(1) Fauna and Flora

During the construction phase, fauna and flora will be not negatively impacted because of the tourism facilities will be constructed avoiding the inhabiting areas of important fauna and flora.

(2) Air Pollution, Noise

During the construction and operating phases air quality and noise will not be negatively impacted because that the construction will be not so large scale and the increase of tourist vehicles is not so much comparing present amount.

(3) Water Quality, Solid Waste

During the construction and operating phases water quality and solid waste will not be negatively impacted because that the construction will be not so large scale and the increase of tourist excreta is not so much comparing present amount.

(4) Other Items

During the construction and operating phases all of other items will not be negatively impacted.

Part 2 (Bcharre)

2.1 EXISTING CONDITIONS

Exhibits 9 and 10 present sensitive eco-system and land cover for Bcharre Qaza.

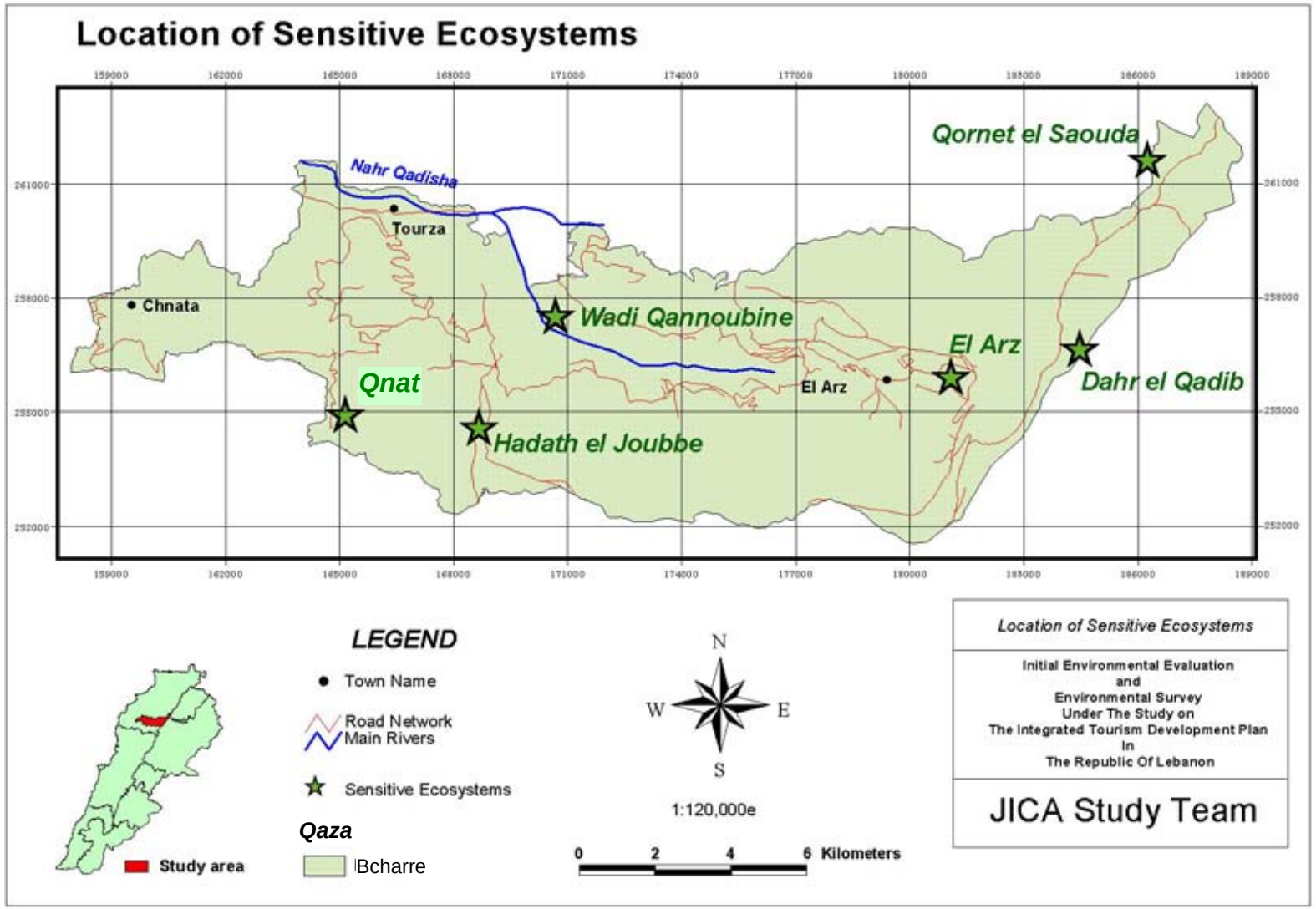


Figure 9 Sensitive Ecosystem Map

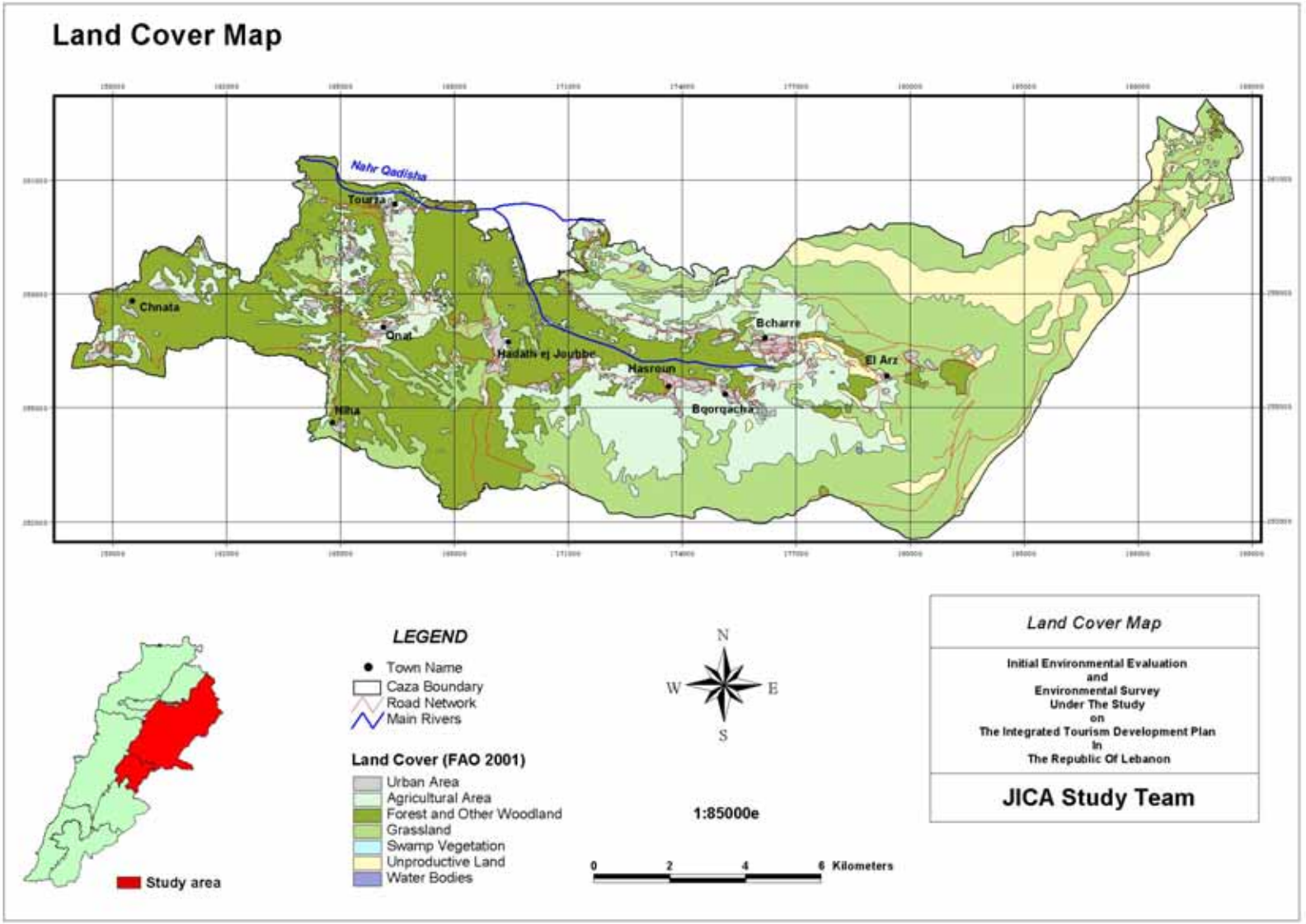


Figure 10 Land Cover Map

2.1.1 TOPOGRAPHY

The study area could be divided into two main topographic units. The two topographic units have one major geographic distribution. This orientation of the study area has an approximately West-East direction. In terms of geology, the study area has a variety of rock formations ranging in age from the Lower Jurassic to Upper Cretaceous with various structural features. The Jurassic formations are mainly outcroppings in the Qadisha and Qannoubine valleys. The lower cretaceous formations are dominated in the villages located above the valley. The upper cretaceous formations are apparent in the elevated areas where the highest mountains exist as Qornet El Saouda (3088m). Three different trends of faults are crossing in the study area.

*** *Stratigraphy***

The following stratigraphic column (Figure 11) presents a summary of the different stratigraphic units in Lebanon and those that are highlighted in yellow correspond to the existing formations in the study area.

