LEBANON REFORESTATION INITIATIVE

Vegetation Map of Lebanon

Task 1: Lebanon-specific vegetation classification system

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1. Introduction: vegetation mapping and vegetation classification

Vegetation mapping has been always an essential tool for describing the distribution, structure, and composition of plant communities. As vegetation generally integrates the ecological processes acting on a site or landscape - more measurably than any other factor or set of factors- and often infers soil and climate patterns, vegetation is often chosen as the basis for the classification of terrestrial ecosystems.

The description and analysis of plant communities is therefore an essential process in the preparation of vegetation maps. Various methods may be used to classify and map vegetation patterns on the landscape, the appropriate method depending on the scale and scope of the project.

2. Scope of work

The Lebanon Reforestation Initiative (LRI) is a project of the United States Agency for International Development (USAID) implemented by the United States Forest Service (USFS). One of the aims of this project is to enhance reforestation by increasing technical capacities related to, amongst other objectives, planting site selection and forest cover mapping (USFS International programs).

Our task is to develop a "Lebanon-specific vegetation classification system" and, using that classification, to generate a vegetation map oriented towards land cover rather than land use. The adopted concepts of "land cover" and "land use" are those that have been defined in the "Land Cover Classification System (LCCS)" edited by the Food and Agriculture Organization of the United Nations (FAO, 2005). *Land cover is the observed (bio)physical cover on the earth's surface whereas land use is characterized by the arrangements, activities and inputs people*

undertake in a certain land cover type to produce, change or maintain it. Subsequently, "grassland" is a cover term, while "rangeland" refers to the use of a grass cover.

The generated map will show the distribution of the different plant communities, displaying them in a way that permits the evaluation of natural habitats in terms of suitability for reforestation and assistance in the selection of plant species to be used.

3. Background: international and national contexts

Classification and description of vegetation was a central objective and major source of ecological thought in the three major traditions or schools of Plant Ecology i.e.: the Zurich-Montpellier (Southern) Tradition, the Uppsala (Northern) Tradition and the English (Anglo-American) Tradition.

Literature reviews show that numerous methods and criteria for vegetation classification and mapping were issued. Based on either one of the above mentioned traditions, most of these methods are essentially visual-descriptive and based on combinations of dominant species and broad vegetation structure reflecting thus the distribution of habitats and biotopes.

Guidelines for vegetation classification and mapping were developed by international organisms as well as national agencies according to specific objectives e.g.:

- providing a comprehensive framework for the more important categories to be used in vegetation maps at scales of 1/1 million or smaller (UNESCO, 1973);

- mapping biotopes and creating a continent (European)-wide comparable database through standardized methodology for land cover assessment and monitoring, including descriptions of new habitats and amendments to some existing habitats (European Commission, 1991, 2007);

- providing an organized approach to mapping vegetation through a decision framework for the steps involved in mapping, establishing objectives, identifying available resources, and determining specifications and costs (O'Neil & Hill , 2000);

- creating a reference set of habitat types including a description of all types and a hierarchical classification (European Environment Agency, 2004, 2008);

- improving access to reliable and standardized information on land cover and land cover change, regardless of data source, thematic discipline or country (FAO, 2005),

- developing vegetation geospatial databases and associated maps that support the various business functions of the Forest Service (Brohman & Bryant, 2005);

- developing a scientific, standardized classification system, with practical use for conservation and resource management (Federal Geographic Data Committee, 2008).

The above list of references reveals some of the most pertinent work that has been done in this field and it is far from being exhaustive.

In Lebanon, vegetation mapping was almost exclusively oriented towards forest cover (Ministry of Agriculture, 1965; Baltaxe, 1966) in addition to the topographic maps produced, at different scales, by the Directorate of Geographic Affairs of the Lebanese Army where wooded lands were figured. The most recent forest map was published in 2005 (MoA & FAO) as a result of the National Forest Resource Assessment (FRA) conducted by the Lebanese Ministry of Agriculture and the FAO in 2003.

