EASTERN AND
SOUTHERN AFRICA

# MOZAMBIQUE

World Bank Group

# COUNTRY CLIMATE AND DEVELOPMENT REPORT

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# MOZAMBIQUE

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# Acknowledgments

The Mozambique Country Climate and Development Report (CCDR) is part of a World Bank Group effort to capture the interplay between the country's development challenges and climate change. It was developed by a multi-sectoral team across the World Bank Group (WBG), in coordination with the Government of Mozambique (GoM), to promote sustainable and climate resilient development in Mozambique.

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# Acronyms & Abbreviations

| | |
|---|---|
| **ADALYs** | Avoided Disability-Adjusted Life Years |
| **AFOLU** | Agriculture, Forestry and Land Use |
| **BAU** | Business-As-Usual |
| **CBAM** | Carbon Border Adjustment Mechanism |
| **CEM** | Country Economic Memorandum |
| **CSA** | Climate Smart Agriculture |
| **DRM** | Disaster Risk Management |
| **DSA** | Debt Sustainability Analysis |
| **FDI** | Foreign Direct Investment |
| **GBV** | Gender-Based Violence |
| **GHG** | Green House Gases |
| **GoM** | Government of Mozambique |
| **ICS** | Improved Cookstoves |
| **LNG** | Liquified Natural Gas |
| **LPG** | Liquified Petroleum Gas |
| **LT-LEDS** | Long-Term, Low-Emission Development Strategy |
| **MADER** | Ministry of Agriculture and Rural Development |
| **MECS** | Modern Energy Cooking Services |
| **MRV** | Monitoring, Reporting and Verification |
| **NAPA** | National Adaptation Programme of Action |
| **NBT** | Nature-Based Tourism |
| **NCCAMS** | National Climate Change Adaptation and Mitigation Strategy |
| **NES** | National Electrification Strategy |
| **NRM** | Natural Risk Management |
| **PFM** | Public Financial Management |
| **PIM** | Public Investment Management |
| **PPP** | Public-Private Partnership |
| **PV** | Photovoltaic |
| **REP** | Renewable Energy Plants |
| **SADC** | Southern African Development Community |
| **SAPP** | South Africa Power Pool |
| **SEA** | Sexual Exploitation and Abuse |
| **SH** | Sexual Harassment |
| **SHSs** | Solar Home Systems |
| **SIF** | Forest Information System |
| **SNGs** | Subnational governments |
| **SSA** | Sub-Saharan Africa |
| **SWF** | Sovereign Wealth Fund |
| **WDI** | World Development Indicators |
| **YLL** | Years of Life Lost |

# EXECUTIVE SUMMARY

# Executive Summary

**This Country Climate and Development Report (CCDR) captures the interplay between development challenges and climate change and climate policies in Mozambique, with the objective of identifying synergies and tradeoffs.** The CCDR informs the World Bank Group's engagement in Mozambique, alongside other key products, such as Systematic Country Diagnostics (SCDs) and the recently adopted Country Partnership Framework (CPF) for the period 2023–2027. The CCDR aims to support Mozambique's strategic vision and identifies a set of priorities for the most impactful and cost-effective actions to boost adaptation, build resilience, and foster low-carbon growth, while delivering on broader development goals.

## Mozambique's development context

**Mozambique is a country endowed with abundant natural resources, which provide a transformative opportunity to promote inclusive and resilient development.** The country has one of the world's largest natural-gas reserves, vast amounts of arable land and miombo forests, considerable hydropower resources, wildlife, outstanding biodiversity, one of the region's longest coastlines and is strategically located to serve as a gateway to global markets. Despite having experienced in 2020 the first economic contraction in 28 years, Mozambique's prospects are promising, with growth expected to reach an average of eight percent during 2023–2027. In recent years, Mozambique has made significant progress in strengthening economic management, disaster risk management, sustainable land-use, and access to electricity, among other areas[1]. Seventy percent of the population is employed in low-productivity subsistence agriculture and live in rural areas. More broadly, Mozambique's growth, driven primarily by mining and natural gas, has not created sufficient job opportunities at the pace needed for rapid poverty reduction. Inefficient factor and product markets, low human capital accumulation, low access to infrastructure services and weak institutions have hindered the process of a needed structural transformation of the economy.

**Despite noticeable progress, government capacity to address Mozambique's development challenges is highly constrained.** Public spending is mostly committed to pay wages, pensions, and debt services. Tax revenues are already amongst the highest compared to peer countries. Debt levels are high and Mozambique, has been assessed to be at 'high risk' of debt distress, with debt sustainable in a forward-looking sense[2]. This is particularly problematic given that the country does not have access to international financial markets at competitive rates. Further, high interest rates constrain access to finance and private sector development in the non-natural gas sectors.

**Mozambique's development challenges are compounded by fragility, conflict, and violence.** The intensification and escalation of an insurgency in gas-rich Cabo Delgado[3] underscored the country's fragility and the need to strengthen social cohesion. The resurgence of violence has had social and economic consequences, with almost one million

[1] World Bank. 2022. (forthcoming). This percentage use the international poverty line of US$ 2.15 a day per person in 2017 PPP (purchasing power parity).

[2] International Development Association International Monetary Fund, Republic of Mozambique, "Joint World Bank-IMF Debt Sustainability Analysis", April 2020.

[3] Since 2017, Mozambique has been facing an insurgency in Cabo Delgado, which has spilled over into the neighboring Nampula and Niassa provinces. Insurgency has resulted in a humanitarian and displacement crisis and has led to delays in the implementation of large liquefied natural gas (LNG) investments. The conflict reflects some of the structural factors that drive fragility in Mozambique, including widespread poverty, north-south disparities, political marginalization, lack of job opportunities and incomplete state building.

people involuntarily displaced and the delay of investments in the two largest natural gas fields. Due to the worsening security outlook, in 2021 gas enterprises halted operations in the northernmost district of Palma, although there are recent signs that project activities are likely to resume. Mozambique's institutions still need to improve effectiveness, inclusiveness, and public trust[4].

**Climate change and the impact of extreme climate events, to which Mozambique has long been exposed, further exacerbates these challenges.** Mozambique is amongst the ten countries that are most vulnerable globally to the impact of climate change and natural hazards. According to the 2021 Global Climate Risk Index, in 2019 Mozambique was the country most affected by climate change[5]. Its location, extensive coastline, and large expanse of low-lying hinterland contribute to its vulnerability. The impacts of climate change are expected to increase over the next decades. Projected rising temperatures, more irregular rainfalls and related sea level rise will increase the frequency and intensity of droughts, floods, and cyclones. In terms of temperature changes, under the SSP5 8.5 scenario, mean temperatures are predicted to rise significantly, with anomalies ranging from 0.8°C over the next 20 years to 4.19°C between 2080 and 2099[6].

**The Government of Mozambique has scaled up its commitment to tackling climate change, building resilience, and enhancing disaster preparedness.** Mozambique is currently in stage 4 of the Nationally Determined Contribution (NDC) Partnership Plan Implementation, and the Government submitted its first updated NDC in December 2021. However, the connection between national plans, sectoral plans, and the NDC is still weak and could be further improved, while keeping expectations consistent with capability. Mozambique would benefit from balancing its foundational institutional and administrative capacity with its ambitious program conducted in an environment of extreme climate exposure.

