

# Conservation and Sustainable Use of Dryland Agrobiodiversity

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الجمهورية اللبنانية  
مكتب وزير الدولة لشؤون التنمية الإدارية  
مركز مشاريع ودراسات القطاع العام

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## ECO-GEOGRAPHIC STUDY: Land cover / Land use

Site I: Ham - Maaraboun

Site II: Nabha

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## *Foreword*

*According to the description (T. O. R) of this project, conducting an eco-geographic study constitutes one (the first) of the components that will allow the identification of the agro-ecological zones where in-situ conservation techniques could be introduced and tested.*

*Within this context, our participation consisted into the identification and mapping of the different Land cover/Land use zones for the sites of Ham-Maaraboun (Site I) and Nabha (Site II). The general characteristics of these sites (geographic components, climatic regimes, soil characteristics and the vegetation cover) were identified through ex-situ studies of existing data (documents, maps, previous studies...). The information that we retrieved was considered as primary indications. Field trips and in-situ investigations enabled us to verify the degree of accuracy of these characteristics but also to pinpoint, through ground-truthing, the specificities of the vegetation distribution inside the studied areas as well as the different categories of land use and, finally, to draw the corresponding maps.*

*The following report contains our findings about the eco-geographic study for the sites of Ham-Maaraboun (Site I) and Nabha (Site II); it is structured as follows:*

- 1. General characteristics of the sites*
  - 1.1. Location and topography*
    - 1.1.1. Site I: Ham-Maaraboun*
    - 1.1.2. Site II: Nabha*
  - 1.2. Soil characteristics*
  - 1.3. Climatic factors*
  - 1.4. Vegetation cover*
- 2. Land cover and Land use*
  - 2.1. Methodology*
  - 2.2. Results*
    - 2.2.1. Botanical characteristics*
    - 2.2.2. Eco-geographic specificities*
    - 2.2.3. Land cover/Land use zones*
- 3. Conclusion and Proposals for future investigations*

*Finally, we would like to thank engineers Ms. Mariana YAZBEK and Mr. Mohammad-Hussein MUNZER for their participation and help during the field trips, as well as engineer Mr. Dany LICHAA-EL KHOURY for his technical assistance in the final mapping output.*

## 1. General characteristics of the sites

The analysis of the physical environment is a prerequisite for every ecological study. The most relevant components of the habitats are geographic (location, topography), climatic (precipitation, temperatures...) and soil characteristics (mother-rock, substratum). These components determine the nature of the vegetation cover and play a major role in the distribution of the Lebanese vegetation.

### 1.1. Location and Topography

#### 1.1.1. Site I: Ham-Maaraboun

This site is located on the southern extremity of the western foothills of Mount Zamarani (the northern range of the Anti-Lebanon Mountain) and covers a total area of 28.82 sq.km (**Figure 1**). It extends approximately between the East longitudes  $36^{\circ} 10' 4''$  and  $36^{\circ} 14' 14''$ , and the North latitudes  $33^{\circ} 50' 4''$  and  $33^{\circ} 55'$ . The general direction of the site is NNE – SSW, going from Aïn el- Bounaya to Ham and then to Maaraboun. Since the (normal) access to the site of Ham-Maaraboun follows this general direction, we have chosen to adopt it all through our description of the site.

The general topography of this latter (**Map 1**) is characterised by the presence of a (relatively) low altitude area surrounded by two mountain ranges. Three consecutive and communicating valleys form this lowest zone: Wadi el-Qalaa, Wadi Aïn ed-Delbé and Wadi Baroukha, presenting an altitude gradient that goes from  $\cong 1550$  m (in the region of Aïn el-Bounaya) to 1300 m (at the southern limit of the site). Furthermore, this valley widens progressively as it extends towards the south.

The relief of the surrounding mountains presents notable variations between the western and eastern ranges. The crest-line altitude of the western range varies within a narrow interval: El Midane (1654 m), Qornet et-Tarché (1642 m), Jouar el-Ghassalé (1607 m), Haql Bou Farés (1636 m) and Qasr el- Banat (1761 m). These summits are separated by shallow depressions with smooth slopes. As for the eastern hillsides of these mountains, we have to go beyond Ham in order to encounter steep slopes, as it is the case between Wadi Baroukha and Haql Bou Farés.

On the other hand the eastern range has a greater altitude range, shows numerous escarpments and is more abrupt than the western one. The upper altitude limits (2036 m at Qobaa Aïn es-Safsaf, 1786 m at Qasr Dahr ez-Zouarib and 1848 at Dahr Haql en-Njassa) are higher than those of the western range. In addition to the fact that this eastern range is scattered with high cliffs<sup>1</sup>, the slopes are generally steep, particularly on the foothills of its southern mountains (Aarid el-Lezab, Haql Aabaid and Qasr Dahr ez-Zouarib). The steepness of the slopes and the presence of huge blocks and screes make the access to these areas very difficult. As for the northern mountains of this same range (Rkakib Aïn el-Bounaya, Qornet el-Laouz, Qornet et-Taour and El Qornet), the slopes are more gentle. These variations of the relief are enhanced by the presence of six major valleys (Wadi el-Kalb, Wadi Souarouir, Wadi el-Knissé, Wadi Quassem, Wadi el-Mazraa and Wadi Aabaid) that run laterally across this range with a general E – W direction.

#### 1.1.2. Site II: Nabha

Located to the North of Baalbeck, the site of Nabha covers an area of 59.25 sq.km, extending from the western limit of the Beqaa plain towards the eastern slopes of Mount Lebanon range (**Figure 1**). The extreme geographic co-ordinates of Site II are the East longitudes  $36^{\circ} 9' 3''$  and  $36^{\circ} 16' 42''$ , and the North latitudes  $34^{\circ} 8' 36''$  and  $34^{\circ} 13' 55''$ .

Taking into consideration the longest axis of the site, which goes from Es-Sablât to Qornet es-Saouma, we can say that its general direction is SE – NW.

The topography map of this site (**Map 2**) shows this latter can be divided into two major sectors: the plain and the mountains range. The first one extends, with a very gentle slope, from  $\cong$  950 m (at the southeastern limit of the site) until the altitude of 1250 m (at the outskirts of the villages of Harfoush, Nabha, Queddam, Ej Joubbaniyé and Mrah Zaaiter). This area is scattered with numerous small hills "Sheab" and seasonal streams<sup>1</sup>.

The second sector, that overhangs the plain, is very rich in valleys and includes several mountains. It is to be noted that the altitude range is different across this sector; it goes from 1250 m up to 1500 m in the northeastern area (Qornet el-Mahrouqa) and up to 2100 m at the northwestern boundary of the site (Qornet es-Saouma). The crest-lines of the mountains are mostly ordered along the general direction of the site. Some of them, however, present other directions: Qornet el-Mahrouqa (WSW – ENE) at the northeastern boundary of the site, Qornet el-Msayyaa (SSE – NNW) and Qornet ez-Zarayeb (W – E) in the northern zone, Qornet es-Saouma (W – E) and Qornet Maql el-Hommos (WNW – ESE) at the northwestern limit of the study area. Another characteristic of the relief must be mentioned: some mountains follow one another along the general direction of the site, whereas some others (*e.g.* Qornet es-Sfalih, Qornet el-Qasr and Qornet Hussein Dib) are ordered in a parallel manner across a SW – NE direction. This gives us an idea about the variety of expositions that we have encountered all over the site of Nabha.

As for the hydrographic network, it is formed by a great number of seasonal streams running into valleys that are mostly oriented along the general direction of the site. The major valleys are Wadi Ghanit, Wadi ed-Damdoum, Wadi el-Turk that joins Wadi el-Laouz, this latter being in continuity with Wadi ed-Daoura. Several other valleys are located at the northern limit of the site.

## 1.2. Soil characteristics

The distribution of the Lebanese vegetation varies according to the type of the soil and, particularly, the nature of the substratum (mother-rock) on which these soils were originated.

As the identification of soil types and characteristics is within the competence and responsibility of the soil expert engaged in this study, we will limit ourselves to the major categories of substratum identified<sup>2</sup> within the limits of the studied sites. Whereas both of the sites are characterised by a predominance of calcareous mother-rock, there are however some differences to be emphasised.

Site I (Ham-Maaraboun) shows a variety of mother-rock categories (**Map 3**):

- n<sub>cg</sub>: coarse alluvial fan conglomerates (blocks and screes);
- c1: basal sandstones;
- c2: alternance of sandy-clayey soils and limestone layers (Cretaceous);
- c4-5: pale regularly bedded limestones (Cenomanian-Turonian);
- j4-5-7: massive pale grey limestones (j4), locally reefal and sandy (j5-7), covering the majority of the area;
- $\beta_c$ : basalts (late Jurassic to mid Cretaceous).

On the other hand, only three categories of substratum were identified within Site II-Nabha (**Map 4**):

- neg: mostly in the plain
- c4-5: extending all over the foothills;
- c6: white marls and marly limestones, covering very scarce and located areas.

Finally, based on the nature and the distribution of the vegetation, it is to be noted that  $\beta_c$ , c1 and c6 constitute different types of mother-rock than limestone.

### 1.3. Climatic factors

Based on our most recent study of the Lebanese climate<sup>3</sup>, we can say that Site I (Ham-Maaraboun) is totally included in the semi-arid bioclimatic level. As for Site II (Nabha), subhumid conditions reign over the remote western and northwestern sectors (covering only 11.53% of the total surface area of the site), whereas the remaining areas (88.47%) are submitted to the same semi-arid conditions as in Site I (**Figure 2**). It is to be noted that these percentages constitute primary indications.

The characteristics of the above-mentioned bioclimatic levels have been defined according to the combination of the principal climatic factors. We can summarise them as follows:

**Table 1: Bracket values of the principal climatic factors**

Bioclimatic level	Precipitation (mm)		Average temperatures (°C)		Average Drought <sup>3</sup> X (Dry days)
	Max.	Min.	M <sup>1</sup>	m <sup>2</sup>	
Semi-arid	510	325	37.2	- 0.3	195
Sub-Humid	979 <sup>4</sup>	680 <sup>5</sup>	34.6 <sup>4</sup>	- 4.2 <sup>4</sup>	150

1- M: average maximal temperature of the hottest month.

2- m: average minimal temperature of the coldest month.

3- X: sum of dry days during the drought period, i.e. for the months where  $P$  (mm)  $\leq 2T$  (°C),  
T being the average temperature recorded.

4- Values relative to Yammouneh meteorological station.

5- Value relative to Flawi meteorological station.

