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BUILDING URBAN RESILIENCE TO CLIMATE CHANGE

A REVIEW OF MADAGASCAR



March 2018

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Cover Photo: Maria Olsen, European Union/European Commission Humanitarian and Civil Protection (EU/ECHO). The local Red Cross assists communities temporarily displaced by floods in Antananarivo's Ankasina neighborhood. In 2015, Tropical Cyclone Chedza caused Antananarivo's primary pumping station to cease operation, leading to flooding and contamination of water supply and sanitation infrastructures across Madagascar's capital.

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Prepared for:

United States Agency for International Development

Climate Change Adaptation, Thought Leadership and Assessments (ATLAS)

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ACRONYMS

AES	<i>Alimentation en Eau dans le Sud</i>
AfDB	African Development Bank
APIPA	<i>Autorité pour la Protection contre les Inondations de la Plaine d'Antananarivo</i>
BNCCC	<i>Bureau National de Coordination des Changements Climatiques</i>
BNGRC	<i>Bureau National de Gestion des Risques et des Catastrophes</i>
CCA	Climate change adaptation
COP	Conference of Parties
CPGU	<i>Cellule de Prévention et Gestion des Urgences</i>
CTD	<i>Collectivités territoriales décentralisées</i>
DGM	<i>Direction Générale de la Météorologie</i>
DRM	Disaster risk management
DRR	Disaster risk reduction
EWS	Early warning system
FID	<i>Fonds d'Intervention pour le Développement</i>
FDL	<i>Fonds de Développement Local</i>
GEF	Global Environment Facility
GIZ	<i>Deutsche Gesellschaft für Internationale Zusammenarbeit</i>
GTCC	<i>Groupe Thématique sur le Changement Climatique</i>
IOM	International Organization for Migration
JICA	Japanese International Cooperation Agency
JIRAMA	<i>Jiro sy Rano Malagasy</i>
LDCF	Least Developed Countries Fund
M2PATE	<i>Ministère auprès de la Présidence en charge des Projets Présidentiels, de l'Aménagement du Territoire et de l'Équipement</i>
MEEF	<i>Ministère de l'Environnement, de l'Écologie et des Forêts</i>
MEEH	<i>Ministère de l'Eau, de l'Énergie et des Hydrocarbures</i>
MGA	Malagasy ariary
MID	<i>Ministère de l'Intérieure et de la Décentralisation</i>
NAPA	National Adaptation Programme of Action
NAP	National Adaptation Plan
NGO	Nongovernmental organization

PCD	<i>Plan Communal de Développement</i>
PND	<i>Plan National de Développement</i>
PRD	<i>Plan Régional de Développement</i>
PUPIRV	<i>Projet d'Urgence pour la Préservation des Infrastructures et Réduction des Vulnérabilités</i>
RF2	<i>Rafitra Fikojana ny Rano sy ny Fahadiovana</i>
SAMVA	<i>Service Autonome de Maintenance de la Ville d'Antananarivo</i>
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WFP	World Food Programme

EXECUTIVE SUMMARY

Madagascar is exposed to a variety of weather and climate phenomena that have wide-ranging impacts on human health and safety, natural resource availability, economic activities, and homes and other infrastructure. Southern Madagascar frequently experiences drought, while the northeastern regions of the island are predominantly exposed to cyclones and heavy rainfall from November to April. In addition, significant migration to and between the capital and largest city, Antananarivo, rapidly expanding secondary cities, and emerging urban centers are outpacing municipal capacity to address existing vulnerabilities caused by years of political turmoil and widespread poverty. Despite the commitment to decentralization from the national to local governments articulated and reaffirmed in the Government of Madagascar's laws and policies, technical and financial capacity to support urban management and delivery of basic services remains limited.

This assessment examines the institutional, legal, and regulatory environment, climate change adaptation (CCA) capacity (and urban management capacity more generally), and financial resources and mechanisms available to address adaptation and disaster risk reduction (DRR) priorities in Madagascar's growing cities.

KEY FINDINGS

- Explicit efforts to move adaptation forward are relatively new in Madagascar. Disaster risk management (DRM) has been the focus of relevant policy and activity on the ground, with priority given to disaster response and early recovery over preparedness and DRR.
- The functions of DRM, DRR, and CCA are distributed between government agencies at the national level. This siloed effect often causes confusion about roles and responsibilities and creates competition among national agencies for international climate finance.
- Years of political upheaval coupled with undercurrents of civil unrest have produced vague and sometimes conflicting guidance regarding the decentralized system of governance, including the appropriate governing structures, and their roles and responsibilities. Weak coordination between the national and local level constrain the ability of urban and peri-urban areas to adequately plan for, respond, and adapt to climate variability. These challenges stemming from the incomplete process of decentralization continue to be a topic of national debate.
- Accessing and interpreting localized weather and climate information is a challenge for municipalities with limited climate change expertise. In addition to material and human resource constraints, the channel for relaying weather and climate data from local stations to Antananarivo for analysis by the national meteorological agency is inefficient and incomplete.
- The practice of local development planning is inconsistent and varies widely across Madagascar's municipalities. Local plans are often developed by consultants when

municipalities can afford to engage them, resulting in plans that fail not only to articulate a strategic vision that resonates with residents, but also to propose feasible adaptation solutions and detailed budgets. The resultant plans are too vague to be a useful framework for local development and improved resilience.

- The realities of limited capacity and finance as well as the immensity of the challenges that Madagascar faces in providing for even the most basic development needs mean that the role of DRM, community development, and service provision is simply delegated to development partners working across the country, with little oversight from local governments.
- Supporting municipalities to identify options for collecting revenue, and accessing external resources and financing is a critical part of investing in urban resilience. Local governments collect only a fraction of their potential revenues due to an unclear legal framework, poor awareness and enforcement of tax and nontax revenue regulations, and challenges in tax collection. Capacity of municipalities to prepare proposals and provide financial and technical information to support grants or loans is extremely limited.

OPPORTUNITIES FOR ENGAGEMENT AT THE LOCAL LEVEL

1. **Improve the availability and accessibility of climate information tailored to the specific and priority needs of municipalities.** A major opportunity exists to facilitate closer collaboration between weather and climate data users (e.g., local planners, transport and logistics companies, agribusinesses) and data providers (the national meteorological agency). Currently, users are not given the appropriate avenues to provide feedback to the national agency on how the data they provide are used, and the national agency and regional meteorological services offer weather information without local context. Improved linkages between the national agency and key entities that operate at a subnational and municipal level could generate a feedback loop through which critical information for urban resilience is shared and disseminated.
2. **Support an integrated approach to CCA within municipality planning and budgeting processes.** In general, local development plans and budgets are drafted without being informed by robust or comprehensive climate change vulnerability assessments. Facilitating multisectoral workshops—with participation from regional agents of the national disaster management office, the meteorological agency, and the national climate change office—at strategic points within regional and local development planning processes could encourage broader buy-in for adaptation objectives. In addition, introducing participatory budgeting could help build capacity and transparency around municipal projects, encouraging greater contribution from taxpayers to fill funding gaps.
3. **Harness best practices and lessons learned to scale those experiences.** Positive and effective efforts to restore mangrove forests, protect sensitive habitats, improve waste management services, provide technical assistance to farmers, and stabilize dunes have taken place throughout Madagascar. However, scaling these efforts requires addressing several challenges, including 1) extreme poverty and isolation, which limit people's awareness of, interest in, or economic ability to take up adaptive practices, and 2) a limited framework for knowledge sharing. Facilitating communication between communities and administrative entities across regions can increase the flow of lessons learned among municipalities, and help municipalities identify mutually beneficial opportunities to develop climate-resilient infrastructure. In addition, Madagascar's

longstanding experience with sister-city arrangements could provide a viable platform for disseminating best practices.

4. **Support municipalities to identify and access finance that can be used for climate action.** Municipal governments are charged with providing many public services, but have little control over cash flow, as most revenue is retained at the level of the central treasury. Urban resilience requires means and mechanisms by which local governments can leverage private investment and in-kind cooperation, and generate (and retain) some revenue at the local level to support adaptation and risk management. Local governments may not understand the procedures for accessing central funds for development available via the *Fonds de Développement Local* (FDL), for example, and the FDL may dismiss proposals that demonstrate strong potential to increase community resilience because resilience indicators are not a part of the evaluation rubric. In addition to strengthening capacity for competitive grants, facilitating linkages between local governments and private sector actors, who are showing increasing interest in supporting local CCA, can generate innovative public–private partnerships to improve resilience.

INTRODUCTION

Madagascar, home to an estimated 25 million people, is exposed to a variety of weather and climate phenomena that have wide-ranging impacts on human health and safety, natural resource availability, economic activities, and homes and other infrastructure. Southern Madagascar frequently experiences drought, while the northeastern regions of the island are predominantly exposed to cyclones and heavy rainfall from November to April. In addition to these weather and climate risks, bush fires are recurrent throughout the island, and significant migration to and between the capital and largest city, Antananarivo, rapidly expanding secondary cities like Toamasina, Antsirabe, and Mahajanga, and emerging urban centers in Tuléar, Ambovombe-Androy, and Taolagnaro (see box) are outpacing capacity to address underlying vulnerabilities.

Despite the commitment to decentralization from the national to local governments articulated and reaffirmed in the Government of Madagascar’s laws and policies, technical and financial capacity to support urban management and delivery of basic services remains limited. Widespread poverty – over 70 percent of the country’s population lives on less than US\$1.90 per day – paired with a national urbanization rate of 4.7 percent, the limited availability of basic services, and weak institutions and systems further constrain the ability of urban and peri-urban areas to adequately plan for, respond, and adapt to climate shocks.

The purpose of the following sections is to examine the extent to which institutions at each level of government contribute to urban management from an administrative, regulatory, financial, and technical capacity perspective, with a view to identify conditions and actions that can increase the resilience of Madagascar’s cities. Climate change impacts will affect cities differently based on the design and structural integrity of existing physical assets (e.g., transport infrastructure, public buildings, housing, sanitation, and water). Therefore, we examine the current state of delivery of goods

Urban Madagascar at a glance

Madagascar’s municipalities (*communes*) are classified as “urban” when the population exceeds 20,000 inhabitants. Communes receive a designation of “urban” or “rural” by national decree (e.g., Decree N° 2015-592). Urban communes, which by law must have the means to maintain a budget, are further divided into first- and second-tier categories.

City	Population
Antananarivo	1.4 million (with 2.63 million residing in greater metropolitan area)
First category urban communes	
Toamasina (Tamatave)	339,221
Antsirabe	309,726 (greater Antsirabe: 417,370)
Mahajanga	258,527
Fianarantsoa	206,337
Toliara (Tuléar)	226,473 (greater Toliara: 271,467)
Second category urban communes	
Antalaha	78,105 (greater Antalaha: 237,754)
Manakara	46,294
Fénéry Est	54,437
Maroantsetra	31,646 (greater Maroantsetra: 226,963)
Ambovombe-Androy	90,761 (greater Ambovombe: 355,159)
Taolagnaro (Fort Dauphin)	62,057 (greater Taolagnaro: 279,249)

Source: Open Data for Africa population statistics (AfDB 2015), JIRAMA data (2017).

and services in Section 2 alongside the functions of local planning and regulation. This provides a means of assessing vulnerability and municipal readiness to implement actions that could eventually address potential impacts from increasing climate variability and ultimately climate change (Section 4).

Information for this assessment was collected from a desk study and field work. In the field, researchers met with national-level stakeholders, including representatives from the state-owned utility agency that provides the bulk of water and electrical services to the country (*Jiro sy Rano Malagasy, or JIRAMA*), international donors and partners (e.g., World Bank, United Nations Development Programme (UNDP)), nongovernmental organizations (NGOs), and research institutions. Researchers

also met with representatives from four municipalities: the capital, Antananarivo; Tsihombe and Tuléar in southern Madagascar; and Maroantsetra in northeast Madagascar. These cities were selected as they represented a range of challenges and climate risks (e.g., floods in Antananarivo, Tuléar, and Maroantsetra, and droughts in Tsihombe) facing urban areas of varying size across Madagascar's diverse geographies. A complete list of individuals interviewed and their organizations is available in Annex A.

Figure 1. Location of field assessment sites in Madagascar



SECTION 1. OVERVIEW OF THE INSTITUTIONAL ENVIRONMENT

Madagascar's political and governing structure has experienced repeated crises and changes since its independence in 1960. This reality of consistent political upheaval coupled with undercurrents of civil unrest are in part the manifestation of the desire to establish a governing structure that simultaneously 1) seeks to establish a unified central government, 2) while also laying the groundwork for a decentralized governance regime as established in the 1992 Constitution, and 3) recognizes indigenous social organizations within the hierarchy. Article 41 of Madagascar's Constitution¹ articulates the goal of governing through decentralization. However, constitutional reforms between 1992–2009, which resulted in one impeachment, and a military coup in 2009 have left only vague and sometimes conflicting guidance on the decentralization process, including the appropriate governing structures and their roles and responsibilities. In fact, Madagascar's current *Plan National de Développement* (PND) (2015–2019) explicitly recognizes the destabilizing effects of such political turnover, noting that decision makers and institutional structures change too often to implement sustainable policies. These challenges translate into a complex landscape of governing regimes, as described below.