## Potential impacts of climate change and implications for structural transformation and household vulnerability

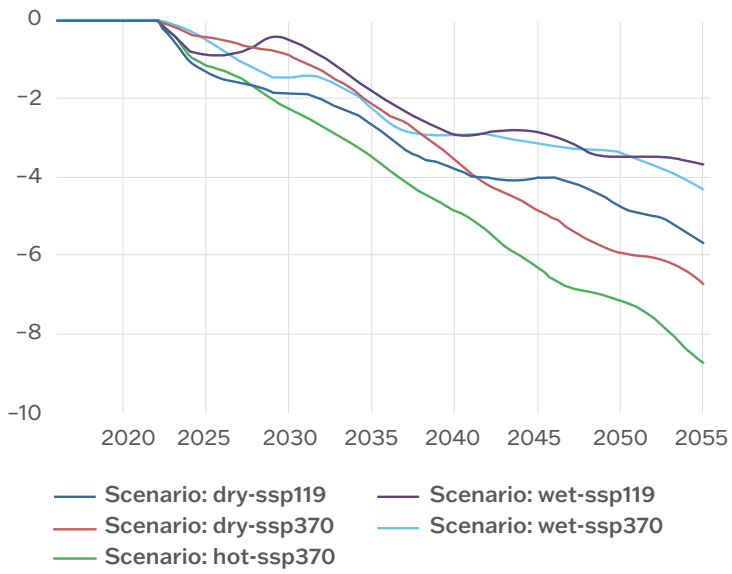
**This CCDR estimates that the impact of climate change and natural disasters on labor productivity and growth are expected to be significant.** Figure E1 shows the impact of climate change on gross domestic product (GDP) for the different climate scenarios. The largest impacts are felt under the "hot" scenarios (SSP3-RCP7), with a GDP reduction of nine percent in 2050 relative to the baseline, mainly through the impact on agriculture and labor productivity. This CCDR shows that the direct and indirect costs of climate-induced natural disasters in Mozambique are also considerable, lowering growth by almost 15 percent for the worst set of outcomes.

[4] For example, firms reported in the 2018 World Bank Enterprise Survey that they consider governance issues the biggest constraint to their business activity.

[5] The Global Climate Risk Index analyses quantified impacts of extreme events, both in terms of fatalities as well as economic losses that occurred. Source: David Eckstein, Vera Künzel, Laura Schäfer "Global Climate Risk Index 2021, Who suffers Most from Extreme Weather Events? Weather-related Loss Events in 2019 and 2000 to 2019", Germanwatch, 202.

[6] These figures refer to average median temperature anomalies. On the different scenarios, see Table 3.

Figure ES.1: Total climate change impact on GDP




*Sources:* Mozambique MFMOD Standalone and Industrial Economics (2022).

**Climate change impacts on poverty and inequality are significant.** The CCDR analysis shows that by 2050, under the worst-case hot scenario, the poverty rate will increase relative to the baseline by five percent, with 1.6 million additional individuals sliding into poverty[7]. Without significant structural transformation, inequality as measured by the Gini coefficient will remain constant by 2050 under all the climate scenarios analyzed.

**The CCDR finds that climate change makes it more difficult for Mozambique to enable structural transformation and diversify its economy, thereby eroding its human, physical, and natural capital:**

» Climate change hinders much needed human capital development. It is estimated that 70 percent of schools in Mozambique are in high-risk areas for one or more hazards[8]. It has been shown that school infrastructure suffers more than US$ 2 million in damages per year by natural hazards (0.25 percent of overall annual education sector spending), which corresponds to 540 classrooms and 57,000 students affected annually.[9] The impact of climate events on health infrastructure is also high. In 2022, Cyclone Gombe destroyed more than 60 health facilities in the Nampula province alone. One of the impacts of climate change on human capital is the reduction of labor productivity directly through temperature increases at the workplace. This is especially concerning for labor types that are outdoors and with more intense physical work such as those in the agriculture sector, which for these reasons shows the largest impacts. This CCDR estimates that in 2050 under the hot SSP370 scenarios, these impacts are as high as 12 percent, 10 percent, and 3 percent in agriculture, industry, and services sectors, respectively.

[7] Estimates use the international poverty line.

[8] Christophe Briere, João de Lima Rego, Andreas Burzel, Conceição Leite, Dana Stuparu, Maaike Maarse, and Mark de Bel, "Multi-Hazard Risk Assessment for the Schools Sector in Mozambique", Global Facility for Disaster Reduction and Recovery, World Bank, 2018.

[9] Ibidem.

» Infrastructure is under threat of damage from natural hazards, leading to disruption of service provision and deepening the infrastructure gap and reducing the benefits of urbanization. As assessed by the CCDR, about 60 percent of the total road network is in flood prone areas. Nearly 30 percent of the national road network was damaged by Cyclones Idai and Kenneth in 2019[10]. Disruptions to the road network due to climate change impacts access to domestic markets, increasing the risks of post-harvest losses and food insecurity. This CCDR estimates that the economic damage from climate events to the road network could equal 1.1 percent of the country's GDP. Cities are also extremely exposed to climate hazards, mainly due to a lack of adequate urban infrastructures and sufficient urban planning. The CCDR found that the unmanaged expansion of Maputo, coupled with unfolding climate change, would increase flooding risks of up to 70 percent on average through 2050.

» Key natural capital-based growth sectors are impacted by climate change. Water scarcity is expected to be exacerbated by climate change. All scenarios predict an increase in water demand in most of Mozambique. Coupled with population growth, this trend will put more pressure on water supply for domestic, agricultural, and industrial water demand. Furthermore, Mozambique's storage and drainage infrastructures are insufficient to buffer against cyclones, floods, and droughts. This also hampers the minimization of the impact of the country's high-water dependency. Agricultural productivity will be further affected, preventing a shift from subsistence agriculture. The situation is compounded by the lack of adaptation investments, which is estimated by this CCDR to highly impact main crops yields, especially bananas, sesame and teas, but also cassava and potatoes. Fisheries, an important source of income and subsistence in coastal communities, are also highly exposed to the risk of climate change. Climate change will undermine natural assets and exacerbate biodiversity losses, which also risks jeopardizing Mozambique's nature-based tourism (NBT) potential. This sector is key for poverty reduction and economic growth, as it tends to employ more unskilled labor while creating new market opportunities for local producers and the scope for off-farm diversification.

**The impact of climate change is particularly significant on Mozambican women, increasing the incidence of poverty and widening gender inequalities.** The share of women in non-agricultural employment has slightly increased but remains considerably low (34.8 percent in 2019 versus 31 percent in 2010[11]). This indicates that Mozambique's women are still highly exposed to climate hazards. Furthermore, there are gender-specific divisions of labor and responsibility in water resource access that have a particular effect on women. With increasing drought, women need to walk longer distances to collect water, increasing risks related to Gender-Based Violence (GBV), Sexual Exploitation and Abuse (SEA), and Sexual Harassment (SH).

## Promoting low-carbon development to successfully manage transition risks

**Low-carbon development is important for Mozambique not because the country needs to reduce its GHG emissions —since they are very low—, but because global low-carbon trends will exert pressure on the country's resource-driven growth path, impacting Mozambique's export performance.** Mozambique's contribution to global

[10] Government of Mozambique (2019), Mozambique Cyclone Idai, Post Disaster Needs Assessment.

[11] United Nations Development Programme, Mozambique, Country profile, https://hdr.undp.org/en/countries/profiles/MOZ.

warming is negligible: in 2019, its total GHG emissions including land use change and forestry (LUCF) were 106.74 million tonnes (metric tons) of carbon dioxide equivalent ($MtCO_2e$), about 0.21 percent of global emissions. On the other hand, Mozambique growth and export performance is highly dependent on aluminum and coal, making the country highly exposed to Carbon Border Adjustment Mechanism (CBAM) and similar measures as other countries pursue low-carbon strategies. Mozambique's LNG sector, which can have a transformational effect in the economy, might also be a challenged by the global low-carbon path.