*** *Structure***

The beddings of the study area are generally inclined towards the west direction. Their inclination gets disturbed in the presence of faults and thus they get slightly inclined towards the East as it shows in Hadath el Jibbe area.

Three different trends of faults are crossing in the study area. These are:

- Faults in the NE-SW direction: mainly crossing in the eastern part of the study area and cutting through the upper Jurassic and lower cretaceous formations.
- Faults in the WE direction are more common in the northern-western part of the study area. These are also cutting the Jurassic and cretaceous formations.
- Faults in the NW-SE direction are mainly crossing in the south-western part of the study area. These faults are mainly cutting in the lower cretaceous formations.

2.1.2 SOIL EROSION

Soil erosion could occur from two major elements: water and wind. The probability of soil erosion by water in the area depends on several factors:

- rainfall intensity,
- steepness of slope,
- soil texture,
- vegetative cover,
- drainage properties.

However it is not anticipated that a tourism development project of the scale envisaged by JICA Study Team would contribute to soil erosion.

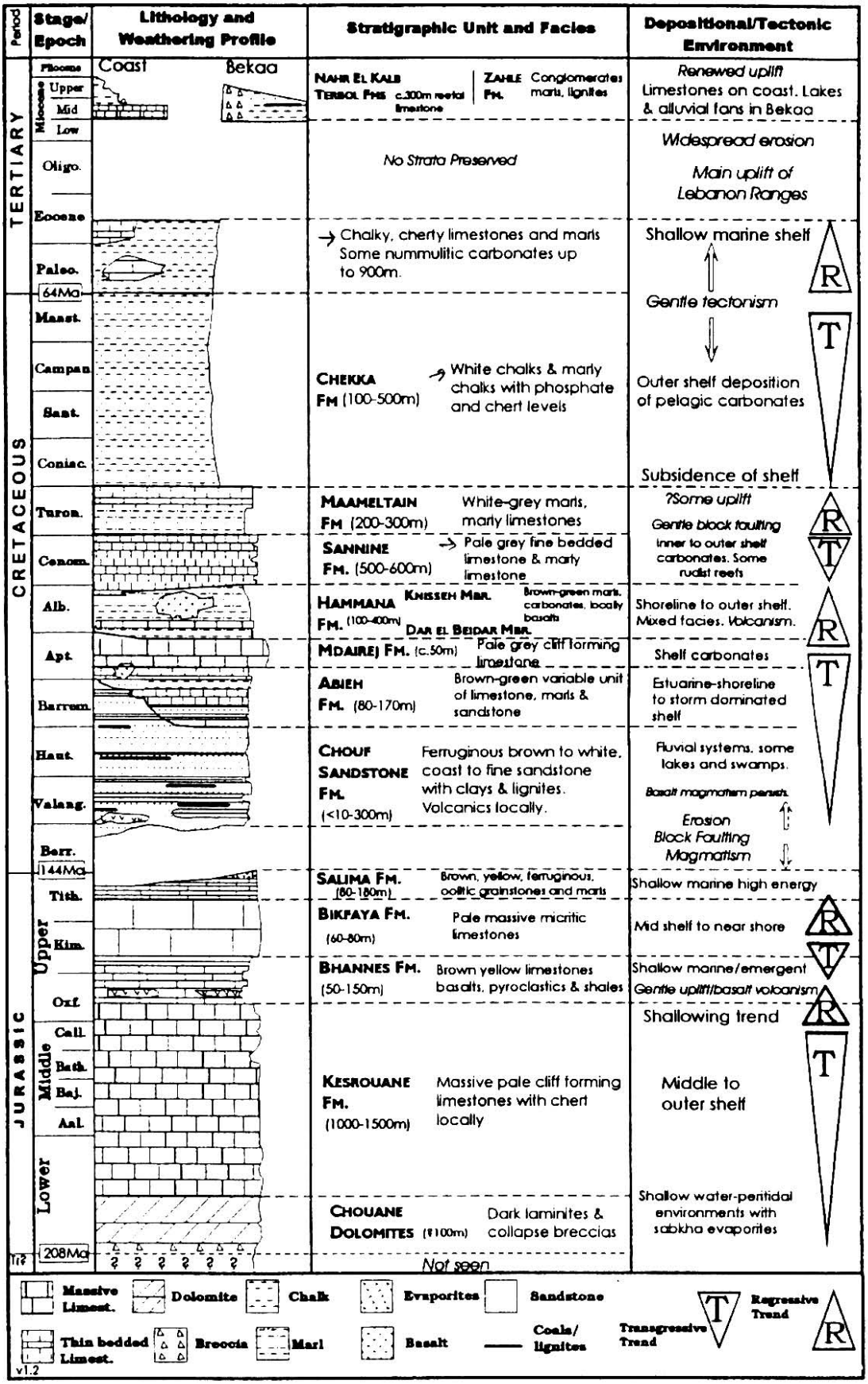


Figure 11: Stratigraphic Column of Lebanon *(Walley,C.D., 1983,1987)*

2.1.3 HYDROGEOLOGY AND GROUNDWATER

The valley is well developed in terms of karstification. The existence of fracturing systems within the carbonate rocks has produced a spectrum of karstic conduits along the weak surfaces. However, surface karstic features are well observed in the valley such as holes, pits, cavities, galleries, and natural bridges. Through such galleries a number of springs are developed such as the Mar Assia Spring. The study area is considered to be rich in water resources. Surface water includes springs and water networks. Several geological formations act as aquifers that collect water, which could be used for irrigation, domestic, and drinking water supply. Figure 12 illustrates the hydro-stratigraphy of Lebanon, and the shaded features characterize the Bekaa Valley.

