



# CLIMATE RISK PROFILE LEBANON

## COUNTRY OVERVIEW

Lebanon is a highly urbanized, middle-income country whose temperate climate and collection of world heritage sites drive its thriving tourism industry. Climate change, manifested through rising sea levels and increasing temperatures, is expected to impact the densely populated coastal urban areas that host infrastructure and industry critical to the economy. Over 85 percent of Lebanon's residents live in urban areas concentrated along a coastline that is vulnerable to sea level rise, with damages projected to cost \$140 million in losses by 2040. The tourism industry contributes 20 percent to the country's GDP, and the country's popular attractions, like ski resorts, are highly weather-dependent and vulnerable to higher temperatures. With an underdeveloped agriculture sector, Lebanon imports most of its food, and rising world food prices, compounded by the effects of global climate change on agricultural yields, will increase the cost of guaranteeing food security. Although small, the agriculture sector still contributes 6 percent to GDP, primarily through wine grapes and citrus production, which are themselves vulnerable to the higher temperatures and more variable rainfall patterns currently experienced and projected to continue. The economic and social impacts of the Syrian crisis compound Lebanon's challenges, as the influx of refugees has strained Lebanon's public finances, service delivery and environment. By necessity, this situation will continue to divert critical resources from climate change adaptation planning. (7, 11, 12)



## CLIMATE PROJECTIONS



1.2–1.7°C increase in temperatures by midcentury (2045-2065)



30–60 cm rise in sea levels by 2040



Decreased total precipitation; more frequent heat waves and drought

## KEY CLIMATE IMPACTS

### Agriculture

Decreased agricultural productivity  
Shift in production zones  
Loss of pasture lands and water resources



### Coastal Resources

Flooding of coastal areas  
Erosion of sandy beaches



### Tourism

Losses to key tourist hotspots, particularly ski resorts, beach resorts and wineries



### Water

Reduced water supply  
Degradation of water quality  
Salinization of coastal aquifers



**December 2016**

This document was prepared under the Climate Change Adaptation, Thought Leadership and Assessments (ATLAS) Task Order No. AID-OAA-I-14-00013 and is meant to provide a brief overview of climate risk issues. The key resources at the end of the document provide more in-depth country and sectoral analysis. The contents of this report do not necessarily reflect the views of USAID.

## CLIMATE SUMMARY

With its location on the eastern Mediterranean Sea, a north-south orientation and a mountainous terrain, Lebanon encompasses four climate-geographical zones: (1) a flat, narrow coastal plain that runs parallel to the Mediterranean Sea; (2) the Lebanon Mountains; (3) the Bekaa Valley; and (4) the Anti-Lebanon mountain range. The climate is characterized by hot, dry summers with low precipitation levels (June–Sept.) and cool, rainy winters (Dec.–mid-March). Nearly 70 percent of rain falls between November and March as heavy storms. The coastal areas experience higher temperatures (reaching up to 30°C in the summer) and humidity, while the mountainous regions exhibit colder temperatures and heavy winter snows. (8, 10, 11, 13)

### HISTORICAL CLIMATE

Since 1960 (unless otherwise stated) climate trends include:

- Increase in annual mean temperature of 0.11 °C per decade, more in spring and summer.
- Increase in the number of “hot” nights by 7 percent, mostly from June to September.
- Decrease in precipitation of 11 mm per month on average since 1950.
- Increase in the amount of rainfall received during one-day extreme rainfall events.
- Rising Mediterranean Sea levels of roughly 20 mm per year.
- Increase of 1.3°C in Mediterranean Sea surface water temperature since 1982.

### FUTURE CLIMATE

Projected climate changes include:

- Increases in mean annual temperatures between 1.2– 1.7°C by mid-century.
- Decrease in precipitation of 4–11 percent by 2100
- Reduced snow cover of 40–70 percent and decreased snow residence time from 110 days to 45 days.
- Increased incidence of drought conditions.
- Continued sea level rise, rising by a total of 30-60 cm in the next 30 years.
- Increased frequency of heat waves and decreased number of frost days.

## SECTOR IMPACTS AND VULNERABILITIES

### AGRICULTURE PRODUCTION

Agriculture in Lebanon, largely dedicated to wine and citrus production, is one of the most climate-vulnerable sectors due to the country’s limited water and land resources. These resources are under increasing pressure from population growth and urbanization, which heighten demand for agricultural products and translate to more intensive agriculture, including increased use of fertilizers and irrigation. Lebanon’s diverse agricultural productivity, ranging from semi-tropical produce in coastal areas to orchards in high mountains, is already strained from higher temperatures, reduced precipitation and high evapotranspiration (decreasing soil moisture and increased aridity). Some farmers have responded to the hotter and drier growing conditions, for example by increasing the area of unirrigated vineyards. Additionally, Lebanon’s steep slopes are prone to erosion and topsoil loss, exacerbated by storms and other climate impacts. Crops particularly at risk are cherries, apples and grapes, the last of which has implications for the country’s wine industry. Changes in temperature and rainfall will also affect the grazing period and quality of pastures, causing a shift in grazing patterns for livestock. Sea level rise