**The global low-carbon transition requires Mozambique to minimize its impact on the most vulnerable households in the coal sector.** Given Mozambique's economic dependence on carbon intensive sectors, there is a need for Mozambique to prepare a 'just transition'. Due to decreasing global demand for coal in a low-carbon scenario, mines will have to close, with the risk that many people will lose their jobs and fall into poverty again. The effects on jobs and poverty from coal mine closures is likely to be felt especially in regions that are more dependent on the production of carbon-intensive sectors, such as Tete Province, where coal has contributed to lifting 40,000 people out of poverty. Additionally, mine closures in South Africa could also affect households in Mozambique, through a decline in remittances and the return of mining workers.

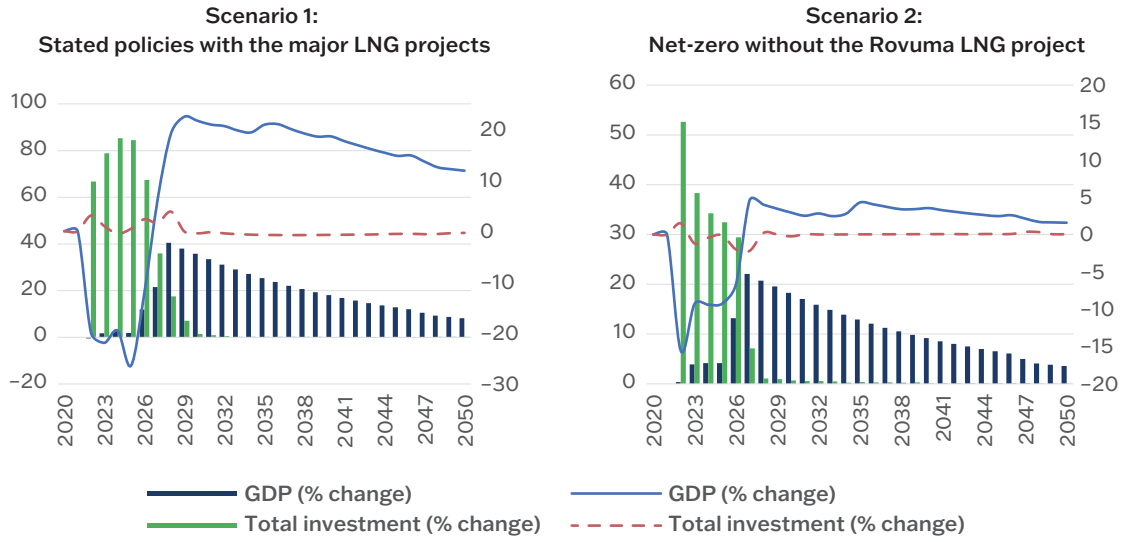
## Harnessing the potential of Mozambique's mineral and gas wealth

**Despite the risk posed by global low-carbon trends, natural gas can play an important role to accelerate growth, mitigate poverty, and generate significant fiscal space in the economy.** Under a baseline scenario—where all LNG investment projects foreseen for Mozambique are completed and prices remain unchanged—Mozambique's GDP in 2033 would more than double the amount without LNG investments, thereby expanding the fiscal space[12]. Estimates[13] indicate that in this scenario, between 2019 and 2033, the LNG industry will directly and indirectly create about 1.6 million jobs per year. As shown in this CCDR, the LNG is still relevant even in a global net-zero scenario. The macro modeling (chapter 3) shows that the impact of LNG investments on poverty reduction and GDP would be positive even under the least favorable global market conditions if revenues are used appropriately and contribute to an inclusive increase in income across the population. Compared to the scenario without the three LNG projects, by 2030, GDP would be 40 percent higher under current market conditions, and still 20 percent higher under the net zero transition scenario with lower gas prices. It is important to mention that these scenarios do not consider risks related to additional delays in starting exploration related to security concerns or others.

[12] The LNG projects include Coral South Floating LNG, approximately US$ 7 billion in investment (started production in 2022); Golfinho/Atum—approximately US$ 23 billion in investment (started in late 2019, was interrupted in 2021 due to the escalation of insurgency in the north); and the Mamba project, estimated at US$ 30 billion (final investment decision was postponed due to COVID-19 and escalating insurgency). Under a less optimistic scenario, where only two LNG projects become operational, real GDP would still be 60 percent higher than without LNG production.

[13] World Bank, "Mozambique Country Economic Memoradum", 2021.

**Figure ES.2: Mozambique's main macro variable dynamics compared to a no-LNG scenario, in % difference**




*Source:* World Bank estimates.

**Mozambique can play a key role in the low-carbon growth of the South Africa Power Pool (SAPP) but it will require additional investments in transmission system and management of climate induced risks due to hydropower variability.** Simulations done for this CCDR show that the least-cost options to meet the country energy needs do not include coal as economical viable option. Instead, the least-cost pathway, based on an advance technology adoption, is based on rapid growth of hydropower generation, and in lesser extend solar power and gas power generation. To fully harness this potential, Mozambique will require larger investments in transmission to connect the solar and hydro rich regions to the demand centers, as well as the need to manage climate risks to its hydropower capacity, as more frequent and intense extreme weather events may lead to more variability in generation output. For instance, to achieve 80 percent emission reduction in power generation in the SAPP by 2040, investing US$ 8 billion more in Mozambique's electricity generation base in a scenario of full regional integration will reduce the overall investment requirements in the SAPP by US$ 42 billion compared to a scenario with limited regional integration.

**Mozambique is also well positioned to capitalize on its critical mineral resources to support the green energy transition globally.** Mozambique is the third largest producer of natural graphite, and home to two graphite mining companies holding high-grade world-class graphite deposits. It is also rich in other minerals central to clean energy, such as ilmenite, iron ore, vanadium, titanium, copper, gold, tantalum, and bauxite. The headline fiscal take of such critical mineral projects will not be at the same level as gas, but there will be much more diverse opportunities for local content and local participation in medium-sized mining than in gas projects. Mozambique's long experience in the extractives sector will turn out to be a key factor to successfully prepare the country to harness this opportunity.

## Mainstreaming climate change considerations into Mozambique's development agenda

**The CCDR identifies a set of priority actions to operationalize the pathways towards climate-resilient development.** With tight fiscal space, Mozambique needs to prioritize policies and investments that enhance the country's resilience while tapping into

opportunities of global low carbon trends. This CCDR estimates that the level of investment needed by 2030 to achieve climate resilience of human, physical and natural capital amounts to US$ 37.2 billion. Therefore, priorities for short-term impact should be identified. These priorities will need to focus on enhancing the country's adaptation capacity, in the most cost-effective way. First, this requires an emphasis on institutional building and policy reforms to maximize the impact of capital investments. Secondly, prioritized measures should aim at increasing the country's long-term climate resilience and have high developmental impact. Thirdly, measures that can crowd in additional climate financing and investments, should be prioritized. Finally, it is key to support the poorest and the most vulnerable when managing climate impacts and low-carbon transitions. This CCDR points to four priorities that are aligned with these criteria, affordable and urgent in the sense that they will cost more if implemented later.

### *PRIORITY 1: Adopt Economy-wide Measures to Enhance Adaptative Capacity*

**Consolidate Mozambique's legal and institutional framework, strengthen institutional capacity to steer climate action, and mobilize and attract additional sources of financing.** This provides the opportunity to effectively integrate climate change challenges into the country's development strategy. A key recommendation is to create a framework law on climate change, and to strengthen the country's coordination capacity on climate change at the highest level of government. This needs to be accompanied by greater efforts in training staff and upgrading equipment for regulation, monitoring, and enforcement. Furthermore, institutional capacity for improved data availability and quality needs to be strengthened, not least to position the country to mobilize additional climate funding sources that require sound monitoring, reporting and verification (MRV) of GHG emissions. A sound institutional framework is also crucial to manage future LNG revenue flows.

**Mainstream climate risk into public expenditure planning to ensure the efficiency of capital expenditure and foster sustainable growth.** To deal with climate risks proactively, Mozambique is committed to reforming its Public Investment Management (PIM) systems to fully integrate climate change risks into the decision-making process. Managing climate risks should be considered not only with regards to PIM, but also in public sector management more broadly, from national planning to procurement, among others. This will also require a careful choice between the types of investments within this sector: for instance, investments in more resilient roads pays off as compared to efficient maintenance in 30 years.