Figure 12 Hydrostratigraphy of Lebanon

Period	Formation (Age)	Lithology	Thickness-m	Hydrogeological Classification
Quaternary	Quaternary Deposits	Coastal or alluvial loose deposits	<50	Semi-aquifer
Tertiary	Pliocene succession	Marl, conglomerate, basalt	60-100	Aquiclude, or locally aquitard
	Miocene successions	Along the coast, localized massive white limestone sequence (Jebel Terbol, Nahr el Kalb)		Aquifer
		In the interior (sides of the Bekaa), sequence of clastics with calcareous breccias and conglomerates, sandy silty marls, lignites, limestones and lacustrine marls	300	Aquiclude to aquitard
	Lower and Middle Eocene successions	e_2 Sub-reefal limestone		Aquifer
		e_1 marly limestone with chert nodules and chalky marl	0-800	Aquiclude to aquitard
Creaceous	Chekka Formation "C_6" Senonian to Lower Paleocene	Chalk, marly chalk with phosphate nodules, and chert bands in its upper sequence	100-500	Aquiclude
	Maameltein Formation "C_5"Cenomanian-Turonian	Limestone, marly limestone, chalky marl	200	Aquifer
	Sannine Formation "C_4" Cenomanian	Massive to thin bedded limestone and marly limestone	600	Aquifer
	Hammana Formation "C_3" Albian	Variable sequence of thin bedded limestone, marls, and terrigenous sands with locally pyroclasts and volcanics	170 - 200	Aquiclude (aquiferous in top C_3 sequences)
	Mdairej Formation "C_2b" Aptian	Massive limestone with locally basalts on top	45 – 50	Aquifer
Cretaceous	Abeih Formation "C_2a" Barremian	Variable unit of fossiliferous limestones, marls, and sandstones	90 – 125	Aquiclude to aquitard
	Chouf Sandstone Formation"C_1"Hauterivian-Barremian	Often ferruginous brown to white sandstones interbedded with clays, shales, lignites, and tuffs, and locally basalts at the bottom	200 - 250	Aquitard
Jurassic	Salima Formation "J_7" Tithonian	Oolitic limestones, marls, clays, and ferruginous grainstones	0–40 May be completely eroded	Aquiclude
	Bikfaya Formation "J_6" Late Kimmeridgian- Early Tithonian	Massive limestone with chert nodules	70 – 90	Aquifer

Period	Formation (Age)	Lithology	Thickness-m	Hydrogeological Classification
	Bhannes Formation "J_5" Late Oxfordian- Early /Middle Kimmeriidgian	Limestones, clays, locally with pyroclastics and basalts	50 – 70	Aquiclude
	Kesrouane Formation "J_4" Liassic- Upper Oxfordian	Massive dolomite, dolomitic limestone, and limestone	App. 1500	Aquifer

Source: Metni M., 2002. Groundwater Protection in Lebanon: A Vulnerability Assessment Approach. MS Thesis, Department of Civil and Environmental Engineering, American University of Beirut, Beirut, Lebanon.

2.1.4 HYDROLOGY

Qadisha spring is one of the major springs feeding the Qadisha River, which meets with the Rachien River after crossing the Qannoubine Valley to form the Abou Ali River. In addition, several springs in the area and along the river course feed the river water. The Qadisha Spring gives birth to an underground river that appears then on the surface forming the Qadisha River that has the name of the valley through which it flows. The first touristic visits to the cave started in 1930, when speleologists were attracted by the different karstic formations of stalactites and stalagmites that are well concentrated in the cave.

The Qadisha River is fed by several springs in the area, in addition to some that are in the valley. Mar Assia Spring is one spring that is situated under the village of Hasroun and about 120 meters above the river. This spring formed a cave and is feeding the river. It was discovered by speleologists who observed black algae coating its pebbles and water surface.The study area is rich in major and minor springs that are contributors to the Qadisha River. Major springs are those that keep on running along the year and are used for irrigation, domestic and drinking supply in the area. Some of these major springs include Qadisha Spring, Mar Semaan, and Harfouch Springs in Bcharre, Mar Sarkis in Ehden, Al-Hadid Spring in Hadchit, and Ras El-Nabaa in Hasroun.All the springs and water channels in the study area collect in the Qadisha-Qannoubine Valley feeding the Qadisha River.

2.1.5 FAUNA AND FLORA

2.1.5.1 Description of Vegetation Communities

Biodiversity in this area can be characterized according to the vegetation levels, which contain distinct series of vegetation with their accompanying plant communities and groupings of plants. In Bcharre, one can notice the following 3 levels: the Supramediterranean, the Mediterranean mountains and the Oromediterranean (MoA, 1996).

(1) The Supramediterranean Zone:

This zone is situated between 1000 and 1500-1600 m on the western slopes of Mount Lebanon and Hermon as well as on part of the eastern slopes to the south of the Beirut parallel. The following are vegetative series that are found in different patches on limestone substrata.

The supramediterranean series of Quercus calliprinos:

In Bcharre, this series is widespread covering many slopes in the lower elevations (1000-1500m). In general, the Qadisha Valley is covered mainly by a community of *Quercus calliprinos.* The species that accompany the calliprinos mostly are *Pistacia palaestinia, Arbutus andrachne, Cercis siliquastrum, and Ramnus sp*. Locations and description of some *Q. calliprinos* forests include (interviews and field survey):

- On the side of the valley under Deir Mar Lichaa is open forest;
- The mountain facing the Hadchit cemetery – not dense cover (50 % vegetation). Main tree is the *Quercus calliprinos*. Other trees include the *Arbutus andrachne* and *Pistacia palaestinia;*
- Next to the Hadchit cemetery are populations of *Cupressus sempervirens* and *Quercus calliprinos*. High density forest;
- Qnat – Berhalioun area are *Pinus brutia* population (mainly) and *Quercus calliprinos*. High density forest;
- Haouqa – Kozhaya area are Garrigue of *Poterum spinosum* and *Quercus calliprinos;*
- Medinet Er Ras area - On the road from Haouqa to Kozhaya, *Quercus calliprinos* and *Pinus brutia;*
- Aabdine/Tourza: *Quercus calliprinos* (main), *Pistacia palaestinia* and *Cercis siliquastrum;*
- Jabal Mar Elias area: Grassland;
- Abandoned vine terraces above Hadchit and Blaouza;
- El Fradis area: in the valley next to the river on the west side of the river: Mostly *Pinus brutia* On the east side of the river: mostly *Quercus calliprinos;*
- North of Tourza: *Pinus brutia* (mainly) and *Quercus calliprinos* High density forest.

The normal series of Quercus infectoria:

In Qadisha, on higher altitudes (on the slopes of the valley), *Quercus infectoria* is present in addition to *Quercus calliprinos.* Locations in Bcharre include: Tourza/Beit Menzer/Qnaiouer: *Quercus calliprinos* and *Quercus infectoria* high density forest.

The series of Ostrya carpinifolia and Fraxinus ornus:

The tree grouping is mostly made of the *Ostrya carpinifolia*, *Fraxinus ornus*, and *Q. infectoria*. Some others include: *Daphne libanotica, Melica uniflora, Paeonia kesrouanensis, Primula vulgaris.*

The series of Quercus cerris:

This series is mostly present at altitudes of 1200 m. The tree grouping corresponds to small forests of *Q. cerris* which include some other characteristic species like: *Bromus bikfayensis, Carex phyllostachys, Lathyrus digitatus, Lathyrus niger.*

Probably these groups are the most endemic in the Lebanese mountains because they do not appear to have any affinities with the other groups of *Q. cerris* in the Eastern Mediterranean. Most forests of *Q. cerris* have been replaced by the intensive growing of fruit trees especially

the apple tree. This is the principle reason why the population has been reduced to a few dispersed patches in the Lebanese mountains.

The Supramediterranean series of Pinus pinea found on sandstone:
It is individualized between 1100 and 1500 m. The tree grouping corresponds to forests which include the following species: *Cytisus syriacus*, *Adenocarpus complicatus*, and *Halimium umbellatum*. The originality of these communities is marked by the endemism of their characteristic species, mainly *Cytisus syriacus* and *Halimium umbellatum*. The herbaceous grouping corresponds to grasslands of *Tuberaria guttata*, *Aira elegans*, and *Briza maxima*. Grasslands of *Isoetes hystrix* develop in the lower humid areas of the zone.

