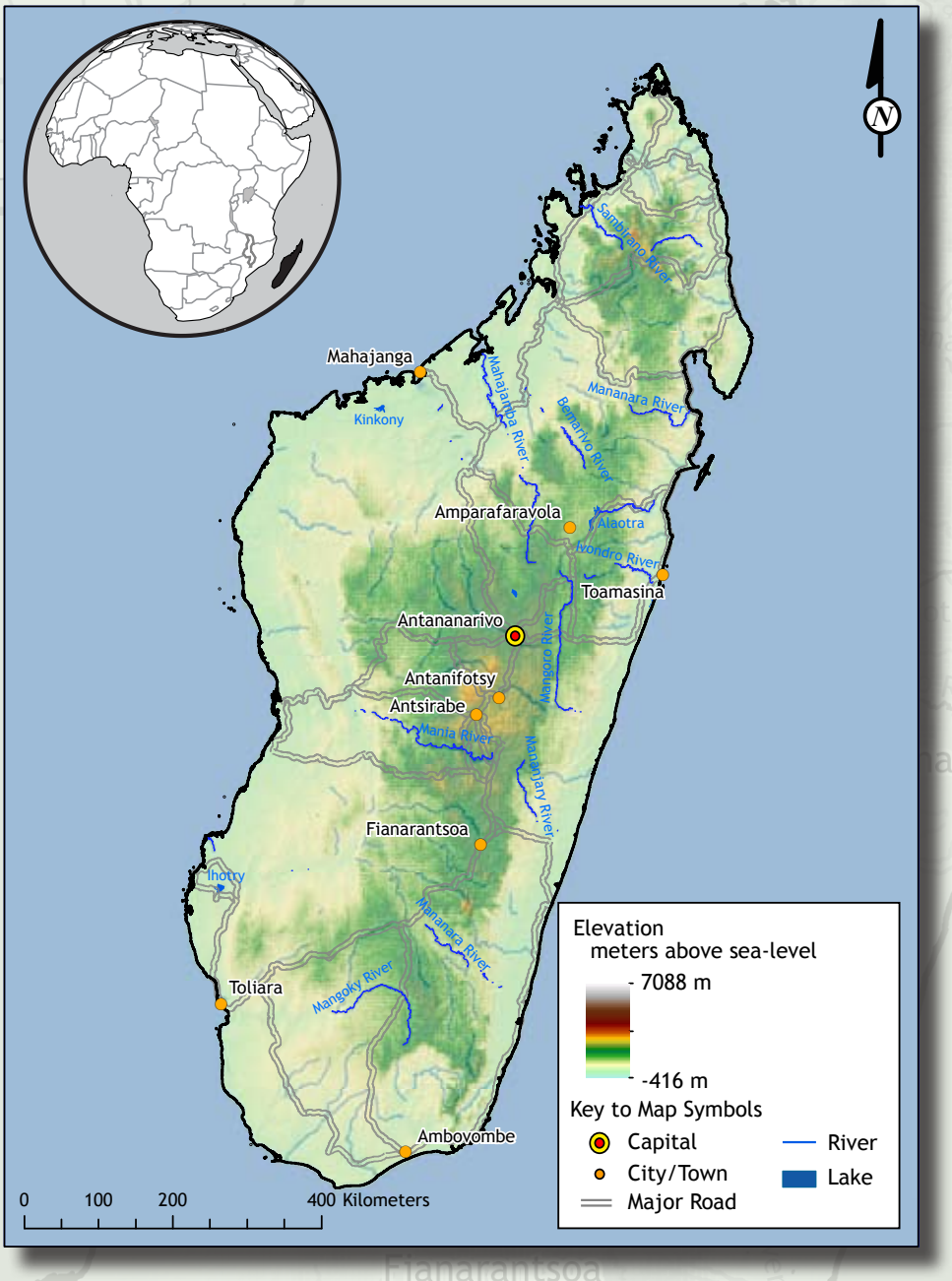


Vulnerability, Risk Reduction, and Adaptation to Climate Change

MADAGASCAR

CLIMATE
DISASTER RISK REDUCTION
ADAPTATION

GFDRR
Global Facility for Disaster Reduction and Recovery

Climate Change Team ENV

COUNTRY OVERVIEW

Madagascar is a large island nation located in the southwestern part of the Indian Ocean, just off the south-eastern edge of the African continent. The 2009 United Nations Development Program (UNDP) Human Development Report classifies Madagascar as a least developed, low-income, and food deficient country and ranked it 145th out of 177 countries. Since its independence in 1960, annual per capita income has fallen by 40%, with Gross Domestic Product (GDP) in the 1990s falling 50% below that of the 1980s. Since 2000, however, GDP has seen a steady rise, signaling sustained economic growth. Nevertheless, poverty levels remain high, with much of this poverty concentrated in rural areas, where subsistence agriculture is practiced to meet basic needs.[1] Food security remains a significant challenge and, according to 2005 estimates, 25% of the country's rural population is classified as food insecure. The country's population is also growing steadily, with an estimated 19 million people living in Madagascar in 2009 and an average population growth rate of 3%.[2] The key sectors of the country's national economy include agriculture, fishery, and livestock production. Cash crops - sugarcane, vanilla, coffee, cloves and cocoa - are grown primarily in the east and northwest of the country.- Subsistence crops - rice, cassava, beans, bananas, and peanuts - dominate household consumption.

The country encompasses a diversity of ecosystems, with a highland plateau extending throughout the center, fringed by low-lying coastal areas on all sides. The highest elevation on the island is Mt. Maromokotro at 2,880 meters (m). Although the country's ecosystems have been severely degraded due to logging and agriculture, Madagascar hosts a unique and increasingly threatened diversity of flora and fauna, including several rare orchid species and lemurs. A number of rivers traverse Madagascar, including the Socia, Betsiboka, Manambao, Mangoro, Tsiribihina, Mangoky, Manannara, and Onilahy.

Key Sectors

Agriculture and Livestock
Coastal Zones and Marine Ecosystem
Water Resources
Public Health
Forestry

Source: Madagascar's National Adaptation Program of Action, 2006

Development challenges loom large for Madagascar, where poverty rates hover at 71%, illiteracy is at 70%, and the political situation is uncertain. In addition, Madagascar faces significant risks imposed by an increasingly variable and changing climate. Cyclones, droughts, and floods are all common occurrences in the country. Between 1980 and 2010 alone, Madagascar was struck by 35 cyclones and floods, five periods of severe droughts, five earthquakes, and six epidemics.[3] These events are becoming increasingly frequent and intense, affecting food security, drinking water supply and irrigation, public health systems, environmental management, and lifestyle.

