



# CLIMATE CHANGE RISK PROFILE MOROCCO

## COUNTRY OVERVIEW

Morocco has enjoyed steady economic growth in recent years, supported in part by strong agriculture and fisheries sectors that contribute 14 percent to GDP and employ more than half of the population. However, climate variability and change are putting increased pressure on these climate-sensitive sectors, as evidenced by the 2016 drought – the worst in 30 years – which reduced cereal yields by 70 percent and projections suggest will slow economic growth. Tourism, key to wealth and job creation, contributes 12 percent to GDP and is vulnerable to rising seas that damage buildings, roads, natural heritage sites, beaches and resorts. Sea level rise is also associated with erosion and flooding and poses a risk to the entire coastline, where 60 percent of the population and the majority of industry and economic activity are located. The predominant climate concern for Morocco is the impact on limited and declining water resources. With water demand expected to increase due to population growth, expanded irrigation schemes and tourism, and water resources projected to decline due to increased drought conditions, water shortages are expected by 2020, particularly in the south. (6, 10, 17)

## CLIMATE PROJECTIONS



1–1.5°C increase in temperatures by 2050



Reduced precipitation; increased incidence of drought conditions



Rising sea levels and coastal flooding

## KEY CLIMATE IMPACTS

### Agriculture

Reduced yields of rainfed crops  
Shortened growing season  
Increased demand for irrigation



### Water

Degradation of water quality  
Reduced supply of freshwater resources  
Increased reliance on groundwater



### Coastal Zones

Coastal erosion and flooding  
Damage to infrastructure  
Increased risk to tourism development



### Fisheries

Reduced productivity  
Migration of species to cooler waters  
Habitat loss/degradation



### Ecosystems

Reduced regeneration of native forests  
Loss and/or migration of critical species  
Drying/degradation of wetlands and oases



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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

Morocco’s climate is as varied as its topography, which includes the Rif Mountains in the north, the Atlas Mountains in the center, plateaus in the east, plains and coast in the west, and desert in the south. Most of Morocco, particularly along the coast, experiences a typical Mediterranean climate, with mild, wet winters and hot, dry summers. The rainy season extends from November–March, with average annual rainfall of 1200 mm. The south is much drier and only receives 100 mm of rainfall on average each year. In the summer, temperatures along the coast range from 18–28°C and can reach up to 35°C in the interior. In the winter, temperatures along the coast are 8–17°C and can drop below freezing in the interior mountain areas. (10, 12, 13, 17)

### HISTORICAL CLIMATE

Since the 1960s, climate trends include:

- An average temperatures rise of 1°C, with rate of increase most rapid from April–June.
- Increase in the annual number of days (21) and nights (40) classified as “hot.”
- More erratic and overall declining precipitation.
- Shift in seasonal rainfall patterns – longer and more intense rain events in October and November (often causing floods) and substantial reductions during the rest of the year.
- Increase in the frequency and intensity of extreme events (droughts, floods, heat waves).

### FUTURE CLIMATE

Future climate trends include:

- Rising temperatures of 1–1.5°C by 2050 (rate of warming faster in the interior).
- Decrease in average precipitation by 10–20 percent across the country; 30 percent decrease for the Saharan region by 2100.
- Reduced snowpack in the Atlas Mountains.
- Continued increase in the number of days and nights classified as “hot.”
- Increased incidence of drought conditions.
- Rise in sea levels between 18–59 cm by 2100. (3, 6, 8, 10, 15, 17)

## SECTOR IMPACTS AND VULNERABILITIES

### WATER RESOURCES

Morocco’s water resources are unevenly distributed across the region; the coastal plains are flooded consistently while the south suffers from water shortages year-round. Renewable water resources per person have declined by almost 60 percent since 1960 due to non-climate stressors such as population growth in the north, irrigation expansion, and urban, industrial and tourism development. At the same time, rising temperatures and more erratic rainfall have reduced river flows and increased evaporation and siltation of storage dams, leading to a 20 percent reduction in overall water resources in the last 30 years. For example, reservoirs of the Hassan Addakhil and Idriss I, both critical water sources, are projected to decrease between 7–40 percent by 2080. Climate change will increase demand for irrigation, which already consumes 90 percent of available water, even though only 13 percent of farmed land is irrigated. Increased water stress will inevitably lead to overexploitation of groundwater resources, and is already happening in Souss, Haouz and Saïss. (1, 4, 7, 8, 10, 17)

