. Cement plants often rely on adjacent lands for raw materials, leading to quarries spreading over 1 million m^2 in the Chekka region[350].

The MoI is in charge of the industry's zoning under Building Law 646/2004, which regulates setbacks[351]. Regardless of the permitted building footprint, it is customary to excavate the entire land parcel and level it afterwards due to construction requirements. Landscapes undergo substantial alteration as the natural terrain arrangement entirely vanishes. Because underground portions of a building might occupy the entire lot area (especially along slopes terrain) and exploitation ratios are only applicable to aboveground levels, building construction thus reduces soil permeability, which in turn reduces vegetation cover and increases flood risk. Other noted effects include the large amount of excavated material, which is typically collected in open dumps, and a higher risk of landslides, particularly when dense building is carried out on unsound slopes[352].

3.2. Pollution

The terrestrial causes of pollutions include, but are not limited to, untreated discharge caused by inadequate infrastructure and treatment plants, unsuitable dumping of waste, wars, and gas emissions from industries, incinerators and vehicles[353]. Moreover, pollution is so widespread in the country due to the lack of law enforcement and proper funding, as well as inadequate awareness on the effects of pollution on the ecosystem[354].

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[348] Candidate Common Indicator 25, "Land cover change" Assessment for Lebanon (Termos S., 2023), p. 31
[349] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf p. 5
[350] 2019 -. Koura's Land: From Fertile Resource to Raw Material for Cement Factories. Public Works Studio.
[351] 2023 - ICZM Questionnaire - Updated report 2023
[352] Lamy, S. (2017). L'ecriture de la regle d'urbanisme adapte au cas des terrains en pente.
2019 - Horsh Beirut competition, Retrieved from http://nahnoo.org/competition-download/, Nahnoo
[353] 2015 - CBD 5th national report for Lebanon, figure 7, p. 40
[354] 2015 - CBD 5th national report for Lebanon, p. 42

Similarly, marine pollution affecting marine and coastal environments is the result of different types of wastes thrown into the sea. In addition, discharge of pollutants from ships occurs due to the lack of maritime regulations. Other pressures that increase the destruction of the present marine ecosystems are mostly linked to the lack of awareness in general, as well as lack of proper legal implementations which could lead to improper social behaviors. Air pollution also affects the coast through acidification as a result of industrial undertakings as well as transportation and traffic congestion along the coast[355].

There are numerous causes for the different symptoms that are seen all along the shore. For instance, strategies to reduce and eventually eliminate some of the sources and hazards of pollution have been in place since the early 1990s. Although many wastewater treatment facilities were constructed along the shore, only a small number of them are still in operation. Likewise, plans were developed for the management of solid waste as part of an integrated system that included land-filling, composting, recycling, and garbage sorting. At all levels, there is currently discussion over solid waste management in Lebanon in the hopes of coming up with an environmentally friendly solution based on sustainable development strategies[356].

3.3. Land-use zoning transformation, transportation, and service provision

Another factor contributing to habitat loss, destruction, or fragmentation is recreational pressure. The primary reason for this incident is the lack of a proper strategy. Recreational activities are leisure pursuits that may occasionally have a negative impact on the environment[357].

Although legislators are aware of the importance of land organization and the effects of artificialization along the coast, especially in regards to water quality and biological resources, only short-term strategies were put in place to handle the mismanagement of the CZ[358].

4. IMPACTS:

Significant effects of urbanization and other land cover changes include habitat loss, biodiversity loss, habitat fragmentation, erosion risk, and carbon sequestration. Practices such as quarrying, sea-filling and sand extraction have hastened erosion, converted landscapes and farmlands, altered ecosystems and natural habitats, and reduced existing resources[359].

Natural processes such as sedimentation, erosion, and land degradation along the coast lead to the loss of important coastal habitats and land. The coastline and coastal landscapes may alter throughout time as a result of these activities, which are a part of the dynamic nature of coastal habitats[360].

Furthermore, due in large to the government's insufficient attention toward safeguarding the coastal agricultural sector in terms of lands, products, and economic outputs, farmers are increasingly turning their productive lands into projects with quick payback periods, primarily in the tourism industry. Permanent urbanization and industrialization of agricultural and natural lands represent additional stress on coastal agricultural plains and lands. Of more significance is the persistent and puzzling lack

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[355] 2015 - CBD 5th national report for Lebanon, p. 42
[356] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf, p. 21
[357] 2015 - CBD 5th national report for Lebanon, p. 36
[358] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf p. 22
[359] 2015 - CBD 5th national report for Lebanon, p. 36
[360] 2023 - Candidate Common Indicator 25, "Land cover change" Assessment for Lebanon, Termos S., 2023

of a national agricultural plan, despite the overwhelming need for one and the persistent aspirations expressed by governmental and community actors to implement one (MOE/UNDP/ECODIT, 2011)[361].

The following succinctly describes the primary detrimental effects of agriculture on the coastal environment (FAO, 2009): Pesticides used in agriculture contaminate and pollute both inland and coastal waters, lowering fish yields and perhaps causing harmful fish to be consumed by humans. Whereas, over-cropping in the coastal zone also reduces fishing and tourism and causes biological variety loss due to soil erosion and marine sedimentation. Furthermore, irrigation from coastal aquifers cause groundwater contamination and the depletion of coastal aquifers, and intense animal operations lead to organic contamination, resulting in fish poisoning and eutrophication.

Despite recent efforts, particularly the drive to improve the wastewater problem, the water sector remains severely weak. Even while independent public agencies oversee the water sector, the distribution of water is still, subpar and uneven. The state of water networks has not improved, sewage networks are nearly nonexistent in some areas and buildings are not connected to the network in others, drinking water is contaminated by feces and other substances, and the upkeep of existing networks is at best meager, all of which affect the health of both the population and the ecosystems[362].

Also, from an aesthetic perspective, damage to the landscape affects both the health of the ecosystem and the economy: industrial areas have an ugly appearance, which deters tourists and puts more strain on the ecology in the area. These lands are also being developed into infrastructure, resorts, and cities, upsetting the delicate balance of coastal ecosystems.

Moreover, Residential areas are often close to industrial sites, which occasionally merge with them[363], leading to cause for health concerns. Further exacerbation of the available natural resources also leads to their endangerment or even possible extinction[364].

The pressure that quarrying and mineral extraction place on land is tremendous. The industry is predominantly driven by the real estate sector and does not confine its operations within the law, which opens the door for toxins to seep into the soil, topsoil removal, and increasing air pollution. Additionally, surface runoff, decreased natural aquifer recharge, and increased seawater intrusion are all caused by abandoned quarries (el Moujabber et al., 2006)[365].

Numerous elements of urban morphology impact a city's microclimate. The term "urban heat island" describes a substantial increase in temperature that occurs in urban areas as a result of hard terrain' high heat potential. Temperatures are predicted to reach 40C by 2100 due to the presence of dark materials such as asphalt and highly reflecting surfaces. The difficulty has grown as a result of the 2004 urban design changes, which allowed for larger buildings with fewer open balconies and green areas. In addition, the narrow, twisting roadways that characterize the Beirut street network provide a noticeable street canyon effect that traps air pollutants and reduces wind speed[366].

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[361] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf
[362] 2012 - ERML-A(ii) Analysis of the Institutional and Legal Frameworks. Coastal Zone. Final Report.pdf, p. 28
[363] 2018 - Strategic Plan for Development Of The Industrial Zones (2018-2030), MoI.
[364] 2023 - Candidate Common Indicator 25, "Land cover change" Assessment for Lebanon (Termos S., 2023), p.8
[365] 2020 - SOER Report - Chapter 6, Land Resources, p. 269
[366] 2020 - The Impact of Changes in Beirut Urban Patterns On the Microclimate: A Review of Urban Policy and Building Regulations." Mohsen, H., Rokia, R., and Ibtihal Y. E. Architecture and Planning Journal (APJ) 25.1: 2

Since the coastal cities in Lebanon are densely populated, building structures are clustered very closely together, thus blocking sunlight and hindering natural ventilation. Odors and other unhygienic situations might arise, particularly in the summer. During periods of precipitation, bouts of localized flooding are caused by the impermeability of ground surfaces, where every year, residents endure floods in low-lying regions, beneath bridges, and in tunnels, as well as wherever that drainage networks are unable to quickly remove standing water. The absence of public facilities like parks, gardens, playgrounds, clean public beaches, dedicated athletic areas also has a major negative influence on the inclusion and well-being of the residents[367].

5. RESPONSES:

This section discusses the series of strategies, legislations, publications that have been published, implemented, or proposed to solve some of the recurring urban pressures and impacts existing along the coast. Integrated coastal management strategies encompass comprehensive studies regarding resources, social needs and economic activities that are then analyzed to understand their threats and opportunities on the coastal areas and propose specific responses and future actions. An integrated coastal strategy inspects past and present conditions to select future optimal outcomes.

5.1. DEFINING THE COASTAL ZONE:

The ICZM of Lebanon was suggested and submitted to be approved by the MoE, and it provides the information that will define the coastal boundary[368]. The articles of this proposed law include first properly defining the CZ as referenced by article 2 of the ICZM protocol, which is the "geomorphologic area either side of the seashore in which the interaction between the marine and the land parts occurs in the form of complex ecological and resource systems made up of biotic and abiotic components coexisting and interacting with human communities and relevant socio-economic activities". This would thus comprise of Lebanese territory, including coastal lands and waters. Similarly, the Coastal Waters consist of either the water extending 12NM from the highest watermark (counting tidal zones) or reaching towards the brink of the continental shelf (200m depth), whichever is closer. These articles also tackle river tributaries, wetlands, and water bodies and resources. On the other hand, the law also defines Coastal lands through both an ecosystem approach and economic and social standards associated with geomorphological features, also including estuaries, rivers, wetlands and water bodies within the caza limits[369].

The need to contextualize the delineation of CZ taking onto consideration the geomorphological specificities and diversities of the Lebanese coast is crucial. An approach combining various factors such as topography (consider a criterion or set figure for altitude), depth from seal level towards inland, along to other factors in relation with ecosystems and other factors, is to be recommended.

5.2. PROTECTED AREAS

On one hand, establishing protected areas (PAs) was a critical first step in recognizing the nation's natural and cultural legacy. Since the 1930s, Lebanon has designated natural areas and landscapes as Pas. Initially, the MoET was in charge of this designation, but the MoE has been credited with PAs foundation ever since it was established in 1993. The MoA's mandate covers a certain category[370].

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367 2020 - SOER Report - Chapter 7, Haphazard Urbanization, p.318
368 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf p. 5
369 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf p. 6
370 2015 - CBD 5th national report for Lebanon, p. 18

More recently, a new PA classification system that specifies each category's establishment criteria along with its management modalities and objectives was introduced, undergoing additional changes between 2006 and 2012 to improve its administration. With the help of decree No. 8045, dated 25/4/2012, the draft Protected Areas Framework Law was brought before the Parliament, which was then approved. As a result, a draft application decree was created that establishes the legal parameters for the different types of PAs, including their goals, classification, administration, and funding sources. This permits the organizations in charge of future natural park management to collaborate with the private sector and apply for loans[371]. The four categories are the Nature Reserves (NRs), natural parks, natural site and monument, and hima[335]. Eventually, the nine NRs were increased to 18 (Annex IX: Map of the Protected Areas, existing and proposed, along the Lebanese Coast).

Moreover, the PINR, TCNR and ACN have been legally recognized as part of the sustainable development of the CZ, but the absence of proper implementation of these strategies resulted in disorganized distribution of industries along the shoreline. To resolve this deficiency in legality regarding the CZ, Law 444/2002 put in place on protection of the environment entrusted the MoE in coordination with the MoPWT and all related authorities involved to undertake administrative plans and issues regarding shore protection and outlining the necessary preventative procedures of marine pollution caused by ships, vessels and facilities in the Lebanese sea, special protection for wetlands and their ecosystems, as well as outlaw drainage, flooding and burning in Lebanese territorial waters that could possibly affect human health, the existing natural resources and seawater quality. However, the law did not include a comprehensive management strategy for the coast or marine territory if there were any plans to be produced for coastline management and protection[372].

5.3. STRATEGIC ENVIRONMENTAL ASSESSMENT

The following two decrees were adopted and executed: The SEA Decree (Decree 8213/2012), which is the first SEA enacted in the Middle East and North Africa Region; and the EIA Decree (Decree 8633/2012).

The integration of environmental considerations into significant national sectors has been made possible by the three SEAs that have been completed and published in Lebanon to date:
1) SEA for Petroleum[373], Activities in Lebanese Waters,
2) SEA for the New Water Sector Strategy for Lebanon, and
3) SEA for the Renewable Energy Sector.

Regional development plans and SEAs are now being produced in tandem. It is worthy to note that SEA is compulsory and should be incorporated within any sectoral strategy formulation moving forward. Additionally, the Environmental Compliance for businesses Decree (Decree 8471/2012) regulates all operations from categorized businesses that may result in hazardous pollution and environmental damage[374].

5.4. MASTERPLANS

The NPMPLT of 2005 tackles the environmental issues by including specifications of coastal zone resources, land zoning (Law 69/ 1983) and buffer zones surrounding nature reserves. It also discusses

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[371] 2015 - CBD 5th national report for Lebanon, p. 19
[372] 2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf p. 23
[373] 2015 - CBD 5th national report for Lebanon, p. 26
[374] 2015 - CBD 5th national report for Lebanon, p. 27

with the Law 69, where the MoPWT prepared the Law on Urban Planning and Transport strategy that will be subject to a SEA in accordance with Decree 8213, dated 24/5/2012[375].

Also, there are existing Specific Masterplans for major cities along the coast that have been circulated through decree such as "decree No. 253/1937 that considers monuments in Byblos and Bet Mery as historical monuments, decree No. 16948/1964 which is a general masterplan for the suburbs of Beirut, decree No. 17702/1964 which manages and organizes the CZ area in Jounieh, decree No. 3362/1972 that entails the General and Specific Master Plans for the CZ in the North, decree No. 3363/1972 that proposes the General and Specific Master Plans for Amchit, decree No. 5450/1973 that entails the General Master Plan for Jounieh CZ, and decision No. 2/1996 that discusses the CZ extending beneath the excavation works area in Byblos as part of the World Cultural Heritage list"[376].

5.5. CONSTRUCTION ON THE COASTLINE

To further counteract the tools that exempt some exploitations on the coastline, the monitoring of the coastal area was under the responsibility of the National Council of Environment through Law 444/2002, and construction within the 200m band beginning from the highest seawater points in winter was forbidden, ensuring providing accessibility of the beach to the public. Despite this, the draft law did not mention any procedures regarding existing illegal constructions along the coast nor any settlement processes to enforce repercussions. Afterwards, building law 646/2004 defined setbacks for maritime construction, whereas Laws 64/2017 and 132/2019 put forward "Illegal Occupancy of Public Maritime Property", but both these laws manage the financial concerns regarding this problem[377].

5.6. QUARRIES

To limit and control quarrying practices, Decision 190/1 of 2018 outlined the licensing requirements and documentation needed for the operations of "small quarries," which are sites with a daily extraction capacity of no more than 40 m³ of material whose sale is prohibited.

Also, after the proposal and approval of the Integrated Management of the Quarries and Crushers Sector Policy Brief (approved by CoM Decision 45 dated 21/3/2019), a draft masterplan was developed in 2019 without the recommended map, through Decision 1, dated September 17, 2019. Based on Budget Law 144/2019, the CoM issued Decree 6569 in 2020 directing the Department of Geographic Affairs (DGA) of the Lebanese armed forces to inspect and catalog all currently operating and closed rock and sand quarries and extraction locations. An inter-ministerial committee is also established under the decree to oversee and support these activities. Additionally, it specifies the fees that must be paid by the owners and investors, including the price of restoring a deteriorated site and the cost of environmental degradation. However, due to the protests that began in October 2019, the proposed map was not approved due to the government resignation after the economic crash[378].

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[375]2023 - ICZM Questionnaire - Updated report 2023
[376]2015 - Final Updated ICZM Draft Strategy 19-03-2015.pdf p. 22
[377]2023 - ICZM Questionnaire - Updated report 2023
[378] 2020 - SOER Report - Chapter 6, Land Resources, p. 283-288

5.7. Coastal and Cultural Heritage Protection

With regards to measures that preserve and protect coastal and cultural heritage, Lebanon was part of several international conventions, such as the UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage; it also ratified Law 19 of 30/10/1990 at the World Heritage Convention in Paris. Moreover, Decision No. 2 from 1996 established the inclusion of coastal areas beneath the excavation area in Byblos as part of the World Cultural Heritage List. The NPMPLT of 2005 also discusses cultural heritage within the coastal zone assets. Furthermore, the "Environment Code" (law 444 of year 2002) upholds the standards for coastal and aquatic environmental protection from all sources of pollution in line with the terms of regional and international treaties that Lebanon has ratified. Additionally, this code lays forth the general guidelines for safeguarding the aquatic environment, with the goal of preventing pollution from endangering the coast, natural resources, and ports of the Lebanese Republic, as well as all water bodies in the region[379].

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[379] 2023 - ICZM Questionnaire - Updated report 2023

CHAPTER V: MARINE AND COASTAL BASELINE MAP

1. INTRODUCTION AND METHODOLOGY

The shoreline of Lebanon reaches around 240km, from the Al-Kabeer River in the north to Naqoura in the south (Annex II: Map of the coastal strips in lebanon). According to the definition of the CZ in the ICZM Protocol for the Mediterranean (Article 3.1), it includes a terrestrial area (still to be determined) and the territorial waters that cover a marine water surface area of ~5400 km2. Both require the development of a Marine and Coastal Baseline Map (MCBM-LB) to be followed by MSP in the future to better inform management approaches.

Lebanon is divided into nine Governorates, or Mohafaza, six of which have a coastal zone. Those are further subdivided into 17 Districts, or Caza, consisting of multiple cadastral zones. Through collection of layers from different sources (Table 9; Annex III: Map and List of coastal administrative units along the LCZ), a comprehensive MCBM-LB for the Lebanese CZ was produced. The MCBM-LB is considered a work in progress that will be regularly updated as new data and layers become available. The aim is to produce, by the end of the project, an ArcGIS interactive map to be made available for all stakeholders showcasing all the assets and stresses of the Lebanese coast. The MCBM-LB will serve as a basis for developing the MSP as well as any other actions that will be undertaken on the LCZ.

Table 9: The different layers used for the production of the marine and coastal baseline maps

Layer Name	Category	Source	Date
Airport	Infrastructure	SDATL	2004
Artificial_Reef_Buoys_UOBreef	Marine Recreational site	MCR-IOE-UOB	2018
Bathymetry	Topography	Dar El Handasa,	2014
Bathymetry	Topography	Lebanese Army	2004
Beirut Rafic Hariri Airport	Infrastructure	SDATL	2004
Cadastral	Administratives	SDATL	2004
Caza	Administratives	SDATL	2004
CDW	Solid waste	MCR-IOE-UOB	2021
Coastal_Cadastral	Administratives	SDATL	2004
Coastal_Caza_limits	Administratives	SDATL	2004
CoastLine_OSM2024_filtered.shp	Shoreline	Open Street Map	2024
DivingCenter	Marine Recreational site	MCR-IOE-UOB	2018
Diving Sites	Marine Recreational site	MCR-IOE-UOB	2018
Erosion_accretion	Geomorphology	Delineated in this project	2024
Fishing_ports_fishermen_coops	Infrastructure	MCR-IOE-UOB	2018
Line23 – Southern Maritime Border	Administratives	East Med Energy Report[380]	2022
LUC	Land use - Land cover	CNRS	2017
Mohafaza	Administratives	SDATL	2004
MSW	Solid waste	MCR-IOE-UOB	2021
MSW (river)	Solid waste	MCR-IOE-UOB	2021
Oil_Gas_blocks	Oil and Gas	East Med Energy Report	2022

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[380] https://www.mesp.me/wp-content/uploads/2022/10/The-East-Med-Energy-Report-Issue-11.pdf

Layer Name	Category	Source	Date
ProposedMarineProtected_Area	Environmental Assets	MCR-IOE-UOB	2012
ProtectedArea	Environmental Assets	Adapted from World Database on Protected Areas (WDPA)	2024
River	Environmental Assets	CNRS	
SeaPorts	Infrastructure	MCR-IOE-UOB	2018
Shoreline_2010	Shoreline	MCR-IOE-UOB	2010
Shoreline_1962	Shoreline	MCR-IOE-UOB	1962
Sub-marineSprings	Environmental Assets	Dr. Amin Shaaban (CNRS)	

2. RESULTS

The map present some of the major components of the LCZ including bathymetry, protected areas, diving centers, land use/land cover of the CZ, gas blocks, and available layers of sources of pollution amongst others.

The bathymetry layer was acquired from the Lebanese Army (2004) and detail isobaths up to 100m depth with two gaps: one before Saida and the other right after Tyre. No layers beyond the 100m depth were acquired, but it is well known that a mission, known as the Shalimar mission in Lebanon focused on measuring isobaths at depths ranging from 50m to 2000m. This mission aimed to understand the geological and geophysical characteristics of the seabed in the region with a focus on seismicity, but to date the source from which the layers may be requested has not been identified. Such layers, if obtained and added to the MCBM-LB, will extensively improve the knowledge base of the marine component of the LCZ.

The coastal cities of Beirut, Tripoli, Chekka, Selaata, Sibline, Choueifat, and Zouk are surrounded by industrial activity mixed with large residential areas (Figure 37 and Annex XVI: Map of the Industrial Sites Along the Lebanese Coast). These areas are significant not only for their economic contributions but also for their potential environmental and social impacts on the coastal regions and their inhabitants. Actually, 51% of industries are located along the coast due to greater access to raw materials provided by the vast network of coastal roads and the quicker export and import of goods and material through commercial ports. About 10% of the coast's overall length, equivalent to ~24km, is made up of large industrial or commercial units in addition to commercial ports, touristic establishments, diving centers and fishing ports (Figure 37). It is noteworthy that 58% of these establishments are members of the Association of

Lebanese Industrialists (ALI) and therefore 42% do not adhere to ALI's norms and standards[381],[382]. These industries threaten the health of both local residents and coastal and marine ecosystems at varying scales.

Additionally, regarding artificialized areas, they typically encompass urban and built-up spaces and are predominant in coastal cities like Beirut, Tripoli, and Sidon and to a lesser extent all along the CZ). These areas reflect significant human activity and development, even though central to the socio-economics of communities pose challenges to coastal management due to their wide impact on natural habitats. On the other hand, agricultural areas are scattered along the coast, particularly in Akkar, near Batroun and near Tyre, indicating regions where farming interacts closely with marine ecosystems. These areas are vital for local economies but must be managed to prevent nutrient and pesticide loading, which can harm water quality and biodiversity. Wooded Lands are less common in the immediate coastal areas but can be found in proximity to the coast, such as near Jbeil (Byblos) and Chouf (Figure 37). These regions are important for biodiversity and act as natural buffers against erosion and habitat loss. Grassland and Wetlands, on the other hand are crucial for biodiversity and are often found in coastal zones such as wetlands near river mouths, which play a significant role in filtering pollutants and providing habitat for aquatic species.

In addition, the LCZ includes three coastal marine protected areas (MPAs) while two draft laws were submitted to the Lebanese Parliament for the declaration of two more, one in Anfe and the other in Jbeil (Anne XII). These will aid the country to meet its obligations in meeting the GBF target of protecting at least 30% of the country's terrestrial lands, inland waters, coastal areas and oceans and seas[383]. Also, "Lebanon's Marine Protected Area Strategy" proposed a list of sites to be declared as MPAs for the establishment of an MPA network across the LCZ28. The list included nine coastal and marine sites, five estuary sites, and four deep water sites (Figure 37, Annex IX: Map of the Protected Areas, existing and proposed, along the Lebanese Coast). The archeological underwater sites of Tyre, Saida, and Enfeh stand out as key historical and cultural assets. These submerged sites include ancient harbors, shipwrecks, and archaeological remains that not only highlight Lebanon's maritime past but also hold potential for eco-tourism, research, education, and sustainable management within the framework of an MSP. In addition to these protected areas, a total of 54 marine freshwater springs were identified and mapped along the Lebanese coast.

Moreover, the shoreline suffers from a variety of pollution sources that introduce different kinds of pollutants affecting community health, the local economy, and the terrestrial, coastal and marine ecosystems. Landfills are a primary source of pollution, affecting recreational assets, water resources, marine and coastal flora and fauna, and economic resources. However, updated data on landfills and their locations are needed to produce a comprehensive layer and add to the MCBM-LB. Inadequate infrastructure and improper wastewater management coupled with river discharges which carry pollutants of the whole watershed into coastal waters are also considered as primary land-based sources of coastal pollution, but solid waste disposal impacts are also recognized as additional sources (Figure 37 and Annex XVII: Map of Sources of pollution on the Lebanese Coast). The MCBM-LB map is dotted with red blue triangles representing MSW sites on rivers and green markers indicating the remaining sites that appear to belocations of MSW sites scattered widely across the CZ. from Beirut and extending to areas such as Nabatye and some in the Batroun-Koura area.

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[381] LEBANESE INDUSTRIAL SECTOR

[382] ali.org.lb/about/

[383] https://www.cbd.int/gbf/targets

River MSW discharge points highlight a critical environmental issue where waste management, or lack of it, intersects with water resources, affecting water quality, riverine ecosystems and by association estuarine and coastal waters. These points are mainly found in the Metn area and Akkar regions.

The inclusion of Construction and Demolition Waste (CDW) sites, marked by red dots, points to another significant pollution challenge. These sites are often found in proximity to urban centers such as Beirut, Tripoli, and Sidon, where construction and demolition activities are frequent. The disposal of construction materials can lead to severe environmental degradation if not managed properly, including the contamination of nearby land and waterways. Currently, the biggest challenge is the treatment of the large volume of rubble that was, and is still being generated by the on-going Israeli war against Lebanon since 2024.

Furthermore, in a recent study and utilizing the 2010 shoreline as a baseline, a map was produced comparing changes that occurred on the land-sea interface up to 2024, employing GIS for precise spatial analysis. The resulting data was then cross-verified using Google Earth to distinguish between tidal changes (usually insignificant) and genuine alterations due to accretion, erosion, man-made sea filling, or excavation.

Accretion was recorded at $157,394m^2$ between 1962 and 2010 and $21,697m^2$ between 2010 and 2024. This drastic reduction suggests changes in sediment supply most likely due to anthropogenic activities such as the illegal occupation of and infringements on the MPD that have negatively modified sediment deposition regimes. As for erosion, the eroded area decreased from $2,605,202m^2$ between 1962 and 2010 to reach $2,559m^2$ between 2010 and 2024. Additionally, the sea-filled area in for the period between 2010 and 2024 reached $2,856,564m^2$ that are added to the $8,288,917m^2$ sea-filled area between 1962 and 2010 for a total of $11,145,481m^2$ (Annex X: Map of the Coastal dynamics in Lebanon: Areas of accretion, erosion, sea-filling and excavation for port creation between years 2010 and 2023). Such a large sea-filled area in comparison to such a short shoreline further validates the imperative need for an implementable ICZM Law and Strategy based on proper scientific assessments.