To our knowledge, there is only two maps related to country-wide land cover i.e. the "Land Cover" map for Lebanon based on the interpretation of satellite remote sensing data (FAO, 1990), followed by the Land Use Land Cover map (MoA & NCSR, 2002). Nevertheless, a number of biodiversity studies and conservation projects resulted in local maps describing the land cover (e.g. Safi, 1999 a, b, c; 2001; MADA, 2007).

The only vegetation mapping covering the entire country is the Vegetation Map 1:500,000 (Abi-Saleh & Safi, 1988) based on the first phytoecological study of Lebanese sylvatic formations (Abi-Saleh, 1978).

4. Concept of the proposed "Lebanon-specific vegetation classification system"

A classification scheme combines generally a set of vegetation types, or vegetation units, which can belong to a single broad rank (vegetation levels or vegetation series) or can be organized into more detailed levels based on the physiognomy (e.g. formations), the evolution stage or the floristic composition (e.g. associations and alliances).

The conception of the "Lebanon-specific vegetation classification system" is primarily based on the Braun-Blanquet concept of vegetation classification i.e. a floristic-sociological approach where plant community types are conceived as units recognized by their total floristic composition. In order to be compatible with the final goal of the LRI project, i.e. the production of a vegetation map that shows the land cover characteristics, this classification will take into

account the climatic and edaphic characteristics. Subsequently, the geographic distribution of the vegetation distribution is related to bioclimatic (Fig. 1) and vegetation levels (Fig. 2).
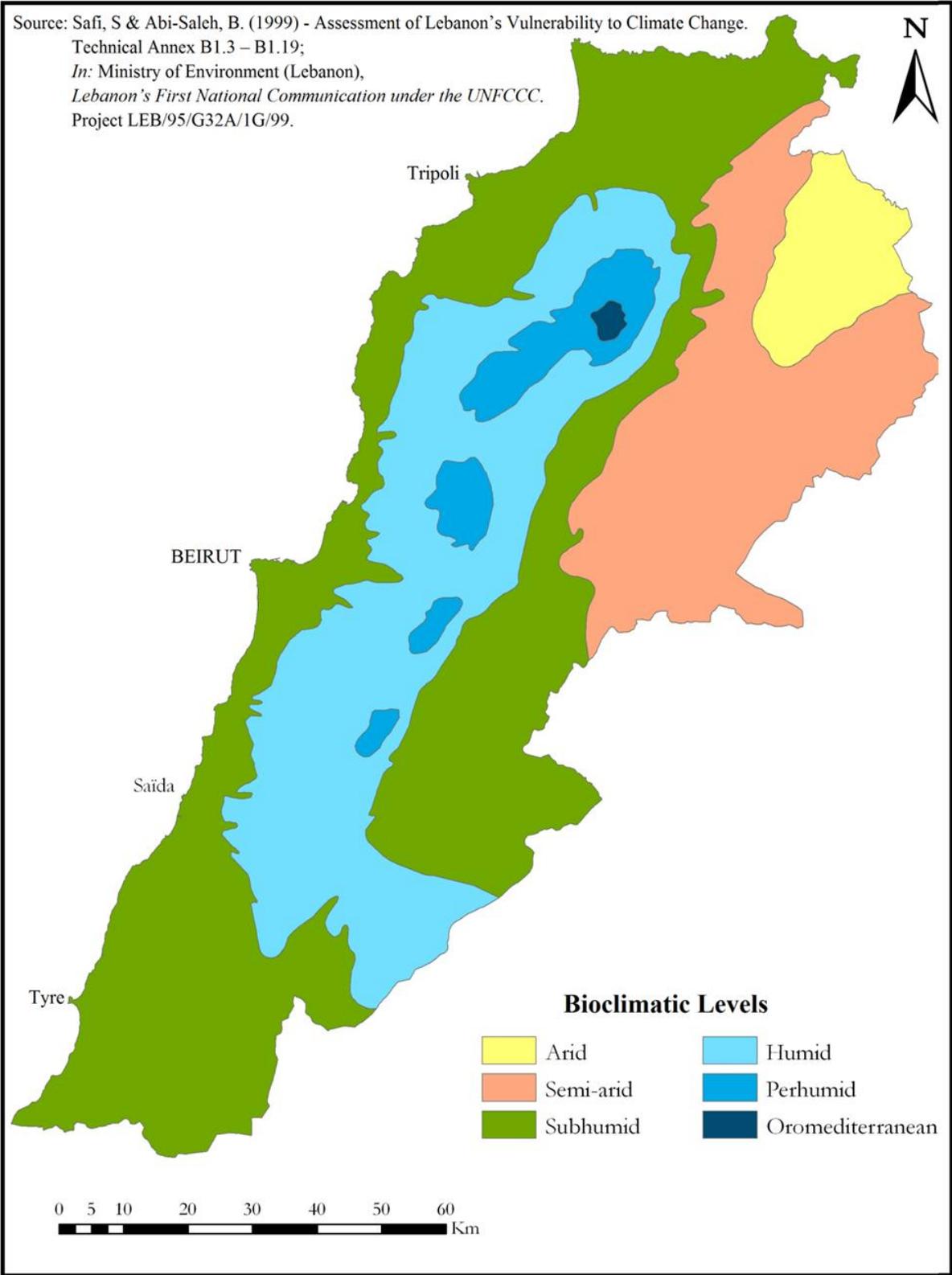

