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Republic of Madagascar: Technical Assistance Report - Climate Macroeconomic Assessment Program

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TECHNICAL ASSISTANCE REPORT – CLIMATE MACROECONOMIC ASSESSMENT PROGRAM

November 2022

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FISCAL AFFAIRS DEPARTMENT

Republic of Madagascar

Climate Macroeconomic Assessment Program (CMAP)

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Technical Report

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ABBREVIATIONS AND ACRONYNMS

CMAP	Climate Macroeconomic Assessment Program
AAL	Annual Average Losses
ADRiFi	Africa Disasters Risk Financing Programme
AFD	Agence Française de Développement
AfDB	African Development Bank
AFR	African Department
ARC	African Risk Capacity
BAU	Business as usual
BNGRC	Bureau National de Gestion des Risques et des Catastrophes
Cat-DDO	Catastrophe Drawdown Option
CBM	Central Bank of Madagascar
CBT	Climate Budget Tagging
CC	Climate Change
CCKP	Climate Change Knowledge Portal
CCPA	Climate Change Policy Assessment
CERC	Contingency Emergency Response Components
CPAT	Carbon Pricing Assessment Tool
CPGU	Cellule de Prévention et Gestion des Urgences
C-PIMA	Climate Public Investment Management Assessment
CRW	Crisis Response Window
CSBF	Commission de Supervision Bancaire et Financière
DGEP	Direction Générale de l'Econmie et du Plan / General Directorate of Economy and Planning
DGM	Météo Madagascar / Meteorological Institute Madagascar
DIGNAD	Debt, Investment, Growth, and Natural Disasters model
DRFI	Disaster Risk Financing and Insurance
ECF	Extended Credit Facility
EM-DAT	Emergency Events Database
ESF	Environmental and Social Framework
EV	Electric Vehicle
FAD	Fiscal Affairs Department
FGRM	Feedback and Grievance Redress Mechanisms
FLEGT	Forest Law Enforcement, Governance and Trade
FMIS	Financial Management Information System
FOI	Freedom of Information
FRS	Fiscal Risk Statement
FSAP	Financial Sector Assessment Program
FX	Foreign Exchange
GDP	Gross Domestic Product
GHG	Greenhouse gas
GRADE	Global Rapid Damage Estimation
HDCT	Human Development Cash Transfer
IDA	International Development Association
IEM	Initiative Emergence Madagascar
IFPRI	International Food Policy Research Institute
INDC	Intended Nationally Determined Contributions
IPF	Investment Project Financing

IRM	Immediate Response Mechanism
IPCC WGI	Intergovernmental Panel on Climate Change Working Group
LIDC	Low Income Developing Countries
LMIC	Low Middle Income Countries
LPG	Liquified Petroleum Gas
LULUCF	Land Use, Land-Use Change, and Forestry
MAEP	Ministère de l'Agriculture et de l'Elevage / Ministry of Agriculture, Livestock and Fisheries
MEDD	Ministère de l'Environnement et du Développement Durable / Ministry of Environment and Sustainable Development
MEF	Ministère de l'Economie et des Finances / Ministry of Economy and Finance
MEH	Ministère de l'Energie et des Hydrocarbures / Ministry of Energy and Hydrocarbons
MGA	Madagascar Ariary
MID	Ministère de l'Intérieur et de la Décentralisation
MSANP	Ministère de la Santé Publique / Ministry of Public Health
MTP	Ministère des Travaux Publics / Ministry of Public Works
MTBF	Medium-term Budget Framework
MTFF	Medium-term Fiscal Framework
NAP	National Adaptation Plan
NDF	National Disaster Fund
NGOs	Non-government organizations
NDC	Nationally Determined Contribution
ONE	Office National pour l'Environnement
PE	Public Corporations
PEFA	Public Expenditure and Financial Accountability
PES	Payments for Environmental Services
PFM	Public Financial Management
PIE	Public Investment Efficiency
PIM	Public Investment Management
PIMA	Public Investment Management Assessment
PPCR	Pilot Program for Climate Resiliency
PPP	Public Private Partnership
PSNP	Productive Safety Net Program
RE	Renewable Energies
REDD	Reducing Emissions from Deforestation and Forest Degradation
RCP	Representative Concentration Pathway
RES	Research Department
SDGs	Sustainable Development Goals
SNGs	Subnational Governments
SOE	State Owned Enterprise
SWIO	Southwest Indian Ocean Risk
RAFI	Assessment and Financing Initiative
TLAS	Timber Legality Assurance System
TPP	Taxe sur les Produits Petroliers
UNDP	United Nations Development Program
VAT	Value Added Tax
VPAs	Voluntary Partnership Agreements

PREFACE

The Climate Macroeconomic Assessment Program (CMAP) aims to assist countries, especially small and low-income countries to build resilience and develop policy responses to cope with the economic impact of climate change. The CMAP is a successor to the Climate Change Policy Assessment (CCPA) with more focus on macroeconomic implications of climate change policies. Madagascar is the second pilot country where a CMAP has been conducted.

CMAP
The Climate Macroeconomic Assessment Program

Staff from the IMF's Fiscal Affairs Department (FAD) supported by the African and Research Departments held remote discussions for the CMAP during February 28-March 21, 2022, followed by a hybrid mission during April 1-12, 2022. The team was led by Valerie Cerra and comprised Vybhavi Balasundharam, Simon Black, Chen Chen, Majdeline El Rayess, Joey Kilpatrick, Katja Funke, Nabil Hamliri, Amr Hosny, Claude Wendling (all FAD), Zamid Aligishiev (RES), and Dominique Fayad (AFR) from the IMF, as well as Carter Brandon, Juan Carlos Altamirano, and Erin Gray from the World Resources Institute. Ms. Rindra Hasimbelo Rabarinirinarison, Minister of Economy and Finance; Ms. Marie-Orlea Vina, Minister of the Environment and Sustainable Development; general directors, directors, management, and the staff of the Ministry of Finance; the Ministry of Environment and Sustainable Development; the Secretariat General of the Presidency; the Ministry of Public Works; the Ministry of Transport, Tourism, and Meteorology; the Ministry of Energy and Hydrocarbons; the Ministry of Agriculture, Livestock and Fisheries; the Ministry of Land Use; the Ministry of Interior; the Minister of Public Health; the Ministry of Labour, Employment, Civil Service and Social Laws; the Ministry of Water, Sanitation and Hygiene; the Ministry of Education; the Ministry of Technical Education and Vocational Training; the Ministry of Higher Education and Scientific Research; the Ministry of Population, Social Protection and Gender; the Central Bank of Madagascar, the Banking and Financial Supervision Commission (CSBF), the Accountant General's Office; the BNGRC; the CPGU; the ONE (Office National de l'Environnement); the Fonds D'Intervention pour le Développement; JIRAMA; and ARO Insurance Company.

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EXECUTIVE SUMMARY

Madagascar is exposed to a multitude of climate hazards such as tropical cyclones, droughts, and floods, which cause significant damage to key sectors, thereby undermining development efforts. The changing climate is also bringing more extreme heat events and more unpredictable rainfalls. More frequent and intense extreme events, both climate and weather related ("extreme events" below) have caused sizable losses in the agriculture, ecosystems, water, and infrastructure sectors. At the same time, slow-moving effects of climate change, e.g., raising temperatures, create pressure on labor productivity across sectors. Madagascar's high level of extreme poverty and dependence on agriculture exacerbate its vulnerability to these conditions.

Madagascar continues to develop and update its national framework for climate change. The country has a set of key climate related policies and strategies in place, which are directly linked to its development goals and largely consistent with its commitments under the Nationally Determined Contribution (NDC). Several of these, including the NDC, are being updated. However, climate change has not been mainstreamed into sectoral strategies. Instead, some sectors developed standalone documents on climate change. The impact of future climate developments and related hazards is not well understood at the sectoral level, which hinders the development of proactive measures for addressing climate change. Madagascar has also developed a complete set of land use and building regulations primarily promoting resilience to climate risks. But lack of capacity has hindered the implementation of the new framework. Table 1 summarizes strategic gaps in climate plans and implementation.

Achieving Madagascar's mitigation goals in the NDC, covering key emitting sectors, can be supported by carbon and energy pricing reforms. Madagascar is a relatively small emitter in terms of energy-based CO_2, though according to the international greenhouse gas (GHG) emissions inventories it has higher emissions per capita compared with countries at comparable income levels due to deforestation. Its mitigation commitments therefore rely heavily on the Land Use, Land-Use Change, and Forestry (LULUCF) sector, in addition to the energy, agriculture, and waste sectors. Madagascar aims to reduce the rate of deforestation and promote large-scale reforestation. These efforts could be strengthened by adopting a feebate system for forest carbon storage and encouraging the take up of energy-efficient appliances that reduce dependence on forest resources such as firewood and charcoal. While the energy sector has relatively low emissions, it faces mounting pressures from inefficient pricing of energy products that is further exacerbated by growing demand. Selected tax reforms such as increasing the excise on diesel, combined with a gradual increase in electricity tariffs to cost recovery levels and the implementation of an automatic fuel pricing mechanism can help meet mitigation objectives. The revenue raised from these tax measures should be used to meet Madagascar's SDG goals, for example, to strengthen the social safety net, thus helping to reduce inequality and poverty, and thereby also mitigating the adverse impact of energy price increases on the vulnerable.

Progress has been made on several elements of a natural disaster risk management strategy, but some gaps remain to be addressed. Adequate provisioning for fiscal risks could be facilitated by integrating disaster risk assessments into the budget process. Madagascar has fiscal mechanisms in place to respond to shocks, but domestic resources available for the response remain small. Expanding the beneficiary registry to a wider social registry that includes vulnerable non-beneficiaries, would facilitate scaling-up social protection systems when needed. While the government has recently improved risk transfer through external contingent financing and sovereign insurance instruments, domestic insurance could be further developed to increase financial resilience of the population. Finalizing the Disaster Risk Financing and Insurance (DRFI) strategy would provide centralized guidance on disaster risk assessments and available instruments in a risk layering framework.

Madagascar has started developing and implementing adaptation measures. Under the guidance of the National Adaptation Plan, there are a few key sectors in Madagascar that have already formulated sector-specific documents on climate change, even though these are stand-alone documents that are not mainstreamed into sectoral strategies. Both investments and non-fiscal measures have been proposed as part of these documents, however, these are not sufficient to address adaptation needs. Many of the investments proposed could bring great benefits in terms of disaster impact reduction, as well as economic and environmental benefits. However, adaptation investments are often selected through fragmented external financing initiatives without a prioritization framework. To select measures according to the government's policy priorities, it is key to cost measures and estimate the potential benefits. This would also be the basis for determining financing needs and addressing financial constraints.

Ongoing public financial management (PFM) and public investment management (PIM) reform efforts provide an opportunity to increase the hitherto very limited focus on climate. While the PIM reform agenda has made some progress since the adoption of a PIM strategy in 2017, its ongoing update could integrate climate-specific elements in project appraisal and selection. In terms of institutional arrangements, relations between the Ministry of Environment, Ministry of Economy and Finance, and line ministries could be strengthened at the planning stage, and climate change concerns could be mainstreamed into comprehensive sectoral strategies. Infrastructure maintenance strategies need to be developed, including to address the impact of climate-related events and to make infrastructure more resilient, building on efforts in the road sector. With respect to PFM in general, a priority should be to increase transparency on macroeconomic and fiscal information related to climate, as a basis for planning and to manage public resources efficiently. The ongoing reform of the budget classification can be used to create capability for identifying and tracking spending on adaptation and mitigation, and to create and gradually enrich a document or annex dedicated to climate change in the annual budget.

Quantifying the impact of climate and climate change on growth and fiscal aggregates is critical to designing an appropriate and sustainable policy response. Madagascar's

macroeconomic and fiscal projections do not factor in climate and climate change risks, even though the country is being consistently and increasingly hit by natural disasters. Policy responses are typically reactive and constrained by the availability of *ex-post* concessional financing. Under a climate-adjusted macroeconomic scenario that includes all humanitarian and reconstruction needs after a disaster, and assuming the government fully covers these needs, debt would quickly become unsustainable and exceed 85 percent of GDP by 2040. Therefore, natural disasters should no longer be treated as downside risks but as components of the country's baseline projections. Even though predicting the frequency and impact of future disasters is a challenging task, a quantification and projection of economic impacts based on historical experience and research-based assumptions would capture some of the risks and build the case for a quick policy response.

Policy responses should focus on designing a comprehensive package of measures that goes beyond adaptation investments only and targets Sustainable Development Goals (SDGs) (Box 1). Given low public investment efficiency, a focus on investments only would inflate debt with limited associated growth and resilience benefits. Improving public investment efficiency would improve the debt outlook but is insufficient to maintain debt sustainability by itself. A comprehensive approach combining investments to scale up resilient infrastructure and to build human capital, with the objective of reaching SDGs, matched with revenue measures from mitigation and additional grants, would significantly increase potential growth and preserve fiscal sustainability. Focusing efforts on resilient investments with the highest returns would contribute to improving debt sustainability. Efforts to mobilize grants and concessional financing should be accelerated but their effectiveness will depend on credible climate policies, as well as improved governance and public investment management capacity.

Box 1. Summary of Key Recommendations 1/

(Short term: within 1-2 years; Medium term: within 2-5 years)

National Climate Strategy	**Time Frame**
• Complete developing and updating key elements of the strategic framework for climate change, including NDC	Short to medium term
• **Mainstream climate change and disaster risk management into sectoral plans based on climate change projections and forward-looking hazard risk assessments**	Medium term
Mitigation	
• **Bring the fuel price to efficient levels by:**	
◦ Normalizing excise taxes and other levies on diesel relative to gasoline	Short term
◦ **Adopting an automatic fuel pricing mechanism that closes the gap between the true market price and the pump price**	Short term
• Eliminating the VAT exemption on the first 100 kWh of electricity consumption	Short term
• **Gradually increase electricity tariffs to cost recovery levels**	Medium term
• Consider recycling tax revenue from mitigation measures to compensate for the adverse impact of price increases on the vulnerable by strengthening the social safety net	Medium term
• Use feebates to encourage uptake of forest carbon storage, fuel-efficient vehicles, and energy efficient appliances	Medium term
Disaster Risk Management	
• **Include an analysis of natural disaster risks in annual fiscal risk statements**	Short term
• **Finalize and publish a Disaster Risk Financing and Insurance (DRFI) strategy**	Short term
• Expand the beneficiary registry to a wider social registry that includes vulnerable non-beneficiaries, to facilitate scaling-up social protection systems when needed	Medium term
Adaptation	
• **Clearly articulate the relationship between adaptation and development throughout the adaptation planning process**	Short term
• **Enhance the National Adaptation Plan (NAP) by providing more data on climate change impacts and exploring financial resources**	Short to medium term
• Continue with a sectoral approach to identify, assess, and prioritize adaptation measures, including by fully reflecting adaptation aspects in cost-benefit analysis	Short to medium term
• Include strategies that address the slow-moving effects of climate change in the NAP and the sectoral development plans	Medium term
Public Investment and Financial Management	
• **Define a methodology to integrate climate change into ex ante project assessments and introduce (e.g., through the ongoing work on the public investment manual) climate-related selection criteria for project prioritization**	Short term
• **Identify those infrastructure assets most vulnerable to climate change** and define maintenance methodologies by main sectors	Short to medium term

Box 1. Summary of Key Recommendations (concluded)

• Strengthen climate-sensitive budgeting**, by introducing and gradually enriching a climate document appended to the annual budget**, and by using the reform of the budget classification to pave the way towards climate budget tagging	Short to Medium term
Macro Fiscal	
• **Prepare a well-costed and prioritized package of climate measures to anchor future reform efforts, based on existing or pending policy documents (e.g., NDC, NAP, PFM reform strategy)**	Short term
• Develop the technical capacity to assess the impact of natural disasters on macroeconomic variables and include climate- and climate change-related shocks in all macroeconomic projections	Short to medium term

1/ Bold indicate recommendations with the highest priority.

Table 1. Strategic Gaps in Nationally Determined Contribution and Other Climate Plans

Mitigation	
Does the NDC have well-specified mitigation targets?	
Are current policies consistent with NDC?	
Are current policies and financing consistent with moving towards net-zero emission by mid-century? (for a low income country)	
Adaptation	
Do adaptation plans in NDC and other climate plans adequately reflect climate shocks?	
Are current policies consistent with NDC and other climate plans?	
Disaster Risk Management	
Are risk management policies adequately reflected in NDC and other climate plans?	
Are current risk management policies adequate?	
National Process	
Are planning processes adequate to support NDC and other climate plans?	
Is PIM adequate to support NDC and other climate plans?	
Is Public Financial Management (PFM) adequate to support NDC and other climate plans?	
Macro-fiscal Implication	
To what extent were macroeconomic vulnerabilities eased by existing climate policies?	
To what extent are climate projects in NDCs and other climate plans costed?	
Are the financing plans adequate?	
Are policies in the NDC and other climate plans consistent with debt sustainability?	

Note: Green indicates little or no gaps; yellow indicates some gaps; red indicates significant gaps
1/ An updated NDC was not received, so assessments in this table are based on the 2016 NDC.

CLIMATE CHANGE RISKS AND IMPACT

Madagascar is exposed to a multitude of climate hazards such as tropical cyclones, droughts, and floods. The changing climate is also bringing more extreme heat events and more unpredictable rainfalls. More frequent and intense extreme events have caused sizable losses in the sectors of agriculture, ecosystems, water, and infrastructure. The slow-moving effects of climate change are also adding pressure to labor productivity across the sectors.

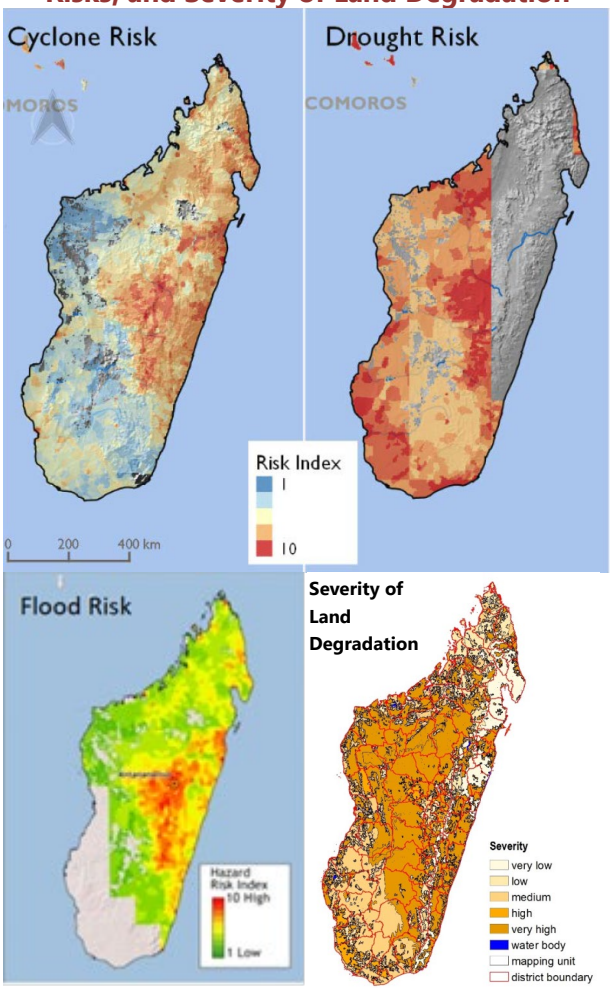
Impact of Climate Change Risks on the Macro Framework and Long-Term Outlook

What are the Main Climate Hazards Faced by the Country?

1. Under the current climate condition, Madagascar is exposed to multiple climate hazards, including tropical cyclones, droughts, and floods (Figure 1). The exposure to climate risks is subject to significant regional variation. Given the island's size and its geography, it is home to various climate zones, which come with important differences in the types of climate hazards and levels of risk exposure.

- **Climate conditions.** The climate is mild on the high plateaus and hot in the rest of the island. The east coast receives heavy rainfall with a humid sub-tropical climate, whereas the south and the southwest have a semi-desert condition.
- **Extreme events.** Compared to the other part of the country, the south-west and the center of Madagascar have a higher risk of *drought*; the risks of *tropical cyclone* are higher in the east and some part of the north compared to the south and the west; the east and the central regions are prone to the risk of *flood*.

Figure 1. Cyclone, Drought, and Flooding Risks, and Severity of Land Degradation



Source: World Bank Climate Risk and Adaptation Country Profile, 2011, USAID, 2018,

- **Poor land use practices across the country.** Land degradation as a result of poor land use practices exacerbate the risks from extreme events.

2. Climate conditions are expected to deteriorate, and the intensity of extreme events is projected to increase (Table 2).

- **Climate conditions.** *Average temperatures* have been steadily increasing across the country, a trend that is expected to continue in the future. *Precipitation* has more regional and seasonal variability, but winter and spring rainfalls have been decreasing in most places. By mid-century dry spells are expected to expand further while annual precipitation is not expected to decline much (CCKP, IPCC WGI Interactive Atlas). The s*ea level* has been rising around Madagascar, but the average rate is slower than the global average due to Madagascar's coastal topology (USAID, 2021).
- **Extreme events.** Cyclones are expected to increase in intensity going forward and their frequency could potentially increase. Madagascar has had significantly more frequent and longer lasting droughts in the past four decades, which have affected more of the population (Reliefweb Situation Report, 2022). Rising temperatures and changing rain patterns are expected to amplify this development. The risk of flooding is expected to increase due to more intense rainfall, causing further land degradation, which would further worsen the devastating impacts.

