11. SOILS AND LAND

Land is affected by all economic activities. It harbors agricultural fields, industries, buildings and houses, ski resorts, beach resorts, country clubs, gas stations and fuel reservoirs. Many of these activities affect the soil. Land is also crisscrossed by roads and power lines and irreversibly modified by quarries and urbanization. The current state of land use is not accurately known. Several studies have been conducted to assess Landuse in select areas or zones. For example, good assessments of the state of the coastal zone and South Lebanon are available and discussed in this chapter.

11.1 Sources of Pressures

Land is at the receiving end of several economic activities. People live on land and generate both solid and liquid waste. Agriculture uses land to produce crops and rear animals, potentially leading to soil erosion and land degradation from excessive grazing. Compared to the agricultural sector, industry uses less land but requires so called industrial zones which are exclusively built to support industrial activities. Construction is an important consumer of land area and tend to spoil the landscape almost everywhere in Lebanon. Transport requires extensive road networks which scar the mountains and opens up new lands for development. The expansion of ski resorts in potentially very sensitive ecosystems, along with beach resorts and country clubs are pressures associated to tourism. Finally, also the energy sector induces land transformations from power grids and fuel storage tanks. Table 11.1 summarizes the most pertinent land based pressures from population and economic activities.

Table 11. 1
An Overview of Land Pressures from Population and Economic Activities

Economic Activity	*Pressure*	*Description*	*See Section*
Population	❑ Population growth	Annual growth rate of 1.65%	1.2.1
	❑ Solid waste generation	1.44 million tonnes of solid waste	1.3.1
	❑ Sewage flow	249 Mm^3 of sewage flow per year	1.3.2
Agriculture	❑ Uncontrolled grazing	About 815,000 sheep and goats	2.2.3
	❑ Agrochemicals	About 2,500 tonnes of pesticides and 32,000 tonnes of fertilizers	2.2.2
	❑ Abandoned terraces	Loss of terraced heritage	2.2.4
Industry	❑ Industrial zones	64 industrial zones in process Industrial establishments consume 8.6 Million m^2	3.1.5 4.1.3
Construction	❑ Quarrying	At least 720 quarries in Lebanon	4.2.1
	❑ Mineral extraction	Estimated at 25 million m^3 in 1995	
	❑ Buildings and establishments	Total of 518,858 buildings (1996-7)	4.1.1
	❑ Urban encroachment	8 percent of Lebanese territory	11.1
	❑ Demolition waste	Disposed at sea or on land and in valleys	4.2.8

Economic Activity	*Pressure*	*Description*	*See Section*
Transport	❑ Road network	About 22,000 km of roads	5.1.1
	❑ Degradation of landscape	No integration with surroundings	5.2.1
	❑ Ribbon construction	Many examples along coastal expressway and in the Bekaa	5.2.3
	❑ Colonization of natural sites	Virgin mountain tops become easily accessible	6.2.3
Tourism and recreation	❑ Expansion of ski resorts	6 ski resorts and 30 km of ski lifts	6.1.3
	❑ Beach front resorts	An estimated 150 resorts, resulting in reduced access to public beaches	6.2.2
	❑ Mountain resorts and country clubs	Mountain resorts have not been surveyed	6.2.2
Energy	❑ Storage facilities and infrastructure	Some 15 storage facilities with a capacity of 0.5Mm^3	7.2.2
	❑ Gas stations	About 1,646 gas stations	7.2.2
	❑ Thermal power plants	9 thermal power plants	7.1.1
	❑ Power grid	Yellow poles across the country	

In particular, urbanization, advertisement, low and medium tension power lines, quarries and roads affect the landscape as follows:

- Urbanization: Landuse maps of the coastal zone (CDR/ECODIT-IAURIF, 1996) reveal that around seven percent of the coastal fringe (8 to 10 km wide) is built up. This includes all types of urban areas including buildings, road network, facilities, services, airport, harbors and urban green spaces. The South-Lebanon map of 1999 (HRC/IAURIF, 1999), based also on SPOT multi-spectral images, indicates that urban extensions in South Lebanon cover eight percent of the study region.

  Using the census on buildings and establishments conducted by CAS in 1996-98, the National Center for Remote Sensing and CERMOC produced a digital map representing the density of residential units at the locality level. The density of residential units was subdivided into five categories, from less than 0.5 buildings per hectare to more than 20 buildings per hectare (see Map 11.1).

- Advertisement: Nowadays, the main access points to major cities are submerged in a sprawl of commercial and industrial buildings heavily advertised by means of billboards, with a resulting deterioration in landscape value. Such is the case along the Dbaye-Dora highway, the Mansourieh road, and Damascus highway, to name but a few. Advertisement is also mushrooming along other inland road sections such as the Zahle-Baalback highway. Today, it is generally recognized that these sites are unsightly and spoil the landscape, in addition to constituting a source of distraction for drivers and potentially increasing the incidence of road accidents. Yet, very little has been done to improve the situation.

  Decree 8861 (25/7/1996) on the organization and licensing of billboards has defined minimum set back distances for billboards that are installed along roads. It ranges from 5 meters for highways and international roads, to 3 meters for local

roads. In addition, billboards are grouped into four size categories which also set minimum distances between boards of the same category. For example, small billboards (measuring up to 3 x 4 meters) should be distanced 100 meters apart, while larger billboards (measuring 4.5 x 14 meters) should be distanced 1,000 meters apart. Moreover, Decree 8861 lists 12 locations and sites in which all forms of advertisements (posters and billboards) are not allowed. These include cultural and touristic buildings, road intersections and roundabouts, bridges, and within 100 meters of rivers and the seashore.