Additionally, Lebanon is currently engaged in the assessment and verification of hydrocarbon deposits within its maritime territories to determine their feasibility for extraction. Law No.132/2010 for the exploration and exploitation of petroleum products was approved on August 24, 2010. Specifically, Article 27 refers to "rational exploitation," however it is interpreted as "the highest possible quantity of oil"[28]. Ten blocks have been allocated, each marked with its corresponding area in square kilometers, emphasizing the spatial extent allocated for potential energy development. (Annex XVIII: Map of Oil and Gas Exploration Blocks Off the Coast of Lebanon). Block 9, highlighted in orange, has already been awarded where exploration rights have been granted. Line 23, highlighted in red, represent the maritime boundary between Lebanon and Israel that was agreed upon on October 27, 2022 (Figure 37).
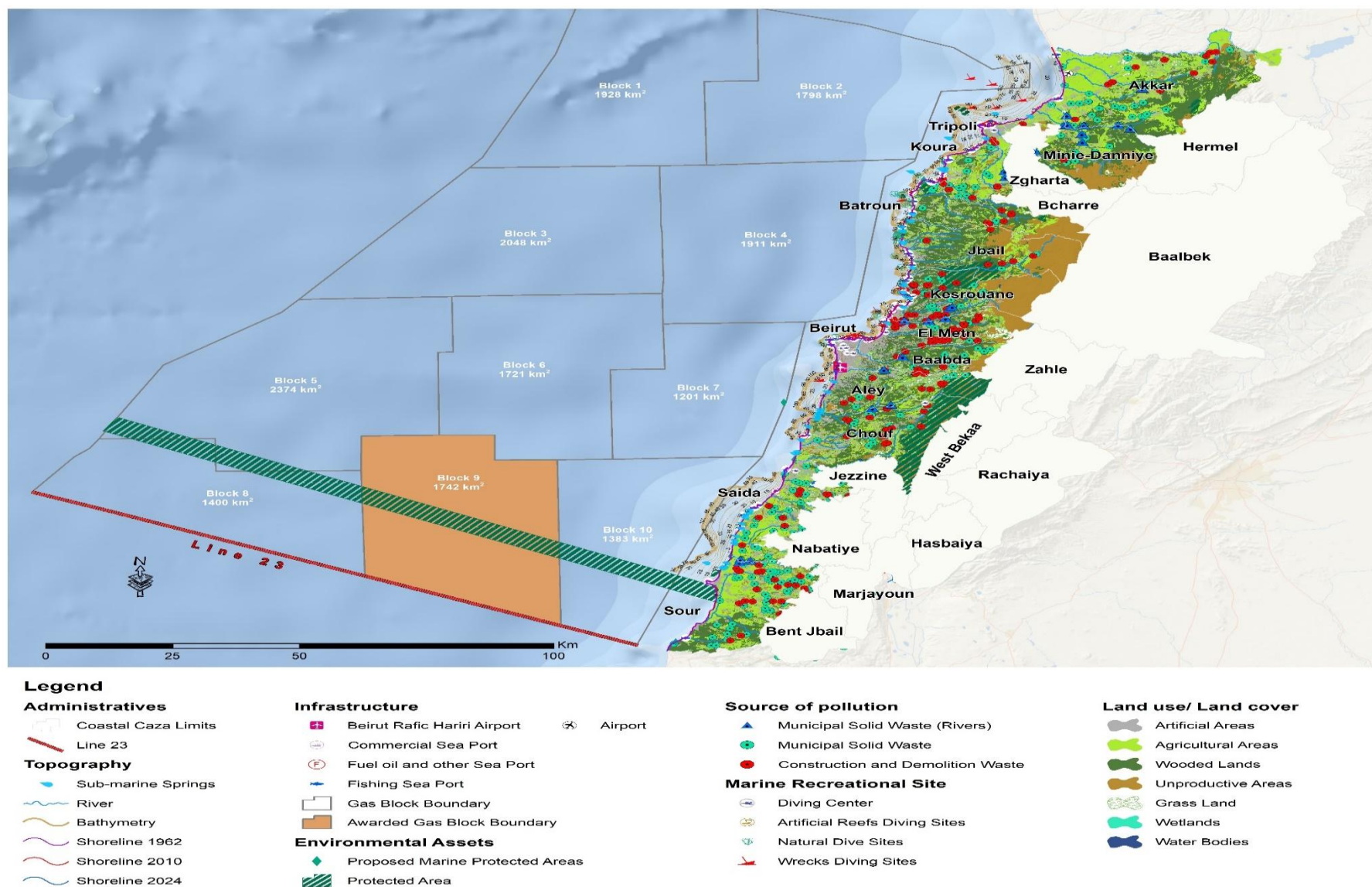
Figure 37: Preliminary Marine and Coastal Baseline Map in Lebanon

3. FURTHER INFORMATION NEEDED

The MCBM-LB is a preliminary contribution towards an MSP for the LCZ. However, more layers and information are needed to have a more comprehensive and detailed MSP map for the LCZ. Most layers should take into consideration the components needed for a successful ICZM Strategy and Action Plan. One of these layers that are needed to produce a more robust and comprehensive MSP map is the General Master Plan and the Specific Master Plans for the coastal municipalities. In addition, it is mandatory to represent the different coastal and marine habitat types and the restricted fishing zones represented by the protected areas and the estuaries. On the other hand, some layers that were represented need to be updated such as the bathymetry that showed discontinuation Northern Saida and Southern Tyre (Table 10).

Table 10: List of needed layers for the Marine and Coastal Baseline Map

Layer	Category	Requirements
Anchoring buoys	Infrastructure	• Data and location of existing and proposed anchoring buoys, including their specific coordinates
Aquaculture sites	Fisheries	• Data and locations of existing and proposed aquaculture farms
Bathymetry	Topography	• Data for the area Northern Saida and the area Southern Tyre
Biodiversity Sensitive Areas including KBAs	Environmental Assets	• Data to be updated based on the ERML report 2012[384] and recent studies, publications, projects, etc...
Climate Change	Climate Change	• Data on the locations of eroded areas on the CZ • Data on Sea Surface Temperature • Data on Sea Level Rise along the LCZ
Coastal population density	Administrative	• Official national or regional census data from government agencies, such as Lebanon's Central Administration of Statistics or other relevant bodies • Data at the administrative level (district, municipality) or finer resolution (e.g., census block or grid cells) • Heat map or choropleth map showing varying levels of population density
Continental Shelf	Topology	• Data and information for the continental shelf (Publications, studies, reports, etc..)

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[384] https://lebanoncp.com/publications/iczm-integrated-coastal-assessment---integrated-solutions-16?blog=Library

Layer	Category	Requirements
Cost of Environmental Degradation		• Data on the economic costs of pollution, erosion, flooding, and other forms of environmental degradation for each caza • Specific layers for each type of environmental degradation cost (e.g., pollution costs, erosion costs) • Heat maps
Cultural, archaeological and historical sites	Tourism	• Updated data and locations • Available shapefiles to be requested from the Ministry of Tourism
Emergency Response	Infrastructure	• Data on the Locations of emergency services, evacuation routes, and shelters are needed • Layer to be produced
Fishing Zones	Fisheries	• Data on the locations of the restricted fishing zones needed
General Master Plan and the Specific Master Plans for the coastal municipalities	Administrative	• Update needed for the General Master Plan • Data and available layers are needed from the Specific Master Plans
Geological Features	Topography	• Information on coastal geology, including rock formations, fault lines, and sediment types are needed
Industrial Areas	Infrastructure	• Locations of factories, warehouses, and other industrial facilities along the LCZ needed • • Layer to be produced if not available
Landfills and Mega dumpsites	Waste Management	• Updated data on coastal landfills and mega dumpsites needed. • Shapefiles to be requested if available • Layer to be added to the Map
Maritime corridors	Infrastructure	• Data and location of shipping lanes, Traffic Separation Schemes, navigation aids (positions of buoys, lighthouses, and other navigational aids) • Data and location of the restricted areas where navigation is restricted or prohibited, such as military zones, conservation areas, and areas with underwater cables and pipelines, amongst others
Nursery ground	Fisheries	• Data and location of nursery ground

Layer	Category	Requirements
Oil spill sites	Oil and Gas	• Official data on the locations of the different oil spills that occurred to be requested • Layer showcasing the locations to be produced
Ports and Harbors	Infrastructure	• Data and location of the different types of ports • Data on the locations of docks, and marinas needed • Layer to be produced if not available
Public and Private Access to the MPD	Land Use – Land Cover	• Data on the public access points needed • Data on the private beaches, parks, etc. needed
Public Facilities	Infrastructure	• Data on schools, hospitals, emergency services, and government building along the LCZ needed • Layer to be produced if not available
Restoration Projects		• Data and coordinates of the locations where coastal restoration and conservation projects are being/have been conducted
Salt Marshes and sand dunes	Environmental Assets	• Data and location of salt marshes • Data and location of sand dunes
Sensitive underwater habitats	Environmental Assets	• Data and location of all types of underwater habitats such as seagrass meadows, underwater caves, amongst others
Spawning grounds (freshwater, marine and estuarine)	Fisheries	• Data and location of spawning grounds
Submarine cables	Infrastructure	• Data and location of cables routes, landing stations, amongst other information
Touristic and recreational sites	Tourism	• Data and location of public beaches, resorts, hotels, amongst others
Terrestrial Transportation Networks	Infrastructure	• Data and location of the terrestrial transportation networks
Submarine pipelines	Infrastructure	• Data and location of pipeline routes, landing Points, amongst others
Urban and industrial areas	Infrastructure	• Data and location of urban and industrial areas to the highest detail available
Waste Management	Waste Management	• Data and location of waste disposal sites and recycling facilities

Layer	Category	Requirements
Wastewater Treatment Plants and Sewage outfall	Waste management	• Coordinates and location of coastal WWTP

4. CONCLUSION

The collection of information and data from all possible sources allowed the production of this MCBM-LB. The MCBM-LB will act as the cornerstone for an MSP for the LCZ that will provide the necessary mapping information for proper decision making for ICZM therefore minimizing conflicts between different sectors and stakeholders and promoting sustainable development. Nevertheless, the current map is but a first step that requires continuous acquisition of information to inform planning activities.

The MCBM-LB will serve as a valuable tool for government bodies, policymakers, researchers, and all other stakeholders including the public at large to better understand the large number of sectors that benefit from this area, its special habitats, and the need to properly manage the LCZ and conserve its resources and amenities for the benefit of both people and the natural environment.

CHAPTER VI: GENDER EQUALITY

1. STATE:

Nearly 51.6% of Lebanon's total population are women, and 48.4% are men (EU/CAS/ILO, 2020). For instance, in the coastal cazas of Beirut, Jbeil, Batroun, Koura, Tripoli, Sidon, and Tyre, the female/male ratio (in %) is 54/46, 52.1/47.9, 53.2/46.8, 53.1/46.9, 52.4/47.6, 52.9/47.1, and 52.4/47.6 respectively (EU/CAS/ILO, 2020).[385]

The ratio of the number of men to the number of women is referred to as the gender ratio. In Lebanon, at younger ages (0–19) the gender ratio is slightly biased towards males. This is followed by a decline in the gender ratio between ages 20 and 74, which may have been caused by the out-migration of men. The ratio is evenly distributed between the sexes at age group 75–79, while after 80 years, the gender ratio again becomes biased towards women (EU/CAS/ILO, 2020).[386]

Moreover, Lebanon has one of the highest overall gender gaps in the world (ranking 145 out of 153 countries in the World Economic Forum Gender Gap report 2020), and amongst the lowest global rates of women's labor market participation, hovering at 29% for women and 76% for men. Prevalence rates for spousal violence are around 25% and women make up only 4.6% of the Parliament (UN Women/Arab States, n.d.).[387]

The 2018-2019 Labor Force and Household Living Conditions Survey found that the average monthly gender wage gap for Lebanese employees was 6.5%, indicating that Lebanese men earn, on average, 6.5% more than Lebanese women; with women's employment set to fall due to economic contraction rates (Table 11).[388] Standing at 145 out of 153 countries (Global Gender Gap Report 2020), Lebanon has one of the highest overall gender gaps in the world, and amongst the lowest rates of women's political participation (149 out of 153 countries) and labor market participation (139 out of 153 countries).

Table 11: Gender Wage Gap of Employees at Main Job by Level of Educational Attainment (Percentages)

Level of Educational Attainment	Men (thousands LBP)	Women (thousands LBP)	Wage gap (%)
Total	1 334	1 248	6.5
Elementary	912	666	27.0
Intermediary	1 094	766	30.0
Secondary	1 311	1 045	20.3
University and above	1 785	1 434	20.2

1,000 LBP = 0.66 USD (10 October 2019)

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[385] LABOUR FORCE and HOUSEHOLD LIVING CONDITIONS SURVEY 2018-2019 for Beirut, Jbeil, Batroun, Koura, Tripoli, Sidon, and Tyre.
[386] EU/CAS/ILO, 2020, Labor Force and Household Living Conditions Survey 2018-2019, wcms_732567.pdf (ilo.org)
[387] Arab States, UN Women, Lebanon, n.d., Lebanon | UN Women – Arab States
[388] ILO/CAS/EU, 2020, Labour Force and Household Living Conditions Survey 2018-2019.pdf (cas.gov.lb)

Standing at 145 out of 153 countries (Global Gender Gap Report 2020), Lebanon has one of the highest overall gender gaps in the world, and amongst the lowest rates of women's political participation (149 out of 153 countries) and labour market participation (139 out of 153 countries).

Additionally, 60% of Lebanese women report having experienced some form of sexual harassment in the street, 31% of women in Lebanon report ever experiencing one or more forms of intimate partner violence, and 24% of men report ever perpetrating one or more forms of intimate partner violence.[389]

2. DRIVERS:

Social and cultural norms, including gender stereotyping and traditional gender roles can restrict opportunities for women in education, employment, and leadership positions, reinforcing gender inequalities. Government policies and legislation can also play a crucial role in shaping the legal framework for gender equality.

In fact, gender equality in Lebanon is significantly influenced by two key drivers. Firstly, the country's family law, rooted in personal status laws in line with religious confessions, serves as a foundational framework that perpetuates gender disparities. These laws often uphold traditional gender roles and norms, resulting in systemic inequalities in areas such as marriage, divorce, inheritance, and child custody. Secondly, the persistent wage gap between men and women cannot be fully explained by factors such as education, experience, or position, indicating broader societal factors at play. Women are often paid less than men for comparable work (USAL, 2020).[390]

3. PRESSURES:

Gender equality in Lebanon faces a multitude of pressures stemming from economic, social, cultural, legal, and institutional factors. Economic instability exacerbates gender disparities by pushing women into informal or underpaid work, limiting their economic independence, and reinforcing gender stereotypes. Social and cultural pressures further support gender stereotypes, imposing expectations on women's roles within society and limiting their participation in decision-making processes. Moreover, legal frameworks and institutional practices still contain discriminatory provisions that hinder progress towards gender equality. Personal status laws, nationality regulations, and insufficient protections against domestic violence create legal and institutional pressures that undermine women's rights and gender equality

4. IMPACTS:

4.1. Inequalities in Accessing Education and Professional Opportunities:

Patriarchal norms often limit females' access to education, leading to lower enrollment rates, higher dropout rates, and limited opportunities for academic advancement hindering women's ability to access professional opportunities and pursue careers in male-dominated fields.

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[389] UN Women, n.d., MWGE Lebanon Brief March 2020.pdf (unwomen.org)
[390] University of Sciences and Arts in Lebanon (USAL), 2020. Earnings and gender wage gap in Lebanon: the role of the human and social capital, Earnings and Gender Wage Gap in Lebanon: The Role of the Human and Social Capital – USAL

4.2. Increased Wage Gaps:

Patriarchal attitudes and practices contribute to wage gaps between men and women, with women typically earning less than their male counterparts for comparable work (USAL, 2020). [391]

4.3. Gender Imbalance in Political Representation:

Patriarchal structures and biases perpetuate gender imbalances in political representation, with women being often underrepresented in decision-making positions and leadership roles. This lack of female representation in government and policymaking results in policies and decisions that may not fully address or prioritize the needs and rights of women, leading to social injustice.

4.4. Limited Economic Growth and Development:

Gender inequality constrains economic growth and development by underutilizing the talent, skills, and potential contributions of women in the workforce. When women face barriers to education, employment, and entrepreneurship due to discriminatory practices and societal norms, it leads to a significant loss of human capital and productivity. As a result, industries and sectors that could benefit from the diverse perspectives and innovative ideas of women remain underdeveloped. Moreover, when women engage to low-paying or informal jobs, they are often unable to fully participate in the formal economy.

4.5. Limited Diversity of Skill Sets:

Gender inequality contributes to a limited diversity of skill sets within the workforce by restricting women's access to education and employment opportunities. When women are discouraged or prevented from pursuing careers in certain fields due to societal expectations or discriminatory practices, it leads to a lack of diversity in the skill sets available in the labor market.

5. RESPONSES:

5.1. Policy Interventions Promoting Gender Equality

The Government can implement policies and legislation aimed at promoting gender equality and eliminating discrimination. This includes laws addressing gender-based violence, ensuring equal pay for equal work, and promoting women's participation in decision-making processes. Additionally, policies can be implemented to support work-life balance, parental leave, and childcare services to enable women's full participation in the workforce.

5.2. Education and Awareness Programs

Education and awareness programs play a critical role in challenging patriarchal attitudes and promoting gender equality. These programs can target various stakeholders, including students, teachers, parents, and community leaders.

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[391] University of Sciences and Arts in Lebanon (USAL), 2020. Earnings and gender wage gap in Lebanon: the role of the human and social capital, Earnings and Gender Wage Gap in Lebanon: The Role of the Human and Social Capital – USAL

5.3. Empowerment and Capacity Building

Empowerment and capacity-building initiatives can strengthen women's leadership skills, decision-making abilities, and economic independence. This can include providing training and mentorship programs, access to financial resources and entrepreneurship opportunities, and support for women's participation in civic and political processes.

5.4. Inclusive Decision-Making Policies

Inclusive decision-making policies ensure that women have equal opportunities to participate in decision-making processes at all levels of society.

5.5. Gender-Sensitive Resources Management:

 Gender-sensitive resources management strategies recognize and address gender differences in access to and control over natural resources. This can involve promoting women's participation in resource management and conservation efforts, as well as integrating gender considerations into resource management policies and practices. An important example for gender-sensitive resource management practice is establishing Gender-Inclusive Agricultural Training Programs given that agriculture plays a significant role in Lebanon's economy and rural livelihoods. Gender-sensitive resource management in agriculture could include offering training programs tailored to the needs of women farmers, focusing on sustainable farming practices (e.g., bio-organic cultivation, culinary and medicinal plants harvest, production of mortar and natural products), access to finance, and marketing strategies.

CHAPTER VII: INTEGRATING COST OF COASTAL ENVIRONMENTAL DEGRADATION INTO THE DECISION-MAKING PROCESS

1. BACKGROUND

The Cost of Environmental Degradation (COED) process was initiated under the former World Bank Mediterranean Environmental Technical Assistance Program in the early 2000s which led to the production of various national and sectoral COED reports[392] carried out for the Middle East and North Africa region including Lebanon.

Several COEDs were carried out in Lebanon over the years. The most recent published COED was released by MoE/UNDP (2019)[393]. Other provided a comprehensive review of Lebanon national, regional and sectoral COED. On average, the national COED fluctuated between 3.5% (2005) and 4.2% (2018) of GDP but will exceed the 10.4% mark of GDP in 2023 (World Bank, forthcoming in 2024)[394] as the effects of the Syrian displaced were factored in the COED calculation. More specifically, the Cost of Coastal Zone Environmental Degradation (CCZED) was calculated for Lebanon northern coast that included the Governorate of Akkar and Northern Lebanon and stood at 4.2% of the northern coast GDP in 2005[395] and the GEF Governance and Knowledge Generation Socio-economic Evaluation of Maritime Activities[396] came up with a health burden of swimmers associated with polluted sea water equivalent to 0.001% of the national GDP in 2008. Conversely, the World Bank Cost of the 2006 Hostilities amounted to 3.6% of the 2006 GDP[397].

1.1. International benchmarks

Total or partial sustainable development and resilience performances are carried out and updated by several international public and private institutions. Only four will be considered to benchmark Lebanon environmental performance:

- The 2024 Sustainable Development Goals (SDG) Index on Lebanon suggests that significant challenges (11 out of 17 SDGs) remain to reach the SDGs in 2030 where Lebanon scores 63.9 over 100 and ranks 110th out of 193 countries with about: 20% of SDGs being achieved or are on track; 30% show limited progress; and 50% are worsening. Figure 38 provides 2024 Lebanon SDG dashboards and trends. Selectively: SDG6 Clean Water displays significant challenges with a stagnating trend; SDG7 Affordable and Clean Energy faces major challenges with a stagnating trend; SDG8 Decent Work and Economic Growth displays major challenges with a decreasing trend; SDG14 Life Below Water shows major challenges albeit it is moderately improving; and SDG15 Life on Land presents major challenges and is stagnating. Interestingly, SDG1 No Poverty is considered as achieved albeit stagnating while the most recent Multidimensional Poverty Index based on the survey conducted in 2021 stands at 82% of residents[398] while around 60% of

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[392] Dr. Gonzague Pillet (†), former Professor at the **University of Fribourg** and at the **University of Geneva,** contributed to the early COED conceptualization.

[393] MoE/UNDP (Ministry of Environment and United Nations Development Programme). 2019. Rapid Cost of Environmental Degradation for 2018. Beirut.

[394] World Bank. Forthcoming in 2024. Cost of Environmental Degradation in Lebanon for 2023. Washington, D.C.

[395] Mediterranean Environmental Technical Assistance Program (METAP). 2009. Coastal Legal and Institutional Assessment and Environmental Degradation, Remedial and Averted Cost in Coastal Northern Lebanon. Funded by EC SMAP III and The Ministry of Foreign Affairs of Finland. Washington, D.C.

[396] Kanbar, Nancy. 2015. GEF Governance and Knowledge Generation Socio-economic Evaluation of Maritime Activities: Lebanon. Plan Bleu and SES. Beirut.

[397] World Bank. 2007. Economic Assessment of Environmental Degradation Due to July 2006 Hostilities. Washington, D.C.

[398] 21-00634-_multidimentional_poverty_in_lebanon_-policy_brief_-_en_0.pdf (un.org)

households considered themselves to be poor or very poor according to the preliminary results of the Central Administration of Statistics (CAS) 2022-23 survey[399].

Figure 38: Lebanon SDG dashboards and trends, 2024 (Source: SDG Index: Sustainable Development Report 2024 https://sdgtransformationcenter.org/sdgindex)

- The Environment Performance Index (EPI) was developed to benchmark the <u>environmental</u> performance of a country relative to other countries (Esty and Levy, 2014)[400]. The EPI determines the degree to which a country works toward maintaining environmental health, ensuring ecosystem vitality, and mitigating climate change. Lebanon EPI scores 40.1 over 100 and ranks 124th out of 180 countries in 2024[401]. Table 12 breaks down the score and ranking by category and subcategory. Selectively, Lebanon EPI scores the lowest in terms of waste management with 36.6 (Environmental Health), biodiversity and habitat with 24.1 (Ecosystem Vitality) and CC mitigation (Climate Change) with 38.0. Interestingly, fisheries scores 96.2 and ranks 4th worldwide which begs the question: how reliable and robust is the data used to generate the EPI for certain sub-categories?

Table 12: Lebanon EPI Score and Rank, 2024 (Source: Block, S., Emerson, J. W., Esty, D. C., de Sherbinin, A., Wendling, Z. A., et al. 2024. 2024 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy. epi.yale.edu)

Category and Sub-category	Score over 100	Rank out of 180 Countries
Environmental Health	**46.3**	**81**
Air Quality	*40.0*	*89*
Drinking Water and Sanitation	*63.2*	*71*

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[399] LEBANON MPO (worldbank.org)

[400] Esty, Daniel and Marc Levy. 2014. Environmental Performance Index. Yale University (Yale Center for Environmental Law and Policy), Columbia University (Center for International Earth Science Information Network) in collaboration with the World Economic Forum and the Joint Research Centre of the European Commission.

[401] Block, S., Emerson, J. W., Esty, D. C., de Sherbinin, A., Wendling, Z. A., et al. (2024). 2024 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy. epi.yale.edu

Category and Sub-category	Score over 100	Rank out of 180 Countries
Heavy Metal	*62.4*	*51*
Waste Management	*36.6*	*63*
Ecosystem Vitality	**38.1**	**151**
Biodiversity and Habitat	*24.1*	*161*
Forests	*48.5*	*85*
Fisheries	*96.2*	*4*
Air Pollution	*62.5*	*117*
Agriculture	*50.6*	*98*
Water Resources	*47.3*	*69*
Climate Change	**38.0**	**113**
Climate Change Mitigation	*38.0*	*113*
Mean	**40.1**	**127**

- The Global Green Economy Index (GGEI[TM]) is based on quantitative and qualitative indicators to measure the results of each country in four major dimensions: leadership and climate change, energy efficiency sectors, markets and investments and environment. Lebanon GGEI[TM] scores 0.389 and ranks 146th out of 160 countries in 2022[402]. Despite some convincing results in the Environment dimension, many improvements can be made in the other three categories. Lebanon has improved its integration environmentally sustainable practices in the national construction sector (possibly the drive by MOE to tackle the waste and quarry issues). Conversely, the most worrying results concern energy and transport as the ambient air pollution is worsening with the communal diesel generators and the growing traffic gridlocks. Figure 39 compares Lebanon results to the Francophone countries in 2018[403].
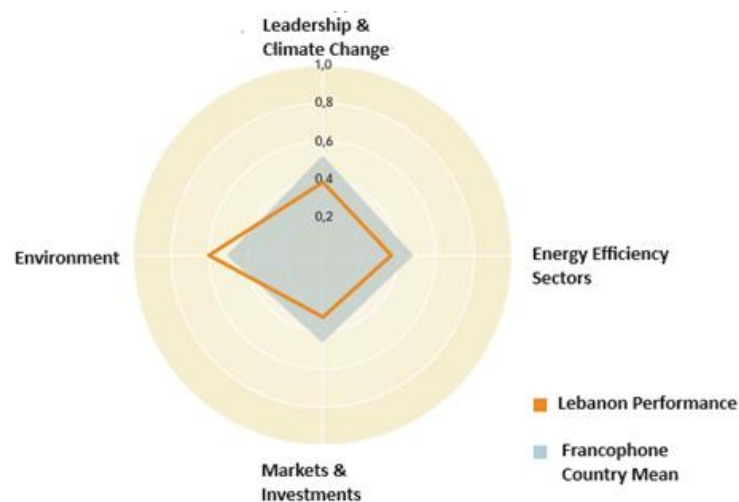
Figure 39: Lebanon GGEI, 2018 (Source : Institut de la Francophonie pour le développement durable, 2019, Atlas francophone de l'économie de l'environnement [Sous la direction de Tamanini, J. et E.L. Ngo-Samnick]. IFDD, Québec, Canada, 224 p.)

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[402] GGEITM Global Green Economy Index: Full Data File Now Available (dualcitizeninc.com)

[403] Institut de la Francophonie pour le développement durable, 2019, Atlas francophone de l'économie de l'environnement [Sous la direction de Tamanini, J. et E.L. Ngo-Samnick]. IFDD, Québec, Canada, 224 p.

- Several indices on vulnerability and climate change are produced by universities and co-funded by international organizations. However, only the University of Notre Dame Global Adaptation Index (ND-GAIN) index is retained as an international benchmark. The ND-GAIN provides data and analysis on climate vulnerability and readiness for countries composed of a vulnerability score and a readiness score: vulnerability measures a country's exposure, sensitivity and ability to adapt to the negative impact of climate change; and readiness measures a country's economic readiness, governance readiness and social readiness or the ability to leverage investments and convert them to adaptation actions.[404] Lebanon ND-GAIN index scores 44.7 over 100 and ranks 116th out of 185 countries in 2022 against 98 in 2013. The vulnerability index scores 0.402 over 1 and ranks 83rd while the readiness index scores 0.296 over 1 and ranks 161th [405].

1.2. Lebanon Total Wealth

The Wealth Accounting and the Valuation of Ecosystem Services (WAVES) methodology was developed by the World Bank in conjunction with development, research and academic partners and allows to: (i) estimate quantitatively the stock of wealth of a country or total wealth (TW) and provide a decomposition of this wealth that helps decision makers identify priority categories; and (ii) present a proxy to estimate depletion for each category (Lange et al., 2011[406]; Lange et al., 2018[407]; and World Bank, 2021[408]). The TW is the sum of the human capital, the produced capital and the natural capital (with a renewable and nonrenewable resources breakdown) adjusted with net foreign assets (foreign liabilities minus foreign assets).