What is the Potential Impact of Climate Change on the Economy?

3. Madagascar's economic and the socio-economic structure exacerbate the country's vulnerability to climate change and extreme events.

- **Madagascar remains an agriculture-based economy with subsistence farming as the primary economic activity, as more than 80 percent of households live in poverty.** While services contribute 55 percent and primary industries (including agriculture, forestry, and fishery) only 25 percent of the national product, the agriculture sector employs about 64 percent of the active population and subsistence farming is widespread. The agriculture sector in Madagascar is highly vulnerable to climate hazards, also in comparison to peers.[1] Fishing, another climate sensitive activity, contributes about 7 percent to the economy as well as to exports, supporting about 5 percent of the population mostly in coastal areas.
- **Extreme poverty inhibits human development opportunities holding back economic growth and the fair sharing of benefits thereof**. Human capital in Madagascar ranks among the lowest globally, reflected in all development indicators, including child mortality, school attendance, literacy and primary completion rates, malnutrition, life expectancy, access to transport, electricity, and potable water. Rising temperatures and droughts are expected to adversely impact agriculture output and opportunities, amplifying food

[1] See ND-GAIN, 2015 for a vulnerability assessment and ILO estimates for agricultural sector estimates: Employment in agriculture (% of total employment) (modeled ILO estimate) - Madagascar | Data (worldbank.org).

insecurity and malnutrition. Increasing temperatures and extreme events will directly affect the health of the population. The health and human habitat have been assessed as highly vulnerable to climate hazards. Destruction of housing, as well as disruptions in access to health and education caused by climate events will further undermine efforts towards reaching the Sustainable Development Goals (SDGs).

High vulnerability levels, combined with more intensified hazards, are expected to deepen the potential impacts and/or make them more probable to occur.

4. Disruptive climate events have significantly damaged key sectors in Madagascar; future climate change is projected to magnify the damage.

- **Agriculture.** Climate change is expected to decrease agricultural production through three channels: (i) the loss of cultivable land because of erosion, more intense rainfall, cyclones, and floods (Llopis 2018); (ii) a decline in land productivity due to more severe drought and drought-induced pests including locust outbreaks; and (iii) the loss of labor productivity caused by extreme heat (Chesney and Moran 2016, Rakotondravony et al. 2018).
- **Water and Sanitation.** The impact assessments of the major cyclones between 2017 and 2019 recorded serious pollution of drinking water, which in turn resulted in the outbreak of water-borne diseases. The ongoing drought also caused a massive food crisis and acute malnutrition in the Grand South. Climate change continues to generate challenges in the health sector indirectly, through the decline in water quality and food security issues associated with drought.
- **Ecosystem.** Extreme events destroy natural capital. But the slow-moving effects of climate change are also significant on Madagascar's terrestrial and marine ecosystems, reducing the volume and the productivity of the natural capital. In Madagascar, for the terrestrial ecosystem, climate change causes tree loss due to changes in rainfall that affects tree growth and reproduction; and degraded forests generate biodiversity loss which in turn further harms forest growth (Carver, 2020). In the coastal and marine ecosystems, declines in natural capital are already evident and are accelerated by climate change, including losses of mangroves, marine vegetation, and fisheries (Cochrane et al 2019). Damage to the ecosystem can adversely affect economic sectors such as agriculture and tourism, especially given that the latter is based almost entirely on the unique terrestrial biodiversity and coastal areas.
- **Infrastructure and Building.** The main threats to infrastructure and buildings from climate change are extreme events, especially floods and high winds associated with tropical cyclones, landslides that are exacerbated by the degraded ecosystem and more intense rainfall events, and drought and heat that accelerate the depreciation of the assets. Expected annual damages to roads and railway assets are estimated around 0.2% of GDP in Madagascar under the current climate (Koks et al, 2019). Variability in precipitation may lead to energy sector impacts, especially hydropower that represents 29% of Madagascar's energy mix.

Table 2. Madagascar: Climate Hazard Profile

Climate condition and hazardous events	Hazard profile
Temperature and heatwave	• Compared to the 30-year average (1960-1990), the average temperature between 1991-2020 increased by 0.53°C. • The numbers of hot days[2] and tropical nights[3] have been steadily increasing since 1961. • By mid-century, mean annual temperature increase likely to be between 0.87°C and 1.67°C in a moderate climate change scenario (SSP1-4.5). • The duration of warm spells[4] is projected to increase by 70 days a year (median value) in a moderate climate change scenario (RCP 4.5)
Precipitation and drought	• The precipitation pattern has seen regional and seasonable variability since 1961. The annual rainfall has been steadily declining in the central and east coastal regions between 1961 and 2005. Reduction of winter and spring rainfall is seen in most parts of the country. • The rainfall decline in the central and east coastal regions has been accompanied by an increased length of dry spells. • By mid-century, the annual precipitation is not expected to decline much but in some already drought-prone areas, the maximum number of consecutive dry days is expected to rise significantly even under the moderate climate scenario (RCP 4.5). • Recent observation: The 2021/2022 drought has been happening across much of the country. The south has been experiencing 70 percent less than normal rainfall.
Flooding	• By mid-century, in a moderate climate scenario (RCP 4.5) Madagascar is going to have higher intensity of single-day rainfall, compared to the 1961-2015 baseline, causing higher chance of hydrological flooding. • Land degradation interacts with the elevated flood hazard, likely to cause more devastating impacts. • Recent observation: The flood in Jan 2022, caused by intense rainfall has caused landslides, destruction of infrastructure and loss of life, affecting Antananarivo and other areas of Analamanga Region.
Cyclone	• The projected frequency of cyclones is subject to uncertainty, but the intensity is likely to increase. • Recent observation: Major tropical cyclones have hit Madagascar an average of about once every three years since 1998. In January and February 2022, however, four cyclones have hit Madagascar, two of which are category 3-4 events.

Source: CCKP, IPCC WGI Interactive Atlas, ReliefWeb Situation Report, 2022.

[2] With temperature higher than 35 Celsius Degree.
[3] With minimum temperature higher than 20 Celsius Degree.
[4] The warm spell duration index counts the number of days with at least 6 consecutive days when the daily maximum temperature exceeds the 90th percentile in the calendar 5-day window for the base period 1979-2009.

NATIONAL STRATEGY FOR CLIMATE CHANGE

Madagascar has a set of key climate change related policies and strategies in place, which are directly linked to the country's development goals and largely consistent with the country's commitments under the NDCs. Climate change has not been mainstreamed into sectoral strategies. However, some sectors developed specific documents on climate change. At the sectoral level, the impact of future climate developments and related hazards is not well understood, which hinders the development of proactive measures for addressing climate change.

The NDC and Other National Mitigation and Adaptation Strategies

Do the NDC and Other Climate Plans Present a Comprehensive and Costed Strategy for Climate Change Response?

5. While Madagascar had some elements of a framework for climate change in place for some time (Figure 1), implementation has been challenged among others by the implications of recent shocks from the COVID pandemic and various natural disasters.

- **At the national level**, the national development plan (Initiative Emergence Madagascar (IEM) 2019-2023), which is being finalized, includes a pillar on environmental promotion and sustainable development, and touches upon various areas of mitigation measures. Also, the 2016 NDC covered mitigation and adaptation aspects alike. It lists measures that are intended to support the achievement of the country's commitments for net emission reduction and for protecting the sectors most vulnerable to climate change. While a global cost estimate for mitigation and adaptation measures is provided, individual measures are not detailed or costed. The National Adaptation Plan (2019) contains a list of defined and costed projects and activities. The strategy relies on mainstreaming climate change related policies into sectoral approaches. While this is also foreseen by the National Policy for Fighting Climate Change (2008), the implementation at the sectoral level is lacking.
- **At the sectoral level**, progress of integrating climate change into sectoral strategies has been limited. And while some sectors, including energy, waste, water, industry, and forestry through the REDD+ initiative formulated documents for addressing climate change, these are mostly not detailed to the level of measures or projects and are not costed. The level of assessment of the implications of climate change and climate related hazards is largely limited to the current situation and recent events and does not take a forward-looking stance.
- **Cross cutting issues**, like climate resilient construction of buildings and roads are addressed through national norms. The land use and building regulations and the national norms for road infrastructure (2022) address the implications of climate change related hazards (see Section VI). The norms are mostly designed to deal with the already prevailing effects of climate change. Climate projections and related climate hazard risk assessments are still

being developed. For example, the Ministry of Public Works is in the process of establishing a unit for developing assessments and recommendations in this regard.

While the identification and costing of climate change related plans need to be supported by an appropriate public financial management (PFM) framework, including Climate Resilient Planning Guidelines (see Section VI), the impact of the COVID 19 pandemic, as well as the need to react to recent droughts and cyclones have distracted from investing into a broad and systematic approach towards effectively implementing climate change related policies.

6. Madagascar continues to develop and update its national framework for climate change. The process for updating key elements of its national framework for climate change including the National Policy for Fighting Climate Change and the NDC, started in 2021 and is expected to be concluded in the first half of 2022. While draft documents could not be shared with the mission, the aim of the policies, which are developed through an intergovernmental and interregional consultation process, is to strengthen the link between national development and adaptation, to foster the implementation of mitigation measures, to integrate climate change at all levels of government, to promote research and development in the field of climate change and technology, and to support all these activities with sustainable financing.

Is the Climate Change Strategy Consistent with Broader National Development and Growth Goals (e.g., vs. SDGs)?

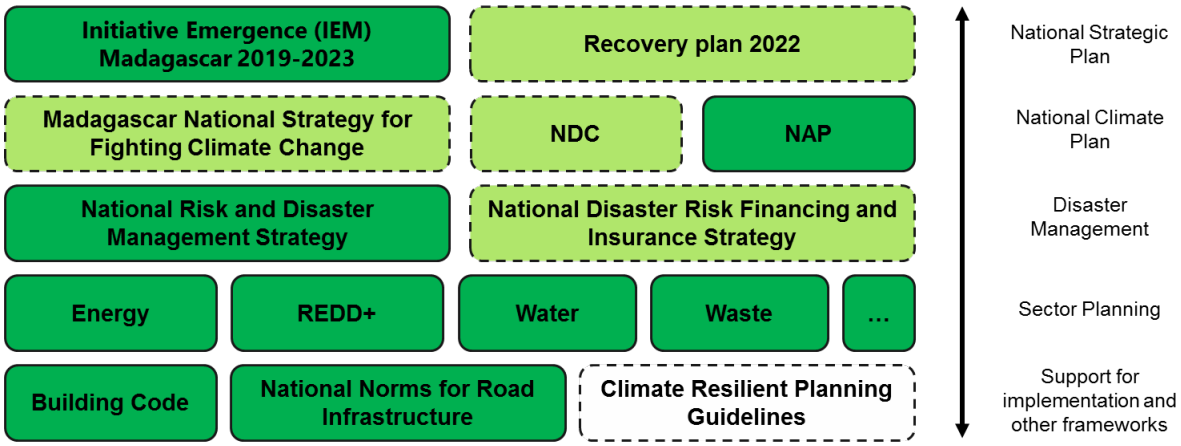
7. Key climate change related strategies, including the National Policy for Fighting Climate Change as well as NDC, link climate change related measures to the country's development objectives. All climate change related strategies, including those at the sectoral level, aim explicitly at taking the country's development needs into account while addressing climate change. However, the link between climate change related measures and development are mainly developed at the general level.

8. Madagascar addresses the concrete impact of natural hazards through a National Risk and Disaster Management Strategy and a two-tiered institutional framework for disaster risk management. The National Risk and Disaster Management Strategy (2016) provides for all steps in disaster management including reduction of risks, communication, and planning and skills training at provincial, local and community level. At the national level, the disaster risk management efforts are driven by the emergency prevention and management unit (CPGU) and the national disaster and risk management office (BNGRC) at the strategic and operational levels, respectively. The disaster management framework is expected to be complemented by a National Disaster Risk Financing and Insurance Strategy, which is currently under preparation (see Section IV).

Is the Long-Term Decarbonization Plan Consistent with Achieving the Target of 'Net-Zero' by Midcentury?

9. Madagascar considers itself a carbon sink and intends to remain a negative net contributor to carbon emissions. The uncertainty about the assessment of the country's current net contributions poses a challenge to the evaluation of future net emissions in absolute terms. Madagascar, as declared in the 2016 NDCs, relies on the promotion of renewable energies and reforestation, which are supported by the New Energy Policy 2015-2030 and the National REDD+ Strategy. Both sectors do however face significant challenges given the pressure coming from increasing energy needs as the country progresses towards its development goals and the management of LULUCF, as also discussed in Section III.

Figure 2. Key Elements of Madagascar's Strategic Planning Framework



Note: Green indicates existing framework documents, light green - documents that are being developed or updated, and white - missing elements.
Source: IMF staff.

MITIGATION PLANS

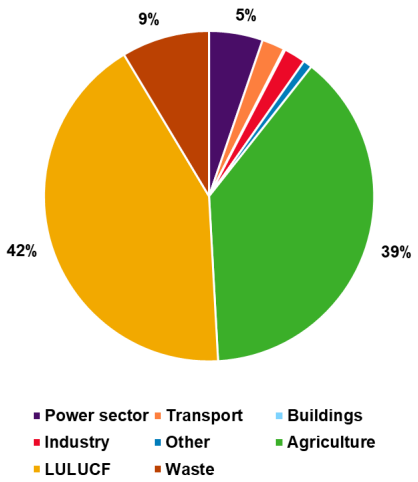
Madagascar's mitigation plans focus on expanding renewable electricity generation; promoting reforestation; enhancing urban waste management, and accelerating adoption of efficient cookstoves. Selected tax reforms in energy products combined with an increase in electricity tariffs and eliminating the fuel subsidy can help meet the country's mitigation objectives. The net revenue gains from these measures could be used, for example, to strengthen the social safety net and abate the adverse impact of higher energy prices on vulnerable households. Sector-specific fiscal policies such as feebates can be used to encourage the take up of energy-efficient capital goods such as cars and cookstoves which could help achieve the country's land-use change and forestry goals.

Meeting Emission Reduction Targets

How Does the Country Intend to Meet its Emission Reduction Targets? Is the Long-Term Decarbonization Plan Consistent with Achieving the Target of 'Net-Zero' by Midcentury?

10. Madagascar's mitigation commitments cover the energy, waste, agriculture and LULUCF sectors (Table 3). These commitments are aligned with its overall GHG emissions, whereby emissions from the agriculture and LULUCF sectors dominate (Figure 3). Madagascar's net GHG emissions in 2020 reached 49 mt CO2e (0.1 percent of global GHG emissions) or 0.13 metric tons per capita, well below other Sub-Saharan African Countries (excluding high income) at 0.76 metric tons per capita. While emission levels are currently low, Madagascar recognizes the importance of progress on mitigation commitments, especially with growing energy needs and accelerating forest degradation.[5] Achieving the NDC could benefit the domestic economy (e.g., reduced reliance on imported fuel, improved health outcomes from adoption of cleaner, energy efficient cookstoves), provide international credibility, and potentially leverage external financing.[6]

Figure 3. Historical GHG Emissions by Source, 2020



Source: IMF staff using CPAT. See Annex V for details on the CPAT.

11. Rapid deforestation and land degradation are substantial downside risks to Madagascar's mitigation goals. In its 2016 NDC, Madagascar has reported that it absorbs more emissions than it produces each year, primarily due to high forest cover and relatively low emissions, and it intends to remain a carbon sink in the future. In fact, in 2015 Madagascar's Paris mitigation pledge was to reduce GHG emissions sources (14%) compared to business as usual (BAU) by 2030 and increase GHG absorption of sink (32%) by 2030, remaining a net absorber of emissions. However, external datasets that include international estimates of LULUCF emissions suggest that Madagascar is a net emissions source country.7 Additionally, Madagascar faces

[5] Madagascar had 16.4Mha of tree cover in 2010, extending over 28 percent of its land area. By 2020, it lost 241,000 ha of tree cover, equivalent to 125 mt CO_2 emissions (Global Forest Watch). The coverage of natural forests in Madagascar had fallen from 9.4Mha in 2005 to 9.2Mha in 2010, a reduction of almost 40,000 ha per year (Madagascar Energy Policy Letter 2015 – 2030).

[6] Madagascar estimates the mitigation costs to be around USD 6.37 billion between 2015-30, with the government aiming to contribute about 4 percent of the indicated costs.

[7] See, for example, the IMF's Climate Indicators Dashboard – https://climatedata.imf.org/pages/country-data Accounting for GHGs from the LULUCF sector varies considerably around the world, due to differences in treatment of sources and sinks of emissions on managed lands. For example, some methodologies include photosynthesis of plants on managed lands to be a sink whereas other do not. This leads to very large differences at the national and global levels.

serious challenges with the management of forestry resources, including from small-scale agriculture (tavy/slash-and-burn), energy production (firewood and charcoal), illicit logging, mining, and livestock practices. Unsustainable harvesting of forest resources is exacerbated by weak governance, population growth, widespread poverty, uncertain land tenure, and economic instability (See Box 2 for a discussion on governance).

Table 3. Madagascar: Mitigation Objectives, Proposed Actions and Estimated Costs

Sector	Mitigation Objective	Proposed Action
Energy	Reduce emissions by 13 percent in 2030 compared to BAU	• Increase renewable energy share from 35 percent to 79 percent • Dissemination of improved stoves, with 50 percent of households adopting improved stoves in 2030 • Improving energy efficiency
Waste	Reduce emissions by 85 percent in 2030 compared to BAU	• Composting for 50 percent of household organic waste in large cities
Agriculture	Reduce emissions by 10 percent in 2030 compared to BAU	• Dissemination of improved rice cultivation systems • Promotion of arboriculture (5000 ha annually)
LULUCF	Increase absorption by 32 percent in 2030 compared to BAU	• Increase the surface areas under forest cover with a program of reforestation in indigenous species by 270,000 ha.[8] • Integration of the REDD+ mechanism • Reduction of wood removal from forests

Source: 2016 NDC of the Republic of Madagascar

What are the Country's Plans to Decarbonize the Energy Sector?

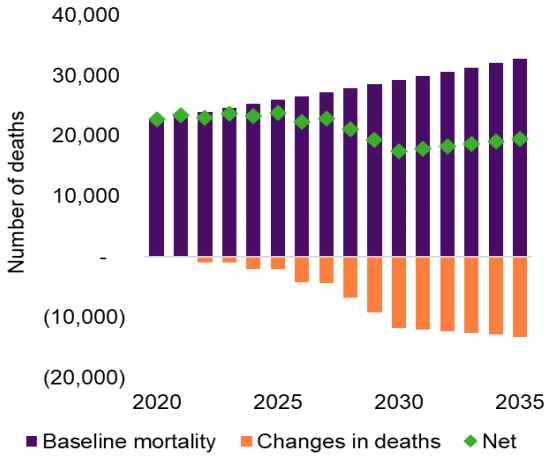
12. Madagascar imports all its refined petroleum products. In 2018, petroleum products were used to meet 12 percent of energy needs (IRENA 2020). The total petroleum-product imports account for more than 20 percent of the value of total imports, with diesel accounting for more than half the imports followed by gasoline, heavy fuel oil, and lamp oil. The transportation sector is the largest user of diesel, the combined households and industries sector is the largest user of gasoline, and households are the primary consumers of lamp oil. The public

[8] The most productive forest areas (i.e. the humid tropics) can sequester up to 11 tonnes of CO2 per hectare per year in aboveground biomass and around 3 to 4 tonnes in the subsoil. Retrospective estimates indicate that reforestation of 270,000 ha can absorb up to 4 mt of CO2e emissions per year, or about 8 percent of Madagascar's total emissions in 2020.

utility company, JIRAMA, consumes around 75 percent of imported heavy fuel oil and some of the diesel for power generation (IMF 2014).

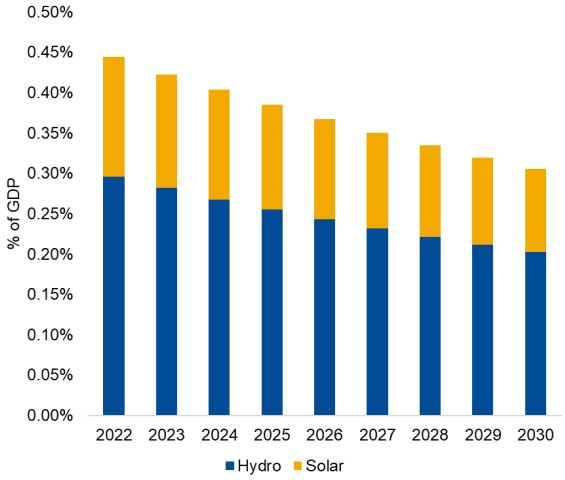
13. Madagascar's dependence on firewood and charcoal has adverse impacts on the health and productivity of its population, and longer-term implications for climate. Over 80 percent of the total primary energy supply is based on biomass, of which 85 percent is from firewood and the rest from charcoal and other biomass products. Biomass continues to be the main source of energy used by households, particularly for cooking. Apart from being a major source of indoor air pollution, firewood and charcoal are also contributing to the island's deforestation as the trees are harvested without following sustainable management practices. To reduce the dependence on biomass, the government aims to ensure that half of households adopt cleaner cookstoves by 2030. Achieving this goal would have substantial welfare co-benefits, saving about 12,000 lives annually by 2030 (Figure 4).

