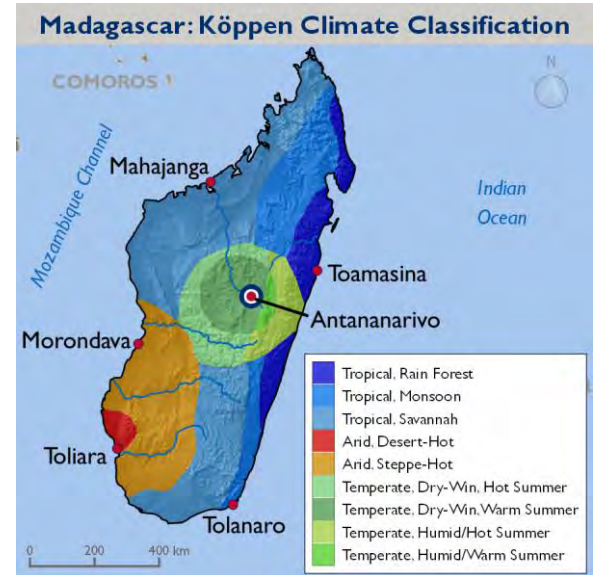




CLIMATE CHANGE RISK PROFILE MADAGASCAR

COUNTRY OVERVIEW

Madagascar is the world's fourth largest island and home to a diverse and unique range of species and ecosystems, many of them vulnerable to current and future climate patterns. The country has one of the highest poverty rates in Africa, with 81 percent of the population living on less than \$1.25 per day. The driving sectors of Madagascar's economy include agriculture (predominantly rainfed), fisheries and livestock production, all of which rely on climate-sensitive natural resources. Food security is a major concern, with 25 percent of the country's rural population classified as food insecure. Madagascar is also vulnerable to extreme weather events, and has the highest risk from cyclones in Africa. These events are becoming increasingly frequent and intense: in the past 20 years Madagascar has been struck by 35 cyclones, 8 floods and 5 periods of severe droughts (a three-fold increase over the previous 20 years), causing \$1 billion in damages and affecting food security, drinking water supply and irrigation, public health systems, environmental management and quality of life. (4, 10, 13, 14)



CLIMATE PROJECTIONS



Projected increase in temperature of 2.5°C - 3°C



Increased unpredictability of seasonal rains



Increased incidence or intensity of extreme weather events, including droughts, cyclones and floods

KEY CLIMATE IMPACTS

Agriculture

Crop loss/failure
Loss of pasture lands and water resources for livestock



Coastal Ecosystems

Loss of marine habitat
Coastal degradation
Ocean warming and acidification



Human Health

Increased ranges of vector-borne diseases and increased risk from waterborne diseases



Fisheries

Biodiversity loss
Habitat destruction and degradation



Water

Degradation of water quality
Reduced access to water supplies



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CLIMATE SUMMARY

Madagascar’s climate is tropical, with regional variations and two distinct seasons: a hot, rainy season from November to April and a dry season from May to October, with less rainfall received between September and October. The eastern region receives rain almost year round. Average annual temperatures are between 23° and 27°C. The climate varies greatly based on regions’ elevation and position relative to dominant winds. An estimated 12 tropical storms pass through the Mozambique Channel on the west coast of Madagascar every year, 30 percent of which reach cyclone status. (6,7,9,14)

HISTORICAL CLIMATE

Climate changes since the 1950s include:

- Significant increases in daily temperatures across all seasons, and pronounced increases in daily maximum temperatures during the dry season.
- Increased variability in the relative distribution of temperature and rainfall, with higher temperatures and decreased rainfall in the northern areas and increased rainfall in the southern areas.
- Reduction in the length of the dry season and longer periods of drought in the central and western parts of the country.
- Increased intensity of rainfall during cyclones.
- More frequent extreme events, with increased intensity. (6, 14)

FUTURE CLIMATE

Projected changes include:

- Average temperature will increase 2.5° – 3°C by 2100.
- Rainfall will reduce overall, particularly during the dry season and in inland areas, and increased amounts of rain will fall during the rainy season (December – February) by 2065.
- Projected changes in rainfall are less certain for the north, with some models suggesting drier conditions and others suggesting wetter conditions.
- By 2100, the frequency of cyclones is projected to decrease over the Indian Ocean, particularly at the beginning of the cyclone season. However, cyclone intensity is projected to increase by almost 50 percent, with landfall tracks shifting northward. (6, 14)