The Quercus infectoria series:
This series is made up of: *Cytisus syriacus, Juniperus oxycedrus, Origanum ehrenbergii, Andenocarpus complicates.*

The series of Quercus cerris series:
This series is made up of: *Andenocarpus complicates, Anthemis tinctoria, Centaurea cheiracantha, Cytisus syriacus, Luzula forsteri, Origanum ehrenbergii, Quercus cerris.*

(2) The Mediterranean Mountain Zone:
This zone is situated between approximately 1500 and 1800 m. This zone can be defined as that of the Cedars of Lebanon and the Fir trees of Cilicia. Three series are individualized there, mainly on compact limestone and dolomitic limestone. On the other hand, no forests or remnants of forests exist on marl. Some remnants of cedar forests on sandstone still exist in particular at Hadath el Jibbe thus forming a variation of the series of cedars.

The Cedrus libani and Abies cilicica series:
There are still some beautiful forests of *Cedrus libani* and *Abies cilicica*. Although these two species are often associated as is the case in the forest of Ehden, their local separation is due to the difference between their ecological requirements.
The arborescent vegetation is very varied. They correspond to cedar-fir forests like that of Ehden, and cedar forests only like those of Bcharre, and Hadath-Tannourine. The Cedar is always associated to oaks like the case of *Quercus cedrorum* in the Hadath-Tannourine region and the *Quercus brantii*. The floristic grouping includes:

> *Acer tauricolum, Bunium elegans, Cicerbita candolleana, Corydalis solida, Doronicum caucasicum, Ferula cassii, Geranium libani, Lathyrus libani, Orchis comperiana, Pimpinella anthriscoides,Sorbus flabellifolia, Tanacetum cilicium.*

The tree grouping includes the *Berberis libanotica* and the *Cotoneaster nummularia*.
The herbaceous grouping corresponds to grasslands of *Dactylis glomerata*, *Agropyron panormitanum*, *Poa diversifolia*, and *Sesleria anatolica*.

One should note that *Berberis libanotica* is endemic of the stages of degradation of this series. It would be desirable in this zone to carry out reforestation programs with the above species because most of them are fast disappearing especially in today's anthropic conditions (MoA, 1996).

The Mediterranean mountain series of Quercus cedrorum and Quercus brantii:
Within the bioclimatic area of *Cedrus libani* and in lower sub-humid conditions, the Cedars can be associated locally with *Quercus cedrodrum* and *Quercus brantii*.

(3) The Oromediterranean Zone:
This zone is situated at around 2000 m and reaches the highest summits of Mount Lebanon extending a little into the eastern slopes. It is defined only in the northern part of the country in Qornet el Sawda because it is at this zone that Mount Lebanon reaches the highest point of 3088 m. The main vegetation series present is the Oromediterranean series of the *Juniperus excelsa*.

2.1.5.2 Tannourine and Hadath el-Jibbe

The forest extending over several villages was declared a protected zone by the MoA. Starting at 1200 m and going up to 2200 m, it is located on the leeward side of the middle Mount Lebanon area. Rainfall varies from 900 to 1500 mm. The area is rocky and mountainous with steep slopes, deep valleys (Ain El Raha) and high erosion potential leading to complete desertification or barren slopes as is the situation in many high elevation areas of the Lebanese mountains. The most abundant and sacred trees are the cedars. This area is distinctive as the native land of *Cedrus libani*. Other companion trees are *Quercus, Cupressus, Pinus, Abies, Populus, Platanus*, *Juniperus* and *Pistacia*, and constitute a very rich ecosystem in plant species. The fauna described as being present in this type of unique ecosystem ranges from the various types of birds (eagles, owls, robins, etc…) to wild animals (hyenas, boars, wolves, squirrels, snakes, bats, and rats). Urbanization (sand removal) constitutes a high risk on top of other natural hazards on this ecosystem.

2.1.5.3 Cedars Forest

The forest reserve of the "Cedars of the Lord" (occupying an area of 11 ha, surrounded by a fence of 3050 meters) contains 376 cedars with some over 1000 years old. In years past, the forest's revenues were mainly from entry fees. In 1995 the fee was cancelled, but the losses in revenues were overwhelmed by a significant increase in donations both on the domestic and the international levels. The magnitude of the donations is a significant indicator for the increase in public awareness concerning forest protection and preservation.

2.1.5.4 The Qadisha Valley

According to R. El Haber, the most important ecological reasons that necessitate the urgent protection and conservation of the Qadisha Region (Dahr El Kadib Mountain, The Cedars

Grove, Mar Elias Mountain, Qannoubine and Qoshaya River Valleys, in addition to their extension valley of Kosba) are:
(1) The extremely high habitat diversity reflecting high topographic, climatic, geological, and edaphic peculiarities;
(2) The high biologic diversity reflected by thousands of species of flora and fauna, of which many are endemic either solely to Lebanon or to the region;
(3) The uniqueness of such an integrated group of ecosystems (Alpine and Sub-alpine mountains, watersheds, valleys and rivers) in this part of the world.

The following figures highlight the importance of the Qadisha ecosystem:
(1) Flora taxa named after Lebanon in the Qadisha Valley: 26 species, 7 subspecies, and 9 varieties;
(2) Qadisha is characterized by a high degree of endemism.
(3) Recorded data of flora in the Qadisha Valley: 912 species (32 % of Lebanese flora), 163 subspecies (5.6 %), and 118 varieties (4%);
(4) Status of plant taxa in Qadisha Valley: 74 taxa Endangered, 174 taxa Rare, 138 taxa Localized, and 37 taxa Sporadic;
(5) Life span of Qadisha Valley flora: 291 Annual species, 43 Biennial species, 568 Perennials species, and 27 arborescent species.

2.1.5.5 Horsh Ehden

Preliminary research (El Haber and Semaan) revealed the occurrence of more than 700 taxonomically established wild flowering plants. These comprise 43 species of tall and small trees and shrubs, in addition to Cedrus libani Rich., of which more than twenty thousand wholesome specimens exist. It is noteworthy to mention that Horsh Ehden is the last refuge of more than 60 endemic species of flowering plants, several of which exist nowhere else in the world (Mouterde, 1972).

2.1.5.6 Terrestrial Fauna of Bcharre

The Mount Lebanon range and the riversides are also considered rich in fauna. Furthermore, several species remain unknown and may not have been included in this report due to the lack of comprehensive studies and long term monitoring projects. As for the avian diversity, the discontinuity of observations in time and space could be leading to inaccurate estimates and distribution.

(1) Amphibian and Reptiles

There are in total 5 reported species of amphibians in Lebanon: 4 species of frogs and toads, and 1 species of salamander. However, this list was identified as “undoubtedly incomplete” (*MoA/UNEP, 1996).* Reported number of species of reptiles in Lebanon is 43; species that are or might be present in the study area include:

land tortoise (encountered during field visits), 1 terrapin, 1 aquatic tortoise (encountered during field visits), 20 lizards of which one endemic species of Lizard *Lacerta frastii* carnivorous living at high altitudes (Bcharre), 13 non-venomous grass snakes, 2 venomous grass snakes, 2 venomous vipers.

(2) Birds

There are 337 bird species noted in Lebanon, of which 65 species are non-native and have strayed into the region, 100 nesting species, 170 migratory species that winter here, 2 recently introduced species, and 10 with no recent data. Although there are no endemic species in Lebanon there is however a semi-species (Alectoris chukar) and some Asian breeds. Rare and quite rare species make up 26.5 % of all species observed in Lebanon or mainly 37 species. According to the analysis of the national biodiversity report study team (MoA/UNEP, 1996), the avifauna of the forests of the high mountains is as large as that of the Bekaa (71 species). The forests and woods of Mount Lebanon provide shelter to 87 species, which is considered as an underestimation due to the difficulty to spot migratory birds in thick woods. [see Figure 13]

Figure 13 Threatened Bird Species Found in Lebanon (adapted from METAP, 1995).