PRIORITY ADAPTATION MEASURES

Madagascar is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. The country is also a signatory to the United Nations Convention to Combat Desertification and the Convention on Biological Diversity. In 2006, Madagascar's National Adaptation Program of Action (NAPA) laid the groundwork for a national plan of action on climate change and identified several poverty and economic growth criteria to be used in the evaluation and prioritization of proposed new projects. Key economic sectors and proposed adaptation strategies for these include:

- Coastal areas
  - Rehabilitation and/or construction of dikes and dams
  - Adoption of anti-erosive techniques of defense and conservation of the soil
- Agriculture and forestry

[1] Climate Change National Adaptation Plan of Action of Madagascar, 2006.
[2] World Bank Data Portal.
[3] EM-DAT: The OFDA/CRED International Disaster Database.

- Promotion of transfer of forest management to the basic local communities –Gestion Locale Securisée (GELOSE), Global Conservation Fund (GCF)
- Support for the intensification of crop and livestock production
- Reforestation of rural areas

➡ Water resource management
- Installation of light structure and/or reinforcement of the decentralized Weather Service
- Establishment and reactivation of associations in water management

➡ Infrastructure
- Development, communication, and application of standards in construction design to ensure resistance to important weather upheavals

➡ Health
- Research on the causes of diseases and adoption of appropriate measures to be undertaken during the transmission period
- Building and strengthening the capacity of local health services through decentralization of staff and equipment

CLIMATE BASELINE AND CLIMATE FUTURE

CLIMATE BASELINE

Due to its geographical position as well as its wide topographic diversity, Madagascar's climate is highly varied. Two seasons are recognized: a hot, rainy season from November to April, with maximum rainfall in December and January; and a cooler, dry season from May to October, with minimum rainfall in September and October (during the dry period rainfall is restricted to the southern and eastern coasts). There is great variation in climate owing to elevation and position relative to dominant trade winds and the movement of the Intertropical Convergence Zone (ITCZ).

Major Climate Processes	Impacts on Climate
Intertropical Convergence Zone (ITCZ)	*Drives rainfall*
El Niño	*Associated with droughts (50% of time)*
Sea surface temperatures in the Indian Ocean	*Regulate temperatures*
Easterly trade winds	*Bring rainfall to the east coast*

The east coast has a subequatorial climate driven by easterly trade winds, along with the heaviest and most consistent rainfall, with a maximum of 3,700 millimeters (mm) annually. This area is also located in the path of destructive cyclones from the Indian Ocean that occur during the rainy season. The west coast of the country is generally drier (especially between May and October) and is subject to significant coastal erosion. The southwest and the extreme south are semi-desert environments, receiving less than 800 mm of rainfall annually. Temperatures vary significantly across the country, due to topography and differences between the west and east coasts. The average annual temperatures vary between 23°C and 27°C along the coast and between 16°C and 19°C in the central mountains.[4] Over the west coast temperatures are highest between October and November, averaging 36°C, with some days significantly hotter than average.

[4] World Bank Climate Change Data portal

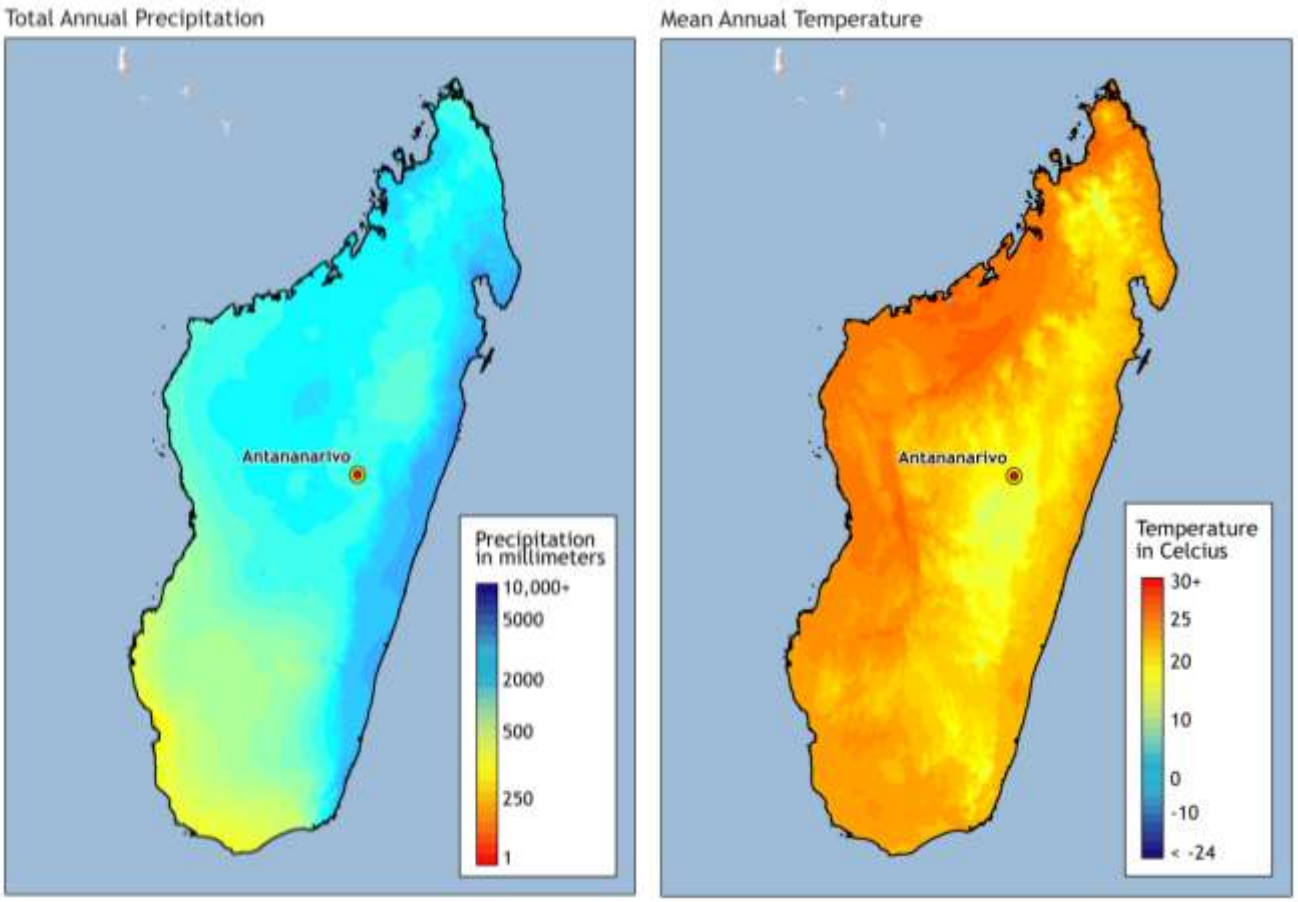


Figure 1: Total annual precipitation and temperature across Madagascar[5]