Figure 4. Total Air Pollution Mortality and Changes in Deaths (OAP, HAP, O3) in Madagascar



Source: IMF and WB Staff using CPAT

Figure 5. Annual Investment Needed (in percent GDP) to Reach 80 percent Renewables by 2030



Source: IMF and WB Staff using CPAT.

14. Madagascar is facing mounting pressures from expanding electricity access. As of 2018, only a quarter of the population had access to grid electricity, with large disparities between rural and urban areas. About two-fifths of generation is from renewable energy (RE), primarily hydro, and the rest through thermal. As electricity coverage expands, there has been a steady increase in import of petroleum products and expensive power purchase agreements with independent power producers to meet the power generation needs.9 The increase in generation costs is resulting in significant losses for JIRAMA, which has been heavily subsidized by the government in recent years.10 The government aims to increase electricity access to 70 percent

[9] JIRAMA's oil bill reached US$150 million in 2014, an increase of more than 100 percent from 2009 (Ministry of Water, Energy and Hydrocarbons, 2018).
[10] Primarily due to the increased dependence on expensive thermal energy, the quasi-fiscal deficit has increased from 0.66 percent of GDP in 2010 to 2.12 percent of GDP in 2017 (World Bank, 2019).

by 2030, primarily by expanding its share of hydro and solar energy in power generation (Madagascar New Energy Policy 2015-2030). This is estimated to require investments of around 0.4 percent of GDP on average annually over the next decade (Figure 5).

Box 2. Addressing Governance Challenges in LULUCF in Madagascar

Madagascar is rich in biodiversity with significant natural resources. However, it faces significant challenges with the development and management of these resources. The illegal and unsustainable exploitation of its natural resources, particularly its forests, presents a serious threat for Madagascar's mitigation goals. Madagascar would need to fundamentally strengthen its governance and meaningfully tackle corruption to achieve its mitigation goals in the LULUCF sector. Below are some examples of policies adopted by countries around the world to improve their governance of forestry sectors, though the effectiveness of these measures remains unclear:

- **Forest Law Enforcement, Governance and Trade (FLEGT):** Under FLEGT, legally-binding trade agreements between exporter and importer countries called Voluntary Partnership Agreements (VPAs) are established to reduce levels of illegal logging and improve forest governance. As a first step, the exporting country must define and approve a legality standard, using an inclusive process that has buy-in from the private sector, local NGOs and other stakeholders. Once a standard is agreed, a national Timber Legality Assurance System (TLAS) is set up that ensures that only timber certified as legal will get a FLEGT license. Seven VPAs have been ratified so far – in Cameroon, the Central African Republic, Ghana, Liberia, the Republic of Congo, Indonesia and Vietnam – and six more are being negotiated.
- **Freedom of Information (FOI) laws:** Laws that protect citizens' rights to access information and promote transparency are key for sustainable forest management. In a recent WRI study of the 14 heavily forested countries surveyed, eight have FOI laws: Brazil, Canada, Colombia, Indonesia, Liberia, Mexico, Russia and Peru. Countries with FOI laws tend to disclose concession data more proactively than countries without them and such laws are effective in getting access to forest information. In contrast, Madagascar, Myanmar, Cambodia and Malaysia lack FOI laws and provide no data proactively (Webb et al., 2017).
- **Feedback and grievance redress mechanisms (FGRM):** Setting up a robust oversight mechanism and consultation processes is essential to guarantee the success of REDD+ programs (Williams and De Koning, 2016). A FGRM is a set of arrangements that provides a formal and informal means of receiving, assessing, and resolving complaints or disputes, of groups and individuals, whose rights may be affected through the implementation of REDD+ activities. Uganda, Nigeria, Ethiopia, Indonesia and Fiji are some examples of countries that have developed or implemented FGRM in recent years.

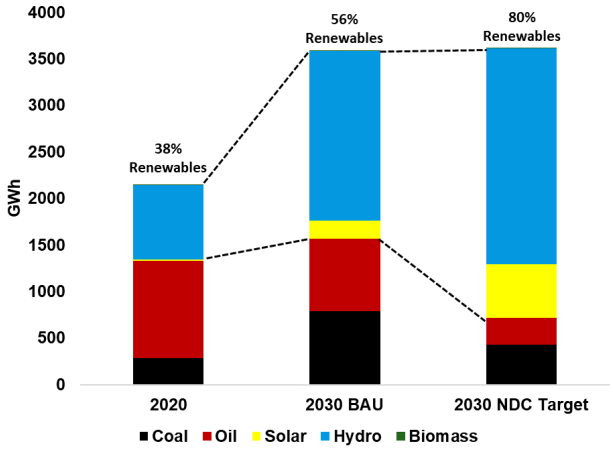
Does the Country have Policies and Regulations to Decarbonize the Power, Industry, Transport, Buildings, and Agriculture Sectors?

15. Madagascar's sectoral plans elaborate on mitigation policies in energy, agriculture, forestry, and waste sector. The New Energy Policy 2015-2030 involves programs to improve energy efficiency, increase the share of renewable energy and reduce dependence on biomass as the primary energy source to protect the forests. The National Climate Change Strategy for the waste sector primarily focuses on strengthening the institutional capacity for waste management. Madagascar is signed up with the World Bank's Forest Carbon Partnership Facility (FCPF) to reduce carbon emissions from deforestation and forest degradation between 2020 and 2024. Under the US$50 million Emission Reductions Payment Agreement (ERPA) in line with its

National REDD+ strategy, Madagascar is expected to reduce 10 million tons CO2 emissions through improved and sustainable agriculture, as well as energy supply (mainly wood charcoal).

16. Madagascar is tapping into its significant renewable energy resources to meet its growing electricity needs. The government aims to increase the share of RE generation from around 38 percent in 2020 to about 80 percent by 2030 (Figure 6). Achieving this target would reduce Madagascar's energy emissions by around 18 percent relative to the baseline in 2030.[11] More than 240 MW of hydropower installations are in the pipeline over the next 4 years. However, to meet the NDC target of 80 percent RE by 2030, around 900 MW of new hydropower capacity will be required – amounting to a gap of 660 MW based on the current pipeline. To foster expansion of RE, the government is seeking to actively crowd-in private sector investment. Its strategy includes power purchase agreements and tax concessions for investments in RE power generation capacity. This includes an exemption from customs duties and VAT on imported equipment for RE as well as tax reduction of 50 percent of the investment made by private companies investing in RE.[12]

Figure 6. BAU vs. NDC Electricity Generation Sources, 2030



Source: CPAT, IMF Staff estimates

17. However, the current investment tax credit (ITC) for RE is extremely generous as it allows full depreciation on top of the tax credit, almost inevitably meaning the effective marginal tax rate is negative and could turn out to be costly in terms of foregone revenue. The government could consider reducing the base for depreciation by the amount of the ITC, lowering the ITC rate well below its current rate of 50 percent, or replacing the ITC with an investment allowance, while ensuring that the base for depreciation is the amount net of the allowance. More importantly, these tax policy concessions would have to be complemented with critical structural reforms that improve the quality of infrastructure, human capital and governance to yield the anticipated boost in green energy investments. The government is also implementing a Decentralized Rural Electrification Program to expand electricity access in rural areas. Off-grid solar kits are increasingly prevalent in rural areas, but official statistics are

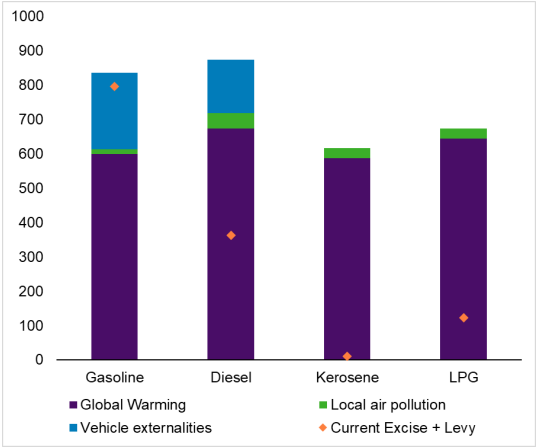
[11] The baseline refers to the BAU scenario in the CPAT which estimates energy emissions of about 5 mt CO2e for the energy sector in 2030. This is significantly lower than the projected BAU emissions in the 2015 NDC of 13 mt CO2e by 2030. The energy emissions component the 2015 NDC is therefore non-binding under these assumptions.

[12] The 50 percent investment tax credit for RE is currently bundled in the tax code with the same tax credit (Article 01.01.14C in the tax code) for investments in various other industries, such as tourism, industrial sector, and public works.

unavailable.[13] The government is studying the possibility of tax exemptions (VAT and customs duties) on these solar kits.[14]

18. Replacing biomass consumption would help Madagascar meet its NDC commitments while bringing welfare benefits (Figure 7). Firewood and charcoal stoves are less energy efficient than modern fuel stoves such as those powered by kerosene and LPG. Increasing the use of efficient cookstoves would lower the energy needs and reduce the rapid degradation of Madagascar's forest cover.[15] In addition, the positive externalities from reduced pollution can yield significant economic benefits that outweigh the increased costs to households of fuels and stoves (World Bank, 2011). The government is currently offering excise duty and VAT exemption on combustible ethanol to encourage transition to efficient cookstoves. In addition, the government has a reduced VAT of 5 percent on butane gas for households from 2020. VAT exemptions/ reductions create inefficiencies and tax revenue losses by breaking the VAT chain and are not cost-effective for helping poor and low-income families. Instead, the government could consider direct subsidies to address the cost barriers for low-income households, both on the upfront cost of purchasing the stove itself and the recurring fuel costs. Finally, developing the domestic production capacity of stoves and the fuel could help improve accessibility and affordability.

Figure 7. Current vs. Efficient Fuel Excises



Source: Parry and others (2021); Ministry of Finance. These estimates are based on global fuel price assumptions as of September 2021.

Carbon Taxation and Fuel Subsidy Policies

19. Madagascar's tax system delivers appropriate carbon pricing for road fuels. The prices for petroleum, diesel, and lamp oil are regulated. All fuels are subject to a petroleum tax (TPP) collected by the customs administration, ranging from MGA 503 per liter for gasoline to MGA 228 per liter for diesel to MGA 10 per liter for lamp oil. Gasoline and diesel are also subject to VAT at 20 percent, but lamp oil has VAT exemption. Other charges, including for the Road

[13] In the FinScope Madagascar 2016 Survey, oil (or paraffin) lamps accounted for 64 percent of lighting, while 8 percent used solar panels in rural areas.
[14] VAT exemptions are generally inefficient and ineffective in reaching the poorest households. The government could instead consider targeted direct subsidies to promote off-grid electrification in rural areas.
[15] World Bank (2011) finds that fully replacing firewood and charcoal in cooking with ethanol would result in avoided degradation of roughly 1.4Mha of unmanaged forests, equivalent to approximately 10% of Madagascar's forest area and reduce emissions by around 663 million tons of CO2e over a 30- year period.

Maintenance Fund and Environmental Fund, are also applied to retail consumption of gasoline and diesel at MGA 288 and MGA 134 per liter, respectively.

20. Fuel prices are below their socially optimal levels in Madagascar for diesel, kerosene, and LPG, but not for gasoline. In economic terms, socially optimal prices are where retail prices reflect the full costs to supply that fuel plus any negative externalities. The sum of the supply costs (which vary depending on international energy prices) and 'Pigouvian' taxes on externalities equal the efficient price.[16] As of 2021, the level of excise and levy taxation on gasoline in Madagascar raised prices to around its efficient level, of which US 15 cents/liter is to reflect the cost of GHG emissions priced at USD 64/tCO2e (Figure 7). In contrast, taxation of diesel, kerosene, and LPG was below the efficient level. However, for kerosene and LPG it should be noted that these estimates exclude the positive externalities of shifting people away from fuelwood, so the gap may be less than implied by Figure 7. With the recent surge in global fuel prices and the incomplete pass-through to consumers, the gap is likely to be higher now on all fuels.

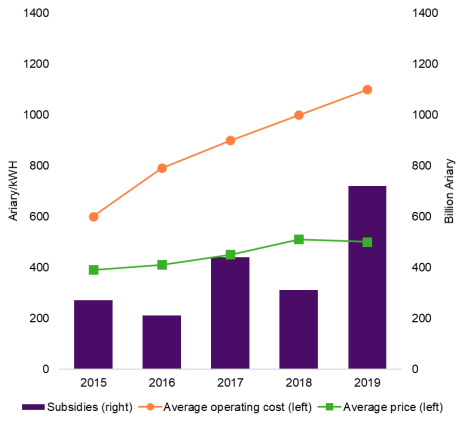
21. Critically, the current pricing mechanism prevents fuel prices from reflecting the full social costs of supply. Pump prices for petroleum products are not adjusted to keep pace with rising international prices, resulting in distortionary price signals and a growing liability of the government due to delays in fulfilling its obligations vis-à-vis fuel distributors in recent months. The government has prepared a roadmap to implement an automatic fuel pricing mechanism by 2024Q1 to eliminate the fiscal risks from fuel price controls. Implementing this reform would complement the government's mitigation ambitions by ensuring that the pump prices are fully-cost reflective and efficient.

22. Passenger motor vehicles are subject to an excise tax and VAT depending on the condition of the vehicle. New vehicles are subject to 5 percent excise tax based on the CIF value and 20 percent VAT declared at the customs administration. Used vehicles are subject to 10 percent excise tax based on the CIF value and an additional 20 percent VAT. This system could be reformed to reflect the emissions intensity and ages of the vehicles. For example, as diesel tends to be more polluting than petrol, the government could consider imposing a higher excise tax on diesel vehicles relative to petrol vehicles. Similarly, older and larger vehicles tend to have much higher social costs (through local air pollution as well as danger to other drivers from increased road fatality and injury risks). This could include a rebate component towards more efficient vehicles (feebate – see below).

[16] For details, refer to Parry and others (2021).

23. Electricity tariffs have not matched cost-recovery prices in recent years. The average cost of electricity has nearly doubled between 2015 and 2019, driven by rising dependence on expensive thermal energy and operational inefficiencies. However, the average tariffs have remained stagnant, resulting in large transfers from the government to bridge the gap (Figure 8). World Bank estimates indicate that without any tariff increases, JIRAMA would continue to incur losses and would require government transfers, even after accounting for significant efficiency improvements. An additional source of pricing inefficiency is the VAT exemption for the consumption of first 100 kWh per month for all consumers. The government retains a social tariff for vulnerable households so eliminating this distortionary VAT exemption and underpricing of average tariffs would not have adverse distributional implications, particularly as poor households generally have limited access to grid electricity in Madagascar.

Figure 8. Underpricing of Electricity Tariffs



Source: JIRAMA.

What Other Carbon Pricing Strategies - Including Feebates and Other Regulations - Can Usefully Contribute to Mitigation?

24. Revenue-neutral feebates ('bonus-malus' scheme) could encourage the take up of fuel-efficient cars. Currently, the government has no incentives to accelerate improvement in fuel economy of the fleet.[17] A feebate involves levying a tax on relatively less fuel-efficient vehicles in proportion to the difference between their fuel consumption rate (or CO2 emission rate per kilometer) and the historical average fuel consumption rate, and conversely providing a subsidy to relatively more fuel-efficient vehicles in proportion to the difference between the average and their fuel consumption rate. For example, with an emissions-rate based carbon price of US$3 per g/CO2e and a pivot point (point of no tax charged) set at the level of Europe's efficiency standards (95g-CO2e/km), this would lead to: a tax of US$2,625 on a vehicle emitting 200g-CO2e/km, a subsidy of around US$1,125 for a very efficient vehicle (50g-CO2e/km), and no tax or subsidy on a car that meets Europe's efficiency standards (95g-CO2e/km). Administrative costs of implementing feebates should be modest as it builds off the existing excise tax (e.g., the subsidy can be deducted from the excise duty) and data on fuel economy of imported used and new vehicles is readily available.

[17] There are other, more substantive, obstacles to the uptake of EVs at the present time, notably the lack of reliable electricity access and, at present, the high cost of EVs.

25. Similarly, feebates on appliances can encourage the adoption of energy-efficient appliances in households, agriculture, and in biomass production. Feebates would reduce the cost of more efficient appliances while penalizing relatively inefficient appliances. At the household-level, feebates could be applied to cookstoves, light bulbs, and other electrical appliances. Similarly, charcoal makers could be encouraged to adopt high-efficiency carbonizer machines to reduce the pace of deforestation, and farmers could be incentivized to take-up improved rice-cultivation systems. The feebates could be complemented with energy efficiency labelling and minimum energy performance standards to foster the adoption of energy-efficient appliances.

26. Madagascar could also use feebates to promote forest carbon storage. A feebate would involve a system of fees and rebates applied to individual landowners according to the tons of stored carbon on the property relative to the baseline level of carbon storage attributed to that landowner during a given year. This program would be similar in spirit to the Payments for Environmental Services (PES) program pioneered in Costa Rica.[18] Under the feebate system, landowners would pay fees, or receive rebates, in a future year depending on whether stored carbon is lower or higher than the baseline level. The carbon storage price in the feebate can be ramped up over time in line with emissions objectives for the forestry sector. The key economic attractions of feebates are its cost effectiveness, scalability, elimination of carbon leakage risks, complementarity with other mitigation efforts and generation of environmental co-benefits (see Box 3 for a discussion of key design issues).[19]

Box 3. A Potential Forest Carbon Storage Feebate in Madagascar

A feebate for forest carbon would involve a system of fees and rebates to landowners according to:

$$\tau_t^{CS} \cdot \left(CS_t^i - CS_{t,BASE}^i\right) = Y_t$$

where CS_t^i is tons of stored carbon on the property for an individual landowner i at time t; $CS_{t,BASE}^i$ is a baseline level of carbon storage attributed to that landowner at time t; τ_t^{CS} is a payment per ton of stored carbon; and Y_t is the landowners' total payment at time t (or subsidy if Y_t <0). Landowners therefore pay fees, or receive rebates, in a future year depending on whether stored carbon is lower or higher than the baseline level. Key design issues include:

- **Baselines** – baseline carbon storage in different land parcels could be based on REDD+ inventories. Fees/rebates could either be administered on an annual basis (to coincide with the collection of other taxes) or every two years (to coincide with the prospective updating of REDD+ inventories). The area of coverage could be restricted to land at the agricultural/forestry border where deforestation is usually the most prevalent. It would be critical to ensure property rights are well defined in the areas, as currently, only 25 percent of total land surface of Madagascar (mostly urban areas) is registered.

[18] PES was implemented by Costa Rica in 1997 to combat the rapid deforestation and loss of forest cover. PES mirrors only the rebate side of the feebate and payments are related not only to carbon storage but also other environmental impacts. Approximately 11 percent of Costa Rica's national territory is protected by the plan which pays out roughly US$15 million a year to around 8,000 property owners. Forest coverage in Costa Rica has increased dramatically from well below 30 percent of total land area in the early 1980s to over 50 percent (World Bank, 2018).

[19] Other environmental co-benefits include reduced risks of (i) water loss, (ii) flood risk, (iii) soil erosion, and (iv) river siltation. They also promote greater preservation of (i) biodiversity, (ii) local cultures and traditions.

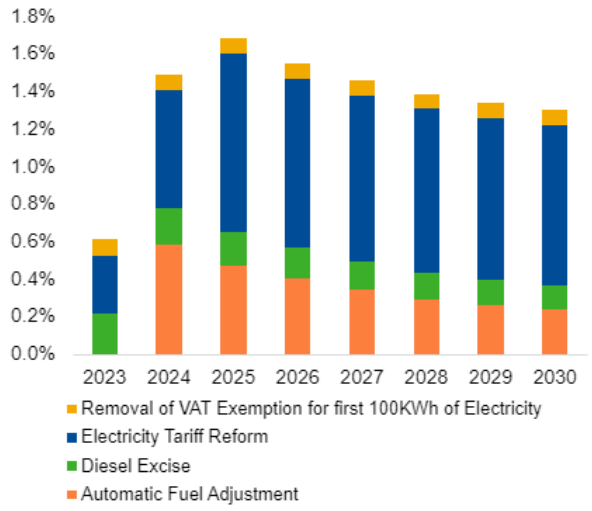
Box 3. A Potential Forest Carbon Storage Feebate in Madagascar (concluded)

- **Payment formulas** – feebates should involve annual tax/subsidy, or 'rental', payments, rather than large upfront payments, given that changes in carbon storage may not be permanent. The problem with one-off, upfront payments is that changes in land use may not be permanent (e.g., due to fires or pests), requiring complex, ex-post re-payment procedures to provide adequate incentives to maintain the land-use change. Annual payments should equal the carbon price times the interest rate.
- **Setting the CO2 price** – should be aligned with emissions objectives for forestry in Madagascar's NDC. Given evidence on the price responsiveness of forestry emissions is lacking, a period of trying an initial price trajectory and adjusting based on the observed future response may be needed in the early years of a feebate program. Generally, phasing in prices gradually according to a pre-announced schedule is recommended to promote certainty and minimize disruption costs
- **Exemptions** – Timber harvested for wood products (e.g., furniture, houses) could be exempt as the carbon emissions (released at the end of the product life) will be delayed by several decades.

What would the Tax System look like with Recommended Carbon Pricing?

