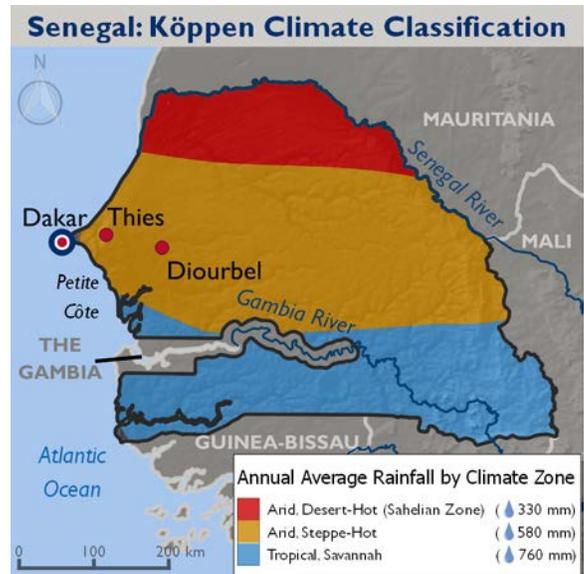




# CLIMATE CHANGE RISK PROFILE SENEGAL

## COUNTRY OVERVIEW

Senegal is one of the most politically stable countries in Africa and has maintained steady economic growth over the last decade. Nonetheless, Senegal remains vulnerable to environmental shocks that threaten its stability, including recurring natural disasters (particularly floods and droughts) that will increase in magnitude and extent due to increased climate variability. Between 1970 and 2000, the country suffered prolonged droughts that contributed to a rural exodus. Today, roughly 67 percent of Senegal’s population resides in the urban coastal zone, also the location of 90 percent of Senegalese industrial production. This coastal area is characterized by low-lying, rapidly expanding, high-population suburbs, high water tables and poorly planned drainage systems. Even small amounts of rain can flood entire neighborhoods. In addition to extreme events, rising sea levels place much of the coastal population, infrastructure and ecosystems at risk from flooding and erosion. Climate change will also impact climate-sensitive sectors such as agriculture (70 percent of production is rainfed), livestock and fisheries, which account for 20 percent of GDP and employ a majority of the workforce. Food security is already stressed due to low yields and high population growth. Estimates suggest that over 15 percent of rural households and over 8 percent of urban households are food insecure, and the country imports approximately 60 percent of its cereal requirements, mostly rice (a main staple crop). (2, 4, 13, 14, 15, 17)



## CLIMATE PROJECTIONS



1–3°C increase in temperatures by 2060



1m rise in sea levels by 2100



Increased unpredictability of seasonal rains and increased intensity of rainfall events

## KEY CLIMATE IMPACTS

### Agriculture



Reduced crop quality and yields  
Decreased livestock productivity  
Increased incidence of locust invasions

### Water



Reduced availability and degraded quality of freshwater resources  
Reduced hydropower production

### Coastal Zones



Flooding of urbanized areas  
Damage to coastal infrastructure  
Salinization of aquifers and arable land

### Fisheries



Shift in distribution of species  
Habitat destruction and degradation  
Loss of income and livelihoods

### Health



Increased risk of water- and vector-borne diseases  
More heat-related health issues

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## CLIMATE SUMMARY

Senegal's climate is generally characterized as tropical, with one rainy season from May–November and a dry season dominated by dry, hot harmattan winds between December and April. Temperatures and rainfall vary across regions, with rainfall generally increasing from north to south and temperatures increasing from coast to interior. Along the coast, temperatures are cool, ranging from 17–27°C. In the northern Sahelian zone, the climate is characterized by cool nights (minimum of 14°C) and hot days (maximum of 40°C). The north has a longer dry season from November–May, and receives about 360 mm of rainfall the rest of the year. Moving south, rainfall increases and reaches up to 1,500mm per year in the extreme south. Hot and humid, the southern region averages temperatures of 30°C throughout the year. (1, 4, 6, 11, 15)

### HISTORICAL CLIMATE

Climate trends since the 1960s include:

- Increase in average temperatures by 0.9°C, with higher rates of warming in the north and more pronounced between October and December.
- Twenty-seven more 'hot' nights per year since 1960.
- Decline in rainfall; although rains have partially recovered since the mid-1990s, they have not recovered their pre-1970 levels and remain 15 percent below the long-term average.
- Rainfall decline is most significant in the southern region during the wet season (June–September).