- Quarries have dealt a serious blow to the once pristine and often spectacular

  Quarries at Msailha (Batroun), Nahr Ibrahim, Nahr el Kalb, and Nahr el Mott are but a few examples. According to the Dar el Handasah survey, only three sites (Abu Mizan, Feghal, and Msailha) have some sort of restoration work underway, including soil filling and planting. Interestingly (and unfortunately), complaints about landscape degradation are not common; instead residents tend to focus on more direct impacts due to quarrying such as noise and dust (CDR / Dar, 1996).

- Roads: The impact of road construction on landscape has to be considered at several levels. In Lebanon, road designs are generally made without any consideration for the surrounding landscape. It is important to conduct environmental assessments for all road projects in sloped terrains or sensitive areas. Roads not only serve commuting needs, they also open up virgin land to new development projects. Hence, new roads are facilitating and accelerating the rate of urbanization (see Sections 5.2.1 and 5.2.3 for information on the impact of roads on landscape, and ribbon construction, respectively).

11.2 Land Use and Land Cover

There is no recent land cover and land use map for Lebanon. The first land cover attributes were generated in 1962 when the Lebanese Army and the French *Institut Geographique National* produced new and reliable topographic maps (scale 1:10,000). These maps provide valuable, but outdated, information on forest cover as well as other attributes such as springs, local roads, streams and elevation contours. Then in 1990, FAO and Khatib & Alami produced a new land cover map for Lebanon using 1987 Spot images. The resulting land use maps were fraught with significant errors (a subsequent evaluation report conducted in 1997 on the derived land use map of Lebanon revealed an accuracy of only 66 percent).[1] Moreover, the generated legends were confusing.

Recognizing the deficiency of current land cover data, the MoE/LEDO are supporting a project to update the land cover map for Lebanon. With technical assistance from the NCRS and CERMOC, the MoE will update and unify the land cover legend. It hopes to release the new land cover map during early summer 2002. This map and corresponding databases will provide valuable data to inform policy makers and help promote sustainable development of natural resources.

11.2.1 Regional land cover maps

In recent years several maps have been prepared in the context of regional environmental assessments. The following two studies provide extensive land cover/use data:

1. Regional Environmental Assessment of the Coastal Zone of Lebanon:[2] and
2. Regional Socio-Economic Development Program for South Lebanon.[3]

The REA report covers approximately 1,840 km^2 (coastal zone) and the second covers 1,773 km^2 (South). Keeping in mind the overlap between the two studies (i.e., costal strip from Saida to the Southern border), the Coastal Zone and the South Lebanon reports

zone and South Lebanon are discussed in Sections and , respectively.

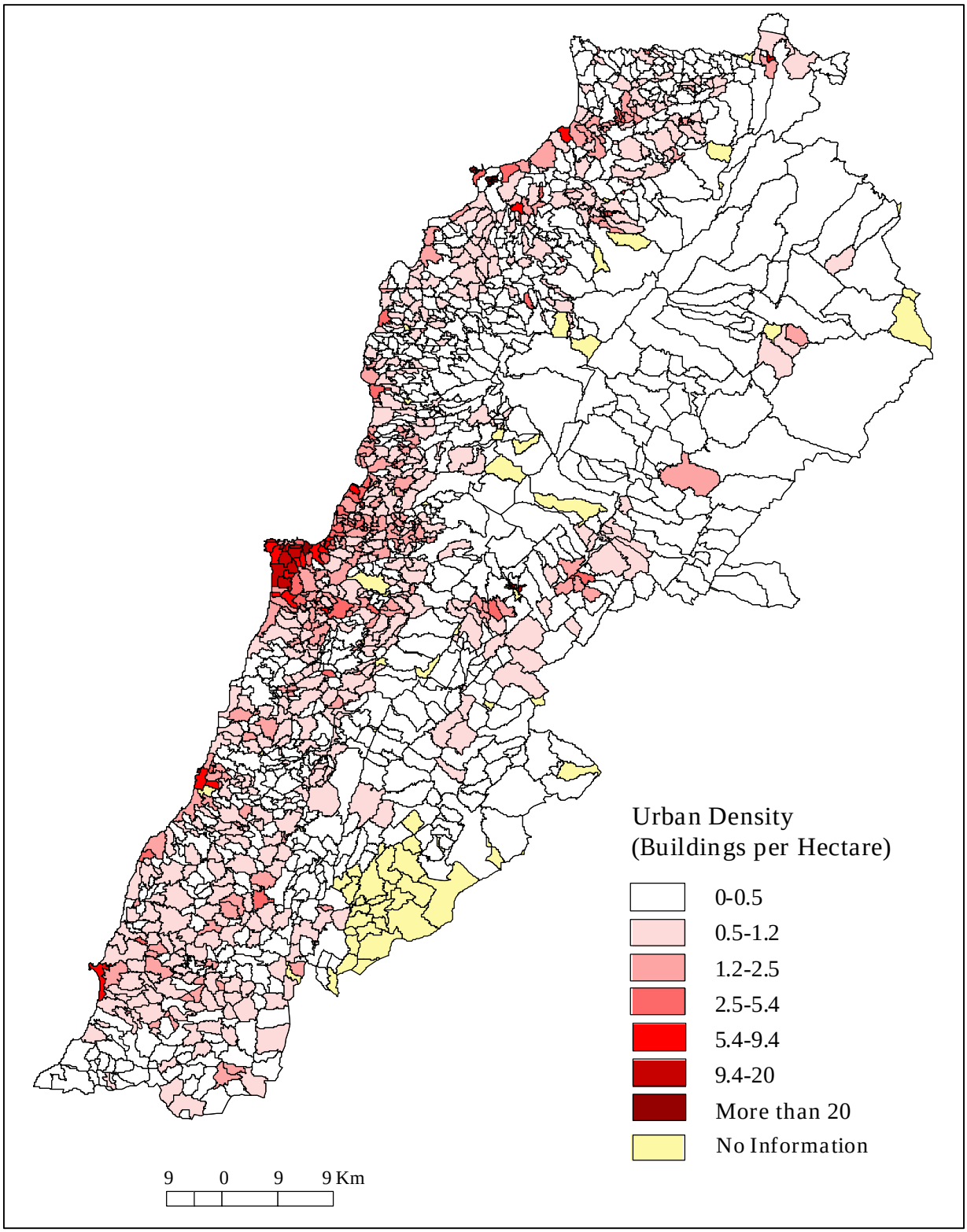
11.2.2 Modes of land tenure in Lebanon

Land tenure in Lebanon is complex and involves at least three major modes of land ownership as follows:

1. rship (private);
2.
3. local communities (e.g., shepherds, farmers who produce coal). These properties are managed by municipalities.