27. Madagascar could support its mitigation efforts by normalizing excise taxes on gasoline and diesel, eliminating fuel price controls and VAT exemptions for electricity, and gradually increasing electricity tariffs to reflect costs. A sample policy package could entail raising the diesel excise by 275 MGA/liter and the road maintenance levy by 154 MGA/liter; eliminating the VAT exemption for the first 100 kWh of monthly household electricity use by 2023; and adopting an automatic fuel pricing mechanism by 2024 to erase any gap between true market prices and pump prices for gasoline and diesel. In line with JIRAMA's recovery plan, average electricity tariffs could increase by 15 percent annually, raising the average tariff from $0.15 per kWh to $0.22 per kWh by 2025, with a social tariff retained for the vulnerable households.[20] These measures would raise up to 1.7 percent of GDP in revenue by 2025 (Figure 9), which can be used, for example, to support vulnerable households (see next subsection) while contributing to energy CO2 reductions of up to 5 percent relative to baseline in 2030.

Figure 9. Fiscal Benefits from Policy Measures



Source: IMF staff using CPAT.
Note: Fiscal benefits including savings from the elimination of energy subsidies and additional revenue for the tax reforms.

[20] The estimated impact of these fiscal policies is modelled under the BAU scenario. Assuming the NDC target on RE share is met would lower the tariff increases needed to achieve cost recovery.

Distributional Impact of Recommended Mitigation Strategies

What would be the Distributional Impact of the Recommended Changes in Mitigation Policies? How can changes in Taxes, Expenditures, and Complementary Policies Help the Policy Reform Contribute to Equity Objectives?

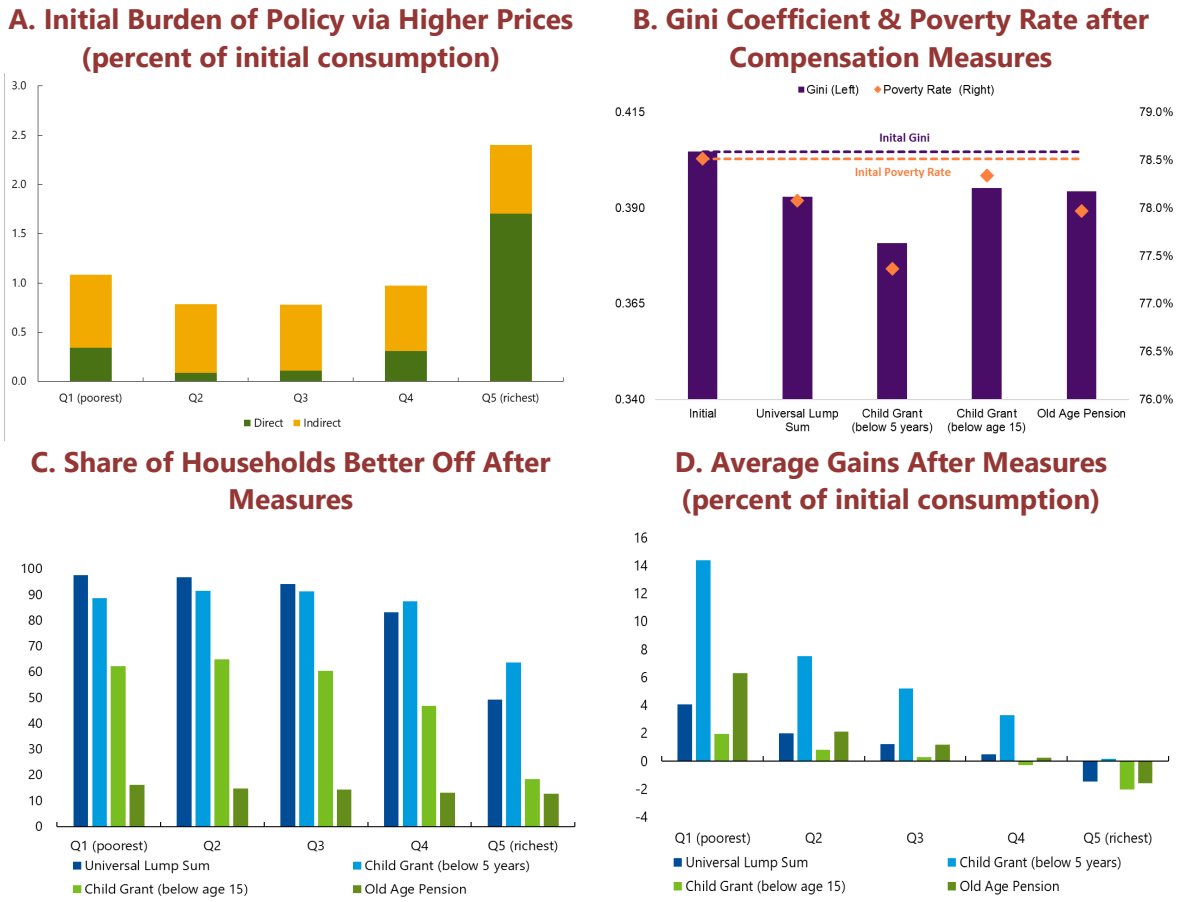
28. Price increases would have a small negative impact on low-income households which could be more than offset by using revenues for targeted compensation and development spending.[21] Normalizing excise taxes on gasoline and diesel, moving to an automatic fuel pricing mechanism, and gradually raising electricity tariffs would increase prices by 10, 44 and 36 percent, respectively. The direct burden from higher energy prices amounting to 1.6 percent of household consumption would be borne mostly by the richest households (Figure 5, Panel A). In contrast, the bottom four quintiles would be relatively more burdened by the indirect cost increases, primarily from higher transportation costs that increase food prices. Overall, the poorest quintile would experience a loss of 1.1 percent of consumption versus 2.4 percent for the richest quintile as the latter consumes much more diesel, gasoline, and electricity. To mitigate the relatively small but non-trivial welfare losses for poor households from the higher prices they face, the government can recycle some of the resulting budgetary savings from the energy price reforms to compensate the economically vulnerable. In fact, only 10 percent of the 1.7 percent of GDP in raised revenues would be needed to fully compensate the bottom 4 quintiles for their welfare loss in 2025. The remaining 1.5 percent of GDP could be used for achieving other development goals, including improving access to electricity, strengthening social spending, and investing in resilience-building.

29. Part of the revenues raised or saved from the proposed reforms could also be used to expand the nascent social safety net in Madagascar.[22] Figure 10, Panel B shows how different compensation measures of redistributing revenue raised from carbon pricing would impact the poverty rates and the country's Gini coefficient (an indicator of inequality). For instance, redistributing revenue from the proposed mitigation policies excluding the potential budgetary savings from automatic fuel adjustment (about 1.2 percent of GDP)[23], by providing a universal lump sum transfer, expanding the current Human Development Cash Transfer (HDCT) program to a universal grant for each child below the age of 5, a grant for each child below the age of 15, or providing a non-contributory old-age pension would all reduce inequality and

[21] See Annex VI for examples of how countries have compensated the poor for the higher energy prices following energy subsidy reforms.
[22] The National Social Protection Strategy 2019-2023 is committed to expanding coverage in the country to reach half a million poor families, with an immediate priority of extending the conditional cash transfer programmes by tripling beneficiaries by 2023. Madagascar has two major conditional cash transfer programs with limited geographical coverage: the Human Development Cash Transfer (HDCT) program for children attending primary school and the Productive Safety Net Program (PSNP) which provides cash-for-work activities.
[23] We exclude revenues 'gained' from the automatic fuel adjustment as the potential savings for the government might not materialize if the government fails to compensate oil distributors for the price gap between true market prices and pump prices and instead builds arrears in the first place.

poverty. Providing a grant per child below age 5 does the most to reduce inequality and poverty decreasing the Gini from an initial .405 to .381 and poverty rate by 1 percent.[24]

Figure 10. Impacts on Households from Reforms, Before and After Revenue Recycling



Source: IMF Staff calculations using CPAT and based on EPM (2010). Notes: Quintiles defined by household expenditure per capita, excluding rental expenditures in panels A, C, and D. Gini coefficient of household expenditure per capita shown in panel B. Mitigation package includes normalizing the excise on diesel, adopting an automatic fuel pricing mechanism, eliminating the VAT exemption, and increasing the average electricity tariffs. Panels B, C, and D simulate alternative compensation measures using all the resources raised by the mitigation package.

30. Lastly, several alternative compensation schemes can make most of the poorest households better off (Figure 10, Panel C), at a small cost for the richest households (Figure 10, Panel D). For instance, a universal lump sum transfer or a grant for each child below age 5 benefits most households across income quintiles, while a grant for each child below the age of 15 benefits households in the bottom three quintiles. The top quintile would experience a maximum loss of around 2 percent of pre-tax consumption if the grant for children below 15 were used and would experience no loss if the grant for children below 5 were used. Providing a

[24] Both World Bank and UNICEF have identified the HDCT program to be the easier, more efficient and effective social protection program to rollout and expand.

grant for each child below the age of 5 would also raise consumption significantly for the bottom two quintiles, by 14 and 8 percent for poorest and second poorest. These social programs could support Madagascar's mitigation goals by reducing the local population's reliance on forest resources for sustenance.[25] They also help enhance resilience to cyclones and other natural disasters, contributing to Madagascar's adaptation goals.

DISASTER RISK MANAGEMENT

Madagascar has made progress on several elements of a natural disaster risk management strategy, although some gaps remain. Integrating disaster risk assessments into the budget process would encourage adequate provisioning for fiscal risks. Madagascar has limited domestic buffers to retain disaster risks, and the social spending is among the lowest in the world. While the government has recently improved risk transfer through external contingent financing and sovereign insurance instruments, domestic insurance could be further developed to improve financial resilience.

Risk Assessment

Does the Government Provide a Comprehensive Assessment of Climate-Related Fiscal Risks?

31. Annual average fiscal costs of natural disasters are estimated to be about 1 percent of GDP. Catastrophe probabilistic models developed by external bodies such as the Southwest Indian Ocean Risk Assessment and Financing Initiative (SWIO RAFI) suggest that Madagascar faces annual average losses (AALs) of over $100mn or about 1 percent of GDP from tropical cyclone, floods, and earthquakes hazards.[26] In-house quantifiable assessments of disaster risks are not available.

32. Disaster risks are not systematically disclosed in budget documents. The government publishes an annual fiscal risk statement (FRS), as an annex to yearly budget laws (also see section VI). The 2020 FRS, for instance, referred to AALs from the SWIO RAFI model, and cited emergency and reconstruction expenses of 0.5 percent of budget expenditures on average during 2005-2018, mostly financed by external partners. While FRSs cover a number of contingent liabilities, such as guarantees and PPPs, natural disaster risks are not systematically

[25] In fact, Madagascar's Emissions Reduction Program Agreement (ERPA) seeks to intervene at this nexus of poverty and environmental degradation, explicitly targeting poverty reduction among forest-dependent communities.

[26] Average annual loss (AAL) measures the average expected direct disaster loss annualized over a long time frame. The SWIO RAFI model for Madagascar also estimates tail events, for instance citing a 10 percent probability that damages could exceed $230mn in any given year (WB 2016). The cited 1 percent of GDP in AALs from the SWIO RAFI simulations are significantly below recent historical events such as cyclones Chedza/Enawo/Ava with damages ranging between 1-4 percent of GDP.

discussed (only twice over the last four years). To better manage fiscal risks and encourage adequate provisioning, an analysis of disaster risks should be included in annual FRSs.

Risk Retention

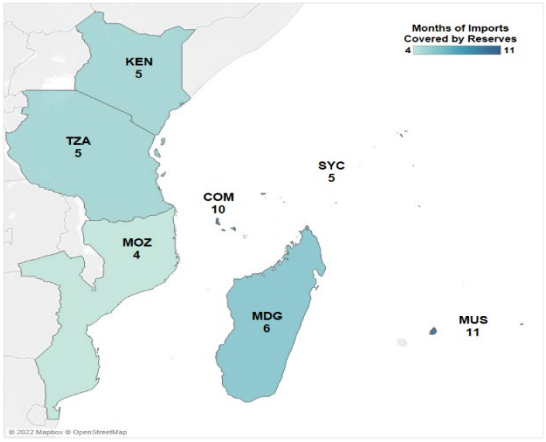
To What Extent Does the Government Self-Insure Against Risks?

33. Madagascar has fiscal mechanisms in place to respond to shocks including from natural disasters, but resources provided remain small in magnitude. Strengthening buffers, in line with best PFM practices, would help protect priority spending and maintain economic capacity in the immediate aftermath of disasters, until other medium-term financing sources are secured.

- **Budgetary contingency.** The Organic Budget Law provides for an annual budget line to self-insure against unforeseen expenses, including those from disasters, but this line is not activated in practice.
- **Advance decrees and budget re-allocations are discretionary.** In case of emergency, additional funds can be approved through advance decrees, up to 1 percent of the approved budget, without provoking a supplementary budget. Advance decrees have often been used in response to disasters, although constrained by the need to find offsetting revenue or expenditure measures (in practice, new funds often arrive from donors or insurance mechanisms). In addition, intra- and inter-ministerial re-allocations can be made, up to 10 percent of approved appropriations, after the government notifies the National Assembly including in a written report.
- **Imprest accounts have been often used for crisis response.** These allow by-passing normal budget procedures to make urgent minor operating payments (renewable imprests, up to 15mn MGA) or one-off larger payments (exceptional single imprests, up to amount of open credit lines) to line ministries when needed, subject to an ex-post audit. Several such "régies d'avance" were utilized in 2020 for instance to pay for emergency expenditures incurred by various ministries in response to tropical rainfalls and Covid.
- **Supplementary budgets can be approved.** Additional spending in amounts exceeding the above may be approved by the legislative assembly as supplementary budgets, as shown after the 2017 cyclone Enawo and the 2020-21 Covid episodes, although the process can take several months.
- **A national disaster fund (NDF) is soon to be operationalized**, with annual transfers from the budget (2bn MGA or around 0.003 percent of GDP) recently put in place. The NDF, an extra-budgetary fund, is to be managed by the BNGRC and the authorities intend to use it as a basket fund for external donors in response to disasters. A first best would have been to integrate the NDF into the budget. Strong PFM systems with clear accumulation and utilization rules, and publishing the NDF's operations along with official budget documents would help reduce fiscal risks and improve transparency.

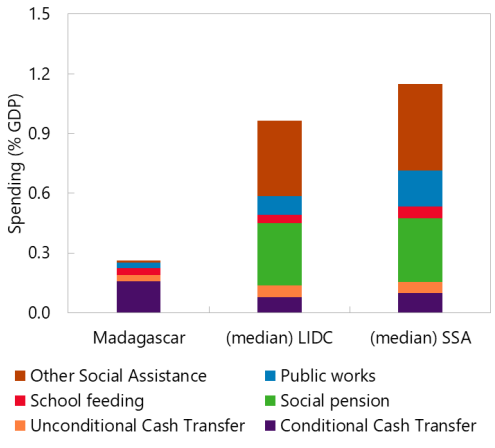
- **FX reserves are adequate.** As of end-2021, FX reserves reached $2.2bn or about 6 months of imports (Figure 11). These buffers could be used to respond to shocks including from disasters if needed.

Figure 11. Adequacy of FX Reserves
(in months of imports, 2021)



Source: Calculations based on IMF WEO.

Figure 12. Social Assistance Spending
(in percent of GDP, most recent available year)



Source: IMF FAD Social Protection & Labor - Assessment Tool (SPL-AT), based on WB ASPIRE.

34. Social protection systems, including in response to natural disasters, are nascent. Social spending is among the lowest in the world, at around 0.3 percent of GDP, much lower than peers (Figure 12). Traditional programs can increase resilience to shocks, including from natural disasters.

- **Traditional systems are small and fragmented.** In Madagascar, these include health insurance, pensions and cash transfers. There is no unemployment insurance. Health insurance, mostly private, covers around 15 percent of the population. Pension assets are less than 2 percent of GDP, and coverage is low, mainly due to high informality, with the public system covering only 3 percent of the workforce and the private system covering 10 percent. Cash transfers, the main form of social safety net, are channeled through two main programs (HDCT and PSNP)[27] supported by development partners[28], with current coverage of around 2.5 million and a target of 4 million beneficiaries (or 20 percent of the population under the poverty line).[29] Identification of beneficiaries was initially done via a combination of community-based pre-selection, geographic criteria and proxy-means-testing; whereas an integrated beneficiary registry became operational in 2020. Payments are small (at around

[27] These are (i) the Human Development Cash Transfer (HDCT), a cash transfer program implemented since 2014, conditional on education, health and nutrition criteria including in areas most vulnerable to climate risks; and (ii) the Productive Safety Net Program (PSNP), a cash-for-work program in vulnerable communities implemented since 2016. In addition, a new urban cash transfer pilot has been introduced in 2021 in response to Covid.
[28] The WB is supporting social safety nets through a $315mn project over 2015-2024. UNICEF provides a top-up for children transitioning to secondary school through the Let Us Learn program (LUL).
[29] The government's 2015 National Social Protection Policy targets 50 percent coverage of the extreme poor by 2030.

$100/household/year or about 20 percent of the consumption basket of the poor) and are increasingly made via mobile money services.

- **Some elements of a shock-responsive system are in place.** Existing safety nets can be scaled-up through both vertical (increasing benefits to existing beneficiaries) and horizontal expansions (adding beneficiaries), following the government's 2020 manual on shock-responsive systems. For instance, cash and in-kind transfers were scaled-up in response to the El Niño drought in 2016, to cyclone Enawo in 2017 and to cyclone Belna in 2019. However, expanding coverage and adequacy remains constrained by the availability of additional external financing and limited own-budget allocations. Expanding the beneficiary registry to a wider social registry that includes vulnerable non-beneficiaries would facilitate scaling-up and a flexible speedy response when needed. In this context, the envisaged centralized digital identification database, supported by an ongoing WB project,[30] would help verify beneficiary identities and reduce misappropriations of public funds.

Risk Transfer

To What Extent Does Madagascar Transfer Risk?

35. Madagascar is a member of the regional catastrophe insurance platform, the African Risk Capacity (ARC). ARC offers its African Union members quick-disbursing, parameter-based insurance cover against disaster hazards. Madagascar purchased drought insurance in 2019, with coverage up to $2.5mn and annual insurance premia of around $0.5mn/year mostly financed through the AfDB-funded Africa Disasters Risk Financing Programme (ADRiFi) through 2022, with the Government of Madagascar paying full premium in 2023 (AfDB 2019). Madagascar received a $2.1mn payout in July 2020 in response to extreme drought in the south. In 2020, Madagascar became the first member country to purchase ARC's tropical cyclone parametric insurance, with an annual premium of $2mn fully financed through ADRiFi for the 2021-22 cyclone season, and received a $10.7mn payout in March 2022 in response to TC Batsirai.[31]

36. Madagascar has recently strengthened ex-ante contingent financing. Ex-ante instruments are typically disbursed soon after qualifying natural disasters events. These include:

- **WB Cat-DDO**. Madagascar is one of the first African countries to use the WB's catastrophe drawdown option (Cat-DDO); a contingency credit line for immediate post-disaster relief triggered by the declaration of state of emergency). The country limit for IDA clients, such as Madagascar, is $250mn. The 2019 DPO is a joint operation by the WB for $50mn and the Agence Française de Développement (AFD) for €25mn, of which WB and AFD disbursed $15mn and €3mn, respectively, in response to the 2020 floods.

[30] This is a $140mn 2021-24 WB Digital Governance and Identification Management System Project (PRODIGY).
[31] Since 2014, 62 policies have been signed by ARC members, with $101.7mn in premiums for a cumulative insurance coverage of $720mn. ARC currently covers droughts and cyclones and envisages introducing a river flood product. See https://www.arc.int/risk-pools for details.

- **WB Immediate Response Mechanism (IRM) and Contingency Emergency Response Components (CERC).** IRM can mobilize up to 5 percent of undisbursed IDA projects to emergency response, subject to a declaration of emergency and preliminary damage assessment. Madagascar mobilized $13mn through the IRM after cyclone Enawo in 2017 to address food security and other emergency response. Similarly, CERCs allow ongoing undisbursed investment project financing (IPFs) to be re-allocated to emergency response activities, albeit with no ceiling. For instance, a $12mn CERC was activated in 2021 in response to the drought in Southern Madagascar (WB 2021). In response to Covid, several CERCs were activated for a total of $123mn to help finance the government's Multisectoral Emergency Plan (WB 2020). Currently, 13 out of 21 ongoing WB IPFs have CERCs embedded in them, with an undisbursed total amount of around $1bn.

37. There are also a number of ex-post instruments available to Madagascar from development partners. These can be larger in amount. However, as they are typically disbursed with a delay, they are better suited for the reconstruction phase. These include:

- **IMF emergency financing.** Madagascar received a Poverty Reduction and Growth Facility (PRGF) augmentation of $32mn after the 2000 cyclones (IMF 2000), and an Extended Credit Facility (ECF) augmentation of $42.4mn after the 2017 cyclone Enawo (IMF CR 17/223). Most recently, in response to Covid, Madagascar received $338mn (or 100 percent of quota) under two 2020 RCFs (IMF CR 20/268) and benefited from debt relief under several Catastrophe Containment and Relief Trust (CCRT) tranches for a total of $30mn over 2020-22 (IMF 2021). Madagascar can have increased access to RCF/RFI resources under the large natural disaster window in case of severe disaster shocks (IMF 2017).
- **WB CRWs** or the Crisis Response Window (CRW), provides IDA countries with financing against severe natural disasters, public health emergencies, and economic crises. Under the CRW, Madagascar accessed $20mn after the 2016 El Niño drought (CDP 2019) and $50mn in 2021 to address the food security crisis in Southern Madagascar (WB 2021). Discussions are ongoing for a $250mn CRW in response to the 2022 cyclones.
- **AfDB.** Madagascar received a total of about $30mn in emergency humanitarian aid following previous disasters, including several droughts and cyclones; the latest of which was an AfDB 2020 grant of $0.7mn in response to the combined impact of drought and Covid in the South.

