

Environmental Diversity and the Threats to Its Sustainability: A Case Study of Lebanon

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Abstract

Due to its small area, Lebanon is remarkably diverse environmentally and culturally. However, the socio-ecological systems of Lebanon and its green forests and resources are under significant threats by the rapid changes associated with an increasingly globalized world and human pressures on the environment. The purpose of this study is to document the threats to environmental sustainability in Lebanon in order to better understand the unique challenges of sustaining life in the country environments today. This study also aims to discuss potential solutions and propose recommendations that are needed to achieve this end. The study conclude that habitat loss, fragmentation and destruction, unsustainable exploitation of natural resources, various forms of pollution, climatic changes, and lack of awareness and vision are the main threats to environmental and cultural sustainability in Lebanon.

Keywords: Environmental diversity, threats, challenges, sustainability.

Introduction

15 years ago, 40 percent of the world lacked access to clean water, assuming what the current consumption patterns hold, compared to just 10 percent today. When we fast forward 20 more years to 2050, global food production used to feed 3.5 billion more people expected on earth will be lagging by 70 percent. However, underlying those grim numbers are other consequences of climate change likely to accelerate unless we drastically cut carbon emissions (Hepler & Grady, 2015).

Environmental sustainability is the ability to maintain the qualities that are valued in the physical environment. This include people wanting to sustain human life, the capabilities that the natural environment has to maintain the living conditions for people and other species (e.g. clean water and air, a suitable climate), the aspects of the environment that produce renewable resources such as water, timber, fish, solar energy, the functioning of the society despite non-renewable resource depletion, the quality of life for all people, and the livability

and beauty of the environment. Threats to these aspects of the environment mean that there is a risk that these things will not be maintained. For instance, the large-scale extraction of non-renewable resources (such as minerals, coal and oil) or damage done to the natural environment can create threats of serious decline in terms of quality, destruction, or extinction (Sutton, 2004).

Environmental diversity loss has become one of the greatest environmental concerns of the last century. This owes to the increasing pressure on the environment by humans combined with the realization that our activities can seriously threaten the future sustainability of the environment and ecosystems.

Historically, environmental, social, and cultural resilience mechanisms are slowly being eroded by external influences such as globalization and global environmental change (Gero et al., 2013).

According to a joint statement by fifty-eight of the world's scientific academies (1993), the magnitude of the threat to the ecosystem is linked to human population size and resource use per person. Resource use, waste production, and environmental degradation are accelerated by population growth. They are further exacerbated by consumption habits, certain technological developments, and particular patterns of social organization and resource management.

Consequently, the opportunities that ecosystems provide for future development are threatened by serious and increasingly sophisticated transnational organized environmental crime, undermining development goals, and good governance (Nellemann et al., 2014).

To sum up, the environment has a remarkable ability to sustain itself. However, human behaviors disrupt the natural environment and threaten environmental sustainability.

Environmental threats to its sustainability have approached the literature as a multi-dimensional phenomenon which addressed both theoretical and applied research. In a recent study, Samoury (2017) concluded that green tourism is a responsible and low-impact environmentally led form of sustainable tourism development. It is employed as a vehicle for conserving and sustaining natural and cultural environments as well as their resources. The report of Lebanese Ministry of Environment (2015) indicated that environmental situation

continues to be alarming due to many structural and emerging factors. Such factors include, but are not limited to, the weak enforcement of environmental regulations; the decline in the quality and quantity of water resources exacerbated by the impacts of climate change; the deterioration of our air quality due to emissions from the transport, industry and energy sectors; and, last but not least, the increasing pressure on Lebanon's biodiversity and natural heritage. Furthermore, these pressures both emanates from anthropogenic sources and climate change. At this stage, the country is witnessing extinction of some of its species and loss of its forest coverage. Lebanon's urban sprawl and haphazard urbanization was further aggravated by a dramatic increase of its population due to the influx of an overwhelming number of displaced Syrians. Thus, this made Lebanon the country that hosts the highest number of displaced people as a proportion of its population (nearly 30%).