1 Khatib & Alami, 1997
2 CDR/ECODIT-IAURIF, 1997
3 HRC/IAURIF et al., 1999

Map 11.1
Urbanization: Density of Buildings at the Locality Level



Source: NCSR & CERMOC, 2001
Atlas of Localites

11.3 Soils

crust in which terrestrial plants can grow, provided water and temperature are adequate, nutrients are sufficiently available and toxic substances are in low concentration. Soils also constitute the critical natural capital of a country with profound socio-economic dimensions, particularly in rapidly urbanizing countries, like Lebanon (see Box 11.1). Surprisingly, soil conservation in Lebanon has received very little attention.

Box 11. 1
What Is the Price of Soil?

Soil is a limited resource and its value is hard to estimate. In rural communities that depend exclusively on agriculture, soil is an invaluable resource, without which agriculture would cease to exist. In urban areas, soil has usually been removed or capped and therefore is not readily available to potential users. For example, ornamental landscaping in public spaces requires relatively large soil volumes to create new gardens, road islets and parks. Construction sites also use soil (preferably rubble) to backfill open excavations during later stages of construction. Landfills also require a continuous supply of soil to serve as daily cover during landfill operations. These sectors (ornamental landscaping, construction and solid waste management) as well as other sectors require non-negligible soil volumes and typically haul soil long distances at great costs. For example, one truckload (12-15 m^3) of soil can easily fetch up to US$100-120. Paradoxically, productive soil is sometimes also used as a cheap backfilling material. Contractors often use agricultural soil for backfilling operation on their construction sites, instead of inert material such as rubble. The Beirut International Airport and the Beirut Sports Stadium stockpiled impressive volumes of soil during their early stages of reconstruction and / or rehabilitation, some of which was sold and hauled to various end users. In short, little is know on the price of soil which deserves more attention.

11.3.1 Soils in Lebanon

In Lebanon, most soils are very shallow (mountain areas) and some are meters deep (Bekaa plain). They have mainly evolved from weathered rock and, to a lesser extent, volcanic material and accumulated plant residues. Many soils in Lebanon arise from transported materials deposited by water (forming so called *alluvial* soils), or by gravity (so called *colluviums*). The soils of Lebanon vary widely in quality and productivity and are typically Mediterranean in character. The lithology has contributed to the diversification of soil resources, most of which are base-saturated calcareous soils, except for the sandy soils formed on the basal cretaceous strata. The most widely represented soils are the Terra-Rossa (Red Mediterranean soils) and the Rendzinas, which represent about 70 percent of Lebanese soils.

Lebanon is predominantly mountainous, and the soils are mostly discontinuous (i.e., the soil mantle is truncated and rock outcrops are apparent), young, fragile and prone to erosion. Thus, lands are particularly susceptible to environmental degradation because soils are shallow and have direct contact with Karst formations, such as in the areas of Faqra, Ajaltoun, and elsewhere in the Lebanese mountains. Inversely, rock outcrops in the Lebanese landscape indicates the presence of Lithic soils.

There has only been few attempts to estimates soil erosions rate in Lebanon. These have been compiled in the 1995 SOER. However, using GIS and remote sensing, new efforts are underway to assess soil-water erosion. With technical assistance from the *Institut National Agronomique* in Paris and the National Center for Remote Sensing, an on-going study is identifying high-risk and water erosion prone areas across a belt transect. The study zone trends North-South from Damour to Jounieh and extends from the shoreline to Ain Beida (Bekaa valley). Several indices are being integrated to develop soil vulnerability maps including soil permeability, soil-water retention, hydrographic density, rainfall and plant cover. Derived maps and data will be ground validated.[4]

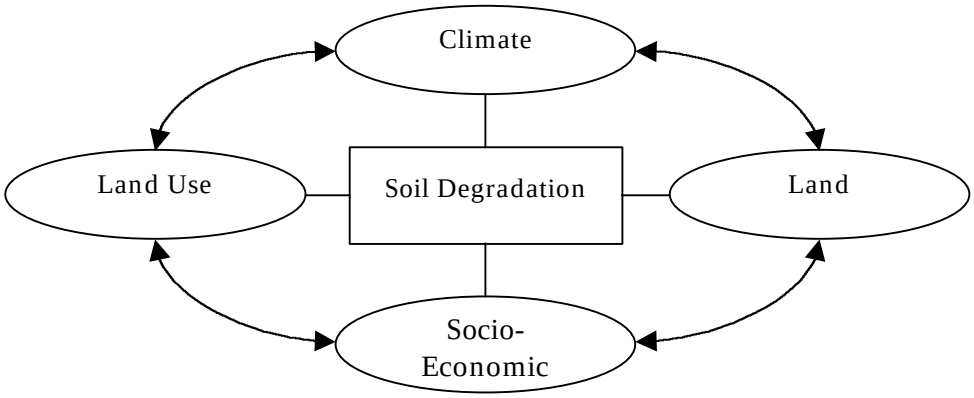
11.3.2 Soils in the Environmental Context

Soils are important bio-regulators. Soil physical and chemical properties are potentially effective barriers to pollutant transport and can hence mitigate environmental impacts associated with heavy metal contamination. Soils therefore have the ability to protect human health, provided adequate soil conservation measures are adopted. Soil properties also greatly influence floristic diversity, species distribution and plant communities. In particular, soil depth, texture, organic matter and electrical conductivity are important environmental factors shaping plant communities and associations.