RECENT CLIMATE TRENDS[6]

- There is clear evidence that temperatures have increased by 0.2°C over northern Madagascar and by 0.1°C over southern Madagascar.
- Between 1961 and 2005, 17 of the 21 weather stations recorded statistically significant increases in daily minimum temperatures across all seasons, and several stations indicated increased daily maximum temperature trends(with the exception of winter temperatures). One station (Maevatanana), however, shows decreasing trends in these statistics for the period on record.
- The character of rainfall across Madagascar has changed significantly, although no obvious trend in rainfall can be surmised from the available record. However, since 1950, the relationship between temperature and rainfall has varied greatly across Madagascar, with increased temperatures yielding decreased rainfall in the northern areas and the opposite in southern areas.
- A reduction in winter and spring rainfall has been detected in most parts of the country.
- In the central and east coastal regions, rainfall was on a steady decline between 1961 and 2005, accompanied by increases in the length of dry spells.

[5] WorldClim 1960-1990 averages. Robert J. Hijmans, Susan Cameron, and Juan Parra, at the Museum of Vertebrate Zoology, University of California, Berkeley, in collaboration with Peter Jones and Andrew Jarvis (CIAT), and with Karen Richardson (Rainforest CRC). www.worldclim.org/current

[6] Tadross, M., Randriamarolaza, L., Rabefitia, Z. and Ki Yip, Z. (2008). Climate Change in Madagascar: Recent Past and Future

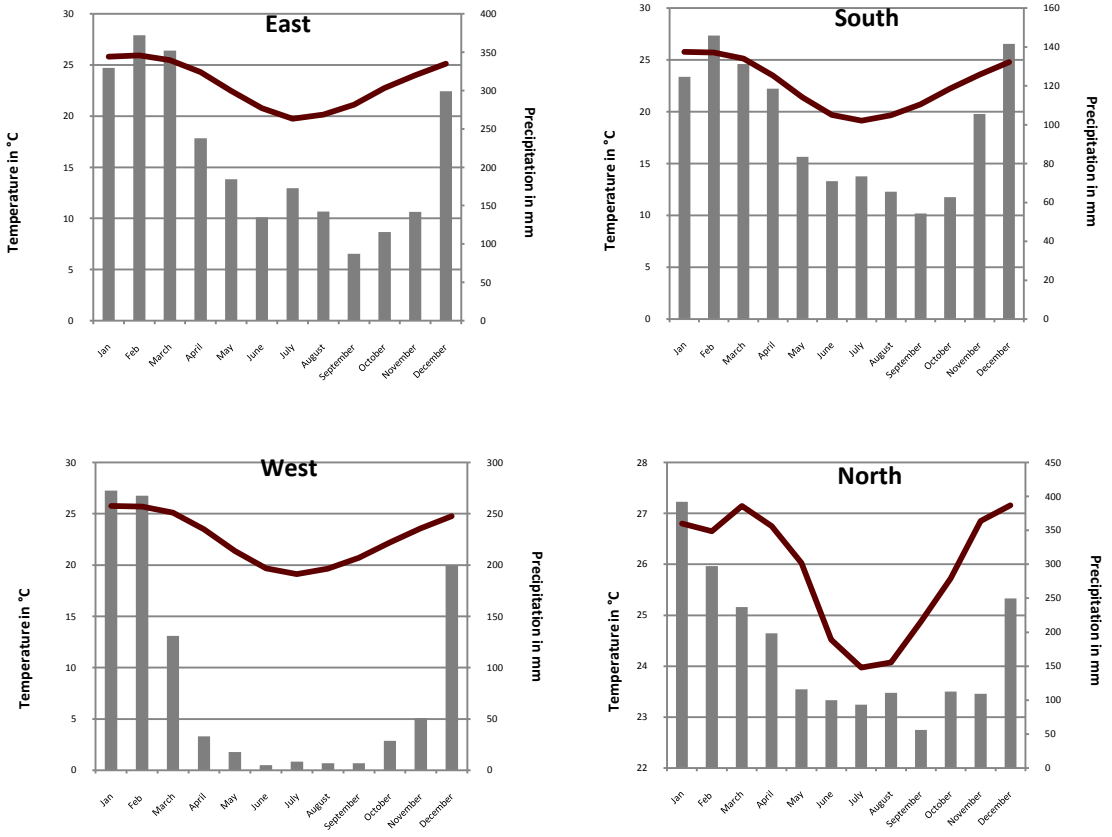


Figure 2: Average rainfall and temperature seasonally (1980-2002) by region across Madagascar[7]

CLIMATE FUTURE

The climate science community sources a suite of models to inform decision makers on future climate. Among the most widely used are GCMs (Global Climate Models), RCMs (Regional Climate Models), and downscaling techniques (both empirical and statistical). GCMs are our primary source of information about future climate. They comprise simplified but systematically rigorous interacting mathematical descriptions of important physical and chemical processes governing the climate, including the role of the atmosphere, land, oceans, and biological processes.

The following insights into a changing climate are derived for the Sahelian region as a whole, from a suite of GCMs used by the Intergovernmental Panel on Climate Change (IPCC), as well as a collection of 23 downscaled stations across the country available from the Climate Systems Analysis Group at the University of Cape Town, and a regional climate model.[8]

- By 2065, temperatures are projected to increase between 1.1°C and 2.6°C, with the lowest projected increases along the northern coastal regions and the highest projected increases for the southern part of the country.
- The spatial manifestations of projected changes in rainfall and temperature across southern, northern, western, and eastern Madagascar for the period between 2045 and 2065 are shown in figures 3-6 below.
- By 2065, in the southern part of the country rainfall is projected to:

[7] Ibid. note 4
[8] Cranfield University: Madagascar Climate Change Briefing

- Increase during the summer months of January-April, and again in October- November, with the exception of the southernmost station, which may become drier in October.
- Decrease during May, with greater decreases projected inland through June and July and additional during August and September.

➡ By 2065, projected changes in rainfall are less certain for the north, with some models suggesting drier and others suggesting wetter conditions.

➡ By 2100, the frequency of cyclones is projected to decrease over the Indian Ocean, particularly between September and December. Cyclone intensity, on the other hand, is projected to increase by 46% and shift northwards[9], with implications for agriculture, food security, and infrastructure.