1.1 LEVELS OF GOVERNANCE

Madagascar is divided into 6 provinces, 22 regions, 119 districts, and 1,695 communes (municipalities). The national capital, Antananarivo, serves as a provincial and regional capital and enjoys special status as a result. A further division includes an indigenous level, the *fokontany* (village or urban neighborhood organizations), which operate within a commune but have no formal role in official governance. Decentralization, the goal of transferring decision-making power from the national to lower levels of administrative organization, has been a stated priority for Madagascar since the 1992 Constitution and in subsequent legislation that granted legal status and financial autonomy to decentralized territorial communities (*collectivités territoriales décentralisées*, or CTDs). In practice, however, decentralization appears to be more an ambition than a reality for the country, as many decisions on budget expenditures and oversight still occur at the national level (World Bank 2003; UNDP 2012b). This bears resemblance to the situation in many sub-Saharan African countries, which often explicitly support decentralization but have not been able to implement it effectively (e.g., Namibia, Botswana, the Democratic Republic of the Congo, and Malawi).

Territorial administration is based on principles of deconcentration, whereby only selected functions and responsibilities of decision making are transferred to provinces and districts.

¹ According to the 1992 Constitution, the prime minister is appointed by the National Assembly and is responsible for all domestic affairs, while the president is the head of state responsible for matters pertaining to international relations, primary executive functions, and national sovereignty.

Deconcentrated entities operate with an administrative mandate from the central authority, whereas decentralized entities (CTDs) are meant to be financially and administratively autonomous. Autonomy at the subnational levels, whether deconcentrated or decentralized, continues to be bounded and limited, and this also varies across the country. As a result, a marked administrative parallelism exists between Madagascar's deconcentrated and decentralized functions (World Bank 2004). Defining who is responsible for key government functions is thus often a challenge. Provinces, for example, are meant to be administered by an elected province head and elected provincial council.² Regional and communal administrations follow a similar structure according to Title VI of Law N°2014–020. By contrast, district leadership is appointed by the central authority and reports to the *Ministère de l'Intérieur et de la Décentralisation* (MID, or Ministry of the Interior and Decentralization) and the prime minister. Similarly, *fokontany* leadership is determined by a partial election process in which the MID nominates a pool of candidates to then be selected by popular vote. In some cases, deconcentrated agents have continued to exercise the executive functions of CTDs. Table 1 describes the functions associated with Madagascar's different levels of government according to Organic Law N° 2014–018 and Law N°2014–020.

² According to interviews with the MID and other stakeholders, this aspect of Madagascar's decentralization process has not been fully implemented to date as a result of delays in formal decrees that effectively operationalize provincial and, in some cases, regional leadership.

Table 1. Roles and responsibilities related to service provision in Madagascar by governance level

Governance level	Role and associated functions and responsibilities
Central	<p>Overall role: Define national policy priorities across all sectors to guide plans and policies at lower levels of decentralization.</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> • Develop policy and oversee policy compliance • Prepare the budget • Nominate heads of various administrative units
Province*	<p>Overall role: Guide and coordinate provincial development and land use planning.</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> • Maintain provincial infrastructure such as provincial roads and hospitals • Finance and support educational services, such as public universities
Region*	<p>Overall role: Guide and coordinate regional development and land use planning. Prepare a 20-year regional development plan (<i>Plan Regional de Développement</i>, or PRD) that is reviewed and updated every five years.</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> • Manage natural and historical assets • Oversee, support, and provide finance to spur economic development in relevant sectors for the region • Maintain regional infrastructure including schools, hospitals, and roads
District	<p>Overall Role: Oversee legal compliance of commune with national, regional, and provincial policy and planning.</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> • Coordinate among municipalities in the same district • Sanction any organization or enforcement actions taken on the <i>fokontany</i> level • Ensure municipality compliance with Ministry of Land Use policies • Coordinate district-level aid distribution (via the <i>fokontany</i>)
Commune*	<p>Overall Role: Lead economic, social, cultural, and environmental development at the commune level, including development of a three-year public investment plan for the commune.</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> • Maintain public registry, military conscription, census • Coordinate intercommunal cooperation • Oversee traffic and maintenance of public roads • Manage and finance primary school system • Coordinate, maintain, and sometimes invest in sanitation and waste management
Fokontany	<p>Overall Role: Serve as a forum for exchange of participatory dialogue for residents.</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> • Maintain public safety and regulate formal and customary law • Support health and education campaigns • Assist communes in monitoring village population and managing the registry of public records • Report and deliver sanctions on customary law code violations

Note: *Legally recognized as a decentralized entity with administrative and financial autonomy.

1.2 MUNICIPAL SERVICE DELIVERY AND REVENUE

Communes are the most deeply rooted of the CTDs, as they were the first recognized by Malagasy law in 1994. They are responsible for the provision of services such as sewerage, sanitation, waste management, and public safety, as well as public infrastructure, including communal roads, primary schools, and community health centers. Investment decisions regarding large social infrastructures and public works such as national roads and airports fall under the purview of the *Ministère auprès de la Présidence en charge des Projets Présidentiels, de l'Aménagement du Territoire et de l'Équipement* (M2PATE, or Ministry for Presidential Projects, Land Use and Development and Equipment), however the criteria and process for prioritizing such projects lack transparency. Communes are legally mandated to develop a three-year public investment plan³ and administer annual budgets meant to support communal social and economic development. Communes also are meant to prepare a *Plan Communal de Développement* (PCD, or Communal Development Plan) every three years. The PCD is expected to be revisited and adjusted each year along with the development and approval of the annual budget. However, the practice of communal development planning appears to be inconsistent and varies widely across Madagascar's communes. For example, the current PCD for Maroantsetra dates to the previous municipal administration (2004–2008) and key government entities interviewed for this assessment did not mention the development of a new PCD as a priority, nor were they even aware of the strategic goals outlined in the 2004–2008 PCD.

Communal, regional, and provincial revenue is derived from various sources, including property taxes on buildings, property taxes on land, market vendor fees, tourism taxes, taxes imposed on water and electricity services, building permits, royalty fees from agricultural commodities and natural resource extraction, as well as usage fees for waste collection and disposal. These revenue

Sources of revenue for Madagascar's CTDs: Communes

The Ministry of Finance and Budget (MEFB) continues to exert control in local revenue assignment and collection through its deconcentrated line agencies. For example:

- Land and property tax levels are set by the communal council and have a 100 percent allocation to the commune, but revenues are recovered by the treasury
- The allocation of revenues collected through excise taxes and licensing rights for gambling, festivals, and alcohol are determined by the MEFB
- Taxes on local natural resources and agricultural commodities (*ristournes*) are collected across both deconcentrated institutions (e.g., *fokontany*) and decentralized entities (i.e., communes)

Own-source revenues, consisting of 37 types of administrative and user fees collected at the commune level, account for only 1–2 percent of decentralized expenditures. Such sources of local revenue include:

- License fees
- Construction permits
- Fines
- Exhumation permits
- Market fees
- Fee for waste management and street cleaning
- Fees on burial grounds

Source: World Bank 2004.

³ In accordance with [Organic Law N° 2014-018](#), Article 146 of [Law N°2014-020 and Decree N°2015-959](#). A preceding law, [Law N° 95-005](#), states that all CTDs (in this case, communes) must have either three-year or five-year public investment plans. Some communes appear to maintain the five-year model, while others adopted the more recent three-year model.

streams are either distributed proportionally to each CTD as prescribed in Law N°2014–020 or are retained by the collecting CTD. For example, of the total revenue collected from entertainment establishment license fees (e.g., nightclubs), 50 percent goes to the benefit of the commune, 30 percent to the region, and 20 percent to the province (Government of Madagascar 2014). Interviews with municipal stakeholders suggest that market vendor fees and taxes on local natural resources and agricultural commodities (*ristournes*) represent the largest share of own source revenue, but the amount collected from such fees and taxes is paltry. For example, the budget included in the 2004–2008 PCD for Maroantsetra reveals an annual budget of approximately US\$250,000 – less than 20 percent being locally generated revenue – for a population of 22,500 people. Limited capacity in revenue collection has been cited as a problem for maintaining adequate budgets. According to one study, communes were able to collect only 30 percent of potential revenue due to limited staffing and regulatory capacity (World Bank 2017b). Residents also cite a lack of standards in billing systems as a major reason for nonpayment.

In addition to communal sources of revenue and annual intragovernmental transfers meant to defray communes’ administration costs (e.g., civil servants’ salaries), the decentralization legislation provides for competitive grants to be disbursed to communes via central funds, such as the *Fonds d’Intervention pour le Développement* (FID, or Development Intervention Fund) and the *Fonds de Développement Local* (FDL, or Fund for Local Development) (Table 2). Although legislation provides for communes’ administrative and financial autonomy, in reality the central government collects and retains an estimated 97 percent of the country’s revenue, while only 3 percent goes back to communes in the form of transfers (World Bank 2004). Madagascar’s single public treasury system is often cited as a barrier to effective municipal service delivery (World Bank 2017b). The unpredictability of funding due to limited cash flows and problems with disbursements from the public treasury are the main challenges affecting budget execution at the municipal level.

Table 2. Sources of subnational financing

Granting mechanism	Managing entity	Background, purpose and application
<i>Fonds d’Intervention pour le Développement</i> (FID)⁴	Office of the Prime Minister	<ul style="list-style-type: none"> • Originally established in 1993 • Historically mobilized to provide capacity to support local development planning and investments in education and health infrastructure (e.g., rehabilitation of schools, health centers) and health initiatives • Is in part a cash-for-work program aimed at rehabilitating basic communal infrastructure • Under the World Bank Emergency Infrastructure Preservation and Vulnerability Reduction Program (known by its French acronym, PUIRV), grants are made for rehabilitation of critical transport infrastructure, disaster risk management (DRM) capacity building, and disaster contingency funds

⁴ In 2016, these safety net programs covered 500,000 extremely poor people, mostly women and children. International Development Assistance (IDA) financing for 2017–2020 committed US\$6.4 billion to Madagascar.

		<ul style="list-style-type: none"> • Previously ensured application of national unit on emergency prevention and management's (CPGU) building codes for weather-resistant public buildings
Fonds de Développement Local (FDL)	Ministry of Interior and Decentralization	<ul style="list-style-type: none"> • Established in 2008 to provide funds for local capacity development and local infrastructure projects • Grants allocated to local government to implement small-scale investments in health and education infrastructure, rural roads, and markets, and to provide additional resources for planned local public investment projects • Between 2009 and 2014, MGA 9.7 billion (approximately US\$3 million) in grants were disbursed • In 2014, 119 communes across four regions (Vakinankaratra, Analamanga, Atsinanana, and Alaotra Mangoro) benefitted from FDL-backed projects (FDL 2014)
Sister-city technical cooperation	Various (e.g., Région Ile-de-France and the Commune Urbaine Antananarivo)	<ul style="list-style-type: none"> • Model dating back to 1961 to connect French municipalities with municipalities in Madagascar as a way of transferring technical assistance in urban management • Funding to date has come entirely from the French government, but the plan is to convert to a cost-sharing arrangement

A third source of revenue for municipalities is derived from a “sister-city” model of technical cooperation, providing technical expertise and capacity for municipal functions. In the case of special projects such as those focused on awareness raising, equipment purchase, and others, this model will also offer limited finance. The cooperation between Région Ile-de-France (which includes Paris, France) and greater Antananarivo, the strongest partnership of its kind, is represented by the *Institut des Métiers de la Ville* (IMV), the operational platform for collaboration between Ile-de-France and the Commune Urbaine d’Antananarivo. IMV provides direct technical assistance in urban management to the Tana municipality and actively promotes municipal capacity in urban agriculture, traffic management and planning, water access, and others. The French government has been the predominant source of funding for this type of cooperation, but is gradually shifting toward a cost-sharing arrangement in which local operators, businesses, and civil society organizations carry out the work with technical support from international experts. Other sister-city arrangements have existed in various forms for Antananarivo and Madagascar’s larger cities.

The availability of basic services varies widely across communes, with service delivery provided by a patchwork of government operators, NGOs and aid organizations, and private sector stakeholders (Table 3). Madagascar’s urban centers are increasingly challenged (both financially and technically) to meet the demand for basic services given growing populations and inadequate resources.

