

# The importance of protecting the Lebanese High Mountains:

## A preliminary ecosystem services assessment



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### **Note from the authors:**

This report presents the preliminary results of a multi-method analysis of diverse ecosystem services in the Lebanese High Mountains. Our aim is to help policymakers and advocacy organizations to visualize and understand the rich natural heritage of Lebanese High Mountains and the unique benefits they provide to the nation as a whole.

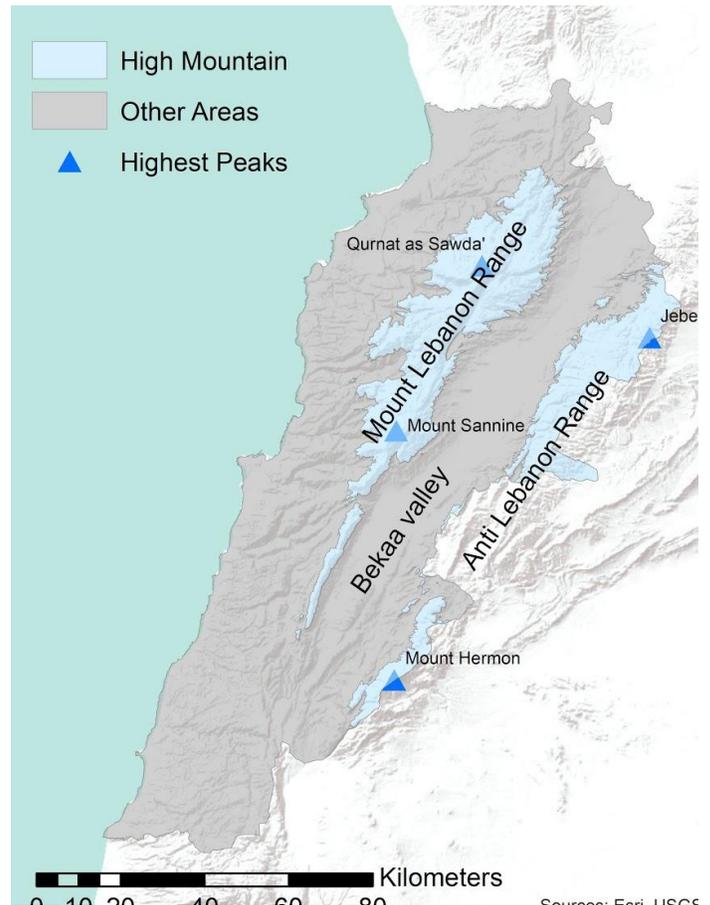
We use the Ecosystem Services framework, an internationally respected concept, and various mapping tools to bring out the multitude of returns that ecosystems provide human society in the case of the Lebanese High Mountains.

This document was prepared for the Lebanese Advocacy Network for the Environment to support in fostering the promulgation of an adequate and modern law for the protection of the high mountains regions in Lebanon.

## The Lebanese High Mountains

Lebanon is predominantly mountainous, including a narrow coast, two mountain ranges, the Mount Lebanon and Anti-Lebanon, that run parallel to the sea and are separated by the fertile Beqaa plain. In the southern part of the Country, an elevated plateau extends from the coast to the anti-Lebanon Mountain chain.

The Lebanese High Mountains, which occur at 1,500 m above sea level and above represent almost a quarter (22%) of the Country's surface (Figure 1). These areas are rugged, and they are mostly bare. Sporadic tree populations molded by strong winds and summer heat grow up to 1,550 m altitude. The lands then transform into sparse scrublands interspersed with screes, rocky grasslands, steep outcrops, and sinkholes. The Anti-Lebanon range is approximately 150 km long and includes the highest peaks, namely Jabal el-Shaykh (2,814 m a.s.l.), and Ta'la't Musa (2,669 m a.s.l.). These peaks, on the Lebanese-Syrian border, are snow-covered for much of the year.



## Critical reasons for protecting the Lebanese High Mountains

■ **Water.** Half (56 %) of the water that feeds major springs in Lebanon comes from snow and rains that accumulate on the Lebanese High Mountains. Similarly, a quarter (25%) of the water that goes into natural underground water reserves (aquifers) comes from the Lebanese High Mountains.