CLIMATE CHANGE IMPACTS ON NATURAL HAZARD VULNERABILITY

AT A GLANCE

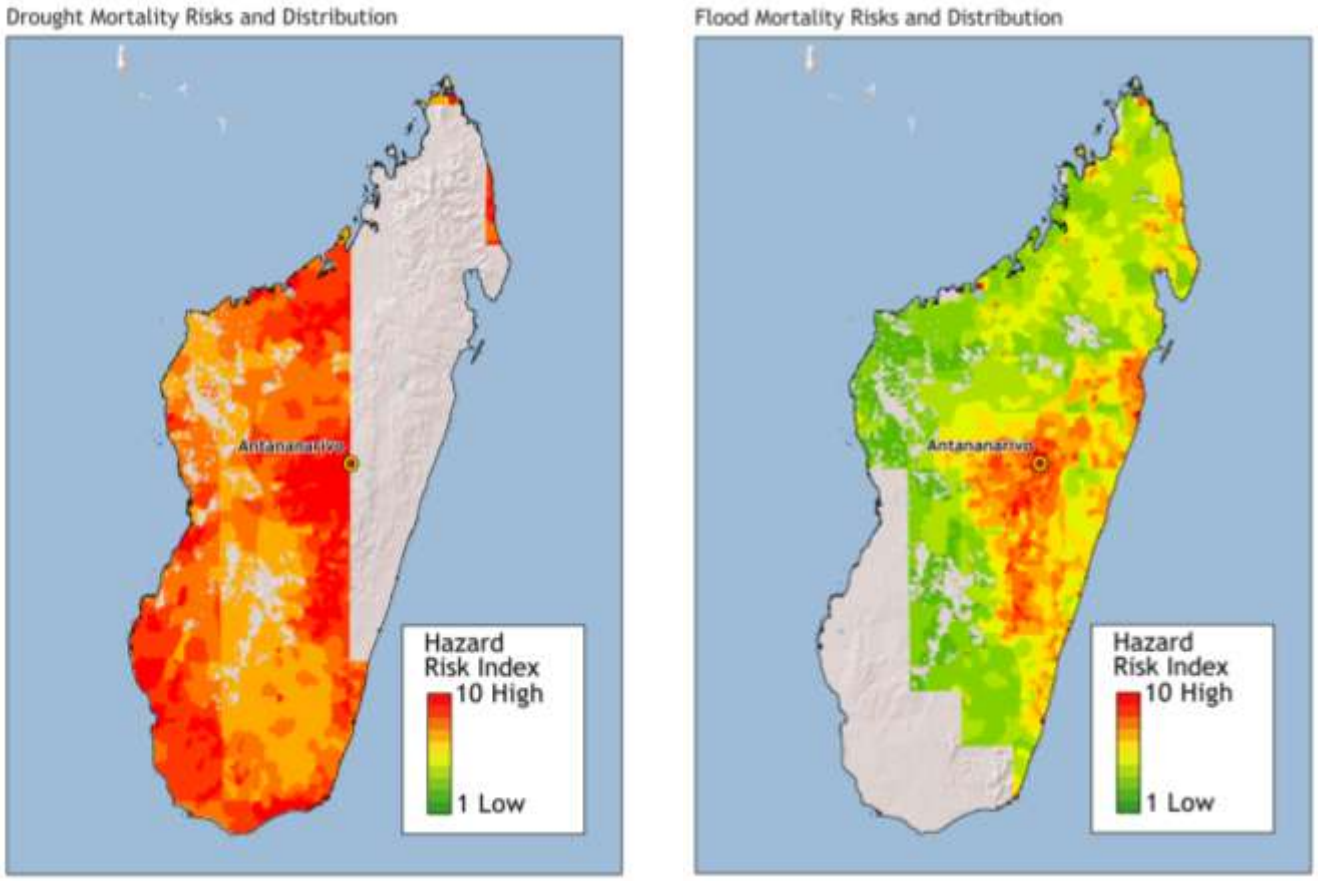


Figure 3: Mortality risks and distribution due to droughts and floods across Madagascar[10]

[9] World Bank (GFDRR), 2010. A brief publication of the World Bank's Africa Region Sustainable Development Department: "Madagascar Disaster Risk Reduction Plan: Moving from disaster response to prevention"

[10] Columbia University Center for Hazards and Risk Research (CHRR) and Columbia University Center for International Earth Science Information Network (CIESIN).

Madagascar's poor economic and development capacity makes it difficult for the country to adapt to a variable and changing climate. From 1980 to 2010, 53 natural hazards - including, droughts, earthquakes, epidemics, floods, cyclones, and extreme temperatures - affected Madagascar and caused economic damages of over US$1 billion.[11] High poverty rates and lack of functional institutions increase vulnerability to climatic hazards such as floods, droughts, cyclones, extreme temperatures, and sea level rise. Their dynamics and impacts are discussed below.

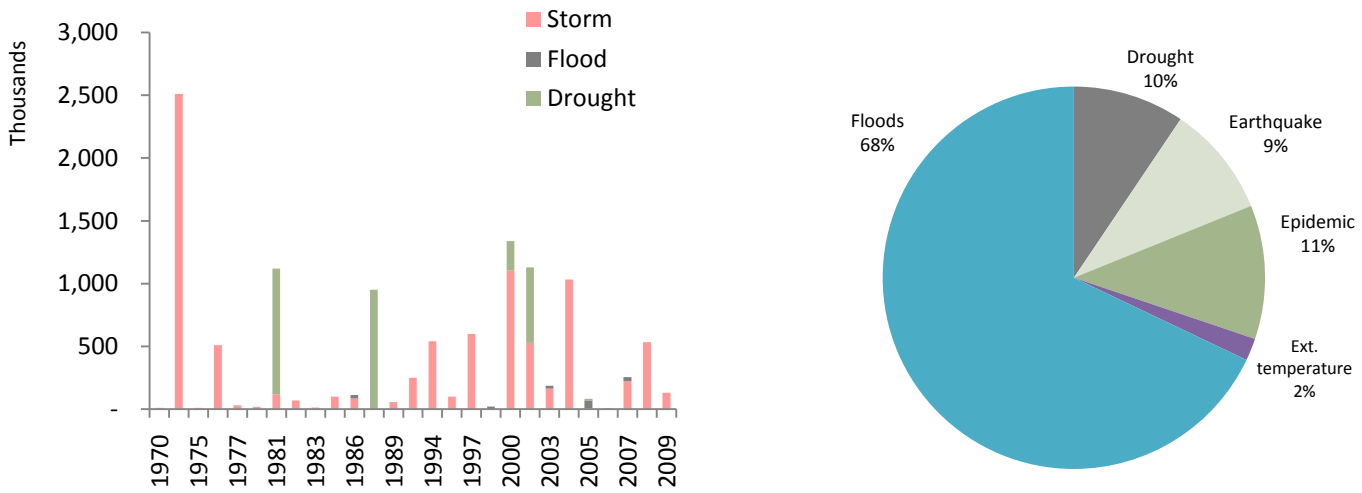


Figure 4: Number of people affected by the top three natural hazards (left) and average distribution of disasters reported each year in Madagascar (right)[12]