The study of El-Zein et al. (2014) indicated that the Arab world faces large-scale threats to its sustainable development and, most of all, to the viability and existence of the ecological systems based on its human settlements. Nellemann et al. (2014) argued that ecosystems play a crucial role especially for developing economies by supporting revenues, future development opportunities, livelihoods, and sustainable harvest sectors relying heavily on natural resources, such as in agriculture, forestry, and fisheries. Healthy ecosystems provide the platform upon which future food production and economies are ultimately based.

Moreover, Page (2012) conclude that although French Polynesia is both ecologically rich and culturally unique, however, its socio-ecological systems are threatened by the rapid changes associated with an increasingly globalized world and human pressures on the environment. According to the World Bank (2011), the environmental sector in Lebanon is "characterized by an uncompleted legal and institutional framework as well as by ineffective policies to address the challenges and political constraints to deliver reforms".

The fourth national report of Lebanon to the convention on biological diversity (2009), found that nearly the same types of threats affect the mammals, birds, and reptiles of Lebanon where habitat loss appears to be the main threatening factor followed by chemical pollution, illegal hunting, and persecution. The study of Young (2008) indicated that sustainable solutions to the environmental threats and challenges will require innovative, practical, and cost-effective strategies that involve all stakeholders and that seek to improve the socio-economic conditions of these stakeholders.

Purpose and Scope

Findings leading to the Rio+20 UN conferences have emphasized the importance of sustainable development and the protection of the environment for future generations. Nevertheless, Lebanon, due to its small area, is remarkably diverse environmentally and culturally. However, the socio-ecological systems of Lebanon and its green forests and resources are under significant threats by the rapid changes associated with an increasingly globalized world and human pressures on the environment. The purpose of this article is to document the threats to environmental sustainability in Lebanon in order to better understand the unique challenges of sustaining life in the country environments today. Also, this study discussed potential solutions and proposed recommendations that are needed to achieve this end. The study is considered the first of its kind based on the author's knowledge. It is also one of the leading studies that demonstrated how environmental threats affect negatively its sustainability.

1. Environmental Natural and Cultural Diversity of Lebanon

1.1 The Status of Biodiversity in Lebanon

Though Lebanon has an outstanding variety of landscapes, the country has a very rich and unique biodiversity mainly due to its geographical location at the far eastern end of the Mediterranean Sea, its mountainous topography, and the great diversity in its climatic conditions. Lebanon is part of the Mediterranean region that is considered as a true "hotspot". Also, it ranks third in plant diversity and endemism after the Tropical Andes and Sundaland. There are 9119 known species in Lebanon, of which it is estimated that at least 4486 are faunal and 4633 are floral species (Lebanese Ministry of Environment, 2009; Saab, 2012).

One of the most remarkable features about Lebanon is the presence of such biodiversity in a very limited area of land. Lebanon covers 0.007% of the world's land surface area and hosts about 0.8% world's species. This high diversity over small surfaces is clear in terms of species/area ratio. Lebanon's vegetation has a very high species/area ratio of 0.25 species/km² compared to other countries that supposedly have larger green lands and occupy outstandingly larger areas than Lebanon. This is also true for faunal diversity where the ratio is 0.028 species/km² high as well compared to neighboring countries (UN Environment Program, 2010).

1.2 Terrestrial Biodiversity

Reports indicate that 81% of the floral species of Lebanon are terrestrial (MoA, 1996). Out of the report, 8.5% are endemic (221 species), 1.3% are rare (34 species), and 2.7% are threatened (69 species) (SOER, 2010). Endemism in Lebanon is significant, owing to its geomorphologic diversity and the isolation effect of its diverse topography. Lebanon has a high percentage of endemic plants species (12%). Analyses show that most of the endemic species are located on the high summits of the two mountain ranges (Mount Lebanon and Anti-Lebanon ranges), specifically at Mount Makmel, Mount Sannine, Quammoua, Ehden, and Mount Hermon. The isolation that characterizes these summits renders the alpine uplands to be a reservoir for endemic species. More than 100 species specific to Mount Hermon and the Anti-Lebanon range have been counted. Analyses (BCS, 1996) show that 46% of faunal species are terrestrial and that 7 mammal species are already extinct, 31% of the existing mammals are rare, 21% vulnerable, and 7.5% are close to extinction species (UN Environment Program, 2010).