**Continue strengthening institutions for disaster preparedness.** Simulations indicate that significantly higher returns (in terms of foregone growth rates) are obtained by reducing the time of recovery of damaged assets (a proxy for response preparedness). This calls for continued support for the implementation of the Disaster Risk Management (DRM) Master Plan, while fostering administrative and financial decentralization to empower local institutions in the early response. Further action is also required to further reduce existing risks of climate disasters (through, for example, the retrofitting of public infrastructure) and future risks (through the systematic inclusion of resilient and affordable standards in the planning and construction of public infrastructure). The education sector is among the most advanced to integrate risk reduction in infrastructure provision, but this needs to be mainstreamed across all institutions commissioning public infrastructure, including water, energy, health, transport, and agriculture.

**Enhance the role of the private sector to accelerate climate-smart investments in key sectors, overcoming public budget constraints and slow onset of LNG revenues.** Some of the challenges to be addressed include: (i) improve capital markets regulation and market

valuation of investment potential and sector prioritization to identify bankable projects; (ii) strengthen institutional capacity to manage, structure and negotiate concessions and profitable public-private partnership (PPP); (iii) support conditions for the private sector to adjust to Carbon Border Adjustment Mechanisms (CBAM), (iv) adopt legislation to support circularity and promote competition for waste management services; (v) adjust import duties for clean technologies, (vi) review and update building codes, and (vii) upgrade construction methods. A visibly organized private sector entity would allow Mozambique to more readily engage or attract private sector finance.

### *PRIORITY 2: Prioritize Critical Infrastructure Development and Management*

**Improve transport infrastructure in Mozambique to reduce the impact of climate change risks, while boosting development in rural poor regions.** Analysis done for this CCDR shows that maintaining the road network in good condition could reduce economic losses caused by flooding by 27.5 percent. By paving all classified roads, the potential climate risk could be mitigated by 58 percent. Paving roads would enhance the resilience of the road network and add redundancies offering more alternatives, thereby further reducing economic disruption. The annual cost of maintaining all classified roads in good condition is estimated at US$ 401 million per year on average. This measure is achievable; however, paving all roads may be less affordable, with an average cost estimated at US$ 807 million per year on average.

**Build climate-smart social infrastructure for human capital development.** This mainly means building resilient schools and health centers, which have proved to withstand cyclones and other climate hazards, as well as retrofit those built not in accordance with resilient standards. It is key to combine this effort by training school management teams and teachers in disaster preparedness. Sensitizing communities on the importance of building resilient social infrastructures is also important to ensure a participatory process. The cost of building new schools on sites not prone to droughts, resilient to intense weather-related events and ensuring good maintenance of equipment is estimated at US$ 100 million by 2030.

**Improve water resource management to address high spatial and temporal water resource variability, as Mozambique is affected by both droughts and floods.** Integrated water resource management amount to estimated investment need of US$ 4.6 billion until 2030. This includes investments in climate resilient water supply and storage infrastructure, and improved flood protection infrastructure including large investments in urban stormwater drainage. It also includes improved watershed, aquifer recharge, and sediment management. In addition, demand-side measures for the water sector are critical, including measures to improve metering, implementation of a polluters-payer mechanism, and development of methodology for water tariff adjustments. Finally, institutional strengthening and improved coordination are key to manage multiple sectoral demands on water use.

### *PRIORITY 3: Protect the Most Vulnerable while Promoting Green, Resilient and Inclusive Growth*

**Promote climate smart agriculture (CSA) and human capital development for structural transformation to reduce impact on those most exposed to climate change.** Adaptation investments, such as increasing the uptake of irrigation infrastructure, coupled with the promotion of CSA practices, such as conservation agriculture, agroforestry, organic farming, sustainable soil fertility management, and integrated pest management, would

enhance the productivity and the resilience of the sector. Increasing the uptake of climate risk insurance products in the agricultural sector can enable insured households to better manage climate shocks and stabilize their productivity and income levels, allowing for better planning and investments. Overall, key interventions to strengthen resilience in agriculture until 2026 are estimated to cost US$ 1.2 billion.

**Promote the integrated management of land and ocean resources to build terrestrial and coastal resilience, while unlocking Mozambique's green and blue growth potential.** Mozambique is very well endowed with renewable natural resources key to building terrestrial and coastal resilience against climate shocks. Integrated management of these resources will not only protect global public goods and Mozambique's natural capital base but also unlock opportunities to foster green and blue growth. These include conservation friendly and export-oriented agriculture products (shade coffee, honey, etc.). Mozambique also has enormous eco— and wildlife tourism potential, as well as potential for sustainable aquaculture, mangrove restoration and mariculture. Such activities can also generate significant climate finance streams from reduced land use emissions and blue carbon or be the basis of innovative mechanisms to crowd in more private funding such as blue or green bonds, the proceeds of which can be used to re-invest in climate adaptation and resilience.

**Support the most vulnerable households through adaptive social protection programs.** Mozambique's current social protection coverage is still below the planned targets and requires a strategic expansion to ensure the poorest and most vulnerable households are included. Win-win solutions can also be promoted by tailoring cash for work programs to productive land restoration activities. The Basic Social Subsidy Program (PSSB), a program with broader coverage, could be used for shock responses, including vertical expansions (top up benefits to current beneficiaries) and horizontal expansion (temporary expansion to cover new beneficiaries affected by shocks). Cash transfers can be enhanced through the expansion of digital payments. It is also important to start planning for a just transition in Tete, a coal-dependent region. Lastly, the focus on the most vulnerable could consider investing in clean cooking which has a positive impact on the health of the poorer segments of the population while also helping contain deforestation. This CCDR estimates that the total cost of inaction on the clean cooking agenda, stemming from the negative externalities for health, gender, and climate, is about US$ 17 billion per year[14].

### *PRIORITY 4: Leverage Mozambique's Energy and Mineral Wealth*

**Increase access to energy and foster clean energy solutions for Mozambique and the region.** Mozambique's location as a gateway to global markets and natural resources endowment provide a unique opportunity to drive a low-carbon energy transition in domestic and regional markets. Expanding energy access to all Mozambicans by 2030 is a core priority agenda for the country. Achieving this while increasing the sector's climate resilience requires investment in renewable on-grid and off-grid electrification (hydro, solar, and wind) as well as in modern and climate-proof energy transmission. This should be combined with effective demand-side measures and risk-based planning to ensure greatest cost effectiveness of energy investments. The scenario analyses conducted in this CCDR show that Mozambique's clean energy potential has a key role in the low-carbon growth of the SAPP. Achieving 80 percent emission reduction in the SAPP with regional integration will require significant investments in Mozambique (US$ 20 billion) but cost 14 percent less than without regional integration. Mozambique could leverage climate finance support

[14] World Bank Estimates. Additional details on the methodology are provided in the Background Note, available upon request.

dedicated to SAPP low-carbon growth to promote these clean energy investments. Continued promotion of transparent and competitive process for procuring new generation will ensure that Mozambique can herness its natural resources at low cost and position as a powerhouse for the region.

**Harness the country's natural gas reserves while managing lock-in risks.** After 2028, revenues from LNG sales will enhance the country's debt sustainability and can generate significant fiscal space to support investments in adaptation needs and climate resilient infrastructures. This requires the right institutional framework and the decision by the Government of Mozambique (GoM) to establish a Sovereign Wealth Fund (SWF) to ensure sound management of LNG revenues, including effective oversight mechanisms that would provide transparency and accountability. This would help balance the needs of present and future generations, as well as mitigate the risk of macroeconomic imbalances. Measures to manage the lock-in risks related to global low-carbon goals include the application of strongest environmental and social standards to the LNG operations, including the options of offsetting any GHG emissions generated by natural gas exploration, and the parallel pursuit of green growth opportunities from renewable natural resources and renewable energies.