- **Cyclones -** Madagascar has one of the highest cyclone risks among African countries, with an average of three to four cyclones affecting the country every year. Cyclone season begins in November and ends in March and can cause significant damage across the island nation, including crop loss, increased incidence of disease outbreaks, degradation of coastal and marine ecosystems, disruption of critical urban services such as water and electricity, severe flooding, damages to infrastructure, and sometimes human casualties. In the last decades, several damaging cyclones have hit the country. Among these there were cyclones Elita and Gafilo in 2004, which caused an estimated 2.3% loss in GDP, and cyclone Boloetse in 2006, which caused a 0.7% decline in GDP.[13] Recent research suggests that while the frequency of cyclones will decrease along this part of the Southern Indian Ocean, their intensity is projected to increase, and could severely impact the country's GDP (leading to a 38% decline in the balance of payments).[14]
- **Droughts -** Driven by large-scale disruptions in atmospheric circulation and exacerbated by poor land use practices, droughts are a common occurrence in the south of Madagascar, which is the hottest and driest part of the island, with some areas receiving less than 400 mm of rainfall each year. Droughts pose a severe strain on subsistence livelihoods, leading to water shortages and crop loss. Between 1980 and 2009, five major droughts occurred with large impacts on agriculture and food security. According to the World Food Program in Madagascar, over the past years droughts have caused widespread failure of maize crops in the southern regions affecting more than 230,000 children under five years of age.[15] The 1981 droughts alone affected over one million people, while in 1988 at least 200 deaths were attributed to droughts.[16] Recent evidence of the prolonged nature of dry periods over southern Madagascar

[11] Ibid. note 3
[12] Source: EM-DAT: The OFDA/CRED International Disaster Database, Université Catholique De Louvain, Brussels, Belgium Data Version: V11.08.
[13] The World Bank & United Nations International Strategy for Disaster Reduction (2007). Report on the Status of Disaster Risk Reduction in the Sub-Saharan Africa (SSA) Region
[14] Ibid. note 9
[15] UN News Service. Madagascar: floods, drought threaten lives of undernourished children, UNICEF warns. Published 2 March 2007.
[16] Ibid. note 3

suggests the need to place increasing emphasis on livelihood diversification activities that can temper the negative impacts of future droughts for vulnerable populations.

- **Floods and Storms -** Intense rainfall events caused by strong storms and tropical cyclones, coupled with poor land use practices and increasing deforestation, can lead to significant and damaging floods across the country. Floods cause damage to roads, bridges, houses, and crops, while also threatening the lives of hundreds of people that live in the affected areas. Over 30 floods or heavy rainfall events affected Madagascar in the past 30 years, killing hundreds of people and affecting thousands. The most damaging floods were those caused by hurricanes Eline and Gloria, which killed 20 people, and tropical cyclone Elita, which killed 363 people and affected one million, causing economic damages of over US$250 million.[17]
- **Sea level rise** - Shoreline erosion caused by sea level rise is already a significant problem to the coastal ports and beaches of Madagascar. Coastal erosion as measured in 1997 was between 5.71 and 6.54 meters, and this is projected to increases exponentially by 2100.[18] Critical infrastructure such as ports and roads are at risk from rising sea levels, as are unique biodiversity hotspots with coastal ecosystems such as the littoral forests on the sandy coastal plains of eastern Madagascar, which are already threatened by development and increased fragmentation.

Implications for DRM

- Cyclones are expected to decrease in frequency but increase in intensity.
- Projected decreases in rainfall, coupled with projected increases in the length of the dry periods could pose additional stress on already vulnerable livelihoods in southern Madagascar.
- Projected temperature increases could disrupt unique and critical micro-climates and lead to significant changes to local farming systems, with implications for food security.

Sectoral Climate Risk Reduction Recommendations

Climate variability and change have and will continue to affect Madagascar. The most profound impacts will be felt in the sectors discussed below.

Agriculture

Agriculture, including fishing and forestry, is the mainstay of Madagascar's economy, accounting for more than 25% of GDP and employing 80% of the population.[19] Agriculture is dominated by small-scale, predominantly subsistence farming that is rain-fed and based on traditional technologies. Apparel exports have increased significantly in recent years primarily due to duty-free access to the markets of the United States. Deforestation and erosion, aggravated by the use of firewood as the primary source of fuel, are serious concerns.

Table 1: Projected changes in rain-fed rice across Madagascar under several management and future scenarios[20]

Crop	Baseline Yield (1961 - 1990)	Future Projected Yield	Change %	Options
Rice	2114	2119	0.24	High Input, 2020s
Rice	2114	2208	4.45	High Input, 2050s
Rice	2114	1789	-15.37	High Input, 2080s
Rice	1127	667	-40.82	Low Input, 2080s

[17] Ibid. note 3
[18] Ibid. note 1
[19] Ibid. note 1
[20] World Bank Climate Change Data Portal – Agricultural Model Generated by IIASA

Climate change adds a layer to the vulnerability of this sector. Climatic changes will negatively impact soil fertility, particularly in highland areas where increased rainfall coupled with deforestation is decreasing soil cover through erosion.[21] Variations in rainfall and temperature, along with increased intensity of activity in some regions have already led to shifts in the farming schedule/calendars of local farmers, and consequently an increase in crop failure. Water supply for agriculture is expected to decrease.[22] Adaptation efforts in the agriculture sector include:

- Improvement and conservation of soils.
- Scaling up natural fertilizer production.
- Switching to different cultivars (drought tolerant/shorter cycle).
- Development and introduction of policy measures.
- Agricultural research and transfer of technology.
- Improvement of farmers' knowledge about proper use of weather information in carrying out agricultural activities to avoid risks of climate change.
- Scaling up reforestation activities to cope with soil degradation.
- Scaling up counter-season cropping and vegetable gardening.
- Increase in research into adaptive seed varieties.
- Construction of small dams for water control.
- Expanding infrastructure and capacity-building for use and maintenance of water management systems.