Figure 1: Lebanon - Bioclimatic levels

Vegetation Levels

Typical Mediterranean
- Thermomediterranean
- Eumediterranean
- Supramediterranean
- Montane mediterranean
- Oromediterranean

Presteppic Mediterranean
- Groupings of *Hammada eigii*
- Mediterranean
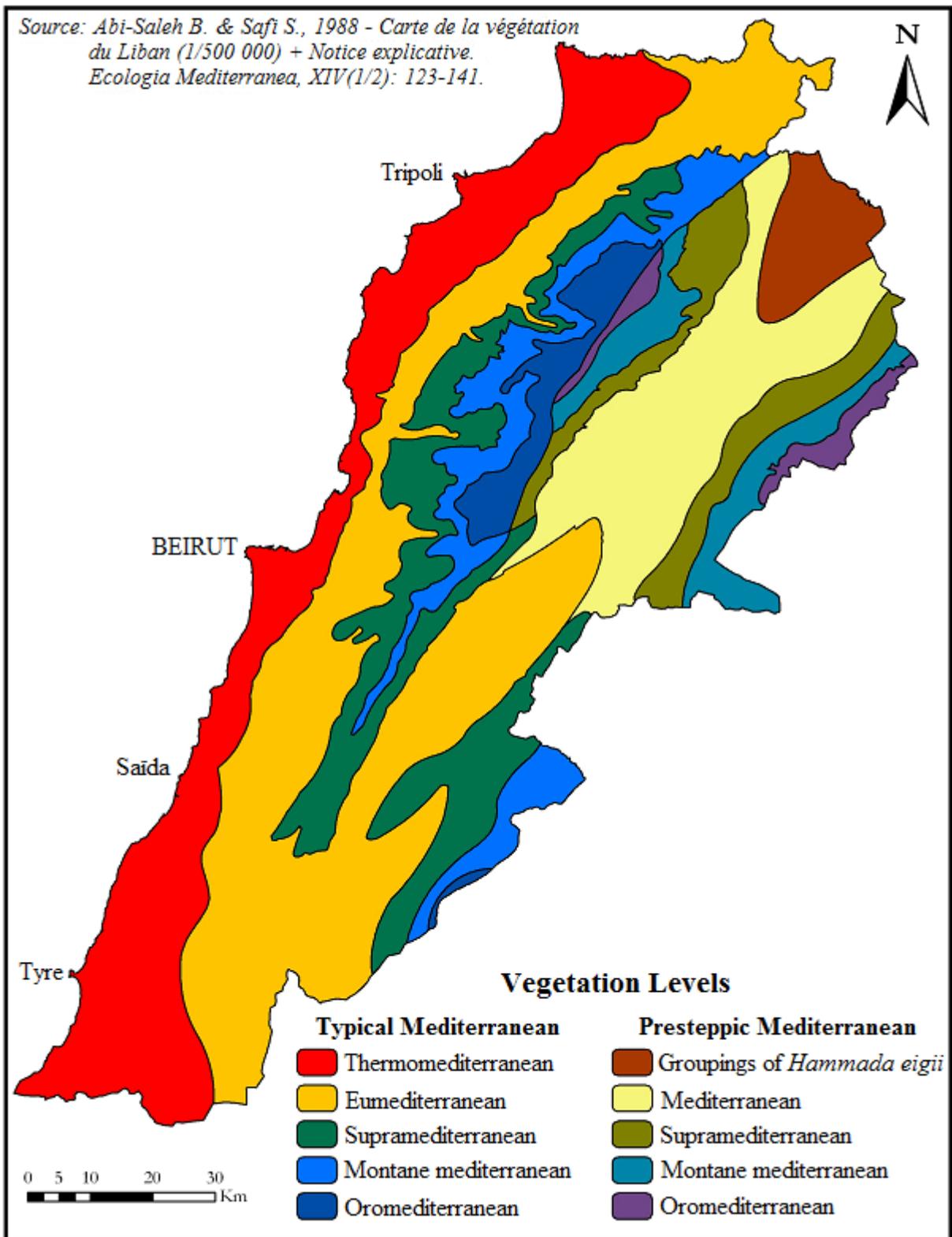- Supramediterranean
- Montane mediterranean
- Oromediterranean