To What Extent Does the Government Insure Public Assets?

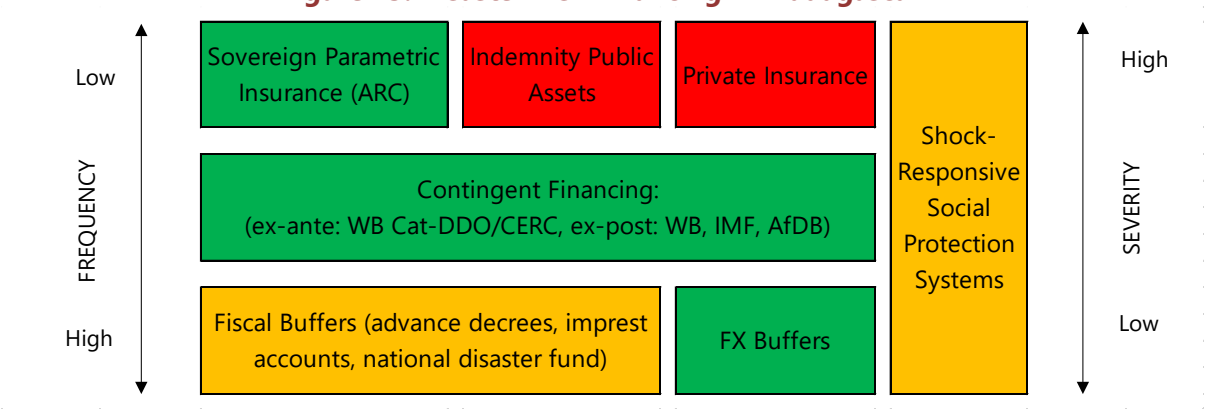
38. Public buildings and infrastructure assets are not insured. The insurance law does not mandate insurance for public infrastructure assets, and the government acts as its own insurer. Pending the finalization of implementation decrees, construction insurance is to become mandatory under the new insurance law (excluding the state) to cover damages caused by defective material or construction, but with no requirement to insure against disaster damages. Adhering to the building code and developing a centralized registry of public assets could

incentivize consolidating insurance coverage into larger policies, as well as facilitate maintenance and repair estimates and post-disaster damage assessments.

How to Improve Risk Layering in Madagascar?

39. Madagascar has strengthened its financial resilience to disasters, although some gaps remain. External contingent financing and insurance are typically only available after extreme events, while domestic resources are used in response to smaller events. Figure 13 assesses how Madagascar applies the World Bank's risk layering framework (WB 2014)[32] using different financing instruments for different layers of disaster risk according to their frequency and severity. Red areas in Figure 13 are instruments assessed to be absent/weak in Madagascar, yellow are partially available/utilized, and green are available/well utilized.

Figure 13. Disaster Risk Financing in Madagascar



Source: Staff assessment based on WB Risk Layering Framework (WB 2014).

40. Madagascar's disaster risk management could be strengthened by coordinating the various instruments in place through a National Disaster Risk Financing and Insurance (DRFI) Strategy. While Madagascar has a proactive approach to DRFI, these are mostly developed in isolation. Finalizing an overarching DRFI strategy, currently under preparation with technical assistance from AfDB-ADRiFi, is important to provide centralized guidance on disaster risk assessments as well as outline different (domestic and external) financing and insurance instruments in a risk layering framework.

[32] The World Bank's risk-layering framework (WB 2014) suggests that countries should have a financing mix that relies on both risk retention and risk transfer instruments when dealing with disaster risks. In practice, this often means that governments should consider covering the costs of small but frequent disasters through fiscal and FX buffers, while larger but less frequent disasters would require the use of ex-ante contingent financing arrangements, sovereign insurance instruments and ex-post support from the international community.

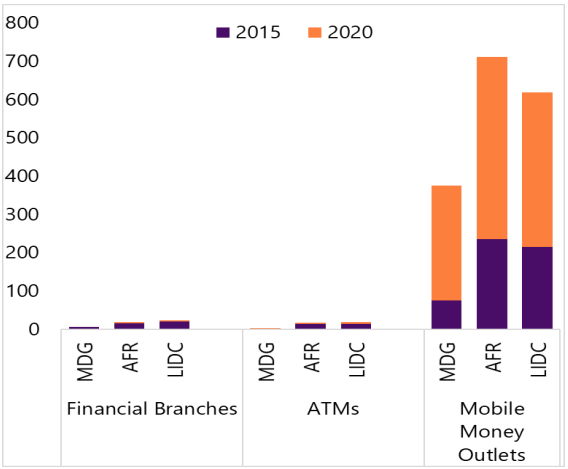
Financial Sector Preparedness

How Does the Financial Sector Respond to Disaster Shocks?

41. The financial sector is vulnerable to natural disaster shocks. Large disaster shocks can pose risks to financial stability given high credit concentration in disaster-exposed sectors such as commerce, transportation, manufacturing and agriculture (IMF CR 20/61). Natural disaster stress tests, conducted under the 2015 FSAP, suggested that banks may incur losses up to 40 percent of their 2014-15 net income (IMF CR 16/377). Relatedly, the same report recommended (i) tightening prudential limits on large exposures and supervision of concentration risks (by sector and geographic area) and (ii) creating a deposit insurance scheme to help protect small depositors.

42. In response to previous shocks, the CBM introduced temporary exceptional measures. In response to Covid, the CBM temporarily relaxed reserve requirement rules, encouraged banks to defer SME and household loan repayments, and extended credit lines to SMEs through commercial banks at reduced interest rates. The CSBF also simplified customer due diligence in opening of mobile accounts, to ease the channeling of government social payments to the most vulnerable, including individuals without national identification. These measures have been later unwound. Similar temporary measures could in theory be introduced in response to large natural disaster shocks.

Figure 14. Availability of Traditional vs. Digital Financial Services
(number per 100,000 adults, 2015-2020)



Source: Calculations based on IMF FAS database.
Note: Financial branches include commercial banks, credit unions, microfinance institutions and other deposit takers. Country groups are simple averages.

43. Digital financial services can help smooth shocks from disasters. In Madagascar, mobile money outlets have much higher penetration compared to traditional financial services (Figure 14). Mobile payments can promote financial inclusion (by reaching the unbanked in remote and rural areas), enhance efficiency of government operations (by reducing leakages) and improve delivery response (by allowing an almost automatic and fast reach to beneficiaries in case of shocks, including from disasters). For instance, cash transfers were increasingly made through mobile money operators in response to Covid.

44. Insurance products are available, including coverage against disasters, although under-insurance is common.

- **The use of insurance services is limited despite national coverage and diversified products.** There are five licensed insurance companies (dominated by two large SOEs holding more than 70 percent of market share). As of end-2018, total assets correspond to about 2 percent of GDP with premiums (i.e., penetration rate) at about 0.7 per cent of GDP. General (non-life) insurance accounts for the majority of assets and premiums. Access to insurance services is low at 3 percent of the adult population (IMF CR 20/61), given low per capita income, high taxes and lack of awareness. The recent transfer of supervisory role of insurance companies from MEF to CSBF is welcome and in line with the 2016 FSAP recommendations (IMF CR 16/377).
- **Cyclone and crop insurance are limited but available to the private sector.** Some private businesses and individuals insure their properties against basic calamities such as fire, whereas cyclone insurance (the main catastrophe hazard) is available as an optional extension on an indemnity value basis. Property insurance is voluntary and is largely driven by bank requirements in case of property loans. Most recently, index-based agricultural insurance has been piloted in accordance with the new insurance law, with payouts dependent on crossing a threshold drought index and the capital insured.

ADAPTATION PLANS

Madagascar's adaptation strategy is hindered by lack of sufficient information, analysis, and integration with development strategies. Investments are often determined by fragmented external financing initiatives, without an overall prioritization framework. Madagascar would benefit from conducting impact assessments of current and projected climate-related hazards and cost-benefit analysis to guide its adaptation efforts. Adaptation measures in the sectors of agriculture, water, ecosystems, and infrastructure would provide greater resilience to climate hazards and the slow-moving effects of climate change, as well as bring additional economic and environmental benefits. This could be complemented by informational, regulatory, and operational measures entailing minimal fiscal cost.

Adaptation Policies and Plans

What Enhancements to the Planning Process could Facilitate Adaptation Planning?

45. Sectoral adaptation efforts could benefit from developing analysis to support prioritization and from mainstreaming into sectoral development strategies, consistent with national strategies.

- **The relationship between adaptation and development strategies should be recognized and articulated in the NAP and the sectoral plans**, including the role that development

plays in providing greater climate resilience and the benefit of climate adaptation plans for protecting the development process. The National Adaption Plan should be made consistent with these strategies.

- **So far, most of the sectoral risk assessment is supported by the international development partners on an ad-hoc basis.** Sectoral policies should be based on systematic climate impact analysis and develop methodologies to quantify costs and benefits of potential adaptation measures to facilitate prioritization and the evaluation later on.
- **Current adaptation analysis is limited and mainly addresses current extreme events such as flood, drought, and tropical cyclones.** This analysis should be broadened to incorporate forward-looking climate risks stemming from both extreme events as well as the slow-moving effects of climate change, such as the direct and indirect impact of steadily increasing temperature and rainfall variation on key sectors such as agriculture, fisheries, tourism, public health, and energy. This kind of analysis should provide the basis of the discussion on the broad economic impacts and the fiscal risk statement.
- **Access to international financing can be unlocked by improving knowledge of the donor landscape and the capacity to meet requirements for receiving financing.** This can be complemented by measures to tap private sector finance by facilitating risk assessment and transparency of the policy environment.

Adaptation Measures

What Key Sectoral Measures are Required to Adapt to Climate Change?

Madagascar faces a range of climate change risks, which are expected to have the largest impacts on sectors of agriculture, water, ecosystems, and infrastructure. The limited quantitative analysis of these impacts in Madagascar can be complemented by sectoral analysis from other countries to suggest investment options with high expected benefit to cost ratios.

Agriculture

46. Adaptation measures should shield agricultural productivity from erosion by climate change. The main impact channels of climate change are the erosion of capital inputs in the short run and loss of productivity in the long run. Floods and tropical cyclones can reduce the volume of capital inputs by damaging agricultural infrastructure and land; drought and extreme heat episodes reduce productivity. Steadily increasing temperatures, more extreme rainfall episodes, and more dry drays can accelerate the decline of productivity which has already fallen by USD 95 per worker over the past 20 years (World Bank, 2022).

47. The NAP and the sectoral investment plan specify some priority areas for investment in the agricultural sector. They include spending on agricultural research, as well as

investing in disaster-risk reduction systems for farmers. These investments cost up to 157 million USD, or 1.1 percent of nominal GDP in 2019 annually.[33]

48. Agricultural plans still largely focus on disaster emergency responses. Apart from investing lightly in agricultural research, the agricultural plans do not have consistent strategies to enhance resilience to climate shocks before disasters strike. Strategies to address the slow-moving effects of climate change are missing altogether. The lack of granular risk mappings for existing agricultural infrastructure also limits the capacity for making targeted investments and efficiently allocating limited financial resources. According to the third National Communication in Madagascar, only a small subset of proposed adaptation measures has been adopted, notably a water pipeline project in the south with an irrigation component and some research investment in climate-resilient crop varieties.

49. Absent financial constraints, Madagascar would benefit from investing in several key areas to reduce damages from climate change. According to a 2019 IFPRI study, an additional US$1.97 billion per year in agricultural research and development aimed at climate resilience in emerging and developing economies could improve food supply by six to seven percentage points between 2030 and 2050 and reduce hunger by 21-24 percentage points. Other key investments include expanding irrigation systems and improving water use efficiency, rainwater harvesting, soil water holding capacity, and resilience of transport and electricity infrastructure.

Water and Sanitation

50. Adaptation measures in the water and sanitation sector should seek to address the vulnerability of the infrastructure. The water and sanitation sector in Madagascar is characterized by poor and outdated infrastructure (Weiskopf et al. 2021), which would not be able to withstand more intense floods and storms. The consequences are the cascading effects of stormwater overflow, which contaminates the drinking water to the detriment of human health. Therefore, improving the resilience of water infrastructure is crucial.

51. The NAP has recommended to expand water infrastructure and improve it to be climate resilient. Together with other strategic recommendations, these adaptation measures are expected to cost $25 million over ten years, according to the NAP. No specific estimation was presented for resilience-enhanced water infrastructure alone.

52. Plans for the reconstruction and rehabilitation of water infrastructure have not incorporated resilience. Universal access to sanitation and to reliable drinking water are important development goals. However, improving resilience to floods and tropical cyclones has

[33] National Adaptation Plan, 2019 (still pending to be formalized by the MEDD); PSAEP/PNIAEP 2016-2020; SPCR (2017); FAO & IRAM Resilience Strategy and Action plan (2017). The budget is not incremental in nature with respect to the development baseline.

not been built into the construction, rehabilitation, and reconstruction processes. Modernizing the water infrastructure is crucial, both for the development purposes and for adaptation.

53. Investing in resilient water and sanitation infrastructure pays off. Examples could include enhancing sewage capacities when building more sanitation facilities, higher and stronger river levees, or simply more dedicated resources for clearing stormwater drainage on a regular basis. On average, in Low-middle Income Countries, the country group closest to Madagascar with available cost estimates, resilient investments could increase investment costs by 1.1 or 2.2 percentage points, which means an additional investment up to $16.5 million annually for the next 10 years in Madagascar for resilience-building[34], and they would halve the disaster damages from climate change (Hallegatte, et al., 2019).

Ecosystem

54. Adaptation measures in the ecosystem sector should focus on protecting or restoring productivity of the existing natural capital and growing new capital. The slow-moving effects of climate change have been reducing the volume and productivity of the natural capital in Madagascar, in both terrestrial and marine ecosystems. Tree growth and reproduction have been affected, and the marine ecosystem has been impacted by coral bleaching, seagrass loss, fisheries loss, ocean acidification, and so forth (Cochrane et al 2019). The changes in natural capital have directly harmed the sectors of agriculture, fisheries, and tourism.

55. The NAP has highlighted several areas that require investments, focusing on restoration and creation of new conservation zones. These measures will also help with adaptation of species, as the restored and the new conservation zones could connect terrestrial ecosystems and facilitate the migration of the species within their natural habitats. Conservation of coral reefs and mangroves, alongside carrying out research on fisheries, are also mentioned. The NAP's ecosystem resilience strategy was embodied in two national programs costing in total USD 90 million over 10 years.

56. Investing in natural capital has high rates of return in the face of climate change. The benefits associated with creating and managing protected areas in Madagascar average from USD35 to USD53 per hectare each year (Cooke et al., 2021) while the management costs are typically 20 percent of that. The cost of creating new protected areas, estimated in the range of USD 27 and USD 101 per hectare, could be recovered economically in about three years. Annex I presents the cost estimation of protecting and restoring natural capital. Different from other sectors, it is virtually impossible to isolate the incremental cost of adaptation in the ecosystem. But the investments in restoration and growth of natural capital is by itself a good adaptation strategy.

[34] The new investment in expanding safe water and sanitation to the Malagasy population is projected to be between USD 3.8 billion and USD 7.5 billion by 2030 by Markandya and Galinato, 2021).

Infrastructure and Building

57. For assets and infrastructure with long life spans, adaptation measures should aim to reduce vulnerability by implementing both grey and ecosystem-based interventions. Ecosystem-based adaptation is relevant for both coastal and inland cities in Madagascar. In coastal cities, buildings, roads, and power infrastructure are exposed to coastal risks such as coastal flooding, storm surge, saltwater intrusion, which have been elevated by climate change, and aggravated by environmental degradation such as coastal erosion, mangrove loss, and sand shifting. In the inland cities, wetland losses and soil-erosion have made infrastructure and building more sensitive to the climate change hazards. Beyond direct intrinsic value of biodiversity and ecosystem services, ecosystem-based approaches can help protect infrastructure. Grey interventions entail retrofitting existing assets and upgrading new infrastructure.

58. Current adaptation plans have considered a mix of strategies. The total programmatic costs range from USD110 million – USD 170 million annually, or 1% of nominal GDP in 2019.[35] The main investments are in hydropower infrastructure (for instance, reservoir capacity enhancement, powerhouse relocation, sediment control, and so forth), and in transport infrastructure (for instance, road surface enhancement, wind-proofing bridges, as well as measures to protect against landslides). The sector has already developed resilience standards for road infrastructure and building codes. A consistent roll-out of these standards would accelerate the resilience-building for the foreseeable future.

59. On average, investing in resilience for roads, railways, and power systems has high benefit-cost ratio. Resilient transport infrastructure in LMICs can be five percent more costly than the standard infrastructure on average, but damage from disasters could be reduced by 50 percent (Table 4). If these parameters are applied to the infrastructure restoration in Madagascar after the four tropical storms in 2022, taking the total cost estimation and the potential damage reduction as the benefit, the benefit-cost ratio could exceed 1[36] after the first several incidents. Investing in resilience in the electricity system, including hydropower generation, also brings significant gains in terms of damage reduction (Table 4).

[35] The estimation is drawn from the NAP (2019), SPCR (2017), World Bank (2018), AFD (2016), European Commission (2014), GET Invest EU (2017), IEA (2020).

[36] As a result of the four tropical storms in Madagascar in 2022, the total damage in the infrastructure sector (mainly roads and railways) is likely to be around USD170 million (according to the Global RApid Damage Estimation (GRADE) Report for Madagascar, February 2022). If the roads and railways had been more resilient, the damage would have been reduced by USD85 million. On the other hand, adaptation investment could cost between USD 25million and USD 115million, depending on the cost assumption (the LMIC average is 5 percent, while the Madagascar has assumed 25 percent in general), so may have paid off from one year's climate events alone.

Table 4. Major Infrastructure Investments in Adaptation: Costs and Benefits

Areas of investment	Category of adaptation measures	Cost increase of adaptation investment, compared to the standard investment	Benefit of adaptation investment
Electricity transmission and distribution	• Construction with higher resilience standard: transmission line hardening, pole stabilizing, etc. • Regular power system maintenance	30% in LMICs	Reduction of damage risk by 50% or 60% for new infrastructure assets
Hydro power	• Improving conveyance efficiency • Increasing reservoir storage capacity • Increasing turbine capacity	2.7%, total cost increase of the seven hydropower projects by the Program for Infrastructure Development in Africa, to enhance resilience	The benefit/cost ratio is 4.03 considering the seven projects altogether.
Transport	• Construction with higher resilience standard • Technical and low-cost maintenance including clearing blockage under bridges or in the roads	5.5% in LMICs	These investments would reduce damage to new infrastructure by 50%

Source: Lampert et al., 2015, Hallegatte, et al., 2019

How does Adaptation Investment Contribute to Broader Economic and Environmental Benefits?

60. Adaptation investments can generate economic, development and environmental benefits. These benefits would accrue even in the absence of climate change. Quantification of these benefits, especially the environmental benefits, is difficult, but incorporating them into the benefit calculation would facilitate access to project finance and broaden the metrics for monitoring and evaluating the investments (GCA, 2019, Heubaum et al., 2022).

61. Several case studies have shown that the economic and environmental benefits of adaptation investments can exceed the benefits in terms of disaster damage reduction. Table 5 provides illustrative examples from the case studies. On the economic and development front, the benefits of nature-based adaptation interventions have included job creation, land value increase, and air quality improvement, among others. On the environment side, the conservation of water and biodiversity and the reduction of land degradation have provided the most value. These studies show benefit-cost ratios 1.1 to 93 times higher than from damage reduction alone.

Table 5. Triple Dividend of Adaptation Investment

(Project-Based Assessment)

Category	Forestation initiatives to reduce flood risks		Coastal protection	Water-saving irrigation
	In Kunshan, China	*In Princes Park, Australia*	*In Felixstowe, UK*	*In Ningxia, China*
Benefit-cost ratio, disaster damage reduction only	5.7 to 1	0.6 to 1	15.1 to 1	0.06 to 1
Benefit-cost ratio, economic and environment benefits	43.8 to 1	1.3 to 1	16.7 to 1	5.6 to 1
Total benefit-cost ratio	**49.5 to 1**	**1.9 to 1**	**31.8 to 1**	**5.6 to 1**

Source: Heubaum et al., 2022

What Public Programs Should be Strengthened other than Investment?

62. Madagascar has adopted a range of non-fiscal measures for adaptation (Table 6). Examples include risk zoning, community-based early warning, and disaster response protocols. Through collaboration between the Ministry of Environment, the CPGU, and the sector ministries, these measures have been helping Madagascar respond to the weather shocks more effectively than before. For instance, weather forecasts and climate services provided by the General Directorate of Meteorology have been used to revise the agriculture calendar on a seasonal basis, which provides farmers information to adjust their planting and harvesting plans. Emergency response has also been incorporated into the school curriculum to strengthen community resilience to climate extreme events.

63. Madagascar should accelerate the adoption of resilience standards for building and infrastructure. Madagascar has been making progress in strengthening the regulatory framework to support climate adaptation. The Ministry of Public Works and the Ministry of the Interior have developed standards for road infrastructure and building codes, respectively, with support from international development partners. But the new frameworks have not been fully rolled out yet due to capacity constraints at the local level (Section VI).