HEALTH

Madagascar's limited public health sector is vulnerable to climate variability and change, particularly with regard to the increased incidence of nutritional deficiencies and vector-borne diseases. Projected temperature increases, coupled with warmer and more humid environments, could increase the incidence of malaria, diarrheal diseases, and acute respiratory infections. There is a potential for an elevation migration of the *Anopheles fluviatilis* malaria vector from endemic coastal areas to elevations above 1500 m. Diarrheal diseases are already a significant problem in the country and flooding may exacerbate these and other water-quality diseases, such as cholera, by increasing surface water pollution. Addressing the impacts of climate variability and change on the health sector requires addressing issues of poverty, sanitation, nutrition, and environmental degradation, all of which significantly hamper a community's vulnerability and capacity to adapt. Adaptation recommendations in the health sector include:

- Strengthening the country's health services – paying particular attention to increasing the system's rapid response capacity with regard to diseases that have a direct climate link, including monitoring and raising awareness. Increased coordination among the country's health sector with broader developmental players will ensure that the health concerns related to climate change are mainstreamed into development activities.
- Promoting research on climate change and health – responding to the urgent need to understand and attribute the health impacts of climate change in Madagascar, especially for vulnerable locations.
- Securing local drinking water supplies and proper drainage: an essential step toward curbing diseases of water quality.[23]

[21] United States Agency for International Development, 2008. Impacts of climate change on rural livelihoods in Madagascar and the potential for adaptation.
[22] Ibid. note 1
[23] Practical Action. Promoting Adaptation in Madagascar, Policy Brief.

FISHERIES

Offshore fish stocks have already been affected by increased sedimentation and runoff from the country's extensive river systems. This impacts corals as well as water acidity levels and temperatures in the productive deltas, all of which have already faced significant degradation from cyclones. An increased migration to new fishing grounds is well documented as are increased supplementary livelihoods in fishing communities and the occasional livelihood conversion altogether. Conversion from a fishing-based livelihood to a livelihood based principally on agriculture may not be a viable or sustainable alternative, but it is already being practiced. Fishermen have to travel longer distances out to sea to fish, creating an increased reliance on material and financial aid to obtain the necessary equipment (e.g. motors) to do so. Climate-related stresses, coupled with over-fishing, increase the vulnerability of fishing-based livelihoods. Onshore fishing is most vulnerable to water supply and quality, sedimentation, and the migration of species.[24] Adaptation efforts in the fisheries sector include:

- Scaling up financial and technical support for small-scale and line fishermen.
- Creation and improvement of fishermen's association/cooperatives.
- Improvement of community management systems for marine resources.
- Increase attention to land use planning, including the intensification of fish-farming in rice fields and the protection of watersheds for onshore aquatic resources.
- Diversification of fishing activities.
- Improvement of coastal management (marine protected areas).
- Improvement of regional communication strategies.

WATER RESOURCES

Water resources in the country are divided geographically, with ample resources and potential in the coastal and northern areas, which are characterized by heavy rainfall during the summer and annual rainfall between 2,000 mm and 3,000 mm. The arid southern areas receive less than 400 mm of rainfall annually and have limited water supplies. Water resources from rivers and rainfall provide for the water needs of the country both in terms of agriculture and human usage, as well as electrical power generation. The country's water utility, JIRAMA, manages all water resources. A National Program for Safe Water was adopted in 2005 to support the country's efforts at meeting its Millennium Development Goal (MDGs) targets by 2015, including provisions to improve sanitation policy and institutional capacity for water resource management. The country's water management system, however, remains inadequate for meeting the agriculture and consumption needs of a growing population, with only 20% of the population having access to piped water and only 50% with access to safe water resources. Furthermore, recent evidence suggests significant reductions in water quality in some areas, especially in the south. Central to the success of managing water resources under a changing climate are several adaptation activities listed below:

- Improvement of water management, including rationalization of local water-rate structures to ensure better cost recovery and greater water conservation.
- Investments in water monitoring and information systems as a basis for more efficient and equitable use of water resources in all sectors, especially as related to increasing pro-poor access to resources.
- Development and implementation of water-saving infrastructure for different types of water use.
- Analyses and revision of water supply and demand with the aim of improving efficiency in the system and taking account of revised water cycles resulting from climate change and variability.
- Awareness-raising campaigns at the community level to promote greater responsibility in managing water resources.

[24] Ibid. note 13

COASTAL RESOURCES

Madagascar has over 5,600 kilometers (km) of coastline—a rich and vibrant resource that includes mangroves and wetlands. The country has about 300,000 hectares (ha) of mangroves[25], which are an essential source of fuel, building supplies, and food and serve to slow coastal erosion. The potential negative impacts of climate change on these resources are significant.[26] Madagascar's unique coral reef ecosystems (3,450 km of coral reefs) are vulnerable to ocean warming and the effects of ocean acidification: in 2005, warm ocean temperatures resulted in bleaching of up to 80% of the coral on the northeast coast of Madagascar. Projected increases in cyclone intensity along the east coast could add to coastal erosion, while soil erosion on the west coast, coupled with rising sea levels, could inundate urban areas. Adaptation activities in the coastal sector include:

- Creating a marine reserve system based on factors likely to increase resistance and resilience to climate change.
- Promotion of Integrated Coastal Zone Management considering the effects of upland watershed activities on coastal marine ecosystem such as mangroves, and corals.
- Supporting community engagement.
- Reforestation in logged mangrove zones.
- Incorporating climate change into outreach efforts focused on marine resources use.

Ongoing Efforts- At a Glance

Vulnerability Reduction

- The Tuléar Fishing Communities Support Project (PACP) aims to help reduce rural poverty in Madagascar. The specific objective of the PACP is to promote sustainable development of traditional maritime fishing through consolidation of beneficiary organizations and State services, joint and responsible management of fishery resources, and adequate equipment of fishermen. Project implementation is carried out by the Africa Development Bank – AFDB.
- Climate Change Adaptation Capacity in Madagascar (implementing partners WWF Madagascar & Western Indian Ocean Program (MWIOPO) together with the Madagascar Protected Areas Commission) raises awareness of climate change impacts on biodiversity and livelihoods within the Malagasy conservation community, decision-makers, and targeted local communities.
- Vulnerability and Adaptation to Climate Change: Agricultural Systems in Madagascar (International Development Research Centre – IDRC) aimed to facilitate dialogue among at-risk groups, decision-makers, and researches.