SECTOR IMPACTS AND VULNERABILITIES

WATER RESOURCES

Climate variability, primarily reduced rainfall and higher temperatures, could impact Madagascar’s water resources, as rivers and rainfall are the primary source of water for agricultural use, household consumption and energy generation. Although fairly abundant, the country’s water resources are unequally distributed geographically and underexploited; shortages are common in the east and south, and only about 4 percent of the country’s available water is utilized, of which 95 percent is used for irrigation. Reduced rainfall and higher temperatures will exacerbate these water shortages and increase demand for irrigation, further straining water resources. Poor management of water infrastructure and increasing demand from a growing population also contribute to the sector’s vulnerability; currently only 20 percent of the population has access to piped water and 50 percent has access to safe water. (12, 14)

Climate Risks and Potential Impacts WATER RESOURCES	
Climate Risk	Potential Impacts
Increased temperatures	Reduction of key water points; draining of swamps and rivers during the dry season
Reduced rainfall and increased drought conditions	Reduced river flows, resulting in reduced access to water supplies for drinking, sanitation and energy generation, and reduced water quality
Increased intensity of cyclones	Cyclone-induced destruction of water infrastructure and flood-induced water quality reductions due to increased sedimentation

AGRICULTURE PRODUCTION

Climate change is likely to compound the existing problems of the country's agriculture sector, which include limited productivity, low yields, lack of technical capacity and limited extension services. Rainfall variability and higher temperatures in particular have consequences for the production of staple rainfed crops such as rice, cassava and maize. For example, unreliable rainfall will lead more farmers to use irrigation, which is likely to strain water resources, and higher temperatures and reduced rainfall are likely to lead to increased incidence of diseases, such as cassava mosaic disease. Extreme weather events also threaten agricultural productivity. Three cyclones that made landfall in early 2000 affected more than a million people and caused nearly \$85 million in damages to agricultural infrastructure. They also devastated the livestock sector and major crops. (4, 13, 11)

COASTAL ECOSYSTEMS

Madagascar has over 5,000 kilometers of coastline that sustain valuable ecosystems such as coral reefs, littoral forests, mangroves and wetlands, with forests and wetlands serving as important carbon sinks and providing a natural buffer against coastal erosion. The country's roughly 300,000 hectares of mangroves are being unsustainably harvested for fuel, food and construction material, and are at further risk from sea level rise and extreme weather events. Madagascar's extensive coral reef ecosystems are particularly vulnerable to climate change due to warming sea surface temperatures. Eighty percent of the northern coral reefs are estimated to suffer from coral bleaching. (14, 15)

FISHERIES

Climate change is increasingly threatening onshore and offshore fisheries, which are critical socio-economic pillars in Madagascar and contribute 7 percent to the country's GDP. Fisheries are central to coastal food security – fish comprise 20 percent of the animal protein in the Malagasy diet. Over the past decade the sector has faced low profitability, increased competition from Asia and South America and overexploitation. These challenges are compounded by the effects of climate variability such as higher temperatures and increased storm intensity, which reduce productivity and increase production costs. Many fisheries are part of larger reef and mangrove ecosystems, which compounds the vulnerability of this sector to climate impacts. (2, 14, 15)

Climate Risks and Potential Impacts AGRICULTURE PRODUCTION	
Climate Risk	Potential Impacts
Increased temperatures	Crop damage and reduced yields
Increased precipitation during the rainy season	Higher rates of evapotranspiration, reducing soil moisture and increasing soil degradation
	Increased need for irrigation, particularly for rice cultivation
Reduced rainfall in the dry season and increased drought conditions	Increase in pests and diseases
	Increased sedimentation, soil erosion and siltation, compromising flat lowland areas
Increased cyclone intensity	Increased livestock mortality (especially cattle)
	Damage to crops, supply chains and infrastructure from cyclones

Climate Risks and Potential Impacts COASTAL ECOSYSTEMS	
Climate Risk	Potential Impacts
Increased temperatures	Increased sea surface temperatures and ocean acidification, impacting coral reefs and undersea coastal ecosystems
	Destruction of marine habitats and biodiversity loss
Increased cyclone intensity	Increased coastal erosion and inland soil erosion and saltwater intrusion
Sea level rise	Reduced water quality and increased flooding in densely populated coastal urban areas