In terms of avifauna, Lebanon is a host to large concentrations of migrating soaring birds each spring and autumn. Due to their mode of flight over long distances, soaring birds such as raptors, storks, cranes, and pelicans avoid sea crossings. In addition, they also fly on well documented migration pathways between their wintering grounds and summer breeding grounds. Birds are important bio-indicators as they are easily displaced if their habitats are disturbed or destroyed. According to the IUCN (2007) red list, Lebanon has recorded 394 species out of which 2 are endangered, 8 are vulnerable, and 15 are near threatened species (Ramadan-Jaradi et al., 2008; Saab, 2012).

Lebanon encompasses important components of the Mediterranean vegetation which are relicts from the ancient forests that dominated the Mediterranean Basin two million years ago. Also, they represent the past and present climax of the country. The flag plant species in the country is the famous *Cedrus Libani* that has been exploited since the rise of civilization in the Fertile Crescent. Thus, Lebanon is known for its forests which occupy 13% of the territory. The highest concentrations of dense forests are found in North Lebanon (30%) and Mount Lebanon (37%), followed by South Lebanon (9%) and Nabatieh (6%). Oak forests occupy the largest forests' surface areas (52.42%), while Cypress (0.15%), Cedar (0.80%), and Fir (1.76%) occupy the lowest cover areas. The relic Cedar and Fir forests host several endemic, threatened, and economic plant species. Mixed forests represent 17.98%, whilst the

Pine forests 14.91%, and the Juniper 8.74% (Lebanese Ministry of Environment, 2010; UN Environment Program, 2010).

1.3 Marine and Coastal Biodiversity

Lebanese waters represent less than 1% of the world's ocean surface. However, almost 6% of all global marine of species are found in those waters (SOER, 2010). This phenomenon can be explained by various historical, ecological, and paleo-geographical factors. The marine floral species of Lebanon represent 12% of the total floral species distribution and the marine faunal species 38% of the total faunal species of the country. The Lebanese coastal and marine flora is considered to be Mediterranean with some sub-tropical features, whilst the majority of marine species and ecosystems are typically Mediterranean. Within Lebanese territorial waters (up to 12 nautical miles) of 4702 km² and a continental shelf of 1169 km², the usual capture consists of marine fish, mollusks, and crustaceans (excluding aquaculture) (Lebanese Ministry of Environment, 2015).

1.4 Freshwater Biodiversity

A wide variety of organisms inhabit Lebanon's freshwater ecosystems, including invertebrates, mollusks, fish, and others. The faunal species in freshwater represent 16% of the total fauna biodiversity of the country and the floral species represent just 6% of the flora species. 5% of the countries freshwater fauna are threatened and 1.3% endemic. The only endemic freshwater fish of Lebanon, Levantine Minnow, is found in Yammouneh Lake, Litani River, and Qaraoun Lake. Many have been exterminated from particular river systems due to over fishing. Also, there are extensive pressures on Lebanon's inland aquatic ecosystems: water pumping, rivers channeling, and pollution of various origins (The World Bank, 2010, 2013).

1.5 Anthropogenic Impact on Biodiversity

Lebanon, as part of the biological diversity of the Mediterranean eco-region, has been greatly influenced by humans that date back 8000 years when the first significant deforestation began. Since that time, landscapes have been as much influenced by people as by nature. Today Lebanon's mosaic of overgrazed grasslands, agricultural lands, evergreen woodlands, and scrubland is an evidence of that. Richness in floral species is still considered high despite