**Plan for a just transition from coal mining, and harness Mozambique's mineral wealth in a sustainable way.** Given the decline in financing and the growing restrictions from international markets, the GoM should plan to transition from coal extraction and exports, while considering social implications. This should happen in a way that protects workers, communities, and the environment. National and regional governments need to be supported in developing clear roadmaps to phase out coal, including design of social protection, reskilling and job transition programs as well as developing comprehensive environmental remediation plans that present possible pathways for economic transition. On the other hand, Mozambique is well positioned to benefit from the critical mineral boom driven by the energy transition, by attracting FDI, fostering economic diversification, and accelerating the creation of formal and well-paid jobs. In this regard, Mozambique's existing coal mining capacity could be shifted to critical mineral extraction, providing significant job opportunities, especially for mine workers affected by the coal phase out. Nevertheless, these resources are concentrated in environmentally sensitive areas; therefore, the extraction of these minerals requires sound land-use planning and impact assessments.

## Financing Mozambique's climate-resilient development path

**Investments for climate-resilient and inclusive development could be partially financed by proceeds from the expected LNG revenues, especially after 2030.** This CCDR shows that even with global net-zero by 2050, the gas sector could generate additional public resources and the corresponding fiscal space to finance a considerable volume of the country's much-needed public investments. To achieve this, it is crucial to establish an adequate policy and institutional framework and clearly identify investment priorities, well ahead of the revenue windfalls. The SWF and planned improvements in the debt and fiscal frameworks can ensure transparent and equitable sharing of natural resources revenues. Finally, it will be critical for the government to continue developing public investment processes and systems, drawing on the resource revenue windfall to finance well-appraised projects that are resilient to climate change. This needs to be combined with continued commitment to budget consolidation.

**Private capital mobilization (PCM) and carbon finance can also play a considerable role.** Private investment can accrue to the most profitable sectors, such as energy, but well-conceived projects and PPP contracts may extend participation of private investment. Beyond financing, private participation in segments such as housing, agriculture, tourism, and municipal solid waste management may also facilitate higher resilience levels. In particular, the off-grid solar power, strongly supported by recent government efforts, has an enormous potential that could be further harnessed by the private sector, whose participation has been limited so far. Another option is expanding access to carbon finance through integrated management of its renewable natural resources.

**Mozambique cannot single handedly finance climate-resilient measures, support from the international community is thus fundamental to deliver results over the short and medium terms.** Significant LNG revenues will not be available before 2028. Preparing PPP projects is likely to take a few years and will be limited by the country's capacity to generate bankable projects. Carbon financing is promising but faces the challenges of technical complexity, the need to accelerate funding commitments, delayed development of an international compliance carbon market under Article 6 of the Paris Agreement, regional imbalances in accessing climate financing, and high transaction costs to navigate the existing voluntary carbon markets and offset schemes. For these reasons, crowding in grant and highly concessional financing, such as very long maturity loans, is likely to be the most effective way to meet the very large investment needs. Building and leveraging bilateral as well multilateral partnerships with donors remains essential to cover the funding gap required to improve climate resilience. Having already benefited from climate finance through the Forest Carbon Partnership Facility (FCPF), Mozambique is well positioned to scale up sustainable and climate smart land use approaches that could benefit from future initiatives such as the World Bank's recently launched Scaling Climate Action by Lowering Emissions (SCALE) partnership. In this regard, it is important for Mozambique to finalize the national policy on climate finance, develop a portfolio of possible investment projects aligned with development and climate priorities, increase coordination among international development partners, and further implement climate-smart public investment management.

# 1 MOZAMBIQUE'S DEVELOPMENT AGENDA IN A CHANGING CLIMATE

# Chapter 1: Mozambique's Development Agenda in a Changing Climate

**This chapter reviews Mozambique's current socioeconomic context and main development challenges, including the constraints on economic diversification, structural transformation, and inclusive growth.** It then provides a profile of climate change risks, and an assessment of the compounding effect of climate change and natural hazards on Mozambique's development agenda.

## 1.1. Mozambique's Context and Main Development Challenges

**Following the end of the protracted civil war in 1992, Mozambique experienced strong economic growth for over two decades, although the macroeconomic outlook has been volatile over the last few years.** Real GDP growth accelerated remarkably with an average of 7.9 percent over 1993–2015, compared to an average of 0.5 percent in 1980–1990.[15] The revelation of undisclosed debts in 2016 (the "hidden debt" crisis) led to a sharp drop in growth, further exacerbated by the combined effects of natural disasters in 2019 and conflict in the natural gas-rich province of Cabo Delgado since 2017. Between 2016–2019, Mozambique's growth averaged three percent. The recent global pandemic has taken a heavy toll on Mozambique's economy just as it was starting to recover from this slowdown. In 2020, the country experienced its first contraction in 28 years, with GDP growth falling by 1.2 percent (Figure 1). The pandemic has worsened food insecurity with an additional 1.4 million Mozambicans at risk of falling below the national poverty line.[16]

**Economic growth is strengthening and expected to accelerate over the medium-term, reaching eight percent over 2023–2027, driven by continued recovery in services, increased LNG production and high commodity prices.** The offshore LNG project started production in 2022 and is expected to reach full capacity between 2023 and 2024[17]. High commodity prices —notably coal, aluminum, and gas— will continue to support export growth, and FDI inflows will sustain investments. Assuming favorable weather conditions, agriculture will maintain a positive performance supported by continued investments in inputs. These trends will be reinforced by the resumption of LNG projects, boosting FDI and demand for services, notably real estate, hospitality, transport, and construction.

**The current account deficit is expected to expand in the medium term as LNG projects advance but it will continue to be fully financed through trade credits and FDI, among others.** As LNG activities resume and overall imports rise, the current account deficit is poised to remain high, and expected to average 30 percent of GDP in the medium-term. Total imports of goods, driven by LNG investments, are projected to average 45 percent of GDP in 2023–2025, markedly higher than the level observed over 2019–2021. This increase will be partly offset by gas exports. Gross reserves are expected to remain at comfortable levels (around US$ 3 billion, equivalent to four months of imports), supported by FDI inflows, grants, and concessional financing.

[15] World Bank, 2022, Macro Poverty Outlook, Washington, DC.

[16] World Bank, 2021, Mozambique Economic Update, Setting: The Stage for Recovery, Washington, DC.

[17] The off-shore Coral project, led by ENI—which is the smallest of the three LNG projects underway in the Rovuma Basin—started production in 2022. The assumption is that the project reached only 17 percent of the total 3.4 million tons per annum (mtpa) production capacity in 2022 and will gradually increase to full capacity in 2024.