Soil degradation

Many anthropogenic and natural factors affect soil quality and potentially result in soil degradation (see Figure 11.1). Natural factors include climate (i.e., rainfall, temperature, wind), and land (i.e., terrain, vegetation cover, parent material and soil type). Anthropogenic factors include landuse systems (i.e., farming systems, use of non-conventional water sources for irrigation, grazing arrangements and intensity, forest management, terracing) and socio-economic factors (i.e., population density, urban encroachment, road networks, industrial zones). In particular, an estimated 815,000 sheep and goats partially depend on rangeland for grazing (reducing plant cover and exposing soil), farmers apply approximately 32,000 tonnes of fertilizers in addition to 2,500 tonnes of pesticides per year, and new road projects open virgin lands for urban development, irreversibly capping soil surfaces resulting in soil carbon transformations.

Figure 11. 1
Interdependence of Soil Degradation on Biological and Socio-Economic Factors



Source: Based on Advances in Soil Sciences, Vol. 10, 1989

[4] *Pers comm* Bou Kheir R, National Center for Remote Sensing

Soils and chemical pollution

With the exception of some marly and sandy soils, soils in Lebanese are generally high in active clays. Active clays are clays with the ability to adsorb and immobilize positively charged ions, namely heavy metals. In case of chemical contamination (i.e., accidental spills, lead dust deposition from mobile sources), the ability of active clay soils to attenuate the associated impacts is limited only by soil depth and soil organic matter. Pollutants which are not absorbed either leach and seep into groundwater or are taken up by plants (vegetation or agricultural crops). Both fates entail risks to public health.

Recent studies examined the fate of select heavy metals in the four main Lebanese soil types (Samad, 2000 and Srour, 2000). To enhance solubility, the authors used acid forming fertilizers to mobilize cadmium, chromium and nickel and monitored their transfer below (leachate) and above the soil (plants including shoots and roots). Acid forming fertilizers are common on the Lebanese market and reduce soil pH locally, potentially resulting in increased mobility of heavy metals. The study revealed that cadmium desorption (i.e., release into the environment) was highest in Sandy Inceptisols. Nickel desorption was highest in Sandy Inceptisols and White Rendzina type soils. These are commonly present in areas rich in sandstone (e.g., Jezzine, Baabdate) and marly limestone (e.g., Chekka). Likewise, plant cadmium levels (in pot experiments using radish) were highest in Sandy Inceptisols and White Rendzina type soils (Srour, 2000).

Acid-forming fertilizers do not affect metal uptake by plants on select Lebanese soils, because these have very low native metal levels and high active clay content.

Widespread use of leaded gasoline is still one of the main sources of lead particles deposition in soils and vegetation near highways and major roads (Eid, 2001). A study on the effect of several parameters on lead distribution in soils along roadsides in Choueifat revealed that soil lead concentrations decreased rapidly as road distance increased (Eid, 2001). Lead levels were highest at a distance of three meters from the road (reaching 115 ppm), and higher in urban roadside soils (up to 113 ppm) compared to rural roadside soils. Overall, soil lead levels in the area of Choueifat ranged from as low as 0.65 ppm to as high as 747.5 ppm with a mean value of 54.3 ppm. These levels are high compared to mean natural soil lead concentrations estimated in the 5-40 ppm range, indicating a net accumulation of Pb due to high traffic. They are also significantly higher than acceptable soil lead levels reported in urban areas (about 150 ppm) and therefore could pose public health concerns (Eid, 2001). However, there seem to be no correlation between soil and plant lead levels suggesting that soil lead is not available for plant uptake (i.e., not transmitted to crops). Thus, the high lead levels observed in roadside soils in urban Lebanon do not result in significant Pb accumulation in plants, and hence do not constitute a health hazard through crops consumption.

Soil organic matter and landuse

Soil disturbance affects carbon oxidation. Reduced carbon and soil organic matter implies increased carbon release into the atmosphere. CO_2 is a leading greenhouse gas. A recent environmental analysis of urban and peri-urban agriculture in Choueifat and Tabarja (two rapidly urbanizing coastal regions) revealed that soil organic matter (SOM) levels in agricultural areas were intermediate between natural areas and urban areas. This means that agriculture as a land use results in enhanced carbon sequestration in the soil compared to urban areas. Thus, the preservation of agricultural zones in rapidly

urbanizing areas (urban agriculture) has the additional benefit of reducing CO2 enrichment of the atmosphere. (Abdul Samad, 2001). Soil organic matter in greenhouses ranged from 1.23 to 4.10 percent, and from 1.37 to 5.81 percent in open agricultural fields. By comparison, soil organic matter in urban settings ranged from 0.41 to 1.91 percent, and from 4.13 to 9.45 percent in natural sites. The very high organic matter content in natural sites is attributed to the presence of a dense vegetation (pine and oak thickets). Furthermore, these sites are undisturbed resulting in the build up of soil organic matter. In summary, compared to soil organic matter in natural sites, the study revealed that open fields, protected agriculture, and urban developments reduce SOM by 48, 62 and 85 percent, respectively. At a national level, the high rate of urbanization (i.e., eight percent ized and hosts approximately 86 percent of the total population) implies an accelerated rate of organic matter oxidation and, hence, carbon release into the atmosphere.