centuries of deforestation and low forest cover. The soils and bedrock structure coupled with the variations in altitudes within small areas has probably contributed to this diversity. Until 2015, Lebanon has established 15 nature reserves to protect its high endemism and the value of its forests and bio-cultural diversity. Internationally, UNESCO in cooperation with the Man and Biosphere Program has identified three sites as Biosphere Reserves: Shouf Cedars Reserve, Jabal Moussa, and Jabal el Rihane. Birdlife International has listed 15 sites as Important Bird Areas (IBA) and there are 4 recognized Ramsar sites in the country. These sites are Ammiq Wetlands, Deir el Nouriyeh cliffs of Ras Chekaa, Palm Islands Nature Reserve, and Tyre Beach. Additional sites (river streams, sinkholes, forests, grottos, valleys, etc...) were declared as natural sites and landscapes under the protection of the Ministry of Environment and/or Agriculture. This is because they are containing one or more natural features or monuments of exceptional importance which deserve protection because of their rarity, representativeness, or beauty. Despite all these identifications, there is still a vital need for a continuous conservation of these areas to preserve the rich and important biodiversity present among the Lebanese landscapes (Lebanese Ministry of Environment, 2015).

Nature reserves have an important role in the protection and sustainable management of natural resources, especially biodiversity. They constitute a crucial component in local and rural development. This was possible through the influx of visitors who contribute via green tourism in augmenting the income of local communities living within the area of the natural reserves. The reserves' committees always work on enhancing the benefits of local communities without compromising the reserve's status by involving locals in their activities (The World Bank, 2011).

1.6 Lebanon's Multicultural Diversity

Lebanon has witnessed, through its long and deep-rooted history, several civilizations and has reflected all through the ages of the Levantine Mediterranean culture, cuisine, folks, history, archaeology, and architecture.

From Stone Age settlements to Phoenician city-states, from Roman temples to rock-cut hermitages, from Crusader Castles to Mamluk mosques and Ottoman hammams, the country's historical and archaeological sites were displayed all across the country reflecting ancient and contemporary world history. Lebanon has a long standing history of cultural diversity. Subsequently, keen interest in the Lebanese Levantine culture has emerged

following the visits of many European orientalists, scholars, and poets particularly Alphonse de Lamartine, Ernest Renan, and Victor Guérin (World Tourism Organization, 1999; Lebanese Ministry of Environment, 2009).

Lebanon's diverse atmosphere and ancient history make it an important destination which is slowly rebuilding itself after continued turmoil. Lebanon offers a plentiful array of cultural attractions: from ancient Roman ruins to temples, citadels and castles; historic Churches and Mosques; old towns and museums; world heritage sites; natural reserves and picturesque scenery; rivers, lakes and beautiful beaches nestled in the Mediterranean Sea; world-renowned Lebanese cuisine, vibrant nightlife to eco-tourist resorts; and mountainous skiing slopes. Significant private investment is currently being carried in the modernization and expansion of a tourism and hospitality sector. The government strongly believes that because of the return of peace and stability to the country and with the development of the necessary infrastructure, tourism will again contribute significantly to invigorate the Lebanon's economy (World Tourism Organization, 2005; Lebanese Ministry of Environment, 2009).

In spite of all of these optimistic expectations, there still remains a vital and primordial need for a continuous conservation of the historical and cultural heritage of Lebanon to preserve its rich environment and protect the Lebanese landscapes in view of a sustainable development. Therefore, this could only be accomplished through the implementation of green tourism principles to minimize environmental deterioration and cultural distortion and reach the anticipated goal of our project (Samoury, 2017).

2. Main Threats to Lebanon's Biodiversity and Environment

Despite Lebanon's rich biodiversity and natural environment, however there are threats including direct pressures on species and ecosystems (species extinction, reduction in genetic diversity, decrease in ecosystems resilience, etc...). On the other hand, there are indirect pressures and consequences on human wellbeing (impacts on health, increase in natural disasters, loss of tourism revenue, etc...).

The main identified threats to environmental and cultural sustainability based on Lebanon's biodiversity are: habitat loss, fragmentation and destruction, unsustainable exploitation of natural resources, various forms of pollution, climatic changes, and lack of awareness and vision. The terrestrial ecosystem of Lebanon is constantly suffering from habitat loss,

fragmentation and destruction, and sometimes with no possible regeneration. This also occurs due to chaotic and anarchical urbanization, amplified demographic pressure, absence of adequate urban planning, illegal constructions, lack of proper enforcement of construction law, and real estate speculations.

Forest fires are also responsible for the destruction of large areas that comprise many ecosystem habitats. The reasons behind this occurrence are the lack of forest management, fire prevention and law enforcement, the absence of civil defense, and insufficient awareness amongst the public.