**Figure 1: Real GDP growth and sectoral contributions to real GDP growth, in %, 2013–2025**

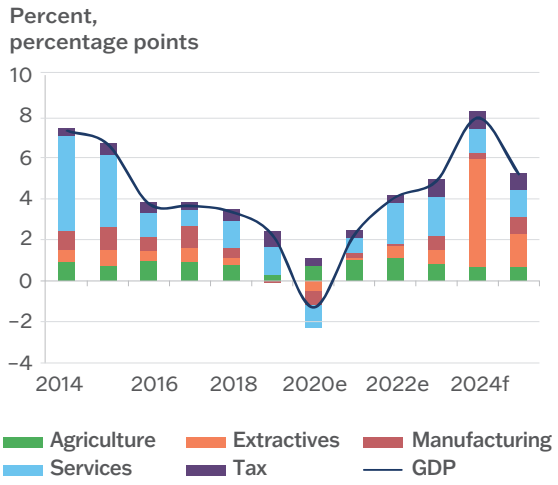
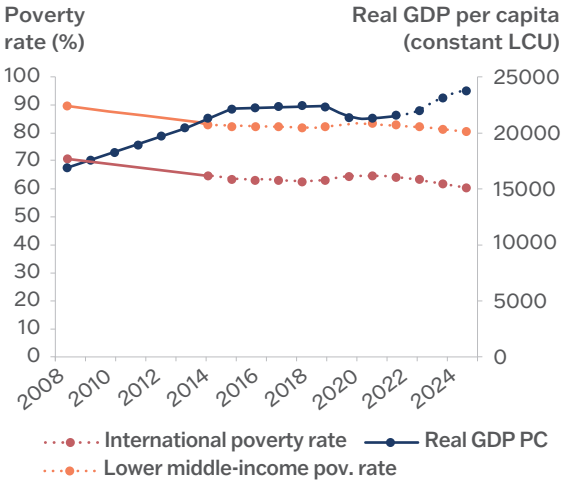



**Figure 2: Actual and projected poverty rates, in %, and real GDP per capita, LCU constant**




*Source:* World Bank, 2023, Macro Poverty Outlook April, Washington, DC.

**Growth, however, has not been inclusive and has not resulted in widespread poverty reduction.** This is because economic growth has been mainly driven by megaprojects and FDI in the extractive industries, with modest benefits to poor and vulnerable populations and limited linkages with the rest of the economy. A good indicator is the performance of non-megaproject manufacturing, which did not match the investment boom and has had the lowest labor share of total employment (4–5 percent since 1997[18]). The country is one of the 10 poorest in the world, with a Human Development Index (HDI) of 0.446, which ranks 185 among 191 countries.[19] Poverty in Mozambique is overwhelmingly concentrated in rural areas, with a large share of the population still engaged in informal rural activities, predominantly smallholder agriculture, especially in the northern provinces.[20] While agriculture still contributes nearly a quarter of the GDP and employs more than 70 percent of the labor force, services account for 40 percent of GDP. Poverty incidence is expected to decrease slightly (from 64.3 to 60.6 percent between 2022 and 2025) but the number of poor is projected to increase due to population growth[21] (Figure 2). At the same time, this resource-driven growth model has also contributed to rising levels of inequality. The GINI coefficient is one of the highest in the world,[22] and the country faces significant regional inequalities and imbalances in terms of access to resources, services, and opportunities. Moreover, since progress has benefited mostly populations in urban centers, large gaps in standards of living and economic opportunities between urban and rural areas continue to be observed.

**Given these persisting fragilities and constraints, the main development challenges for Mozambique are to trigger structural transformation and promote inclusive growth.** The economy is characterized by the absence of labor movements to high-productivity sectors,

[18] World Bank, 2020, Mozambique Country Economic Memorandum, Washington, DC.

[19] Figures elaborated by United Nations Development Programme (UNDP).

[20] Mozambique exhibits high heterogeneity in poverty rates between provinces: Niassa (66.7 percent), Nampula (64.84 percent), Zambezia (61.76 percent), Cabo Delgado (50 percent), Manica (37.15 percent), Inhambane (34.52 percent) and Maputo Province (11.80 percent). Source: World Bank estimates. World Bank, 2018, Mozambique Poverty Assessment, Washington, DC.

[21] World Bank, 2023, Macro Poverty Outlook, April, Washington, DC.

[22] The most recent value indicates the GINI index equals to 54.0. Source: World Bank.

limited agricultural productivity, low physical and human capital accumulation, and lack of economic diversification in a mainly resource-driven growth model. The country has a large share of agricultural employment compared to peer countries. Small-scale subsistence agriculture is the primary source of income for nearly nine in ten rural households.[23] Most agricultural income is in the form of self-consumption and to a lesser extent through the sales of their own production, and yet many households remain food insecure. Rapid growth in the services sector has offered a wider path to jobs outside agriculture in the last decade, but services remain dominated by low-productivity commerce and informal activities (Figure 3). Manufacturing's employment share remains stagnant, and its output share continues to fall. Additionally, the gradual move out of agriculture has not been evenly distributed, with the southern region registering the greatest growth in industry and services, while the poorer central and northern regions are still dominated by agriculture. While physical and human capital accumulation remain relevant sources of growth, structural transformation shifting labor from low subsistence agriculture to more productive activities is an opportunity to improve aggregate productivity.[24]

**Figure 3: Average labor productivity by sector**

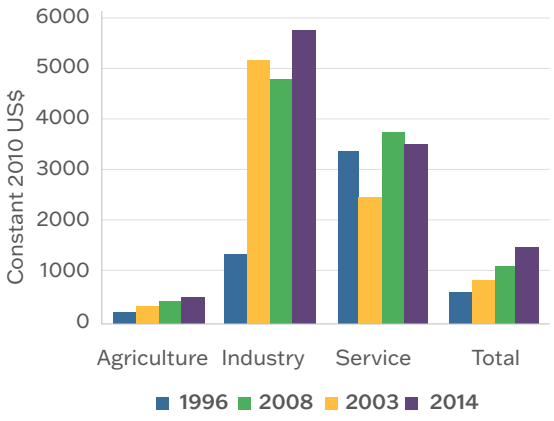
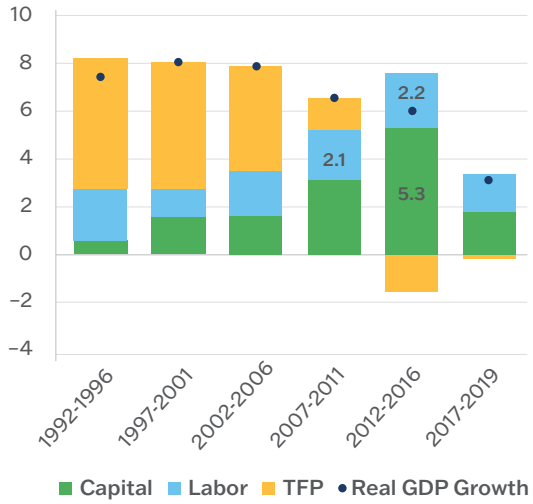



**Figure 4: Mozambique: Growth decomposition (1992–2019)**




*Source:* World Bank. 2020. Mozambique Country Economic Memorandum, World Bank.

**Human capital is essential to ensure that jobs in more productive sectors are created and filled.** However, long-term structural transformation has been undermined by weak human capital. Mozambique ranks 148 out of 157 in the World Bank's 2020 Human Capital Index, below most of its peers in sub-Saharan Africa. The contribution of human capital remained low and stagnant (Figure 4), especially in rural areas, trapping rural poor into poverty and excluding them from the gains of economic growth. Human capital accumulation is also constrained by poor performance in learning: it is estimated that a child born in Mozambique today will be only 36 percent as productive as she could have been if she had enjoyed complete education and full health.[25]

[23] World Bank, 2020, Cultivating Opportunities for Faster Rural Income Growth and Poverty Reduction: Mozambique Rural Income Diagnostic, World Bank.

[24] Lachler U. and Ricaldi F., 2021, "Mozambique Jobs Diagnostic: Volume 2 — Jobs Strategy Policy Note", World Bank, Washington, DC.

[25] World Bank. 2020. Mozambique Country Economic Memorandum, World Bank.

**Poor physical infrastructure is a critical obstacle to faster and more inclusive growth in Mozambique.** Given large geographical distances between the areas of highest agricultural potential (rural center and north) and the areas of greatest effective demand (urban south), infrastructures deficit represents a key constrain for spatial transformation[26] and higher output performance. Increasing connectivity between areas with strong agricultural productivity and markets as well as scaling up investments in rural infrastructure would yield large benefits across the country, and especially in rural poor areas in the northern and central regions.