### FUTURE CLIMATE

Projected changes by the 2060s include:

- Rising average annual temperatures by 1.1–3.1°C; projected rates of warming are faster in the north and interior, and during the dry season.
- Substantial increases in the frequency of 'hot' days and nights, with more rapid increases in the south and east.
- Uncertainties exist about whether rainfall will increase or decrease, but overall increases in heavy rainfall events are expected.
- Rising sea level of up to 1 meter (by 2100).

## SECTOR IMPACTS AND VULNERABILITIES

### WATER RESOURCES

Senegal has a relatively large supply of both surface and groundwater, and access to improved water sources across the country is relatively high – more than 93 percent of urban and 67 percent of rural populations have adequate access. But rising demand, regional disparities in terms of access and quality, pollution and inadequate infrastructure make the water sector highly vulnerable to increasing climate variability and future climate change. Surface water and shallow groundwater are highly dependent on rainfall conditions; for example, river flows in Senegal declined by an estimated 35.7 percent from 1981 to 1989 due to droughts and rainfall deficits. Groundwater levels also decreased significantly during this period, 5 meters to 10 meters in the north and 15 meters to 20 meters in the south. In addition to reduced surface flows, future rainfall deficits and increased variability are likely to reduce aquifer recharge rates. Along the coast and in major cities like Dakar, saltwater intrusion into coastal aquifers and arable land is already a problem, and sea level rise and decreased rainfall will exacerbate salinity issues.

Climate Stressors and Climate Risks WATER RESOURCES	
Stressors	Risks
Rising temperatures	Reduced supply of freshwater resources; increased evaporation of surface water and reduced recharge of groundwater, impacting water quality
	Increased salinity of groundwater
Reduced or variable rainfall and increased heavy rainfall events	Increased flood risk and associated erosion, soil salinization, sedimentation and loss of land
	Increased demand for irrigation
Sea level rise	Reduced or interrupted hydropower production; reduced potential for future investment in hydropower

Future demand for irrigation will be a concern as rains become more erratic; agriculture consumes more than 90 percent of water resources, but only 4 percent of land is currently irrigated. Hydropower production, which contributes more than 10 percent to the country's electric supply, is susceptible to variable rainfall and increased evaporation rates of retention ponds and dams. (6, 7, 8, 10, 15)

## AGRICULTURE

Agriculture employs more than 70 percent of the Senegalese workforce and is the backbone of the rural economy. Cereals like millet and sorghum are key subsistence crops, while groundnuts, a main cash crop, are grown on 40 percent of cultivated land and employ up to 1 million people. Smallholder agriculture, which is predominantly rainfed, is already stressed by overexploitation of land, degraded soil and limited extension services. Climate change is expected to magnify most of these challenges. Groundnuts are sensitive to both rainfall variability and higher temperatures, and crop models project a 5–25 percent decrease in yields. Rainfall has been inadequate and decreasing in some areas, affecting important growing regions near Thies and Dioubel. While clear evidence does not yet exist, climate factors may also increase the frequency of Desert Locust infestations, which cause significant crop losses throughout West Africa.

## COASTAL RESOURCES

Senegal's rapidly urbanizing coastal zone is home to the majority of the country's population, infrastructure and industry, as well as diverse ecosystems providing vital services upon which local economies are highly dependent. Coastal infrastructure, including 74 percent of housing, is at risk from sea level rise-induced coastal erosion and inundation. Rapid and pervasive erosion (due to both climate and human activity) affects almost every major coastal city, leading to losses of physical and financial assets. The 2009 floods caused over \$100 million in damages (\$67 million in Dakar alone), affecting housing, transportation and health systems. Most of the country's tourism infrastructure lies along the Petite Côte, which already faces the impact of erosion, losing 1–2 meters of sandy beachfront a year. Rising sea levels threaten shallow coastal groundwater sources through increased salinization. Climate change will