Bird species	Status (B/NB)[1]	Habitat	Threat[2]	IUCN threat status
Greater spotted eagle (*Aquila clanga*)	NB	Forests, woodlands, and wetlands	LoH, D	Small declining population; Severe fragmentation >1000 individuals (vulnerable)
Imperial eagle (*Aquila heliaca)*	NB	Forests, woodlands, and grasslands	LoH, H, D, P, T	Small declining population
Lesser Kestrel (*Falconaumanni)*	NB	Natural lands	LoH, P	Rapid decline

[1]B=breeding; NB=non breeding

[2]LoH= loss of habitat; H = hunting, trapping; P = pollution, pesticides, poisoning; D=disturbance (Human activities); T = trade and egg collecting

(3) Mammals

There are 52 reported mammal species in Lebanon. Seven species are already extinct. Figure 14 presents a list of species potentially found in the Bcharre district adapted from Tohmeh (1985) and the MoA biodiversity report (1996) and their conservation status.

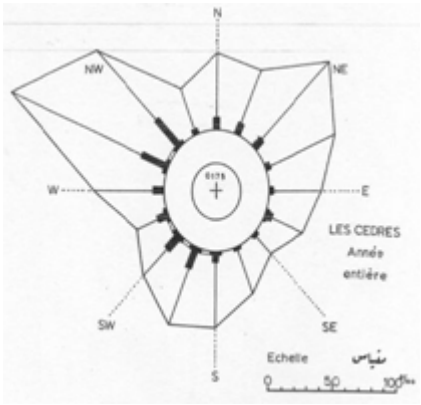
Figure 14 Fauna of Bcharre

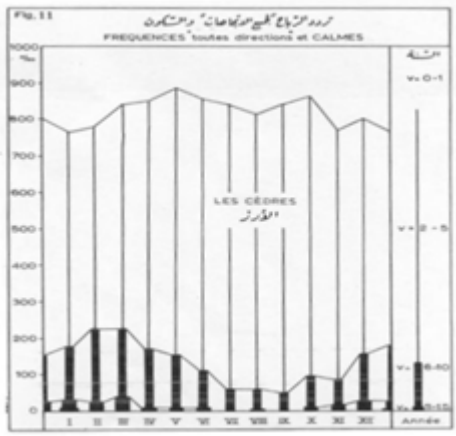
Species	Common name	Places found	Status
Apodemus mystacinus mystacinus	Field mouse	Cedars	No apparent danger
Apodemus sylvaticus	Common field mouse	Bcharre	No apparent danger
Cricetulus migratorius cinerascens	Grey hamster	Bcharre	No apparent danger
Crocidura suaveolens	Lesser white-toothed shrew	Bcharre, Cedars	Rare
Eliomys melanurus	Black-tailed dormouse	Bcharre	No apparent danger
Hyaena hyaena syriaca	Striped hyaena	Zghorta	Vulnerable
Martes foina syriaca	Stone Martin	Hadath el Joubbe	Vulnerable
Microtus nivalis hermonis	Snow vole	Bcharre	No apparent danger
Microtus guentheri guentheri	Levant vole	Bcharre	Growing
Sciurus anomalus syriacus	Squirrel	Bcharre, Ehden	Very close to extinction
Sus scrofa lybicus	Wild boar	Hadath El Jobbe	Growing
Canis lupus pallipes	Wolf		Very close to extinction
Canis aureus syriacus	Jackal	Besharreh	Growing
Vulpes vulpes palaestina	Red fox	Besharreh	No apparent danger

The wolf, the wild cat, the mongoose, and the squirrel are considered to be very close to extinction (MoA/UNEP, 1996). Locals claim to have seen wolves in the mountain tops and Dahr El Qadib, and wild cats in forests of the Bcharre area. Some of those species were identified during the field survey such as the fox (encountered in Bcharre), the field mouse, the jird, the snow vole and the levant vole identified by locals (field survey; personal contacts).
Furthermore, the area might also contain the hedgehog *Erinaceus europaeus concolor*, which is common in Lebanon. Its habitat appears not to extend beyond an altitude of 1300 m and its extension is limited by desert and arid zones. It is common in wood and olive groves.

2.1.6 METEOROLOGY

There exists only one meteorological station in the study area that records wind parameters and it is located at the Cedars. The wind direction varies along the different months and has a dominant yearly direction as North-West. Figure 15 shows the yearly wind directions with its respective histogram showing the wind speed frequency distribution along the twelve months.





Source: Cedars station of Lebanese Meteorological Services

Figure 15 Wind Direction and Speed Frequency

2.2.1.7 LANDSCAPE

Several **point of view** locations on the valley and the mountains are dispersed along the valley surroundings. The Qadisha Valley and Cedars of the Lord site has a rich landscape, characterized by high rocky cliffs, the Cedars Forest, widespread caves and sinkholes, thick vegetation, old monasteries and villages that form a harmonized equilibrium with its mountains. **Waterfalls** are visually pleasing as they fall from the top of the mountains and the top of the valley forming natural bridges at some places and reaching into the valley. A large number of **caves and sinkholes** and other natural cavities are located in the valley and the mountains due to the high karstification of its rocks. The **old architecture and ruins of monuments and wheat and olive mills** left in the villages help to complete the landscape's richness. Hasroun is one of the few villages that has preserved its architecture where houses are made of two to three floors with red tiled roofs. **Monasteries and churches** are dispersed throughout the valley and its villages and complete the valley landscape.

2.1.8 AIR POLLUTION

2.1.8.1 Air Quality Survey

(1) Sampling Location

The JICA Study Team conducted an air quality survey. All sampling locations were along the main road. Air quality was continuously measured for 48 hours at each location using equipment (EMS and SKC) to monitor particulate matter. Measurements were recorded at a rate of 30 min by the EMS which records the average of every parameter at every half hour, while the SKC records were done at a 1 minute rate. Figure 16 shows a brief description of the sampling locations for air quality monitoring. Figure 17 shows the sampling locations.

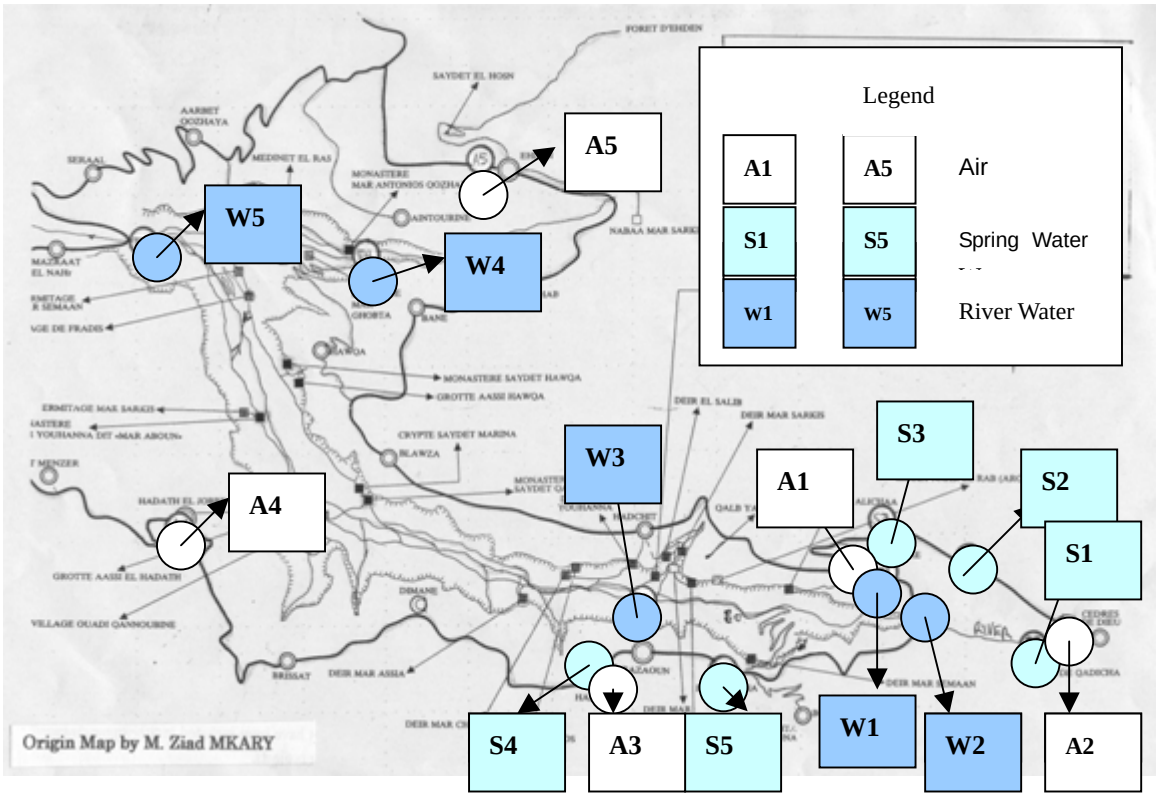
Figure 16 Air Quality Sampling Locations