Soil and biodiversity

Soils greatly influence the landscape by determining its floristic component. The relationship between soil substrate and plant communities was described by Abi Saleh et al (1976)[5]. Their study related geological formation to forest communities, and indicated that umbrella pines (*Pinus pinea*) occur predominantly on sandstone, while oak (*Quercus* spp.) dominate on the mid-elevation limestone formation. A recent study analyzing the relation between floristic diversity and landscape components in the Lebanese coastal zone demonstrated that soil physical properties, including soil texture, depth, organic matter, electrical conductivity and pH, are the principle compositional gradients affecting vegetation distribution patterns (Chatila, 2001).

11.3.3 Soil Mapping

The National Center for Remote Sensing (NCRS) has generated a new soil map for Lebanon and a Soil Terrain Database (SOTER). The SOTER database provides comprehensive information related to soil physical and chemical properties, including landforms, lithology, slope gradient, drainage conditions, surface stoniness, texture, and soil depth. In parallel, the NCSR initiated the preparation of the unified soil map of Lebanon at a scale of 1:50,000. Using GIS applications and field surveys, it produced landform, terrain units and terrain components based on Spot and Landsat images. The final soil classification system is based on US soil taxonomy, FAO-UNESCO revised legend and World Reference Base. During the course of the project, more than 360 soil profiles from the northern and central parts of Lebanon were excavated and about 850 soil samples were analyzed. More work remains to be done in South Lebanon during 2002. Nevertheless, the generated data can already be used to produce soil capability and suitability maps, model soil erodibility and monitor the impact of different types of landuse on soil degradation.

[5] Abi saleh, B., Barbero, M, Nahal, I, and Quezel, P. 1976. Les series forestieres de vegetation au Liban. Essai Bull. Coc. Bot. Fr. 123, 541-560.

11.4 The Coastal Zone

The coastal zone extends over about 162,000 hectares of coastal plains and mountains (16 percent o

[6]

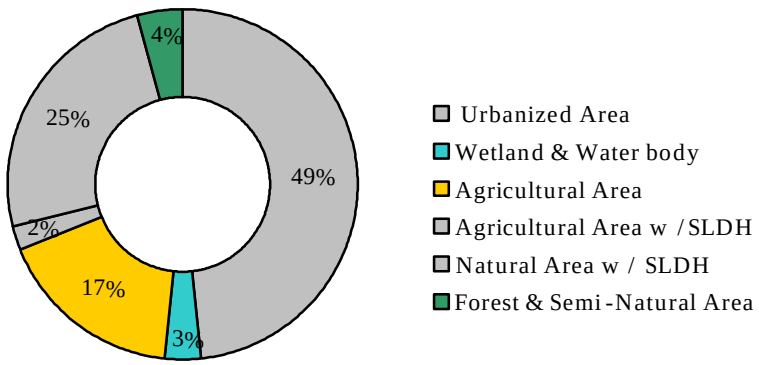
commercial ports and over 15 fishing harbors, dozens of sea pipelines for petroleum imports, three fuel power plants, and various industries. The coastal zone is rich in cultural / archaeological heritage and natural landscapes and contains key drinking water sources.

11.4.1 Land use and land cover in coastal area

Using a scale of 1:50,000, Leb
(north of Ras el Bayyada) are covered by the Regional Assessment Report on the coastal zone of Lebanon (CDR / ECODIT-IAURIF, 1997).

Figure 11. 2 summarizes land uses along the Lebanese coastline based on six major land use types that were consolidated from a group of 44 land use categories. Urbanized areas cover almost half of the coastline, and include urban fabrics (21 percent), large industrial and commercial units (10 percent), seaside tourist resorts (7.5 percent), ports (5.3 percent), and sea embankment and dump sites (4 percent). Furthermore, the incidence of scattered low-density housing (SLDH) is widespread within agricultural and natural areas, thus constituting two distinct land use types. Beaches and dunes cover only 49 km of the coastline (21 percent), while bare rocky outcrops about 11 km (4.7 percent). The four km of sea embankment or dumpsites include the Beirut Normandy landfill but exclude the Metn-Nord sea reclamation project. Table 11.2 presents the surface area covered by each land use in a 2,000 meters coastal fringe (covering 432 km^2). Within this zone, urbanized areas cover almost 154 km^2 while non-urbanized areas and land uses cover 278 km^2.

Figure 11. 2
Land Uses Along Coastline (Percent of Total Length)



[6] The coastal zone is defined as a 16-km wide sea-land corridor along the Lebanese coastline (eight km on either side), with some exceptions: about 15 km off the coast of Tripoli to capture the Nakhl Islands and about 10 km inland north of Tripoli and east of Sour to capture agricultural plains.

Table 11. 2
Land Uses within a 2000 Meters Coastal Fringe

Major Land Use Category	*Total Surface Area (hectares)*	*Percent*
Urbanized Area	15,380	35.6
Agricultural Area	14,626	33.8
Agricultural Area w/ SLDH	1,536	3.6
Forests & Semi-Natural Areas	10,122	23.4
Natural Areas w/ SLDH	1,127	2.6
Wetlands & Water Body	432	1.0
Total	**43,200**	**100**

[a] SLDH: Scattered Low Density Housing
Source: CDR/ECODIT-IAURIF, 1997

11.4.2 Hot spots and Sensitive Areas

The REA report on the coastal zone of Lebanon identified 12 sensitive sites as priority conservation areas due to rich or unique ecological and landscape value. The study also identified several coastal areas that are currently either degraded (current hot spots) or being degraded (potential hot spots by within the next decade) due to the combined effects of concentrated residential, industrial, tourism development, and/or infrastructure activities. Table 11.3 lists key sensitive areas and hot spots and their conservation status and summarizes the rationale for their listing. The presence of at least six large-scale seafront dumps (e.g., Normandy, Borj Hammoud, Tripoli, Sour and Saida) further exacerbates coastal ecosystems and cause significant pollution of marine waters. Appendix G provides an overview of the current status of these dump sites, four of which are still operational, as well as other inland dumps (i.e., Baalbeck and Zahle).