Climate Stressors and Climate Risks WATER RESOURCES	
Stressors	Risks
Rising temperatures	Reduced stream flows and water availability overall
	Water shortages as early as 2020, particularly in the south
Reduced snowpack	Shift in seasonal water availability; increased flooding in October and November, reduced availability rest of the year
More erratic precipitation; increased drought conditions	More rapid springtime melting, reducing supplies of seasonal snowmelt for lowland areas
	Increase in demand for irrigation
Increased frequency of intense rainfall events	Accelerated siltation of dams from heavy rainfall
	Increased reliance on groundwater resources; risk of overexploitation and insufficient recharge; lower water tables
	Reduced surface water quality due to concentration of pollutants

## AGRICULTURE PRODUCTION

Agriculture is critical to the Moroccan economy and rural livelihoods, but has suffered as population pressure and erratic rainfall have pushed production into fragile and degraded land. Crop production is primarily rainfed (87 percent) and is highly vulnerable to increased rainfall variability (particularly barley and wheat). The recent 2016 winter grain harvest is a striking example: harvested yields were 70 percent lower than in 2015 due to widespread drought. Hotter, drier conditions will increase crops' water requirements by up to 12 percent, increasing demand for irrigation and further stressing limited water resources. Drought also promotes proliferation of the Hessian fly (midge), increasing risk of damage to wheat yields. (1, 5, 9, 12)

## COASTAL ZONES

Morocco has an extensive coastline on which 60 percent of the population, 90 percent of industrial activity, and important natural reserves are located. Coastal erosion from sea level rise is an issue in Saidia (due to its low altitude and sandy beaches) and Tangier, where erosion is already estimated to be 2–3 m per year. Low-lying lands at risk from flooding due to sea level rise include the Nador Lagoon, the Moulouya River and its delta (a biologically important estuary), and the low-lying coastal plains of Oued Nekkor and Oued Laou. If sea levels rise 0.86 m by 2100, Tangier Bay is projected to lose 99.9 percent of its port infrastructure and 63 percent of the city's industrial zone. These climate risks are worrisome as the coast continues to draw people from the drought-

## FISHERIES

Morocco's thriving fisheries sector produces an estimated 1 million tons annually (mainly sardine and mackerel) and constitutes an important source of foreign currency inflows, valued at \$1 billion. The sector is an important employer for coastal and rural communities, but is under growing threat from non-climate stressors such as illegal and unregulated fishing practices and pollution. Climate change will further aggravate these issues as increased temperatures induce migration of fish species, particularly plankton, and open the way for invasive species to outcompete those upon which the industry relies. Fish habitats are impacted by rising sea levels and by toxic algae blooms caused by warmer Mediterranean waters. (10)

Climate Stressors and Climate Risks AGRICULTURE PRODUCTION	
Stressors	Risks
Rising temperatures	Reduced yields (50–75 percent) of rainfed crops during dry years
	Proliferation of Hessian fly populations and emergence of new pests and diseases
More erratic precipitation; increased drought conditions	Shortened growing season; reduced yields and/or lowered productivity
	Decreased water availability for irrigation, reducing profitability of irrigated agriculture (need to pump groundwater)

Climate Stressors and Climate Risks COASTAL ZONES	
Stressors	Risks
Rising sea levels	Flooding of low-lying coastal areas
	Coastal erosion (two-thirds of beaches are at risk)
	Increased risk of flooding from tidal storms and "mini tsunamis" (occurred in Casablanca in 2014)
More erratic rainfall	Salinization of coastal aquifers, leading to water shortages (especially in the central and eastern Mediterranean coast)

ridden interior, and developing tourism and other industries along the coast continue to be a development priority. (1, 2, 10, 14)