## FISHERIES

In Senegal fisheries employ 17 percent of the workforce, contribute 2.5 percent to GDP and are one of the main sources of animal protein in the Senegalese diet. Already stressed from overfishing, fisheries are expected to be negatively impacted by climate change as rising surface water temperatures and ocean acidification alter species reproduction and migration. This in turn affects biodiversity and the livelihoods, incomes and nutrition that depend on fisheries. (9, 11, 15)

Climate Stressors and Climate Risks AGRICULTURE	
Stressors	Risks
Rising temperatures	Reduced crop quality and yields, particularly for rainfed maize, sorghum, millet and groundnuts
	Reduction in available land suitable for growing groundnuts
Reduced or variable rainfall	Increased occurrence of locust infestations
	Heat stress and reduced water and feed supplies for livestock
	Food shortages and increased food insecurity

Around 30 percent of households rely on livestock (mainly cattle and small ruminants) to support their livelihoods. Climate change impacts livestock directly (via heat stress and reduced productivity) as well as indirectly through reduced water and forage resources. (6, 14, 15)

Climate Stressors and Climate Risks COASTAL RESOURCES	
Stressors	Risks
Rising temperatures	Erosion and flooding of coastal infrastructure
	Economic losses to tourism industry; loss of sandy beaches and damage to hotels
Sea level rise	Damage to coastal ecosystems, particularly mangroves
	Sea water intrusion/salinization of coastal aquifers and arable land

also impact mangroves, a vital coastal resource as they protect the coastline by moderating storm and wave impacts. Mangroves also stabilize sand and soils, cycle nutrients, absorb and break down waste products, provide wildlife habitat and maintain biodiversity. Mangroves are extremely dependent on sea level variations, rainfall and salinity and could therefore migrate or decrease significantly. (3, 6, 15)

Climate Stressors and Climate Risks FISHERIES	
Stressors	Risks
Rise in sea levels and temperatures	Reduced fish yields/productivity
	Temperature-induced migration
	Damage to habitats (mangroves)
Ocean acidification	Loss of income and livelihoods (50 percent decline in related employment by 2050)
Extreme events	Loss of life and equipment

## HEALTH

Climate change is likely to exacerbate the risks and impacts associated with water- and vector-borne diseases, which are already prevalent in Senegal. Across the country, higher temperatures will alter water availability and quality, increasing the incidence of waterborne diseases such as cholera and diarrheal disease, especially during the dry season as lower water levels from evaporation concentrate bacteria. Urban areas such as Dakar, already prone to flooding, will likely see more cholera outbreaks due to an increase in intense rainfall events that damage water and sanitation facilities. In the south, malaria (the number one cause of death in children under 5) will remain a significant risk as temperatures rise and may spread to the north. (6, 12, 18)

## POLICY CONTEXT

### INSTITUTIONAL FRAMEWORK

The Directorate of Environment and Classified Establishments is responsible for strengthening the awareness and knowledge of various government agencies on climate change and adaptation issues. The National Committee on Climate Change (COMNACC) think tank is the national platform for climate change coordination and acts as the focal point for the United Nations Framework Convention on Climate Change (UNFCCC). Senegal set up the National Climate Fund as an instrument to mainstream climate finance into its 20-year blueprint to achieve reforms and economic emergence, and to help tap into global climate finance. Senegal is reformulating its Country Investment Plan to factor resiliency into agricultural investments. (5, 15)

Climate Stressors and Climate Risks	
HEALTH	
Stressors	Risks
Rising temperatures	Reduced water quality and quantity, leading to increase in waterborne diseases
Reduced or variable rainfall	Changing distribution of vector-borne diseases such as malaria
Increased frequency of intense rainfall events	Increased disaster risk and exposure to droughts and floods
	Increased risk of food insecurity and malnutrition