Lebanon's TW covers the 1995-2020 period and steadily increases between 1998 and 2016 and declines since (Figure 40). However, the positive increase in 2020 is due to the inclusion of Lebanon offshore gas reserves of 7.19 trillion of m^3 as estimated by the British geophysical company Spectrum ASA[409] in 2012. This figure is not included in the WAVES dataset while the Lebanese authorities consider Spectrum ASA's figure as conservative. Therefore, the TW amounts to US$244 billion in 2019 constant prices with the stock of offshore gas and US$211 billion without It (Figure 41). Interestingly, the produced capital (47.1 billion US$ in 2020) shows a positive trend between 2007 and 2020 whereas the non-renewable resources (33.2 billion US$ in 2020) trend is quasi flat over the period, the human capital (180.6 billion US$ in 2020) starts eroding starting 2016 and the net foreign assets (-48.3 billion US$ in 2020) show a steady and steep decline that preceded Lebanon 2019 financial, economic and monetary crisis. The TW is not depicted per capita as the total population is showing large variations since the 2011 influx of Syrians and the migration of Lebanese since the 2019 crisis (Annex XX: Lebanon Wealth and Renewable Resources Time series and Annex XX: Lebanon Wealth and Renewable Resources Time series).

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[404] ND-GAIN is computed through the following formula: (Readiness index - Vulnerability index + 1) x 50 = ND-GAIN

[405] ND-Gain https://gain-new.crc.nd.edu/country/lebanon#vulnerability

[406] Lange, Glenn-Marie, K. Hamilton; G. Ruta, L. Chakraborti, D. Desai, B. Edens, S. Ferreira, B. Fraumeni, M. Jarvis, W. Kingsmill, and H. Li. 2011. The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium. Washington, DC: World Bank Group. http://documents.worldbank.org/curated/en/630181468339656734/The-changing-wealth-of-nations-measuring-sustainable-development-in-the-new-millennium.

[407] Lange, Glenn-Marie, Quentin Wodon, and Kevin Carey, eds. 2018. The Changing Wealth of Nations 2018: Building a Sustainable Future. Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-1046-6.

[408] World Bank. 2021. The Changing Wealth of Nations: Managing Assets for the Future. Washington, DC: World Bank. https://www.worldbank.org/en/publication/changing-wealth-of-nations.

[409] TGS Completes Acquisition of Spectrum, Spectrum ASA was bought by TGS ASA in 2019. Offshore gas estimate was retrieve from France 24: Lebanon years away from gas riches despite Israel deal: analysts (france24.com)
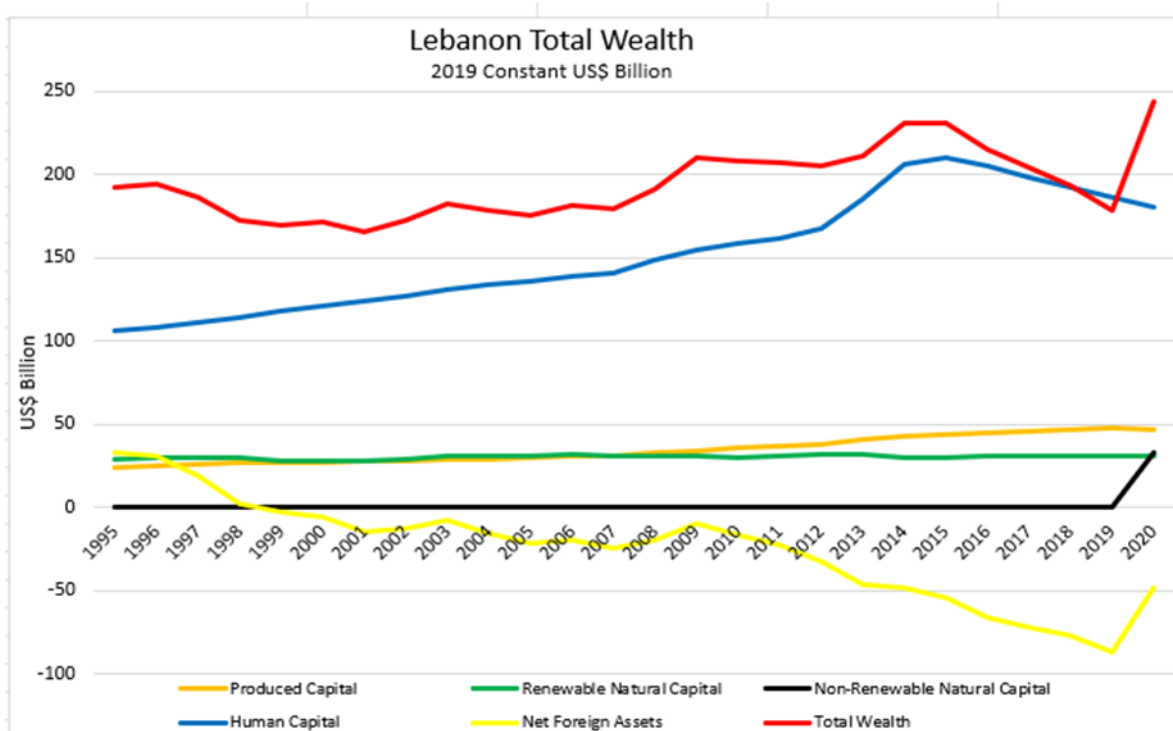
Figure 40: Lebanon Total Wealth (*Note: Offshore gas stock was added in 2020 and is represented as nonrenewable natural capital. Source: World Bank (2021); Spectrum ASA (2012); and Table A2.1.*)
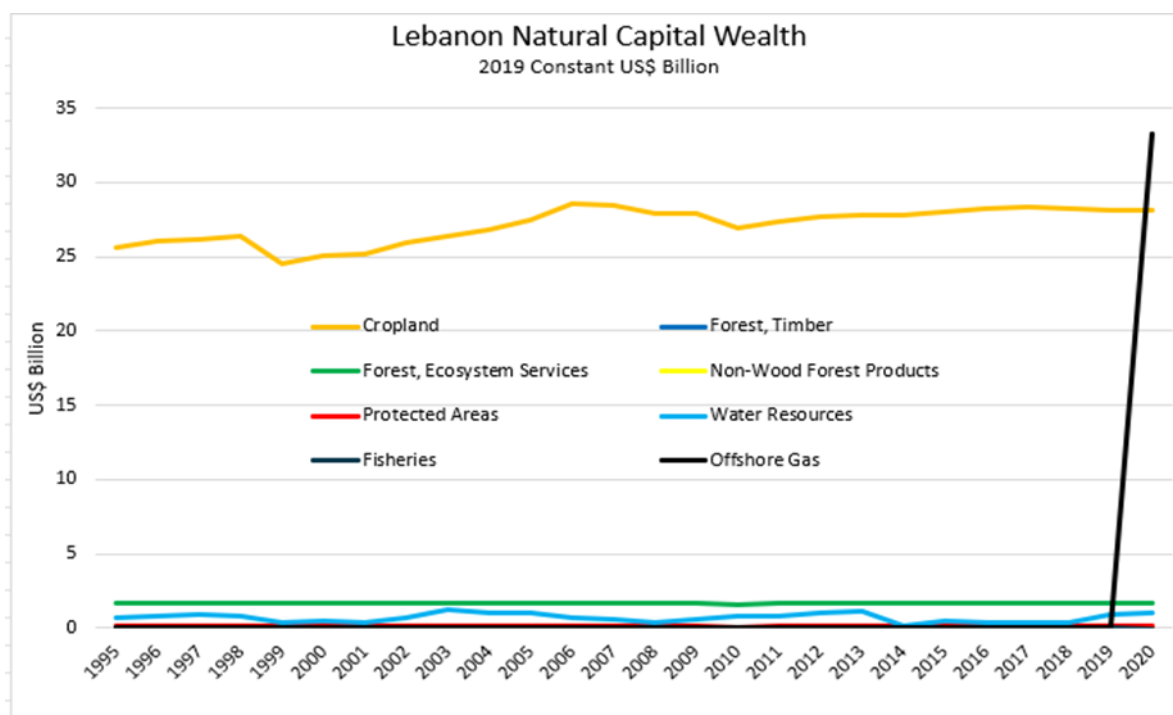
Figure 41: Lebanon Renewable and Non-Renewable Natural Capital (*Note: Offshore gas stock was added in 2020 and is represented as offshore gas. Source: World Bank (2021); Spectrum ASA (2012); and Table A2.2.*)

It is difficult to disaggregate the TW by region or coastal zones. Hence, the produced capital in terms of roads, energy, waste and water treatment, industries, hotels, etc. nor the human capital are disaggregated by coastal zones. The offshore gas (US$33.1 billion), a proportion of the protected areas (US$46.2 million in 2020 or 0.07% of natural capital representing 3 on the coastal areas over a total of

13), and fisheries (US$9.1 million or 0.01%) amount to US$32.3 billion and represent a portion of the coastal natural capital (Annex XX: Lebanon Wealth and Renewable Resources Time series). Yet, the cropland as well as forest and non-forest products and services will require data disaggregation by region (casa level) to be able to derive their coastal share. Incidentally, the offshore gas stock value (US$33.1 billion in 2020 or 51.6% of natural capital) is larger than Lebanon cropland stock value (US$28.2 billion and 43.7% of natural capita) with the remaining categories only representing 4.7% of the natural capital. Finally, efforts are needed to better value the marine ecosystem services (seabed, fauna, flora, etc.) and non-mineral mining (rocks, gravel and sand for construction) that are overlooked by WAVES.

2. Drivers: ANTHROPOGENIC AND NATURAL FACTORS

2.1. DEMOGRAPHIC CHANGE

The NPMPLT was released in 2004, approved (Presidential Decree 2366/2009) but never implemented. The strategic plan is articulated along three main principles: unity of the country; balanced development; and the rationalization of uses of resources. The NPMPLT notably: (i) assessed the coastal urban, rural, touristic, natural, ecological, and archeological site baseline; (ii) identified vulnerabilities; and (iii) gauged potential and possible future expansion of coastal urban, rural and tourism build-up while mapping the natural, archeological and cultural sites requiring preservation. Short of implementing any of the developmental priorities recommended by the NPMPLT (e.g., building 3 economic development poles to relieve coastal congestion), the GoL failed to spread the economic activity all over the Lebanese territories to contain the migration of the Lebanese population towards the CZ. These migrants were seeking livelihood opportunities towards the traditional coastal urban clusters of Tripoli, Mina, Batroun, Jbeil, Jounieh, Beirut, Jyieh, Saida and Tyre (Figure 36) that led to greater urbanization and densification of these areas, especially during and after the 1975-1990 Civil War when governance practices were at a minimum. Since the start of the multifaceted crisis in 2019, the Lebanese emigration is on a fast track and this drive is marginally relieving some of the pressures on the coastal and marine environment. However, this emigration is being evened out by the unrestricted influx of displaced Syrians and seasonal workers living in formal and informal settlements since 2011 (Table 13) and leading to increased pressures on coastal natural resources, infrastructure, utilities, and social services.

Table 13: Coastal Governorate Population and Mean Annual PM2.5 in 2022

Coastal Governorate	Residents	Lower Bound Displaced & Seasonal Worker Syrians		Total	Mean Annual PM2.5
	Lebanese, Palestinians Refugees & Foreigners	Informal Settlements	Regular Settlements		
	#	#	#	#	µg/m3
Akkar	291,827	30,109	113,267	435,203	31.52
North Lebanon	571,126	44,619	167,851	783,595	30.40
Beirut	407,676	8,016	30,156	445,847	35.70
Mount Lebanon	1,532,425	88,127	331,526	1,952,079	29.60
South Lebanon	568,716	23,443	88,191	680,350	25.48
Total	**3,371,769**	**194,314**	**730,991**	**4,297,074**	**29.48**

2.2. Sectors

This analysis only covers the formal sector as the informal sector is not reported in the GDP aggregation although the informal sector marginally increases the pressures on: air (e.g., polluting energy generation, etc.); water (e.g., effluents from informal sector production); land (e.g., illegal construction, etc.); resources (e.g., overfishing, coastal sand extraction, illegal quarrying, etc.); and ecosystem services (e.g., waste dumping and littering, etc.). Nevertheless, these pressures should duly be considered in the design of any policy to curb the pressures. Conversely, the formal sector share of the average GDP over the 2004-20 period is 40.7% and is driving environmental pressures nationwide and by extrapolation on the CZ. The remaining share of 49.6% is exclusively constituted of tertiary sector activities and could have an indirect (already accounted under productive utilities, transport sectors, etc.) to no pollution effect while the residual share is the net product taxes equivalent to 9.8%[410]. The 40.7% of GDP sectors do environmental harm in terms of air/noise, water, land, ecosystem services and carbon footprint and are charted in a matrix for better targeting. Pollution and resource stress are considered for the current Lebanese context but could be extrapolated to the coastal context where a preliminary qualitative scoring and ranking based on professional judgement suggests the following: 11.6% of GDP sectors do high harm; 28.0% of GDP sectors do medium harm; and 50.6% do little (indirect as they are captured in other sectors) to no harm while net product taxes are obviously not considered (see Chapter on Economic State and Impact). The sectors with the highest environmental harm scores have the potential of producing multimedia pollution across environmental media and include: the secondary utility sector, i.e., electricity, water, wastewater, and waste; mining and quarrying; transport; chemicals, rubber and plastics manufacturing; and livestock, livestock products and fishing (Table 14).

Table 14: Environmental Harm by average 2004-20 GDP Sector Share Matrix in constant 2010 prices

Primary, Productive/Utility Secondary & Tertiary Sectors	GDP Share	Air Noise	Water bodies	Landscape Sight	Ecosystem services	Carbon footprint	Score Ranking
Primary	**5.0%**						
Agriculture & forestry	2.8%	Low	High	Medium	Medium	Low	9
Livestock & livestock products; fishing	1.8%	Low	High	Medium	Medium	High	11
Mining & quarrying	0.4%	High	Medium	High	High	Medium	13
Secondary Productive	**10.3%**						
Manufacturing of food products	1.2%	Medium	High	Low	Medium	Low	9
Beverages & tobacco manufacturing	0.8%	Medium	Medium	Low	Medium	Low	8
Textile & leather manufacturing	0.3%	Medium	Medium	Low	Medium	Medium	9
Wood & paper manufacturing; printing	0.6%	Medium	Medium	Low	Medium	Medium	9
Chemicals, rubber & plastics manufact.	0.7%	Medium	Medium	Medium	High	High	12
Non-metallic mineral manufacturing	0.9%	Medium	Medium	Low	Medium	Low	8
Metal products, machinery & equip.	2.1%	Medium	Medium	Low	Medium	Medium	9
Other manufacturing	0.5%	Medium	Medium	Low	Medium	Low	8
Construction	3.2%	High	Medium	High	Medium	Medium	12
Secondary Utilities	**2.3%**						

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[410] CAS_Lebanon_National_Accounts_2020.pdf

Primary, Productive/Utility Secondary & Tertiary Sectors	GDP Share	Air Noise	Water bodies	Landscape Sight	Ecosystem services	Carbon footprint	Score Ranking
Electricity	1.2%	High	High	Medium	Medium	High	**13**
Water supply & waste management	1.1%	Medium	High	High	High	Medium	**13**
Tertiary (Partial)	**23.0%**						
Wholesale & retail trade	13.3%	Low	Low	High	Medium	Low	8
Vehicle maintenance & repair	1.0%	Low	Medium	Low	Medium	Low	7
Transport	3.2%	High	Medium	Medium	Medium	High	12
Hotels & restaurants	2.5%	Low	Medium	Medium	Medium	Low	8
Health & social care	3.0%	High	Medium	Medium	Medium	Low	10
Subtotal Primary, Secondary & Tertiary	*40.7%*						
Other Tertiary Sectors	**49.6%**	Low	Low	Low	Low	Low	5
Net Product Taxes	**9.8%**						
High Environmental Harm	**11.6%**						
Medium Environmental Harm	**28.0%**						
Low to No Environmental Harm	**50.6%**						
Total	**100.0%**						

Note: Sectors color codes based on Figure 1 in the Economic Change Section. Scores are based on professional judgement and assigned as follows: High = 3; Medium = 3; and Low = 1; color-coded ranking are assigned as follows: red ≥11; yellow ≥8 and ≤10; and green <7. Totals may not add up due to rounding.
Source: adapted from CAS_Lebanon_National_Accounts_2020.pdf; and authors

2.3. Natural Factor

Natural factors have a noticeable impact on the coastal and marine environment and should be considered as factors exacerbating or moderating current national pressures and future global pressures from climate change. For instance, air pollution in Lebanon comes from both anthropogenic factors (mainly energy, transport, industry, and solid waste) and natural factors in terms of seawater particulates as well as geological particulates originated from the deserts surrounding Lebanon. Seasonal variation could be quite high but on average, they represent about 30% of the mean annual $PM_{2.5}$ not only in Beirut but all over Lebanon[411]. Moreover, the Mediterranean circulation models are contributing to the erosion and accretion along the Lebanese shores that could increase or decrease areas at risk from SLR in the future.

3. SCOPE AND METHODOLOGY

For the Lebanon current rapid $CCZED_{2023}$ with a 2023 as a base year, the analysis and estimates are organized into 5 categories: ambient air (household, vehicular, power plant and industrial emissions and dust in terms PM_x, O_3, NO_x, and asbestos only in Chekka): water (water-borne diseases, surface water and water bodies are contaminated or impacted mainly due to the release of untreated or partially treated municipal and industrial effluents, waste leachate, agricultural runoff, water salinity,

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[411] 2022 - Source apportionment, identification and characterization, and emission inventory of ambient particulate matter in 22 Eastern Mediterranean Region countries: a systematic review and recommendations for good practice. Faridi, S., Yousefian, F., Roostaei, V., Harrison, R.M., Azimi, F., Niazi, S., Naddafi, K., Momeniha, F., Malkawi, M., Moh'd Safi, H.A., Rad, M.K., Hassanvand, M.S., Environ. Pollut. 310, 119889 https://doi.org/10.1016/j.envpol.2022.119889.

water scarcity do to irregular flow of perennial rivers, natural resource productivity, etc.); soil degradation and increased uncontrolled urbanization is other areas, is affecting agricultural yields, and forest coverage that are compounded by unsustainable quarrying practices and poor solid waste management; coastal zone artificialization as well as degradation of the marine environment, the disruption of ecosystem services and the unsustainable fish catch.

The environmental degradation categories are exacerbated by the influx of more than 2.08 million Syrian displaced[412], but a marginal analysis is not carried out as it was covered in the forthcoming World Bank COED report. Moreover, the number of displaced Syrians remains controversial as the 2.08 million mentioned by the Advisor to the Prime Minister is much lower than the figure of 1.5 million used in the World Bank Report. Hence, controlling for the Syrian displaced was deliberate as the methods used such as contingent valuation and hedonic pricing cannot be applied to the Syrian displaced. Hence, the geographic scope includes the five coastal administrative governorates and their population, i.e., 3.37 million including residents and Palestinian refugees.

The methods include techniques that are charted under 3 main categories, i.e., change in productivity, change in condition and change in behavior. The techniques are well established and were used for the previous COEDs and the forthcoming World Bank COED$_{2023}$. Details are available in Annex XXI: CCZED Methodology.

4. PRESSURES: POLLUTANTS AND POLLUTERS

4.1. Demographic change

Lebanon population stands at 4.9 million in 2022. Depending on the source, Lebanon is hosting between a lower bound 1.5[413] million to a higher bound 2.08[414] million displaced Syrians and seasonal workers. The population in the coastal administrative districts (caza) is not readily available, therefore, the five coastal governorate population stands at 3.37 million or 3/4th of the resident population and Palestinian refugees who mainly live along coastal watersheds with possible air, wastewater and waste pressure accruing to the coastal and marine environment (Table 13).

4.2. Air by pollutant and by polluter

By pollutant, all critical pollutants exceed both national and WHO standards for ambient levels earlier to 2018 and show extremely high variations that are affected by location (e.g., canyon effect in Beirut southern suburb due to plane NOx emissions[415]) and seasonality (e.g., Polycyclic aromatic hydrocarbon (PAH) during winter due to temperature inversion exacerbated by domestic heating[416]): PM$_{2.5}$: 7-50 µg/m^3 a mean annual exposure of 29.48 µg/m^3 (almost 5 times the WHO limit) for the

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[412] El Daher, Samir. 2024. Lebanon For a New Approach to Managing the Unparalleled, Massive Displaced Syrians' Presence with the Objective of their Return to their Homeland. Beirut.

[413] 2023 Lebanon Crisis Response Plan (LCRP) | United Nations in Lebanon

[414] CAS. 2018-19. Lebanon Crisis Response Plan adjusted by Official figures, notably, Sameer el Daher, Advisor to the Prime Minister (Al Hadath TV interview, 2 2024).

[415] 2006 - Incertitudes liées aux mesures du NO$_2$ par échantillonneurs passifs dans Beyrouth-Municipe (Liban). Gérard, J., Abboud, M., Farah, W., Rizk, T., Chelala, C. and Afif, C., Afif. Université St Joseph.

[416] 2018 - Comparison of atmospheric polycyclic aromatic hydrocarbon levels in three urban areas in Lebanon. Baalbaki, R., J. Nassar, S. Salloum, A. Shihadeh, I. Lakkis and N. Saliba. Atmospheric Environment, 179, 260-267.

entire country in 2022 with more than 99.5% of the population being exposed to these levels[417]; PM_{10}: 13-59 µg/m³; NO_2: 9-79 µg/m³; SO_2: 0-24 µg/m³; O_3: 12-123 µg/m³; PAH: 25-92 ng/m³; CO and Volatile Organic Compounds (VOC) are prevalent, but data is not readily available; and 30,089 Gg CO2eq. (as total emissions) in 2019[418]. By polluter, the largest polluters are: public power stations,[419] communal generators,[420] transportation (air, terrestrial and sea), industries, construction, waste categories, households (heating: fuel oil and fuel wood), forest fires (anthropogenic including conflict and natural)[421, 422]and others (slash and burn, etc.) (Figure 42, Figure 43).
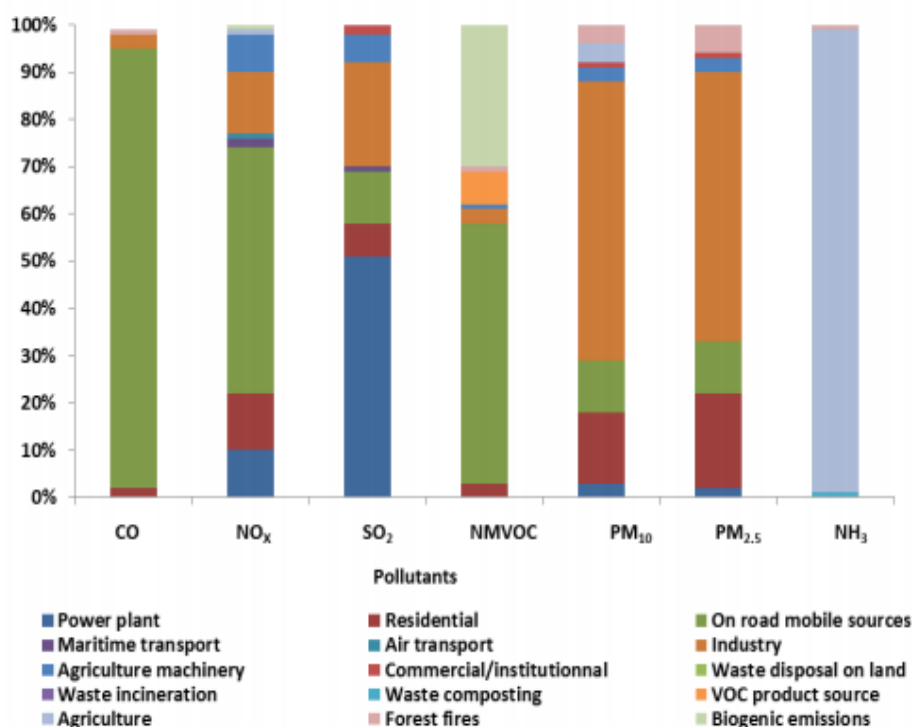
Figure 42: Beirut Source Apportionment in 2011 (Source: Waked, A., C. Afif and C. Seigneur. 2015. Assessment of source contributions to air pollution in Beirut, Lebanon: a comparison of source-based and tracer-based modeling approaches. Air Quality, Atmosphere and Health, 8, 495-505; MoE/UNDP/GEF. 2022. Lebanon's 4th 46 National Communication to the UNFCCC. Beirut)

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[417]https://cdn.who.int/media/docs/default-source/country-profiles/environmental-health/environmental-health-lbn-2023.pdf?sfvrsn=4012fb25_3&download=true

[418] MOE/UNDP/GEF, 2022.

[419] 2018 - PM_{10} Plume dispersion data of the Zouk power plant in Lebanon. Salloum, S., J. Nassar, R. Baalbaki, A. Shihadeh, N. Saliba, and I. Lakkis... Data in Brief, 20, 1905-1911.

[420] 2020 - Identifying urban air pollution hot-spots by dispersion modeling when data are scarce: application to diesel generators in Beirut, Lebanon. Al Aawar, E., A. Baayoun, A. Imad, J. El Helou, L. Halabi, M. Ghadban, I. Lakkis, and others.in review.