Keeping in mind that homologous eco-geographic zones are included under the same bioclimatic level some remarks must be, nevertheless, brought up:

- There are no meteorological stations inside Site I (Ham-Maaraboun), whereas only one pluviometric station, located at Nabha, exists (existed, to be more accurate) within Site II.
- Values shown in the table above refer to existing (non-updated) climatic data.
- According to the Pluviometric Map of Lebanon<sup>4</sup>, the average amount of precipitation over Site I goes from 600 to 700 mm; however, the general bioclimatic conditions as well as the nature of the vegetation show that Site I is more dry than Site II.

- We have noticed, during our *in situ* investigations, that the relief effect on the local bioclimatic conditions is very important within Site II. Consequently, the percentage of area covered by the different bioclimatic levels is different from the above-mentioned primary values (c.f. Table 2)

## 1.4. Vegetation cover

Based on the “Vegetation Map of Lebanon”<sup>5</sup>, our *ex-situ* studies show that the vegetation cover presents the following characteristics:

- Both sites belong to the botanical *Pre-Steppic Mediterranean Ensemble* which covers the eastern slopes of Mount-Lebanon chain, the western slopes of the Anti-Lebanon range (both in their northern parts) and the plain extending between them.
- Four “vegetation levels” have been distinguished within this ensemble: *Pre-steppic Mediterranean* (900 m – 1400 m), *Pre-steppic Supramediterranean* (1400 m – 1800 m), *Pre-steppic Mountainous Mediterranean* (1800 m – 2400 m) and *Pre-steppic Oromediterranean* (> 2400 m). We have to precise that these altitude limits are subject to some variations, depending on whether we are on the eastern slopes of the Mount-Lebanon or the western slopes of the Anti-Lebanon<sup>5</sup>.
- According to this distribution (**Figure 2**), two vegetation levels could be identified over Site I (Ham-Maaraboun): Pre-steppic Supramediterranean and Pre-steppic Mountainous Mediterranean (covering respectively 97.67% and 2.33% of the total area). As for Site II (Nabha), the vegetation would be distributed along three vegetation levels: Pre-steppic Mediterranean (72.75% of the total area), Pre-steppic Supramediterranean (22.63%) and Pre-steppic Mountainous Mediterranean (4.63%).

*At this point of our study, we have to emphasise the following:*

- ❖ *The reference maps<sup>3,5</sup> were drawn originally on a small scale (1/500,000 for the bioclimatic levels and 1/200,000 for the vegetation levels).*
- ❖ *Data collected from these maps were used as guidelines to draw the boundaries of the above-mentioned levels (Figure 2) and to calculate their percentage of area coverage (§ 1.3 & § 1.4). They must be considered, until this point, as general characteristics and as primary indications.*
- ❖ *In-situ verification of these primary indications allowed us to note that:*
  - *The actual bioclimatic conditions correspond to the general climatic characteristics that were described previously. However, based on the present vegetation distribution (c.f. § 2.2.2), signs of “desertification” can be observed. Moreover, the preliminary boundaries of the bioclimatic levels within the Site of Nabha have been ultimately modified according to the vegetation distribution that was defined by the current study (c.f. Map 6).*
  - *On the other hand, in both sites, the nature and the boundaries of the vegetation levels show significant and local variations in comparison with the general distribution defined on the global scale of 1/200,000 (c.f. § 2.2. Results).*
  - *The description of the actual vegetation levels is presented through our study of the Land cover characteristics (§ 2.2.1)*

▪ Boundaries of the actual bioclimatic and vegetation levels are shown on **Map 5** (Site of Ham-Maaraboun) and **Map 6** (Site of Nabha).

❖ The variations in bioclimatic and vegetation levels, in terms of area coverage (%), between the primary indications and the results of the current study are shown hereafter (Table 2).

**Table 2: % of area coverage for the Bioclimatic and Vegetation levels  
Comparison between Primary and Current data**

		Site I: Ham-Maaraboun		Site II: Nabha	
		Primary	Current	Primary	Current
<b>Bioclimatic levels</b>	Semi-Arid	100	100	88.47	87.40
	Sub-Humid	---	---	11.53	12.60
<b>Vegetation levels</b>	Pre-steppic Mediterranean	---	44.62	72.75	65.29
	Pre-steppic Supramediterranean	97.67	55.38	22.63	34.71
	Pre-steppic Mountainous Mediterranean	2.33	---	4.63	---
<b>Vegetation/ Bioclimatic levels</b>	Pre-steppic Mediterranean / Semi-Arid	---	44.62	72.75	65.29
	Pre-steppic Supramediterranean / Semi-Arid	97.67	55.38	15.73	22.11
	Pre-steppic Mountainous Mediterranean / Semi-Arid	2.33	---	---	---
	Pre-steppic Supramediterranean / Sub-Humid	---	---	6.90	12.60
	Pre-steppic Mountainous Mediterranean / Sub-Humid	---	---	4.63	---

## 2. Land cover and land use

### 2.1. Methodology

Our identification of the different land cover/land use zones was based on the principle that each category would present a specific set of ecological characteristics, different from those of the other categories. The resulting zonation takes into consideration two major elements:

- the nature and the distribution of the natural vegetation within the sites (land cover), and
- the different agricultural practices that are undertaken (land use).

In terms of "land use", three principal categories were defined:

- "orchards" (with various fruit trees),
- fields where only "annuals" (barley, wheat...) are cultivated, and
- zones of "mixed cultures", where both previous "land use" modes are carried out.

As for the "land cover", three parameters were used to classify the different botanical communities:

➤ **Community structure** (or physiognomy). We have considered as *forest* any settlement presenting a preponderance of trees. The term of *shrubland* was reserved for the formations characterised by the absence or the scarcity of trees while shrubs (and bushes) are the most abundant. We qualified as *grassland* spaces where the vegetation cover is constituted about exclusively by herbaceous species. This physiognomic distinction comprises, in an implicit manner, indications on the evolutionary stage of the formation, reflection of the dynamics of the vegetation.

➤ **Floristic (Species) composition**. The denomination of a botanical community is based not only on its principal specie(s) but also on its floristic composition. Each group of the identified categories (forest, shrubland or grassland) is characterised by a "floristic homogeneity", defined by a stability of the nature of the species present and resulting from the affinities of these species to associate between each other's. On the other hand, all the physiognomic communities that could evolve towards the same climax stage are joined under the same "*vegetation sere*".

➤ **Spatial distribution**. This parameter indicates the "*vegetation level*" to which belongs every identified community. In addition to the geographic and botanical distribution of the Lebanese flora, vegetation levels have been defined<sup>5</sup> taking into account other ecological parameters, such as bioclimatic conditions, altitude ranges and soil characteristics.



## 2.2. Results

Our *in-situ* "land cover" studies showed that the natural vegetation of the studied areas shows a clear resemblance as to the general floristic composition (botanical characteristics), whereas the different vegetation levels present some particularities as to their geographic extension within each of the sites (eco-geographic specificities).

### 2.2.1. Botanical characteristics

The study of the floristic composition shows that, in both sites, the identified vegetation communities belong to two vegetation levels only: Pre-steppic Mediterranean and Pre-steppic Supramediterranean (Maps 5 & 6). Their botanical characteristics are the following:

➤ Pre-steppic Mediterranean:

One single vegetation sere has established itself within this level: the pre-steppic sere of *Quercus calliprinos* Webb. The arborecent communities have an aspect of open copeswood with a covering ratio of 20 to 40% for the oak trees. *Amygdalus korschinskii* (Hd-Mz.) Bornm., *Pirus syriaca* Boiss. and *Crataegus azarolus* L. appear here and there while *Pyracantha coccinea* Roem., *Acer hermoneum* Bornm. & Schwer. and *Jasminum fruticans* L. are relatively frequent.

The shrubland communities of this sere are characterised by the disappearance of *Poterium spinosum* L. and *Calycotome villosa* (Vahl) Link. over the western slopes of the Anti-Lebanon range (as in Site I: Ham-Maaraboun). On the other hand, we can note the presence of some other characteristic species such as: *Stachys nivea* Lab., *Euphorbia macroclada* Boiss., *Onosma sericea* Willd., *Notobasis syriaca* (L.) Cass., *Convolvulus doryenium* L., *Stachys cretica* L. subsp. *Vacillans* Rechf. and *Phlomis brachyodon* (Boiss.) Zohary subsp. *damascena* (Bornm.) Sam.

➤ Pre-steppic Supramediterranean:

This level is the domain of the "Pre-steppic mixed sere of *Quercus calliprinos* Webb. and *Quercus infectoria* Oliv.", where the scattered arborecent groups present an almost equal distribution of these two species. They are accompanied by the following characteristic species: *Pyracantha coccinea* Roem., *Amygdalus orientalis* Mill., *Amygdalus korschinskii* (Hd-Mz.) Bornm., *Arum dioscoridis* Sibth. & Smith., *Acer hermoneum* Bornm. & Schwer. and *Pirus syriaca* Boiss.

In addition to *Jasminum fruticans* L. and *Berberis libanotica* Ehrenb., all the above-mentioned species are still present at the shrubland stage but in a more stunted state. As for the grassland communities they have a very small covering ratio, around 10%, and are constituted essentially by *Ziziphora capitata* L., *Thelygonum cynocrambe* L., *Serratula behen* Lam. and *Legousia falcata* (Ten.) Fritsch.

A special mention must be made here about the "*Juniperus excelsa* facies" of this same sere. This *facies* gathers vegetation communities that present a floristic composition characteristic of the above-mentioned "Pre-steppic mixed sere of *Quercus calliprinos* Webb. and *Quercus infectoria* Oliv." accompanied by some elements of the degradation stages of the "Pre-steppic Mountainous sere of *Juniperus excelsa*", this latter being normally encountered within the Pre-steppic Mountainous Mediterranean vegetation level (1800 m – 2400 m).

The vegetation communities that have been classified under this *factes* (e.g. Zones 3 & 4 of Site I and Zones 4 & 5 of Site II) are very much related to the homologous xerophytic botanical formations that we find, at high altitudes, within the "Mediterranean Ensemble" over the Mount-Lebanon range<sup>5</sup>. They are characterised by the appearance of:

- ◆ *Juniperus excelsa* M. Bieb., *Rhamnus punctata* Boiss., *Prunus prostrata* Labill. and *Cotoneaster nummularia* Fisch. & Mey., but under the physiognomy of a high and scattered shrubland stage;
- ◆ *Astragalus hirsutissimus* D.C., *Astragalus lanatus* Labill., *Acantholimon libanoticum* Boiss., and *Onobrychis cornuta* (L.) Desv., as dominant species of the low shrubland communities;
- ◆ *Agropyron libanoticum* Hack. in the grasslands, accompanied essentially by *Dianthus libanotis* Labill., *Galium libanoticum* Ehrenb. and *Convolvulus libanoticus* Boiss.