Climate Stressors and Climate Risks FISHERIES	
Stressors	Risks
Increased sea surface temperatures	Temperature-induced migration of plankton and/or changes in composition and hatching
	Decreased productivity of crustaceans, corals and echinoderms
Rising sea levels	Loss of habitat and spawning grounds
Increased acidification of ocean	Increased upwelling and changes to ocean circulation, decreasing productivity
	Increased risk of toxic algae blooms, impacting shellfish
	Loss of livelihoods for coastal populations

## ECOSYSTEMS

Morocco hosts a remarkable diversity of climate zones; the High Atlas Mountains are considered a biodiversity hotspot in the Mediterranean region. In addition to their natural and social value, Morocco's ecosystems have economic potential (ecotourism, for example) that is vulnerable to a changing climate. Of particular concern are cedar and fir forests, which are already under pressure due to population growth and continued use of firewood for fuel. Forest dieback has been observed in the Rif, Middle and High Atlas Mountains, where native trees are being replaced by more drought-tolerant species. Coastal erosion and sea level rise threaten habitats of rare and endemic species in wetlands and estuaries in places like the Moulouya River delta. The oasis in Sous-Massa suffers from land degradation and biodiversity loss associated with higher temperatures and drier conditions. (1, 9, 10)

Climate Stressors and Climate Risks ECOSYSTEMS	
Stressors	Risks
Rising temperatures	Biodiversity loss and/or migration of species to cooler, more humid climates
	Increased forest dieback and lack of regeneration (particularly <i>Sapin de Talasemtante</i> , <i>Tizilfri Ceder</i> , <i>Rif Ketama</i> , <i>Rif Ceder</i> and <i>Spanish Juniper</i> )
More erratic rainfall; increased drought conditions	Increased risk of forest fires (particularly in the Rif Mountains)
Rising sea levels	Habitat loss due to coastal erosion; disturbance to important migratory sites for birds
	Increased land degradation and lower water levels in oases and wetlands

## POLICY CONTEXT

### INSTITUTIONAL FRAMEWORK

Morocco's National Committee for Climate Change was established in 2007 and oversees all climate-related activities. The committee is chaired by the Department for the Environment, which is also the national focal point for the United Nations Framework Convention on Climate Change (UNFCCC). Morocco's National Plan of Action against Climate Change (PNRC) focuses on investing in renewable energy and energy efficiency. A range of sectoral strategies, including "Plan Maroc Vert," complement the Climate Change Plan. (10)

### NATIONAL STRATEGIES AND PLANS

- [Third National Communication to the UNFCCC](#) (2015)
- [Moroccan Climate Change Policy](#) (2014)
- [National Plan of Action Against Climate Change](#) (PRNC) (2009)
- [Intended Nationally Determined Contribution](#) (2015)
- [National Charter for Environment and Sustainable Development \(2012\) and Framework Law](#)

### KEY RESOURCES

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## SELECTED ONGOING EXPERIENCES

Selected Program	Amount	Donor	Year	Implementer
Adaptation to Climate Change and Biodiversity	Not available	GIZ	2013–2016	Ministry Delegate to the Ministry of Energy, Mines, Water and Environment, Morocco; High Commission for Waters, Forests and Combating Desertification, Morocco
Desert Ecosystems and Livelihoods	\$3 million	GEF, World Bank	2016–2021	Ministry of Agriculture and Maritime Fisheries
Community-based Adaptation Project	\$6.7 million	UNDP, GEF small grants	Ongoing	Local NGOs, UN Volunteers
Climate Change Adaptation in Oasis Zones – PACC-ZO	\$9.9 million	Adaptation Fund	2016–2020	Agence pour le Developpement; National Agency of Development of Oases and Argan Tree Zones
Integrated Disaster Risk Management and Resilience Project	\$200 million	World Bank	2016–2021	Ministry of the Interior