[421] Issam Fares Institute for Public Policy and International Affairs website: <Forest Fires in Lebanon: A Recurring Disaster (aub.edu.lb)>

[422] Gaza War: Preliminary Findings on the Socio-Economic and Environmental Impact on Lebanon | United Nations Development Programme (undp.org)

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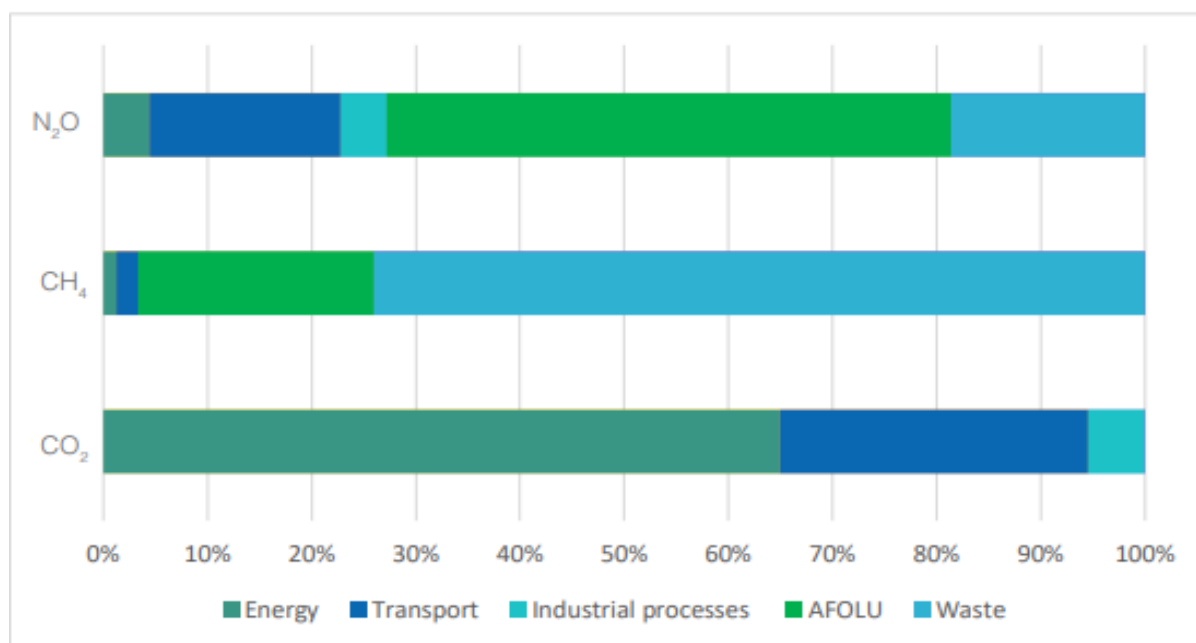
Figure 43: Sectoral GHG Emissions, 2019 (Note: AFOLU stands for Agriculture and Forestry and Other Land Uses)

4.3. Water by User, by Pollutant and by Polluter

By user, Lebanon abstracted 40.4% of its renewable resources in 2020, which is twice the water stress threshold of 20% of which:[423] 33.3% for industries; 47% for agriculture; and 19.7% for municipalities[358]. Municipal water demand in the 5 coastal governorates reached 373 million of m3 out of 522 million of m^3 in total (Table 15). There is an abrupt decline in the discharge from rivers estimated to more than 60% of their average annual discharge due to over pumping from rivers and coastal wells[424] that allows for water table salt intrusion[425] [426]. By pollutant, most Lebanon surface and underground water is contaminated to various levels with bacteriological and physiochemical compounds as well as heavy metals that often make their way to the marine environment[427] (CNRS and recent research provide surface, underground and marine water quality: high alkalinity, microplastics, bacteria, nitrates, pesticides, herbicides, chemicals and heavy metals)[428] [429]. By Polluter, municipal wastewater generated 252 million m^3 in the 5 governorates out of 324 million m^3 in 2022 (Table 3). In addition to wastewater discharge, the marine environment's pollution is tied to industries (estimated at 60 million m^3 in 2015)[430], ports (ballast, liquid and solid waste, oil leaks or spills, etc.), agriculture runoffs (nitrate,

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[423] FAO AQUASTAT Dissemination System

[424] 2012 - Seawater Intrusion at the Lebanese Coastal Aquifers Khalde-Jiyeh Case Study. Hdeib, Rouya... Thesis.
[425] 2020 - Rivers of Lebanon: Significant Water Resources under Threats . Shaban, Amin... Hydrology, edited by Theodore V. Hromadka II and Prasada Rao. Rivers of Lebanon: Significant Water Resources under Threats | IntechOpen
[426] 2018 - Synergy of climate change and local pressures on salt water intrusion in coastal urban areas: effective adaptation for policy planning. Safia,A., G. Rachida, M. El-Fadela, J. Doummarb, and M. Abou Najm.. . Water International. Vol. 43, NO. 2, 145–164
[427] 2012 - Chemical Profile of Lebanon's Potential Contaminated Coastal Water. Korfali, Samira Ibrahim and Mey Jurdi. Journal of Environmental Science and Engineering A 1 (2012) 351-363 Microsoft Word - 10-Chemical Profile of Lebanon's Potential Contaminated Coastal Water.docx (fanack.com)
[428] 2017 - Deterioration of Groundwater in Beirut Due to Seawater Intrusion. Journal of Geoscience and Environment Protection. Saadeh, Mark and Wakim, Elie. 05(11):149-159
[429] Orbmedia website: <Invisibles - Multimedia | Orb (orbmedia.org)>
[430] EU-Switch-MED, UNEP, MoE and MoI website: <01.-SCP-NAP-Lebanon.pdf (switchmed.eu)>

pesticides, and herbicides), potential fish farming (Akkar's shrimp farm) and waste mismanagement (leachate). However, pollution loads, and level of pollutants released by these sectors in the marine environment are not available but are inferred mainly from coastal surface and underground water quality testing.

Table 15: Coastal Governorate Municipal Water Use and Wastewater and Waste Generation in 2022

Item	Unit	Residents & Palestinians	Syrians	Total
Water Supply	m3 Million	328.3	44.8	373.2
Wastewater	m3 Million	208.4	43.5	252.0
Municipal Waste	ton x 000'	1,292.2	253.3	1,545.5

Source: Based on 2023 Lebanon Crisis Response Plan (LCRP) | United Nations in Lebanon; and EU-AfD. 2023. EU-AFD Technical Assistance Programme to Support Reforms in the Water and Wastewater Sectors in Lebanon. Executed by ASPA and SCE. Beirut.

4.4. Waste by Generator, by Pollutant and by Polluter

By generator, municipal waste generation is estimated at 1,546 million tons in the five coastal governorates out of 2.024 million tons per year in 2022. All other sectors (agriculture, industries, and services) generate different categories of waste that are poorly reported. By Pollutant (air is covered above), biological (organic, agriculture, slaughterhouse, sludge, etc.), inert (construction debris, industries, etc.), chemical (industry, energy storage leaks, leachate, etc.) hazardous (industry, medical, consumer electronics, batteries, etc.) and other (tires, etc.) are probably prevalent in the coastal and marine environment with almost no reporting or monitoring. By polluter, municipalities, industries and construction generate the largest volume but the medical and industrial sectors generate the most potent contaminants.

4.5. Change in coastal land use and land cover

The coastal land use and land cover has dramatically changed over the years with pressure from the increase of the buildup areas to the detriment of agricultural, natural and forest areas[431] leading to a loss of ecosystem services. More dramatic is the artificialization of the shoreline that was illegally appropriated by the private sector[432] which is altering the seascape where significant seafilling have overtaken anthropogenic or natural accretion and erosion[433]. However, three MPAs were set up in the coastal and marine environment, e.g., PINR, TCNR and ACNR[434]. Moreover, the CZ landscape is scared by quarries (notably in Chekka and Sibline by the cement companies and other gravel and sand quarries), and municipal and construction waste dumps[435] leading to air, noise, sight, water resources and land pollution with a decline in ecosystem services.

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[431] 2023 - Candidate Common Indicator 25 "Land cover change" For (Lebanon). Termos, Samah. GEF MedProgramme Child Project 2.1. PAP/RAC of UNEP/MAP. UNEP. Split.
[432] Beirut Urban Lab website: www.beiruturbanlab.com and MOPWT website: http://mopw.gov.lb/
[433] 2020 - Investigating the performance of sentinel-2A and Landsat 8 imagery in mapping shoreline changes. Mitri, George, Manal Nader, Manale Abou Dagher and Karen Gebrael. Journal of Coastal Conservation (2020) 24:40 https://doi.org/10.1007/s11852-020-00758-4
[434] Ministry of Environment: www.moe.gov.lb
[435] 2021 - Spatial distribution and landscape impact analysis of quarries and waste dumpsites. Mitri, George, Georgy Nasrallah and Manal Nader. Environment, Development and Sustainability https://doi.org/10.1007/s10668-020-01169-z

5. STATE

The CCZED$_{2023}$ in Lebanon ranges between 3.7% and 9.5% of Gross Domestic Product (GDP) in 2023 with a mean estimate of 6.2% equivalent to about 1.26 billion US$ in 2023. By sources of degradation: (i) substantial negative impacts to health from mainly ambient air pollution with 302.9 million US$ equivalent to 1.50% of GDP; (ii) water-borne diseases associated with poor water and sanitation provision as well as behavior practices for a small segment of the population, whereas water quality degradation that cover both river basins and the marine environment exceeds water quantity with a total for water degradation reaching 513.2 million US$ with 2.54%; (iii) significant strain on land resources in terms of land, range and forest degradation while active and passive quarries have scared the landscape with a very high rehabilitation cost to restore initial landscapes with total land degradation reaching 150 million US$ with 0.74%; (iv) waste, whose treatment and disposal remain a significant problem, has a degradation of reaching 208.1 million US$ and 1.03%; (v) and coastal zone degradation includes the stress on coastal and marine ecosystem services, coastal erosion and the depletion of the fish stock with total degradation reaching 83.4 million US$ and 0.41%. By Governorate: Mount Lebanon is the most affected as it is house to the majority of the coastal population with degradation reaching 633.3 million US$ equivalent to 3.1% of GDP; North Lebanon with 229.1 million US$ and 1.1%; South Lebanon with 183.7 million US$ and 0.9%' Beirut with 121.0 million US$ with 0.9%; and Akkar with 89.7 million with 0.4%. These estimated degradations are very conservative, charted by governorate and environmental category and presented in terms of absolute costs and relative costs as a percentage of the 2023 GDP in Table 16, Figure 44 and Figure 45.

Table 16: Lebanon CCZED by Governorate and Category, 2023

Category	Akkar	North Lebanon	Beirut	Mount Lebanon	South Lebanon	Total	Percentage of GDP
	million US$						%
Air	26.2	51.4	36.6	137.5	51.0	302.6	1.5%
Water	35.5	82.4	69.2	242.1	84.1	513.2	2.5%
Land	8.2	35.1		92.8	13.8	149.9	0.7%
Waste	13.2	45.8	6.1	124.1	18.8	208.1	1.0%
Coastal Zone	6.6	14.8	9.2	36.9	15.9	83.4	0.4%
Total	89.7	229.5	121.0	633.3	183.7	1,257.2	6.2%
Percentage of GDP %	0.4%	1.1%	0.6%	3.1%	0.9%	6.2%	
GDP 2023 US$ million						20,170.7	
Population #	291,827	571,126	407,676	1,532,425	568,716	3,371,769	
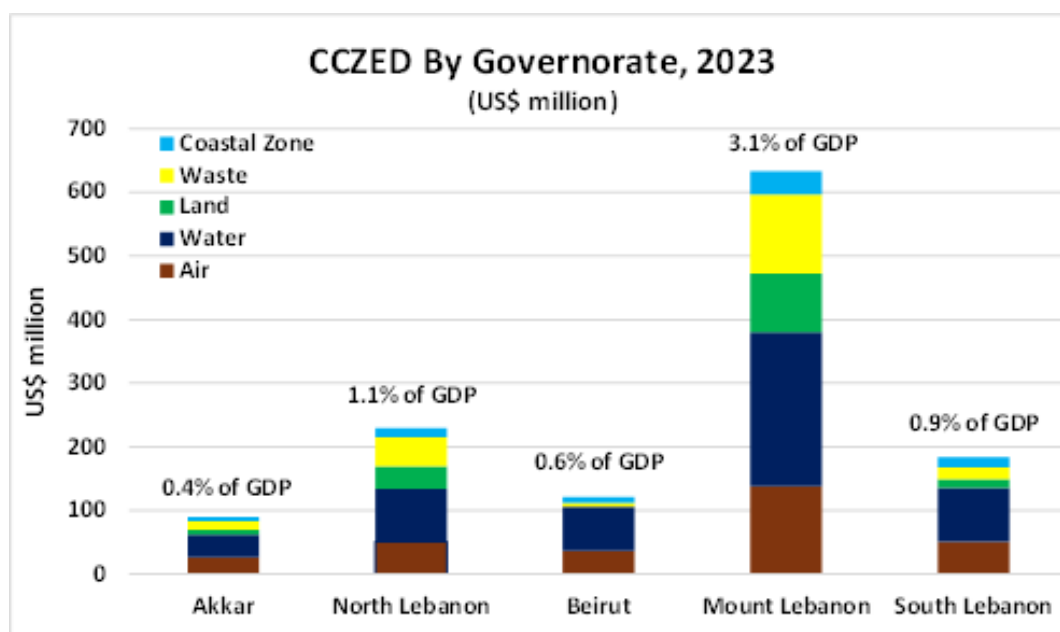
Figure 44: Lebanon CCZED By Governorate, 2023
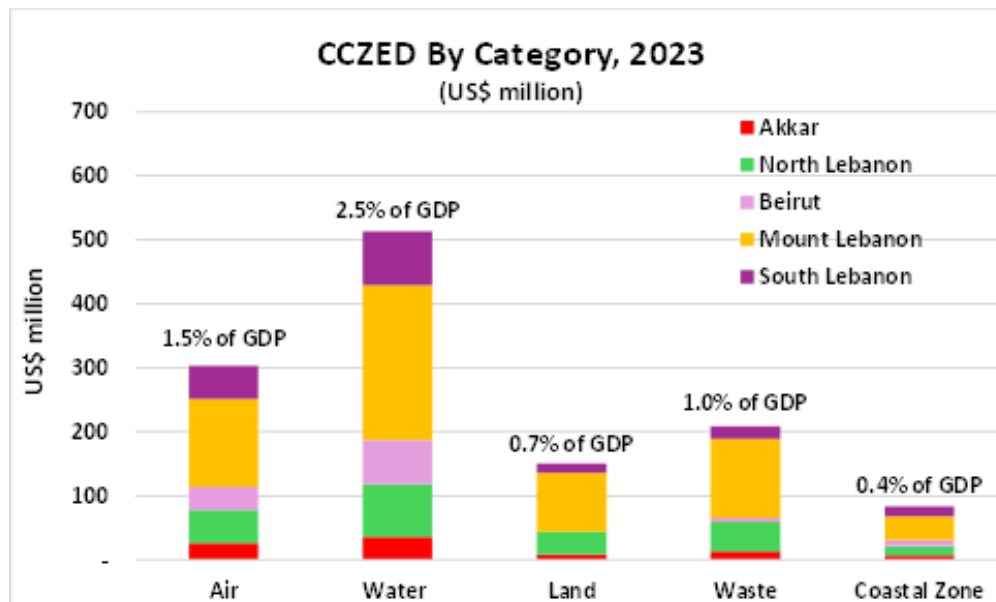
Figure 45: Lebanon CCZED by Category, 2023

5.1. Global Indicators and Outlook

Lebanon Environment Performance Index (EPI) shows a dramatic fall in both ranking from 67 in 2018 to 78 in 2022 among 180 countries and scoring from 61.08 to 45.4 respectively towards environmental

sustainability[436]. ND GAIN ranks Lebanon as the 116th with a score of 44.7 in 2022 and ranks 80th as the most vulnerable country and 156th as the readiest country. Relative to other countries, its current vulnerabilities are manageable but improvements in readiness will help it better adapt to future challenges[437]. CC is expected to have diverse implications on Lebanon's environment, economy, and social structure. Extreme weather events can have adverse impacts on public health, human settlements, transport infrastructure, agriculture production, power supply and the economy at large. The fragile biodiversity, ecosystems, and natural habitats will be threatened by increased forest fires, pest outbreaks and SLR.[438]

5.2. Local indicator

The 2018 COED[439] was equivalent to 4.4% of GDP in 2018 and reached 10.9% of GDP in 2023 by the World Bank of which 3.3% are associated with the displaced Syrians[440]. The same data will be used to calculate the COED degradation for the ICZM Strategy.

5.3. Demographic change

The trend of Syrian influx and Lebanese emigrating is still prevalent with all the socioeconomic problems that ensue. Due to the multifaceted crisis, the GOL has no leverage and is bound by controversial foreign policies where donors have been providing financial aid to host communities and displaced Syrians to increase their integration in the Lebanese society. Yet, it is not possible to disaggregate the contribution of the displaced Syrians to the formal and informal GDP.

5.4. Air

Despite the formulation of the MoE's 2017 *National Strategy for Air Quality Management*, there is no progress on managing air pollution across sectors. Ambient emission levels were monitored by MoE's National Air Quality Monitoring Network (NAQMN) until 2018 without any kind of enforcement towards standards that eventually need to be updated. Monitoring was discontinued due to budgetary constraints. Monitoring stations exist in Tripoli and in a few universities. PM2.5 (about mean annual 30 $\mu g/m^3$ in 2022) is measured by universities by using satellite imagery without ground truthing. Other pollutants are measured by universities for research and mostly remain in the academic domain.

5.5. Water and Wastewater

The NWWS was updated in 2020 but remains unimplemented as the public water sector (4 Water Establishments –WE) is collapsing. Although tariffs were adjusted upwards in 2023, the collection rates have dramatically decreased across the four WEs which prevent them for ensure the bare minimum in terms of operations and maintenance and are relying on donors, notably UNICE[441] to obtain gasoil to be able to use the generators to pump water. Similarly, the wastewater sector is even in a more

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[436] Lebanon | Environmental Performance Index (yale.edu)

[437] https://gain.nd.edu/our-work/country-index/rankings/

[438] Lebanon - Heat Risk | Climate Change Knowledge Portal (worldbank.org)

[439]

bing.com/ck/a?!&&p=c0a8a726e01f687eJmltdHM9MTcxMTQxMTIwMCZpZ3VpZD0xYjc2MmJmZS02NWVjLTYxMDctMGI2YS0zYTcwNjQ1Yj

YwZjAmaW5zaWQ9NTIwNQ&ptn=3&ver=2&hsh=3&fclid=1b762bfe-65ec-6107-0b6a-

3a70645b60f0&psq=lebanon+undp+rapid+cost&u=a1aHR0cHM6Ly93d3cudW5kcC5vcmcvbGViYW5vbi9wdWJsaWNhdGlvbnMvcmFwaWQ

tY29zdC1lbnZpcm9ubWVudGFsLWRlZ3JhZGF0aW9uLTIwMTg&ntb=1

[440] 2024 forthcoming Cost of Environmental Degradation (COED) of Lebanon for 2023. World Bank. Washington, D.C.

[441] Interestingly, 69.1% of Lebanese residents use bottled water, and this figure could be considered as a robust proxy for household revealed preference as they do not trust the drinking water quality provisioned through the network. Incidentally, Lebanon tap water microplastics' prevalence reached 97% in 2017 (second to the United States) while 11 different global and national bottled water brands including one from Lebanon showed a microplastics' prevalence of 93% in 2018. Also, a recent study on food contamination in Lebanon is quite revealing as 55% of tap water had unacceptable levels of contamination

catastrophic state as out of 36 installed WWTPs, only nine are in operation or partially in operation with one on the coast: Ghadir/Beirut with 84,500 m^3 (operating at 65% of its installed capacity of 136,000m^3 per day) treated to primary level. Four WWTPs are operational in coastal watersheds with an installed capacity of 6,700m^3 per day with treatment to 2nd level (Roum and Ainbal with 850 m^3 per day) and 3rd level (Safa and Barouk with 385m^3 per day) (MOEW database). Users seek more expensive alternative sources (bottled water, gallons, wells, trucks, etc.) to secure needs while untreated wastewater discharge is often used for irrigation as water reuse from the few WWTPs is still not common practice. Water quality is usually measured by the public sector (Litani River Authority, Water Establishments) but the WE budgetary constraints shifted this responsibility to donors such as UNICEF/WHO. The Joint Monitoring Programme Lebanon Water Quality Survey revealed that resident had access to improved water provision but that 47% of the drinking water samples revealed faecal contamination (Figure 46). Indeed, 69.1% of Lebanese residents use bottled water, and this figure could be considered as a robust proxy for household revealed preference as they do not trust the drinking water quality provisioned through the network. Surface and underground water quality is mainly tested by donors funded programs and is highly contaminated[442]. Regarding marine waters, the Lebanese CNRS[443] publishes the state of the water bathing quality (marine pollution is covered under Water) sometimes in June of each year and in 2023, out of 37 sampling spots along the coastline, 22 spots being classified as good to very good, six spots were classified as polluted to very polluted with the remaining nine were classified as cautious to critical unsafe and are attributable to untreated wastewater and leachate from main dumps. Moreover, vanadium, lead, copper and cadmium are found in sediments with higher than acceptable levels in Ramlet el Bayda and Dora in Greater Beirut, while phosphates are found in Selaata, Antelias and Ramlet el Bayda and nitrates in Nahr Ibrahim and Antelias after being discharged into the marine environment. Still, the CNRS results are questionable as under the EU-funded Evaluation of the Lebanese marine environment: a multidisciplinary study Project provides a different picture: Mahfouz et al., 2023[444] identified that coastal landfills and raw sewage effluents were the main sources and routes for microplastics into the Lebanese coastal marine environment; Elseblani et al., 2023[445] confirmed based on sampling in 14 marine locations in 2021 that microplastics are a vector of contaminants in the marine environment and detected microplastics being contaminated with several toxic metals either used as additives or taken up from the media; Hassoun et al., 2018 and Hassoun et al., 2020[446] show that high carbonate with increasing rates of alkalinity and total dissolved inorganic carbon compared to other Mediterranean areas and an annual increase in acidification rates between 2012 and 2017.

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[442] LEBANON_Brief4v4a (fao.org)

[443] CNRS Status of the Marine Environment in Lebanon: Annual Report. Beirut. www.cnrs.edu.lb

[444] 2022 - First assessment of microplastics in offshore sediments along the Lebanese coast, South-Eastern Mediterranean. Mahfouz, C., Jemaa, S., Kazour, M., Hassoun A.R., Lteif, M., Ghsoub, M., Ouba, A., Amara, R., Fakhri, M. Marine Pollution Bulletin, Volume 186, 2023, 114422, ISSN 0025-326X, https://doi.org/10.1016/j.marpolbul.2022.114422.

[445] 2023 - Study of metal and organic contaminants transported by microplastics in the Lebanese coastal environment using ICP MS, GC-MS, and LC-MS. Elseblani, R., Miguel C.G., Simon G., Jimenez-Lamana, J., Fakhri, M., Rodríguez, i. and Szpunar, J. Science of The Total Environment Volume 887, 20 August 2023, 164111

[446] 2019 - The carbonate system of the Eastern-most Mediterranean Sea, Levantine Sub-basin: Variations and drivers. Hassoun, A. R., Fakhri, M., Raad, N., Abi Saab, M., Gemayel, E., De Carlo, E. Deep Sea Research Part II: Topical Studies in Oceanography, Volume 164, June 2019, Pages 54-73

2020 - offshore Lebanon-Levantine Mediterranean Sea. Hassoun, A. R., Fakhri, M., Habib, M., Ouba, A., Jemaa, S., Mahfouz, C., Jaber, H., Ghanem, A., Tannous, M. and El Kheir, M. . EGU General Assembly 2020. CO Meeting Organizer EGU2020 (copernicus.org)
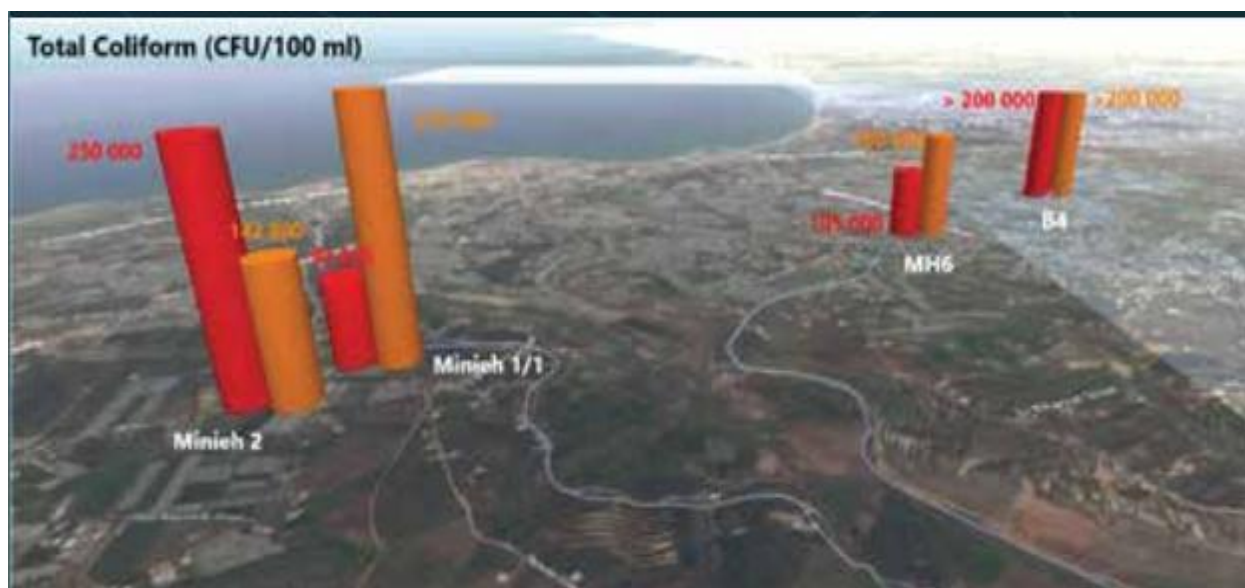
Figure 46: Water bacterial contamination in Akkar and Minieh Dennieh (*Source: FAO:* *LEBANON_Brief4v4a (fao.org)*)

5.6. Industrial effluents

Lebanon has 72 designated industrial zones of which 50% of industries are in Mount Lebanon that are lacking the proper infrastructure to effectively manage the generated industrial effluents and comply with national standards[447]. Moreover, many industries are located outside of these industrial zones which increase the complexity of managing industrial wastewater discharges that are usually released untreated in the sewer network or in nature.

5.7. Waste

Lebanon prepared several integrated solid waste management strategies and plans over the years with the latest one being release in February 2024[448] without being successful so far at putting the sector on a sustainable footing. Lebanese resident municipal collection is almost universal and reached 98.9% on average in 2023[449]. However, waste treatment capacity, composting and recycling face tremendous challenges in terms of quantity, quality, operations and financing. The state of the waste sector is illustrated in Table 17 where there is neither recycling nor composting except for private start up and entrepreneurs who are diverting a small share of the waste generated. There are three landfills on the coast (Tripoli with an area of 7.5ha, Jdeideh with 21.2ha, Costa Brava with 53.8ha) while the coastal dump in Saida was rehabilitated in 2016 where a 33,000 m2 park was opened on the reclaimed land[450].

The Naameh landfill was closed in 2015 that led to the 2015 waste crisis in Beirut and Mount Lebanon that led to the creation of the Costa Brava and Jdeideh landfill. There is another landfill further from the coast in Hbaline (0.417ha) but within the 10km coastal band servicing to the Jbeil caza. There are between 229 to 371 dumps (Authors' GIS compilation) in the five coastal governorates that are not

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[447] 2016 - Second National Action Plan for the implementation of the LBS protocol and its regional plans in the framework of SAP-Med to achieve good environmental status for pollution related ECAP ecological objectives. Mawla, D. Beirut.
[448] Draft-National-Integrated-Solid-Waste-Management-Strategy_Executive-Summary_EN.pdf.aspx (cdr.gov.lb)
[449] CAS (2020) op. cit.
[450] OCHA: From Shame to Fame… Saida Trash Mountain to Green Park - Lebanon | ReliefWeb

necessary located along the coast but are mostly active along coastal watersheds, hence affecting river basins, underground water and the marine environment. There are no reported figures on the leachate treated vs. non-treated in Lebanon. Whereas the CDR contracts include landfill (Bourj Hammoud and Costa Brava) that are supposed to treat leachate, Office of the Minister of State for Administrative Reform (OMSAR) contracts only cover the disposal cost without monitoring leachate treatment if it is being performed. A rough estimate of the leachate generated from the total population waste flows amounts to about 400,000m^3 in 2020 of which 137,000m^3 generated in the 4 Mohafazat of the Litani Basin[451]. This does not include the leachate released from active and passive dumps from previous year's waste disposal.

Table 17: *State of the Municipal Waste Management in the Coastal Governorates, 2023*

Governorate	Total Volume	Collection Transfer	Landfill	Dump	Recycling	Composting
Unit	Ton/year	%	%	%	%	%
Akkar	151,092	100%	0%	100%	0%	0%
North Lebanon	277,048	100%	47%	53%	0%	0%
Beirut	166,691	100%	100%	0%	0%	0%
Mount Lebanon	702,182	100%	85%	15%	0%	0%
South Lebanon	248,520	100%	0%	100%	0%	0%
Total	1,545,533					

Source: UNDP database on waste treatment.