### 2.2.2. Eco-geographic specificities

Our field investigations have confirmed that the altitude limits of these vegetation levels, the surface areas covered by each of them (*c.f.* Table 2) and, consequently, the importance of the different vegetation communities vary a lot between the two sites.

Two main factors originate these modifications: the relief and the climate. In addition to the general effect of the relief, a special mention is to be brought upon the continuous variation of the exposition within the sites and upon the differences in the steepness of the slopes (*c.f.* § 2.2 and Maps 1 & 2). As for the climatic conditions, a particular attention must be given to the actual trend of desertification and to the fact that the eastern slopes of Mount Lebanon are more humid than the western slopes of the Anti-Lebanon. The presence of different microclimatic conditions and the individualisation of various habitats (even within one same vegetation level) reveal the influence of these factors. The most relevant examples of this influence are the extension of the Pre-steppic Mediterranean level within Site I and the disappearance of the "true" Pre-steppic Mountainous Mediterranean level from both sites. Furthermore, we have often observed some overlapping of the vegetation from high altitude ranges to the lower ones.

The "land cover" specificities of our study sites are described hereafter:

#### ➤ Pre-steppic Mediterranean:

- The theoretical upper altitudinal limit (1400 m) of this vegetation level shows significant variations; it extends up to a middle range of 1600 m in Site I (Ham-Maaraboun) while it goes approximately up to 1500 m in Site II (Nabha). These variations are even more acute within Site II where this limit goes down to 1250 m in the remote northeastern zone.
- Due to scale and mapping constraints, the primary data (*c.f.* Figure 2) indicates that the Pre-steppic Mediterranean vegetation level does not exist in Site I (Ham-Maaraboun). On the other hand, the description of the vegetation communities<sup>5</sup> shows that this level is present in this area between 1000 and 1500 m. Our field investigations confirmed that it actually covers an important area (44.62 %) within this site. All the zones that correspond to the valley and to the adjacent foothills present a vegetation cover that belongs to this level (*c.f.* § 2.2.1). As for Site II (Nabha), this same vegetation level covers the plain zone, extending into the nearby valleys, and represents 65.29 % of the total site area.
- The areas that lay under this vegetation level present, in general, an aptitude for agricultural practices whilst the natural vegetation is often submitted to overgrazing.

➤ Pre-steppic Supramediterranean:

- Around 55% of the surface area of Site I (Ham-Maaraboun) belong to this level. Its upper altitudinal limit is located higher than the theoretical value of 1800 m. It goes beyond 1850 m at Qobaa-ed-Debb, reaching even 1950 m at Qobaa Ain-es-Safsaf (located respectively at the southeastern and eastern geographical boundaries of the site). Furthermore, due to the uneven landscape of this site (resulting from a continuously changing topography in all directions), this vegetation level is much imbricated with the previous one. Consequently, different microhabitats are encountered within this altitudinal range as the floristic composition of the vegetation communities varies on a par with the altitudinal distribution.

- As for Site II (Nabha), only 35% of its total area are included in this vegetation level. The position of its upper limit varies upwards and downwards throughout the site, accompanied by a difference in the bioclimatic conditions. The western part of this area has a maximum altitude of 1700 m and benefits from sub-humid conditions. On the other hand, the northern and north-northwestern zones are a sector of high altitudes (ranging respectively up to 1900 m and 2050 m) covered by the semi-arid bioclimatic level. Despite these differences in the altitude ranges, the vegetation cover of this level presents some homogeneity. This homogeneity results from the fact that low altitudes, that should have been under "dry" conditions, are more humid whereas high altitudes present a vegetation cover that is usually seen in "drier" habitats.

➤ Pre-steppic Mountainous Mediterranean:

This vegetation level is the domain of the "Pre-steppic Mountainous sere of *Juniperus excelsa*" and extends, theoretically, from 1800 m up to 2400 m. According to the primary data (*c.f.* Figure 2 and Table 2) only 2.33% of the area of Site I (Ham-Maaraboun) and 4.63% of Site II (Nabha) would belong, geographically, to this level.

In fact, these areas are located respectively within the semi-arid and the sub-humid bioclimatic levels whereas the "Pre-steppic Mountainous Mediterranean" vegetation level is generally characterised by more humid conditions<sup>3</sup>. Furthermore, the vegetation communities of these areas present a floristic composition that is identical to the one that characterises the "*Juniperus excelsa* facies of the Pre-steppic mixed sere of *Quercus calliprinos* Webb. and *Quercus infectoria* Oliv.". Based on these specificities, we have opted to include these areas within the Pre-steppic Supramediterranean vegetation level.

### 2.2.3. Land cover / Land use zones

The result of this study, based on all above-mentioned criteria, was the identification and the delimitation of the different natural vegetation communities (land cover) and the different categories of agricultural practices (land use) within the two sites. They are represented on **Map 7** (Site I: Ham-Maaraboun) and **Map 8** (Site II: Nabha). The list of the different zones that were defined for each site, as well as their surface areas and % of total area coverage, are included in **Table 3**. As for their botanical characteristics and eco-geographic specificities, we have summarised them in **Table 4** (Site I) and **Table 5** (Site II), including additional observations about each zone.

Table 3: Land cover/Land use zones  
Area (sq.km) and Coverage (% of total area)

**Site I: Ham-Maaraboun**

Zone	Type	Area	Coverage	
1	Grassland of " <i>Quercus calliprinos</i> pre-steppic sere"	1a: High density cover	1.27	4.39
		1b: On blocks & screes	3.23	11.21
		1c: Overgrazed	4.50	15.62
2	Grassland of "Mixed <i>Q. calliprinos</i> / <i>Q. infectoria</i> pre-steppic sere"	1.78	6.18	
3	Shrubland of "Mixed <i>Q. calliprinos</i> / <i>Q. infectoria</i> pre-steppic sere"	10.67	37.01	
4	Woodland of <i>Juniperus excelsa</i>	1.12	3.90	
5	Orchards	5a: amongst riverbank vegetation	0.92	3.21
		5b: On reclaimed lands	1.26	4.36
6	Annuals	0.26	0.90	
7	Mixed cultures	3.26	11.32	
8	Urban	0.55	1.90	

**Site II: Nabha**

Zone	Type	Area	Coverage	
1	Grassland of " <i>Quercus calliprinos</i> pre-steppic sere"	1.55	2.61	
2	Woodland of <i>Q. calliprinos</i>	1.77	2.99	
3	Forest of <i>Q. calliprinos</i>	10.81	18.24	
4	Mixed forest of <i>Q. calliprinos</i> / <i>Q. infectoria</i> , with <i>Juniperus excelsa</i> facies	17.73	29.93	
5	Forest of <i>Juniperus excelsa</i>	2.61	4.41	
6	Mixed cultures (annuals + ...)	6a: vineyards	1.87	3.15
		6b: grapes, figs, olives and tobacco	21.04	35.52
7	Urban	1.87	3.15	

Table 4: Land cover/Land use zones – Site I (Ham – Maaraboun)  
Botanical characteristics & Eco-geographic specificities

Zone	Community Structure	Characteristic Specie(s)	Vegetation Sere	Vegetation level	Observations & Principal specie(s) other than the characteristic ones
1	Grassland	<i>Arum dioscoridis</i>	Pre-steppic Mediterranean of <i>Quercus calliprinos</i>	Pre-steppic Mediterranean	<p>All the areas classified under this category show the same floristic composition (c.f. § 2.2.1). Nevertheless, we observed some eco-geographic particularities as to the spatial distribution of this community. Based on the differences in the exposition and in the nature of the soil, we defined three sub-categories:</p> <p>1a - With an exposition to the West, this zone presents a homogenous and rich soil that carries a high-density natural vegetation cover. Some patches of these slopes, in particular at the entrance of the village of Ham, are planted with barley.</p> <p>1b - Whereas the exposition is similar to that of "1a", this area has a less dense vegetation cover as it develops on (and between) blocks and screes.</p> <p>1c - Located all along the eastern slopes of the western mountain range, this sub-category is characterised by a very poor vegetation cover. This may be due also to the fact that it is submitted to overgrazing.</p>
2	Grassland	<i>Teucrium creticum</i> ; <i>Anarrhinum orientale</i>	Pre-steppic Mixed of <i>Quercus calliprinos</i> & <i>Quercus infectoria</i>	Pre-steppic Supramediterranean	<p>Typical grassland of this sere where we should find also <i>Ziziphora capitata</i>, <i>Thelygonum cynocrambe</i>, <i>Serratula behen</i> and <i>Legousia falcata</i>. This zone presents a very poor vegetation cover: this could be the result, as it is the case for zone "1c", not only of its exposition to the East but also to the grazing practices that are carried out in this area.</p>

Table 4: Land cover/Land use zones – Site I (Ham - Maaraboun)  
Botanical characteristics & Eco-geographic specificities

Zone	Community Structure	Characteristic Specie(s)	Vegetation Sere	Vegetation level	Observations & Principal specie(s) other than the characteristic ones
3	Shrubland	<i>Berberis libanotica</i> ; <i>Jasminum fruticans</i>	Pre-steppic Mixed of <i>Quercus calliprinos</i> & <i>Quercus infectoria</i> (with <u><i>Juniperus excelsa</i> facies</u> )	Pre-steppic Supramediterranean	In addition to the usual flora of the shrubland community of the Pre-steppic Mixed Sere of <i>Quercus calliprinos</i> & <i>Quercus infectoria</i> we found, starting from the altitude of 1600 m, species that characterise the <i>Juniperus excelsa</i> facies of this sere, e.g. <i>Acantholimon libanoticum</i> , <i>Onobrychis cornuta</i> , <i>Astragalus lanatus</i> and <i>Astragalus hirsutissimus</i> . Astragals were also found in some specific habitat like, for example, at the altitude of 1450 m in the downstream sectors of Wadi Aabaïd that have a southern exposition.
4	Woodland	<i>Juniperus excelsa</i>	Pre-steppic Mixed of <i>Quercus calliprinos</i> & <i>Quercus infectoria</i> (with <u><i>Juniperus excelsa</i> facies</u> )	Pre-steppic Supramediterranean	This zone presents the true physiognomy of Juniper woodland: scarce, scattered and shrubby trees, with a very poor density cover of the grassland layer. Reaching downwards until the altitude of 1625 m. in the upstream area of Wadi El-Knissé, this community occupies a very specific habitat. Its presence at this level indicates that the flora of high altitude vegetation levels is extending to lower habitats (that lay presently under similar "extreme" climatic conditions as the higher ones), as it is also the case of the Astragals in zone 3.
5	Orchards		Pre-steppic Mediterranean of <i>Quercus calliprinos</i>	Pre-steppic Mediterranean	The main species of fruit trees that are cultivated in the region are apple, pear and cherry. Fig trees accompany them here and there. Two sub-categories were defined: 5a - Fields that are obviously the most ancient ones to be exploited. They are located in the fluvial plain, near Maaraboun, amongst riverbank vegetation where poplars are dominant. 5b - This zone appears to be an extension of the previous area (5a). Some of the fields are even very recent: they are installed on reclaimed land, mostly on terraces.