11.4.3 Uses and abuses of the public maritime domain

Beach resorts, large commercial and industrial units and ports occupy fifty-six km of coastline. This represents 23 percent of the Lebanese coastal zone. These establishments either wholly or partially obstruct pubic access to the coast, thereby confining coastline utilities to a small number of private beneficiaries. While several beach resorts and industrial projects have illegally expropriated coastal lands, many others have been granted exceptional authorization to use the maritime public domain, provided these projects are declared of public utility and do not interrupt the continuity of the coastline.

Decree 144 (1925) declares the sea --including the sea bed and the sea floor-- and the coast as public domain. The coast is delineated by the highest water point during the winter months, including the sand and gravel beaches.

maritime public domain, the territorial sea extends 12 nautical miles from the coastline, consistent with the Convention on the Law of the Sea (ratified by Lebanon).

According to Article 1-6 of Decree-law 4810 (24/6/1966), which unequivocally provides for the right of public access to the maritime public domain, owners of seafront properties may use (lease) the adjoining maritime public domain to an extent double the area of their property and within the limits of their lot frontage. Each permit is renewable on a yearly basis, and no reference is made to the unconditional right of the public

Table 11. 3
Sensitive Areas and Hotpots

Sensitive Area/Hot Spot	*Status*	*Rationale*
1. Akkar beach and dunes	B	Beach degradation and erosion
2. Akkar agricultural plain	A	Potential loss of agricultural area due to urbanization and free trade zone
3. Coastal stretch from IPC (Beddawi) to El-Mina port	C	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 & Enfe	B	Characteristic landscape (salinas, historic port) threatened by mass-scale tourism development
5. Ras ech Chaquaa, w/ Chekka and Selaata industries (from Chekka to Batroun)	A	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	A/B	Cultural, archeological, and natural landscape requiring protection. Visual impacts of illegal quarry behind Msaylha fortress.
7. Batroun marine reserve	B	Declared reserve ill-defined with no management or conservation plan
8. Amsheet-Jbail coastal area	A	Tourism development pressures could hinder public access to the beach and spoil landscape. Rocky mountain (w/ garrigues) and green area could serve as urbanization buffer zone
9. Nahr Ibrahim valley	B	Unique ecology and legendary landscape devastated by quarrying and currently still threatened by industry and urbanization
10. Jounieh and mountain	C	Characteristic landscape and quality of life degraded by uncontrolled urban growth
11. Nahr el-Kalb valley and river mouth	B	Geology, paleontology, biodiversity, and history of this unique site threatened by infrastructure (highway and power plants) and rampant urbanization. Jeita spring source threatened by increased pollution
12. Metn-Nord	C	Beaches either lost forever or privatized. Opportunity for planned urban development of reclaimed land. High environmental impacts of supplying required aggregate and sand
13. Beirut, w/ Grotte aux Pigeons	C	Several hot spots (port, Normandy landfill) and sensitive areas
14. Airport and ELISSAR	C	Beaches either lost forever (if land reclamation options selected) or privatized. Delicate relocation of industries and people
15. Damour plain	B	Agricultural plain/green space threatened by tourism development pressures
16. Nahr Hammam valley	A	Pristine valley with interesting ecological habitat needing legal protection
17. Saida coastal area	C	Northern beaches threatened by urbanization and tourism development pressures. Coastal highway project would separate old city from fishing port and Sea Castle. Environmental and socio-economic impacts of SIDON port
18. Rmeileh beach	A	Sandy coast to be protected
19. Zahrani area	C	Old refinery site and industrial area requiring rehabilitation
20. Litani sea shore and valley & Kasmieh plain	A	Ecological and economic importance of river need special protection. Sandy coast and scenic valley to be protected. Agricultural plain threatened by ribbon urbanization along new highway
21. Mhaylib coastal area	B	Publicly-owned illegal housing

Sensitive Area/Hot Spot	*Status*	*Rationale*
22. Tyre, to Rashidieh camp south	B	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	A	Competing interests of conservation, agriculture, and tourism need integrated planning and management approach
24. Iskandarouna beach	A	Sandy coast to be protected
25. Ras en-Naqoura	A	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 begin

A - Preserved but threatened areas requiring protection
B - Areas currently being degraded requiring protection
C - Degraded areas requiring rehabilitation

Source: CDR / ECODIT-IAURIF, 1997

Furthermore, a tourist development that is separated from the seashore by a coastal road may obtain a permit to be connected to the maritime public domain through an overpass or underpass and to rent part of the seashore for private commercial or personal use. There are many examples of underpasses in Greater Beirut, including the Riviera Hotel and the AUB beach.

If current trends continue, more segments of this coastline would be eaten up by beach resorts and sea embankments in the future. Potential tourism, beach resorts, and sea embankment projects could use up several other stretches of prime beach front and coastline in Tripoli, Chikka, Amsheet, Byblos, Damour, Jiyeh, Saida, and Sour. Already, a large multi-function beach resort is under construction in el-Hirre in Chikka. Another beach resort was envisioned on the sand beaches on Jbeil, but was luckily aborted following fierce opposition by NGOs, local inhabitants and the mayor of Jbeil.

If conditional use permits under Decree 4810 continue to be granted as currently (i.e., for private tourism projects without any public utility) and / or additional real estate companies are created with a mandate to reclaim land from the sea, public access to and enjoyment of the beach at these areas would be seriously hampered, and perhaps lost forever due to the installation of permanent structures. Also, if long-term solid waste management plans are not implemented in coastal urban poles, such as Tripoli, Tyre and Saida, seashore dumping could continue leading to the creation and or expansion of beach front landfills.