5.8. Land Use

Verdeil et al., 2019[452] have reported 1,036 infringements in 2014 while MoPWT has reported 1,068 infringements in 2021 on the public maritime domain and the 2024 the General Budget Law 324/2024[453] has special provisions to fine the culprits. The fines are denominated in US$ and range between 10,000 US$ and 35,000 US$. The MoE has a Strategy to close all the dumps[454] and penalize the quarry operators so that they pay what is due to the Treasury and rehabilitate the quarries[455]. t. The land use land cover is changing yearly without any remit while the quarries and dumps are significantly changing the overall landscape of Lebanon. The MoA launched the 40 Million Trees

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[451] 2014 - *Cost Assessment of Solid Waste Degradation Model Guidebook*. Doumani, F., Sherif, A.and Ilyes, A.. GiZ SWEEP-NET. Tunis.
[452] 2019 - *Atlas of Lebanon : New Challenges*. Verdeil, E.; Faour, G. ; Hamzé, M. Nouvelle édition [en ligne]. Beyrouth : Presses de l'Ifpo,. https://books.openedition.org/ifpo/13178.
[453] Official Gazette #7 of February 15, 2024. (pcm.gov.lb) م عدد 7 تاريخ 2024-2-15
[454] https://www.undp.org/lebanon/publications/updated-master-plan-closure-and-rehabilitation-uncontrolled-dumpsites-throughout-country-lebanon
[455] Calculating the Quarrying Sector's Dues to the National Treasury in Lebanon | United Nations Development Programme (undp.org)

Pogramme in 2012. However, despite all the ongoing efforts and initiatives, the net result is that the forest cover is diminishing due to encroachment and forest fires[456].

5.9. Marine environment

Despite the designation of additional coastal protected areas, Lebanon's National Biodiversity Strategy and Action Plan (NBSAP) 2016-2030[457] that is currently being implemented under the project "Provision of "Services for the Alignment of the NBSAP and Relevant Policy Framework in Lebanon with the Post-2020 Global Biodiversity Framework (GBF) is not being implemented. Also, the National Strategy for Conservation and Management of Plant Genetic Resources for Food and Agriculture in Lebanon 2015 - 2035 is not being implemented[458]. A draft law on fisheries and aquaculture was prepared and needs to be ratified by Parliament. Regarding the fish stock trend, it is being depleted as illustrated in Figure 47.
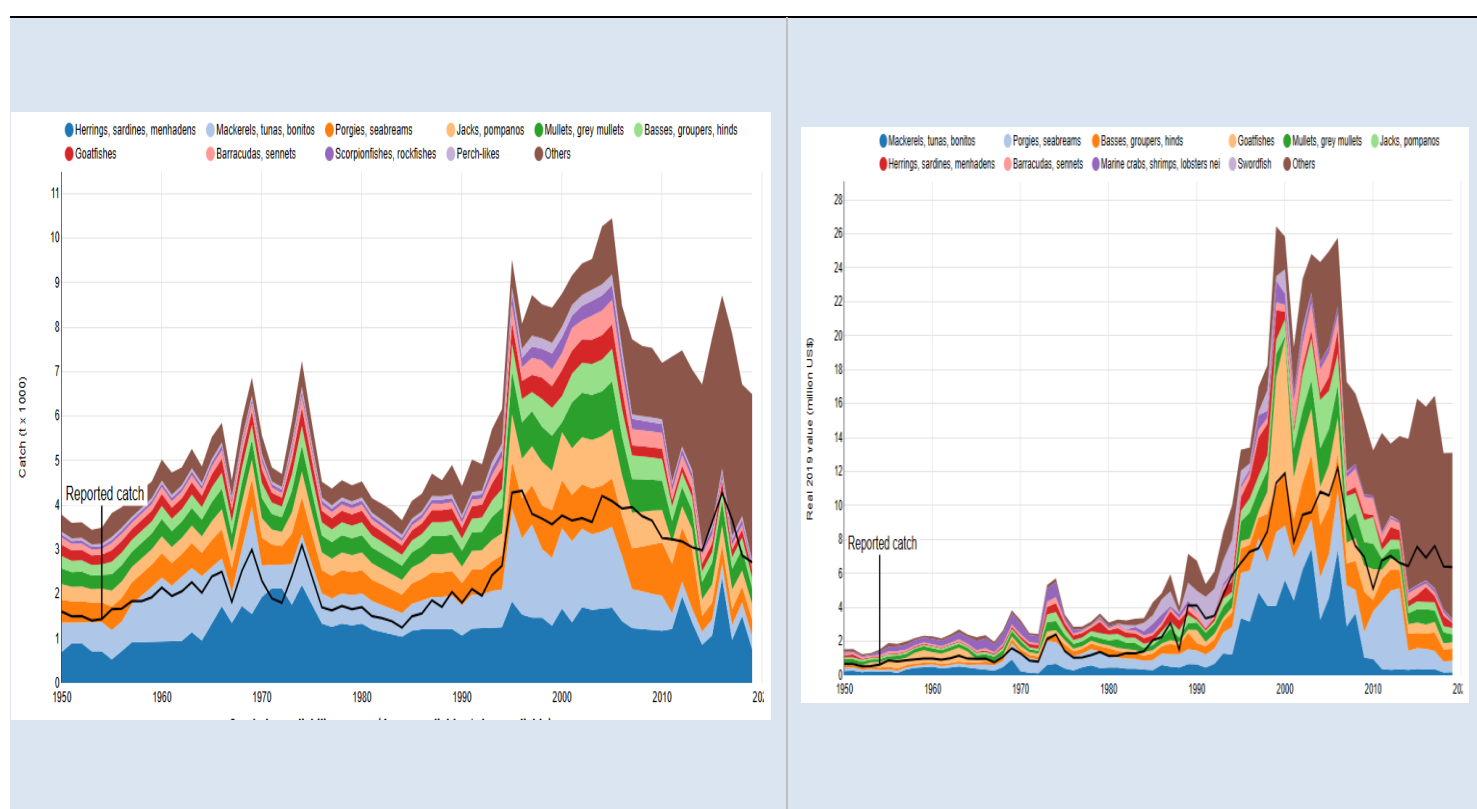
Figure 47: Fish stock, catch and landed value trend, 1950-2019 (*Source: Sea Around Us website: www.seaaroundus.org*)

6. Impact

6.1. Demographic change

The impact is on land use land cover as well as air, water and waste pollution. There is an incremental impact on the air, water and land pollution where higher levels of the pollution are affecting residents

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[456] https://documents1.worldbank.org/curated/en/099091423111014258/pdf/P1794350610b210cd082df0ed2c2d79c757.pdf
[457] MOE: lb-nbsap-v2-en.pdf (cbd.int)
[458] MOA: leb169447.pdf (fao.org)

and Syrian alike when they live in the same area. The burden of disease is detailed in the 2018 COED in terms of quantity measured by the Disability Adjusted Life Years (DALY) metric and the monetization of the environmental health burden in terms of increasing the burden on the economy, reducing competitiveness and incurring damage that is sometimes irreversible. Moreover, any environmental health burden reduces the productivity of the economy and stresses the health care sector and the health care insurance system.

6.2. AIR

$PM_{2.5}$ remains the most potent pollutant and affects human health, agricultural productivity, and ecosystem services that remain to be better analyzed. Diseases associated due to high concentration of $PM_{2.5}$ include premature death and morbidity from the following diseases: Ischemic Heart Disease (IHD); Chronic Obstructive Pulmonary Disease (COPD); Trachea, Brochus and Lung Cancer; Acute Respiratory Infection (ARI); Stroke; Diabetes Mellitus II; Prenatal; and others and Ozone. Similarly, exposure to NOx leads to respiratory infections and asthma. Long-term exposure to high levels of nitrogen dioxide can cause chronic lung disease. The burden of air disease is detailed in the 2018 COED.

6.3. WATER AND WASTEWATER

The ineffective water and wastewater sector is increasing the burden of water-borne diseases (diarrhea, hepatitis B, bluebaby syndrome, to cancer associated high level chemicals, nitrates and heavy metals, etc.), reducing the reliability of the provision of water, increasing the cost of water for all sectors hence reducing their competitivity and having a tremendous impact on the environment, ecosystem services and all the sectors that benefit from the environment, e.g., agriculture, tourism, municipalities, industries, environmental flow to maintain the ecosystem services, amenities, etc.

6.4. WASTE

The mismanagement of the sector increases the burden of health (PAH emission and other pollutants) during burning or self-ignition that could lead to respiratory diseases, pollution of water bodies, etc. Moreover, dumps and littering produce a disutility affecting all the activities associated with tourism, beach activities, circularity (efficient industrial reuse of recyclables, etc. while sight and odor pollution affect the price of assets, etc.)

6.5. LAND USE/ LAND COVER

Changes lead to land dismemberment, disruption and tremendous pressure on the ecosystem that will lose some of its functionality: provisioning services; regulating services; habitat services; and cultural services.

6.6. MARINE ENVIRONMENT

Excess pollution will affect the fauna and flora and endanger species, reduce the natural capital of the marine environment leading to the reduction of resources extracted from the marine environment, e.g., fish, salt, algae and reduce all the amenities associated with the beach and the sea.

7. RESPONSE

The COED provides policy-makers with a tool to make informed, effective, efficient and possibly equitable policy choices to support the integrity of the environment and promote conservation within the context of sustainable development. The COED uses quantitative methods to calculate the

degradation cost but could also be used to determine the most efficient investments that will provide the best and most efficient alternative among options, being a policy, a program or a project. For instance, a strategy could be formulated based on environmental costs and costs of remediation by performing a benefit cost analysis; a green tax could be introduced and could be calibrated to see what is the most efficient rate to remedy is or reduce a pollution; a tariff or a gate fee could be introduced by performing the same process; or a Nature-Based Solution (NBS) could be considered instead of a hard structure, etc.

This aspect will be elaborated further. In the meantime, the attached matrix provide policy instruments where a cost benefit analysis could be performed to see the effect and efficiency of such a policy: regulatory; fiscal; market creation; and moral suasion that are illustrated in the Matrix in Table 18, for instance:

- Regulation: e.g., regulatory and incentive-based hybrid policy instrument like World Bank Lebanon Pollution Abatement Project (LEPAP) 2016-23 that helped effectively reduce industrial air pollution.
- Fiscal: e.g., rights, license, permits, fines, penalties, green tax, tariff adjustments, etc. that will reduce the pressure on a resource.
- Incentive: e.g., provide fiscal and/administrative exemption for industries adopting the circular economy principles (e.g., less input and less output) or reducing carbon footprint.
- Knowledge and Moral suasion: e.g., let the people put pressure on polluters by being informed on the pollution; make sure that goods are produced sustainably and get certified, etc.

Table 18: Matrix of Selected Policy Choices Whose Efficiency Could Be Calculated by Using the COED and the Benefit Cost Analysis

Regulatory	Fiscal	Incentive-based	Knowledge and Moral Suasion
Pollution abatement Command and control as part of Pollution Management Compliance System)	Adjusting rights, license, charge, permits, fines, penalties, green tax, tariff adjustments, etc. Removing subsidies Green tax (as part of a Compliance System)	Tradable permits (Air Pollution Cap and Trade as part of a Compliance System) Green Blue Bonds	PROPER (Program for Pollution Control, Evaluation and Rating as part of a Compliance System) Fair Trade Corporate Social Responsibility Environment, Social and Governance
Conservatoire du Littoral **Protected Areas/Reserves**	Special Economic Zone exemption	Tradable permits (Waste Landfill, e.g., UK where municipalities have landfill rights that could be sold to other municipalities if actual disposal less than planned disposal) Green/Blue Bonds	Eco-Labeling Ecotourism certification[459] Compost certification[460] Fish certification[461] Water conservation certification[462].
Strategic/Environmental Impact Assessment **Zoning policies and derivatives** **Urban growth boundaries** **Open Space Preservation** **Smart growth** **Green Belt** **Land Consolidation through Swaps** **Rate of growth controls**	Tax Increment financing Development Impact Fees Land value tax Property tax	Transfer of development rights (Perquazione Urbanistica or tradable exploitation coefficient rights) Conservation easements Brownfield Redevelopment Incentives (Green bonds) Historic Rehabilitation Tax Credits Other Taxes Joint development	Certification: AOC (Appellation d'Origine Contrôlée) classification (controlled designation of origin) Social, Governance and Informative measures Technological Tools

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[459] IES: Certification and Standards - The International Ecotourism Society
[460] BPI: BPI - Compostability Certification (bpiworld.org)
[461] MSC: Sustainable Fishing | MSC | Marine Stewardship Council
[462]AWWA:https://www.bing.com/search?q=water+conservation+certification&qs=n&form=QBRE&sp=-1&ghc=1&lq=0&pq=water+conservation+certification&sc=9-32&sk=&cvid=5286EDA6781940ECA5CC736226AC3E30&ghsh=0&ghacc=0&ghpl=

CHAPTER VIII: INEQUALITIES AS PER SDG 10

1. STATE:

Sustainable Development Goal 10 (SDG10) focuses on reducing inequality within and among countries. It emphasizes the need to empower and promote the social, economic, and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion, economic, or other status. SDG10 also aims at ensuring equal opportunities by eliminating discriminatory laws, policies, and practices.

The relevance of SDG10 to Lebanon is profound, given the country's current socio-economic challenges. Lebanon faces significant inequalities exacerbated by a severe economic crisis, political instability, armed conflicts and the impacts of hosting a large number of refugees. The economic downturn since 2019 has led to widespread poverty, unemployment, and an increasing gap between the rich and the poor. Additionally, Lebanon's sectarian political system and existing legal frameworks contribute to disparities among different groups in society, including gender-based inequalities. The refugee crisis further strains Lebanon's infrastructure and public services, widening the gap between different communities within the country.

In fact, Lebanon has been assailed by the most severe, multi-prolonged crisis in its modern history for five three years. The ongoing economic and financial crisis, which began in October 2019, has been aggravated by the economic impact of the COVID-19 pandemic, the major Port of Beirut explosion in August 2020 and the current armed conflict with Israel that started in October 2023. The economic crisis though ranks among the worst economic crises globally since the mid-nineteenth century[463].

Nominal GDP fell from about 52 billion US$ in 2019 to an estimated 23.1 billion USD$ in 2021. Between 2019 and 2021, Lebanon's GDP per capita fell by 36.5%, and the World Bank classed the nation as lower-middle income, down from upper middle-income classification in July 2022. Similar brutal contraction is generally associated with conflicts and/or wars[464].

Years of rising public debt, high fiscal deficit, depreciation of the LP, increased unemployment and poverty, business closures, inflation, limited access to foreign exchange and imports, and decreased foreign remittances, all contributed to this severe crisis, which has increased the poverty rate to 82% in 2021, up from 45% in 2019, 30% in 2018, and 27.4% in 2011-2012. Vulnerable Lebanese households can barely access food, healthcare, education, and other essential services, and the unemployment rate reached 30% in 2022, up from 11% in 2019[465].

The purchasing power of wages – 80% to 90% of which were usually paid in LP - dropped by at least 75% since 2018, considering that more than 55% of total labor force are wage earners. The minimum wage decreased from 585 US$ to 43 US$ in 2021. Additionally, wealth inequality is clearly very high with the extreme concentration of wealth in the 1-10% of the adult population that ends up receiving almost 25-55% of the national income. This places Lebanon among the countries with the highest

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[463] The World Bank, 2022, Lebanon Overview: Development news, research, data, Lebanon Overview: Development news, research, data | World Bank
[464] The World Bank, 2022, Lebanon Overview: Development news, research, data, Lebanon Overview: Development news, research, data | World Bank
[465] ACAPS, 2022, Lebanon Socioeconomic crisis, Lebanon Socioeconomic crisis | ACAPS. Retrieved from: https://www.acaps.org/country/lebanon/crisis/socioeconomic-crisis

levels of income inequality[466]. An interesting fact is that this fact has been problematic and unchanged since 1960 based on the IRFED (Institut de Recherche en Vue de Developpement) study conducted back then on socio-economic disparities, which highlighted that 5% of the total Lebanese population has more than 50% of the national wealth. Fragmented social cohesion and increased vulnerability of marginalized groups, including refugees, low-income families, and those living in rural areas.

The already poor and vulnerable Lebanese and refugee populations have been particularly affected. An estimated 1.5 million members of the most vulnerable Lebanese populations, 1.5 million Syrian refugees, 180,000 Palestinian refugees from Lebanon, and 29,000 Palestinian refugees from Syria are considered vulnerable and in large need of humanitarian support[467].

Additionally, 60% of Lebanese women report having experienced some form of sexual harassment in the street, 31% of women in Lebanon report ever experiencing one or more forms of intimate partner violence, and 24% of men report ever perpetrating one or more forms of intimate partner violence.

Elaborated below are the updates in some key priority areas[468]:

1.1. Food security

22% of Lebanese families were food insecure during March and April 2021. 47% had difficulty meeting their basic necessities, up from 43% in November-December 2020.

1.2. Nutrition

Rates of chronic and acute malnutrition increased across Lebanon in 2021. Approximately 25% of Syrian children, 11% of Lebanese children, and 10.5% of Palestinian children suffer from chronic malnutrition, and 41% of children and 42% of women suffer from anemia. Poor access to nutritional services, inadequate nutritional intake, and poor access to Water, Sanitation and Hygiene (WASH) and health services are major issues affecting all populations groups.

1.3. Livelihood/Poverty

Almost 80% of Lebanese were pushed to live in multidimensional poverty in 2021. Overall, the deteriorating economic conditions and weak governance are likely to further aggravate poverty in Lebanon, affecting all population groups, which in turn reflects on solid waste generation and composition.

1.4. Education

The socioeconomic crisis and COVID-19 have disrupted education for Lebanese and Syrian refugee children in Lebanon; only 43% of children enrolled in school in the year 2021/2022. About 30% of young people have stopped their education, and 40% have reduced spending on education to buy essential items.

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[466] Assouad, 2021; Rethinking the Lebanese Economic Miracle: The Extreme Concentration of Income and Wealth in Lebanon 2005-2014
[467] ACAPS, 2022, Lebanon Socioeconomic crisis, Lebanon Socioeconomic crisis | ACAPS. Retrieved from: https://www.acaps.org/country/lebanon/crisis/socioeconomic-crisis
[468] ACAPS, 2022, Lebanon Socioeconomic crisis, Lebanon Socioeconomic crisis | ACAPS. Retrieved from: https://www.acaps.org/country/lebanon/crisis/socioeconomic-crisis

1.5. Water, Sanitation and Hygiene (WASH)

Most wastewater treatment plants in Lebanon are no longer operational due to the financial challenges facing the municipalities, leading to an urgent need for clean water and sanitation services amid the cholera outbreak in Lebanon. The Ministry of Public Health confirmed 448 cases as of October 21, 2022. Cases have been recorded in refugee camps and in other areas with polluted and contaminated drinking water. A survey of more than 19,000 people (3,522 households) living in informal settlements in Baalbek–Hermel governorate found that 80% of those households are using unsafe water. A large population of Palestinian refugees in various camps are also exposed due to unsafe WASH services. Lack of humanitarian funds, limited resources of public institutions, and the rapid escalation of the outbreak are raising concerns[469].

1.6. Solid Waste

Lebanon lacks a comprehensive solid waste management strategy and relies on costly landfills. The Beirut port explosion further damaged the waste management infrastructure, and the inefficiency of waste management exposes the population to higher health and environmental risks. During this socioeconomic crisis, Borj Hammoud/Jdeideh landfill reached capacity on April 30, 2020 and stopped receiving waste, which made trash pile up on the streets in Beirut and surrounding areas, in scenes similar to the 2015 trash crisis[470]. Furthermore, children and scavengers are frequently seen searching through trash bins in Beirut, or waiting for residents to bring out their trash to search for anything they might be able to sell[471].

1.7. Energy

The severe fuel shortage has caused more than eight continuous blackouts on the national power grid as public power supply averages one to two hours per day. Fuel shortages have also hindered access to medical supplies and clean water, while food supply shops, transportation service providers and telecom network operators face severe disruptions to their supply chains[472].

1.8. Banking sector

The banking sector, which informally adopted strict capital controls, has stopped lending and does not attract deposits. Instead, it endures in a segmented payment system that distinguishes between older (pre-October 2019) US$ deposits and minimum new inflows of "fresh dollars". The former is subject to sharp deleveraging through "lirafication" and "haircuts" (up to 85% on dollar deposits). The ongoing adjustment and deleveraging is highly regressive, affecting smaller depositors and Small and Medium Enterprises (SMEs), the most. The decline in average income coupled with triple-digit inflation and a severe currency depreciation are immensely decreasing purchasing power. Inflationary effects are disproportionately affecting the poor and middle class[473].

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[469] ACAPS, 2022, Lebanon Socioeconomic crisis, Lebanon Socioeconomic crisis | ACAPS

[470] Human Rights Watch, 2020, Lebanon: Huge Cost of Inaction in Trash Crisis, Lebanon: Huge Cost of Inaction in Trash Crisis | Human Rights Watch (hrw.org)

[471] Jabois *et al.,* 2022, The children who rummage through Lebanon's trash, The children who rummage through Lebanon's trash - La Prensa Latina Media

[472] The World Bank, 2022, Lebanon Overview: Development news, research, data, Lebanon Overview: Development news, research, data | World Bank

[473] The World Bank, 2022, Lebanon Overview: Development news, research, data, Lebanon Overview: Development news, research, data | World Bank

2. DRIVERS:

A high level of bureaucracy, corruption, and discrimination within public institutions impedes efficient governance and equitable distribution of resources, exacerbating socio-economic disparities. Lebanon's political system, characterized by sectarian divisions, fosters unequal access to resources, services, and political representation, leading to social and economic inequalities.

Additionally, political and regional instability, compounded by the refugee crisis, fiscal imbalances and soaring public debt, among the highest globally, pose significant challenges to economic sustainability and growth. Moreover, structural imbalances, including the lack of economic diversification, with the majority of economic activities concentrated in Beirut and Mount Lebanon, exacerbate regional disparities and hinder inclusive development efforts across the country.

3. PRESSURES:

Social tension with the economic disparities and competition for limited resources fuel social tensions between different demographic groups, including sectarian communities and between nationals and refugees. Moreover, inequitable access to quality education, healthcare, and essential services perpetuates socio-economic disparities. Furthermore, limited employment opportunities coupled with labor market discrimination based on nationality or gender compound these challenges, spreading marginalization and exclusion.

4. IMPACTS

- **Marginalized Communities Face Social Exclusion, Limiting Their Participation In Economic, Social, And Political Life:**

Discrimination prevents marginalized groups, such as refugees, ethnic minorities, and those living in high poverty areas, from accessing opportunities for education, employment, and civic engagement.

- **Increased Rates of Poverty, Particularly Among Refugees and in Marginalized Communities, with a Significant Impact on Children And Youth:**

Economic marginalization deprives individuals and families of basic necessities, such as food, shelter, and healthcare, leading to many social and health challenges. Children and youth from these communities are particularly vulnerable, facing barriers to accessing education, healthcare, and opportunities for personal development.

- **Limited Opportunities for Upward Social Mobility due to Entrenched Inequalities and Lack of Access to Quality Education and Employment:**

Limited access to quality education and employment leads to poverty and exclusion, trapping individuals and families in disadvantaged circumstances. Discrimination in the labor market based on factors such as nationality, gender, or socio-economic background further exacerbates these challenges, hindering individuals' ability to secure stable and fulfilling employment opportunities.

5. RESPONSES:

- **Implementation of Policy Reforms Aimed at Reducing Economic Disparities, Such as Progressive Taxation, Social Protection Measures, and Inclusive Economic Policies:**

Progressive taxation can help redistribute wealth by imposing higher taxes on the wealthy corporations while providing tax relief for low-income individuals. Social protection measures and inclusive economic policies prioritize job creation and business development.

- **Initiatives to Improve Access to Quality Education and Healthcare for all, Particularly Targeting Marginalized and Vulnerable Groups:**

Initiatives to improve access to education can include expanding school infrastructure, providing scholarships and financial assistance, and implementing inclusive curricula that address the needs of diverse learners. Similarly, efforts to enhance healthcare access may involve expanding healthcare facilities, training healthcare workers, and implementing preventive health programs. Targeted interventions are particularly important for marginalized and vulnerable groups to ensure that they have equal access to essential services.

- **Leveraging International Support and Cooperation to Address the Refugee Crisis and its Impact on Social and Economic Inequality:**

The refugee crisis in Lebanon has placed immense strain on the country's resources and infrastructure, exacerbating social and economic inequalities. International organizations, donor countries, and humanitarian agencies can play a crucial role in providing financial aid, technical assistance, and capacity-building support to alleviate the burden on Lebanon and mitigate the impact of the refugee crisis on social and economic inequality.

- **Enforcing and Strengthening Anti-Discrimination Laws to Ensure Equal Opportunities for all, Regardless of Sect, Nationality, or Socio-Economic Status:**

Enforcing and strengthening anti-discrimination laws is essential for promoting equal opportunities and ensuring that all individuals are treated fairly and equitably. This may involve implementing measures to prevent discrimination in employment, housing, education, and public services, as well as establishing mechanisms for addressing complaints and enforcing sanctions against committers of discrimination.