Table 3. Current status of the provision of basic services across Madagascar

Service	Responsible entity	Current status
Transport infrastructure	Ministry of Public Works manages national road network; others responsible for provincial, regional, and communal network. Some major public works managed by M2PATE.	<ul style="list-style-type: none"> • Congested and aging network • Only 33 percent of national road network is characterized as being in good condition by the national roads authority (Autorité Routière de Madagascar 2016)
Power, water, and sanitation	Ministry of Water, Energy and Hydrocarbons invests in and manages water and power infrastructure for the majority of the country, though some municipalities have alternative arrangements.	<ul style="list-style-type: none"> • 51 percent of population has access to safe water (35 percent rural, 82 percent urban) (WHO and UNICEF 2017) • 12 percent of population has access to sanitation facilities (9 percent rural, 18 percent urban) (WHO and UNICEF 2017) • 15 percent of population has access to electricity (6.5 percent rural, 53.0 percent urban) (USAID 2016) • National water operator and power utility, JIRAMA, has limited reach across Madagascar
Waste management	Managed entirely by municipalities.	<ul style="list-style-type: none"> • 33 percent of waste produced is treated in disposal sites
Health	Ministry of Health sets national policy and coordinates resources; regional directorates provide technical support to districts, which oversee commune primary health centers.	<ul style="list-style-type: none"> • Inadequate distribution of health centers and services
Education	Ministry of National Education sets national policy; regional directorates oversee application of national policy; districts manage nonsalary budgets for primary schools (maintenance, administration, and supplies) and carry out local procurements.	<ul style="list-style-type: none"> • Insufficient school facilities and overcrowded classrooms

While estimates suggest that 70–80 percent of the country’s population lives in rural areas, versus 20–30 percent in urban centers, the movement of populations from rural areas to urban centers is complex and poses a challenge both for arriving communities and those from which migration takes place (see box). It is clear that this migration strains the colonial-era urban infrastructure, water, and land resources in urbanized areas and affects the resilience of the communities that migrants leave behind.

Migration and poverty dynamics in Madagascar’s south

Rural–urban disparities in poverty, health, and education contribute to Madagascar’s high rate of urbanization (4.7 percent annually) (World Bank 2017b). While internal seasonal migration is commonplace in Madagascar, climate variability and change were important drivers of migration in recent years. According to International Organization for Migration (IOM) data gathered through its *Displacement Tracking Matrix* (DTM) for southern Madagascar, the urban commune of Tsihombe witnessed a large exodus in the last decade, due almost exclusively to drought. The principal destination for residents leaving Tsihombe between 2009 and 2017 was Tulear (IOM 2017a, 2017b). While an important departure point, Tsihombe also absorbs migrants originating from even more remote rural communes like Anjapaly.

Several municipalities noted that weak or virtually no enforcement of zoning or building permits occurs, as the principal criterion for obtaining a building permit is limited to providing proof of land title. Representatives from the urban commune of Tuléar noted that migration from the more remote and rural south into Tuléar is mainly an influx of vulnerable populations (i.e., poor agrarian and pastoralist populations less likely to be formally educated), engendering a proliferation of illegal construction and sanitation issues, along with an increase in the number of *pousse-pousses* and *cycle-pousses* (hand-pulled and cycle rickshaws), which contribute to road congestion (Commune Urbaine de Tuléar, onsite interview, June 2017). Historically, decentralization efforts and land reform led to confusion for landowners attempting to formalize their landownership, as legal authority for taxation, land registration, and issuance of land titles and building permits was divided among regional and municipal government entities. The 2015 Law on Land Use Planning mandates local governments to identify private land, untitled parcels, conservation areas, and communal land reserves and to ensure these are reflected in local plans.

The World Bank assisted the national unit on emergency prevention and management (known by its French acronym, CPGU, for *Cellule de Prévention et Gestion des Urgences*) in the development of weather-resistant building and infrastructure codes in 2010 with the goal of preventing losses and injury during extreme weather events like cyclones, floods, and earthquakes (Global Facility for Disaster Reduction and Recovery, World Bank 2015). However, enforcing these codes is still a challenge. *Fokontany* are charged with addressing infractions raised by inspectors, but inspectors are few and inspections irregular due to limited financing, staff shortages, and lack of technical expertise. Municipalities have shown weak oversight in the coordination of projects implemented within and across communes as a result of insufficient personnel and limited funds.

SECTION 2. CLIMATE RISKS AND VULNERABILITIES AT THE MUNICIPAL LEVEL: CASE STUDIES FROM SELECTED COMMUNES

Madagascar’s climate is tropical with regional and subregional variations. While most of the island is exposed to cyclones, the northern and eastern regions, which receive 1,000–2,000 millimeters (mm) of rainfall on average, are most affected by them (USAID 2013; World Bank 2017a). By contrast, the more arid south experiences consecutive droughts periodically amplified by El Niño. Data for rainfall (from 1983 to 2014) and temperature (from 1961 to 2014) reconstructed from station observations and remote sensing proxies suggest that Madagascar is already subject to significant climate variability, which is projected to continue. The available evidence on projected future climate for Madagascar is summarized in Table 4.

Figure 2. Köppen climate classification for Madagascar

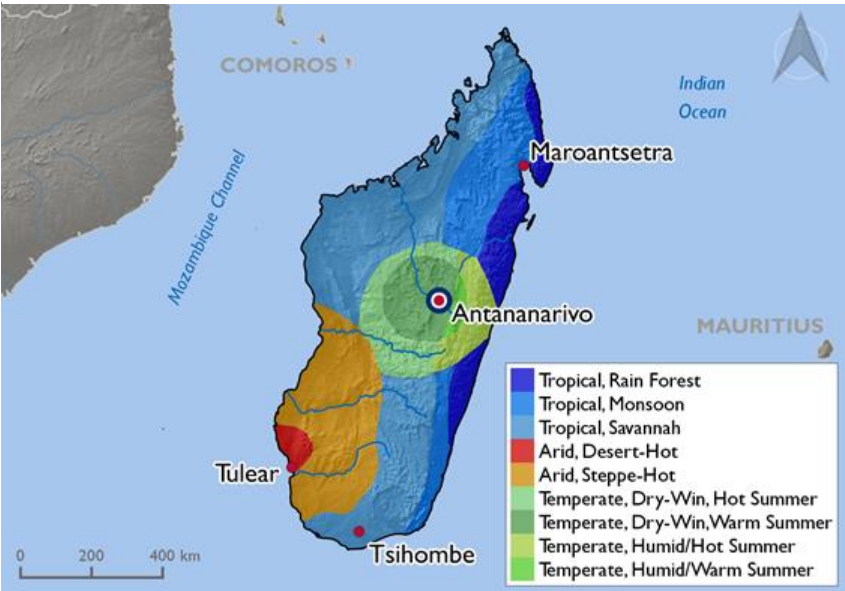





Table 4. Historical and future changes in climate in Madagascar

Climate parameter	Observed changes since the 1960s	Projected changes in climate by 2050
Temperature 	<ul style="list-style-type: none"> Significant increases in daily temperatures across all seasons, and pronounced increases in daily maximum temperatures during the dry season. 	<ul style="list-style-type: none"> Projected increase in temperature of 2.5°C–3°C by 2100. Increase in temperature extremes and heat waves.
Rainfall	<ul style="list-style-type: none"> High interannual variability. Increased variability in the relative distribution of rainfall, with decreased 	<ul style="list-style-type: none"> Increased unpredictability of seasonal rains. Greater frequency of extreme rainfall events. Overall rainfall will decline, particularly during the dry season and in inland areas, and

	<p>rainfall in the northern areas and increased rainfall in the southern areas.</p> <ul style="list-style-type: none"> • Reduction in the length of the dry season and longer periods of drought in the central and western parts of the country. 	<p>increased amounts of rain will fall during the rainy season (December–February) by 2065.</p> <ul style="list-style-type: none"> • Projected changes in rainfall are less certain for the north, with some models suggesting drier conditions and others suggesting wetter conditions.
<p>Cyclones</p> 	<ul style="list-style-type: none"> • Increased intensity of rainfall during cyclones. 	<ul style="list-style-type: none"> • 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.

Climate change impacts will affect cities differently based on a number of factors, including their location, the condition and structural integrity of existing physical assets (e.g., transport infrastructure, public buildings, housing, sanitation infrastructure), the needs of the population, and the capacity of their current institutions. An understanding of this vulnerability against critical mechanisms of municipal planning and regulation is key to determining municipal readiness to adapt to a changing climate. Table 5 presents a summary of the drivers of vulnerability for the country while subsequent sections delve more deeply into the vulnerability of critical municipal functions for the cities visited as part of this work.

Table 5. Drivers of vulnerability for major hazards in Madagascar

Hazard	Impacts	Underlying drivers of vulnerability
Floods and cyclones	<ul style="list-style-type: none"> • Intense rainfall can overwhelm cities' limited drainage systems, leading to flooding • Prolonged intense precipitation 	<p>Infrastructure</p> <ul style="list-style-type: none"> - Lack of or aging services infrastructure - Obstruction of drainage structures with residue, vegetation, and waste - Limited planning for migrant influx and growing populations in need of service provision and delivery
Droughts	<ul style="list-style-type: none"> • Reduced rainfall • Prolonged periods of drought 	<p>Institutions</p> <ul style="list-style-type: none"> - Limited institutional capacity and training - Limited number of educated and trained civil servants - Lack of clarity in the roles of relevant institutions and poor coordination across horizontal institutions
Rising temperatures	<ul style="list-style-type: none"> • Increased heat stress for people, crops, and livestock • Evaporation from water sources 	<p>Compounding factors</p> <ul style="list-style-type: none"> - Deforestation and land clearing alongside limited land use planning - Diversion of streams and rivers - Environmentally driven migration and resulting poverty - Poorly integrated water resources management - Acute poverty - Lack of access to/opportunity for employment

The following subsections seek to answer the question: What makes Madagascar's cities vulnerable to climate variability and change? The summary analysis of four communes, representing a range of urban areas across Madagascar's diverse geographies, aims to identify the links between current and future drivers of vulnerability, including social and biophysical drivers such as population density, land use and land cover, as well as climate drivers such as rising temperatures and altered rainfall patterns. Doing so will identify areas of opportunity for investing in improved climate risk management and adaptation at the municipal level, as described in detail in Section 4.

2.1 ANTANANARIVO

Priority climate risk: Floods

Madagascar's capital and largest city is home to 1.4 million people and lies approximately 1,280 meters above sea level in the central highlands region. The city is nestled among 12 hills and lies in the natural floodplain of the Ikopa River, which skirts Antananarivo to the south and west. The Ikopa plays an important role in rice-dominated agricultural production, which occupies some 60 percent of land in the capital (Commune Urbaine d'Antananarivo 2004). Goods arrive to Antananarivo either via Route Nationale 2 or railway, which both connect the capital to Toamasina, Madagascar's largest seaport.

The city currently experiences significant challenges due to flooding during the rainy season, which severely hampers the already limited transportation network and overwhelms the existing drainage systems, often leaving behind stagnant, polluted waters. The city's current urban plan dates from 2004, with a vision through 2015. As of the writing of this report, a new plan is being drafted with support from the Japanese International Cooperation Agency (JICA) to cover urban development through 2030. While CCA is not explicitly mentioned in any of the commune's existing plans or strategies, the need for improved drainage and flood management is a recurring theme. In addition to rampant urbanization characterized by illicit construction in lowland flood zones, the proliferation of water hyacinth and *Cyperus* overgrowth and residue threaten the efficiency of the city's drainage network, which relies on a pumping station (Ambodimita) that has been in operation since the 1980s. Table 6 provides a summary of Antananarivo's key basic services.

As is the case across Madagascar, the implementation and enforcement of national building codes has proven to be a challenge for Antananarivo. Of its approximately 3,300 employees, the commune has 10 inspectors and 5 engineers within its urban division (Commune Urbaine d'Antananarivo, onsite interview, June 2017). The commune attempted to streamline its system for construction permit applications and approvals by instituting a *guichet unique* (one-stop-shop for permits), but is unable to keep pace with rapid expansion, particularly in vulnerable neighborhoods in low-lying areas.