Location	Starting Date	Brief Description
A1	28(Mon.)-July-2003	Located at the centre of Bcharre, main road to Cedars
A2	30(Wed.)-July-2003	Located at the Entry of El-Arz
A3	01(Fri.)-Aug-2003	Located at Hasroun main road
A4	03(Sun.)-Aug-2003	Located at the centre of Hadath el Joubbe
A5	05(Tues.)-Aug-2003	Located at the centre of Ehden

JICA Study Team

(2) Air Quality Standards

Air quality standards are set to prevent adverse effects on public health and welfare. The concentration level is expressed in either parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$) and averaged over a specific time period such as one-hour, eight-hours, 24-hours, or one year. Generally, the air quality of the outdoors is determined by comparing the monitored level of air with air quality standards for every pollutant. Figure 18 presents Lebanese and international ambient air quality standards.



Source: JICA Study Team

Figure 17 Sampling Locations

Figure 18 Lebanese and International Air Quality Standards

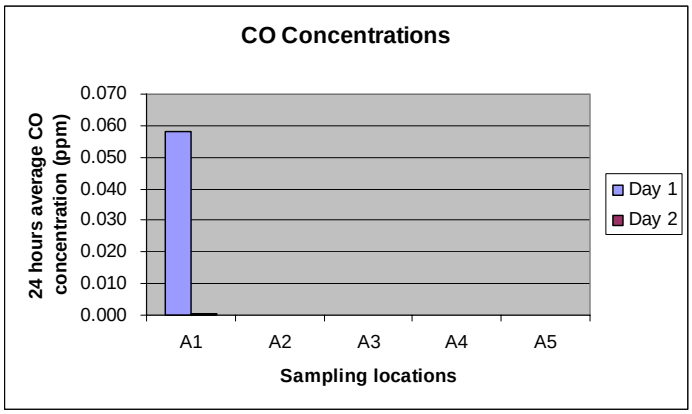
Pollutant	Lebanese Standard (MoE[1]) µg/m^3 (ppm)	Source	International Standard µg/m^3 (ppm)	Averaging Period
Sulfur Dioxide (SO_2)	350(0.61)	WHO[2]	350 (0.61)	1 hour
		USEPA[3]	1300 (0.5)	3 hours
		EU[4]	120 (0.21)	24 hours
	120(0.21)	USEPA	365 (0.14)	24 hours
		USEPA	80 (0.03)	1 year
Nitrogen Dioxide (NO_2)	200(0.106)	WHO	400 (0.212)	1 hour
		EU	200 (0.106)	1 hour
	150(0.079)	WHO	150 (0.079)	24 hours
		USEPA	100 (0.053)	1 year
Carbon Monoxide (CO)	30000(27)	USEPA	40000 (35)	1 hour
		WHO	30000 (27)	1 hour
	10000(9)	USEPA	10000 (9)	8 hours
		WHO	10000 (9)	8 hours
Total Suspended Particulate (TSP)	120	USEPA	75	1 hour
		USEPA	260	24 hours
		WHO	150-230	24 hours
		USEPA	75	1 year

Source: JICA Study Team

[1] Ministry of Environment, [2] World Health Organization, [3] United Nation Environmental Protection Agency, [4] European Union

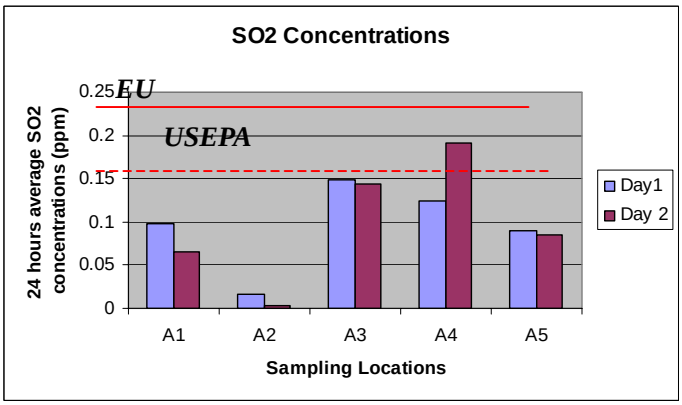
(3) Survey Results

The following graphs (Exhibits 19-22) show the average concentrations over 24 hours for CO, NO_2, SO_2, and TSP at the five different locations. While CO and NO_2 concentrations were found to be within standards at all times, SO_2 and TSP concentrations exceeded standards at some instances.



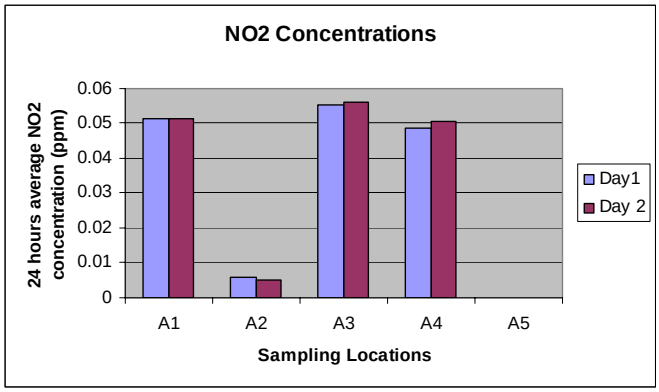
A1:Bcharre, A2:El-Arz, A3:Hasroun, A4:Hadath el Jibbe, A5:Ehden

Figure 19 Average CO Concentrations at Sampling Locations



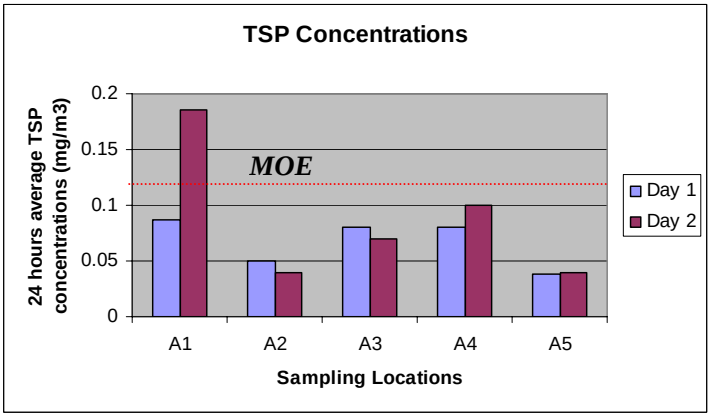
A1:Bcharre, A2:El-Arz, A3:Hasroun, A4:Hadath el Jibbe, A5:Ehden

Figure 20 Average SO_2 Concentrations at Sampling Locations



A1:Bcharre, A2:El-Arz, A3:Hasroun, A4:Hadath el Jibbe, A5:Ehden

Figure 21 Average NO_2 Concentration at Sampling Locations



A1:Bcharre, A2:El-Arz, A3:Hasroun, A4:Hadath el Joubbe, A5:Ehden

Figure 22 Average TSP Concentrations at Sampling Locations

2.1.9 WATER QUALITY

2.1.9.1 Water Quality Survey

(1) Equipment

Water samples were collected using sterilized bottles and analyzed at the laboratories of the American University of Beirut (AUB). Water discharge was measured using a moulinet with the following description: Moulinet: 53398, C31-100, Helice No: R-55370.