ANNEXES

ANNEX I: DPSIR SUMMARY TABLE

Sector/Theme	State	Pressures	Impacts	Drivers	Responses
Regulatory and Legislative Context	Lack of knowledge on the ICZM protocol, and relevant national legislation Lack of update and/or enactment of new laws for CZM Lack of the adoption of an ICZM law and strategy Violations of environmental laws Some plots of the coastline are private property Possible oil pollution from the "Oil & Gas" sector No clear legal definition of the CZ Various illegal occupation of the CZ	Increased urbanization and resource exploitation of the coastal area Weak enforcement of applicable laws Powerful lobbying blocking legal and regulatory reforms Outdated legislation and unclear definitions Understaffed and under-resourced public authorities Low deterrence of infringements due to insufficient penalties Political interference preventing accountability and promoting exceptions allowing private property claims on the maritime public domain	Degradation of coastal and marine ecosystems and deterioration of coastal water quality Economic losses Unsustainable coastal development and resource exploitation Difficulty in implementing ICZM protocol commitments Limited coastal access Coastal infrastructure and habitats vulnerable to extreme weather events Lack of accountability for environmental offenders Uncontrolled human activity in fragile ecosystems	Absence of political will and lack of coordination between concerned institutions Non-binding NPMPLT recommendations Environmental issues relegated to a secondary priority Slow update and publication of legislation and implementing decrees Sanctions and fines are not dissuasive Insufficient number of MOE and ISF employees and Environmental police was not staffed Most violators protected by political parties Lack of awareness	Update existing regulations, legislation, publish implementing decrees, and strengthen their enforcement power Accountability, transparency and citizen engagement Environmental awareness campaigns, lobbying campaigns, and curriculum update Strengthen coordination between concerned ministries Update sanction and fine values to be more dissuasive Establish an environmental unit within the ISF Recruit the 40 Environmental police officers. Recover MPD land

Sector/Theme	State	Pressures	Impacts	Drivers	Responses
					Update and publish the ICZM draft strategy and draft law

Sector/Theme	State	Pressures	Impacts	Drivers	Responses
Environment	Poorly managed urban expansion with little regard to environmental preservation Species richness threatened Degraded marine and coastal habitats High introduction and spread of invasive species Stressed aquifers, and wetlands Water scarcity Reduction in numbers of marketable species	Change in Land-cover/Land Use, and rural migration to coastal areas. Coastal Landfills, erosion and sea-filling Climate Change and catastrophic events Pollution Overexploitation of resources Introduction of invasive species through migration or by humans and competition with native species Increased diversion of rivers and building of dams	Privatization of the MPD Fragmentation and deterioration of coastal habitats Degradation of health of coastal and marine ecosystems and biodiversity Economic drawbacks Reduction in sedimentation and nutrients reaching coastal area Increase in drought, and prominent salinization of coastal aquifers	LCZ being the focus for economic activities Population growth and urban expansion Lack of monitoring and enforcement of regulations Diminished treatment capacity of solid and liquid waste Opening and enlargement of the Suez Canal Climate change and disaster prevalence Temporal and spatial variations of hydrological cycle	Three MPAs were created along the Lebanese coastline, two more are being processed for declaration. Creating economies dependent on marine invasive species Update of legislation and policies Enforce monitoring Increase conservation and ensuring connectivity Rehabilitation of degraded sites
Social	Increase in total population Gender distribution inequality and wage gap Increase in youth education dropouts and redirection into the workforce Daily power cuts Irregular supply of water from utilities	Increased demand for natural resources Women pressured into informal or underpaid work, and inequitable access to basic services and rights Reduction in incomes and public funding Decreased access to healthcare service	Overexploitation of natural resources and habitat destruction Inequalities in accessing education and professional opportunities Economic stagnation, increased immigration, and increased health burdens	Socio-economic crisis, economic disparities, COVID-19 pandemic, and refugee crisis Cultural and societal norms Failure of the water treatment and pumping system Lack of financial support to farmers, reliance on imports, and inadequate	Urban planning strategies Immigration policies Promoting gender equality Fiscal reforms Reforms to restore adequate coverage by NSSF Providing 24/7 electricity from the grid, diversifying energy sources

Sector/Theme	State	Pressures	Impacts	Drivers	Responses
	Worsening of the quality of internet services Collapse of the Lebanese national currency exchange rate Larger agricultural potential than currently utilized Built-up area and main cities geographically concentrated on the seashore, with limited number of major inland poles Multi-sectoral crises	Continuous blackouts Lack of access to clean potable water, and increasing sea water intrusion Poor telecommunications network Increased GHG emissions and increased coastal extreme climate events Increase in urban expansion	Dependency on private generators, and adoption of renewable energy Network failures Unlicensed wells financial burden associated with purchasing alternative potable water sources Reduced fish stock, loss of livelihood, and increased poverty Overburdened infrastructure Social exclusion of marginalized communities	enforcement and monitoring of laws Anthropogenic pollution and unorganized economic development Family law in Lebanon codifies gender inequalities High level of bureaucracy, corruption and discrimination within institutions	Improving access to basic services and reducing economic disparities Enforcing the laws and policies Strengthening water sector capacity Telecommunication infrastructure investments Restore depleted fisheries
Environmental economy	Resident population concentration on coastal zone Multifaceted financial-economic-political-health-displaced-conflict crisis Pollution and resource scarcity Land use/encroachment	Uncontrolled influx increases densification All macro-indicators are in the red Multi-sectoral inefficient use of fossil fuels Over abstraction and untreated land-based and sea-based discharge Increased coastal urbanization and artificialization	Rising emigration Social tension and job substitution GDP contraction, depreciation of the currency, foreign exchange crunch, trade/Balance of Payments deficits Hyperinflation, insolvent banks, public services deficit Poverty rampant, unemployment	Unplanned land and coastal use Multi-faced crisis which led to a laissez-faire governmental policy encouraged by Donors Lack of a government commitment, and of poorly updated coherent policies, governance strategies, stimulus package climate-resilient planning, and enforcement	Update and implement the NPMPLT Sovereign political commitment and formulate a strategy to tackle the refugee issue Increase implementation and enforcement power of MOE Implement, monitor and evaluate the NWSS

Sector/Theme	State	Pressures	Impacts	Drivers	Responses
			Death, injuries, destruction and natural damages due to the conflict in the south.		Enhance management of MPA, pristine and cultural areas
					Formulate a climate resilient ICZM strategy
Urban Planning / Marine Spatial Planning	Conversion of natural and semi-natural areas into built-up zones, extensive erosion and sea-filling	Unorganized spread of industrial enterprises with discharge of wastewater into marine waters and criteria pollutants and GHG emissions	Reducing the resilience and equilibrium of coastal environments and species.	Coastal centric service provision, job opportunities, and tourism opportunities	Implementation and enforcement of construction regulations and enforcing a setback zone
	Presence of a large amount of quarries	Chronic electricity crisis and haphazard urbanization	Rising sea levels, erosion, flooding, and the intrusion of saltwater into freshwater ecosystems	Gaps and distortions in the legal framework and inability to enforce laws	Enforce Law 444/2002
	Lack of management plan for the coastal and marine zones	Traffic jams	Water, air, noise, and visual pollution	Poor land-use regulations, lack of infrastructure management and maintenance	Develop new master plans considering recommendations of the NPMPLT
	Poor road, water and electricity network infrastructure	Illegal sand extraction and unsustainable quarrying practices	Destruction of existing arable land and altering of ecosystems integrity	Poverty, increase in the number of refugees, wars, regime instability, and corruption at the political and public levels	Revise and implement existing regulations and land use plans
	Encroachment and privatization of the coastline	Illegal occupation of the maritime public domain	Increasing stress on coastal resources		Improve urban and rural transport infrastructure
	51% of industries are situated on the coastline	Shortage in water supply, unsustainable consumption and poor wastewater management	Change in microclimates creating urban heat islands	Lack of coordination, amongst the various sectors	Promote integrated water management
	Poor management of cultural and natural resources	Coastal landfills	Degradation of cultural heritage sites	Reliance on quarries for construction,	Ban coastal quarries, rely on imports presenting comparative advantage
	Tourism along the coastline mostly focuses on sea resorts	Solid waste is dumped into landfills, burned or flashed out into the sea from illegal disposal in river basins	Lack of access to the maritime public domain	Unregulated tourism development especially along the coast	Manage landfills, and ban new and old coastal landfills
					Ensure public coastal access

Sector/Theme	State	Pressures	Impacts	Drivers	Responses
		Difficulty of the DGA to carry out its mandate Shrinkage in green spaces		Location of industries along the coast	Prohibit further occupation of the maritime public domain Remove illegal construction Create a network of MPAs
Climate Change	Increase in atmospheric GHG concentrations, atmospheric and sea surface temperatures Decrease in precipitation, and increase in drought, and heatwaves Sea level rise Stress on surface flows and groundwater sources	Increasing demand affecting the quality and quantity of natural resources Uncontrolled and illegal development along the coastline Pollution, coastal dumpsites, and sand dredging Legal and illegal drilling of groundwater wells and the excessive withdrawal of groundwater Poor enforcement of Coastal setbacks	Coastal erosion and loss of sediments, leading to loss of beaches Degradation of coastal ecosystem services Salinization of coastal aquifers Economic losses Increase in demand for cooling Threatened access to freshwater Health problem (Heart problems, Pulmonary Diseases, lung cancer, etc...) and increase in food insecurity	Urbanization and population growth Poorly monitored economic growth, agricultural practices, industrial siting, shipping industry, fishery practices, and tourism	Strengthen enforcement of law, monitor and punish violations Awareness programs Design soft and hard measures to protect areas vulnerable to seal level rise Establish monitoring systems for coastal zone indicators Effective early warning system along the coasts for coastal hazards Enforce coastal land-use plan to ensure a sufficient buffer zone Develop a management plan for key natural / historical sites taking into consideration climate change impacts

ANNEX II: MAP OF THE COASTAL STRIPS IN LEBANON
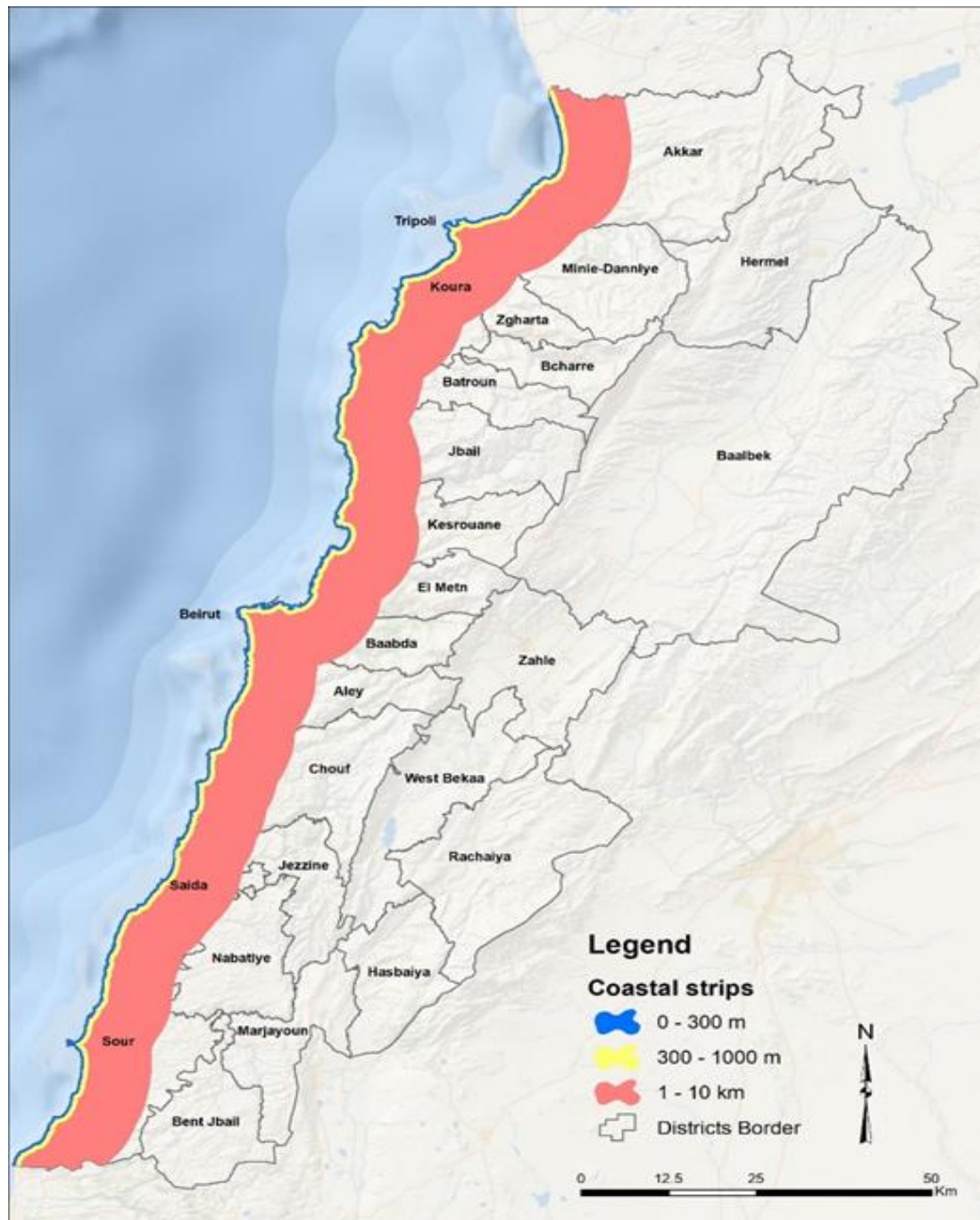
ANNEX III: MAP AND LIST OF COASTAL ADMINISTRATIVE UNITS ALONG THE LCZ

Mohafaza	Caza	CAD_NAME_1
Akkar	Akkar	Arida
Akkar	Akkar	Bebnine
Akkar	Akkar	Cheikh Zennad Tal Bibé
Akkar	Akkar	Al-Mehamra
Akkar	Akkar	Al-Moukaiteh
Akkar	Akkar	Al-Kleiat
Akkar	Akkar	Kobbet Bchamra
Beirut	Beirut	Ain el-Mreissé
Beirut	Beirut	Beirut Central District
Beirut	Beirut	Port
Beirut	Beirut	Medawar
Beirut	Beirut	Minet el-Hosn
Beirut	Beirut	Moussaytbeh
Beirut	Beirut	Ras Beyrouth
Mount Lebanon	Aley	Chouaifat Oumara
Mount Lebanon	Aley	Chouaifat Qobbat
Mount Lebanon	Baabda	Chiah
Mount Lebanon	Baabda	Tahouitat-el-Ghadir
Mount Lebanon	Chouf	Damour
Mount Lebanon	Chouf	Jadra
Mount Lebanon	Chouf	El Jiyeh
Mount Lebanon	Chouf	Naamat
Mount Lebanon	Chouf	Rmeileh
Mount Lebanon	Chouf	Sebline
Mount Lebanon	El Metn	Wata Amaret Chalhoub
Mount Lebanon	El Metn	Antélias
Mount Lebanon	El Metn	Baouchariat
Mount Lebanon	El Metn	Borge Hammoud
Mount Lebanon	El Metn	Dbayé
Mount Lebanon	El Metn	Jal-el-Dib
Mount Lebanon	El Metn	Naccache
Mount Lebanon	El Metn	El-Zalka
Mount Lebanon	El Metn	Zouk-Khrab
Mount Lebanon	Jubail	Amchite
Mount Lebanon	Jubail	El-Berbara
Mount Lebanon	Jubail	Fghal
Mount Lebanon	Jubail	Halate
Mount Lebanon	Jubail	Jbail
Mount Lebanon	Jubail	Kfar-Keddé
Mount Lebanon	Jubail	Mastita
Mount Lebanon	Jubail	El-Mouncef
Mount Lebanon	Jubail	Nahr-Ibrahim
Mount Lebanon	Jubail	Kartaboune
Mount Lebanon	Jubail	El-Rihané
Mount Lebanon	Kasrouane	El-Ekaïbé
Mount Lebanon	Kasrouane	Edma et Defné
Mount Lebanon	Kasrouane	El-Bouar
Mount Lebanon	Kasrouane	Boukak El-Dine
Mount Lebanon	Kasrouane	Ghazir

Mohafaza	Caza	CAD_NAME_1
Mount Lebanon	Kasrouane	Djounié Ghadir
Mount Lebanon	Kasrouane	Djounié Haret Sakhr
Mount Lebanon	Kasrouane	Djounié Sarba
Mount Lebanon	Kasrouane	Kferyacine
Mount Lebanon	Kasrouane	Wata Salam
Mount Lebanon	Kasrouane	EL-Safra
Mount Lebanon	Kasrouane	Djounié Salel Alma
Mount Lebanon	Kasrouane	Zouk Mikaèl
Mount Lebanon	Kasrouane	Zouk Mousbeh
North	Batroun	Batroune
North	Batroun	Chekka
North	Batroun	Hamat
North	Batroun	Al-Hery
North	Batroun	Kfar Obeida
North	Batroun	Koubba
North	Batroun	Salaata
North	Batroun	Tehoum
North	Koura	Enfeh
North	Koura	Al-Hraïché
North	Koura	Ras Maska
North	Minieh-Danieh	Al-Beddaoui
North	Minieh-Danieh	Borge-El-Yahoudié
North	Minieh-Danieh	Deir Omar
North	Minieh-Danieh	Al-Minieh
North	Minieh-Danieh	Zouk Bhanine
North	Tripoli	Al-Mina Jardins
North	Tripoli	Al-Mina No2
North	Tripoli	Al-Mina No3
North	Tripoli	Al-Kalmoune
North	Tripoli	Tripoli Jardins
South	Saida	Adloun
South	Saida	Addoussiat
South	Saida	Bissariat
South	Saida	Ghazyat
South	Saida	Yahoudiat
South	Saida	Nadjariat
South	Saida	Saïda Dekerman
South	Saida	Saïda Wastani
South	Saida	Saïda Ville
South	Saida	Saksakiat
South	Saida	Sarafend
South	Sour	Abbassyat
South	Sour	Aïn Abou Abdallah
South	Sour	Nakoura
South	Sour	Deir Kanoun Ras El Aïn
South	Sour	Hamoul
South	Sour	Eskandaroun
South	Sour	El-Mansouri
South	Sour	Mahaïlib

Mohafaza	Caza	CAD_NAME_1
South	Sour	El-Kleilé
South	Sour	Sour (Tyr)

ANNEX IV: CHARACTERISTICS OF LEBANESE CLIMATE

Table 19: Average temperature in LCZ – Beirut. (1991 - 2020)

Beirut – Average Temperatures (1991 – 2020)			
Month	Min (°C)	Max (°C)	Mean (°C)
January	11.2	17.8	14.5
February	11.3	18.4	14.9
March	12.8	20.4	16.6
April	15.2	23.3	19.3
May	18.6	26.4	22.5
June	21.9	28.6	25.3
July	24.4	30.7	27.6
August	25.2	31.4	28.3
September	24	30.3	27.2
October	21.2	28	24.6
November	16.7	23.8	20.3
December	13	19.8	16.4
Year	18	25	21.45

Table 20: Monthly average precipitation in Beirut

Beirut – Average Precipitation		
Month	Millimeters	Days
January	155	12
February	125	10
March	85	8
April	30	5
May	11	2
June	1	2
July	0	0
August	0	0
September	5	1
October	60	4
November	115	7
December	140	11
Year	730	62

Table 21: Monthly Sunshine hours average in Beirut

Beirut – Sunshine Hours		
Month	Average	Total
January	4	130
February	5	145
March	6	190
April	8	245
May	10	310
June	11.5	350
July	11.5	360
August	11	335
September	9.5	290
October	8	245
November	6.5	200
December	4.5	145
Year	8.1	2940

Table 22: Monthly Sea temperature average in front of Beirut

Beirut – Sea Temperature	
Month	Celsius (°C)
January	18
February	17.5
March	17.5
April	18.5
May	21
June	24.5
July	27
August	28
September	27.5
October	26
November	23
December	20
Year	22.3

Table 23: Average temperature in Inland Areas of Lebanon - Arz

Arz – Average Temperatures			
Month	Min (°C)	Max (°C)	Mean (°C)
January	-2	2	0
February	-3	2	-0.5
March	-1	5	2
April	1	9	5
May	6	15	10.5
June	10	20	15
July	15	22	18.5
August	13	22	17.5
September	11	19	15
October	6	15	10.5
November	3	12	7.5
December	0	6	3
Year	5	12.5	8.7

Table 24: Average temperature in Sahel Areas of Lebanon – Zahle. (1991 – 2020)

Zahle – Average Temperatures (1991 – 2020)			
Month	Min (°C)	Max (°C)	Mean (°C)
January	2.2	12	7.1
February	3.3	13.8	8.6
March	5.6	17	11.3
April	8.7	21.8	15.2
May	12.4	27.6	20
June	15.8	31.7	23.8
July	18.2	34	26.1
August	18.2	34.7	26.4
September	15.8	31.8	23.8
October	12.3	27	19.6
November	7.4	20.3	13.8
December	4	14.5	9.2
Year	10.4	23.9	17.1

ANNEX V: MAP OF LEBANON

ANNEX VI: FRESHWATER OF LEBANON

Table 25: List of major rivers in use for potable water or irrigation. (Source: National Water Sector Strategy)[474]

River	Watershed Area (km²)	Average Annual Volume (1990 – 2013) (Mm³)	Specific Average Flow (l/s/km²)	Reference Gauging Station
Abou Ali	481	218	14.4	Abou Samra
Arka	121	49	12.7	Hakour
Assi	1764	390	7.0	Sea Mouth
Awali	302	433	45.5	Saida
Bared	281	127	14.3	Sea Mouth
Beirut	222	78	11.2	Daychounieh
Damour	293	183	19.8	Sea Mouth
El Ghadir	52	9	5.6	Sea Mouth
El Jouz	180	57	10.0	Sea Mouth
El Kabir	300	432	45.7	Sea Mouth
El Kalb	258	190	23.4	Sea Mouth
Hasbani	526	151	9.1	DS Wazzani Spring
Ibrahim	336	335	31.7	Sea Mouth
Litani	1288	223	5.5	Joub Jannine
Litani	2163	215	3.2	Sea Mouth
Ostouane	161	71	14.0	Sea Mouth
Sainiq	108	11	3.3	Sea Mouth
Zahrani	109	18	5.1	Sea Mouth
Perennial rivers	7,656	3,189	13.2	
Main wadis*	1,223	448	11.6	
In-between and secondary seasonal rivers	1,522	623	13.0	
Grand Total	10,400	4,260		

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[474] Updated National Water Sector Strategy 2020 – 2035. (2020)

ANNEX VII: LEBANON RAMSAR SITES
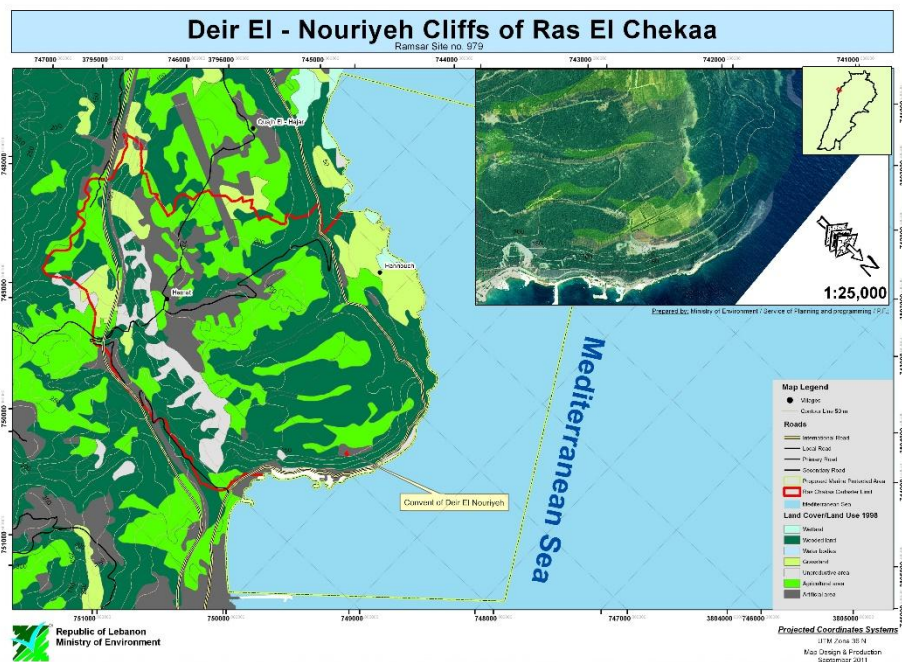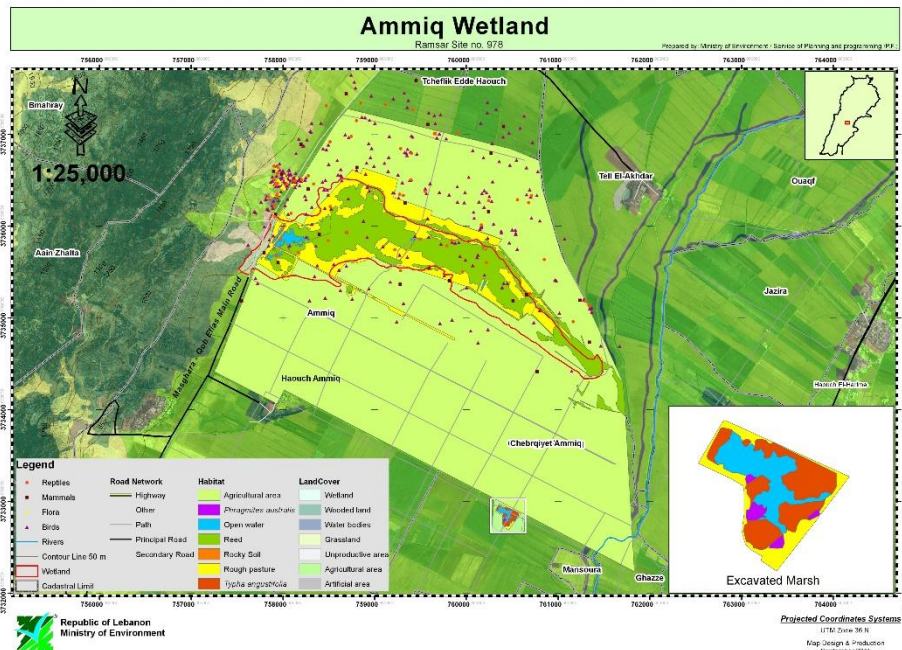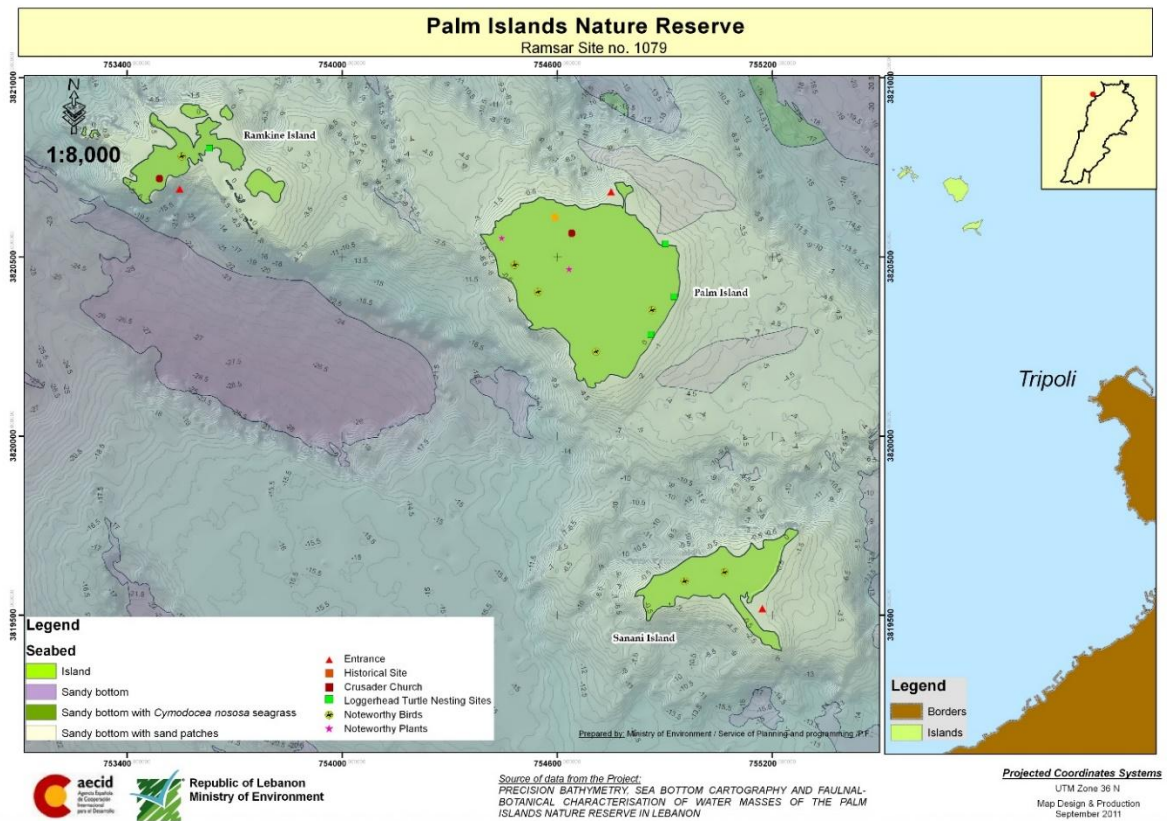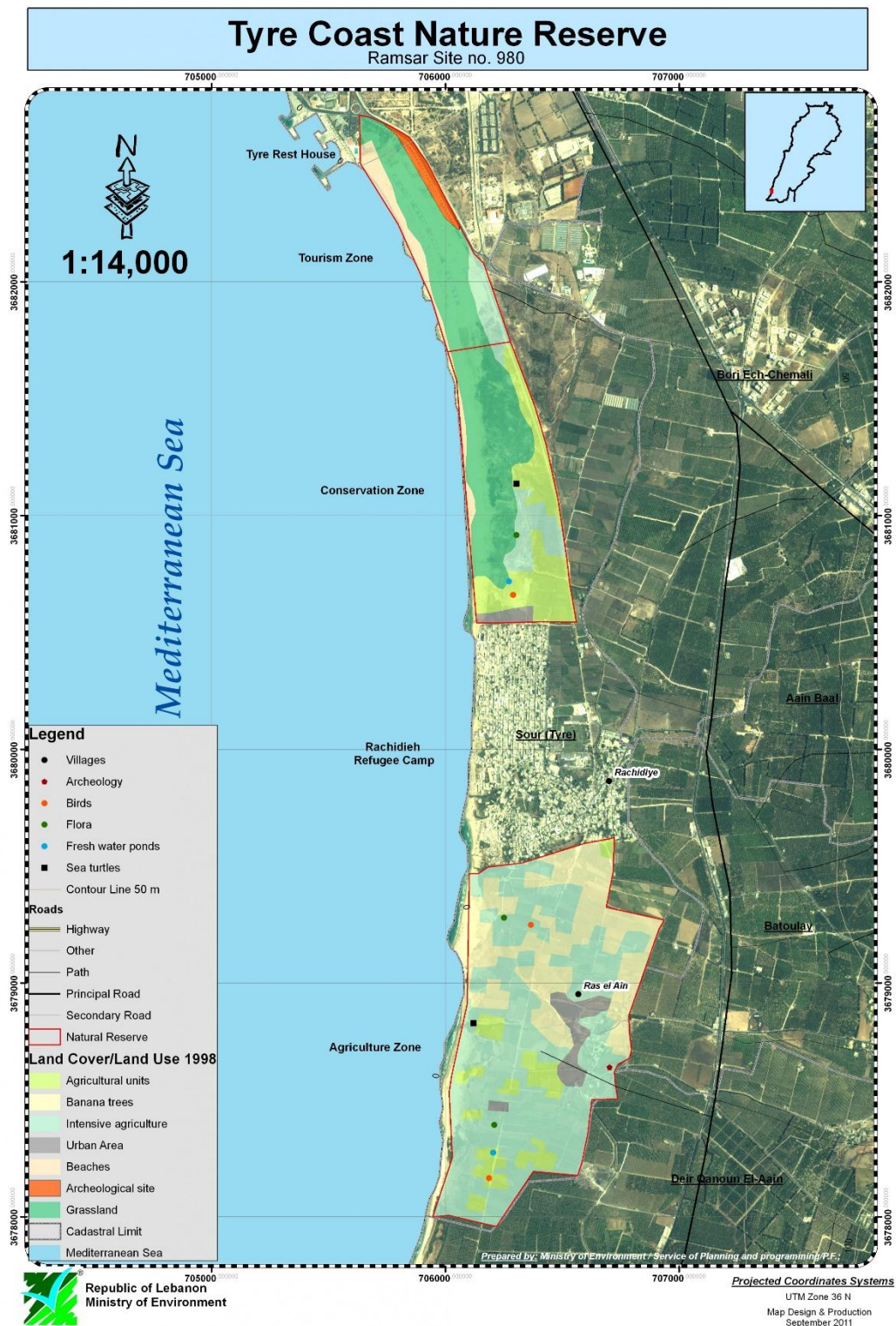
ANNEX VIII: TERRESTRIAL COASTAL HABITATS ALONG THE LCZ[475]

Natural features	Definition
Coastal dune	A ridge or hill which forms when marine deposits of sand are blown to the back of the beach. The rate of formation and the extent of these dunes are dependent upon the supply of sand to the beach.
Wetland	A general term describing swamps, bogs, marshes, and shallow (up to 5 meters) lagoons and lakes. In coastal environments, these include salt marshes (Salinas), mangrove swamps, reed swamp, rush swamp, and seagrass beds.
Promontory	A coastal protrusion or headland, high and bordered by cliffs or bluffs, usually smaller than a Cape.
Cliff	A steep coastal slope cut, usually>40, often vertical and sometimes over-hanging into rock formations produced by basal marine erosion, but occasionally by faulting or earlier fluvial or glacial erosion.
Beach	An accumulation on the shore of generally loose, unconsolidated sediment, ranging in size from very fine sand up to pebbles, cobbles, and occasionally boulders; often also containing shelly material.
Bay	A general term for wide coastal re-entrant between two headlands, typically >1 km, its seaward boundary generally wider than the extent of landward penetration. A small bay is termed a cove, a large bay a gulf.
Cape	A large, often rounded coastal protrusion, located where the coastline intersects a range of mountains, hills, or a plateau, usually where a drainage divide reaches the coast. However, some capes are low-lying e.g., Cape Canaveral (Kennedy) and others on the American Atlantic coast.
Spring	In hydrology, an opening at or near the Earth's surface where water from underground sources is discharged. Springs discharge either at ground level or directly into the bed of a stream, lake, or sea.
Estuary	The seaward end of a river, opening toward the sea, typically through a funnel-shaped inlet, and usually subject to tidal movements and incursions of salt water from the sea.
Island	A body of land completely surrounded by water.
Offshore zone	Zone that lies below the mean storm wave base and is characterized by fine-grained sediment settling out of the water.
Cultural heritage	Cultural heritage sites include the significant monuments, architecture, artistry, archaeology, artifacts and other human works of outstanding universal value from the point of view of history, art or science.