Table 6. Current status of key basic services for Antananarivo

Description	Responsible entity	Current status	Challenges
Drainage / stormwater management	<ul style="list-style-type: none"> - <i>Service Autonome de Maintenance de la Ville d'Antananarivo</i> (SAMVA)¹ - <i>Autorité pour la Protection contre les Inondations de la Plaine d'Antananarivo</i> (APIPA)² 	<ul style="list-style-type: none"> - Many drainage networks remain heavily clogged by waste and debris, hindering their effectiveness 	<ul style="list-style-type: none"> - Unclear delineation of roles and responsibilities - SAMVA's role often conflicts with that of APIPA
Water and sewerage	<ul style="list-style-type: none"> - JIRAMA - SAMVA - APIPA 	<ul style="list-style-type: none"> - Estimates of percentage of population with access to safe water vary between 32 percent (World Bank 2016a) and 90 percent³ 	<ul style="list-style-type: none"> - The unclear knowledge of the number of people with access to clean water is indicative of the challenges posed
Waste management	<ul style="list-style-type: none"> - SAMVA - <i>Rafitra Fikojana ny Rano sy ny Fahadiovana</i>, more commonly referred to as RF2, are community agents hired by an estimated 155 <i>fokontany</i> to complete door-to-door garbage collection⁴ - Private operators (e.g., Sotherly's) 	<ul style="list-style-type: none"> - 320 waste collection bins distributed throughout greater Antananarivo - One 16-hectare landfill site⁵ - Unknown number of people served by the RF2 	<ul style="list-style-type: none"> - Difficulties identifying a new landfill site⁶ - The current landfill site will reach its maximum holding capacity within the next 10 years

Note: 1/ A quasi-public institution under the auspices of the Ministry of Water, Energy and Hydrocarbons (MEEH); 2/ APIPA, a quasi-public institution under the auspices of the MEEH is also tasked with upkeep of the primary sanitation network of canals and stormwater basins; 3/ As of 2016, there were 1,079 communal water taps throughout the city according to 2016 data from JIRAMA (JIRAMA, onsite interview, August 2017); 4/ RF2 agents facilitate collection for a small monthly fee (between MGA 500 per individual household to MGA 5,000 per small business) and deposit consolidated waste in one of SAMVA's communal collection bins; 5/ Antananarivo produces an estimated 1,500 tons of waste per day; 6/ SAMVA has faced difficulty in identifying a new site as a result of a) growing population pressures affecting land use, and b) challenges navigating municipal jurisdiction, given its position as a quasi-public entity linked to a national ministry rather than the commune.

The *Service Autonome de Maintenance de la Ville d'Antananarivo* (SAMVA), a quasi-public institution under the auspices of the *Ministère de l'Eau, de l'Energie et des Hydrocarbures* (MEEH, or Ministry of Water, Energy and Hydrocarbons), is the primary entity responsible for solid waste collection and wastewater management across the commune's 192 *fokontany*. SAMVA is also responsible for wastewater management along a 47-kilometer stretch of the commune's canal network. The *Autorité pour la Protection contre les Inondations de la Plaine*

d'Antananarivo (APIPA) also plays a role in sanitation and drainage in the city. With respect to drainage and sanitation, SAMVA and APIPA, both accountable to the MEEH⁵ rather than the commune, have suffered from a lack of clarity in their respective roles and poor coordination between relevant ministries and the commune. The maintenance of tertiary canals (those that are not supported by APIPA or SAMVA) falls to the *fokontany*, which do not have the clear legal authority, budget, or skills required to ensure that the canals function.

2.2 TSIHOMBE

Priority climate risk: Drought

Tsihombe is located in Madagascar's southernmost and driest region, Androy, an area historically marginalized by the national government that continues to suffer from a dearth of public investment. Tsihombe is isolated, but lies along Route Nationale 10, a secondary, largely unpaved transport corridor that links up to Route National 13 to connect people and goods moving between Tsihombe and the port of Fort Dauphin on the east coast of Madagascar via Ambovombe. The Commune Urbaine de Tsihombe counts 46,213 residents who depend primarily on rainfed agriculture and animal husbandry for their livelihoods (Commune Urbaine de Tsihombe 2016).

Tsihombe's primary climate risks are 1) persistent and recurring drought conditions, which strain already limited water resources available for people and livestock, and 2) intense southern coastal winds between the months of August and November that lead to an accretion of sand inland. As temperatures continue to rise, these conditions are likely to worsen, resulting in increased evaporation of above-ground water sources and increased heat stress for people and livestock.

Tsihombe's existing PCD was completed in 2016 and identifies the lack of agricultural infrastructure and inputs (vaccinations, veterinary services, access to water) as the biggest obstacle to local development. The plan also puts an emphasis on reforestation efforts, citing deforestation as a driver of reduced rainfall and soil degradation, but it contains a list of priorities that neither address the main hazard of drought nor describe actionable ways to improve the situation of Tsihombe's residents. Representatives from the Commune Urbaine de Tsihombe noted that the preliminary budget and rudimentary three-year investment plan it put forward as part of the PCD has not been validated by the *Ministère des Finances et du Budget* (MEFB). This limits their ability to apply for grants via the FDL, as communes without a validated budget are considered ineligible for funding.

The majority of residents source water directly from the Manambovo River or its riverbed by digging shallow wells in the floodplain. Commercial water and sanitation service is provided by JIRAMA through groundwater underflow captured from the Manambovo River to supply water

⁵ The MEEH was created in 2017, merging functions of the Ministry of Water and Ministry of Energy in part to provide better oversight for JIRAMA. As of this report writing, a General Director for the division responsible for sanitation had yet to be nominated by the sitting minister.

via communal taps (Table 7). *Alimentation en Eau dans le Sud* (AES), the allied water operator for southern Madagascar, operates a water cistern that relies on water piped from a pumping station in Ampotaka in Beloha commune to fill a 100 m³ reservoir. When either the diesel-operated water pump in Ampotaka or the 142-kilometer pipeline is not functioning, AES delivers water to Tsihombe by truck, increasing costs.

Table 7. Current status of key basic services for Tsihombe

Description	Responsible entity	Current status	Challenges
Water and sewerage	JIRAMA and <i>Alimentation en Eau dans le Sud</i> (AES)	<ul style="list-style-type: none"> - Less than 1 percent of population has access to safe water - Less than 1 percent of population has access to sewerage services 	<ul style="list-style-type: none"> - High costs of repair of diesel pumps - Frequent service disruptions lasting more than a week, making service unreliable
Waste management	Commune	<ul style="list-style-type: none"> - A few public waste collection bins are available along the city's main road 	<ul style="list-style-type: none"> - Waste management is not a priority articulated by the commune, even though it is identified as a concern in the 2016 PCD

Tsihombe has been a focal point of humanitarian intervention from the United Nations (UN) and other international donors in response to persistent drought conditions that stymie longer-term development. Acute poverty and severe drought conditions, in addition to lack of technical and financial capacity within the commune, have been a challenging dynamic for striking an appropriate balance between timely humanitarian assistance (e.g., distribution of food aid and WASH kits) and resilience interventions.

2.3 TULÉAR

Priority climate risk: Floods

With approximately 226,473 residents, Tuléar is the largest city in southern Madagascar. The city is located on Madagascar's western coast, where the delta of the Fiherenana River meets the Mozambique Channel. Tuléar is well-connected through its transport infrastructure, which comprises an airport, a seaport, and a major highway, Route Nationale 7, which connects the city to Antananarivo. Route Nationale 9 links Tuléar with Morondava to the north, but sections of the road require repairs.

Although Tuléar (an urban commune, district capital, and seat of the Atsimo-Andrefana region capital) fares better with respect to connectivity and infrastructure compared to other urban centers in Madagascar, its existing infrastructure is in poor condition. For example, in February 2013, heavy rains and winds associated with the passage of Cyclone Haruna through southwest Madagascar caused a dike built in 2003 along on the Fiherenana River to rupture. This led to severe flooding that resulted in damage to roads, surrounding public infrastructure (mainly

schools), agricultural infrastructure, and more than 15,000 homes within a 70–100 mile radius (WFP 2013). In addition to bringing about physical damage and economic and human losses, Cyclone Haruna brought to light weaknesses in municipal drainage and sanitation services, as a significant number of traditionally built wells were contaminated by floodwater.

Table 8. Current status of key basic services for Tuléar

Description	Responsible entity	Current status	Challenges
Drainage / stormwater management	Commune	- 4 kilometers of canals and gutters in place as of 2004 (Commune Urbaine de Tuléar 2004a, 2004b)	- Flooding during the rainy season suggests the current drainage network is inadequate (World Bank 2016b)
Water and sewerage	JIRAMA	- 83 percent of population has access to safe water - The commune relies on two water pumping stations to supply water: the Miary station (17 kilometers away) and the Andranomena station (7 kilometers away)	- Repairs of pump infrastructure are a challenge when it breaks down
Waste management	Madacompost, a private operator	- Tuléar produces an estimated 100 tons of waste per day; waste collected from the city's 35 public bins is brought to one of two sites: Andatabo landfill (15 kilometers from the city center) or a 5-hectare landfill and waste reclamation site in Aboriha Belalanda (7 kilometers north of the city center)	- Poor and irregular maintenance of municipal waste management trucks

While Tuléar’s urban plan for 2004–2023 acknowledges the city’s exposure to natural disasters (floods and cyclones), it makes no explicit mention of climate change or measures of adaptation or contingency given the potential impacts of extreme weather events (Commune Urbaine de Tuléar 2004b). Despite political turnover in recent years, the Commune Urbaine has seen longevity in its technical staff, particularly in its urban management division. Nevertheless, Tuléar’s provincial, regional, district, and municipal authorities have faced challenges in comprehensively addressing rapid urbanization and the associated challenges of deforestation and land use.

2.4 MAROANTSETRA

Priority climate risk: Cyclones and floods

Maroantsetra sits at the northern end of the Bay of Antongil in northeastern Madagascar, surrounded by the Antenambalana River. Route Nationale 5 connects Maroantsetra, both an urban commune and a district capital, to the regional capital of Fénérive Est and Madagascar's largest port in Toamasina. The poor condition of the road network around Maroantsetra contributes to the city's economic and political isolation. The airport is the city's main access point, but it does not have sufficient runway capacity to accommodate large aircraft. While the primary mode of transport is via boat, the city's "port" is too shallow for large vessels. Instead, smaller boats relay between larger vessels anchored offshore to load and offload goods and people. Not unlike most other cities in Madagascar, Maroantsetra's 31,646 residents are generally isolated from Antananarivo.

The city received national and international attention in March 2017 after Cyclone Enawo induced record-breaking flooding, temporarily displaced thousands of people, tore through a section of Route Nationale 5, and damaged bridges in neighboring communes (BNGRC 2017). A previous cyclone, Hudah, leveled public buildings and homes in 2000.

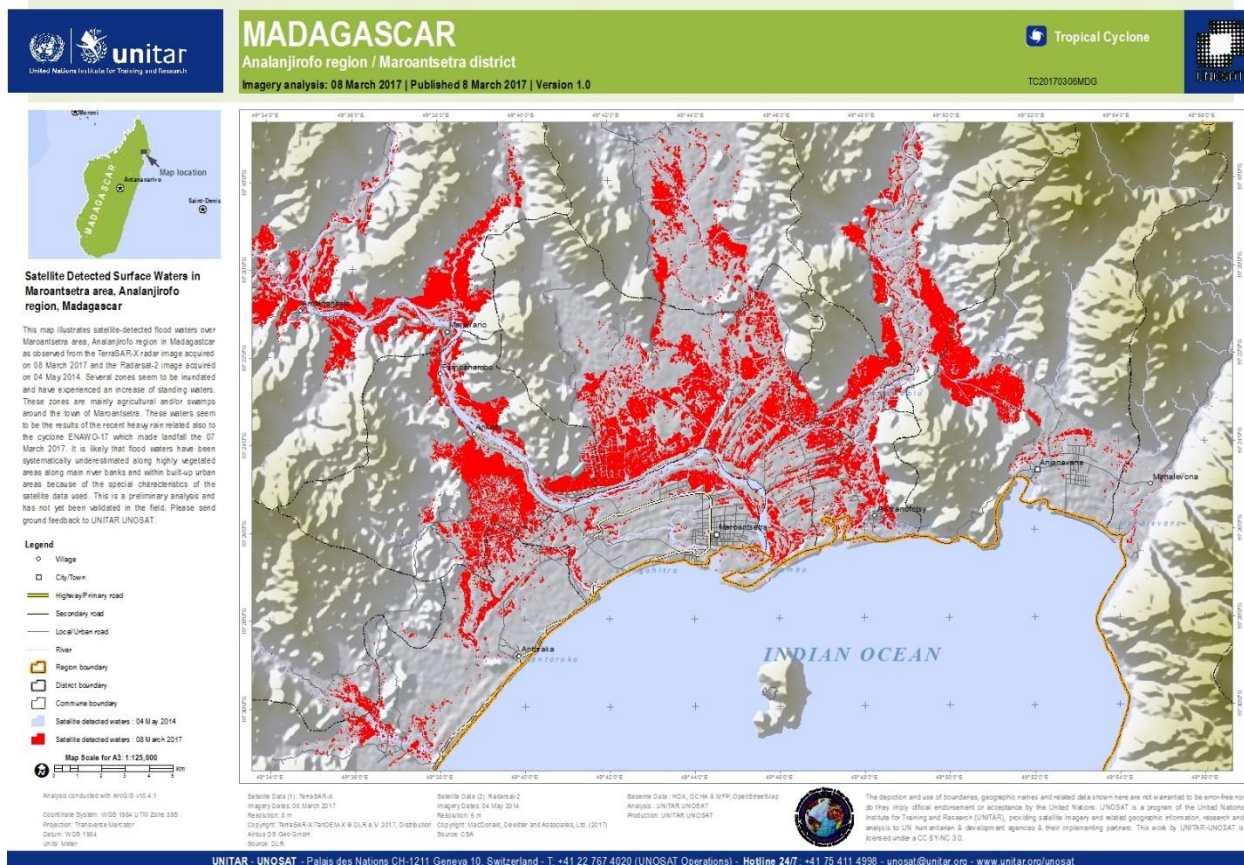
Table 9. Current status of key basic services for Maroantsetra

Description	Responsible entity	Current status	Challenges
Drainage / stormwater management	Commune	- Aged drainage canals	<ul style="list-style-type: none"> - Drainage canals are at least 60 years old, and often blocked by sediment and waste (Commune Urbaine de Maroantsetra 2004) - Artificial islands in the Antenambalana used for agricultural production have changed flood patterns within the last 10 years
Water and sewerage	Commune	<ul style="list-style-type: none"> - 3.7 percent of population has access to safe water¹ - JIRAMA is not operational for water services; most residents obtain water via wells or directly from the Antenambalana River 	<ul style="list-style-type: none"> - Wells are not well-maintained or protected and are susceptible to contamination, especially during flood events
Waste management	Commune	- Commune has established public waste bins and possesses one collection truck	<ul style="list-style-type: none"> - Enforcement of waste disposal is low; most people bury or burn garbage or dispose of it along the river

Note: 1/ Data from JIRAMA, which does not currently supply water to Maroantsetra.