**Table 4: Land cover/Land use zones – Site I (Ham - Maaraboun)**  
**Botanical characteristics & Eco-geographic specificities**

Zone	Community Structure	Characteristic Specie(s)	Vegetation Sere	Vegetation level	Observations & Principal specie(s) other than the characteristic ones
6	Annuals				Barley and wheat are the major crops cultivated in these areas with, however, very limited surface areas when they constitute homogenous cultures. They are rather more abundant within the zones of mixed cultures.
7	Mixed cultures				<p>This mode of "land use" occupies the widest area of the three agricultural practices that were defined. In addition to the above-mentioned cultures (fruit trees and annuals), vineyards have been also planted. The distribution of the different cultures presents some particularities:</p> <ul style="list-style-type: none"> <li>• All over the site, and wherever the slope is smooth or permits the establishment of terraces, narrow strips of land are occupied by these mixed cultures. Signs of culture rotation are also observed.</li> <li>• On the western slopes of the eastern mountain range, fields of cherry are cultivated at low altitude whereas almond and grapes occupy the higher zones.</li> <li>• Wild hawthorn (<i>Crataegus</i>), almond, pear and prune trees are scattered within the cultivated fields, especially at high altitudes.</li> </ul>
8	Urban				With an exception for Ain El-Bounaya, which is currently uninhabited, there are signs of urbanisation extension, accompanied by an increase of areas transformed into "kitchen gardens".

**Table 5: Land cover/Land use zones – Site II (Nabha)**

## Botanical characteristics &amp; Eco-geographic specificities

Zone	Community Structure	Characteristic Specie(s)	Vegetation Sere	Vegetation level	Observations & Principal specie(s) other than the characteristic ones
1	Grassland	<i>Arum dioscoridis</i>	Pre-steppic Mediterranean of <i>Quercus calliprinos</i>	Pre-steppic Mediterranean	Typical floristic composition and physiognomy of this vegetation community (c.f. § 2.2.1).  This zone presents the same floristic composition as the next one (zone 3). However, we had to differentiate it into a particular zone due to the following specificities. <ul style="list-style-type: none"> <li>• <i>Quercus calliprinos</i> is dominant in the arborescent stratum whereas the other characteristic species (<i>Amygdalus</i>, <i>Pirus</i>, <i>Crataegus</i>...) are rare. On the other hand, <i>Poterium spinosum</i> and <i>Calyptome villosa</i> are abundant in the shrub stratum, which gives to this community a general physiognomy of rather a very high shrubland than that of a forest.</li> <li>• The degradation of the arborescent stratum may be due to "tree cutting". Signs of this practice were observed in the vicinities of Mrah El-Harfoush where "annual crops" are cultivated in the cleared spaces.</li> </ul>
2	Woodland	<i>Quercus calliprinos</i>	Pre-steppic Mediterranean of <i>Quercus calliprinos</i>	Pre-steppic Mediterranean	
3	Forest	<i>Quercus calliprinos</i>	Pre-steppic Mediterranean of <i>Quercus calliprinos</i>	Pre-steppic Mediterranean	True example of the climax stage that could be reached by similar vegetation communities. Characteristic and principal species, within all of the strata, are well represented in number, density and coverage ratio. The presence of <i>Pistacia palaestina</i> amongst these species is an additional reason to differentiate this zone from the previous one.  This state of equilibrium could be the result of the protection that this area has undergone, up until now, by the (local) inhabitants of the village of Qalilé. The same remark can be made about Zone 4. It is to be noted however that agricultural practices are carried out in some areas, as it is the case in Sahlét Qalilé and on the riverbanks of Wadi El-Laouz. Annual crops and tobacco are cultivated in this valley, between Qornet El-Qasr and Qornet Sfaïlih up to Qornet Ez-Zarayeb.

Table 5: Land cover/Land use zones – Site II (Nabha)



## Botanical characteristics &amp; Eco-geographic specificities

Zone	Community Structure	Characteristic Species(s)	Vegetation Sere	Vegetation level	& Principal specie(s) other than the characteristic ones
4	Forest	<i>Quercus calliprinos</i> & <i>Quercus infectoria</i>	Pre-steppic Mixed of <i>Quercus calliprinos</i> & <i>Quercus infectoria</i> (with <i>Juniperus excelsa</i> facies)	Pre-steppic Supramediterranean	<p>Botanical characteristics and eco-geographic specificities of this vegetation community are given in detail through § 2.2.1 and § 2.2.2. Nevertheless, we have noticed some particularities as to the distribution of some species and to the microhabitats that they occupy such as, for instance:</p> <ul style="list-style-type: none"> <li>• Astragals begin to appear at the altitude of 1650 m, whereas Acantholimon is not spotted until 1700 -1750 m.</li> <li>• Although the Juniper starts, rather scarcely, at the altitude of 1500 m, the true "<i>Juniperus excelsa</i> facies" does not start until 1650 m.</li> <li>• <i>Quercus infectoria</i> is dominant between 1500 and 1700 m. On the other hand, Juniper is widely represented above 1800 m, in such a manner that it constitutes the beginnings of "Juniper forests".</li> </ul> <p>Despite the state of ecological equilibrium of this forest we have unfortunately observed, all over this zone, not only signs of grazing but also tree cutting for firewood and charcoal production.</p>
5	Forest	<i>Juniperus excelsa</i>	Pre-steppic Mixed of <i>Quercus calliprinos</i> & <i>Quercus infectoria</i> (with <i>Juniperus excelsa</i> facies)	Pre-steppic Supramediterranean	<p>Located within 1200 and 1500 m, this zone should have been classified within the "Pre-steppic Mediterranean" vegetation level (c.f. § 1.4). In fact, the eco-geographic specificities of this area (c.f. § 2.2.2) as well as the floristic composition of its vegetation community correspond to the category to which we have attached it.</p> <p>Furthermore some habitats of this area very peculiar, as it is the case on the northeastern limit, at the altitude of 1200 m and nearby the bottom of the valley, <i>Juniperus excelsa</i> presents a fair development on slopes with a SW exposition whilst we found one specimen of <i>J. oxycedrus</i> on the opposite side, that is with a NW orientation.</p>

Table 5: Land cover/Land use zones – Site II (Nabha)

## Botanical characteristics &amp; Eco-geographic specificities

Zone	Community Structure	Characteristic Specie(s)	Vegetation Sere	Vegetation level	Observations & Principal specie(s) other than the characteristic ones
6	Mixed cultures (Annuals + ...)				<p>“Annual crops” is the main agricultural resource within this site; they are, however, accompanied locally by other “accessory” cultures. According to the nature of these latter, we defined two sub-categories:</p> <p>6a - where only vineyards are introduced. Such areas are more concentrated near the villages of El-Joubbaniyé and Queddam, with an extension inside the valley of Wadi Ghanit.</p> <p>6b - which covers the whole region of the plain, extending also to the W (between Nabha and Queddam) and to the NW (in Wadi Ed-Damdoum). Within all the areas of this sector, “annuals” are cultivated wherever the slope is not steep; only the top of the “Sheab” is not exploited.</p> <p>As for the additional cultures, we can note the following:</p> <ul style="list-style-type: none"> <li>- vineyards are still present, but very scarce, whereas tobacco plantation is the most dominant agricultural practice;</li> <li>- other fruit trees are also planted locally, such as figs, olives and pears.</li> </ul>
7	Urban				<p>Some of the “villages” that appear on the topography map constitute very small areas (Harfoush); others are located outside the boundaries of our study site (Beit Medlej). Therefore, and due to technical mapping constraints, they were not accounted for within this category. On the other hand, signs of current urbanisation were observed; this is also accompanied, as it seems to be the case in all rural areas, by the extension of “kitchen gardens”.</p>

### 3. Conclusion and Proposals for future investigations

The goal of this study was to identify of the different categories of Land cover/Land use within the Sites of Ham-Maaraboun and of Nabha. At this point, it appears obviously that the general eco-geographic characteristics play a major role as well in the distribution of the natural vegetation as in the mode and nature of the agricultural practices.

Two major remarks may be pointed out:

- The natural vegetation cover presents a well-established stage of ecological equilibrium within the area of Nabha, especially in the mountainous areas. This cover is rather poor inside the Ham-Maaraboun site, mainly due to the current bioclimatic conditions.
- Whereas the inhabitants of Site I rely rather on the plantation of "fruit trees", those of Nabha exploit their land with "annual crops". In addition to the effect of the "climatic" and "geographic" parameters, the previous agricultural practices carried out within Site II could be at the origin of this actual state.

As for future investigations, they will be enhanced through a detailed study of the species composition (for each type of community) by taking phytosociological readings. These latter, relating to what is agreed to call "association's individuals (samples)", would give more exhaustive data about the specific floristic composition of the identified associations. These readings would be conducted preferentially inside the "monitoring sites" (*c.f.* Figure 1) that were delineated according to the T. O. R. of this project. These monitoring sites correspond to the distribution areas of "annual weeds" and "fruit trees" that were chosen between the (most interesting) wild and indigenous species of the target areas.

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#### REFERENCES

<sup>1</sup> *Carte Topographique du Liban (1/20 000)*. Ministère de la Défense Nationale, Direction des Affaires Géographiques, 1970.

<sup>2</sup> Dubertret, L. – *Carte Géologique du Liban (1/200 000)*. Ministère des Travaux Publics, 1955.

<sup>3</sup> Safi, S. & Abi-Saleh, B. - Assessment of Lebanon's Vulnerability to Climate Change. Technical Annex B1: Assessment of Bioclimatic Change, B1.3-B1.19, *in*: Ministry of Environment (Lebanon), *Lebanon's First National Communication under UNFCCC*. Project LEB/95/G32A/1G/99, 1999.