GFDRR Interventions

With a GFDRR grant of US$1.2 million the country designed cyclone-resistant codes, which were adopted by a Government Decree signed by all 31 Ministries on April 20, 2010.[27] These codes are being applied as climate-proof norms for roads, irrigation systems, schools, public health centers, and agriculture in areas highly vulnerable to cyclones, droughts, and other climatic shocks.

[25] Conservation International and WWF (2008). Assessing the Impacts of Climate Change on Madagascar's Biodiversity and Livelihoods (a Workshop Report).
[26] Ibid. note 1
[27] Ibid. note 9

EXISTING ADAPTATION FRAMEWORK/STRATEGY/POLICY AND INSTITUTIONAL SET-UP

Over the past decades the Government of Madagascar has taken significant steps to identify priority activities that strengthen its capacity to protect natural resources and to adapt to adverse climatic variability and climate change in the future. The Government has developed and established several programs, plans, and institutions to improve disaster risk management and to reduce the country's vulnerability to natural hazards, in particular cyclones and droughts.

- Madagascar was the first African country to apply the ECLAC/DaLa methodology of Post Disaster Risk Assessment (PDNA), with assistance from the Global Facility for Disaster Reduction and Recovery (GFDRR).[28]
- **NAPA**: The National Action Plan for Adaptation (December 2006) to climate change aims to empower the country to adopt urgent and immediate adaptation measures, addressing the adverse effects of climate change and targeting particularly the five priority sectors: agriculture and livestock, public health, water resources, coastal zones, and forestry. NAPA was written by the Government of Madagascar with technical and financial support by the Global Environment Facility in the World Bank.[29]
- **NEAP**: The National Environmental Action Plan was developed by the Government of Madagascar in 1989. It consisted of a long-term investment program divided in three phases: 1991-1997, 1997-2003, and 2003-2008. This plan aimed to manage the national heritage of biodiversity in protected areas, improve human living conditions through protection areas and better management of natural resources, promote environmental education, improve policy and management, and establish mechanisms for research, management of data, and monitoring of the environment. [30]
- **CCA**: The Common Country Assessment reviews and analyzes the country's development situation toward the overall goal of poverty reduction. All themes taken into consideration in the CCA are essential for helping the country achieve the Millennium Development Goals (MDGs) for 2015. For each thematic area, this document presents a strategic analysis, identifies root and underlying causes of key issues, and assesses the factors for success, providing recommendations for future areas of cooperation and underscoring the urgency of acting now. The thematic areas are: food security, education, health and nutrition, HIV/AIDS; environment, energy, water/sanitation, natural disasters, and governance. [31]
- **PRSP**: The Poverty Reduction Strategy Paper describes the country's macroeconomic, structural, and social policies and programs over a three-year or longer horizon to promote broad-based growth and reduce poverty as well as determine associated external financing needs and identify major sources of financing.[32]
- **HFA**: The Hyogo Framework for Action was adopted by the Government of Madagascar in 2005. The Plan aims to support the creation and strengthening of national integrated mechanisms and to ensure that disaster risk reduction is a national and local priority. The Government has to report to the International Strategy for Disaster Reduction (ISDR) secretariat every two years on progress in the implementation of this plan. [33]
- **MAP**: The Madagascar Action Plan was produced by the Government of Madagascar and incorporates risk reduction and disaster management (DRR). It is a bold, five-year plan that establishes direction and priorities for the nation from 2007 to 2012. The MAP strives to fight poverty and to improve the economy through 8 commitments and strategies: responsible governance; connected infrastructure; educational transformation; rural development and a Green Revolution; health, family planning, and the fight against HIV/AIDS; a high-growth economy; cherishing the environment; and national solidarity.[34]

[28] Ibid. note 9
[29] Ibid. note 1
[30] The National Environmental Action Plan for Madagascar, 1989.
[31] The Common Country Assessment for Madagascar, 2003.
[32] The Poverty Reduction Strategy Paper, 2009.
[33] The Hyogo Framework for Action, 2005.
[34] The Madagascar Action Plan, 2006.

- **SNGRC**: The National Strategy for Risk and Disaster Management was published in 2002 and aims to identify and manage risks and hazards in Madagascar. A key result of this strategy will be the availability of an effective and sustainable institutional structure and a strategic plan that will indicate Madagascar's priorities for disaster risk management for a period of three to seven years. [35]
- **BNGRC**: The National Bureau of Risk and Disaster Management was established by the Government of Madagascar in 2006. It supports the Council for National Risk and Disaster Management (CNGRC) under the Ministry of Interior and provides disaster prevention, organization and management in case of emergency. The BNGRC replaces the Council for National Security (CNS), which was created by a first decree in 1972 to ensure the coordination of disaster-related activities across the country. [36]
- **CNGRC**: The Council for National Risk and Disaster Management.[37]
- **CRIC**: The Reflexion Stakeholders Comity for Disasters was established by the Government of Madagascar in 1999 initially as a think tank to discuss disaster-related matters and, subsequently, in 2003 as a national platform for disaster risk reduction. It does not have legal status or formal decision-making power. However, it decides consensually on a number of disaster risk reduction activities that will be implemented under the coordination of the BNGRC.[38]
- **SNAP**: The National Early Warning System reports on all indicators of vulnerability of a population (social, economic, physical, environmental, infrastructure, etc.).[39]
- **The National Platform** takes part in the development and the preparation of all matters concerning DRR. The Platform is composed of 7 commissions: Health, Logistics and Infrastructure, Information, Education, Communication, Agriculture, and Science. [40]

While Madagascar has made steps forward to address disaster risk management, major gaps and challenges remain and hinder a proactive and timely response and preparedness in light of future climate change. Some examples are listed below.

Institutional and Policy Gaps [41]

- Strengthening and formalizing the National Platform. As of now, the platform is an informal forum of coordination and does not control the flow of funds spent by NGOs and the UN System for DRR. This needs to be remedied in order to effectively implement the proposed platform activities.
- Strengthening local institutions in disaster risk management. Current institutional capacity is dispersed and fragmented and a significant effort is required to provide the necessary tools and capacity at the local level to respond to and prepare for disasters in the future. Decentralization is the key to this goal, allowing district and community leaders to draw funds to clean drains, raise dykes, store communal seed, and manage local water resources.
- Integrating climate change considerations into the country's National Strategy, including budget lines to address potential risks.
- Coordinating donor assistance. At the national level, development partners should reopen discussion on a Disaster Contingency fund and assist the Government in finalizing an Operational Manual for disaster management that is acceptable to all parties. This should include updating the disaster risk management strategy and policy.[42]

[35] The National Strategy for Risk Management and Disaster, 2002.
[36] Ibid. note 34
[37] Ibid. note 34
[38] International Strategy for Disaster Reduction (2008). Towards National Resilience Good practices of National Platforms for Disaster Risk Reduction.
[39] Ibid. note 34
[40] Ibid. note 38
[41] National Report on implementation of the Hyogo Framework (2009-2011), 2010.
[42] World Bank publication, 2010 by Ratsimamanga A. and Bettencourt S. "A disaster risk management in Madagascar: a policy note"

Research, Data, and Information Gaps

The economy of Madagascar is primarily agricultural and thus particularly vulnerable to climate-related events, such as weather extremes and increasing variability. The Government of Madagascar has taken significant steps to improve its disaster risk management activities. However, much remains to be done to improve both short-term responses and long-term planning for disaster risk reduction. Existing information deficiencies are outlined below.