Figure 2: Lebanon - Vegetation levels

It is to be noted that the proposed scheme of classification does not follow the FAO LCCS system which focuses particularly on developing land cover map units and does not provide details on plant community or vegetation types. In contrast this scheme complies, to a great extent, with the U.S. National Vegetation Classification that stands out by as an evolving a posteriori classification and presents the following criteria (Jennings, 2003 and 2009):

- The classification standard is dynamic, allowing for refinement as additional information becomes available (open-end classification).

- The classification is of existing, not potential, vegetation and is based upon vegetation condition at the optimal time during the growing season. Vegetation types are defined on the basis of inherent attributes and characteristics of the vegetation structure, growth form, and cover.

- The classification is hierarchical (i.e., aggregatable) to contain a small number of generalized categories at the higher level and an increasingly large number of more detailed categories at the lower levels. The categories are intended to be useful at a range of scales.

- Upper levels of the classification are based primarily on physiognomy (life form, cover, structure) of the vegetation (not individual species). Life forms (e.g., herb, shrub, or tree) in the dominant or uppermost stratum will predominate in classification of the vegetation type. Climate and other environmental variables are used to help organize the standard, but physiognomy is the driving factor.

- Lower levels of the classification are based on actual floristic (vegetation) composition.

On the other hand, the "Lebanon-specific vegetation classification system" presents the following specific criteria:

- *Even though the classification is of existing vegetation, the dynamics and potentialities will be shown through the identification of vegetation series and evolutional stages of each series.*

- *Evolutional stages (forest, shrubland and grassland) are identified by their physiognomy and floristic composition:*
  * *physiognomy: describes the broad features of the vegetation, such as the growth forms and/or the life form of dominant species within a plant community. It will be determined according to canopy cover and the dominant specie's height. The level of detail will remain an open-end criterion. For example, the definition of a forest adopted for Lebanon (Gyde Lund, 2012) - as per the FAO recommendations - is "forest land*

spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds in situ". We consider that the surface area does not quite apply to "mediterranean forests in the arid and semi-arid zones". Some guidelines (USGS/NPS, 1994; Brohman & Bryant, 2005) take into consideration more classes of canopy cover. In our case, we will replace these clusters through the identification of the indexes of cover-abundance and sociability indexes for each population within the community.