■ **Biodiversity.** Half (52%) of the Lebanese High Mountain terrain is necessary for the survival of a large number of plants, birds, and some animal species. Lebanon has an estimated 2,612 plant species that grow only in the East Mediterranean region. Most of these species occur in the Lebanese High Mountains, and many hold untold human benefits that have yet to be discovered.

■ **Agro-ecosystem.** Large areas of the Lebanese High Mountains contribute to the food security of the Country. More than 25,000 ha (11% of the high mountain surface area) are used as grazing lands for flocks. Additionally, 11,000 ha (5% of the high mountain surface area) is dedicated to the growing of fruit orchards and for the summer production of vegetables and pulses.

■ **Ecotourism.** One third (35-40 %) of the reported social media outdoor tourism activities in Lebanon take place in Lebanese High Mountains. People go to higher elevation mountains for physical fitness, to escape from the pressures of everyday life, and to enjoy snow-related activities.

■ **Climate change.** The Lebanese High Mountains help in climate regulation by storing 11% of Organic Carbon, and the evergreen forests clean the air contribute to protection against natural hazards and the impacts of extreme events.

*We need to take urgent measures to conserve Lebanon High Mountains because they are among the most sensitive regions in Lebanon to climate change, they are ecologically fragile, and given the economic marginality, low land value, and poor or absent governance, the areas are readily exploited and lands are carelessly destroyed by unregulated development.*



## **Explaining how the Lebanese High Mountains are essential:**

### ***Study Focus***

We have captured the values of the Lebanese High Mountains using ecosystem services: a standardized approach to classify and quantify natural resources in ways that are meaningful in both ecological and socio-economic terms. The ecosystem services conceptual framework enables us to better understand the multitude of ways by which people benefit from the Lebanese High Mountains, and what is really at stake when these areas are not protected, and environmental costs of destruction not considered.

### ***Ecosystem Services in the Lebanese High Mountains***

The concept of ecosystem services is defined as direct and indirect goods and services provided by ecosystems (Millennium Ecosystem Assessment, 2005). Ecosystem services are organized into four categories, and the framework gives a standardized method to classify and quantify natural resources in terms that are useful for socio-economics.

#### ■ ***Provisioning services.***

All elements and aspects of nature that we use, for example, water, fertile lands for farming, plants, and animals that we eat, and material that we use to build and to produce different forms of energy.

#### ■ ***Regulating services.***

How nature regulates our immediate environment, for example, trees purify our air, water going through plants and

soil is cleaned, bees pollinate our orchards and farms, and woodlands reduce floods.

#### ■ ***Cultural services.***

How nature connects us to our heritage. For example, the cedar tree is the symbol of Lebanon. The pine forests remind us of summers in the mountains, and wild plants have enriched the Lebanese cuisine. Nature is ever-present in our traditional songs, and holy sites are hidden in our mountains and rocks. Finally, our health is best served when we take a hike in a forest far from pollution and noise.

#### ■ ***Supporting services.***

How nature is interconnected, and every element supports another, for example, the water cycle, soil formation, nutrient cycling, and the provision of habitats for all forms of life on earth.

### ***Method to identify ecosystem services in the Lebanese High Mountains***

We used the definitions and framework provided by the Economics of Ecosystem and Biodiversity (TEEB). We mapped 11 ecosystem services using different models and methods, each catering for the ecosystem service in question (Table 1).