Another cause for habitat loss, fragmentation, and destruction is deforestation (cutting trees for fuel wood during winter season) and the lack of a proper forest law enforcement (chopping Jupiter and various oak species for illegal production of charcoal). This constitutes a major threat for the vegetation cover as forests are often totally harvested even on very steep slopes. Declining forests are also threatened by overgrazing which can inhibit regeneration. Recreational tourist activities, such as ATV, quads, hunting, and camping are also considered as causes of deforestation.

Quarrying is also an important factor leading to habitat loss, fragmentation and destruction. This is because it accelerates the erosion processes and subsequent destruction of existing arable lands, modify preexisting ecosystems, change landscape patterns and integrity, destroy natural habitat, interrupt natural succession, and modify genetic resources. Sand is as well extracted from shores for construction purposes threatening such habitats also.

Recreational and leisure tourism activities can be harmful too to the surrounding environments. It can also contribute to habitat loss, destruction or fragmentation such as construction of beach resorts, hotels, restaurants, and outdoor activities on coastal areas, expansion of ski resorts, and construction of mountain and country clubs. It also involves camping and outdoor activities leading to forest fires and littering. The absence of an adequate strategy to manage the development of resorts, the lack of enforcement of construction regulations, and environmental impact assessments are the causes of such incidents.

Based on the unsustainable exploitation of natural resources, many violations were witnessed due to unsustainable hunting practices and hunting malpractices. The substantial harvesting

of trees, medicinal, and economic plants used for local consumption and many other environmental issues constitute also an additional malpractice. With an increasing population in Lebanon, the pressure on ground water for irrigation purposes is becoming more and more accentuated. This also puts the freshwater ecosystem at risk.

Poverty is a further major factor that drives people to behave in an unsustainable manner in order to meet their basic needs for survival, especially in peripheral areas of the North, South, and Bekaa where slums are continuously expanding.

Moreover, the sources of pollution threat to the terrestrial ecosystem encompass the discharge of untreated municipal wastewater due to the lack of treatment plants and the absence of adequate policies; the discharge of untreated industrial effluents; the improper solid waste disposal through the creation of open uncontrolled dumps; the excessive quantities of pesticides, fertilizers and agrochemicals used in the agro industries and the agricultural sector; the healthcare wastes that are usually discharged into the environment with no prior control or treatment; and the gas emissions from industries, incineration processes, vehicles and machinery, and heavy transportation.

Climate change is another omnipotent threat to the environment as the concentration of Green House Gases in the atmosphere is increasing. This, however, is enormously affecting all forms of life on earth including biodiversity. The main causes responsible for this phenomenon are the lack of alternative sources of energy, the overuse of fossil fuels, the absence of alternative public transportation options, and the insufficient adaptation to climate change due to lack of coordination and awareness.

Furthermore, many historical sites and monuments scattered in various locations all through Lebanon are permanently exposed to damage and deterioration. Also, many features of the Lebanese cultural heritage and traditions are continuously being distorted. All of these landmarks need to be sustainably protected and preserved for future generations.

Furthermore, there is effectively a lack of awareness and vision which allows the establishment of a national framework of Lebanon's biodiversity and environmental conservation in the longer term that imperatively need appropriate solutions.

Conclusion and Recommendations

Despite its relatively small area, Lebanon is remarkably diverse environmentally and culturally. It currently faces many threats and challenges related to habitat loss, fragmentation and destruction, unsustainable exploitation of natural resources, various forms of pollution, climatic changes and lack of awareness and vision, which leads to further pressure on the country's natural resources. In order to achieve long-term environmental and cultural sustainability, Lebanon have to strike the right balance between remaining open to the world and preserving the cultural richness and natural resources within its archipelagos. This is in a bid to limit their negative impacts that can sometimes become irreversible. Community involvement and cooperation of local community representatives, conservationists, tourism operators, property owners, policy makers, those preparing national development plans, and site managers is central to the success of sustainable development initiatives. In addition, further research to expand the understanding of environmental threats and the challenges to its sustainability is recommended.

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