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[475] Lebanon's second national communication to the United Nations Framework Convention on Climate Change. (2011)

ANNEX IX: MAP OF THE PROTECTED AREAS, EXISTING AND PROPOSED, ALONG THE LEBANESE COAST
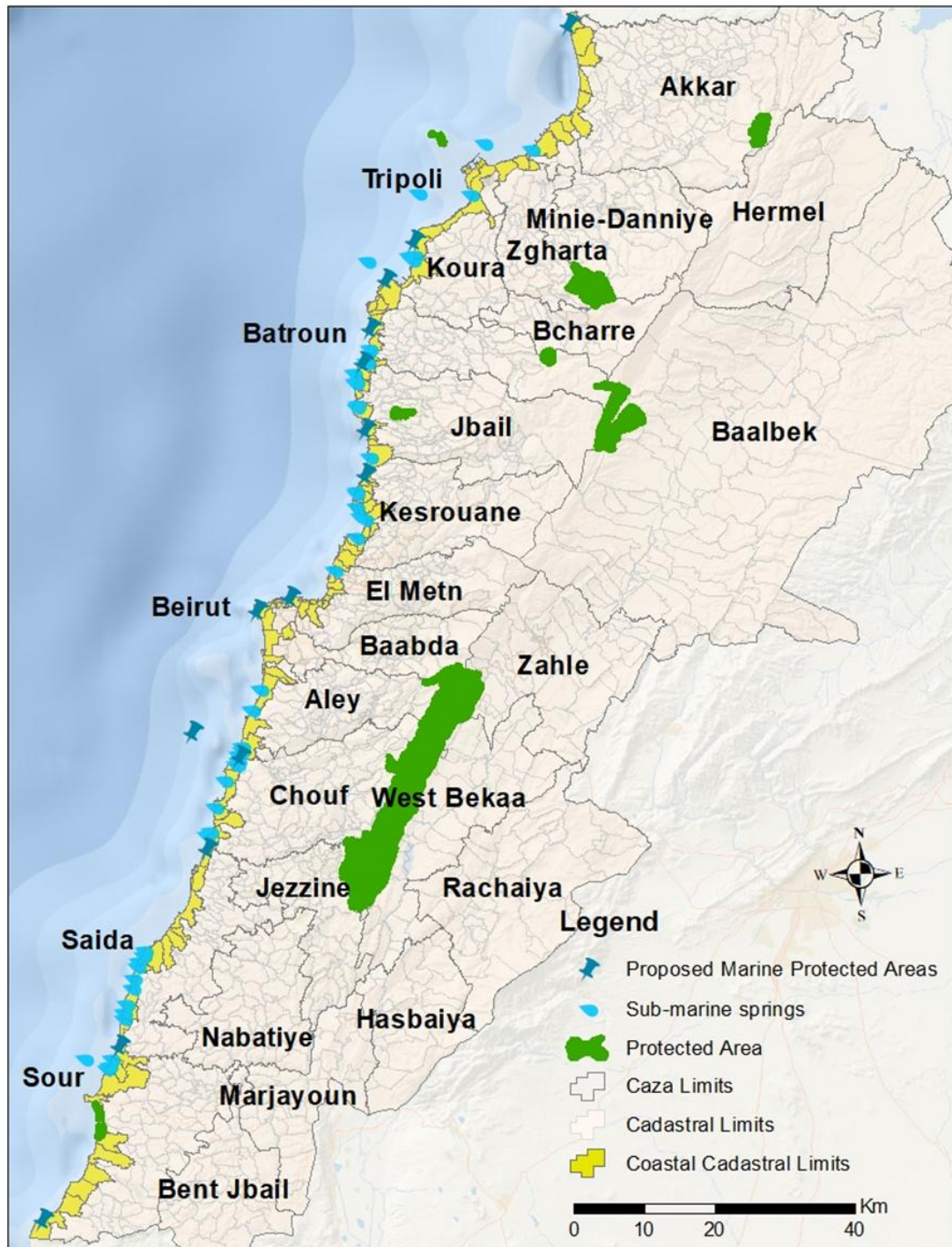
(Source: World Database on protected Areas WDPA, 2024 and Lebanon Marine Protected Area Strategy, 2012)

ANNEX X: MAP OF THE COASTAL DYNAMICS IN LEBANON: AREAS OF ACCRETION, EROSION, SEA-FILLING AND EXCAVATION FOR PORT CREATION BETWEEN YEARS 2010 AND 2023

Source: S. Termos, 2025

ANNEX XI: MSW GENERATION RATES PER GOVERNORATE[476]

Governorate	Generation Rate (t/d)(rounded)
Mount Lebanon	2,558
North Lebanon	1,050
Bekaa	740
Beirut	614
South Lebanon	551
Keserwan & Ftouh-Jbeil	533
Nabatieh	516
Akkar	430
Baalbek-Hermel	350
Total Quantity	7,342

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[476] SOER Report 2020, "Lebanon, State of the Environment and Future Outlooks: TURNING THE CRISES INTO OPPORTUNITIES". (2021)

ANNEX XII: LEBANON MUNICIPAL SOLID WASTE FACILITIES[477]
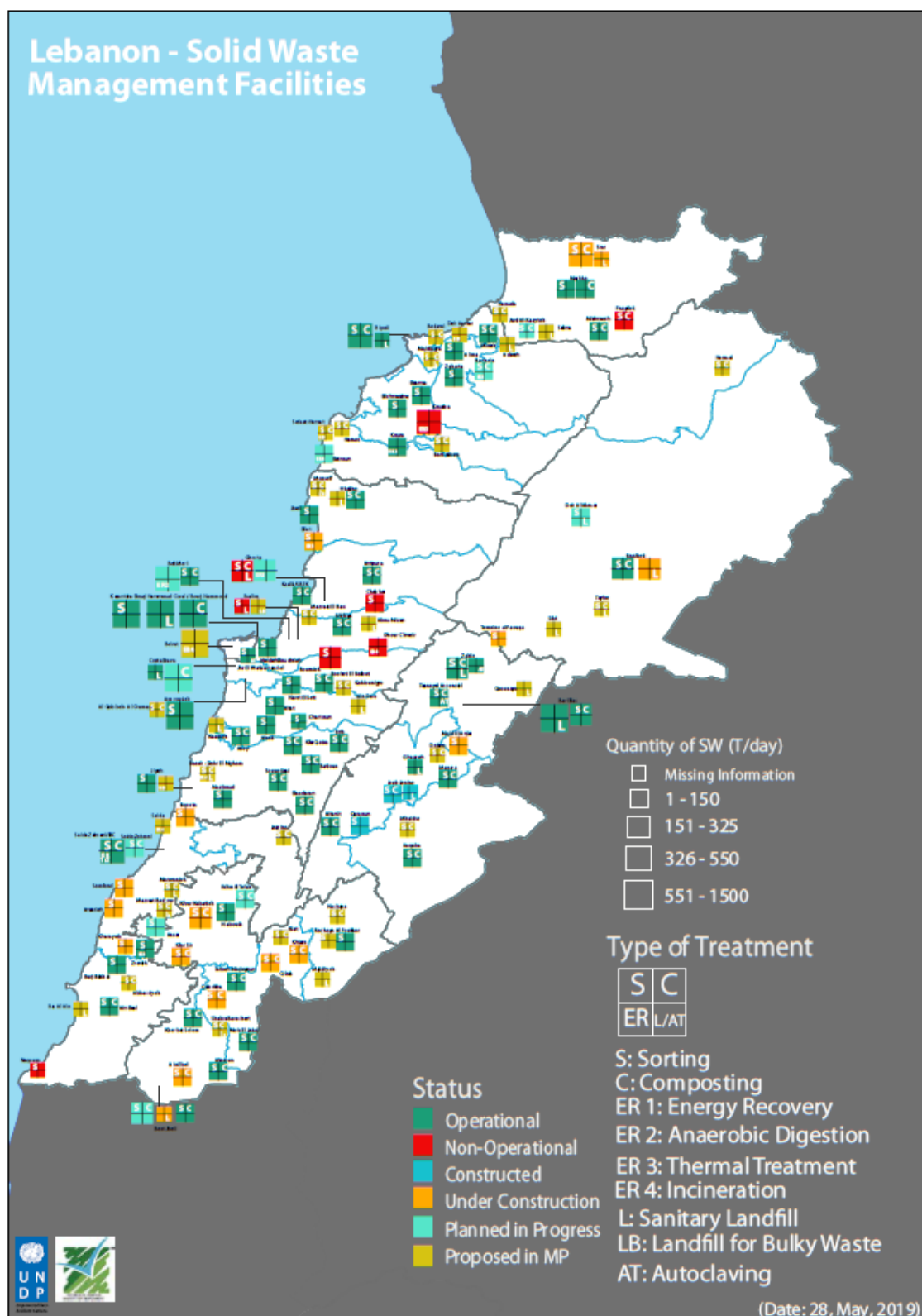
ANNEX XIII: STATUS OF WWTPS IN LEBANON ACROSS WATER ESTABLISHMENTS

Stage	Process	BMLWE			BWE			NLWE			SLWE			TOTAL		
PRI	PT	1												1		
SEC	AS	1		1	1		6	1	1	2	1		1	4	1	10
	AT										1			1		
	TF				1		1			10				1		11
	TF & AS	2												2		
	MMBR	1												1		
	BF			1												1
	MB			1												1
	RBC									1						1
TER	AS + NR				1				1					1	1	
	AS + UV	1												1		
Others	RB	12	2	27	7	2	17	20	3	72	20	2	19	59	9	135
	Wetland									13	2			2		13
Unknown			5	1		1	3			1		3	5		9	
Total		18	2	35	11	2	25	24	5	98	25	2	23	78	11	181
Grand Total		55			38			127			50			270		
Total Capacity (m3/day)														1,845,690[478]		

E: Existing, UC: Under Construction, P: Planned, PRI: Primary; SEC: Secondary; TER: Tertiary, PT: Preliminary Treatment, AS: Activated Sludge, AT: Aeration Tank, TF: Trickling Filter, MMBR: Moving Bed Biofilm Reactor, BF: Biofilters, MB: Membrane Bioreactor, RBC: Rotating Biological Contractors, NR: Nitrogen Removal, RB: Reed Bed.

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[478] of the 1,845,690 m3/day total capacity, only 824,664 m3/day are operational; 128,257 m3/day are under construction and the rest are planned

ANNEX XIV: LAND USE - LAND COVER MAP OF LEBANON
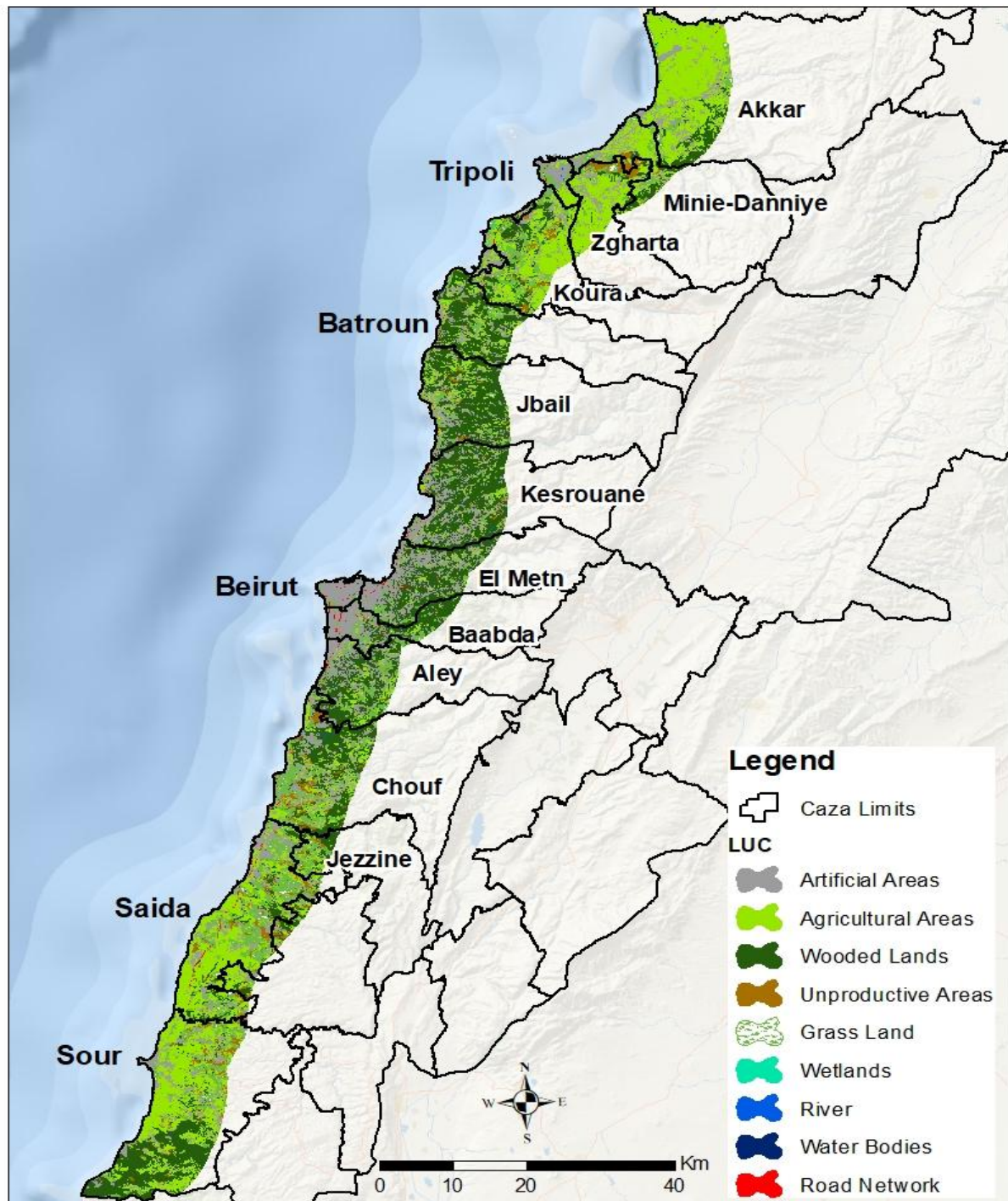
(Source: CNRS, 2017)

ANNEX XV: MAP OF LEBANON'S COASTAL INFRASTRUCTURE, HIGHLIGHTING SEA PORTS, RIVERS, AIRPORTS AND DIVING CENTERS

Source: MCR-IOE-UOB, 2018 and SDATL, 2004

ANNEX XVI: MAP OF THE INDUSTRIAL SITES ALONG THE LEBANESE COAST

Source: S. Termos, 2025

ANNEX XVII: MAP OF SOURCES OF POLLUTION ON THE LEBANESE COAST
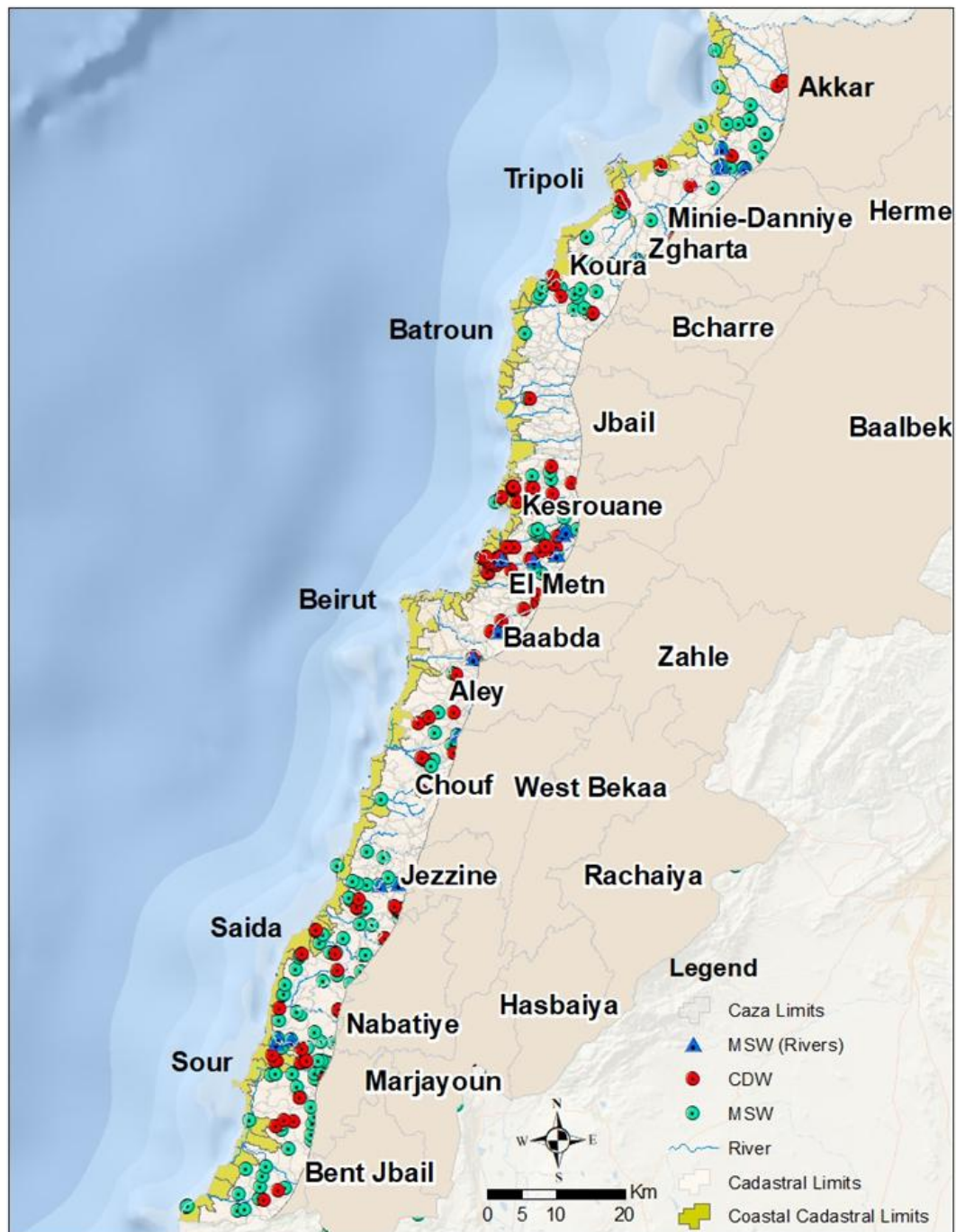
Source: MCR-IOE-UOB, 2021

ANNEX XVIII: MAP OF OIL AND GAS EXPLORATION BLOCKS OFF THE COAST OF LEBANON
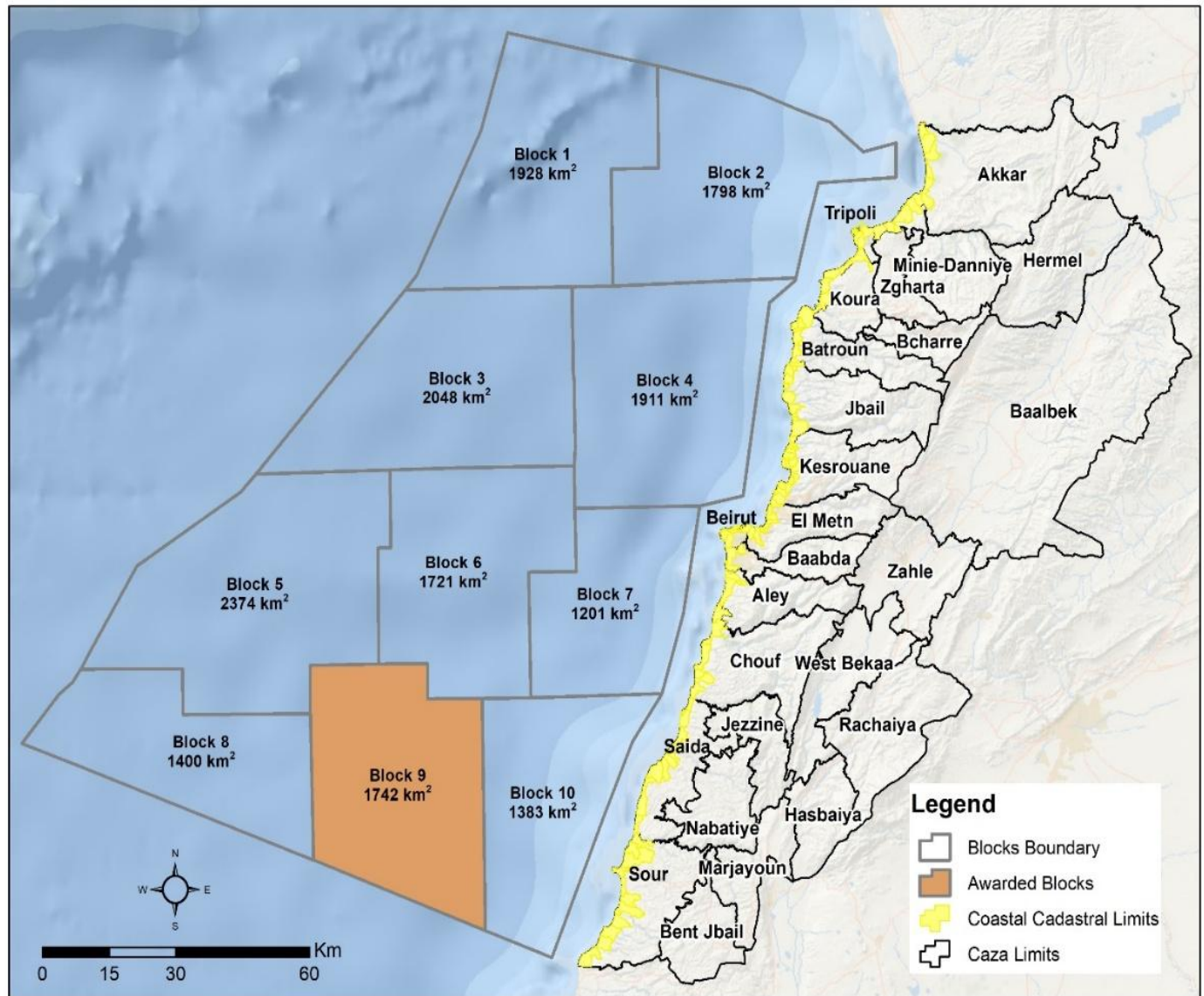
Source: East Med Energy Report, 2022

ANNEX XIX: OFFSHORE GAS VALUATION METHOD TO CALCULATE THE LEBANON NON-RENEWABLE RESOURCES

The WAVES method is used for potential extraction where projected stock and extraction stock were derived from Spectrum ASA (2012). Incidentally, all variables (volume and prices) could be adjusted to carry out simulations and sensitivity analyses in the future.

Lebanon Offshore Natural Capital

In 2020 Prices	Unit	NPV	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
Offshore Natural Gas Extraction Cost	US$/m3		0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.20
Natural Gas Price (Henry Hub)	US$/m3		0.14	0.18	0.19	0.20	0.20	0.21	0.21	0.22	0.23	0.23	0.24	0.25	0.25	0.26	0.27	0.27	0.28	0.28	0.29	0.29	0.30	0.30	0.30	0.31	0.31
Med Sea Offshore Gas Expected Production	m3 billion		28.77	28.77	28.77	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8
Lebanon Gas Natural Capital			(0.5)	0.8																							
Med Sea Nonrenewable Resources	US$ billion		(0.5)	0.8	0.9	1.0	1.1	1.3	1.4	1.5	1.7	1.8	2.0	2.1	2.3	2.5	2.6	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.2	3.2	3.3
Med Sea Nonrenewable Resources NPV at 3%	US$ billion	33.2																									

Note: Estimated offshore gas stock is assumed to be exploitable over 26 years and is derived from Spectrum ASA as British Petroleum Statistics are not reporting any gas stock for Lebanon. The extraction was annualized over 26 years and discounted at 3%.