<b>Selected ecosystem service</b>	<b>Indicators and data used</b>	<b>Model adopted</b>
<b>Provisioning</b>		
Food	a)number of grazing animals distributed over the pasture area b)surface of high mountain orchards and terraces	in house method (Crossman framework)
Water	Climatic data, digital elevation model (dem), soil groups, watershed, land use.	InVEST Seasonal Water, Local Recharge
Raw material	Wood area protected Areas and coniferous forest	in house method (Crossman framework)
<b>Regulating</b>		
Climate regulation	multispectral satellite images from MODIS GPP/NPP	ARIES Organic Carbon
Regulation of water flows	same as water plus Soil, Land-use, dem	(USPED)ARIES Erosion Control from Vegetation
Maintaining soil fertility	Quickflow map, nitrogen probable sources, watersheds, climatic data.	InVEST, Nutrient Delivery Ratio
Water treatment	Quickflow map, nitrogen probable sources, watersheds, climatic data.	inVEST, Effective Nitrogen retention
Pollination	climatic data, Land use, threats map	ARIES, Pollinators` probability
<b>Habitat</b>		
Life cycle maintenance	Important Bird areas (SPNL), Important Plant areas (IUCN), Important Wildlife areas (Chirdiac, 2019).	IBA, IPA, IWA scores
<b>Cultural and Amenity</b>		
Recreation	number of registration to facebook nature events	in house method (Crossman framework)
Ecotourism	Proximity of urban centres to strategic nature areas (refs on ARIES methods)	ARIES, potential for Ecotourism

Table 1. List of Ecosystem Services adopted from TEEB 2010[24], and model used for the mapping.

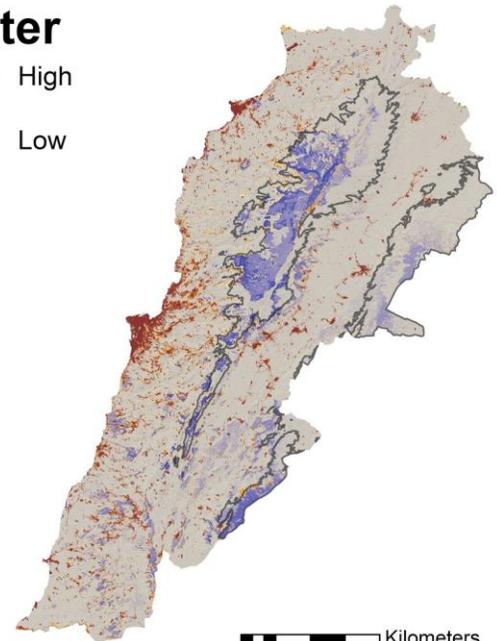


## ***Preliminary study findings***

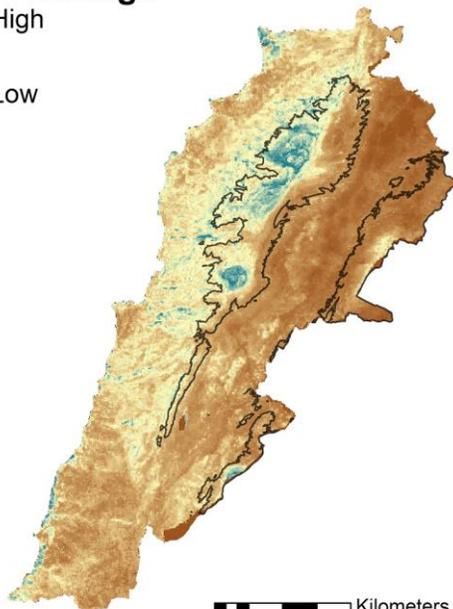
### ■ ***Provisioning services.***

**Water** is undoubtedly the most essential provisioning service in High Mountain Areas. Thanks to the Lebanese High Mountains, which hold some of the most significant peaks in the Middle East, the Country is considered water-rich relative to the region. This is because the Lebanese High Mountain Areas receive higher rates of precipitation, and perform critical storage of both ice and snow. Relative to other terrestrial ecosystems, they provide a high quantity of runoff and are birthing grounds for surface water such as springs and rivers and the primary contributors of groundwater. Lebanon is exceptionally reliant on seasonal precipitation and natural storage in the form of mountain snowpacks, which melts into the dry season and provides water resources to rural, peri-urban, and urban communities and industries.