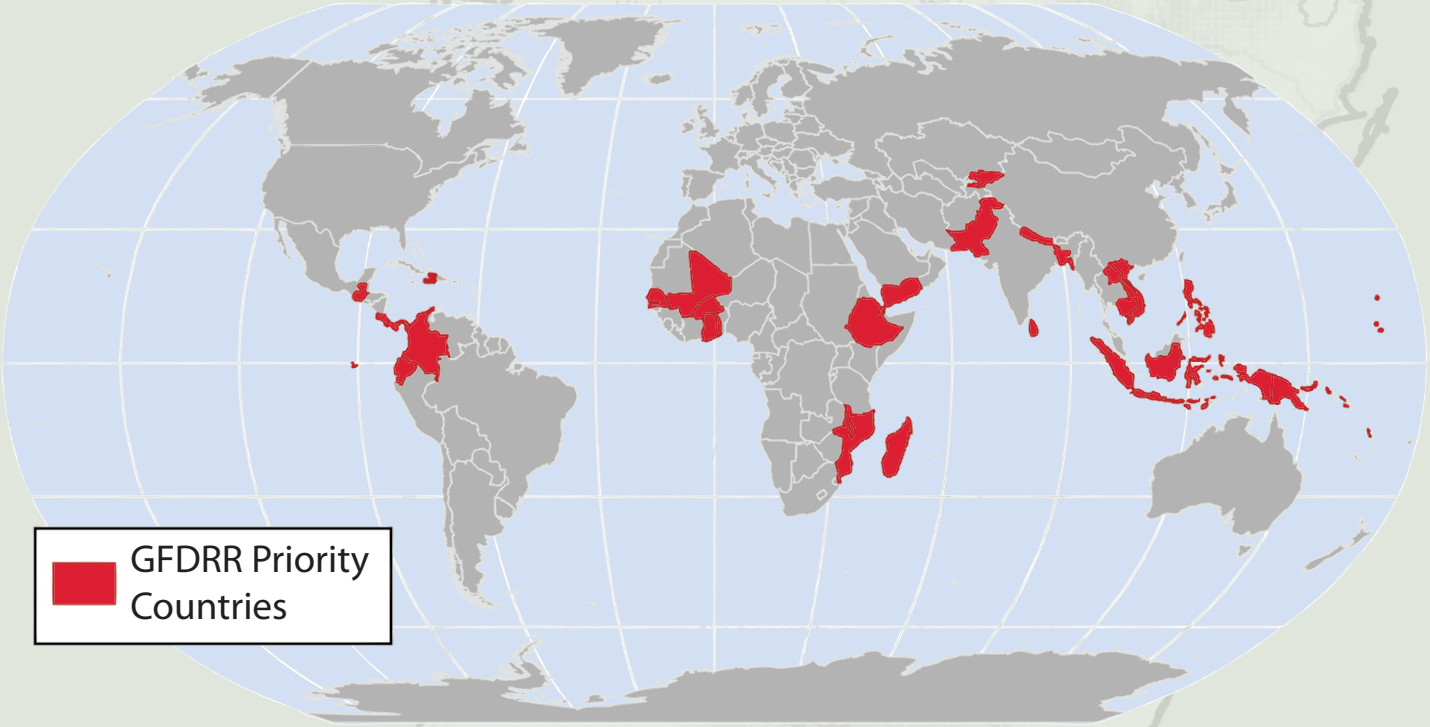
Research Gaps

- More careful and comprehensive adaptation will require greater technical capacity in the country. Improvements to technical capacity are required at the district and community level, but also at the research level, so support to national research institutes and universities is important.
- Mainstreaming disaster risk management into planning and administration, particularly in a diverse environment such as Madagascar, requires further research on appropriate mechanisms for mainstreaming at the administrative level, including studies on the differential effects of climate variability and change on disaster vulnerability, including increased glacial melting and shifting rainfall patterns.
- More research is necessary on integrated spatial planning to designate areas at risk, flood-prone zones, and areas where agriculture or settlements should not be permitted.
- Capacity building in Satellite and Lidar photo-interpretation amongst a core group of national staff, to open the door to technological advancements in disaster risk management – including rainfall and flood forecasting, post disaster damage assessment.

Data and Information Gaps

- Madagascar has an inadequate or missing capacity building program for staff at the department responsible for national education in environmental and climate change matters. Technical and financial support is required to conduct appropriate awareness raising campaigns.
- More data, disaggregated data by gender, caste, and ethnic group, is needed to assess the relative impact of natural disasters and for planning purposes.
- Existing climate forecasting mechanisms should be improved and appropriate early warning and crop forecasting systems should be introduced where appropriate.
- Hazards and vulnerabilities need to be mapped. Highlighting the location of specific hotspots where climate-related hazards are experienced or likely to be felt is a key step in identifying intervention areas. Risks vary over time and space (even over relatively short distances) – this reflects both the changing probability of the risk occurring and the changing scale of consequence when and if the risk occurs. Proper documentation of existing risks is a critical first step toward understanding the underlying dynamics that lead to disasters. Mapping exercises should document current hazards, use socioeconomic information to characterize the vulnerability of the areas exposed to these hazards, and identify the projected changing dynamics of these hazards in light of climate change.
- Lack of standardized information system.

This Country Profile *(**http://countryadaptationprofiles.gfdrr.org**) is part of a series of 31 priority country briefs developed by the Global Facility for Disaster Reduction and Recovery (GFDRR) as part of its Disaster Risk Management Plans. The profile synthesizes most relevant data and information for Disaster Risk Reduction and Adaptation to Climate Change and is designed as a quick reference source for development practitioners to better integrate climate resilience in development planning and operations. Sources on climate and climate-related information are linked through the country profile's online dashboard, which is periodically updated to reflect the most recent publicly available climate analysis.*



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