11.4.4 State of public beaches

Establishment and management of public beaches falls within the responsibility of the Ministry of Tourism (Law 21, 3 / 29 / 66, Art. 1 and Decree 15598, 9 / 21 / 70). In 1993, the Council of Ministers approved a draft decree by the Ministry of Tourism to establish the following 10 public beach sites: Tripoli (500 m), Byblos (300 m), Maameltein (200 m), Nahr el Kalb river mouth (200 m), Dbayeh (now overtaken by the North Metn sea reclamation project), Ramlet el Baydah (2 km), Khalde, Ghaazieh (250 m), Sidon (300 m), and Tyre (600 m). However, the decree was later reversed, at the request of the Ministries of Transport and Environment, when analytical results showed relatively high pollution levels in different locations along the coast.

According to the Ministry of Tourism, adequate management of public beaches is only feasible through a Build-Operate-Transfer (BOT) scheme and under strict public sector oversight. This would require a minimum admission charge, in addition to parking fees. Today, admission charges at privately managed public beaches range from as low as LBP 1,000 (Byblos), to as high as LBP 15,000 (Jiyeh), plus parking fees (see Section 6.2.2 on beachfront recreation facilities).

11.4.5 Coastal erosion due to sand dredging

One of the major problems facing the Lebanese coast is a deficiency in sediment leading to erosion of sandy beaches. Since the construction of the Aswan High Dam in Upper Egypt (1964), erosion has increased greatly in the Nile delta because sediments are trapped in Lake Nasser. Yet, since no monitoring of coastline retreat has been carried out in Lebanon, it is difficult to ascertain the extent to which beach erosion along the Levant coast can be attributed to the Aswan dam. Apart from this possible sediment loss, three kinds of extraction activities cause or exacerbate coastal erosion in Lebanon:

- sediment dredging offshore;
- sand extraction on beaches; and
- gravel quarrying in river beds.

Box 11. 2
Coastline Protection

The present erosion of beaches in Lebanon is considered serious. Only the area South of Sour can be assessed as relatively stable. To bring further erosion to a halt, it is important to ban offshore dredging in areas shallower than 30 m, sand mining on beaches, and gravel extraction in river beds. The building retreat in the coastal strip over a width of 100 m, as practiced in most European countries, will further guarantee the stabilization of the coast. Also, regional and local authorities could look into the possibilities of coastal defense works, especially in areas where a stable sandy beach is a major asset for beach recreation and international tourism (Tyre, Byblos).

Artificial beach nourishment by dumping sand pumped from the infra-littoral zone (deeper than 30 m) may be considered, subject to proper environmental impact analysis. Beach nourishment has the major drawback in the Mediterranean to kill off biodiversity in the infralittoral zone (e.g, Zostera grasses and coralline reefs). In most cases it only brings a temporary solution since it needs to be repeated routinely (e.g., every three or four years) since sand on an unstable beach profile will move after stormy weather spells.

Another solution consists of revetments or concrete walls (to protect a road or an urban settlement) or groynes or breakwaters (either perpendicular or detached parallel to the coastline). Parallel breakwaters eventually form tombolos between the breakwater and the mainland, thus trapping accretionary sand moved about by littoral drift. In Cyprus, various breakwaters have been constructed recently to protect the coast East of Limassol, without the expected results so far. The success of these coastal protections depends on the availability of sand in the active bed load sediment, the distance of the breakwater to the mainland and the design (determined by the non-breaking or breaking nature of waves), size, and periodicity of wave action. The geometrical and porosity (use of geotextiles) characteristics of the breakwater define also the effectiveness to combat beach erosion.

Source: CDR / ECODIT / IAURIF- 1997

11.4.6 Sustainable development of the coastal zone

Sustainable development of the coastal zone will require preservation (at a minimum) and restoration (in the long-term) of public access to the coast and beaches of Lebanon. Any future tourism project would need to respect the right of public access to the beach and the continuity of the coastline, as stipulated by Decree 4810. One way to accomplish this is to require a minimum setback distance of 60 to 100 meters (depending on local conditions) for all construction; the current 10-meter setback is not sufficient to protect the beach and the right of public access to it. Another way is to prohibit any types of permanent or semi-permanent structures in the maritime public domain. Also, tourism projects (of any type) would not be granted permits for conditional use of the maritime public domain (e.g., Decree 4810). Finally, any sea embankment projects without a strong public utility component would not be authorized. Any project that goes forward would respect, at a minimum, the right of public access to the beach and the continuity of the coastline.

The Cyprus Act of 1959 forbids foreshore construction within a 50-meter wide coastal fringe. In 1992, 1,991,000 tourists visited Cyprus, principally to enjoy the beach and the sun. Almost 27 percent of these tourists stayed in Limassol. Direct income from tourists is estimated at 625 million Cypriot Pounds per year (about US$1 billion).

11.5 South Lebanon After the Occupation

South Lebanon was liberated in May 2000, after 22 years of occupation. This has triggered immense interest and curiosity among younger and older generations. Although the region offers extensive natural landscapes, the occupation has left numerous scares (burnt forests, military roads, destroyed houses, abandoned fields, etc.). The challenge ahead lies in reconciling conservation and reconstruction. Box 11.3 provides a baseline account of some of the perils of war and peace in the Rihane mountain region, part of the former occupied South Lebanon.

11.5.1 Land cover/use of South Lebanon

Land use and land cover data prepared for South Lebanon includes 42 categories.[7] For this report, they were simplified down to nine categories, as shown in Table 11.4. Dense and scattered guarrigue formations represent the single largest land cover category (almost 42 percent), followed by agriculture (26.9 percent) and forests (9.1 percent). Urban extensions, which include dense to moderately dense areas as well as tourist complexes, quarries, industrial and commercial areas, represent almost eight percent of the land area. Burnt area included 7,879 hectares, most of which is presumably attributed to the occupation. Land use in South Lebanon is severely hampered by landmines and unexploded ordnances. Section 11.5.2 describes the extent of the land mine problem in Lebanon, and the South in particular.