### **Water**



### **Carbon Storage**



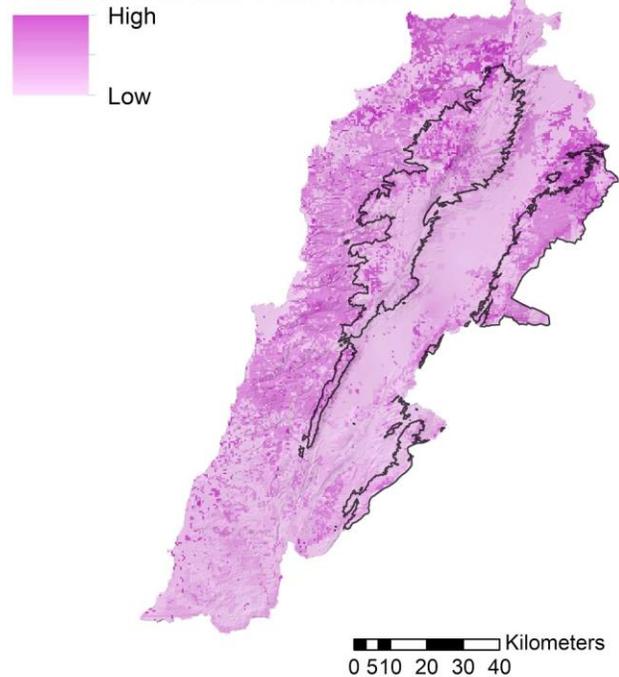
### ■ ***Regulating services.***

One of the most essential regulating services provided by the Lebanese High Mountains is **carbon storage**, which helps Lebanon play its part in mitigating climate change. Additional regulating services include regulation of pollination for agriculture, seed dispersal to foster forest growth, and natural pest and disease control. The extent to which the Lebanese High Mountains perform these roles in comparison to other terrestrial areas is still under investigation.

■ **Cultural services.**

The Lebanese High Mountains provide an abundance of opportunities for **tourism and recreation**, which are often at the core of the rural economies in the area. Ecotourism is on the rise in Lebanon, and its unique high mountain landscapes, ski slopes, and old-growth forests set it apart from neighboring countries. High mountain areas provide ample room for rural economic growth through responsible ecotourism. Also, many sites in the Lebanese High Mountains are considered to be sacred for various religions. This is particularly the case for the many who over the generations sought solitude in high altitude nature where they develop in their spirituality or gained inspiration from the serene landscapes.