64. Madagascar should develop operational guidelines to facilitate adaptation actions by the private sector. Examples include guidelines for the tourism sector, for conservation (water and electricity), and for adoption of innovation (for instance, sea surface temperature control, architecture innovation for insulation from heat), among others. These guidelines help direct autonomous adaptation by businesses and can accelerate the diffusion of new adaptation technologies.

Table 6. Non-Fiscal Public Programs for Adaptation in Place in Madagascar

Climate hazard	**Recommended Non-fiscal measures 1/** *What are nonfiscal public programs to address each hazard*		**Adopted Non-fiscal measures in Madagascar 2/** *Which measures are adopted in Madagascar and by which entities?*
Tropical cyclone and flooding	Planning	Risk zoning	By CPGU, MAEP, DGM
	Regulatory	Building code	By MID
		Standard for infrastructure construction and maintenance	By MTP
		Development restriction	
	Educational/outreach	Community-based early warning and disaster response protocol	By MAEP, BNGRC, MSANP
		Operational guideline incorporating climate risk-proofing	
		Drainage design manual	
Drought	Planning	Water resource mapping and water level monitoring	By MEH
		Weather forecasting and climate service	By DGM
	Regulatory	Conservation measures (e.g., price differentiation, groundwater protection and preservation, building water benchmarking ordinance, etc.)	No information
	Educational/outreach	Community-based early warning and disaster response protocol	By MEH, MAEP
		Operational standard incorporating climate risk-proofing	
Extreme heat	Planning	Terrestrial and marine "hot spots" mapping	
		Identifying cooling centers and vulnerable population in the communities	
	Educational/outreach	Operational guideline in fisheries and tourism	
		Community-based early warning and disaster response protocol	By MSANP

1/ Recommendation extracted from key policy lists from EPA's Smart Growth Fixes for Climate Adaptation and Resilience, FAO's Impacts of Climate Change on Fisheries and Aquaculture and FAO's Practical Guideline for Early Warning.

2/ The color code reflects the stage of the adopting the recommended non-fiscal programs: green represents implementation of the program; yellow means the instrument has been developed but have not fully rolled out; red means the instrument has not been developed.

NATIONAL PLANNING

Some key aspects of climate-responsive public investment management are already in place, notably with respect to the planning stage and to risk management, but project appraisal and selection still lack climate-specific elements. Public financial management has limited focus on climate issues and the budget does not identify climate-relevant spending, but the ongoing reform of the budget classification may provide an avenue to gradually incorporate climate concerns into budget information both at the preparation and at the execution stage.

Public Investment Management

Are Adequate Public Investment Management Systems in Place to Ensure Climate-Related Investments will be Well-Spent?

65. The assessments in this section are largely based on the IMF Climate PIMA conceptual framework[37]. The assessment results are summarized in Table 7.

Table 7. Madagascar: Heat Map for C-PIMA

	Institutional design	Qualitative Assessment of Implementation
C1. Climate-aware planning		Efforts to incorporate climate change in the building code and land use rules, but no real mainstreaming of CC into planning strategies
C2. Coordination across public sector		Limited coordination mechanisms for the State, none with respect to climate-related investment for PCs and SNGs
C3. Project appraisal & selection		No methodology related to climate change for appraisal and selection of projects
C4. Budgeting & Portfolio Management		No clear identification of investment spending related to climate change and lack of ex post climate audit and asset management
C5. Risk Management		Some elements of risk management do exist, but there is scope to progress in the assessment of fiscal risks

Climate Aware Planning

66. National and sectoral public investment strategies and plans only partly incorporate the government's climate objectives and targets. The *Initiative Emergence Madagascar* (IEM) 2019-2023, which serves as a National Development Plan, includes a pillar (Pillar II: Environmental Emergence and Sustainable Development) with actions on restoring the environmental balance (in particular through reforestation and implementation of international climate commitments) and on promoting energy transition and independency (notably through the development of renewable energies). However, while there are national strategies for climate

[37] "Strengthening the climate resilience of public investment", IMF 2021.

change covering sectors such as industry, water and waste management, this falls short of a full "mainstreaming" of climate change concerns into sectoral strategies.

67. Strong efforts have been made to incorporate climate resiliency concerns into land use regulations and building codes. Madagascar has developed a complete set of land use and building regulations, most notably through a series of decrees published in late 2019, promoting resiliency and adaptation to climate change risks (cyclones, floods). This work conducted under the aegis of the CPGU at the Prime Minister's Office has been supported by donors, notably WB (through a Pilot Program for Climate Resiliency – PPCR) and AFD. Actual implementation of the newly established framework remains an issue however, as the authorities readily acknowledge a lack of capacity at the level of local government, already flagged in 2018 USAID report.

68. However, there is no centralized guidance or support for government agencies on how to plan public investment in the context of climate change. There are numerous services involved in PIM (DGEP at MoF which is mostly in charge of planning and guidelines for project evaluation and selection, Direction of Economic Cooperation and General Directorate in charge of Presidential Projects within the Presidency playing a role for priority projects monitored by the Presidency) but they lack specialized expertise in climate change and do not provide specific guidance on climate-related investments. Building up on their economic expertise, DGEP with the help of the Ministry of Environment could start work on Climate Resilient Planning Guidelines to screen projects for climate risks and providing training and support to line ministries to help them integrate climate change in their investment plans.

Coordination Across the Public Sector

69. Decision-making on public investment is not coordinated across central government from a climate-change perspective. While instances for coordination and decision-making do exist (National Committee for Adaptation, Interministerial Committee for Environment), the Public Investment Management Strategy (adopted in 2017 and currently under review), which presents the institutional framework for infrastructure governance and processes across the public investment cycle (planning, programming, budgeting, execution, and monitoring), does not refer at all to climate change. Decision-making remains largely *ad hoc*, responsive to political impulse and priorities of donors more than reflecting an integrated approach to climate change. A way forward could be to integrate into the revised PIM Strategy a mechanism to ensure that sectoral investment strategies and projects adequately reflect climate change concerns, possibly involving both DGEP and MEDD.

70. Efforts are underway to integrate a climate change perspective into capital spending of Subnational Governments (SNGs). Madagascar is divided into 23 administrative regions, 119 districts and 1,695 municipalities. The latter (known as communes) are supposed to play a pivotal role in public service provision at the local level, notably in the field of primary education and primary health care, as per Organic Law 2014-018 of August 14, 2014 on the competences of communes. However, this remains largely an unfunded mandate, reflecting the

very partial decentralization, with investment by communes representing only 2 percent of total public investment in 2017. The legal framework (notably decrees 2019-1931 on the preparation of regional development plans and 2019-1932 on the preparation of urban zoning plans) prescribe that SNGs integrate climate resiliency concerns into their investment planning. Some support has been provided for this purpose, with (i) the elaboration in 2019 and gradual roll-out to regions of a guide on how to integrate CC concerns into regional development plans with help from the WB PPCR (ii) efforts to integrate climate concerns into town planning through an AFD project started in 2019. However, the low level of own resources for SNGs means a heavy reliance on grants from central government conveyed by the Local Development Fund (FDL), whose allocation criteria do not factor in vulnerability to climate change.

71. The regulatory and oversight framework for public corporations (PCs) is weak and does not address the need for consistency between the investment plans of PCs and national climate policies and guidelines. PCs play an important role in Madagascar in key economic sectors in Madagascar, with the combined balance sheet of majority-owned PCs representing 11 percent of GDP in 2018. JIRAMA (electricity generation and distribution) and Air Madagascar (airline company) are highly relevant from a climate change perspective. Within MoF the DGT is tasked with oversight of PCs; however, there are no strategy or guidelines for the State as shareholder.[38] Developing such a strategy and incorporating climate change aspects in the governance of PCs would help in ensuring that they contribute to CC goals (see Box 4 for the example of France).

Box 4. Integrating Climate Change Concerns in Oversight of PCs in France

The French Agency for State Shareholdings (APE) made an initial stocktaking of GHG emissions and climate policies of its portfolio of PCs and defined on this basis guidelines for PCs in order to respect the goals of the Paris Agreement, which include (i) measuring direct and indirect carbon impact, (ii) setting targets for reduction of GHG emissions for the most important emitters, (iii) defining an action plan for meeting these targets and (iv) presenting annually to the Board and to APE the results achieved under this plan.

Further, one of the laws passed in the context of the COVID-19 crisis (Supplementary Budget Law 2020-935 of July 20, 2020) made it compulsory to condition APE support through exceptional COVID-related bailouts to explicit commitments by PCs in terms of reduction of GHG emissions. This was applied notably to the Air France bailout, which was made contingent on tougher emission reduction targets and termination of some domestic flights to encourage other alternatives such as rail transportation.

Source: Annual Report of the State Shareholding Agency (APE), 2021

Project Appraisal and Selection

72. Appraisal and selection of large infrastructure projects does not include a climate-related analysis to be conducted following a standard methodology. The current regulations and guidance do not include a standard method for assessing projects including technical details pertaining to climate change adaptation and mitigation. An environmental impact study is

[38] See 2019 FAD report, Improving Fiscal Risk Management, El Rayess et al.

conducted by *Office National pour l'Environnement* (ONE) for major projects, but it intervenes at a late stage of the appraisal process when the project has already been decided upon in principle and without any specific climate change analysis. In addition, the draft regulations intending at reforming the public investment strategy and processes do not include clear and direct references to climate change in the appraisal and selection of projects: (i) the latest version of the draft public investment strategy[39] only requires that the appraisal of projects is aligned with the objectives of the National Development Plan which includes a pillar on environmental emergence and sustainable development (see paragraph 65); and (ii) the June 2020 draft of the PIM guide clearly describes the institutions, processes and coordination mechanism in the appraisal and selection of the public investment financed by technical and financial development partners and implemented through the budget but no reference to a clear methodology in assessing the climate change impact during the appraisal phase.

73. The externally financed projects representing the majority of public investments are not subject to national appraisal and selection processes. Development partners identify and appraise public investments according to their internal systems and procedures and transmit the infrastructure project file to the concerned sectoral ministry and the Ministry of Finance's Debt Division when the capital investment is financed through a loan. For capital investments that might trigger environmental and climate risks, development partners, as for instance the World Bank, systematically undertake the environment and climate impact assessment.[40]

74. The public private partnership (PPP) legal framework in Madagascar does not include any specific references to climate considerations. There are only a few PPPs in Madagascar yet (power sector, Ivato airport). The current legal framework[41] does not include specific provisions related to climate change and in particular the risk sharing mechanisms. This mechanism of risk sharing is negotiated during the contract phase, but it is not based on established guidelines in the legal framework. It is basically ad-hoc depending on the type and nature of projects. Usually, the effects of climate change and the measures of adaptation are treated as a force majeure clause. However, depending on the sector the clauses included in the contracts differ. For example, for the PPP project related to the aviation sector (managing airports), the contract included a rendez-vous clause, while for the energy sector projects (for example hydroelectric dam of Volobe), the contract would include the modalities of calculating indemnities in case of natural disaster.

Budgeting and Portfolio Management

75. Madagascar remains dependent on external funding to support capital investment. According to the 2022 budget law, the capital budget is 5,257 billion Ariary (MGA) amounting to

[39] The mission received the March 2022 version of the draft which is used as the reference for the C-PIMA assessment.
[40] Environmental and Social Framework (ESF), World Bank, 2018.
[41] Law 2015-039 on PPPs, and (i) decree 2017-149 related to the implementation guidelines of PPP contracts and (ii) decree 2014-150 related to the institutional framework.

36.4 percent of the total expenditure and 9.2 percent of GDP. Externally financed public investment projects account for 68 percent of the capital budget. Over the last ten years, the externally funded projects related to climate change consist of 94 projects with commitments totaling USD 2.8 billion and disbursements of USD 991 million. Table 8 provides a summary of these projects by sector.

Table 8. List of Externally Funded Climate Related Projects for the Last Ten Years

Sector	Number of projects	Total Commitments (millions of USD)	Total Disbursements (millions of USD)	Percent of total disbursement
Rural development	48	900.3	322.2	33%
Environment	23	159.9	88	9%
Energy	11	480.2	215	22%
Road infrastructure	6	838.7	169.5	17%
Fishing	1	74	17.4	2%
Others	5	303.1	178.9	18%
Total	**94**	**2,756.2**	**991**	**100%**

Source: Directorate of Economic Cooperation at the Presidency

76. Public investment expenditures related to climate change are not clearly identified in the budget nor in related documents and are not properly monitored and reported. The current financial management information system (FMIS) is composed of two modules – budget preparation and budget execution modules that do not fully integrate budget preparation and budget execution data. The current codification of the public investment projects (PIP code, an alphanumeric code) is not always assigned to individual projects and is not followed at the execution stage preventing a comprehensive monitoring of the execution of public investment expenditures, precluding clear identification and tracking of investment spending related to climate change. A tagging system would be needed to obviate this problem.

77. There are no systematic ex post reviews of the impacts of specific public investment projects on adaptation or mitigation, except when projects are externally financed. There is no legal and regulatory framework defining the methodology to undertake ex-post evaluation of public investment projects. Ex post reviews including evaluation of the impact of investments on climate change are carried out for some externally financed investment projects. For instance, there are requirements for systematic environment and climate ex post review of certain projects supported by the World Bank.[42]

78. Climate-related risks are not systematically reflected in methodologies for estimating the maintenance needs of infrastructure assets, despite some progress in the road sector. Methodologies for estimates of infrastructure maintenance needs are not widely applied in Madagascar. However, standards for road infrastructure resistant to flooding and geological phenomena[43] have been adopted and published formally in January 2022, and cover elements related to maintenance. Building on progress in this sector, identifying the

[42] Environmental and Social Framework (ESF), World Bank, 2018.
[43] Known as NIRIPG – *Normes sur les infrastructures résistantes aux inondations et phénomènes géologiques.*

infrastructure assets most vulnerable to climate change and defining a methodology for asset management and maintenance should become a priority.

Risk Management

79. Madagascar has a well-established and published disaster risk management strategy, underpinned by some ad hoc financing and insurance mechanisms. As discussed in Section IV on Disaster Risk Management, Madagascar has made efforts to integrate disaster risk management into sectoral plans, notably through the PPCR project operated under the aegis of CPGU (Prime Minister's Office for Prevention and Management of Emergencies). Ex ante financing mechanisms have also been put in place even if they have yet to be captured in an overall disaster risk financing strategy, currently under preparation.

80. Madagascar does not conduct an analysis of fiscal risks linked to the impact of climate disasters on public infrastructure. The last two fiscal risk statements (FRS) appended to the draft budget law did not contain any elements on disaster risks, let alone on the possible impact of disasters on public infrastructure. In the FRS appended to the 2020 budget, some elements on the cost and impact of recent climate disasters were presented but there was no specific mention of infrastructure. Going forward a systematic analysis of fiscal risks related to climate, notably affecting the infrastructure, seems warranted in the FRS on a yearly basis.

Public Financial Management

Are Climate Considerations Effectively Incorporated Across Major Stages of the Budget Cycle?

81. Developments in this section are largely based on the IMF's "Green PFM Framework"[44]. Madagascar is a member of the Coalition of Finance Ministers for Climate Action and has committed to the "Helsinki Principles", including Principle 4 which urges Ministries of Finance to mainstream climate change concerns into the PFM and PIM institutions and processes. There is, however, limited progress so far in this respect, largely owing to well-documented limitations in Madagascar's overall PFM framework and capabilities. Further progress in this field is also largely contingent on enhancing the dialogue and collaboration between MoF and Ministry of Environment and will need at some stage to be captured in the legal framework given the strong legalistic culture prevailing in Madagascar.

Strategic Planning and Fiscal Framework

82. Climate considerations are to some extent reflected in the Government's strategic plan and in sector strategies but not in medium-term fiscal plans. There is no specific and systematic effort to align medium-term fiscal and budget frameworks (MTFF / MTBF) with

[44] "Climate-Sensitive Management of Public Finances = Green PFM", IMF 2021.

climate objectives. This may however have to do more with general capacity and decision-making issues in the preparation of the MTFF / MTBF rather than with specific lack of climate commitment or expertise.

Budget Preparation

83. There is limited focus on climate issues in the budget preparation process, except for the major externally funded projects. The budget preparation circular does not highlight climate concerns and there is no general requirement for climate impact assessment of budget measures. Only major projects, most of them financed by donors, are subject to climate impact assessments. There is no specific tagging of climate expenditure, and the budget program structure does not allow to identify climate-relevant spending in the budget documents. However, an ongoing reform of the budget classification with support from IMF could provide an opportunity to insert in the budget classification a code that would allow to track climate-relevant expenditure. Box 5 provides some elements on experiences of climate budget tagging (CBT) in Ghana.

Box 5. CBT in Sub-Saharan Africa – The Experience of Ghana

While most of the trailblazers for adoption of CBT are located in the Asia-Pacific region, a few countries in Sub-Saharan Africa have also adopted CBT as a way to emphasize efforts for climate mitigation and adaptation in their budgets. These include Ethiopia, Ghana, Kenya and Uganda.

Ghana developed in 2018 a CBT tool (CLIMATRONIC), produced by the Natural Resources and Climate Change Unit in the MoF. CBT covers national (Ministries, Departments and Agencies) and subnational budget allocations and can account for actual expenditures as well.

Climate relevant expenditures are grouped in three categories (high, medium and low relevance) and weighted at 100%, 50% or 20% according to their category. The MoF leads the process of integrating climate finance into the annual budget and planning processes and oversees the mainstreaming of the tracking tool. There is no manual tagging or tracking but categories are determined ex ante and captured in the Chart of Accounts.

CBT allowed to track the evolution of climate-related spending in the budget – estimated at an average of 4% over the period 2015-2020.

Source: Climate Change Expenditure Tagging – An Overview of Current Practices, WB, Xenia Kirchhofer, 2021, and website of the Ghana MoF. (https://mofep.gov.gh/sites/default/files/news/Intergrated-MRV.pdf)

84. Creating and gradually enriching a dedicated annex to the annual budget on climate change could also foster transparency. Such an annex exists in countries like Bangladesh. It can be gradually enriched to reflect more fully the information available, including from climate budget tagging when available, but also information on climate-related contingent liabilities (e.g., power purchase agreements with RE producers, see Section III for more detail). It can also feed into the citizen budget for greater relevance and outreach to citizens.

Budget Execution

85. Climate considerations are not explicitly reflected in budget execution and accounting. There remains major scope for improvement in mechanisms for budget execution and accounting in Madagascar, as evidenced in the recently published 2021 PEFA assessment. Hence, it is not surprising that these mechanisms do not include yet any specific provisions for climate-related spending. In the absence of a systematic framework for climate tagging or a budget program structure that reflects key climate objectives, any analysis of climate-related spending will be ad-hoc in nature. The public accounts, produced with a significant delay (as of April 2022, the 2020 *Compte Général de l'Administration des Finances* is yet to be published), do not provide any information on climate spending.

Control and Audit

86. Climate considerations are not explicitly and systematically reflected in internal controls, nor internal and external audit. The Cour des Comptes (Supreme Audit Institution) is currently benefitting from USAID support to expand into performance audits but has not carried out yet any performance audits of climate projects or programs.

MACRO-FISCAL IMPLICATIONS OF CLIMATE POLICY

The effects of climate (natural disasters) and of climate change (higher frequency and intensity of disasters and gradual permanent reduction in productivity) are not included in the authorities' baseline macro-fiscal projections. Their inclusion results in an unsustainable debt trajectory and/or a permanently lower growth path. Investments in resilient infrastructure and adaptation projects alone are insufficient to restore debt sustainability, even when public investment efficiency is enhanced. Adaptation investments should take place within the broader context of the country's efforts to reach the SDGs, that include investments in human capital to durably increase potential growth and investments in resilient infrastructure.

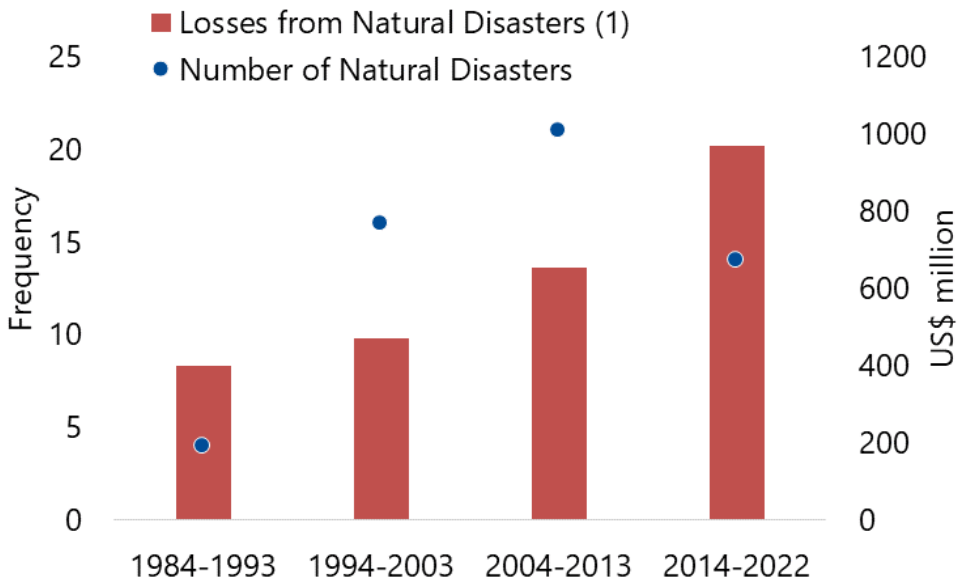
Fiscal Sustainability Under a Climate-Adjusted Baseline Scenario

87. Madagascar's exposure to recurrent natural disasters[45] inflicts recurring economic losses and threatens medium-term debt sustainability. Madagascar has been historically hit by a tropical cyclone every 0.9 years on average, while droughts and floods take place every 2.7 and 3 years respectively (EM-DAT, 2022). Natural disasters destroy capital and reduce output in the short run while also lowering potential growth in the long run. They reduce revenues and create spending needs, thereby worsening deficits and increasing public debt. Although there is

[45] According to the EM-DAT database, Madagascar is mainly subject to cyclones, floods and droughts. Viral diseases and insect infestations are not considered in this analysis.

significant uncertainty on the future frequency of tropical cyclones, floods and droughts, their impact is expected to increase as the variance of temperature and precipitations rise. For instance, a typical tropical cyclone could become 18.4% more damaging by 2050 (Acevelo, 2016).