### Climate Stressors and Climate Risks AGRICULTURE PRODUCTION

Stressors	Risks
<b>Increased temperatures</b>	Reduced productivity of land used to produce most crops and fruit trees
	Reduced fruit tree yields of up to 50 percent through blossom pollination and fecundation of mountainous fruit trees
<b>Reduced rainfall and snow cover; increased incidence of drought</b>	Migration of mountain fruit production to higher elevations
	Decreased crop quality, particularly for wine grapes
<b>More frequent heat waves and fewer frost days</b>	Increased vulnerability of agricultural plains of Akkar, Damour, Saida and Tyre to coastal flooding and inundation
	Reduced soil moisture availability, with impacts on agricultural yields
<b>Sea level rise</b>	Increased infestation of fungi and bacterial diseases
	Shift of grazing areas and periods for livestock

threatens important coastal banana and tomato plantations through increased salinization of soil. (2, 3, 4, 8, 11)

## WATER RESOURCES

Lebanon’s surface flows and groundwater sources are increasingly stressed by climate changes along with high population growth, increased demand from agriculture and industry, inadequate water storage capacity, increased water pollution and inefficient utilization. Per capita renewable water resources are below the scarcity threshold, with further decreases projected. Of particular concern is the changing nature of mountain snow cover, which is projected to decrease by 40 percent (70 percent under a 4°C warming scenario). The snow line is also projected to shift from an elevation of 1500 meters to 1700 meters by 2050. A vital water source in Lebanon, changes in snow levels will negatively impact retention, and therefore water supply, particularly from April to June (a period of high demand for water for irrigation), reducing river flows. Water deficits are especially acute in the Bekaa Valley, a key agricultural area, where potential evapotranspiration exceeds 70 percent of precipitation, adversely impacting river and groundwater recharge. Reduced precipitation (both snow and rain) is likely to increase the incidence of

## COASTAL RESOURCES

Lebanon’s coastal zones are vulnerable to rising sea levels and increased sea surface temperatures. The majority of the country’s population and economic activity is concentrated in the coastal zone, including Lebanon’s four largest cities (Beirut, Saida, Tripoli, Tyre) and ports, which together contribute more than 74 percent of GDP. Beach resorts and marinas, historical/archaeological monuments, diverse ecosystems (Ras Chaqaa, Enfeh, Pigeon Rock) and natural reserves (Palm Islands, Tyre Coastal Nature Reserve) are all located in the coastal region. Sea levels are rising at an average rate of approximately 20 mm annually in the region, and are projected to rise by a total of 30–60 cm in the next 30 years. This will continue to erode sandy beaches in the south, and could inundate important natural reserves such as the Palm Islands and the Tyre, which provide nesting sites for endangered loggerhead and green sea turtles. Poor land use planning, high population density, concentrated industrial/commercial activity and weak enforcement capacity all contribute to coastal zone vulnerability. (5, 7)

Climate Stressors and Climate Risks WATER RESOURCES	
Stressors	Risks
Increased temperatures	Increased evaporation of surface water sources
	Reduced snow cover, earlier snowmelt altering seasonal water regimes
Reduced rainfall and snow cover; increased incidence of drought	Reduced river flows and increased strain on limited groundwater sources, limiting freshwater supply
Sea level rise	Salt water intrusion/salinization of coastal aquifers; destruction of coastal water infrastructure

drought, while higher temperatures will amplify the effect of drought. Already dry regions such as the Bekaa, Hermel and the south will be the most sharply affected by longer drought periods. Saltwater intrusion into limited coastal aquifers, particularly in Choueifat-Rmeileh region, is already a problem and will continue with rising seas. (1, 2, 4, 8, 11)

Climate Stressors and Climate Risks COASTAL RESOURCES	
Stressors	Risks
Sea level rise	Coastal and shoreline erosion, leading to loss of sandy beaches and forcing expansion of coastal plantations to higher elevations
	Coastal flooding and inundation of natural reserves, beach resorts and harbors
Increase in sea surface temperatures	Increased vulnerability of agricultural plains of Akkar, Damour, Saida and Tyre to coastal flooding and inundation
	Temperature-induced changes or declines in marine fish stock and marine biodiversity (increase in sardine population, but also an increase in toxic algae blooms)
Increase in the frequency and intensity of weather events	Increased risk of damage and destruction of coastal urban infrastructure and services
	Economic losses in coastal and marine activities such as tourism, agriculture, fisheries and transportation