Climate Risks and Potential Impacts FISHERIES	
Climate Risk	Potential Impacts
Sea level rise	Reduced productivity due to increased sedimentation and runoff, and reduced water quality
Rise in sea surface temperature	Temperature-induced shifts in the ranges and populations of fish; changes in reproduction cycles
Increased cyclone intensity	Destruction of fish habitat and ecosystem (e.g., coral reefs and mangroves); migration of fish away from historical fishing areas
Increased frequency of extreme events	Increased production costs due to destruction of infrastructure and interruption of supply chains

HUMAN HEALTH

Climate change could have a multiplier effect on existing challenges to Madagascar's health sector, which include poor sanitation, high rates of malnutrition and persistent poverty, which adversely affects households' ability to pay for medical services. For example, incidence of diarrheal disease increase during the cyclone season, which increases flooding and leaves standing water, a breeding ground for waterborne diseases. Malaria is an important cause of overall mortality in the country, and higher temperatures would expand the disease vector's range, particularly to higher elevations where a large percentage of the population lives. Acute respiratory diseases, known to be exacerbated by higher temperatures, are also a concern as they are the number one cause of death in children under five. (3, 7, 10, 14)

POLICY CONTEXT

INSTITUTIONAL FRAMEWORK

Madagascar created a Directorate of Climate Change under the Ministry of Environment and Forests in 2010. The Directorate is responsible for coordinating all national response actions to climate change, and represents Madagascar in international negotiations. In past years, Madagascar has been active in international efforts to move forward a national REDD agenda. Madagascar is a signatory of the United Nations Framework Convention on Climate Change (UNFCCC), and a signatory to the 2016 Paris Agreement. (5)

Climate Risks and Potential Impacts HUMAN HEALTH	
Climate Risk	Potential Impacts
Increased temperatures	Extended range of disease-carrying vectors (e.g., mosquitoes) to higher elevations (above 1500 m)
Increased frequency of extreme events and flooding	Increased risk of diarrheal and other waterborne diseases such as cholera
	Increased risk of acute respiratory disease

NATIONAL STRATEGIES AND PLANS

- [Initial Communication](#) (2004) and [Second National Communication](#) (2010)
- [National Adaptation Programme of Action](#) (2006)
- National Strategy for Disaster Risk Management (2002 – 2013), currently under revision
- National Climate Change Policy (2010)
- National Strategy for Climate Change in Agriculture Livestock Fishery (2013)
- The Madagascar Action Plan (MAP, 2007 – 2012) (5, 14)

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15. World Bank. 2016. [Madagascar Dashboard](#). Climate Change Knowledge Portal.

16. WWF. n.d. [Climate Change Adaptation Capacity Project Brief](#).

Map Source: Adapted from Peel, M.C., et al. 2007. [Updated world map of the Köppen-Geiger climate classification](#); data accessed from [SDAT](#)

SELECTED ONGOING EXPERIENCES

The majority of foreign aid to Madagascar is dedicated towards agriculture, governance, infrastructure and health. Major donors working in Madagascar in the climate change, biodiversity conservation and environmental realm include UNEP, GIZ, KfW, UNDP, World Bank, EU, AFD, USAID and the Global Environment Facility (GEF). The table below outlines relevant ongoing initiatives, highlighting donor activities that are mainly focused around building community resilience to climate change in the agriculture sector in rural communities.

Selected Program	Amount	Donor	Year	Implementer
Adapting Coastal Zone Management to Climate Change in Madagascar Considering Ecosystems and Livelihoods	\$17.3 million	UNEP, GEF	2014–2019	Ministry of Environment, Ecology and Forests
Enabling Climate Resilience in the Agriculture Sector of Southwestern Madagascar	\$39.4 million	AfDB, GEF	2014–2018	Ministry of Agriculture, Regional Unit of Tulear and Rural Engineering Unit; Ministry of Environment, Ecology and Forests
Enhancing the Adaptation Capacities and Resilience to Climate Change in Rural Communities in Analamanga, Atsinanana, Androy, Anosy, and Atsimo Andrefana	\$67.4 million	UNDP, GEF	2016–2021	National Climate Change Coordination Office
Strengthening the resilience of the rural population in South Madagascar	€7.7 million	GIZ	2012–2017	Ministry of Agriculture
IARIVO (Disaster risk reduction for flood-prone areas)	\$835,000	USAID/CARE	2015	Urban commune of Antananarivo
Promoting Climate Resilience in the Rice Sector	\$5.1 million	Adaptation Fund/UNEP	2012–2017	Ministry of Environment and Forests; Ministry of Agriculture