Maroantsetra's PCD for 2004–2008 acknowledges cyclones, floods, and intense rainfall as risks that threaten residents' safety, livelihoods, and assets (Figure 3). The focus of the investment plan, however, is on the construction of public buildings (e.g., primary schools, administrative buildings). Emergency preparedness capacity building from the CPGU via the World Bank PUPIRV (Emergency Infrastructure Preservation and Vulnerability Reduction Project) was provided to district officials in Maroantsetra.

Figure 3. Flooded zones in Maroantsetra post-Cyclone Enawo (2017)



Representatives from the current administration of the Commune Urbaine de Maroantsetra noted that transport infrastructure, such as a larger port, is needed to accommodate current demand and to encourage economic growth. However, the investment needed is substantial and will require external funding.

SECTION 3. MADAGASCAR'S RESPONSE TO CLIMATE CHANGE

Explicit efforts to move CCA forward are relatively new. Disaster management and response have been the focus of relevant policy articulation and activity on the ground, with disaster risk management (DRM) practice prioritizing disaster response and early recovery over preparedness and risk reduction. Budgets for disaster risk reduction (DRR) activities are meager or nonexistent, and actions tend instead to concentrate on the response to disasters (IFRC 2014). Madagascar's first national strategy for DRM, developed in 2003, does acknowledge the need for further analysis of climate risks and vulnerability. Subsequent assessments were conducted for specific regions by individual donors,⁶ pointing to specific needs for drought-prone regions and agriculture support. Partly in response to these assessments, in 2006, the structure formerly known as the *Conseil National de Secours* (CNS, or National Relief Council) became the *Bureau National de Gestion des Risques et des Catastrophes* (BNGRC, or Office for Disaster Risk Management). The *Bureau National de Coordination des Changements Climatiques* (BNCCC, or Office for Climate Change Coordination) was established nearly 10 years later.⁷ Although awareness of the risks posed by climate change is widespread, even among local government representatives, capacity and funding remain limited, especially with regard to identifying, planning, and implementing projects to support adaptation.

3.1 NATIONAL-LEVEL RESPONSE

As an island nation vulnerable to extreme weather events—including the highest risk from cyclones among countries in Africa—Madagascar is increasingly turning its attention to CCA and climate risk preparedness. Previous efforts to improve climate resilience halted by the 2009–2014 political crisis are slowly beginning to regain momentum. As Madagascar regains political stability (which is tenuous in light of upcoming elections in 2018), its focus is shifting to climate adaptation and active participation in the Conference of Parties (COP) 21 Paris Climate Agreement.

⁶ WFP completed an urban vulnerability assessment in Antananarivo, Toamasina, and Toliara as well as a food security risk assessment in southern Madagascar. In 2012, the World Bank completed a preliminary assessment of available climate information to support index-based insurance mechanisms for farmers.

⁷ The BNCCC's predecessor, the *Direction du Changement Climatique*, was in place from 2010 to 2014 under the General Directorate for the Environment within the MEEF. The shift from a subdirectorate to national office suggests an effort to elevate its importance and visibility within the Government of Madagascar.

NATIONAL POLICIES

With support from the World Bank, Madagascar submitted its [National Adaptation Programme of Action](#) (NAPA) in 2006. The NAPA prioritizes actions related to agriculture and livestock, public health, water resources, coastal areas, and forests. It also recognizes the degradation of terrestrial forests and mangroves, and the risk of sea level rise and coastal erosion on coastal cities and towns, and sets forth actions to address observed challenges. Of the projects identified as priorities in the NAPA, three were implemented, including one on coastal areas⁸ (United Nations Environment Programme, or UNEP), another on agriculture in the southwest region⁹ (African Development Bank, or AfDB), and one on rural areas¹⁰ (UNDP) (Table 10). As of March 2015, Madagascar was in the process of developing its National Adaptation Plan (NAP), which is meant to be completed by 2020 as stated in Madagascar's Intended Nationally Determined Contributions (INDC). The purpose of the NAP is to revisit priorities identified in the NAPA in light of more recent climate dynamics and the realities on the ground across regions, with a view toward identifying projects that could be implemented to improve climate resilience across the country.

The 2010 [National Policy for Combating Climate Change](#) prioritizes CCA and adaptive management over mitigation. Drafted by the *Ministère de l'Environnement, de l'Ecologie et des Forêts* (MEEF, or Ministry of Environment, Ecology and Forests), the policy sets forth a vision for integrating climate change across all sectors and levels of government and envisions the establishment of a national climate change fund. The [National Development Plan \(2015–2019\)](#) acknowledges potential losses in biodiversity due to both human destruction of habitats and climate change and highlights the integration of natural capital accounting as a priority to improve climate change resilience (Government of Madagascar 2015b). The [National Strategy for Domestic Resource Mobilization](#) for 2016–2030 aims to optimize and allocate natural resources wealth.

The 2016 [National Policy for Disaster Risk Management](#), which replaces Madagascar's first DRM policy of 2003, frames DRM as part of CCA and mitigation (Government of Madagascar 2015a). The policy, supported by the [National Strategy for Disaster Risk Management \(2016–2030\)](#), calls for improvements in national and local government capacity to integrate DRR and DRM in all development planning processes.

Table 10 presents a selected list of ongoing projects related to adaptation and resilience across the country, emanating in large part from efforts outlined above.

⁸ Project Title: Adapting coastal zone management to climate change considering ecosystem and livelihood improvement.

⁹ Project Title: Enabling climate resilience in the agriculture sector in the southwest region of Madagascar.

¹⁰ Project Title: Enhancing adaptation capacities and resilience in rural communities in Analamanga, Atsinanana, Androy, Anosy, and Atsimo-Andrefana.

Table 10. Adaptation and resilience projects or initiatives in Madagascar

Name	Donor and implementer	Coverage
Climate Change Adaptation Capacity and Conditions Strengthening (PRCCC)	EU, MEEF, GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit), Office Nationale pour l'Environnement	Support to national agencies in Antananarivo and implementation in Analamanga, Boeny, and Diana Regions.
USAID Fararano and Asotry	USAID Food For Peace / Catholic Relief Services and Adventist Development and Relief Agency	DRR capacity building, including early warning mechanisms, for local populations in 80 rural communes across the regions of Atsinanana, Vatovavy-Fitovinany, Atsimo-Andrefana, Amoron'i Mania, and Haute Matsiatra.
Emergency Infrastructure Preservation and Vulnerability Reduction Project (PUPIRV)	World Bank, CPGU	Support to establish early warning systems (EWS) in 70 communes on the east coast (high cyclone risk) and in Antananarivo for flood risk to enhance DRM capacity. Rehabilitation of transport lifeline infrastructure (key points along national roads RN7, RN4, RN6, RN 12, and RN25) and of community-level basic infrastructure (e.g., schools, community health centers) to ensure building code requirements for hurricane-resistant structures are met.
Integrated Urban Development and Resilience Project for Greater Antananarivo	World Bank, M2PATE	Structural improvements (canal rehabilitation, reinforcements to dikes) to 67-hectare floodplain area of Antananarivo.
Adapting Coastal Zone Management to Climate Change in Madagascar Considering Ecosystems and Livelihoods	UNEP, GEF/LDCF (Global Environment Facility/Least Developed Countries Fund), MEEF	Institutional capacity building for the central MEEF and regional MEEF administrations in Menabe, Boeny, Vatovavy-Fitovinany, and Atsinanana Regions to develop comprehensive regional adaptation plans for coastal zones.
Enabling Climate Resilience in the Agriculture Sector in the Southwest Region of Madagascar	AfDB, GEF/LDCF, Ministry of Agriculture, Regional Unit of Tuléar and Rural Engineering Unit; MEEF	Support for installation of sustainable agricultural infrastructure and its management by beneficiaries in the Atsimo-Andrefana Region, while focusing on strengthening water users associations. The project also provides technical assistance to farmers for agricultural development and land tenure, to relevant national bodies working on anti-locust control, and for information campaigns on waterborne diseases.

Enhancing the Adaptation Capacities and Resilience to Climate Change in Rural Communities in Analamanga, Atsinanana, Androy, Anosy, and Atsimo Andrefana	UNDP, GEF/LDCF, BNCCC	Provides support to build institutional, structural, and technical foundations needed to disseminate appropriate adaptation measures and technologies, including strengthening the collection, production, and dissemination of reliable climate information. Vulnerability Reduction Assessments completed across 11 communes: Analamisampy, Manombo, and Miary (Atsimo-Andrefana Region); Imongy and Tranovaho (Androy Region); Sampona and Tanandava (Anosy Region); Ilaka Est and Betsizaraina (Atsinanana Region); and Betatao and Ambatolotarakely (Analamanga Region).
Pilot Program for Climate Resilience	Climate Investment Fund, CPGU	Development of a national Strategic Program for Climate Resilience to bring sector strategies into alignment.
Strengthening the resilience of the rural population in South Madagascar	GIZ, Ministry of Agriculture	Focus on livelihood diversification and promotion of four value chains – castor oil, honey, beans, and goat meat – in the Androy, Anosy, and Atsimo-Atsinanana Regions.
USAID IARIVO	USAID, CARE, Commune Urbaine d’Antananarivo	Focus on disaster preparedness in 75 flood-prone <i>fokontany</i> in Antananarivo and improving DRR/DRM technical capacity for commune officials.
Sustainable Agriculture Landscape Project	GEF, World Bank, MEEF	Increases access to improved irrigation services and agricultural inputs; strengthens the integrated management of natural resources in the targeted landscapes by local actors; and provides immediate and effective response to an eligible crisis or emergency.
Promoting Climate Resilience in the Rice Sector	Adaptation Fund/UNEP, MEEF, Ministry of Agriculture	Pilot program in three communes of the principal rice-growing region, Alaotra-Mangoro: lakana commune, Bemaintso commune, and Ambohijanahary commune.