**Energy poverty remains a key development challenge for Mozambique.** Access to electricity stands at 41 percent in 2022 with an impressive increase of 15 percent points in the last five years, almost reaching average SSA rates (42 percent) but additional work is required to reach the whole population. (EDM) has increased access to electricity services from 18 percent in 2010, reaching through the grid all administrative centers across the country while also serving some isolated areas, in the absence of a nationally interconnected grid system. In the past five years, emerging new players in the off-grid space are providing high-quality certified solar products with more flexible payment schemes such as the pay-as-you-go (PAYGO) model. Yet, low access to electricity hinders economic growth and job creation, contributing to deforestation and harming health due to the prevalent use of biomass energy. Additionally, unequal access causes economic and social disparities across regions, as well as between urban and rural areas. The rural electricity access rate is estimated at about four percent, against 75 percent in urban areas, and only 22 percent of the population in the northern provinces have access to electricity (about 12 million people are living without modern energy solutions). The government aims to achieve universal access to electricity by 2030.

**The low rate of urbanization remains an underutilized powerful lever to trigger structural and spatial transformation, reduce poverty and foster shared prosperity.** Although the pace of urbanization has grown in recent years, the overall rural-urban transition is below the levels observed in other parts of Africa. Two of every three Mozambicans live in rural areas, where population density is low relative to the amount of arable land available.[27] This trend is expected to continue, with Mozambique's population growth largely concentrated in rural and northern and central areas. Therefore, although slowly becoming more urbanized, the country is projected to remain mainly rural until 2040.[28] Only in 2050 will urban dwellers exceed half of the total population. Furthermore, Mozambique's growing population will increase the demand for agricultural land and forestry products, exercising higher pressure on limited natural resources.

**Limited institutional capacity is a central development challenge for Mozambique.** Gaps in public expenditure and delivery of basic services remain a source of grievance in the central and northern regions, fueling discontent. Mozambique's fragile capacity has two other important dimensions. First, a weak governance regime which, despite efforts since the 2016 'Hidden Debt' episode, continues to hamper the provision of public services, economic growth, and job creation. The second dimension refers to the long-term status of public finances. Fiscal adjustments have been hampered by persistent public-sector financing needs and increased domestic borrowing. Fiscal pressures remain high with a wage bill corresponding to about 13 percent of GDP (about double the peers' average). The

[26] Spatial transformation refers to the sectoral transformation of countries from agrarian to industrial and then to services, and has its manifestation in the urbanization process.

[27] World Bank, 2020, Cultivating Opportunities for Faster Rural Income Growth and Poverty Reduction: Mozambique Rural Income Diagnostic, World Bank.

[28] Ibidem.

debt burden has increased sharply in recent years, reaching about 130 percent of GDP in 2020, due to the hidden debt crisis and other shocks, including COVID-19. Mozambique remains in debt distress, with debt assessed as 'sustainable in a forward-looking sense', according to the April 2020 Fund-Bank Debt Sustainability Analysis (DSA). The poor state of public finances has severe negative impacts on growth, and thereby, poverty, inequality, and the ability of the state to provide public goods.

## 1.2. Climate Change Shocks, Impacts and Future Climate Change Projections

**Mozambique has long been exposed to extreme climate events.** It is among the ten countries most vulnerable globally to the impact of climate change,[29] and the most vulnerable on the African continent. Between 1950 and 2018, Mozambique was impacted by more than 90 tropical cyclones. According to the 2021 Global Climate Risk Index, Mozambique was the country most affected by climate change in 2019.[30] Its location, extensive coastline, and large expanse of low-lying hinterland, all increase its exposure. From 1980 to 2020, floods and storms were the first and third most recurring natural hazard on average, with 33 and 22 percent incidence, respectively[31] (Figure 5). Floods affected 8.5 million people and storms affected 6.2 million people between 1980 and 2020[32] (Figure 6). Nampula and Zambezia, followed by Inhambane, Cabo Delgado and Sofala, are the provinces most affected by cyclones, while floods are mainly reported in Sofala, Zambezia and Nampula (Figure 7). Droughts are a recurrent hazard in Mozambique and around 46 percent of people are affected every year by sustained periods of below-normal water availability. The most drought-affected province is Zambezia, followed by central and southern provinces (Manica, Gaza, Sofala and Inhambane) with impacts on child nutrition,[33] and consequences for learning and future income generation.

**Figure 5: Distribution of natural hazard type 1980–2020**

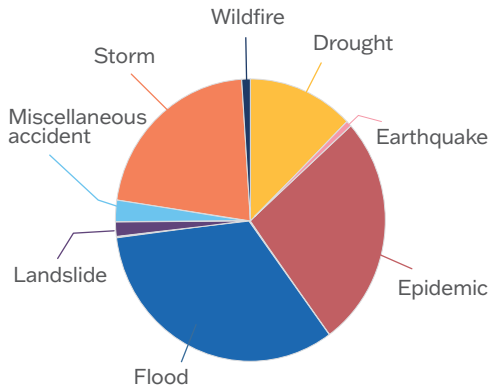
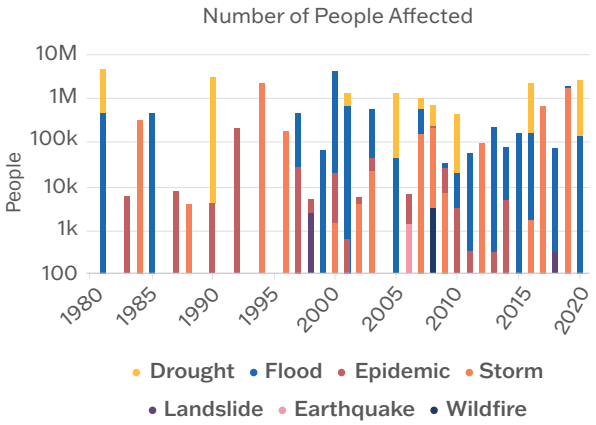



**Figure 6: Distribution of the number of hazard occurrence, in %, 1980–2020**




*Source:* Climate Change Knowledge Portal – Mozambique Profile, World Bank, 2022.

[29] Eckstein D., Künzel V. and Schäfer L., 2021, Global Climate Risk Index 2021, Germanwatch.

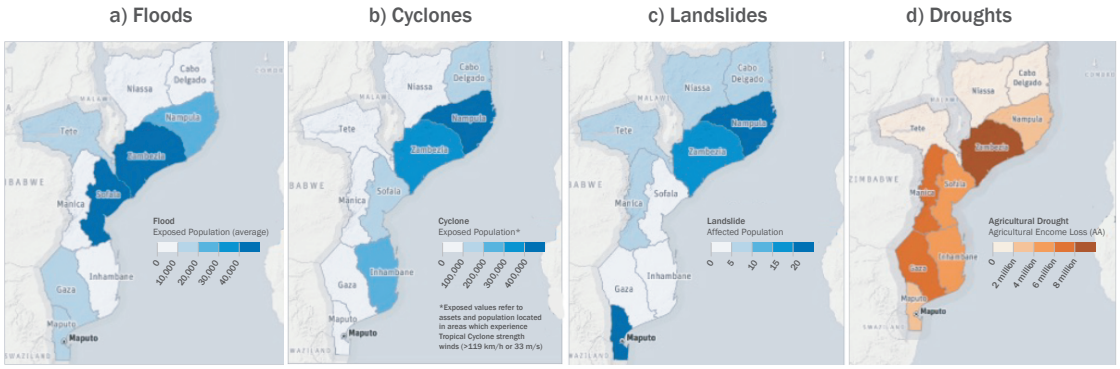
[30] The Global Climate Risk Index analyses quantified impacts of extreme events, both in terms of the fatalities as well as the economic losses that occurred. Source: .

[31] Climate Change Knowledge Portal — Mozambique Profile, World Bank, 2022.

[32] Ibidem.

[33] Sylvia Blom et all, Heat exposure and child nutrition: Evidence from West Africa Cornell University, 2022.