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<sup>4</sup> Plassard, J. – *Carte Pluviométrique du Liban (1/200 000)*. Ministère des Travaux Publics et des Transports, Direction Générale de l'Aviation Civile, 1971.

<sup>5</sup> Abi-Saleh, B. & Safi, S. - Carte de la végétation du Liban (1/200 000) + Notice explicative. *Ecologia Mediterranea*, 1988, XIV (1/2): 123-142.

### TABLES

Table 1: Bracket values of the principal climatic factors

Table 2: % of area coverage for the Bioclimatic and Vegetation levels;  
Comparison between Primary and Current data

Table 3: Land cover/Land use zones;  
Area (sq km) and Coverage (% of total area)

Table 4: Land cover/Land use zones – Site I: Ham-Maaraboun  
Botanical characteristics and Eco-geographic specificities

Table 5: Land cover/Land use zones – Site II: Nabha  
Botanical characteristics and Eco-geographic specificities

### FIGURES

Figure 1: Target areas geographic location

Figure 2: Primary vegetation and bioclimatic levels

### MAPS

Map 1: Topography – Site I: Ham-Maaraboun

Map 2: Topography – Site II: Nabha

Map 3: Geology – Site I: Ham-Maaraboun

Map 4: Geology – Site II: Nabha

Map 5: Vegetation and bioclimatic levels – Site I: Ham-Maaraboun

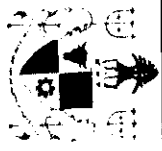
Map 6: Vegetation and bioclimatic levels – Site II: Nabha

Map 7: Land cover/Land use – Site I: Ham-Maaraboun

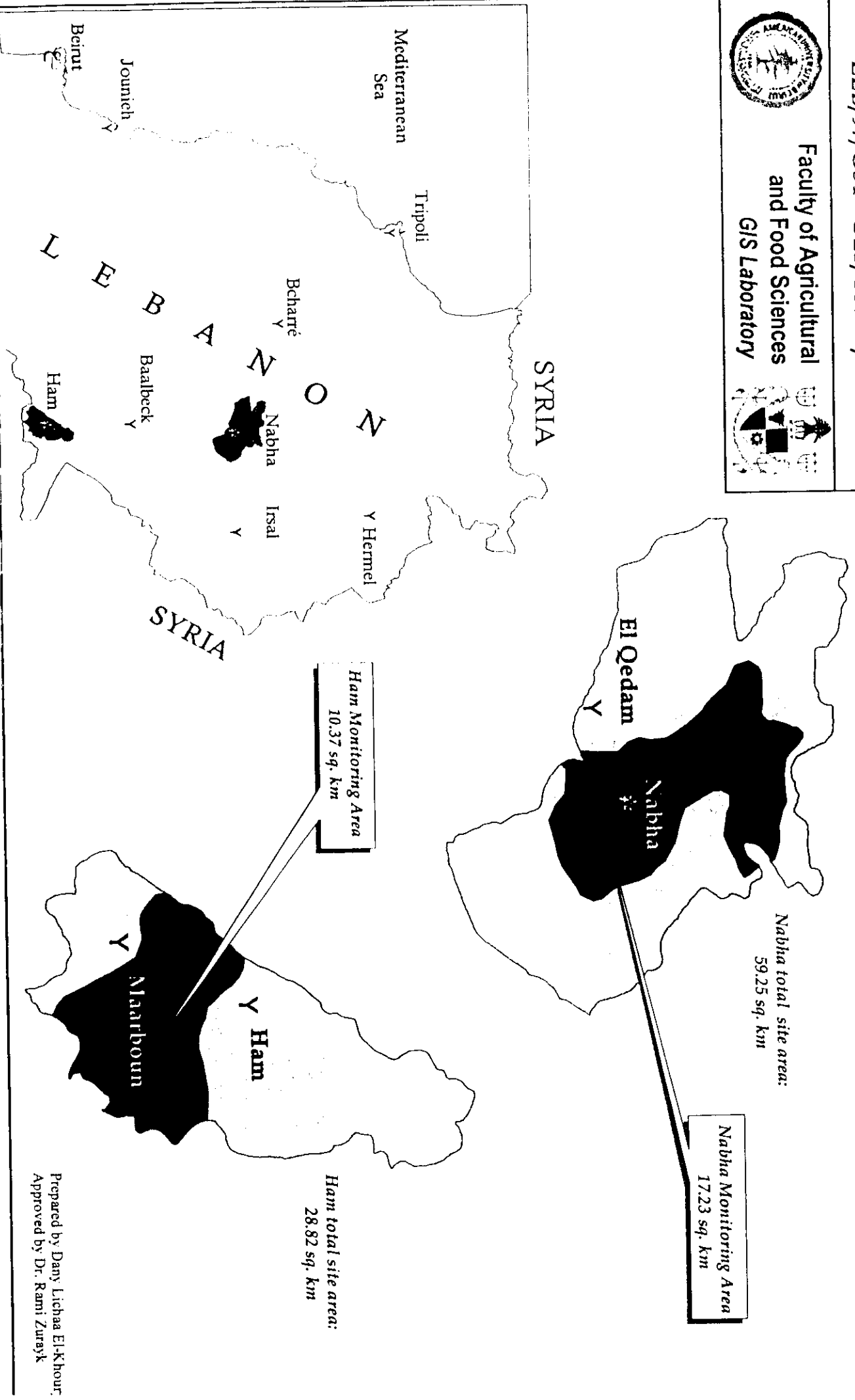
Map 8: Land cover/Land use – Site II: Nabha



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**Figure 1:**  
**Target Areas Geographic Location**



**Figure 2:**  
*Primary Vegetation and Bioclimatic Levels*



Prepared by: Dr. Samir Safi






Mapped by: Danny Elchahal El-Khourey  
Approved by: Dr. Rami Zurak

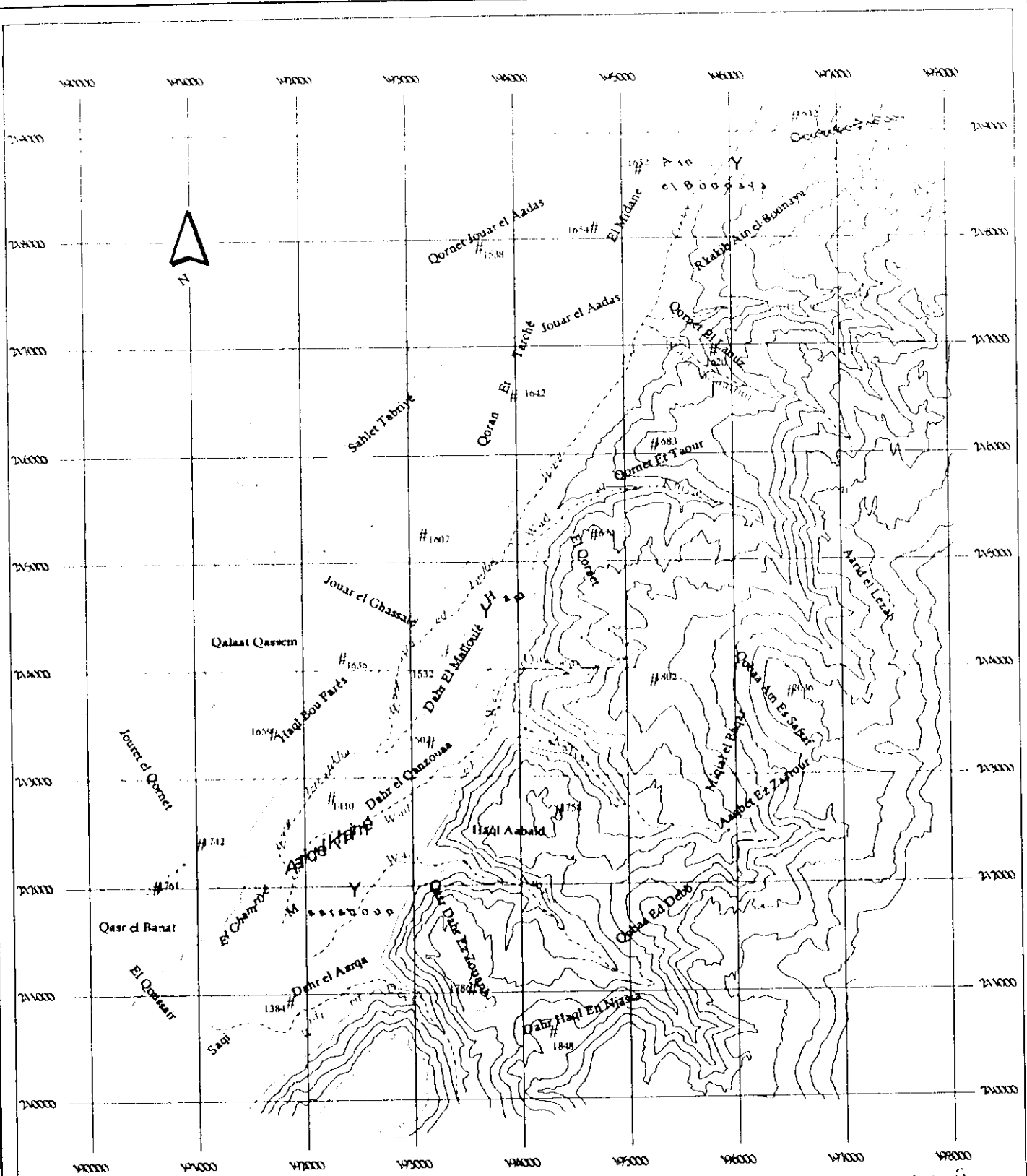


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-  Prestepic Mediterranean Semi-arid
-  Prestepic Supramediterranean Semi-arid
-  Prestepic Mountainous Mediterranean Semi-arid
-  Prestepic Supramediterranean Subhumid
-  Prestepic Mountainous Mediterranean Subhumid