Figure 15. Historical Frequency of and Total Losses from Natural Disasters in Madagascar



Source: EM-DAT, 2022 database.
1/ Includes the latest World Bank GRADE damages estimates for the 4 climate disasters from January 22 to February 23, 2022, in Madagascar: Tropical Depression Invest 93S, Tropical Cyclone Batsirai, Moderate Tropical Storm Dumako and Tropical Cyclone Emnati. Total losses in EM-DAT include the estimated amount of damage to property, crops and livestock.

88. As such, natural disasters should not be treated as downside risks but as an integral part of the authorities' baseline scenario. The impact of possible natural disasters is currently not reflected in macroeconomic projections and annual budgets, but only as fiscal risks in selected annual fiscal risks annexes to Budget Laws. Growth projections reflect the authorities' objectives and are not adjusted for possible climate shocks. Additional spending needs are dealt with in a reactive and ad-hoc manner, through supplemental budgets and emergency donor funding, rather than pre-emptively through contingency measures (e.g., adequate provisions commensurate to the expected level of risk) in initial budgets.

89. In the absence of disaggregated climate impact data by sector/region, historical frequencies, and impacts of disasters, though probably underestimated,[46] can provide a starting point for the inclusion of climate risks in macroeconomic projections. Increasing

[46] In the absence of systematic assessments of economic damages, the publicly available figures for damages may be underestimated. Most recent estimates of the impact of cyclone Batsirai (2022) by African Risk Capacity point to total damages of up to US$2.1bn (14% of GDP), while World Bank estimates point to damages of about 4.5% of GDP.

temperature and precipitation intensity and variability generate climate events whose economic impact typically depends on the location of the event and the capital intensity/economic structure of the affected region. Data on the past impacts of disasters on specific sectors and/or regions, if combined with regional climate scenarios (e.g., precise frequency of droughts/cyclones in different regions), could provide granular projections that could then be aggregated into a country-wide projection. Economic data currently produced in Madagascar does not allow for such an assessment, and therefore projections need to rely on aggregated damage data. A starting point would be to include climate risks in baseline budgets and cover climate change risks as part of fiscal risks analysis, with possible associated mitigation measures (e.g., insurance).[47]

90. Climate risks can be included into growth projections through three complementary channels:

- **Immediate GDP losses and damages to physical assets.** A typical tropical cyclone produces 1.8% of GDP in total losses, of which 57% in damages to physical assets (based on authorities' assessments of the impact from tropical cyclones Ava and Enawo), and an average flood produces 2.4% of GDP in total losses (EM-DAT, 2022). Both cyclones and floods also typically reduce productivity in the short term. An average drought may reduce yearly real growth by 0.3 percentage points, with persistent impacts in the following years according to IMF estimates[48] on Sub-Saharan Africa. Impacts are typically differentiated by sector: the split between damage to physical assets and income loss varies depending on the capital intensity of the sector. Economic losses can also be estimated by aggregating sectoral impacts when such estimates exist.
- **Permanent scarring effects due to long recovery times.** The high frequency and rising intensity of natural disasters, coupled with relatively long economic recovery times, create economic scarring and permanent damages to economic output in the long run as the economy never fully recovers from a natural disaster before being hit by another one. Economic recovery from a natural disaster, i.e., reconstruction of physical assets and productivity recovery to pre-shock level, takes time, with estimates pointing to approximately 4 years to fully rebuild public infrastructure.
- **A gradual permanent reduction in total factor productivity reflecting the slow-moving effects of climate change.** Shifts in temperature patterns in Madagascar lower labor productivity. Deterioration in health and education quality also have long-lasting effects. These effects would produce a gradual reduction in total factor productivity. Estimates can be

[47] Climate risks can be equated to the baseline frequency and impact of natural disasters, while climate change risks are those risks that natural disasters will occur with higher frequency and impacts than their historical trend.
[48] *Regional Economic Outlook* for Sub-Saharan Africa, April 2020 (IMF, 2020).

found in the literature and point to a loss in GDP per capita of up to 1.5% in GDP per capita by 2050 based on historical trends (Kahn et al, 2019).[49]

91. Climate risks can be reflected in fiscal and debt projections through four channels:

- **Fall in government revenues.** Lower economic activity and tax relief measures to support affected populations after a disaster reduce government revenues. This impact is expected to increase in the absence of revenue mobilization measures.
- **Higher emergency current and capital spending.** Natural disasters typically prompt a fiscal response to support affected households and cover post-disaster reconstruction needs. The authorities recently estimated social spending needs alone after cyclone Batsirai (2022) at 1.3% of GDP.
- **Lower non-emergency growth-enhancing spending.** Spending is adjusted following a natural disaster to create fiscal space for emergency spending. Emergency fiscal adjustments typically focus on capital spending cuts, especially as donors partially shift their financing towards post-disaster programs. Capital spending cuts reduce in turn current and long-term growth.
- **Financing constraints.** Any increase in deficit each year leads to higher financing needs, with uncertainties on the level of incremental grants and concessional debt that can be raised. Financing availability constrains the size of the government's response to a disaster. Debt accumulation may also increase the cost of financing and reduce donor appetite to provide concessional funding without a fiscal adjustment program.

92. Absent the materialization of any natural disasters, future macroeconomic policies can be assumed to remain in line with the authorities' macroeconomic framework under the ongoing IMF ECF program. Growth is expected to stabilize at a potential level of 5 percent in 2030, after some years of slightly higher growth (around 5.1% in 2022-2026 on average). This growth level does not include the impact of climate and climate change related risks and reflects a continued increase in productivity that is supported by a scale-up of public investment, public financial management, and governance reforms to improve the business environment, as well as higher social public spending (including in health and education[50]). Primary deficits should remain in check (0.2% of GDP on average in 2022-2026): the public investment scale-up in the medium term (+0.5% of GDP by 2030) should be financed by continued revenue mobilization efforts (+2.4% of GDP by 2040) and additional fiscal space generated by lower transfers and contained fiscal risks. Madagascar should remain at a moderate level of debt distress, with concessional funding and grants covering the bulk of financing needs, and domestic and external

[49] Both Kahn et al. (2019) and Acevedo (2016) produce a range of estimated impacts of climate change, where the lower bound corresponds to a case of countries complying with the Paris Agreement (RCP 2.6) and the upper bound to the case of no climate change policies (RCP 8.5). Staff's median climate change impact scenario assumes mid-range values from these studies. Estimates range from a gain of 0.45% in GDP per capita in RCP 2.6 to a loss of 1.54% in RCP 8.5. Such estimates aim to capture the overall impact of temperature rises, including sectoral impacts such as losses in agricultural productivity.

[50] See TMU definition in ECF program.

borrowing slowly ramping up as Madagascar's fundamentals strengthen, including through the development of a short-term domestic debt market.

Table 9. Extended Credit Facility Macroeconomic Projections[1/]

(in percent of GDP, unless otherwise indicated)

	2021	2026	2040
GDP growth (in percent)	3.5	5.0	5.0
Primary deficit[2/]	5.7	2.7	2.9
Total revenue and grant	13.2	14.3	14.9
Total expenditure	18.7	17.9	18.9
Total domestic debt	11.7	10.6	9.6
Total external debt	41.4	41.0	47.2

1/ As per the 2nd Review under the ECF arrangement approval by the IMF Board on March 7, 2021.

93. Quantifying the impacts of natural disasters on growth and fiscal aggregates requires drawing a link between disasters and GDP, deficits, and debt. Staff calibrated a Debt, Investment, Growth, and Natural Disasters (DIGNAD) model to the economy of Madagascar using historical data (see Table 10) and the ECF macroeconomic framework (see annex III. for details on the model). The model assumes that the economy is hit by repeated natural disasters (cyclones, floods and droughts) with increasing frequencies and intensities[51], reflecting a higher projected level and variance of temperature and precipitations. Natural disasters destroy both public and private capital[52], generate economic losses and temporarily reduce productivity. Disasters also generate additional public spending needs: (i) gradual reconstruction of lost public capital[53]; and (ii) additional transfers to the population. The accumulation of natural disasters prevents the economy from fully recovering to its steady state. Slow-moving effects of climate change were modelled as a gradual and anticipated decrease in total factor productivity.

[51] The annual increase in the expected frequency of natural disaster events is calibrated to be half of that observed over the last 40 years in the EM-DAT database, obtained using 10-year rolling sample frequencies, discounting the rate of increase to account for the selection bias in the early years of the EM-DAT data. The frequency of tropical cyclones, floods and droughts is expected to increase by 1.45%, 4.6%, and 1.2% annually, respectively. Impacts may be underestimated (see note 2).

[52] The model differentiates between two types of capital: standard capital and resilient capital. Resilient capital, also called adaptation capital, is less prone to destruction and has higher economic returns.

[53] Any public investment, including reconstruction investment, is subject to a public investment efficiency factor, reflecting the difference between amounts invested and gross fixed capital formation. Efficiency has been estimated in the IMF's Public Investment Efficiency database at 31%.

Table 10. Calibrated Parameters and Initial Values

(in percent)

Definition	Value
Return to standard infrastructure [54]	25
Return to adaptation infrastructure	30
Public investment to GDP ratio	5.2
Grants to GDP ratio	1.4
Consumption tax (VAT) rate	20
Public domestic debt to GDP ratio	13.2
Public external concessional debt to GDP ratio	22.3
Public external commercial debt to GDP ratio	3.5
Remittances to GDP ratio	2.6
Imports to GDP ratio	17.6
Real interest rate on domestic debt	0
Real interest rate on external commercial debt	0.98
Depreciation rate of standard public infrastructure	7.5
Depreciation rate of resilient public infrastructure	3
Public investment efficiency	31%

Source: Madagascar's authorities and IMF staff calculations.

94. Encompassing these assumptions and channels into a climate-adjusted baseline scenario points to an unsustainable debt and/or lower growth in the medium term.[55]

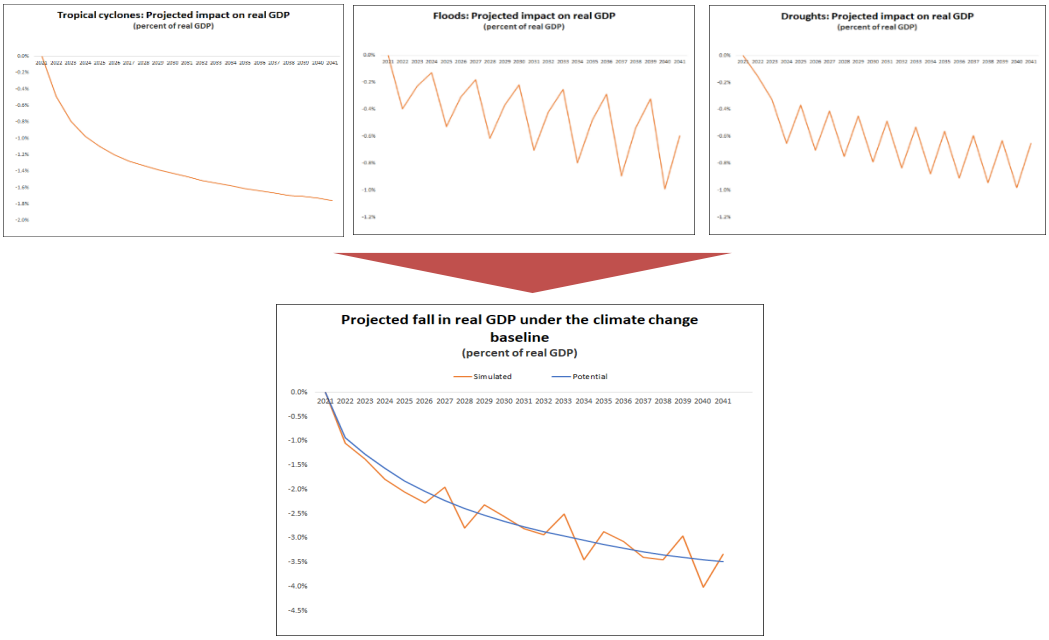
- **Under the assumption that the country can borrow its gross financing needs in full in any given year, and that it would cover in full for the reconstruction and humanitarian spending needs that arise after a disaster, debt-to-GDP would increase by 28 percentage points relative to a no-climate change baseline by 2040 and become unsustainable.** Debt is expected to exceed 70% of GDP in 2034 and reach 84% of GDP in 2040. These debt levels are inconsistent with the authorities' intention to maintain a moderate level of debt distress. Overall deficits are expected to remain at -5.4% of GDP on average after 2024. These fiscal outcomes reflect increasingly higher reconstruction and humanitarian costs. Under this scenario however, total cumulative GDP losses only amount to 4.4% of GDP, reflecting the absence of financing constraints in fully rebuilding damaged capital and output after a disaster. Trend real GDP growth during the period would be lower by 0.18 percentage points relative to a no-climate change scenario. Growth is volatile however, with strong deviations around the trend (see figure 16).

[54] Returns to infrastructure measure output elasticities with respect to the stock of capital (standard or adaptation). Since the DIGNAD framework assumes diminishing marginal returns, these values correspond to year 2021 (initial year of the simulation). Future returns will depend on the assumed path of public capital.

[55] The simulations below include both the effects of climate (i.e., baseline impacts of natural disasters) and of climate change (i.e., increase in intensity and frequency of natural disasters, and long-term effects on productivity). See figure 17 for a decomposition of the impacts on growth of each channel.

- **Under the assumption that the country will face a financing constraint if it is no longer assessed to be moderate risk of debt distress[56], debt would stabilize around 65% by 2040, but at the price of higher cumulative GDP losses.** When debt-to-GDP moves closer to 65%, the country still covers reconstruction and humanitarian needs in full, but strongly limits debt raising and implements a fiscal adjustment covered mostly by public investment cuts and partly by revenue mobilization efforts[57]. Fiscal adjustment negatively affects consumption and real GDP growth, and the financing limit becomes more binding every year as GDP losses accumulate. When the indicative debt ceiling of 65% of GDP is reached, the debt rule creates a painful trade-off between fiscal adjustment and disaster recovery. This contractionary scenario leads to durable cumulative GDP losses, reaching 5.2% by 2040, and an average yearly GDP growth loss of 0.22 percentage points.

Figure 16. Aggregating Impacts of Three Types of Natural Disasters on Real GDP Growth[58]

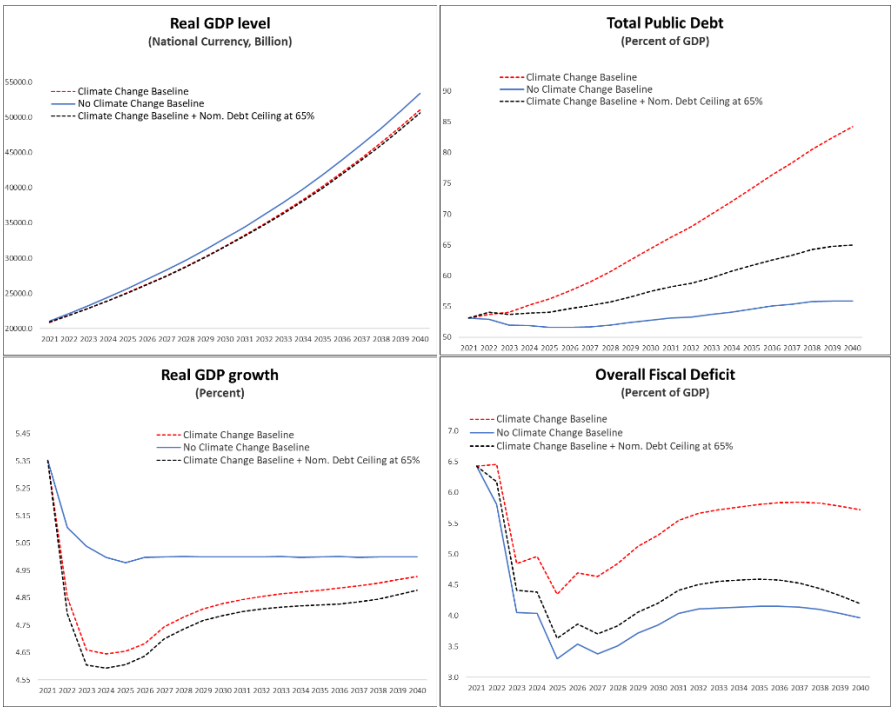


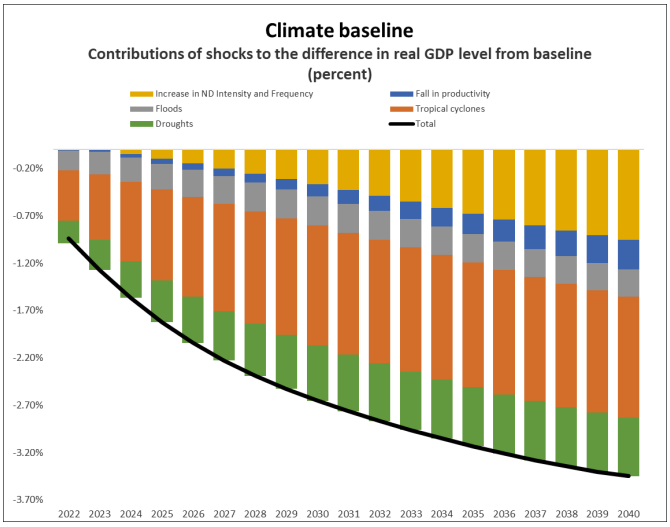
[56] Under the LIC-DSF framework, the PV of debt-to-GDP needs to remain below 55% for Madagascar to remain at a moderate risk of debt distress, assuming the country retains a medium debt-carrying capacity. Given current average maturity and cost of debt, this can be approximated as a limit on nominal debt of approximately 65%. The country does not currently have a formal debt rule. See https://www.imf.org/external/pubs/ft/dsa/lic.htm for the full framework.

[57] In the model, public investment cuts reduce public capital accumulation, and higher taxes reduce consumption. The fiscal adjustment mix includes ¾ of public investment cuts and ¼ of higher tax mobilization, in line with qualitative information shared by the authorities.

[58] The first three graphs reflect both climate-related impacts (i.e. baseline occurrence of natural disasters) and climate change (increase in impact and frequency). The fourth graph aggregates these impacts and adds to them the projected impact of slow-moving climate change. See annex 3 for a decomposition of impacts by channel. The climate-adjusted baseline assumes that natural disasters materialize as early as 2022 in line with historical frequencies, leading to a high impact on growth in 2022. Growth in subsequent years is only impacted by the impact of raising frequency and intensity of disasters.

Figure 17. Climate-Adjusted Baseline and Contributions of Shocks to Loss in Real GDP





Note: Climate shocks (floods, cyclones and droughts) accounts for about 63 percent of total real GDP loss by 2040 and climate change shocks (increase in intensity/frequency and loss in productivity) accounts for about 37 percent.

Modelling Policy Responses to Climate Change

95. The unsustainability of Madagascar's government debt in a climate-adjusted scenario requires an important and immediate policy response along the four areas identified in the report, namely: (i) climate mitigation measures that improve fiscal and distributional outcomes; (ii) adaptation investments that are more resilient to natural disasters and shield the rest of the economy; supported by (iii) PFM measures to improve the efficiency of public investment; and (iv) risk management measures to facilitate the authorities' fiscal response to a natural disaster.

96. These policy responses can be framed within the wider challenge of reaching the SDGs. Important spending needs to strengthen the resilience of the economy to natural disasters can only pay for themselves if they are combined with efforts to increase durably productivity through human capital investments (health and education)[59] and with ambitious revenue mobilization measures. Revenue mobilization could focus on mitigation measures, with revenues possibly recycled into SDG-compatible programs and transfers (e.g., *cash-for-schooling*), and on donor grants in support of high-quality investments.

97. Staff modelled three policy scenarios in response to climate change as well as their impact on growth and debt sustainability. These scenarios include:

- **Scenario 1:** adaptation investments reflecting both (i) effort to *build back better* after a natural disaster (rebuilding standard infrastructure as resilient infrastructure), and (ii) a resilient investment scale-up plan amounting to 1.5% of GDP annually[60].
- **Scenario 2:** in addition to scenario 1, gradual improvement in public investment efficiency from 31% (see footnote 57) up to the average Sub-Saharan African level of 63% in the 10 coming years.
- **Scenario 3:** SDG investments in human capital and resilient infrastructure (amounting to 4.8% of GDP per year for 10 years, i.e. until 2033, see table 11), funded partly by mitigation measures[61] and mobilization of grants.