## TOURISM

The tourism industry is one of the most important economic sectors in Lebanon, contributing 7.6 percent to GDP (20 percent when indirect investments are considered). The sector also employs 38 percent of the country's workforce. A changing climate could severely impact tourism, as many of the major Lebanese tourist attractions are weather-dependent, and the mild Mediterranean climate itself is a tourism draw. The ski region of Mzaar Kfardebian, home to the largest ski resort in the region, reported losses of up to \$20 million in 2010 due to unseasonably warm temperatures. Rising sea levels will impact low-lying beach areas and coastal reserves, while reduced rainfall will impact the quality of wines (and tourism potential of wineries by extension), and the increased

## POLICY CONTEXT

### INSTITUTIONAL FRAMEWORK

Established in 1993, the Ministry of Environment (MoE) is the focal point to the United Nations Framework Convention on Climate Change (UNFCCC) and oversees all climate change-related activities. MoE and other government agencies (Ministry of Water and Energy, Ministry of Public Works and Transport, Ministry of Agriculture, Council for Development and Reconstruction, Directorate General for Urban Planning, etc.) develop legal and regulatory instruments to protect the environment. Policies are addressed by the highest Executive level (through the MoE at the Council of Ministers) as well as by the Legislative Branch (through the Environmental Committee of the Parliament).

Climate Stressors and Climate Risks TOURISM	
Stressors	Risks
Increased temperatures; more frequent heat waves	Shortened ski season due to earlier snowmelt; shift of skiing regions to higher elevations
	Decreased quality of grapes in wine-producing regions
Reduced snowpack and snow residence time	Reduced tourism demand on coast due to climate-related biodiversity reductions
Reduced rainfall	Damages to coastal tourism infrastructure, particularly beachside resorts; losses due to coastal erosion at key tourist hotspots
Sea level rise	

occurrence of extreme heat waves will damage Lebanon's reputation and attractiveness for mild weather vacations. (5, 7, 8, 9)

The Climate Change Coordinating Committee (CCCC), led by the MoE, was established following ratification of the Kyoto Protocol. In cooperation with its various focal points located at the line ministries, government agencies, private sector and academic institutions, the CCCC oversees execution of all climate change activities as well as climate mainstreaming. (6, 7)

### NATIONAL STRATEGIES AND PLANS

- [Lebanon's Intended Nationally Determined Contribution under the UNFCCC](#) (2015)
- [Third National Communication](#) (2016)
- [Second National Communication](#) (2011)
- [First National Communication](#) (1999)
- [National Water Sector Strategy \(NWSS\)](#) (2012)

### KEY RESOURCES

1. Bou Zeid, E., and M. El-Fadel. 2002. [Climate Change and Water Resources in Lebanon and the Middle East](#).
2. Farajella, Nadim, et al. 2010. [The National Economic, Environment and Development Studies \(NEEDS\) for Climate Change Project Final Report](#).
3. Farajella, Nadim, et al. 2014. [Climate Change in Lebanon: Higher-Order Regional Impacts from Agriculture](#).
4. Republic of Lebanon. 2012. [Technology Needs Assessment Report for Climate Change](#).
5. Republic of Lebanon Ministry of Environment Climate Change Portal. [Vulnerability and Adaptation](#).
6. Republic of Lebanon Ministry of Environment Climate Change Portal. [Negotiations](#).
7. MoE. 2011. [Second National Communication](#).
8. MoE. 2016. [Third National Communication](#)
9. Riebe, Manja. 2010. [Climate change and Tourism in Lebanon](#). Heinrich Boll Stiftung Middle East.
10. United Nations Development Programme. [UNDP Climate Change Country Profile, Lebanon](#).
11. World Bank Climate Change Knowledge Portal. 2016. [Climate Risk and Adaptation Profile, Lebanon Dashboard](#).
12. World Bank Country Profile. 2016. [Lebanon](#).
13. World Travel and Tourism Council. 2015. [Economic Impact 2015 Lebanon](#).
13. Zodiatis, G., and Y. Samuel-Rhoads. n.d. [Climate change impacts on SST in the Mediterranean](#).

Map modified from: [World Atlas, Lebanon](#).

## SELECTED ONGOING EXPERIENCES

Selected Program	Amount	Donor	Year	Implementer
Hilly Areas Sustainable Agricultural Development Project	\$36.64 million	IFAD	2012–2017	Ministry of Agriculture
Climate Smart Agriculture: Enhancing Adaptive Capacity of Rural Communities in Lebanon	\$7.8 million	Adaptation Fund, IFAD	2014–2018	Ministry of Agriculture
Sustainable Agriculture Livelihoods in Marginal Areas	\$33.25 million	GEF, FAO	2012–2017	Ministry of Agriculture
National Action Programme to Mainstream Climate Change into Lebanon’s Development Agenda	\$0.5 million	UNDP	2013–2015	Ministry of Environment
Lebanon’s Low Emission Capacity Building Programme	\$0.674 million	European Commission and partners	2013–2015	Ministry of Environment