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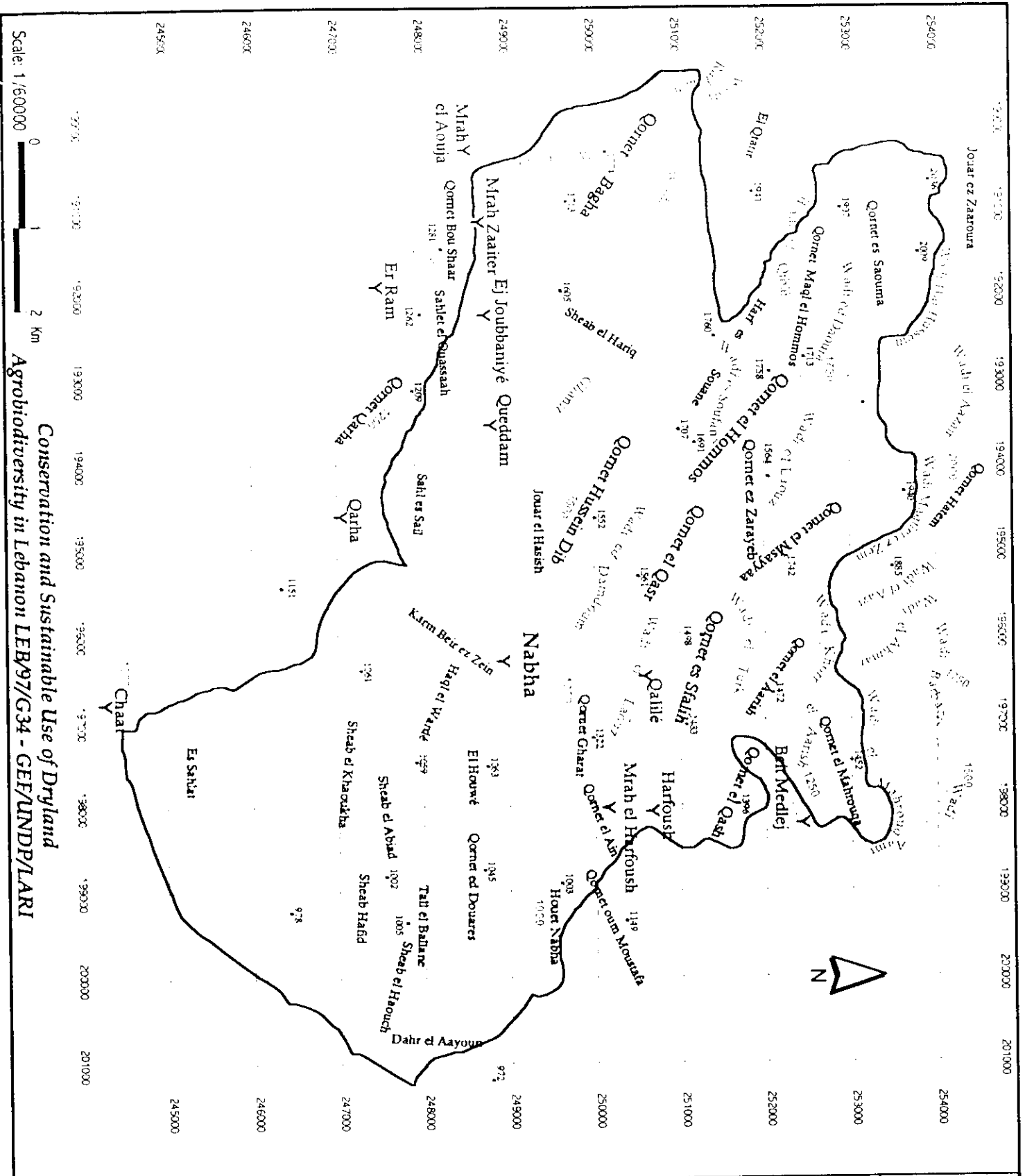
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 of Diverse Agro-biodiversity in Lebanon  
 FEB 197103A  
 G E E J U N D R I V A R I



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 O.S. Laboratory  
 Prepared by Omayyeh El-Hachem  
 Approved by Dr. Faris Louhe

Legend:  
 - - - - - Site 1: Ham M. asaraboun Boundaries  
 x Village  
 --- Seasonal streams  
 --- 50 m contour lines

Map no. 1  
 Topography  
 Site 1: Ham M. asaraboun







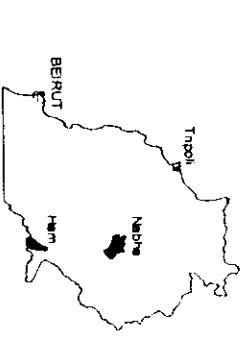
Map no. 2

# Topography

Site II: Nabha

**Legend:**

-  Site II: Nabha boundaries
-  Villages
-  Seasonal streams
-  50m contour lines



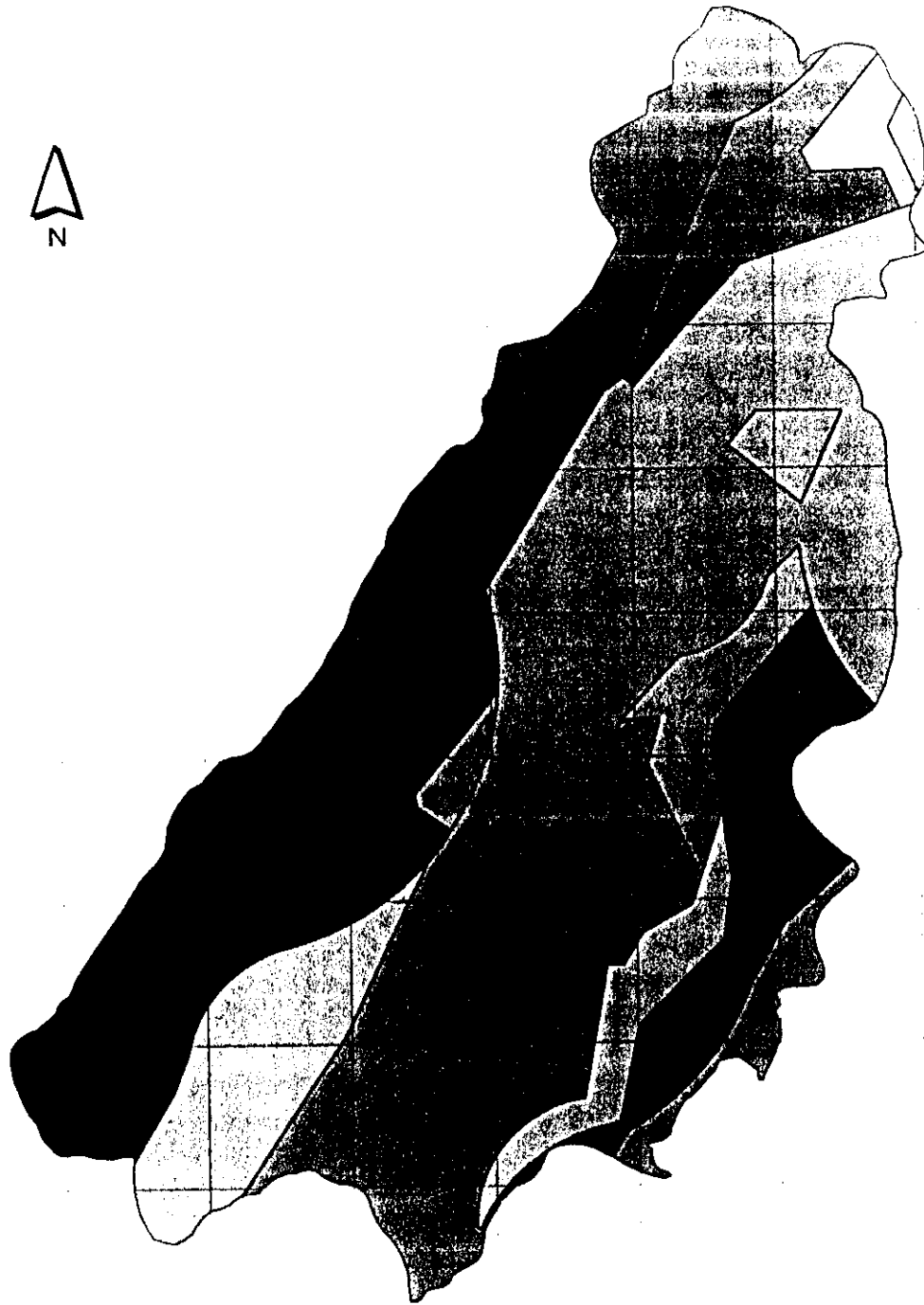
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Prepared by: Darry Lichaa El-Khoury  
Approved by: Dr. Rami Zurayk

Scale: 1/60000  
0 1 2 Km

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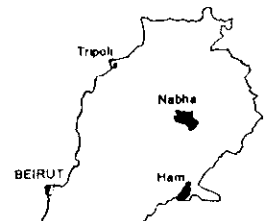




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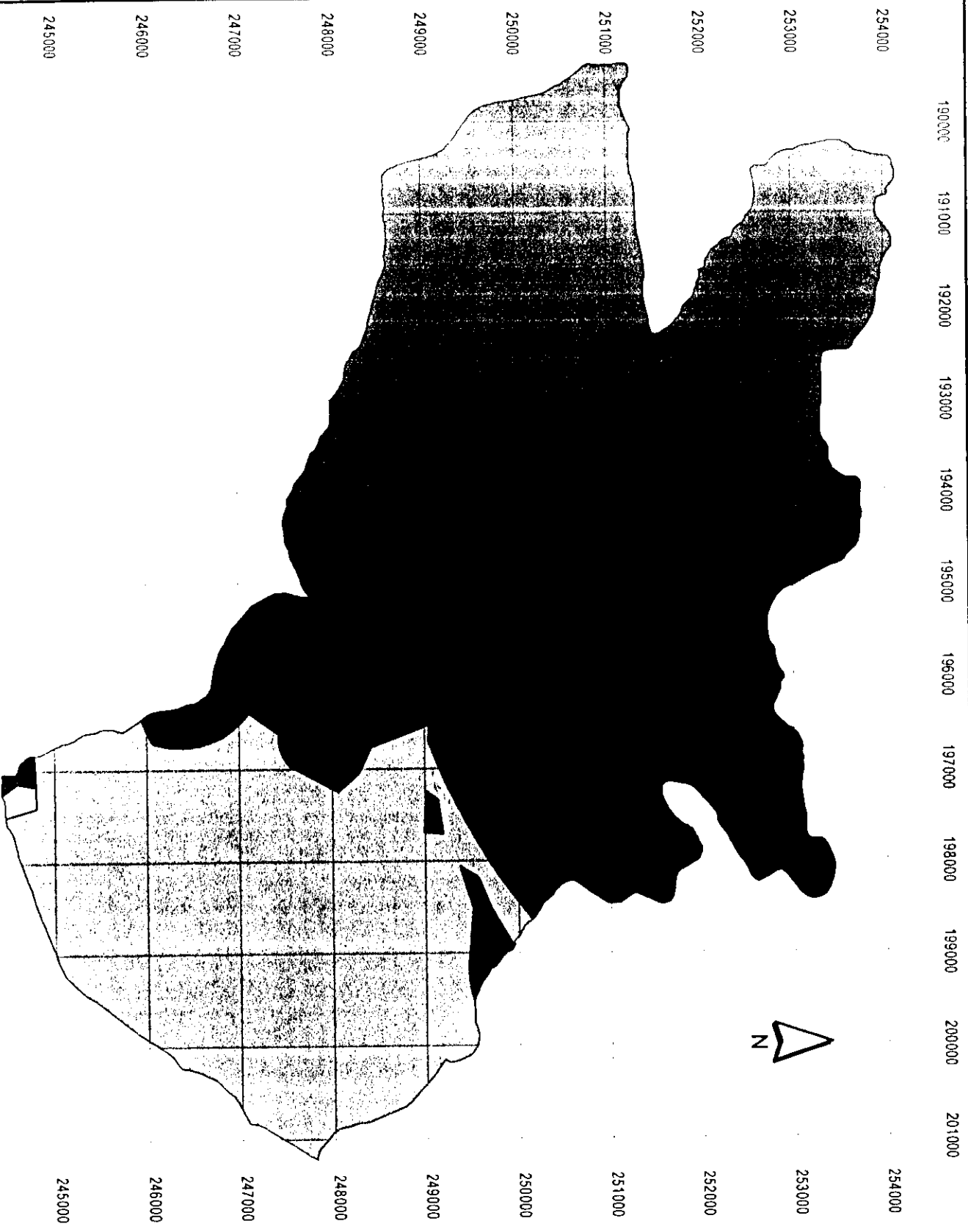
Legend:

- Basal sandstones (c1)
- Basalts (late Jurassic to mid Cretaceous: Bj, Bc)
- Coarse alluvial fan conglomerates (ncg)
- Pale regularly bedded limestones (c4-5)
- Sandy clayey beds of limestones (c2)
- Massive pale grey limestones (j4)

Map no. 3

*Geology*

Site I: Ham-Maaraboun



Scale: 1/600000  
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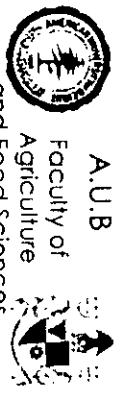
Map no. 4

# Geology

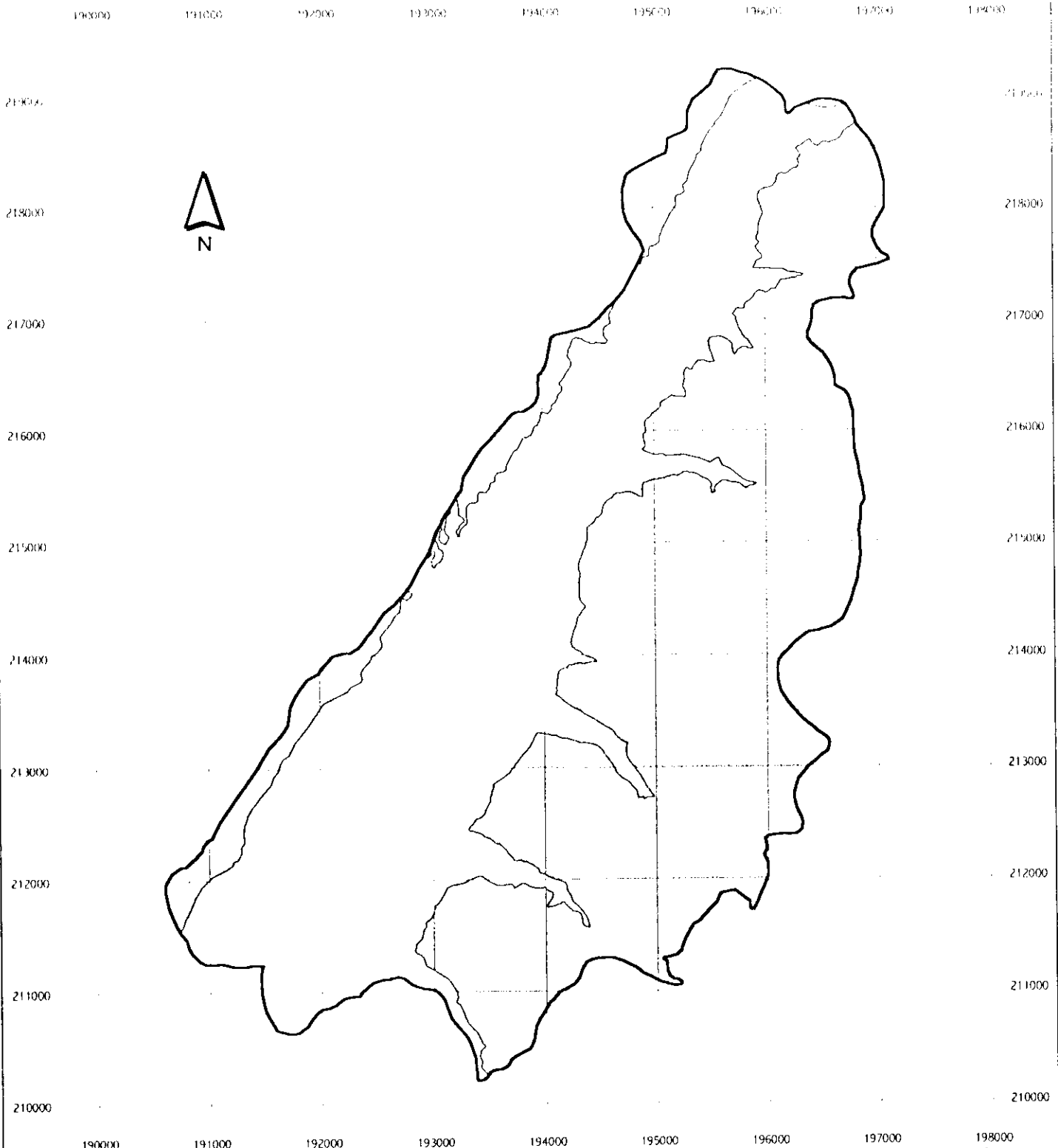
Site II: Nabha

## Legend:

-  White marls & marly limestones (c6)
-  Coarse alluvial fan conglomerates (ncg)
-  Pale regularly bedded limestones (c4-5)



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Approved by: Dr. Ramzi Zurayk

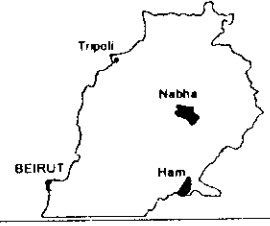


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Scale: 1/50000



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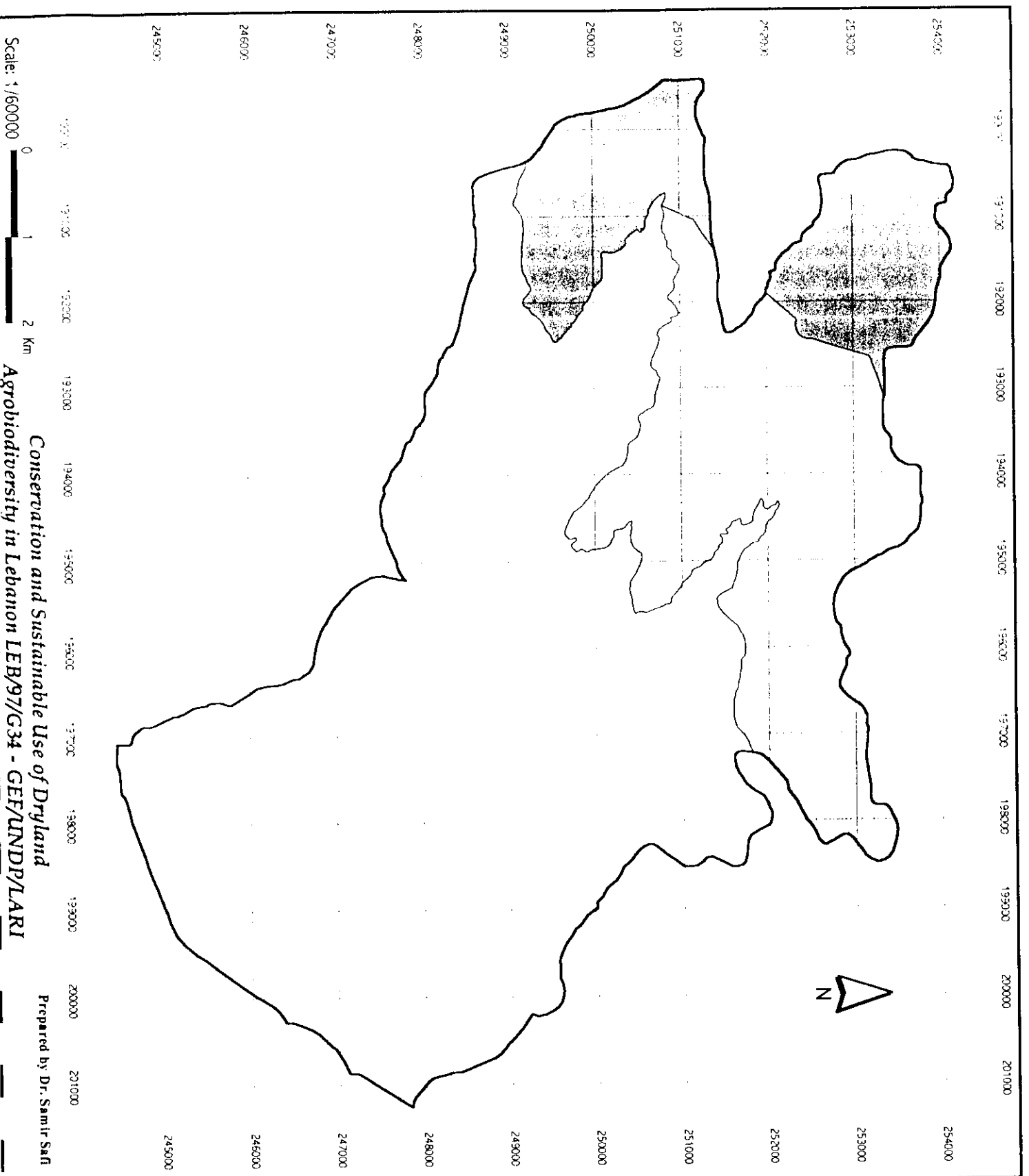
Legend:

- Presteppic Supramediterranean Semi-arid
- Presteppic Mediterranean Semi-arid

Map no. 5

***Vegetation &  
Bioclimatic levels***  
Site I: Ham-Maaraboun

Mapped by Daisy Lichaa El-Khoury









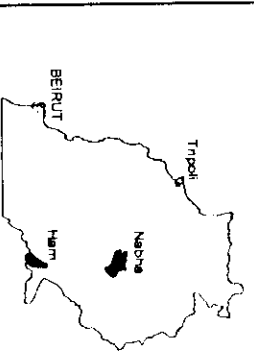
Map no. 6

## Vegetation & Bioclimatic levels

Site II: Nabha

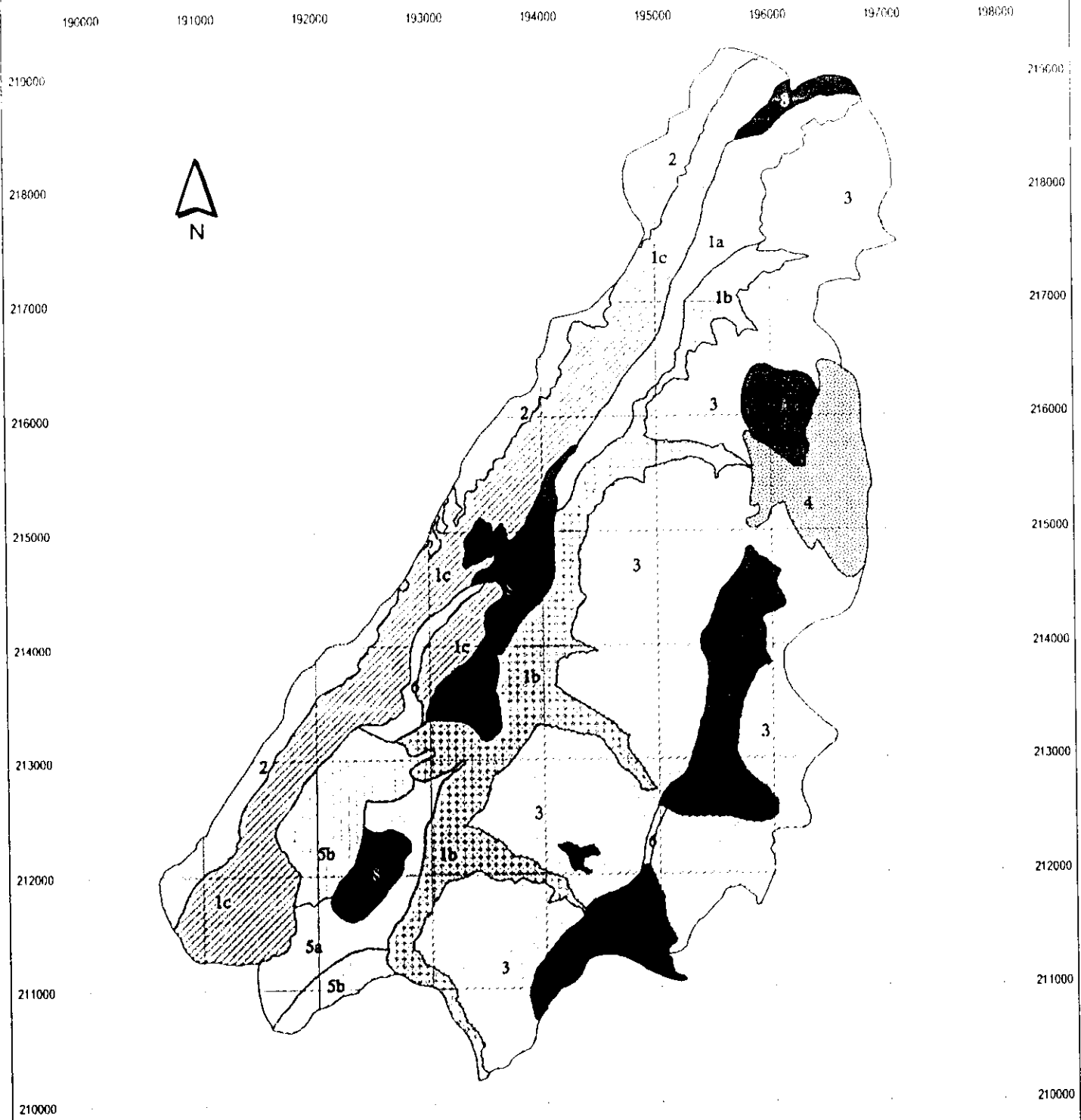
Legend:

-  Presteppeic Mediterranean
-  Semi-arid
-  Presteppeic Supramediterranean
-  Semi-arid
-  Presteppeic Supramediterranean
-  Subhumid



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 Approved by Dr. Rami Zurayk

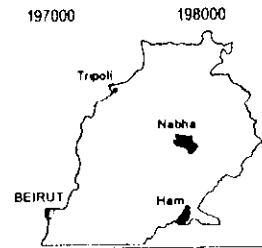


Prepared by Dr. Samir Safi

Scale: 1/50000



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Assisted by Dr. Rami Zarak

**Legend:**

- 1 Grassland of "Q. calliprinos pre-steppic sere":
  - 1a high density cover
  - 1b on blocks & screens
  - 1c overgrazed
- 2 Grassland of "mixed Q. calliprinos/Q. infectoria pre-steppic sere"
- 3 Shrubland of "mixed Q. calliprinos/Q. infectoria pre-steppic sere"
- 4 Woodland of Juniperus excelsa
- 5 Orchards
  - 5a amongst riverbank vegetation
  - 5b on reclaimed land
- 6 Annuals

Map no. 7

**Land Cover /  
Land Use**

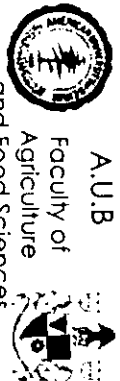
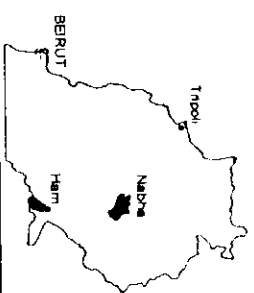
Site I: Ham-Maaraboun

# Land Cover / Land Use

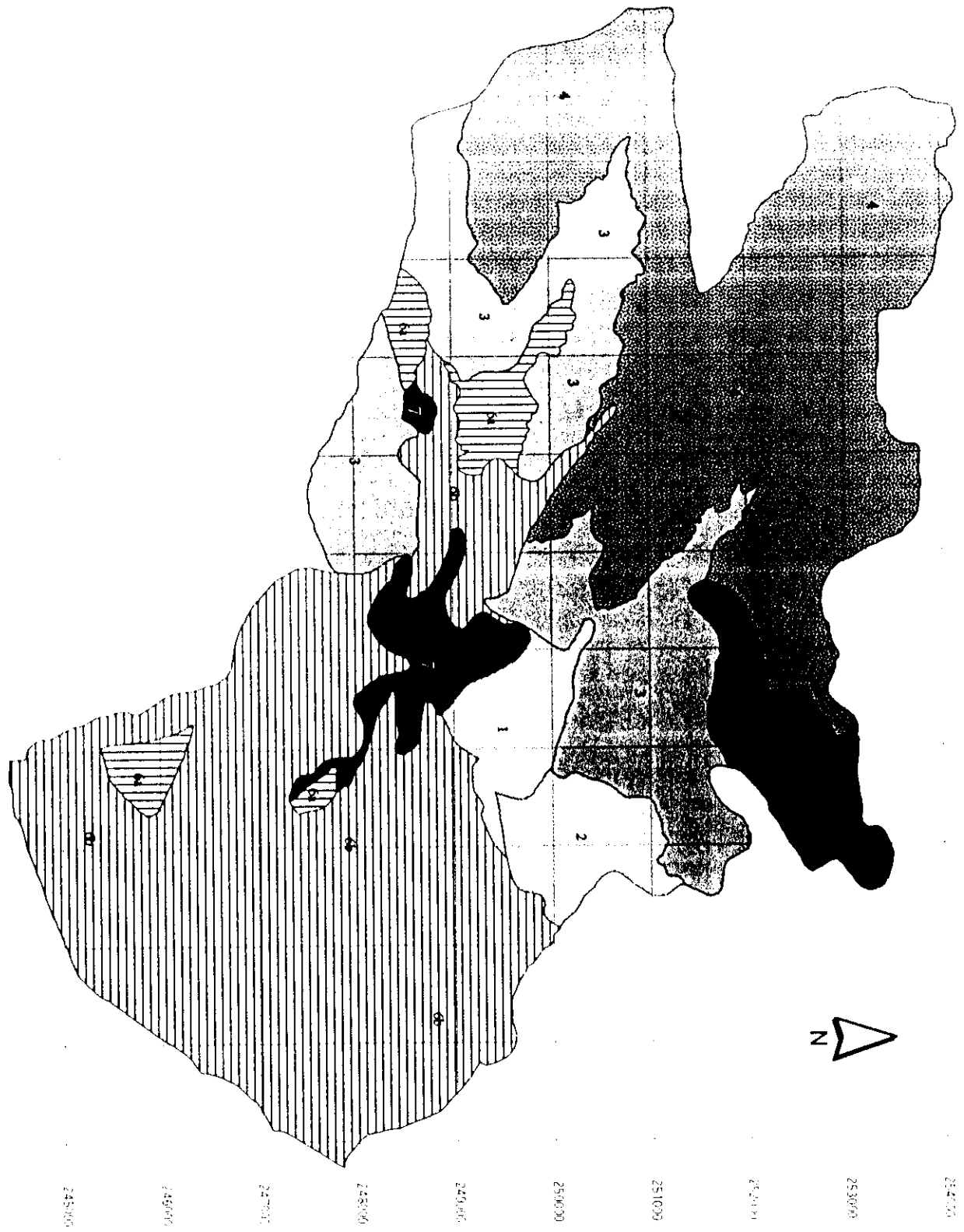
Site II: Nabha

**Legend:**

- 1 Grassland of "Q. calliprinos pre-stepic set
- 2 Woodland of Q. calliprinos
- 3 Forest of Q. calliprinos
- Mixed forest of Q. calliprinos/Q. infectoria, with Juniperus excelsa facies
- Forest of Juniperus excelsa
- 6 Mixed cultures: annuals + vineyards
- 6a grapes/figs/olives/tobacco
- 7 Urban



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Scale: 1/60000



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Prepared by Dr. Samir Saifi