* *floristic composition: includes all species occurring within a plant community. The study will be conducted according to the Braun-Blanquet method[1] (Indexes of cover-abundance and sociability for each population). Thus, every evolutional stage will be characterized by one specific association.*

- *A vegetation association is a plant community of definite floristic composition, presenting a uniform physiognomy and growing in uniform habitat conditions. Among the species that make up the community some are better indicators; these are qualified as "diagnostic species", the remaining species being called "companion species".*

- *A vegetation series is defined as the ensemble of vegetation associations that follow each other on one site (or location), each association preparing the following and being replaced by it.*

- *Vegetation series are considered one of - if not the - highest level in this classification scheme.*

- *Other levels of description can be added, e.g. subdivisions of the forest class, according to the purpose of the survey; the hierarchy will be then modified as an end-result.*

The basics of the proposed classification scheme are the distribution of the vegetation already defined in the Vegetation Map of Lebanon 1:500,000 (Abi-Saleh & Safi, 1988), as shown in Table 1.

In order to be used through the mapping phase, this classification scheme will be organized into hierarchical levels as shown in Table 2.

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[1] This method will be detailed in Task 2 (Protocol for the data collection at training sites).

Table 1: Distribution of the Lebanese Vegetation

Floristic ensemble	Vegetation level	Mother-rock		
		Limestone	Marl and Marly limestone	Sandstone
M E D I T E R R A N E A N	Thermomediterranean (0 – 500 m)	* *Ceratonia siliqua* & *Pistacia lentiscus* serie * Thermophile serie of *Quercus calliprinos*	* Thermomediterranean serie of *Pinus brutia* & *Cupressus sempervirens*	*Thermomediterranean serie of *Pinus pinea*
	Eumediterranean (500 – 1000 m)	* Mediterranean serie of *Q. calliprinos* * Mediterranean serie of *Quercus infectoria*	* Mediterranean serie of *P. brutia* & *C. sempervirens*	* Mediterranean serie of *P. pinea*
	Supramediterranean (1000 – 1500 m)	* Supramediterranean serie of *Q. calliprinos* * Normal serie of *Q. calliprinos* * Serie of *Ostrya carpinifolia* & *Fraxinus ornus* * Serie of *Q. cerris*		* Supramediterranean serie of *P. pinea* **Serie of *Q. infectoria* sandstone variety *** Serie of *Q. cerris* sandstone variety
	Montane mediterranean (1500 – 2000 m)	* Serie of *Cedrus libani* & *Abies cilicica* * Montane mediterranean serie of *Q. cedrorum* & *Q. brantii* ssp. *Look* * Montane series of *Juniperus excelsa*		
	Oromediterranean (> 2000 m)	* Oromediterranean serie of *J. excelsa*		
MEDIT. **P R E S T E P P I C**	Mediterranean presteppic (1000 – 1500 m)	* Formation of *Hammada eigii* * Presteppic serie of *Q. calliprinos*		
	Presteppic supramediterranean (1400 – 1800m)	* Mixed presteppic serie of *Q. calliprinos* & *Q. infectoria*		
	Presteppic montane mediterranean (1800 – 2400m)	* Montane presteppic serie of *J. excelsa*		
	Presteppic oromediterranean (> 2400 m)	* Presteppic oromediterranean serie of *J. excelsa*		

Table 2: Position of the classification scheme within the land cover map

Level 1 Land Cover	Level 2 Vegetation levels	Level 3 Mother-rock	Level 4 Vegetation series	Level 5 Evolution stage	Level 6 Floristic composition	Level 7 Management Status
Natural vegetation	i.e. Thermomedi-terranean	This level is part of the classification scheme though it will not show on the final layout, but it would be present as a layer of the map and also in the attribute table	i.e. Thermophile series of *Quercus calliprinos*	Forest	This level would be defined for each evolutional stage and embedded in the attribute table	managed
						unmanaged
				Shrubland		
				Grassland		
Cultural vegetation						Urban
Water body						
Unproductive land						Barren

__N. B.__: The levels that are within the double frame constitute the classification scheme.

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