### NATIONAL STRATEGIES AND PLANS

- [Republic of Senegal's Third National Communication to the UNFCCC](#) (2016)
- [Decree 2014-880 on the Powers of the Ministry of the Environment and Sustainable Development](#) (2014)
- [National Adaptation Programme of Action \(NAPA\)](#) (2006)
- [Environment Code Law 2001-01](#)
- National Strategy for Sustainable Development (2005)
- National Adaptation Plan of Action (2006)
- Contribution prévue déterminée au Niveau national (Ministère de l'Environnement et du Développement durable, Septembre (2015)
- Fisheries National Adaptation Plan (2016)

### KEY RESOURCES

1. Clark, A. et al. 2016. [Senegal – Climate](#). Encyclopedia Britannica Online.
  2. FEWS NET. 2012. [A Climate Trend Analysis of Senegal Fact Sheet](#). Informing Climate Change Adaptation Series.
  3. GFDRR. 2014. [Senegal: Urban Floods](#).
  4. GFDRR. 2015. [Senegal Country Profile](#).
  5. Grantham Research Institute. 2016. [Senegal Country Profile](#), Global Climate Legislation Study.
  6. IPCC. 2015. [Africa Chapter](#).
  7. IRENA. 2012. [Senegal Renewable Readiness Assessment](#).
  8. UNEP. 2015. [Water Resources in Senegal](#).
  9. URI. 2016. [Collaborative Management for a Sustainable Fisheries Future in Senegal](#).
  10. USAID. 2010. [Senegal Water and Sanitation Profile](#).
  11. USAID. 2014. [Senegal Climate Change Vulnerability Assessment and Options Analysis](#).
  12. USAID. 2015. [Climate Change and Health Risks in Senegal](#).
  13. USDA. 2007. [Senegal Agricultural Situation Country Report](#), GAIN report.
  14. WFP. N.d. [Climate Risk and Food Security in Senegal](#).
  15. World Bank. 2011. [Senegal Climate Risk and Adaptation Profile](#).
  16. World Bank. 2016. [Senegal](#), Climate Change Knowledge Portal.
  17. World Bank. 2016. [Senegal Overview](#).
  18. WHO. 2015. [Senegal: WHO Statistical Profile](#).
- Map: adapted from Peel, M.C., et al. 2007. [Updated world map of the Köppen-Geiger climate classification](#); data accessed from [SDAT](#). Rainfall data from [WorldClim](#).

## SELECTED ONGOING EXPERIENCES

Selected Program	Amount	Donor	Year	Implementer
Adaptation to Coastal Erosion in Vulnerable Areas	\$8.6 million	Adaptation Fund	2011–2014	Directorate of Environment and Classified Establishments
Climate Change Adaptation Project in the Areas of Watershed Management and Water Retention	\$1.4 million	GEF, IFAD	2012–2016	Ministry of Agriculture, Ministry of Hydraulics & National Water System, and Ministry of the Environment, Nature Protection, Water Retention and Artificial Lakes
Collaborative Management for a Sustainable Fisheries Future (COMFISH) and COMFISH Plus	\$16 million	USAID	2011–2018	University of Rhode Island, Coastal Resources Center
Mainstreaming ecosystem-based approaches to climate resilient rural livelihoods in vulnerable rural areas through the Farmer Field School methodology	\$30.9 million	GEF, FAO	2015–2019	Ministry of Agriculture and others
Promoting Innovative Finance and Community-based Adaptation in Communities Surrounding Community Natural Reserves	\$22.5 million	UNDP, GEF	2016–2020	Ministry of Environment and Sustainable Development
Senegal National Adaptation Plan	\$11.9 million	GEF, UNDP	2016–	Ministry of Environment and Sustainable Development
Senegal Disaster Risk Management and Climate Change Project	\$5 million	World Bank	2010–2015	Civil Protection Directorate
Increasing Productivity and Livelihoods in the Nioro du Rip Basin in Senegal	Not available	USAID-CIAT	2014–unknown	CCAFS, AgMIP
Climate Information Services for Increased Resilience and Productivity in Senegal	\$3.5 million	USAID	2016–2019	CCAFS, ICRISAT, and ANACIM