NATIONAL INSTITUTIONAL ACTORS

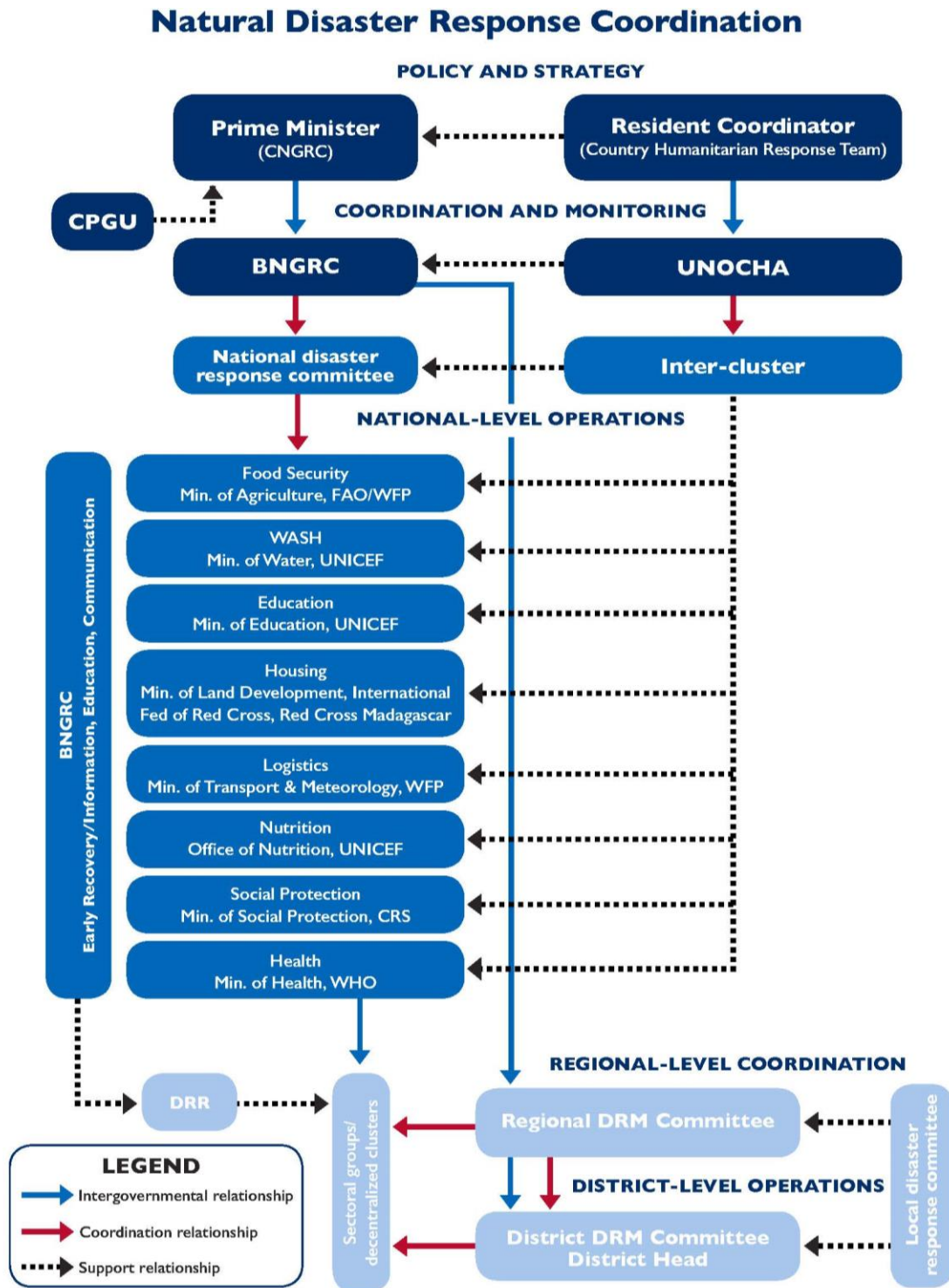
The BNCCC, within the MEEF, is the principal government institution responsible for coordinating climate change actions, and participates in international climate negotiations. Although a recently created institution, the BNCCC serves as the national designated authority and has successfully assumed coordination of projects financed through the Global Environment Facility (GEF) Least Developed Countries Fund (LDCF) and the Green Climate Fund for the implementation of Madagascar’s NAPA. Since its inception in 2015, the BNCCC has led the Government of Madagascar in the development of the NAP with support from UNDP, UNEP, and GIZ (*Deutsche Gesellschaft für Internationale Zusammenarbeit*).

In addition to the BNCCC, several other institutions support CCA and climate risk management efforts:

- The [Direction Générale de la Météorologie](#) (DGM) within the Ministry of Transport and Meteorology produces and disseminates daily weather bulletins and seasonal forecasts. The DGM has also mapped historical cyclone paths. Some capacity exists to generate climate models, but the DGM more often validates regional satellite data. The DGM has benefited from a collaboration between the USAID-NASA SERVIR program and the Enhancing National Climate Services (ENACTS) initiative to maintain reliable and readily accessible climate data.¹¹
- The prime minister oversees the *Conseil National de Gestion des Risques et de Catastrophes* (CNGRC), an interministerial decision-making body responsible for setting DRM and DRR policy and accompanying strategies (Figure 4).
- The CPGU is a national-level, permanent structure under the Prime Minister's Office established to support policies and strategies for DRR/DRM and to advise the prime minister in all matters related to risk management and disaster response. It has played a role in training and capacity building on DRR and emergency preparedness.
- The BNGRC within the MID is responsible for the organization, coordination, and monitoring of activities related to emergency preparedness and disaster and humanitarian response. During ongoing emergencies, the BNGRC activates and coordinates the humanitarian response via national-level government actors, such as the Ministry of Transport and Meteorology, and the *Comité de Réflexion des Intervenants en Catastrophes* (CRIC, or Emergency Response Committee) which comprises international NGOs and donors. In coordination with the CPGU, the BNGRC develops multi-risk national contingency plans ([Plan de Contingence Multi-Risques](#)) that consolidate sectoral contingency plans and include maps for national logistics and transport infrastructure. The BNGRC also supports the development of regional and local DRM plans, such as the one for the Analanjirifo Region (BNGRC 2016), providing advice on disaster-specific (e.g., cyclones, floods, fires, tsunamis) risks and impacts, and conferring with the BNCCC on issues related to climate change. As the coordinating body for DRR/DRM operations, the BNGRC collects information from Madagascar's meteorological agency to issue advisories through the cyclone and flood early warning system (EWS) via local radio, Internet, and SMS through Madagascar's major telecommunications provider, Telma. To better support DRR/DRM efforts at the subnational level, the BNGRC intends to assign permanent representatives to regional offices.

¹¹ See <http://www.meteomadagascar.mg/maproom>.

Figure 4. DRM coordination in Madagascar



Source: Adapted from BNGRC 2015.

COORDINATING BODIES AND NONGOVERNMENTAL INSTITUTIONS

In addition to state-level institutions, several other bodies operating at the regional, national, and subnational level support CCA and DRR to some degree:

- The ***Groupe Thématique sur le Changement Climatique (GTCC)*** is a voluntary and unfunded knowledge-sharing platform that brings together stakeholders representing national ministries, NGOs, civil society, technical partners, and financial and research institutions. Created in 2009 amid the political crisis, the GTCC has been called upon by the BNCCC to identify priorities for the NAP process, to encourage members to draft proposals to implement priorities outlined in Madagascar's NAPA, and to organize and host United Nations Framework Convention on Climate Change (UNFCCC) COP side events. In 2014, the GTCC began a comprehensive mapping exercise to inventory CCA actors and interventions in Madagascar.
- **The Food Security Cluster**, co-chaired by the Ministry of Agriculture, the UN Food and Agriculture Organization (FAO), and the WFP (which provide funding and technical and operational support), coordinates food assistance and climate-smart agricultural interventions to improve food security. Since 2014, the Food Security Cluster has monitored drought conditions in the southern regions of Androy, Atsimo-Andrefana, Atsimo-Atsinanana, and Anosy. The Cluster's recent efforts to establish a functional EWS for drought have faced difficulty due to the lack of consensus on thresholds for issuing drought alerts, as rainfall and drought conditions can vary widely from commune to commune. As such, the system is yet to be implemented. Additional thematic clusters for Nutrition, Health, Education, and Social Protection coordinate activities among national and regional actors.
- The **[Centre Technique Agroécologique du Sud](#)** (CTAS) is an NGO that promotes and disseminates best agro-ecological practices and technologies (e.g., improved seeds) tailored to the socioeconomic and climatic conditions of Madagascar's southernmost regions: Androy, Atsimo-Andrefana, and Anosy.
- **The Famine Early Warning Systems Network (FEWS NET)** provides food security analysis by mapping and defining livelihood zones and sharing integrated agroclimatic and household livelihood data with agricultural production information, market, and food distribution to help governments, regional organizations, and communities find solutions to food insecurity.
- **The Information Management Working Group** is an information-sharing platform established to facilitate coordination for the UN and other agencies involved in humanitarian response (e.g., UNICEF, Office for the Coordination of Humanitarian Affairs/OCHA, IOM).

3.2 SUBNATIONAL-LEVEL RESPONSE

The realities of limited capacity and finance as well as the immensity of the challenges that Madagascar faces in providing for even the most basic development needs mean that the role of DRM, community development, and service provision is simply delegated to development partners working across the country. DRM after Cyclone Enawo in 2017, for example, was coordinated in large part by MedAir, a humanitarian response NGO working in Maroantsetra. This continues to this day, whereby even the local BNGRC representative temporarily assigned to the region essentially records the information provided by MedAir on Cyclone Enawo's extent and impacts.

Regions and communes prepare social and economic development plans (*Plan Régional de Développement* [PRDs] and PCDs) that are accompanied by a land zoning and development blueprint (*Schéma d'Aménagement*). Urban communes develop urban plans (*Plan d'urbanisme Directeurs*, or PUDi). Few development plans reflect climate change considerations and priorities for adaptation explicitly, and even fewer cite or are informed by climate change vulnerability assessments.

Some PCDs include priorities that do address potential climate impacts, whether perceived or real. For example, the Tsihombe communal development plan (2016) does not explicitly mention climate change, but cites crop genetic diversity, degraded pastureland, deforestation, soil erosion and degradation, pests and diseases, and water stress as recurring challenges to development. However, the plan does not provide feasible, actionable solutions or a detailed budget for proposed actions, rendering it too vague to be a useful framework for communal development and resilience.

Due to the limited investment and thinking on climate change issues, international donors (e.g., GIZ, UNDP, UN Habitat) are now financing both 1) the development of local development and land use plans to reflect climate change considerations, and 2) the creation of specific resilience plans for communes and/or regions with significant exposure to climate risks. Examples of specific resilience plans include:

- Urban Resilience Action Plan for Morondava commune (2017–2027) – developed with support from UN-Habitat to be aligned with and integrated into other development planning frameworks, such as the PCD, the communal contingency plan, and the broader PRD for Menabe Region. The plan presents climate risks and communal vulnerabilities, lists actions for mitigation and disaster preparedness, and prioritizes specific activities with budgets.
- Urban Resilience Action Plan for Greater Antananarivo (2016–2020) – developed with support from UN-Habitat and informed by a 2014 diagnostic assessment (UN-Habitat 2014) to be aligned with and integrated into other development planning frameworks. The plan presents climate-related hazards and communal vulnerabilities for Antananarivo and its surrounding communes, lists actions for mitigation and disaster preparedness, and prioritizes specific activities with budgets and timelines.

Given the continued challenges facing local governments within the current administrative structure, emerging growth poles and corridors (*espaces de croissance*) may provide an effective entry point to integrate a CCA approach for sustainable economic and social development. As business interests and investment potential increase in these zones, demand for climate-proofing those investments may influence the design, planning, and execution of special projects.

SECTION 4. BUILDING BLOCKS FOR CLIMATE CHANGE ADAPTATION AT THE MUNICIPAL LEVEL

Most communal governments are aware of the impacts of climate change, and many have seen the damaging effects of more intense cyclones and/or prolonged periods of drought. However, many municipalities operate under severe financial constraints, with numerous competing priorities and limited capacity to identify feasible solutions for adaptation. To better understand what is needed to move climate adaptation work forward, this section identifies challenges and opportunities for CCA at the local level. The framework for this section is based on the USAID building blocks for effective, climate-resilient development: 1) Improving the availability, quality, and use of weather and climate information; 2) Mainstreaming adaptation measures into governance, planning, and budgeting; 3) Piloting and disseminating risk-reducing management practices; and 4) Mobilizing finance for adaptation measures from multiple sources.

4.1 IMPROVING THE AVAILABILITY, QUALITY, AND USE OF WEATHER AND CLIMATE INFORMATION

Extreme weather events have become more frequent and more intense in Madagascar: in the past 20 years Madagascar has been struck by 35 cyclones, 8 floods, and 5 periods of severe drought (a threefold increase over the previous 20 years) (USAID 2013). All of these events – which affect food security, drinking water supply and irrigation, public health systems, environmental management, and quality of life – highlight the need for a better understanding and dissemination of climate information, such as historical trends and future projections, for improved decision making and urban planning at all levels of government.

IDENTIFYING CLIMATE TRENDS AND PROJECTIONS

The DGM maintains historical climate data and in 2008 published a report on climate change in Madagascar. The report contains a comprehensive summary of historical trends in air temperature, precipitation, and tropical cyclones, and future projections for temperature, precipitation, and cyclones. To inform weather observations and validate satellite data for daily forecasts, seasonal trends, and early warnings for extreme events (e.g., floods, cyclones), the DGM has a network of synoptic weather stations that measure and transmit information every three hours. However, regional operating budget constraints, in addition to inconsistent electricity and internet connectivity in parts of the country, affect the ability of technical observers to communicate with the DGM in Antananarivo. International organizations such as World Wildlife Fund (WWF) have provided technical assistance to establish *in situ* climatology

stations to augment the DGM's network, which currently covers 19 of Madagascar's 22 regions and represents the recognized major climatic zones. The Enhancing National Climate Services (ENACTS) initiative, led by the International Research Institute for Climate and Society (IRI), provided support to make climate and weather data available online via the DGM's website. The DGM is often solicited by stakeholders in different sectors, such as transport and logistics, on an *ad hoc* basis to provide weather and climate data for a fee, but is not asked to provide any interpretation or data analysis (often because large companies have their own experts who can provide this level of information).

DETERMINING ACCESSIBILITY AND USABILITY

In interviews with the research team, representatives of the DGM noted that probability is not introduced in weather bulletins because capacity to articulate and interpret probabilities is lacking across the country. To make weather and climate information more accessible, the DGM is experimenting with simple data visualization at weather stations so that local agents can better identify potential risks (e.g., if rainfall level dips below a certain threshold, the station assigns a color to convey potential risks) and more easily collect weather data *in situ* to transmit back to the DGM in Antananarivo.