Source: Offshore Gas Extraction Cost: https://ihsmarkit.com/products/oil-gas-drilling-rigs-offshore-day-rates.html; Gas Prices: Henry Hub Natural Gas Spot Price (Dollars per Million Btu) (eia.gov);British Petroleum Statistical Review: bp-stats-review-2022-full-report.pdf; World Bank (2021); and Spectrum ASA (2012).

ANNEX XX: LEBANON WEALTH AND RENEWABLE RESOURCES TIME SERIES

Table A2.1: Lebanon Total Wealth, US$ billion in constant 2019 prices

Total Wealth Category	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Produced Capital	24.4	25.4	26.0	26.7	27.1	27.5	27.9	28.3	28.8	29.4	30.0	30.6	31.5	32.6	34.1	35.5	36.8	38.2	40.4	42.5	43.9	45.1	46.2	47.2	48.0	47.1
Renewable Natural Capital	29.2	29.7	29.9	30.0	27.6	28.1	28.2	29.2	30.8	30.8	31.3	31.6	31.4	30.5	30.9	30.3	30.7	31.5	31.7	30.2	30.4	30.7	30.8	30.7	31.1	31.2
Non-Renewable Natural Capital																										33.2
Human Capital	106.3	108.3	111.2	114.2	117.7	121.3	124.4	127.5	130.7	134.1	136.2	138.6	141.5	148.5	155.3	158.6	161.7	167.6	185.4	206.4	210.7	205.0	198.9	192.9	186.7	180.6
Net Foreign Assets	32.9	31.2	19.5	2.1	(3.1)	(5.7)	(14.5)	(12.6)	(8.1)	(16.0)	(21.7)	(19.1)	(24.9)	(19.7)	(9.7)	(16.1)	(22.1)	(32.2)	(46.3)	(48.1)	(54.0)	(65.6)	(71.7)	(76.9)	(86.9)	(48.3)
Total Wealth	192.9	194.6	186.7	172.9	169.3	171.3	166.0	172.5	182.2	178.2	175.8	181.8	179.5	191.9	210.6	208.2	207.1	205.1	211.2	231.0	231.0	215.1	204.3	193.9	178.9	243.8

Source: World Bank (2021); and Spectrum ASA (2012).

Table A2.2: Lebanon Natural Capital, US$ billion in constant 2019 prices

Natural Capital Category	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cropland	25.62	26.00	26.17	26.34	24.51	25.04	25.16	25.92	26.38	26.86	27.48	28.57	28.49	27.90	27.90	26.93	27.39	27.69	27.77	27.86	27.98	28.23	28.33	28.26	28.18	28.18
Forest, Timber	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Forest, Ecosystem Services	1.67	1.67	1.66	1.66	1.66	1.66	1.66	1.66	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.66	1.66	1.67	1.68	1.68	1.69	1.70	1.71	1.71	1.72
Non-Wood Forest Products	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Protected Areas	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Water Resources	0.71	0.77	0.87	0.76	0.32	0.43	0.32	0.66	1.27	1.06	1.01	0.67	0.57	0.36	0.60	0.81	0.78	1.06	1.12	0.19	0.46	0.37	0.40	0.34	0.94	0.99
Fisheries	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Offshore Gas																										33.23

Source: World Bank (2021); and Spectrum ASA (2012).

ANNEX XXI: CCZED METHODOLOGY

The process of estimating the cost of environmental degradation involves placing a monetary value on the consequences of such degradation. The CCZED$_{2023}$ methodological framework often relies on a 3-step process:

1. Quantification of environmental degradation (e.g., monitoring of ambient air quality, river/lake/sea water quality, soil loss, and soil quality).

2. Quantification of the consequences of degradation (e.g., negative impacts on health from air pollution, impact on water body quality, changes in soil productivity, changes in forest density/growth, reduced natural resource based recreational activities, reduced tourism demand).

3. A monetary valuation of the consequences (e.g., estimating the cost of ill health, soil productivity losses, reduced recreational values).

The main methods for estimating impacts are grouped around 3 pillars with specific techniques:

1. Change in production.
   - Value of changes in productivity such as reduced agricultural productivity due to salinity and /or loss of nutrients in the soil;
   - Opportunity cost of such shortfall of not re-selling the recycled waste;
   - Replacement cost when for example the cost of construction of a dam to be replaced by a dam that was silted.

2. Change in condition with the dose-response function to establish between for instance a pollutant (inhalation, ingestion, absorption or exposure) and disease or a state (assets and economic activity) and a catastrophic event (flood where the intensity and length of the flood will have a different effect on asset damages and economic activity).
   - The value associated with mortality through two methods: the future shortfall due to premature death, and the willingness-to-pay (WTP) to reduce the risk of premature death. Only the latter method called Value of Statistical Life is commonly used). Moreover, the Disability-Adjusted Life year metric developed by the WHO and the World Bank is used in this study.
   - The quantification of morbidity relies on the burden of disease's Disability-Adjusted Life Year (DALY) metric developed by the WHO and the World Bank in 2003 where a DALY lost is the loss of 1 year of health life. For the valuation of the morbidity, the forgone income and the cost of illness is used. A new approach was retained by the World Bank 2021 on air pollution is currently being considered.

3. Changing behavior with two sub-techniques: revealed and stated preferences.
   - Revealed preferences by deriving the costs associated with behavior: e.g., hedonic method where for instance the lower value of land around a landfill is derived; trying to derive travel costs to visit a specific place; and preventive behavior as when households buy filters for drinking water.

- Stated preference where a contingent valuation is used to derive the WTP through a survey for example, *improving the quality of water resources*.
- Choice modeling where respondents are asked to choose their preferred option from a set of alternatives with particular attributes (a variation on the WTP without a monetary value).

When data is not available to use one of these specific techniques, an alternative is to use a benefit transfer method that allows transferring a benefit that can be based on studies made in other countries by adjusting the results for the differential income, education, preference, etc. Usually, an elasticity of 0.8 is used for high income countries and an elasticity of 1.2 is used for middle- and low-income countries when the benefit is transferred from a high-income country. Table 26 illustrates the methods used for each subcategory.

Table 26: Valuation Methods Used for Subcategories

Category and Subcategory	Method
Air	
-Ambient Air	IHME Dose-Response Function (Lower Bound); VSL and COI adjusted for Lebanon
-Ground Level Ozone	IHME Dose-Response Function (Lower Bound); VSL and COI adjusted for Lebanon
-NOx	IHME Dose-Response Function (Lower Bound); VSL and COI adjusted for Lebanon
-Asbestos	IHME Dose-Response Function (Lower Bound); VSL and COI adjusted for Lebanon
Water	
-Drinking Water, Sanitation and Hygiene	IHME Dose-Response Function (Lower Bound); VSL and COI adjusted for Lebanon
-Water Resource Quality	Household WTP Benefit Transfer adjusted for Lebanon to improve inland and marine water resources
-Water Resource Quantity	Productivity Change; UfW >10% benchmark based on 2022 Cost Recovery Tariff
Land	
-Land Productivity (Forest, Grassland and Cropland) Degradation	EO Productivity degradation; TEV metaanalysis adjusted for Lebanon
-Forest, Grassland and Cropland Fires	EO Forest Fire Replacement Cost and Losses based on TEV metaanalysis adjusted for Lebanon
-Quarries	Two techniques: metaanalysis based on mass extracted and associated value and COED figured released by UNDP and updated in 2023.
Waste	
-Opportunity Cost Recycling Composting	Opportunity cost of composting 54% and recycling 18% of total waste
-Improved Hazardous Waste Management	Defensive spending to improve HW management
-Landfill Dump Hedonic Pricing	EO Amenities loss; Hedonic pricing metanalyses based on 2016 survey where areas were annualized over 26 years; Property Value derived from online real estate companies
Coastal Zone	
-Marine Environment	Metanalysis on the reduction of TEV from pollution and plastic adjusted for Lebanon
-Erosion and Seafilling	EO Opportunity Loss of Land; and Coastal Property Value derived from online real estate companies

Category and Subcategory	Method
-Change in Shoreline Cover	EO Productivity Loss due to Change in Land Cover; and TEV metaanalysis adjusted for Lebanon
-Infringement on Maritime Public Domain	Illegal appropriation and Shoreline transfer from Common Good to Club Good; Penalties included in 2024 Budget Law in US dollar
-Fisheries	Productivity Loss due to stock depletion

Population

The population was obtained from the Lebanon Crisis Response Plan (LCRP -2023)[479] that is based on the Central Administration for Statistics (CAS -2019)[480].

Table 27 charts the CCZED by degradation categories and subcategories as well as by governorate.

Table 27: Lebanon CCZED by Category, Subcategory and Governorate, 2023

Category	Population Considered	CCZED and Opprotunity Losses 2023				Coastal Governorates				
		Lower Bound	Upper Bound	Middle Bound		Akkar	North Lebanon	Beirut	Mount Lebanon	South Lebanon
	million	US$ million	US$ million	US$ million	% of GDP	US$ million	US$ million	US$ million	US$ million	US$ million
Air		257.2	348.0	302.6	1.50%	26.2	51.4	36.6	137.5	51.0
-Ambient Air Lebanese	3.37	246.7	333.7	290.2	1.44%	25.1	49.2	35.1	131.9	48.9
-Ground Level Ozone Lebanese	3.37	2.4	3.2	2.8	0.01%	0.2	0.5	0.3	1.3	0.5
-NOx Lebanese	3.37	8.0	10.9	9.4	0.05%	0.8	1.6	1.1	4.3	1.6
-Asbestos Lebanese	0.03	0.1	0.2	0.1	0.00%		0.15			
Water		125.6	900.8	513.2	2.54%	35.5	82.4	69.2	242.1	84.1
-Drinking Water, Sanitation and Hygiene Lebanese	3.37	7.2	9.8	8.5	0.04%	0.7	1.4	1.0	3.9	1.4
-Water Resource Quality Lebanese	3.37	85.8	847.0	466.4	2.31%	30.8	73.3	66.0	230.1	66.2
-Water Resource Quantity Lebanese	3.37	32.6	44.1	38.3	0.19%	3.9	7.7	2.2	8.1	16.4
Land		201.4	245.8	149.9	0.74%	8.2	35.1	0.0	92.8	13.8
-Land Productivity (Forest, Grassland and Cropland) Degradation	3.37	1.6	2.2	1.9	0.01%	0.49	0.47		0.45	0.53
-Forest, Grassland and Cropland Fires	3.37	27.8	37.6	32.7	0.16%	5.0	7.3		17.6	2.8
-Quarries	3.37	172.0	206.0	115.3	0.57%	2.7	27.3		74.8	10.5
Waste		98.8	308.6	208.1	1.03%	13.2	45.8	6.1	124.1	18.8
-Opportunity Cost Recycling Composting Lebanese	3.37	36.9	49.9	43.4	0.22%	3.8	7.4	5.3	19.7	7.3
-Improved Hazardous Waste Management	3.37	5.6	7.6	6.6	0.03%	0.6	1.1	0.8	3.1	1.0
-Landfill Dump Hedonic Pricing Lebanese	3.37	56.3	251.1	158.0	0.78%	8.9	37.3	0.0	101.3	10.5
Coastal Zone		65.3	104.2	83.4	0.41%	6.6	14.8	9.2	36.9	15.9
-Marine Environment	3.37	30.2	60.3	45.3	0.22%	3.8	7.8	5.7	21.3	6.7
-Erosion and Seafilling	3.37	9.4	12.7	11.0	0.05%	0.6	2.3	0.0	2.8	5.3
-Change in Shoreline Cover	3.37	0.00	0.00	0.00	0.00%	0.0	0.0	0.0	0.0	0.0
-Infringement on Maritime Public Domain	3.37	23.2	27.6	24.0	0.12%	2.0	4.2	3.0	11.3	3.5
-Fisheries	3.37	2.6	3.5	3.1	0.02%	0.3	0.5	0.4	1.4	0.5
Total		748.4	1,907.4	1,257.2	6.23%	89.7	229.5	121.0	633.3	183.7

Ambient Air Pollution

See MOE and UNDP (2022) for methodological details.

- Risk factors from PM$_x$, Ozone, NOx and asbestos are used to derive DALY lost are from IHME for year 2021[481].

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[479] Central Administration for Statistics (CAS): http://cas.gov.lb/images/Publications/Labour%20Force%20and%20Household%20Living%20Conditions%20Survey%202018-2019.pdf
[480] OECD. 2012. Mortality Risk Valuation in Environment, Health and Transport Policies. Paris: OECD Publishing.
[481] www.healthdata.org

- Monetization used is the Value of Statistical Life (VSL) as derived from the (OECD) (2012)[482] and adjusted to 2023 prices is used for premature death using (Navrud, 2009)[483] benefit transfer method, whereas the human capital approach is used for morbidity as follows: the Cost of Illness methodology available in the World Bank (2021) is used to value morbidity.
- Navrud (2009) for the benefit transfer method.

GDP figures are derived from World Bank WDI (2024)[484]
Several epidemiological studies revealed even stronger correlations recently between long-term exposure to $PM_{2.5}$ and **premature mortality** (e.g., Stanaway et al. (2017)[485], Vohra et al. (2021)[486], Shen et al. (2024) and Naghavi et al. (2024)[487] dose response functions[488] are used by IHME and were considered for Lebanon.

For the Valuation, the VSL is used as mentioned above whereas the World Bank (2021) is used for the cost of illness calculation and is available in Annex 3 of the document[489].

The benefit transfer involves transposing existing monetary environmental values estimated at one site (study site) to another (policy site), usually with similar context or physical characteristics. There are two approaches for the benefit transfer: the unit value transfer; and the transfer function. In this particular case, we will rely on the unit value transfer and more specifically on the transfer of the unit to adjust for differences in income value as described in Navrud (2009).
The transfer of the unit to adjust for differences in income value is as follows:

$$WPp = WPs \times (Yp / Ys)^{ß}$$

Where:

WPp = willingness to pay by household in policy country
WPs = willingness to pay by household in study country
Yp = income in the country policy denominated in purchasing power parity dollar (PPP$)
Ys = income in the country of study denominated in purchasing power parity dollar (PPP$)
ß = income elasticity for different environmental goods and services, which are considered normal goods, are typically greater than 0 (perfectly inelastic which would have meant that the WPp = WPs only adjusted by income where ß = 1.2).

In this particular case, the income elasticity is assumed to be conservatively set at 1.2 (more inelastic), which means that the percentage responsiveness of quantity demanded (in this case the resource) is significantly and slightly lower to the percentage change in income. Incidentally, a new study, which provides VSL through a benefit transfer method estimates to monetize fatality risks in 189 countries,

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[482] OECD. 2012. Mortality Risk Valuation in Environment, Health and Transport Policies. Paris: OECD Publishing

[483] Navrud, Ståle. 2009. Value Transfer Techniques and Expected Uncertainties. New Energy Externalities Developments for Sustainability (NEEDS). Project no: 502687. Deliverable n° 2.1 - RS 3a. SWECO. Stockholm.

[484] World Bank World Development Indicators: https://databank.worldbank.org/source/2?country=IRN&l=en

[485] Stanaway, J., and GBD 2017 Risk Factor Collaborators. 2018. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017: Main Document; Supplements I and II. Lancet, 392: 1923–94.

[486] Vohra K Vodnos A Schwartz J Marais EA Sulprizio MP Mickley LJ. 2021. Global mortality from outdoor fine particle pollution generated by fossil fuel combustion: Results from GEOSChem. Environmental Research. 2021;195(0013-9351) doi: 10.1016/j.envres.2021.110754 https://www.sciencedirect. com/science/article/abs/pii/S0013935121000487

[487] Naghavi, Mohsen et al. 2024. "Global burden of 288 causes of death and life expectancy decomposition in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021." The Lancet, Volume 403, Issue 10440, 2100 – 2132.

[488] Shen, S., Li, C., van Donkelaar, A., Jacobs, N., Wang, C., Martin, R. V. 2024. Enhancing Global Estimation of Fine Particulate Matter Concentrations by Including Geophysical a Priori Information in Deep Learning. ACS ES&T Air. DOI: 10.1021/acsestair.3c00054 (2024)

[489] World Bank (WB). 2021. The Global Health Cost of Ambient PM2.5 Air Pollution Washington D.C.

derives a VSL of 177,028 US$ for Lebanon in 2023[490]. Hence, the VSL for Lebanon is used for the premature death for Ambient Air Pollution (AAP) including PM$_{2.5}$, Ozone, NOx and asbestos; and Water, Sanitation and Hygiene (WASH).

Indoor Air Pollution
Not covered.

Noise and Odor Pollution
Not covered.

Water
See MOE and UNDP (2022) for methodological details.

o   Unimproved Water, Sanitation and Hygiene
  •   Risk factors to derive DALY lost are from IHME <www.IHME.org> for year 2021.
  •   Monetization used is the Value of Statistical life as derived from OECD (2012) and adjusted to 2023 prices is used for premature death using (Navrud. 2009) benefit transfer method (using adjusting for purchasing power for parity and elasticity for preference) whereas the Cost of Illness approach is used for morbidity (World Bank, 2021).
  •   GDP figures are derived from World Bank WDI (2024).

o   Water Resource Quality
  •   Baker et al. (2007)[491].
  •   Navrud (2009) for the benefit transfer method.
  •   GDP figures are derived from World Bank WDI (2019) and World Bank Economic update (April 2019).

For water resource quality, a benefit transfer was used based on a contingent valuation carried out in the United Kingdom to improve the water quality of all bodies as illustrated in Figure A2.1. Hence, Baker et al. (2007) results of £ 299 per household per year over 8 years to improve water body quality was used and adjusted to 2023 prices due to the difficulty of accounting for the multiplicity of water pollution sources in Lebanon. An elasticity of 1.2 was also used for the benefit transfer (Figure 48).

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[490] Viscusi, W. Kip and Clayton J. Masterman. 2017. "Income Elasticities and Global Values of a Statistical Life." J. Benefit Cost Anal. 2017; 8(2): 226–250.
[491] Baker, B., Metcalfe, P. Butler, S., Gueron, Y., Sheldon, R., and J,. East. 2007. The benefits of the Water Framework Directive Programme of Measures in England and Wales. Sponsored by Defra, Welsh Assembly Government, Scottish Executive, Department of Environment Northern Ireland, Environment Agency, Scottish Environment Protection Agency, Department of Business, Enterprise and Regulatory Reform, Scotland and Northern Ireland Forum for Environmental Research, UK Water Industry Research, the Joint Environmental Programme, UK Major Ports Group, British Ports Association, CC Water, Royal Society for the Protection of Birds, National Farmers' Union and Country Land and Business Association (the "Collaborative Partners").

Potential Water Quality Benefits

- **Current Use Benefits**
  - **Direct Use**
    - **In Stream**
      - Recreational – fishing, swimming, boating...
      - Commercial – fishing, navigation
    - **Withdraw**
      - Municipal – drinking water, waste disposal
      - Agriculture – irrigation
      - Industrial/Commercial – cooling process, waste disposal...
  - **Indirect Use**
    - **Near Stream**
      - Recreational – hiking, picnicking....
      - Relaxation – Enjoyment of peace and quiet
      - Aesthetics – Enjoyment of natural beauty
- **Intrinsic Benefits**
  - **Potential Use**
    - **Option**
      - Near and Long Term potential Use
  - **No Use**
    - **Existence**
      - Stewardship – maintaining a good environment for everyone to enjoy (including future family use-bequest)
      - Vicarious consumption – enjoyment from the knowledge that other are using the resource
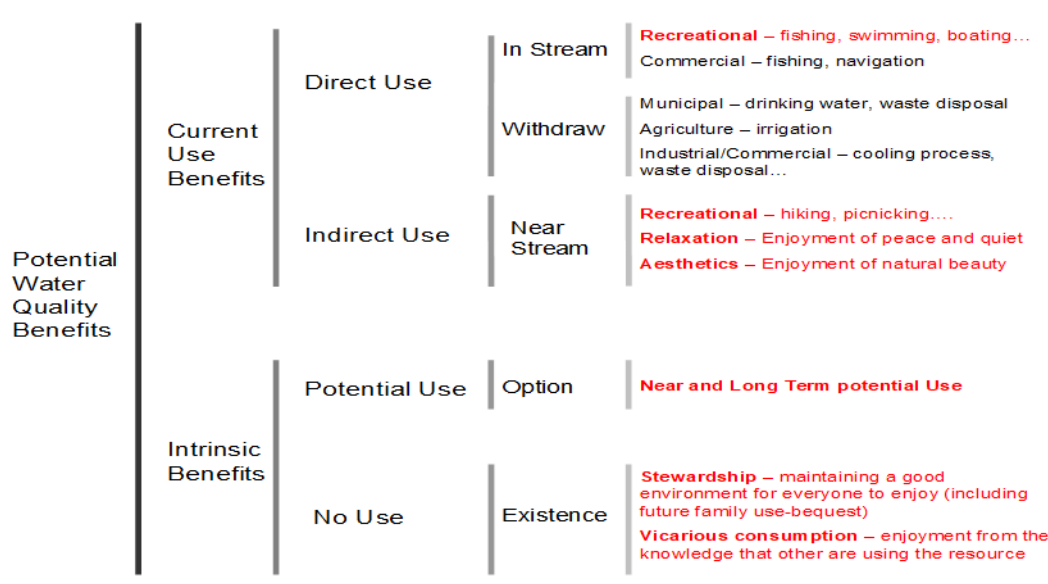
Figure 48: Use and Non-Use Value of Water Resource Improvements (Source: Baker et al. (2007))

For water resource quantity, the unaccounted-for-water is based on MoEW Roadmap (2022)[492]. the for the water used for domestic and industrial use was considered as a proxy for accounting for the water that was extracted which affected environmental flow, ecosystem services, rising water table salinity and decreasing water table level.

Land

See MOE and UNDP (2022) for methodological details.

- Valuation methods used is the replacement cost for cropland. rangeland and forest degradation are based on the net loss of land productivity based de Groot, et al. (2020)[493], Mitri et al. (2021)[494], Mitri et al. (2021) and Mitri et al. (2022)[495].
- MoE/UNDP (2022 updated in 2023)[496] and Menegaki and Damigos (2020)[497] for quarries.

The valuation for 1ha of the highest level of land degradation is based on de Groot et al. (2020 --values in 2020 prices and adjusted to 2023 prices) for rangeland whereas: the valuation of cropland is based on the opportunity cost of 1ha of cropland and adjusted for 2020 prices. As for the quarries, the valuation is based COED available in MOE and UNDP (2022 and updated in 2023).

Waste

See MOE and UNDP (2022) for methodological details.

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[492] Ministry of Energy and Water (MOEW). 2022. Roadmap to Recovery of the Water Sector in Lebanon. Beirut.

[493] de Groot, Rudolf, Luke Brander and Stefanos Solomonides. 2020. Update of global ecosystem service valuation database (ESVD). FSD report No 2020-06 Wageningen, The Netherlands (58 pp).

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[496] Ministry of Environment and United Nations Development Programme (MOE/UNDP) 2022. Calculating the Quarrying Sector's Dues to the National Treasury in Lebanon. Beirut.

[497] Menegaki, Maria and Damigos, Dimitris (2020) "A systematic review of the use of environmental economics in the mining industry," Journal of Sustainable Mining: Vol. 19 : Iss. 4 , Article 5. Available at: https://doi.org/10.46873/2300-3960.1034

- World Bank and MOE (2023) for generation per capita, waste characterization and level of composting and recycling[498].
- Treatment: see Chamieh et al. (2016)[499] for market cost of recycled materials method.
- Disposal: see MOE and UNDP (2017)[500] for hedonic pricing for disamenities from dumps and landfill.

Coastal Zone

See MOE and UNDP (2022) for methodological details.

- Plastic in coastal area: World Bank and ProBlue (2023)[501] and de Groot et al. (2020) for Marine environment and ecosystem services.
- Coastal Erosion: Mitri et al. (2020)[502] and various real estate companies to derive coastal price of land.
- Coastal land cover degradation: Termos (2023)[503].
- Illegal appropriation and Shoreline: Verdeil et al. (2019)[504] and Official Gazette 2/15/2024 page 45[505].
- Fisheries (FAO and sea around the world)[506].

Biodiversity

- Covered under water quality, land, coastal and marine degradation. The ecosystem services values (Table 28) are derived from de Groot et al. (2020).

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[499] Chamieh, Naji, Mohamad Ghassan Abiad, Fadi Doumani and Karine Abdelnoor-Tohme. 2016. Economic Instruments to Incentivize Recycling in Lebanon. Ministry of Environment and EU funded Support to Reforms – Environmental Governance, Lebanon and executed by a consortium headed by GFA. Beirut.

[500] Ministry of Environment and United Nations Development Programme (MOE/UNDP). 2017. Updated Master Plan for the Closure and Rehabilitation of Uncontrolled Dumpsites Throughout the Country of Lebanon. Vol. I and II. Prepared by Elard. Beirut.

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[504] Verdeil, Eric, et al., éditeurs. Atlas of Lebanon. Presses de l'Ifpo, Conseil National de la Recherche scientifique, 2019, https://doi.org/10.4000/books.ifpo.13178.

[505] Official Gazette: <http://www.pcm.gov.lb/arabic/landing.aspx?pageid=9>

[506] https://www.seaaroundus.org/data/#/eez/422?chart=catch- chart&dimension=taxon&measure=tonnage&limit=10

Table 28: Biome used to Account for Degradation of Ecosystem Services (*Source: de Groot et al. (2020).*

Biome	Cropland Mean Value (US$/ha/year)	Forest Mean Value (US$/ha/year)	Grassland Mean Value (US$/ha/year)	Sparsely Vegetated Land Mean Value	Woodland Mean Value (US$/ha/year)	Inland Wetland Mean Value (US$/ha/year)	Watershed/Lakes Mean Value (US$/ha/year)	Sea Mean Value (US$/ha/year)	Coastal Systems Mean Value (US$/ha/year)
Total (2023 US$)	7,056	1,476	221	99	59	15,924	30,156	10,057	11,672
	–	–	–	–	–	–	–	–	–
Provisioning services	5,713	9	155	6	3	3,177	3,775	8	1,623
Food	5,515	1	–	2	3	1,974	749	7	1,619
Fresh Water Supply	198	–	102	–	–	633	3,011	–	–
Raw materials	0	8	52	4	0	551	15	1	4
Genetic resources	–	–	–	–	–	20	–	–	–
Medicinal resources	–	–	–	–	–	–	–	–	–
Ornamental resources	–	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–
Regulating services	768	734	12	6	15	6,280	18,388	9,239	9,239
Influence on air quality	2	521	–	–	–	11	–	–	–
Climate regulation	2	157	12	6	15	49	41	11	11
Moderation of extreme events	163	2	–	–	–	4,360	3	–	–
Regulation of water flows	4	22	–	–	–	1,191	691	–	–
Waste treatment / water purification	13	–	–	–	–	669	16,617	9,228	9,228
Erosion prevention	57	2	–	–	–	–	–	–	–
Nutrient cycles (maintenenace of soil fert	8	29	–	–	–	–	1,013	–	–
Pollination	368	–	–	–	–	–	–	–	–
Biological control	152	–	–	–	–	–	23	–	–
	–	–	–	–	–	–	–	–	–
Habitat services	–	–	–	–	–	1,739	3,075	–	–
Lifecycle maintenance (nursery)	–	–	–	–	–	617	131	–	–
Gene pool protection (conservation)	–	–	–	–	–	1,122	2,944	–	–
	–	–	–	–	–	–	–	–	–
Cultural services	575	732.7	54	87	41	4,728	4,918	810	810
Aesthetic information	129	11.5	–	8	–	16	373	810	810
Opportunity for recreation and tourism	1,015	92.0	30	31	41	871	4,463	–	–
Inspiration for culture, art and design	5	–	–	18	–	37	51	–	–
Spiritual experience	–	–	–	–	–	0	12	–	–
Cognitive information (education and sci	–	36.1	24	30	–	39	19	–	–
Existence and Bequest Value	–	593.2	–	–	1	3,764	–	0.7	1