[59] Health and education investments also have strong climate co-benefits, see IMF (2019).
[60] Preliminary estimate for modelling purposes. In the absence of historical data on adaptation investments, the amount of adaptation investments was approximated based on additional costs of building resilient. infrastructure for new infrastructure spending in selected sectors. Overall adaptation investment assumptions are in line with IMF estimates of investment needs for Sub-Saharan Africa of 2-3% of GDP annually (see IMF, 2020).
[61] The model assumes that mitigation revenues are recycled towards SDG investments (e.g. through spending that facilitates reaching health and education SDGs, such as *cash-for-schooling* programs).

Table 11. Modelling the Growth and Fiscal Impact of Policy Responses to Climate Change

Type of measure	Description	
Mitigation policies	Fiscal reforms that improve climate and distributional outcomes, including liberalizing fuel and electricity prices to eliminate regressive subsidies and removing inefficient tax distortions (see section III.)	- Higher tax revenues - Lower spending - Lower consumption
Adaptation investments	Public investments (typically infrastructure) with clear benefits relative to costs. (see section IV.)	- Higher resilience to disasters - Higher costs vs. standard investments 1/ - Higher economic returns on adaptation investments 2/ - Shielding effect on the rest of the economy
Risk management measures	Budget measures (contingency buffers, automatic stabilizers) and insurance products to mitigate revenue loss, absorb spending needs after a shock and preserve growth (see Section V.)	- No loss of public investment efficiency in the aftermath of a shock - Insurance to cover for losses beyond average frequency/impact
Public financial management/ public investment management	Reforms to improve public investment efficiency 3/ (see Section VI.)	- Gradual improvement of public investment efficiency to average Sub-Saharan Africa level - Higher build-up of capital stock - Human capital investments raise productivity and potential growth 5/
Sustainable Development Goals	Ambitious spending plan in human capital (health and education) and in resilient infrastructure (water, roads, energy) to reach SDGs 4/ within 10 years	- Resilient infrastructure in three sectors (water, energy, roads) with same benefits as adaptation investments and higher cost than standard investment - Focus on renewable energy to reach the energy decarbonization targets (see figure 3 and table 3)
Non-fiscal measures for adaptation	Regulatory standards for infrastructure and other public programs (risk zoning, early-warning systems, disaster response protocols, etc.)	Standards for adaptation infrastructure reflected in higher unit costs of adaptation investments. Public programs not modelled.

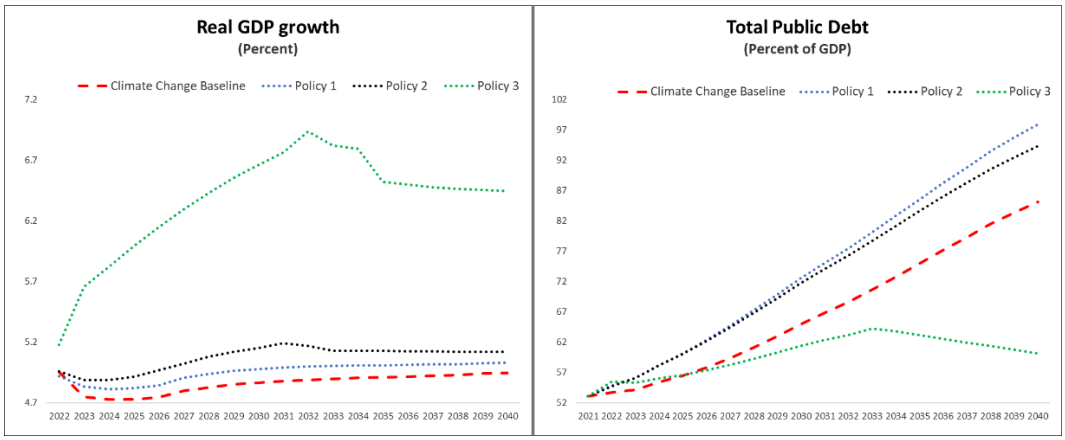
1/ Adaptation investment is assumed to be 25 percent more costly for the government than standard investment (Cantelmo, Melina and Papageorgiou, 2019).
2/ Returns on standard investments have been estimated in literature at 25% (World Bank, 2010), while returns on adaptation investments are assumed to be only marginally higher, at 30%.
3/ Public investment efficiency (PIE), at 31%, is very low compared to an average of 61% in LIDCs. Public investment reforms are modelled as a gradual 10-year increase of efficiency from 31% to 61%.
4/ SDG costing was based on the IMF's FAD SDG costing tool. Total annual public investment needs to reach the SDGs in 5 sectors (health, education, water, roads, energy) by 2033 could amount to c. 4.8% of GDP over the next 10 years on top of existing public investments, including additional costs of building resilient infrastructure.
5/ The mission used the IMF SDG fiscal financing tool to quantify the impact of human capital investment in health and education on long-term potential growth. According to the tool, human capital investments in the orders of magnitude needed to reach the SDG could boost potential growth by 1.5% by 2040.

98. Given the magnitude of the investment needs, resilience to natural disasters can only be achieved through a combination of climate measures, public investment efficiency measures and ambitious investments in both human capital and resilient infrastructure.

- **In policy scenario 1, scaling up adaptation investments alone is insufficient to restore a viable debt trajectory.** Under the first scenario, debt reaches 98% of GDP, reflecting the inefficiency of public investment and a higher cost of building resilient infrastructure. Adaptation capital remains limited by 2040 and only provides limited protection against disasters of increasing frequency and intensity.
- **In policy scenario 2, public investment efficiency reforms increase adaptation capital accumulation, but debt remains unsustainable.** Total debt-to-GDP ratio is reduced by 4 percentage points compared to scenario 1, due to lower damages from natural disasters and higher potential GDP.
- **In policy scenario 3, a sustainable growth approach centered on SDGs improves durably the economy's capacity to withstand climate shocks and succeeds in putting debt on a downward trajectory in the medium term.** More ambitious investments in resilient infrastructure, combined with public investment efficiency measures, limit losses from natural disasters and boost growth, while human capital investments durably boost productivity by 17% by 2040 and strengthen economic recovery after a shock. The country's ability to mobilize revenues from mitigation measures and additional grants from donors in support of human capital spending keeps deficits in check.

99. If Madagascar is to implement the first-best policy scenario (policy scenario 3), then it would require substantially higher support from donors to preserve debt sustainability. The country needs to build the case for higher support through a credible package of high-quality climate measures, centered on durably increasing the resilience of the economy and on ensuring higher spending efficiency.

Figure 18. Growth and Public Debt Under the Three Scenarios



Note: Policy scenarios 1 and 2 assume a financing mix in line with the country's historical financing mix: 67.1% of total financing needs met through concessional debt, 24.6% through grants and 8.3% through external commercial debt. Policy 3 assumes additional grants in support of SDG investment (about 1 percent of GDP per year), while the remaining financing needs are covered by the same mix as in Policy 1 and 2.

100. A range of measures is required to mainstream climate into macro-fiscal policy:

- Reflect natural disasters in annual and medium-term budgets by including explicit assumptions on climate scenario and its expected impacts, adequate buffers and well-costed response measures *(short-term)*
- Prepare a well-costed document reflecting a package of climate measures, including adaptation, public investment efficiency, mitigation and SDG-oriented measures and with associated implementation plans, to anchor future reform efforts. Such a document would build on existing policy documents (e.g., NDC, NAP, PFM reform strategy) *(short-term)*
- Develop the technical capacity to assess the impact of natural disasters on macroeconomic variables and include climate shocks in all macroeconomic projections *(short- to medium-term)*
  - Develop a database of past economic impacts of natural disasters
  - Conduct systematic economic impact assessments (sectoral GDP impact, physical capital losses)

Annex I. Assessment of Adaptation Policies

Adaptation goals

What are the goals and objectives of adaptation as elaborated in national plans?

Madagascar's National Adaptation Plan laid out three strategic areas for the planning:

- strengthen the governance and integration of adaptation;
- implement a program of priority sectoral actions;
- financing adaptation to climate change.

Sectors have had thorough contingency plans to cope with climate extreme events:

- Tropical Cyclones
- Droughts

Adaptation policies

What policies do the national plans specify to reduce risks of climate change?

Institutional arrangement:

Madagascar follows a sectoral approach to develop and implement adaptation plans in a participatory manner. The national entities provide technical supports when sectors request helps.

The ten structuring programs articulated in the NAP present the approaches to managing the climate change risks through:

- more targeted development at the sectoral levels (four out of ten programs)
- better information system that helps manage extreme events (four out of ten programs)

Knowledge mechanism:

- The sectors are responsible for collecting and reporting the data on the impacts of disasters in the past, whereas the capacity is not there yet.
- So far, the adaptation policy-making has not been effectively informed by learning from the evaluation of the policies in the past.

Funding mechanism:

- Most of the adaptation interventions are project-based and driven by the development partners.
- There is not much involvement from the private sector.

Gaps

Do the adaptation policies align with the country's risk profile, as well as the adaptation goals?

Strategy Gap

- The national plan does not fully distinguish adaptation and mitigation. Mitigation is one of the ten structuring programs that were intended to strengthen climate resilience.
- The sector plans do not clarify on the relationship between adaptation and development.
- Insufficient recognition of the slow-moving effects of climate stresses
- Lack of prioritization mechanism that allows an efficient selection of adaptation interventions.

Knowledge Gap

- Sectoral ministries lack the systematic impact data from the disasters in the past
- Sectoral ministries lack the data and information on the impact projection of the future climate stresses and exacerbated climate extreme events.

Finance Gap

- The sectoral entities lack the capacities to understand the landscape of adaptation finance in the international space, limiting the potential for Madagascar to take advantage of the international funding mechanism and provide extra finance for important adaptation actions.
- There is no strategy in place aiming to unlock private finance for adaptation.

Annex II. The Fiscal Cost of Protecting and Restoring Natural Capital in Madagascar[62]

Projected Costs of Protecting and Restoring Madagascar's Natural Capital

		Total area to be protected or restored by 2030 (million ha)		Unit cost per hectare per year (US$)		Total Cost, 2020-2030 (million US$)	
		Low	High	Low	High	Low	High
Managing existing forest areas 1/		8.46	10.36	$5	$12	$432	$1 285
	Source:	*GFW+Bonn*		*Cooke*	*Markandya*		
Forest restoration 2/		0.49	0.92	$96	$680	$469	$6 256
	Source:	*Prop'l Rule*	*Bonn*	*Markandya*	*AFR100*		
Restoring degraded agricultural land 3/		1.64	3.08	$390	$640	$1 050	$1 200
	Source:	*Prop'l Rule*	*Bonn*	*Markandya*	*Markandya*		
Creating new terrestrial protected areas 4/, 5/		2.42	5.33	$27	$101	$65	$538
	Source:	15% target, Cooke	20% target, Cooke	GEF, 2017			
Creating and managing new marine protected areas 5/		5.49	10.99	$15	$36	$82	$396
	Source:	*Markandya*	*Markandya*	*Markandya*	*Markandya*		
Totals		18.50	30.68			$2 090	$9 675

1/ Includes both protected areas and community forest management
2/ Government Bonn and AFR100 restoration commitments
3/ Extrapolated from UNCCD 2018. 15% of rural population lives on degraded land, and average landholding per rural household is between 0.5 and 1.8 hectares.
4/ Targets are to increase PA coverage from 12.1% to 15% (low) or 20% (high)
5/ The costs of creating new protected areas arise only once per hectare created, not annually.

[62] The fiscal costs of these strategies are taken from both national planning documents for Madagascar and estimated costs from the academic literature.

Annex III. Building the Climate Change Baseline Using the DIGNAD Model[63]

The Debt, Investment, Growth, and Natural Disasters (DIGNAD) model is a dynamic small open economy model designed to simulate the impact of one natural disaster and associated policy trade-offs between debt accumulation, public/private investment, and growth.[64] It was developed by Marto, Papageorgiou, and Klyuev (2018) as an extension of the DIG model (Buffie et al, 2012). The key assumption in DIGNAD is that there are two types of public capital, one is standard physical capital, and the other is adaptation capital. Standard capital is vulnerable to natural disasters, and part of it is destroyed each time a natural disaster hits the economy. Adaptation capital is more resilient to such events. Both types are used as an input to production by perfectly competitive firms, jointly with private capital and labor. The government has access to a wide range of financing sources, including external concessional loans and grants from international donors. The model captures many key mechanisms and policy trade-offs that should be considered in a typical cost-benefit analysis of climate change policies (Aligishiev et al., 2022), particularly those associated with the linkages between public adaptation investment, economic growth, and debt.

The mission team leveraged the DIGNAD framework to simulate the impacts of repeated natural disasters and slow-moving climate change through the following three channels:

(i) Permanent decrease in the total factor productivity due to changing temperature patterns. Climate change is expected to reduce labor productivity across the entire economy and cause disproportionately lower productivity of certain types of economic activities that are sensitive to changing temperature/precipitation patterns (e.g., fisheries and agriculture). DIGNAD approximates this phenomenon through a gradual and anticipated fall in the factor productivities in both tradable and non-tradable sectors:

$$y_{t,i} = A_t\left(k_t^g\right)^{\psi} k_{t,i}^{\alpha} l_{t,i}^{1-\alpha} \qquad for \quad i \in \{T, NT\}$$

where $y_{t,i}$ is the total output of the sector in real terms; A_t is the common total factor productivity; K_t^G is the stock of public capital; $K_{t,i}$ is the sector's stock of private capital; and $N_{t,i}$ is the corresponding labor supply. A permanent decrease in A_t— calibrated to match the mid-range of estimates of GDP losses in Kahn et al. (2019)—pushes the economy into a new steady state of lower total factor productivity by 2050.

(ii) Scarring from multiple and coinciding natural disasters. We assume that the three types of natural disasters (tropical cyclones, floods, and droughts) occur at frequencies in line with historical patterns over the last 43 years. In the model, natural disasters are expected to affect the economy through the following three channels: (i) damages to public capital; (ii) damages to private capital; (iii) a temporary productivity loss. Despite the transitory nature of storms and floods in Madagascar (permitted by the "building back better" approach of the country

[63] The development of the DIGNAD model is part of a research project on macroeconomic policy in low-income countries (IATI Identifier: GB-1-202960) supported by the U.K.'s Foreign, Commonwealth and Development Office (FCDO) and the partners in the IMF's COVID-19 Crisis Capacity Development Initiative (CCCDI)—Belgium, Canada, China, Germany, Japan, Korea, Spain, Singapore, and Switzerland.

authorities), natural disasters produce scarring as the time lags between natural disaster events (observed in the historical data) are typically shorter than the time necessary for the country to replenish its capital stock and see the recovery in TFP to the pre-disaster level. The model assumes that after a natural disaster, the economy gradually recovers to its steady state (i.e., capital is entirely rebuilt, productivity recovers, and GDP growth goes back to trend) absent another natural disaster.

(iii) Increasing frequency and intensity of natural disasters. Over the following decades, Madagascar is expected to experience more heatwaves, more irregular rainfalls that bring heightened hazards of flooding and droughts, and stronger tropical cyclones. Based on the historic patterns in cyclone, drought and flood frequencies, the country will most probably face more disaster events per 10 years in the future. This application approximates the increase in the impact of natural disasters by assuming linearity of responses to shocks in the DIGNAD model. In other words, we leverage the simplifying assumptions that increasing the intensity of a given natural disaster by a factor β produces a response of macroeconomic indicators that is higher by the same factor β.[65]

The impact of climate change on real GDP, fiscal deficit, and public debt from each of these three channels were simulated separately using the model. The model applied natural disaster shocks and long-term adjustments to the country team's baseline debt projections, resulting in increased volatility in growth and fiscal projections. In the case of repeated natural disasters, a Hodrick-Prescott filter was used to separate long-run adjustment to the baseline from noisy short-term fluctuations.[66] The impact on the baseline from each of the three individual channels were then summed up to produce final climate change projections presented in Figure X. Figure Y presents the decomposition of the deviation of climate change baseline from team's initial real GDP projection. The largest driver of lower potential GDP projection under the climate change baseline are tropical cyclones, which account for 1.3 percentage points of the total real GDP loss in 2040. Nonetheless, the contribution of the increase in the intensity and frequency of natural disasters—caused by slow-moving climate change—rises rapidly and becomes by 2040 the second largest driver behind the lower potential GDP projection.

[65] This approach may lead to underestimation of the economic costs of climate change as damage functions of natural disasters are typically expected to be non-linear.

[66] Filtering relied on smoothing parameter $\lambda = 100$ since DIGNAD produced simulations at an annual frequency. Although, model simulations were extended for an additional 10 years after 2040 to reduce the end-point bias, further extending the simulation horizon proved to be complicated due to data limitations.

Annex IV. Detailed Scoring for the C-PIMA Assessment Module

The following scores have been used to describe the institutional strength of the various dimensions:

Score	Low	Medium	High
	1	2	3
Color			

C1. Climate-aware planning	
C1.a.	**National and sectoral planning**
C1.b.	**Land use and building regulations**
C1.c.	**Centralized guidance on planning**
C2. Coordination between entities	
C2.a.	**Coordination across central government**
C2.b.	**Coordination with provincial and local governments**
C2.c.	**Oversight framework for public corporations**
C3. Project appraisal and selection	
C3.a.	**Climate analysis in project appraisal**
C3.b.	**Framework for PPP and long-term contracts including climate risks**
C3.c	**Climate consideration in project selection**
C4. Budgeting and portfolio management	
C4.a.	**Climate budget tagging**
C4.b.	**Ex post review of projects on climate outcomes**
C4.c.	**Asset management**
C5. Risk management	
C5.a.	**Disaster risk management strategy**
C5.b.	**Ex ante financing mechanisms**
C5.c.	**Fiscal risk analysis including climate risks**

Annex V. CARBON PRICING ASSESMENT TOOL (CPAT)

Carbon Pricing Assessment Tool (CPAT) is a spreadsheet-based tool used for the quantitative analyses in the mitigation section.[67] The tool is available for around 175 countries and allows to estimate the impact of energy pricing reforms and other mitigation policies such as increase in RE on emissions; energy mix; revenue potential; effects on long-term GDP growth; and distributional and poverty effects.

While the CPAT includes assumptions on emissions, energy mix, energy prices, and electricity generation capacity compiled from publicly available and IMF sources, with inputs from proprietary and third-party sources, the analysis can be enhanced by incorporating data and projections on emission inventory, energy mix, taxes, and subsidies etc. from the authorities.

For the analysis on Madagascar, the following updates were made to the baseline CPAT tool:

- The data on energy taxes, subsidies, and price inputs from authorities when available.
- The pipeline of hydro projects already in the works was added to sources of electricity generation in the medium-term.
- The distributional and poverty effects were analyzed using inputs from the 2010 Enquête Périodique auprès des Ménages (EPM).

[67] CPAT has been developed by IMF and World Bank staff. For descriptions of the model and its parameterization, see IMF (2019 Appendix III), and Parry, Mylonas and Vernon (2021).

Annex VI. The Role of Social Protection in Energy Subsidy Reforms

To mitigate the impact of higher energy prices on the poor, our main recommendation is to expand social transfers using budgetary savings from the energy pricing reforms. In fact, a study of 25 fuel subsidy reform episodes in the MENA region found that all reforms that used cash transfers successfully removed fuel subsidies, whereas only 17 percent of reforms without cash transfers succeeded (Sdralevich et al., 2014). Below we present some examples of countries which have used transfers to reduce the welfare loss for households and some takeaways for Madagascar[68]:

- Iran implemented subsidy reforms in 2010, increasing the price of petroleum products by between 230 and 840 percent. The government opened bank accounts for heads of households prior to the removal of subsidies and started making bi-monthly cash transfers to 70 to 80 percent of all citizens using about 80 percent of the revenue from price increases (Rentschler and Bazilian, 2017). Given the administrative challenges and to ensure buy-in from all stakeholders, all citizens were allowed to apply for the compensatory transfers, The equal transfers were large enough to lift virtually every Iranian out of poverty as the compensation represented a larger share of poor household's income than it did for the middle class.

  Takeaway: Successful reforms are well planned with a clear reform strategy, including by expanding financial inclusion. In cases where targeting is administratively difficult, providing all households with equal transfers could still achieve redistributive effects and build support for the reform. Targeting of these transfers can then be improved over time.

- Kenya implemented electricity reforms such that subsidies declined from 1.5 percent of GDP in 2001 to zero in 2008. The subsidy reforms are part of a broader package intended to address supply problems. In place of the electricity price subsidies, the government subsidized connection costs, which helped expand coverage to poor households and those in remote and rural areas. The rural electrification program helped increase the number of connections from 650,000 in 2003 to 2 million as of 2014, with a fund for connection fee payments financed by donors.

  Takeaway: Subsidies can be redirected to achieve other development goals such as improving access to electricity. Electricity pricing reforms accompanied by a broader reform package to improve operational efficiency of the electricity company would increase the likelihood of success.

[68] Based on IMF (2013) Supplement "Case Studies on Energy Subsidy Reform-Lessons and Implications".

- Ghana implemented fuel subsidy reforms in 2005, increasing the price of petroleum products by 50 percent on average. The government introduced a range of programs to alleviate the burden on the most vulnerable, including the elimination of fees for state-run primary and secondary schools; an increase in public-transport buses; a price ceiling on public-transport fares; and more funding for health care in poor areas.

  Takeaway: While targeted cash transfers or near-cash transfers are typically the preferred approach to compensation, they might not be immediately feasible due to capacity constraints. In such cases, other programs can be utilized while administrative capacity is developed to scale up cash transfer programs. Here, efficient and visible reallocation of the resources saved through the removal of fuel subsidies to programs with immediate benefits to the most vulnerable would help secure a successful subsidy reform.

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