CHALLENGES TO IMPROVING THE AVAILABILITY, QUALITY, AND USE OF CLIMATE INFORMATION

The distribution of weather stations is sparse throughout Madagascar, and often the equipment is installed at unsecured locations and subject to theft or tampering. Local meteorological stations lack sufficient staff with expertise to maintain the equipment and effectively man the station. For example, Tuléar's station counts just three technical staff, an accountant, a guard, and a driver who cover the entire region of Atsimo-Andrefana (Direction Régionale de Transport et de la Météorologie Atsimo-Andrefana, onsite interview, June 2017). In addition to material and human resource constraints, the channel for relaying weather and climate data from local stations to Antananarivo for analysis is inefficient and incomplete.

OPPORTUNITY FOR ENGAGEMENT AT THE LOCAL LEVEL

The main opportunity for improving the availability and use of weather and climate information is related to facilitating closer collaboration between data users (e.g., transport and logistics companies, agribusinesses, university students) and data providers (the DGM). Because stakeholders are not given the appropriate avenues to provide feedback to the DGM on how the data they provide are used, the DGM and regional met services offer typical weather information without detailed local context. Nevertheless, improved interaction between the DGM and key entities could offer critical information for resilience. The DGM's department of applied meteorology, in collaboration with sectoral stakeholders, could help decision makers better make the link between annual phenomena, longer-term impacts, and actions to take in specific sectors if such a feedback loop existed. For example, the DGM could help to define drought conditions across regions and facilitate the development and implementation of a drought EWS.

4.2 MAINSTREAMING ADAPTATION MEASURES INTO GOVERNANCE, PLANNING, AND BUDGETING

Poor communication and coordination between different levels of government constrain local planning for adaptation and climate risk management. This challenge is exacerbated by a lack of financial and technical support for municipalities as well as varying perceptions of risk throughout Madagascar.

INTEGRATING CCA/DRR INTO THE LOCAL DEVELOPMENT PLANNING PROCESS

Sanitation projects, reforestation efforts, and prevention of further deforestation figure prominently among municipal priorities. Municipalities can build an enabling environment to support concrete adaptations related to articulated priorities through planning and policies, but real impact comes through budget, inspection, and enforcement of regulations. In most municipalities, the budget to implement adaptation actions is lacking. Several international donors – JICA, GIZ, UNDP – are supporting regional and municipal governments to integrate CCA into sectoral planning documents, but efforts to identify climate vulnerabilities to comprehensively address them through development have been limited. The AfDB provided funding to support the development of urban sanitation plans that incorporate an integrated waste and wastewater management approach in eight urban centers.¹² Broadly, the urban sanitation plans will aim to address issues of solid waste, blackwater, greywater, and stormwater and include a schedule for the development of five-year investment plans and tariff schemes to ensure the maintenance of water and sanitation infrastructure. The Indian Ocean Commission commissioned a national climate change vulnerability assessment in 2011 that identified acute vulnerabilities in the water, agriculture and fisheries, and health sectors (Indian Ocean Commission 2011). Local vulnerability reduction assessments carried out using UNDP methodology were completed in a handful of communes across Madagascar (see Table 10).

Although some sectoral plans may cite anticipated climate impacts identified through vulnerability assessments completed by international NGOs and donors (e.g., WFP 2015; Indian Ocean Commission 2011; UNDP 2012a), the plans do not sufficiently consider changes expected from increasing demographic pressure. For example, the effects of increased drought in Tsihombe would be amplified by population growth. Plans need to include practical short-, medium-, and long-term CCA actions that can be added to budget lines so that they are more likely to be funded and therefore implemented. In smaller urban areas, participatory budgeting could help build capacity and transparency around municipal projects, encouraging greater contribution from taxpayers to fill the funding gap. In one case, the municipality of Ambalavao managed to increase local land tax collection from 8 percent to 52 percent between 2006 and 2010 through a participatory budgeting approach (GIZ 2010).

¹² *Schéma Directeur d'Assainissement Urbain* are being developed in five provincial capitals – Tulear, Fianarantsoa, Mahjanga, Toamasina, and Antsiranana – and the secondary cities of Antsirabe, Fort Dauphin, and Nosy-Be.

CHALLENGES TO MAINSTREAMING ADAPTATION INTO PLANNING, AND BUDGETING

Many communes already face challenges in drafting local development plans on a regular basis. Often, local development plans are drafted by hired consultants because expertise may be lacking within the commune. The changing landscape of decentralization in Madagascar has also affected the regularity with which communes prepare and apply their sectoral plans. For local decision makers, no- or low-regret actions for adaptation are difficult to articulate and implement in the face of acute levels of poverty and fundamental development challenges.

OPPORTUNITY FOR ENGAGEMENT AT THE LOCAL LEVEL

The BNGRC is in a position to support capacity building beyond disaster preparedness and response awareness training. As it looks to establish a cadre of regional representatives to better manage localized hazards (like the drought in southern Madagascar), the BNGRC can facilitate the integration of climate considerations into local plans and budgets with technical support from the CPGU and the BNCCC. Regional BNGRC representatives can: 1) educate local governments and communities about the risks identified and described in the atlas of risks developed by the CPGU and BNGRC for Madagascar's regions, beginning with those highly vulnerable to climate risks; 2) share guidance for conducting risk mapping and vulnerability assessments; and 3) advise on options for adaptation that can be incorporated into local plans.

Although budgetary constraints have prevented municipalities from implementing adaptation actions, some municipalities are beginning to examine the potential role of carbon markets as a financing mechanism to support adaptation. Municipal authorities often lack the technical expertise and initial capital required to monitor carbon sequestering activities and manage carbon payments. NGOs such as Blue Ventures and ADES in Tuléar have some experience generating carbon credits through reforestation and coastal conservation efforts. They could provide technical assistance or recommendations to interested municipalities for participating in voluntary carbon markets, which tend to have greater flexibility and lower costs associated with carbon accounting, verification, and certification. Furthermore, conservation and reforestation efforts would bring about added ecosystem services for adaptation (e.g., coastal and soil erosion control, flood mitigation). Engaging the BNCCC, with support from the GTCC, to facilitate linkages within voluntary carbon markets can help local government agencies to incorporate CCA measures in their proposals for domestic funding through the FDL or to apply for international funds to supplement municipal budgets for adaptation.

4.3 PILOTING AND DISSEMINATING RISK-REDUCING MANAGEMENT PRACTICES

A series of positive and effective efforts to restore mangrove forests, protect sensitive habitats, improve waste management services, provide technical assistance to farmers, and stabilize dunes have taken place throughout Madagascar. However, scaling up these good practices requires addressing a number of challenges, including 1) extreme poverty and isolation, which limit people's awareness of, interest in, or economic ability to take up adaptive practices, and 2) a limited framework for knowledge sharing and intercommunal mentoring. Promoting

communication between communities and administrative entities across regions can increase the flow of lessons learned among municipalities.

LEVERAGING EXISTING COOPERATION PLATFORMS

Madagascar benefits from a longstanding presence of international NGOs and humanitarian organizations, and parties interested in CCA began to coalesce in recent years.

- The GTCC is a professional network of climate change experts that works closely with the BNCCC to organize COP side events. The GTCC has active participation from members representing various sectors, including environmental management and conservation, public health, and agriculture.
- Sister-city partnerships, like the cooperation between Région Ile-de-France and Antananarivo, facilitate knowledge sharing and technology transfer between regional and international experts, research organizations, and universities.
- Sector clusters, such as the Food Security Cluster, bring together humanitarian aid agencies and regional and local government agencies. These coordination platforms provide a forum for dissemination of best practices and lessons learned.

CREATING INCENTIVES THROUGH OPPORTUNITY

Fady or cultural norms around some practices, such as using organic manure and compost (a practice that is frowned upon), can limit their adoption. However, *fady* can be reversed or changed when proper incentives or motivations are linked to the activity. Local leaders, particularly at the *fokontany* level, play a key role in this process and could be champions if properly trained and convinced.

Madagascar's wealth of natural resources – flora, fauna, and mineral – is attractive to foreign investment and could help pave the way for local businesses to flourish while also facilitating adaptation. For example, Phileol, a company specializing in castor seed oil production exclusively for export, supports women-led artisanal activities, reforestation, and improved agricultural practices in Tsihombe.

CHALLENGES AT THE LOCAL LEVEL TO DISSEMINATING GOOD PRACTICES

Cultural preferences may inhibit the uptake of actions to improve adaptive capacity if those actions are perceived as *fady* or only beneficial to a few members of the community. Past interventions around shared management of communal water kiosks or wash basins have not been sustained because dispute resolution mechanisms among operators and users are weak (Water and Sanitation for the Urban Poor, onsite interview, June 2017).

OPPORTUNITY FOR ENGAGEMENT AT THE LOCAL LEVEL

Municipalities like Antananarivo and Tuléar that enjoy access to adequate telecommunication and transport infrastructure and the presence of business interests have a role to play in disseminating good adaptation practices. The presence of technical working groups like the GTCC in Antananarivo can provide a platform through which successful approaches and lessons learned may be shared. Nevertheless, engagement at more localized levels will require that a greater emphasis be placed on deconcentrated technical experts who can communicate and disseminate examples of good practice elsewhere. In addition, regions, districts, and communes, in their functions of coordination, could establish and promote climate issue sharing

committees to support information sharing and dialogue around climate adaptation and responses.

4.4 MOBILIZING FINANCE FOR ADAPTATION MEASURES FROM MULTIPLE SOURCES

While larger municipalities such as Antananarivo have been able to attract bilateral, multilateral, and national funds to support their climate change work, smaller, more remote municipalities such as Tsihombe struggle to fund climate change actions. Despite regional government support and significant interest from international donors, southern Madagascar appears to be a challenging environment for projects, except those supported by self-funding organizations/ social enterprises with a commitment to long-term implementation. Furthermore, the majority of the finance available through global finance facilities such as the LDCF and the GEF are implemented by international donors, namely through international partners, with very limited participation by local authorities and/or NGOs. The reason is that local authorities have limited capacity to operationalize required procurement processes, and are themselves already severely understaffed, with limited resources at their disposal and limited technical expertise.

FINANCING AT THE NATIONAL AND SUBNATIONAL LEVELS

The BNCCC is the national designated authority for international climate funds and provides technical oversight in its role as either an executing agency or as a member of the steering committee for the following initiatives under the LDCF and the GEF:

- The [Adapting Coastal Zone Management to Climate Change in Madagascar Considering Ecosystems and Livelihoods](#) project aims to strengthen institutional capacities to address climate change in the coastal zones of Menabe, Boeny, Vatovavy Fitovinany, and Atsinanana, and to provide training to relevant staff to identify flood risk and other vulnerabilities to inform comprehensive CCA plans. The project also establishes mechanisms to develop more resilient standards, legislative instruments, and an effective coordinating system to address CCA strategies.
- The [Enabling Climate Resilience in the Agriculture Sector of Southwestern Madagascar](#) project focuses on upgrading agricultural infrastructure to render it more climate-resilient and preventing flooding in the Atsimo-Andrefana Region.
- The [Enhancing the Adaptation Capacities and Resilience to Climate Change in Rural Communities in Analamanga, Atsinanana, Androy, Anosy, and Atsimo Andrefana](#) project targets 11 communes across five regions of Madagascar to strengthen institutional, structural, and technical capacity to apply appropriate adaptation measures and technologies, including strengthening the collection, production, and dissemination of reliable climate information.

A fourth project, the [Sustainable Agriculture Landscape Project](#), was approved for GEF Trust Fund funding in February 2017. It will focus on developing an information base for planning and on strengthening the policy framework for implementing a landscape approach in multiple landscapes in Madagascar: the Andapa landscape (Sava Region) and the Iazafo and Soaneireana-Ivongo landscapes (Analanjirifo Region) in the eastern coastal agro-ecoregion, and the Bealanana landscape (Sofia Region) and Marovoay landscape (Boeny Region) in the northwestern low altitude plains agro-ecoregion.

In addition to ongoing projects financed by the LDCF and the GEF, the BNCCC participates in the steering committee for two Climate Investment Fund (CIF)-financed projects:

- Pilot Program for Climate Resilience (PPCR), which focuses on strengthening institutional capacity, channeling public investments toward infrastructure, and working with the agriculture sector to fortify food and livelihood security.
- Scaling Up Renewable Energy Program (SREP), through which a SREP Investment Plan will be developed to identify specific institutional, financial, and economic barriers to scaling up renewable energy in Madagascar.