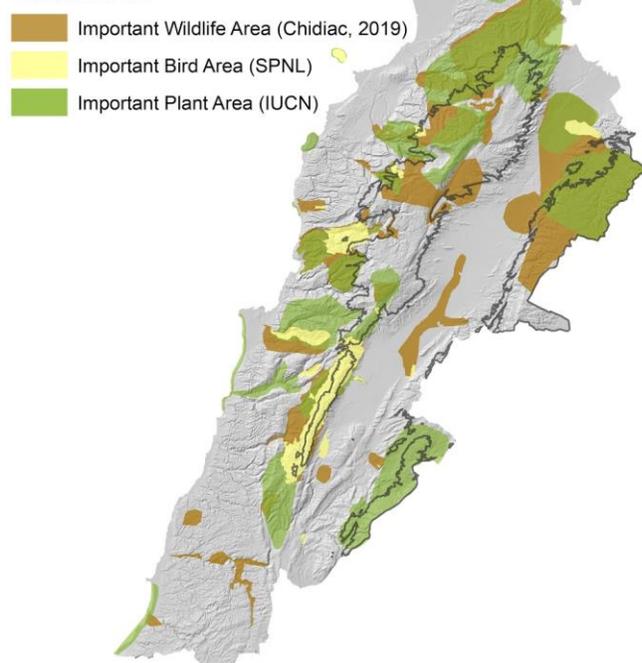
**Ecotourism and Recreation**

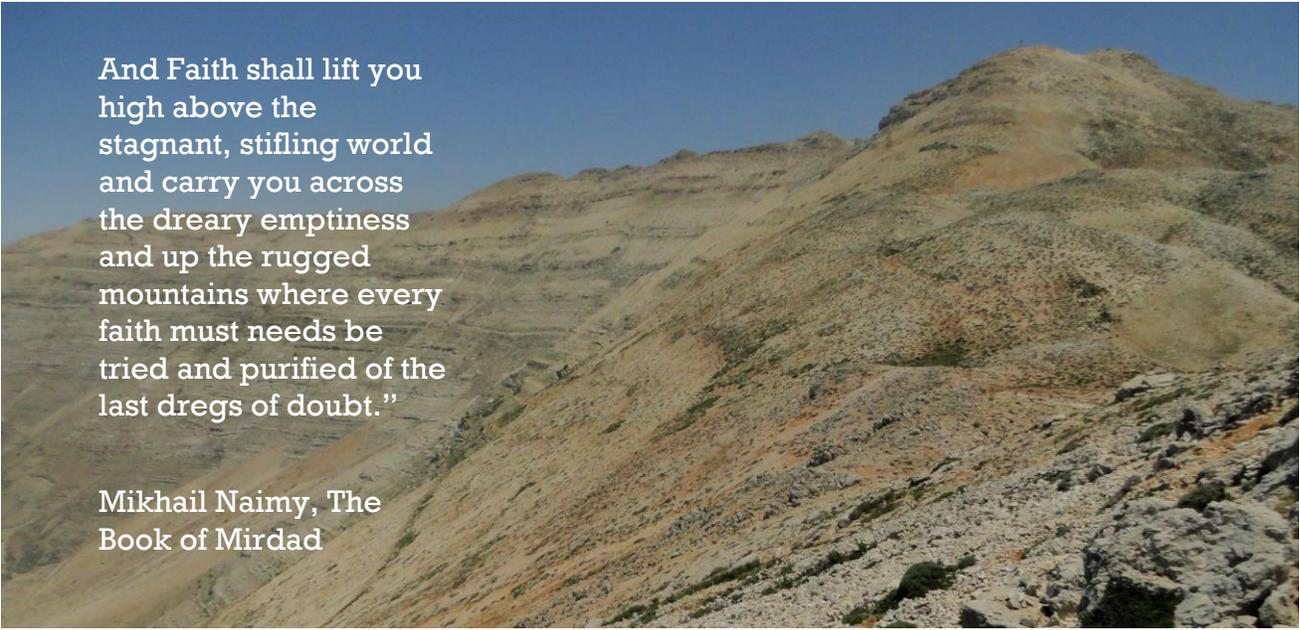


■ **Supporting services.**

The Lebanese High Mountains maintain a diversity of complex processes that underpin all the other ecosystem services. They provide **habitats** for many plants, birds and some animals, many of which are found nowhere else in the Country. These habitats are essential for the lifecycle of numerous species. The highest concentrations of Lebanese endemic plant species estimated at 2612 species occur in habitats found in Lebanon's highest summits. They retain a considerable portion of the Country's important bird areas and important plant areas. High mountain areas, therefore, create living space for genetic diversity, which has countless known and undiscovered agricultural, medicinal, and industrial applications.

**Habitat**





And Faith shall lift you  
high above the  
stagnant, stifling world  
and carry you across  
the dreary emptiness  
and up the rugged  
mountains where every  
faith must needs be  
tried and purified of the  
last dregs of doubt.”

Mikhail Naimy, *The  
Book of Mirdad*

### ***Threats and Uncertainties***

Particular attention needs to be given to the threats placed on the Lebanese High Mountains considering high susceptibility to exploitation and the resulting degradation of the fragile natural capital they offer. Policy-based actions that involve local communities and society at large are a critical part of realizing human development and healthy ecosystems.

The Lebanese High Mountains are extensively grazed during spring and summer. Overgrazing provides a case for improved management of provisional services in ways that keep connections and trade-offs between provisioning, regulating, and cultural typologies of ecosystem services.

Irresponsible tourism in certain localities in winter and/or summer can result in trampling and excessive generation of solid waste and wastewater that, in most cases, go untreated and openly dumped into the environment. Often times dumping occurs in waterways, degrading

habitats and causing pollution to downstream water users.

Different regions in the Lebanese High Mountains will become more fragile as they experience losses in habitat, biodiversity, and forest products from lower average precipitation resulting from climate change.

Political instability and economic deterioration are allowing uncontrolled exploitation and destruction of resources.

### ***Concluding Remarks***

The Ecosystem Services Framework is a useful tool to understand the quality, density, and distribution of benefits that people gain, particularly from Lebanese High Mountains. We presented preliminary results that provided concrete examples and evidence on the potential of the Ecosystem Services approach to inform decision-makers and galvanize environmental advocacy at various levels.

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