The area covered by guarrigue is astonishingly high, in comparison with a separate and more localized assessment of forests in the Rihane mountain region (Jezzine). According to that field study, oak and guarrigue cover an estimated 20 percent. The vegetation in the Caza of Jezzine is notoriously lusher than further south. Such

[7] HRC / IAURIF, 1999

discrepancies confirm the need to reconcile and develop standard Landuse / land cover categories for all of Lebanon.

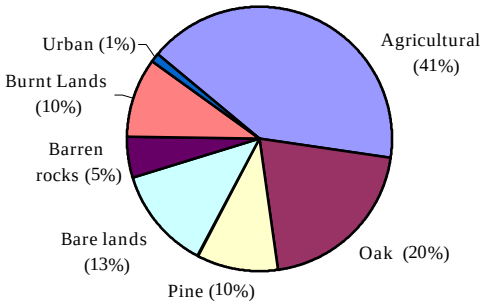
Table 11. 4
Land Use in South Lebanon after 22 years of Occupation

Land use category	*Area*	*Percent*
Urban	13,856	7.8
Agriculture	47,643	26.9
SLDH in agricultural / forested areas	3,758	2.1
Forests (conifers and deciduous)	16,139	9.1
Dense and scattered guarrigue	74,217	41.9
Bare rock and guarrigue	5,400	3.0
Bare rock	8,178	4.6
Burned zone	7,879	4.4
Other	221	0.1
Total	**177,291**	**100.0**

Source: HRC / IAURIF, 1999

Box 11. 3
Perils of War and Peace on Forest Cover in Rihane Region, South Lebanon

During the summer of 2000, and three months after the Israeli pullout, a team of specialists conducted a field assessment of the natural resources in the Rihane Mountain Region, 113 km^2 in the Caza of Jezzine. The study zone covered former occupied territory and included 24 cadastral zones. Using 1997 satellite images and GPS, the study revealed that 30.4% of the area was still forested with pine and oak (of which 81% were on private lands) but armed conflicts burnt forests equivalent to 10% of the study zone. This brings the potential forest cover to 40%. The occupation also left an indefinite number of land and anti-personal mines that have severely restricted economic activity and removed fertile land from agricultural production. Almost 41% of the land was identified as former agricultural land, but currently abandoned (see pie chart). Literature review and consultation have revealed the potential presence of 328 plant species, of which 64 were confirmed during field visits and 24 plants have therapeutic properties according to local traditions. Twenty-two other species had melliferous properties, important for apicultural activities. Three of eight sand quarries, located within pine forests, were being reactivated after the Israeli pull-out. Unless serious environmental measures are taken, sand quarries will proliferate, villages will experience chaotic reconstruction, and uncontrolled grazing will potentially hinder the regeneration of burnt forest areas.



Land cover in Rihane region (2000)

Source: South for Construction / GLA, 2000

11.5.2 The Problem of Landmines in Lebanon

This section was prepared based on information provided to ECODIT by the Landmines Resources Center at the University of Balamand (LRC, 2001).

Although landmines have been a severe source of concern for more than 30 years, Lebanon is not a signatory of the Landmine Treaty. Fifteen years of civil strife (1975-1990) and 22 years of occupation have left more than 150,000 landmines, including unexploded ordnance and cluster bombs. After the Israeli pullout in May 2000, the UN estimated that South Lebanon and the Bekaa contained another 130,000 landmines in an 850-km^2 area, of which Israel has admitted planting 70,000 landmines and 288 booby-trapped devices. At least 188 minefields are spread among border villages stretching from Ras Naqoura on the coast to opposite Shebaa in the Mount Hermon foothills. During a survey conducted in July 2000, the Landmines Resource Center (LRC) identified 429 dangerous areas reported by local communities in 196 villages. The Lebanese Army has reported about 508 dangerous areas in the cazas of Nabatiyeh, Jezzine, Saida, Hasbayya, Bint Jbeil, Marjeyoun and West Bekaa (see Appendix K for a complete list of presumed minefields). These are typically found in agricultural fields, pedestrian paths and backyards and have caused many injuries over the past years.

As per May 2001, there were 2,714 landmine victims in Lebanon, of which 114 have occurred in the first year after the Israeli pullout - 15 were killed and 99 were lamed.

The socio-economic impacts of landmines in Lebanon are indisputable. Agricultural fields are laden with landmines and booby traps, principally for their capacity to effectively paralyze the sector and thereby cause mass exodus. In the likelihood of persistent landmines, opportunities for normal life cease to exist. During the occupation, less than 26 percent of the local population resided in the South; seven percent tried to return and settle after the occupation and a large majority did return by the end of the summer 2000. The risk of injuries has thereby significantly increased as farmers will attempt to re-cultivate their fields and children will potentially play, near unmarked or poorly marked minefields.

The government established the Lebanese Demining Office at the Lebanese Army in April, 1998. Later that year, the World Rehabilitation Fund launched a landmine project to disseminate information, promote awareness, provide assistance to landmine victims and support Demining activities by the Lebanese Army. Since then, a number of NGOs have joined the campaign and carried out various activities. For instance, the LRC established a dynamic database on landmine victims and hot spots. In May 2000, UNICEF joined mine awareness campaigns and in June 2000 other UN agencies intervened including UNMAS, UNIFIL, and UNESCO. In August Swedish Save the Children started a child-to-child project on mine awareness in Bint Jbeil and in January

West Bekaa. Unfortunately, limited funds and resources are limiting the geographic coverage of awareness campaigns and de-mining activities. Mine clearance is a very expensive operation requiring sophisticated equipment. Furthermore, UNIFIL operations in mine clearance are only military. This means that they do not clear mines for humanitarian objectives such as promoting agricultural development and / or encouraging the return of the displaced. It remains unknown how long the problem of landmines in Lebanon will persist and how much it will cost to remove them.