The private sector in Madagascar is increasingly interested in working at the local level to increase resilience to climate change. Some experiences to date include:

- Fondation Telma (telecommunications) supported development and operationalization of the cyclone and flood EWS through a grant to the BNGRC.
- Mangily Solidarity Hotel (ecotourism), an initiative of Bel Avenir, an international NGO, supports “green classroom” learning experiences for Malagasy youth to learn about climate change impacts and resilient environmental management.
- Copefrito and Indian Ocean Trepang (IOT) (aquaculture exporters) work in collaboration with international NGO Reef Doctor, the regional arm of the Ministry of Marine Resources and Fisheries, the University of Tuléar, and FI.MI.HA.RA, a regional fishermen’s association, to support fishing communities in southwest Madagascar to restore and regenerate habitats on degraded patch reefs and redirect fishing pressure away from fragile coral reefs.

A significant barrier to a municipality providing its own funding for CCA is the fact that many municipalities already function at a revenue deficit and struggle to provide basic services. For example, Tsihombe and Tuléar local government staff have not received salaries for several months.

Acquiring goods or services to support CCA can be difficult within the current procurement system of municipalities. In Tuléar, respondents noted that the procurement process is convoluted and not well understood by municipal agents, who need to put out requests for proposals and then evaluate offers. As with many government procurement systems, priority is given to cost savings rather than quality or skill level. Current partners of the Tuléar municipal government recommend performance-based contracts with government agencies or facilitation of their procurement processes with technical assistance as necessary.

CHALLENGES AT THE LOCAL LEVEL TO ACCESSING CLIMATE FINANCE

Many communal governments, while versed in principles of DRM and notionally aware of opportunities for climate finance, are challenged to make the link between DRR, adaptation, and DRM to put forward viable proposals that articulate a business case for funding. The institutional separation of DRR and DRM at the national level (in the CPGU and the BNGRC, respectively), further reinforces a distinction between interventions that reduce risk and interventions that respond to risk.

OPPORTUNITY FOR ENGAGEMENT AT THE LOCAL LEVEL

Communal governments are charged with providing many public services, but have little control over cash flow, as most revenue is retained at the level of the central treasury. Urban resilience requires means and mechanisms by which local governments can leverage private investment and in-kind cooperation, and generate/retain some revenue at the local level to support adaptation and risk management. An opportunity exists to provide technical assistance to develop commune-level funding for services through mechanisms such as: a convention with the central treasury; development agreements whereby the developer assumes the cost of structural upgrades or offsets the effects of construction and land use on the surrounding environment; and public–private partnerships (PPPs) to make needed physical adaptations (e.g., water-saving infrastructure, warehouses).

CONCLUSION

Madagascar ranks among the most vulnerable countries to climate change and variability, with recurring and prolonged droughts affecting the south, and powerful cyclones striking the northern and eastern coasts on a near annual basis. Recent events like 2017's Cyclone Enawo have had substantial impacts on human safety, natural resource availability, economic activities, and homes and other infrastructure. Efforts to train local communities in DRM have shown some encouraging results, with many communities demonstrating awareness of relevant practices to respond to specific hazards. Yet as the climate becomes more variable and extreme events happen with greater intensity, already chronic food insecurity in Madagascar will deepen and likely affect growing numbers of people. In rapidly expanding urban centers, climate risk will exacerbate problems of inadequate water supply, sanitation, and waste management.

Recognition is widespread of the urgency for DRM and more recently CCA, yet governance challenges from the national to the local level limit capacity to address underlying vulnerabilities. The practice of local development planning appears to be inconsistent and varies widely across Madagascar, but the majority of plans and budgets are not informed by robust climate change vulnerability assessments. An even greater challenge lies in incentivizing actions that reduce climate risk and build resilience, as information alone does not guarantee uptake.

The BNGRC, in collaboration with the CPGU and BNCCC, is in a position to support capacity building beyond disaster preparedness and response awareness training. As it looks to establish a cadre of regional representatives to better manage localized hazards (like the drought in southern Madagascar), the BNGRC can facilitate the integration of climate considerations into local plans and budgets. Regional representatives can: educate local governments and communities about the risks identified and described in the atlas of risks developed by the CPGU and BNGRC for Madagascar's regions, beginning with those highly vulnerable to climate risks; share guidance for conducting risk mapping and vulnerability assessments; and advise on options for adaptation that can be incorporated into local plans.

Because financing remains one of the most significant barriers to implementing CCA, with many municipalities operating at a deficit, initiatives to build capacity for DRM and CCA could be accompanied by efforts to introduce participatory budgeting. Experience in Madagascar, albeit limited, has shown that a participatory budgeting approach has the potential to encourage greater contribution from taxpayers to fill municipal funding gaps.

The private sector is also an important yet underexploited source of finance for CCA in Madagascar. Emerging growth poles and corridors (*espaces de croissance*) may provide an effective entry point to integrate a CCA approach for sustainable economic and social development. As business interests and investment potential increase in these zones, demand for climate-proofing those investments may influence the design, planning, and execution of special projects.

With rapid urbanization still a relatively new phenomenon in Madagascar, only a small fraction of the country's potential urban space has been developed. Opportunity exists now for new developments to benefit from improved information on climate vulnerabilities to build more resilient urban spaces. This opportunity hinges on proactive investment in resilient urban planning and infrastructure development that is underpinned by meaningful community and stakeholder engagement across sectors, economic development, DRM, and equity of service provision.

SOURCES

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ANNEX A: MADAGASCAR INTERVIEW LIST

Institution	Name	Position
National-level Institutions		
Bureau National de Coordination des Changements Climatiques (BNCCC)	Nivohary Ramarason	Director
Direction Générale de la Météorologie (DGM)	Marie Louise Rakotondrafara	Executive Director
	Tatiana Arivelo Andry	Director of Hydrometeorological Research and Development
	Luc Yannick Randriamarolaza	Director of Applied Meteorology
Bureau National de Gestion des Risques et des Catastrophes (BNGRC)	John Heriniandry Razafimandimby	Director, Center for Research and Monitoring (CERVO)
Fonds de Développement Local (FDL)	Hanitra Raharinjatovo	Executive Director
Fonds d'Intervention au Développement (FID)	Mamisoa Rapanoelina	Director of Partnerships and Support Funds
Ministère de l'Intérieure et de la Décentralisation (MID)	Roger Mahazoasy	Director of Decentralized Cooperation and PPPs
Cellule de Prévention et Gestion des Urgences (CPGU)	Elisaha Rakotoseheno	Technical Lead
	Pelanoro Randriamaro	Technical Assistant
Ministère de la Population, de la Protection Sociale, et Promotion de la Femme (MPPSPF)	Anja Hobiniaina Ratovomamonjy	Head of Social and Environmental Impact Assessments, Environment Unit
	Andriamiharimanana Ravo Ratovo	Technical Assistant, Directorate for Social Protection
	Andrianavalaona Benja Rakotondravelo	Head of Social Assistance, Directorate for Response to Shocks
Ministère auprès de la Présidence en charge des Projets Présidentiels, de l'Aménagement du Territoire et de l'Équipement (M2PATE)	Gérard Andriamanohisoa	Director, Directorate for Land Development and Equipment
JIRAMA	Rija Ramarosandratana	Interim Deputy Director for Water

	Nestor Ndalana	Interim Deputy Director for Electricity
Ministère de l'Eau, l'Energie et des Hydrocarbures (MEEH)	Ravaloson Andrianaritsifa	Director, Directorate for Sanitation and Hygiene
Donors and Implementers		
World Bank	Gaël Raserijaona	Consultant
UN-Habitat	Monique Rakotoarison	Human Program Manager
	Jaotiana Rasolomamonjy	Urban Risks Expert
	Harifidy Randrianirina	Technical Assistant for Urban Development
CARE	Andriamarinarivo Rajaonarison	Country Director
	Malalatiana Rakotobe	Head of Communications
	Rija Haritiana Randrianarisoa	Humanitarian Assistance and Resilience Specialist
	Haingo Rajaobelison	Food Security and Climate Change Specialist
	Avo Ratoarijaona	Institutional Capacity Strengthening Specialist
IMV Tana City Lab	Carmen Zuleta Ferrari	Head of Climate Resilience Strategy
USAID/Madagascar	Daniel Whyner	Director, Environment and Climate Change Office
	Carrie Antal	Director, Office of Food Security and Disaster Assistance
	Jessie Snaza	Agriculture Officer, Environment and Climate Change Office
	Serge Ramanantsoa	Program Management Specialist, Environment and Climate Change Office
International Organization for Migration (IOM)	Daniel Silva y Poveda	Chief of Mission
Water and Urban Sanitation for the Poor (WSUP)	Julie Ranaivo	Program Coordinator
UNDP	Miliaribenja Ranjatomalala	Local Planning Consultant, Programme d'Appui à la Décentralisation et la Résilience Communautaire (PADRC) / Planification de Développement, Secteur Privé, Emploi (PDSPE)
Food Security / Emergency and Humanitarian Assistance Cluster	Blandine Legonou	Chief of Mission, World Food Programme
	Theodore Mbainaissem	Emergency Coordinator, World Food Programme

	Lee Philippisson	Lead Monitoring Agronomist, Food and Agricultural Organization
		BNGRC Ambovombe-Androy Representative
Agronomists and Veterinarians without Borders (AVSF)	Tsilavo Randrianiaina	SOHAVELO/ASARA Project Director
Centre Technique Agroécologique du Sud (CTAS)	Adrien Ratrimo	Executive Director
GRET	Hery Razafimamonjiraibe	Regional Coordinator and AINA Project Director
Welthungerhilfe (WHH)	Mercie Ramilanajoharivelo	Deputy Project Director, PASSAT Project
Blue Ventures	Lalao Aigrette	Blue Forests Coordinator for Southwest Madagascar
	Jen Hacking	Blue Forests Madagascar Program Manager
Association for the Development of Solar Energy (ADES)	Hantanirina Anatolie Razafindrafeno	Director of Information, Education and Communication / Coordinator for Southern Madagascar
ONG Bel Avenir	Jose Luis Guirao Piñeyro	Madagascar Country Director
Red Cross of Madagascar	Nicolas Randriamanantena	Regional Program Coordinator, Maroantsetra
Medair	Ketsia Bonnaz	Program Coordinator
	Cyril Eicher	Disaster Risk Management / M&E Specialist
Research Institutions		
Groupe Thématique sur le Changement Climatique (GTCC)	Harisoa Rakotondrazafy	GTCC President / Climate Change Adaptation Officer, World Wildlife Fund
	Andriamandimbisoa Razafimpanana	Conservation Support Coordinator, Wildlife Conservation Society
	Jean Roger Rakotoarijaona	Director of Information, Office Nationale pour l'Environnement (ONE)
	Jean Romuald Randriamanarivo	Researcher, Centre National de Recherches en Environnement
Private Sector Organizations		
Phileol	Odon Andriamampiany	Head of Production and Maintenance
Ramanandraibe Exportation SA	Leva Ramanantsoa	Director
Subnational and Municipal Level		
Commune Urbaine d'Antananarivo (CUA)	Mamy Rakotoarisoa	Director, Information Systems Division

	Harimbola Ranaivo	Chief of Staff, Urban Division
Service Autonome de Maintenance de la Ville d'Antananarivo (SAMVA)	Damy Jean Baptiste Ratolonjanahary	Executive Director
Autorité pour la Protection contre les Inondations de la Plaine d'Antananarivo (APIPA)	Philippe Ratelason	Executive Director
District de Tsihombe	Christoline Soafara Mananasy	Deputy Chief of Territorial Administration
Commune Urbaine de Tsihombe		Deputy Mayor
Eligse FJKM Atsimon'ny Mahamasina	Michele Tolotra	Pastor
Service de District de Santé Publique de Tsihombe	Gervais Razafimahatratra	Deputy Medical Inspector
Alimentation en Eau dans le Sud (AES) - Tsihombe		Station Manager
Centre de Services Agricoles (CSA) - Tsihombe	Jean Baptiste	Project Manager, Fonds
Région Atsimo Andrefana	Rabe Jules	Chief of Region
Direction Régional de Transport et de la Météorologie (DRTM) Atsimo Andrefana		Tuléar met station agents
Commune Urbaine de Tuléar	Niny Augustin Zafindravola	Deputy Mayor
	Boto Razafindrambily	Director, Urban Management Division
District de Maroantsetra	Désiré Mariano	District Head
Commune Urbaine de Maroantsetra	Fortuné Philippe Ramonjarison	Deputy Mayor, Head of Technical Services and Infrastructure Management
	Maurice Dimilahy	Former Deputy Mayor of Maroantsetra (2004-2007)
JIRAMA Maroantsetra	Manandraibe Jean Rakotonirina	Head of Electricity Sector, Maroantsetra
Fokontany de Androkaroka, Commune de Maroantsetra	Vincent Randrianaivo and community members	President
BNGRC Maroantsetra	Gervais Bemahefa	Cyclone Enawo Response Officer
Service de District de Santé Publique de Maroantsetra	Christian Rajao	District Medico-Sanitary Chief
	Dera Ralalason	Medical Inspector

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