(2) Sampling Location

Five major springs in the study area in addition to five locations along the Qadisha River were selected. At each location, water discharge was measured and a water sample was taken to be tested for physical, chemical and biological parameters. Figure 23 displays the information regarding the samples locations and characteristics. Samples S1 to S5 are drawn from springs and samples. W1 to W5 are river stations.

Figure 23 Water Sampling Locations

Location	Name	X (km)	Y (km)	Z (m)	Measurement Date	Remark
S1	Mgaret Qadisha	178,941	255,721	1837	31/07/2003	Qadisha Grotte
S2	Nabaa Nbat	177,773	257,730	1786	31/07/2003	Nearby the new road
S3	Nabaa Mar Semaan	176,478	257,788	1800	31/07/2003	Village at highland
S4	Nabaa Ras El-Ein	173,793	254,841	1498	31/07/2003	Hasroun
S5	Bqorqacha Spring	175,237	255,175	1459	31/07/2003	Bqorqacha
W1	El Challel-Bcharre	177,028	256,636	1387	31/07/2003	Bridge of Bcharre
W2	Ej Jisr- Bcharre	177,457	256,116	1380	31/07/2003	Restaurant Mississippi
W3	Qadisha Valley	174,387	256,271	1007	01/08/2003	Fish-breeding pond
W4	Deir Qozhaiya	168,723	260,435	1800	31/07/2003	Valley to Ehden
W5	Qozhaiya Electricity	170,810	260,180	940	01/08/2003	Tourza Bridge

(3) Survey Result

Water samples were analyzed for physical properties (turbidity, conductivity, and color), aggregate properties (Hydroxide alkalinity, Bicarbonate alkalinity (HCO_3^-), and total suspended solids (TSS), inorganic parameters (pH, Calcium, Chlorine, Ammonia, total Nitrogen, and Sodium), organic parameters (Biochemical Oxygen Demand (BOD_5) and Chemical Oxygen Demand (COD), microbiological parameters (Total Coliforms and Fecal Coliforms), in addition to silica and oil content. Figure 24 shows the results for the five different springs of discharge together with local and international standards for drinking water. Figure 25 displays the results for the river samples together with standards for surface water quality. Pollution for sewage discharge is evident from the large value of fecal coliforms identified, especially in the surface water samples.

Figure 24 Water Quality Results at Springs(S1~S5)

Parameter	Units	S1	S2	S3	S4	S5	MOE (Guidance)	MOE (Maximum)	USEPA
Temperature	^{0}C	7	6.8	5.8	9.6	10	12 C	25 C	-
Turbidity	NTU	0.5	0.5	0.5	0.5	0.5	0.4 NTU	10 NTU	5 NTU
Conductivity	(µS/cm@25C)	222	165	162	460	519	400	1500	
pH	-	7.56	7.38	7.45	7.77	7.11	6.5-8.5	9	6.5-8.5
OH Alkalinity	mg/L	0	0	0	0	0	-	-	-
HCO_3^-	mg/L	0	0	0	0	0	-	-	-
Ca^{++}	mg/L	28	32	24	68	80	100 mg/l	200mg/l	-
Cl	mg/L	10	10	7	9	9	25 mg/l	200 mg/l	250mg/l
NH_4	mg/L	0.02	0.02	0.02	0.02	0.03	0.05mg/l	0.5 mg/l	1.5 mg/l
Total P	mg/L	0.22	0.18	0.18	0.21	0.23	-	-	-
Total N	mg/L	10	9	3	12	12	-	-	-
Na^+	mg/L	1	1	1.5	5.5	10.5	20 mg/l	150 mg/l	-
BOD_5	mg/L	2	2	2	2	2	-	-	-
COD	mg/L	2	2	2	2	2	-	-	-
TSS	mg/L	1	1	1	1	1	-	-	-
Fecal Coliforms	cfu/100mL	2	0	0	1	0	0/100ml	0/100ml	0/100ml
TotalColiforms	cfu/100mL	11	0	1	22	47	0/100ml	0/100ml	1/100ml
Color	CU	1	1	1	1	1	1 CU	20 CU	15 TCU
Silica	mg/L	3	2.2	2.3	4	8	-	-	-
Oil content	mg/L	16.7	-	-	-	-	-	-	-
Discharge	m^3/sec	0.83	0.16	0.28	0.01	0.001			

Figure 25 Analyzed Parameters at the Qadisha River (W1~W5)

Parameter	Units	W1	W2	W3	W4	W5	MOE (Guidance)	MOE (Maximal)	USEPA
Temperature	^{0}C	11.7	8.3	10.4	14	9	22	25	
Turbidity	NTU	16.1	2.9	9.2	3.9	3.6	-	-	1 NTU
Conductivity	(µS/cm@25C)	278	247	296	328	445	-	-	-
pH	-	7.88	7.87	7.96	7.97	7.7	-	6.9-8.2	6.5-8.5
OH Alkalinity	mg/L	0	0	0	0	0	-	-	-
HCO_3^-	mg/L	0	0	16	16	0	-	-	-
Ca^{++}	mg/L	40	36	48	48	56	-	-	-
Cl	mg/L	7	6	7	9	16	-	-	250mg/l
NH_4	mg/L	1.2	0.19	0.04	0.04	0.04	-	-	-
Total P	mg/L	0.68	0.19	0.26	0.22	0.26	-	-	-
Total N	mg/L	9	7	15	9	10	-	-	-
Na^+	mg/L	7	1	2	1	1	-	-	-
BOD	mg/L	10	2	2	2	2	-	-	-
COD	mg/L	33	20	2	2	2	-	-	-
TSS	mg/L	43	9	14	1	1	-	-	-
Fecal Coliforms	cfu/100mL	Numerous	49	448	200	300	-	-	0/100ml
Total Coliforms	cfu/100mL	Numerous	97	470	280	330	-	-	1/100ml
Color	CU	1	1	1	1	1	-	-	15 CU
Silica	mg/L	8.7	5	7	3.2	8	-	-	-
Oil content	mg/L	16.7	-	-	-	-	-	-	-
Discharge	m^3/sec	0.09	0.70	1.53	0.12	0.46			

2.1.10 SOIL CONTAMINATION

Figure 26 shows a description of the soil in the study area.

Figure 26 Description of Soils in the Study Area

Type	Mother rock	Color	Texture
Mixed soil with several sources	Calcareous, marly, sandy, and basaltic rocks	Dark brown	Sandy soil (76%) to low clay
Mixed soil of secondary sources	Calcareous and marly rocks	Dark to grey brown	Sandy soil (66-76%)
Eboulis	erosion of calcareous rocks mixed with sand and clay caused by landslides	Brown to reddish	Clay loamy to clay
Terra Rossa	Calcareous rocks	Red to dark red	Clay loamy to clay
Grey soils	Volcanic rocks	Reddish brown to dark grey	Sandy loamy to sand clay loamy

Source: Soil Map of Lebanon (Geze)

There is however limited information available on soil contamination

2.2 INITIAL ENVIRONMENTAL EXAMINATION

2.2.1 SCREENING AND SCOPING

2.2.1.1 JICA FORMAT

Based on examination of screening as presented in main report, a scoping procedure for further examination was carried out and the result is presented in Figure 27. The evaluation results are as follows:

Figure 27 JICA Format for Screening (Tourism) in Bcharre

Environmental Item		Description	Evalu-ation	Remarks (Reason)
Social Environment				
1	Resettlement	Resettlement due to land occupancy (transfer of rights of residence/land ownership)	(U)	Approximately twenty vendors may be relocated because of the establishment of a buffer zone; need to survey for houses.
2	Economic Activities	Loss of bases of economic activities, such as land, and change of economic structure	(N)	No negative impacts. Positive impact is assumed.
3	Traffic and Public Facilities	Impacts on schools, hospitals and present traffic conditions, such as the increase of traffic congestion and accidents	(U)	Some increase in traffic volume is expected. There can be some mitigation measure for this.
4	Split of Communities	Community split due to interruption of area traffic	(N)	No big traffic flow is expected.
5	Cultural Property	Damage to or loss of the value of churches, temples, shrines, archaeological remains or other cultural assets	(U)	Positive impact. Historical sites in the Qadisha valley will be well maintained under a site management plan.
6	Water Rights and Rights in Common	Obstruction of fishing rights, water rights, rights of common	(N)	No change of rights to drinking or irrigation water.
7	Public Health Condition	Deterioration of public health and sanitary condition due to generation of garbage and the increase of vermin	(N)	No change expected with Public Health Condition.
8	Waste	Generation of construction and demolition waste, debris and logs	(N)	No significant construction works are expected.
9	Hazards (Risk)	Increase in risk of landslides, cave-ins and accidents	(N)	No significant construction works are expected.
Natural Environment				
10	Topography and Geology	Changes of valuable topography and geology due to excavation or filling work	(N)	There is no factor regarding this item
11	Soil Erosion	Topsoil erosion by rainfall after reclamation and vegetation removal	(N)	There is no factor regarding this item
12	Groundwater	Change of distribution of groundwater by large-scale excavation	(N)	There is no factor regarding this item
13	Hydrological Situation	Changes of river discharge and riverbed condition due to changes of habitat conditions	(N)	There is no factor regarding this item
14	Coastal Zone	Coastal erosion and sedimentation due to landfill or change in marine condition	(N)	There is no costal zone.
15	Fauna and Flora	Obstruction of breeding and extinction of species due to changes of habitat conditions	(U)	According to the 2000 Red List, the Cedars of Lebanon (*Cedrus libani*) is in the Study areas.
16	Meteorology	Changes of temperature, precipitation, wind, etc. due to large-scale land reclamation and building construction	(N)	There is no factor regarding this item
17	Landscape	Changes of topography and vegetation due to reclamation. Deterioration of aesthetic harmony by structures	(U)	The designs of new tourism new facilities are not clear at present, but design guidelines are recommended.
Pollution				
18	Air Pollution	Pollution caused by exhausted gas or toxic gas from vehicles and factories	(U)	The increase of tourist vehicles is not clear compared to present traffic volumes.
19	Water Pollution	Pollution by inflow of slit, sand and effluent into rivers and groundwater	(U)	How to manage the tourist excreta, is not clear at present but treatment is necessary.
20	Soil Contamination	Contamination of soil by dust and chemicals, such as herbicides	(N)	There is no factor regarding this item
21	Noise and Vibration	Noise and vibration generated by vehicles	(N)	The increase of tourist vehicles is not clear comparing with present amount.
22	Land Subsidence	Deformation of land and land subsidence due to the lowering of groundwater table	(N)	There is no factor regarding this item
23	Offensive Odor	Generation of exhaust gas and offensive odor by facility construction and operation	(N)	There is no factor regarding this item
Overall Evaluation: Either IEE or EIA is necessary for the project implementation ?			(Y)	EIA is necessary for the project implementation because that the evaluation column includes (Y and U).

Y: Yes N: No U: Unknown

Source: JICA Study Team

2.2.1.2 Scoping

The following section discusses some of the items that may require mitigation as signaled in the Figure 27.

(1) Approximately twenty vendors would be relocated about 200 m West because of the establishment of the buffer zone for the Cedars Reserve. Impact on residences will be checked.

(2) Traffic and Public Facilities

Among the items of social environment, only “traffic and public facilities” have a possibility to receive a negative impact. The purpose of the prospective interventions for tourism development is to improve the socioeconomic conditions of the community. Therefore, from the socioeconomic aspects, positive impacts will be expected rather than negative ones.

Major towns in the Qaza of Bcharre ring a road that encircles the Qadisha Valley. This road is eight to ten meters in width, however, there are traffic jams, especially during summer weekends. This is mainly because of the cars parked at both sides of the roads in the built area. Tourism projects might increase vehicle flow in the area and worsen the traffic congestion. The most effective counter-measure or mitigation method may be preparation of parking space.

(3) Cultural Property

Positive impact. Monasteries in the Qadisha Valley will be well maintained with tourism promotion and management plan.

(4) Fauna and Flora

During the construction phase, fauna and flora will not be negatively impacted because the locations of tourism facilities will avoid the inhabited areas of important fauna and flora. However, in the Study Area, there is the isolated Cedar Forest (*Cedrus libani*) that is considered an endangered plant species in Lebanon according to the the “2000 Red List.” During the operating phase, discharged gas from vehicles and impacts from increased numbers of tourists may affect the forest. Therefore, an EIA is necessary regarding fauna and flora.

(5) Landscape

The landscape will be evaluated for preservation issues and compatibility of new structures.

(6) Air Pollution

There was no data on air pollution in Bcharre. The first measurement of air pollution was carried out by the JICA Study. According to the results, SO2 and TPS exceeded standards at Hasroun, Hadath el Jibbe and Bcharre respectively. The measurement at Hasroun, and Hadath el Jibbe was implemented on Saturday and Sunday in high season. On the other hand, CO and TSP concentrations at Bcharre indicated high pollution. These facts mean that air pollution is affected closely by traffic volume or economic activity. During the construction and operating phases air quality will be negatively impacted if the construction is large scale

and the increase of tourist vehicles greatly increases current amounts.

(7) Water

A water quality survey was carried out at 5 springs and 5 rivers by this study. Total coliform numbers at all sampling points except Nabbaa Nbat slightly exceeded the MOE standards. High Total Coliforms Numbers and BOD concentration at El Challel-Bcharre indicated that the sewage was being discharged from Bcharre village into the river. The BOD, Total Coliforms and Discharge (m3/sec) are shown at Figure 28 to portray a general view of the Qadisha River.

According to the discharge volume, the following assumption can be made. The polluted water at El Challel-Bcharre (10ppm of BOD) became clear at Qadisha Valley (2ppm of BOD) because of the polluted water would be diluted by other streams on the way to Qadisha Valley (3km down stream from El Challel-Bcharre). However, the water was used for irrigation on the way to Qozhaiya Electricity (10 km from El Challel-Bcharre). Therefore, the discharge at Qozhaiya Electricity was less than at Qadisha Valley.

Figure 28 Analyzed Parameters at the Qadisha River

Parameter	Units	ElChallel -Bcharre	Qadisha Valley (3 km down stream from ElChallel- Bcharre)	Qoshaya Electricity (10 km down stream from ElChallel-Bcharre)
BOD	mg/L	10	2	2
Total Coliforms	cfu/100mL	Numerous	470	330
Discharge	m^3/sec	0.09	1.53	0.46

(i) Wastewater Solid Waste

Sewage treatment system and data of waste effluent is not existed in Bcharre areas. Sewage is directly to stream through simple pipes. Domestic wastewater flow is directly related to water supply.

Solid waste collecting is carried out two or three times per week in Bcharre areas. The solid waste is put in the andfill or dumped over the cliffs into Qadisha. However, the amount of the solid waste is unknown actually. At present stage, it is not clear how to manage the increasing tourist Tourism-generated sewage.

(8) Noise

Data of noise level does not exist in the Bcharre area. Construction noise can be a significant source of community noise. The noise levels generated from the different construction activities are checked by the Lebanese daytime noise standard set for urban residential areas and business districts. During the construction phase, noise may be a negative impact. During the operation phase, the noise along streets may be negatively impacting. Therefore an EIA is necessary.