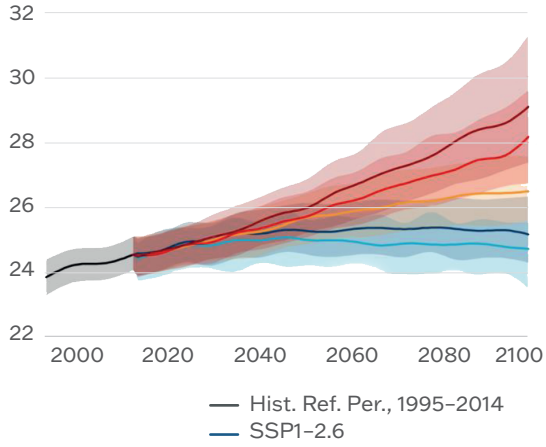
## Figure 7: (a) Exposed population to floods and (b) cyclones; (c) affected population by landslides (d) and drought



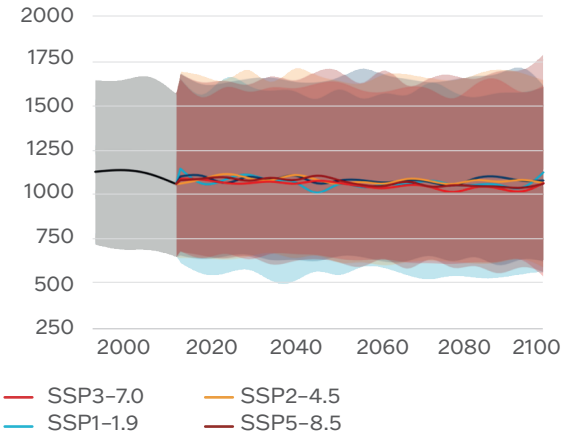

*Source:* World Bank (WB), 2019, "Disaster Risk Profile: Mozambique", Washington, DC.

**Climate change is expected to increase Mozambique's vulnerability over the next decades.** Projected rising temperatures, more irregular rainfall, and related sea level rise (see Figures 8 and 9) will increase the frequency and intensity of droughts, floods, and cyclones. Under the 'fossil-fueled development' scenario (SSP5–8.5),[34] mean temperatures are predicted to rise significantly, with anomalies ranging from 0.8°C over the next 20 years to 4.19°C between 2080 and 2099.[35] Projected precipitation anomaly is expected to range from –1.5 mm over the next 20 years to –5.2 mm by 2100. Anomalies are projected to vary throughout the country, ranging from –89.5 mm in Nampula to 49.4 mm in Maputo (2080–2099).[36]

## Figure 8: Projected Mean-Temperature (Ref. Period: 1995-2014), in °C, 2014–2100




## Figure 9: Projected Precipitation (Ref. Period: 1995-2014), in mm, 2014–2100





*Source:* World Bank (WB), 2019, "Disaster Risk Profile: Mozambique", Washington, DC.

[34] Projections used for this report used the CMIP6 suite of climate models, examining scenarios that combine Shared Socioeconomic Pathways (SSPs) with Representative Concentration Pathways (RCP). The SSP-RCP combinations chosen for this report SSP1–2.6, SSP2–4.5, SSP3–7.0, SSP5–8.5 are run through General Circulation Models (GCM) that project future climate conditions.

[35] These figures refer to average median temperature anomalies.

[36] These figures refer to average median temperature anomalies.

## 1.3. Impacts of Climate Change on Mozambique's Development Agenda

**Climate change acts as a major constraint to inclusive and resilient socio-economic development in Mozambique.** Climate change introduces additional shocks and aggravates existing challenges, disproportionally affecting the poor and the most vulnerable, exacerbating poverty and inequalities, and ultimately complicating Mozambique's efforts to diversify its economy. Climate change puts pressure on the country's asset base, jeopardizes the drivers of growth and amplifies the effect of the above-mentioned constraints on effective structural and spatial transformation: it makes agricultural even less productive, depletes natural capital, erodes physical capital, hampers improvements in energy access, reduces the benefits of already slow urbanization and undermines human capital development.

**The compounding effects of climate change and natural hazards are exacerbated by the country's weak state capacity and very tight fiscal situation.** Mozambique's low institutional and fiscal capacity can hinder the adoption of cost-effective prevention measures, such as investments in infrastructure maintenance, and the deployment of timely emergency disaster-response. At the same time, the economic impact of climate shocks crowd-out already scarce public financing. Contractions in economic activity and disaster-induced increase in public spending worsen public debt and inhibit private investments. The conflict in the north further exacerbates the impacts from natural disasters on already depleted and inadequate infrastructure, housing, and services.

**Climate change is significantly impacting Mozambique's agriculture, aggravating food insecurity and poverty.** Agriculture is the main economic activity for 81 percent of the population, of which 97.5 percent are small-scale subsistence farmers.[37] It is one of the sectors most affected by climate shocks, especially because most of the nation's agriculture continues to be rain-fed, with less than two percent of land being irrigated.[38] Promotion and implementation of improved climate-smart agricultural technologies and practices remains incipient. Due to climate change, yields of major crops such as cassava, sorghum, soybeans, and groundnuts are estimated to decrease by between two and four percent over the next 40 years, particularly in the central region.[39] Some drought-sensitive food crops, like maize could decline by as much as 11 percent on average (2046–2065), and by as much as 45 percent in areas such as Tete.[40] In addition to direct crop loss, climate change has an adverse impact on agricultural trade. In periods of climate-induced low agricultural productivity, farmers lack the capacity to generate a surplus for exports, as the primary focus is on subsistence. As a result, key value chains of main food and cash crops, such as sesame or soy, risk suffering disruptions, generating additional pressure on local communities' agriculture-based income.

**Climate change exacerbates water scarcity in Mozambique, which is already under pressure.** All scenarios predict an increase in water demand in most of Mozambique (Figure 10). Coupled with population growth, this trend will put more pressure on water supply for domestic uses and require increased agricultural and industrial water for food

[37] Alex Armand, Joseph Flavian Gomes, Ivan Kim Taveras, Managing agricultural risk in Mozambique, International Growth Center (IGC), 2019, F-36421-MOZ-1.

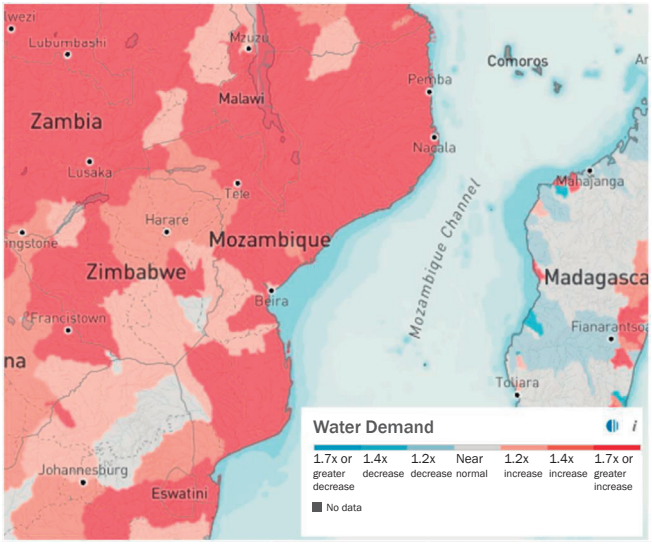
[38] World Bank, 2020, Cultivating Opportunities for Faster Rural Income Growth and Poverty Reduction: Mozambique Rural Income Diagnostic, World Bank.

[39] USAID, 2018, Climate Risk Profile Mozambique, https://www.climatelinks.org/sites/default/files/asset/document/2018_USAID-ATLAS-Project_Climate-Risk-Profile-Mozambique.pdf.

[40] Ibidem.

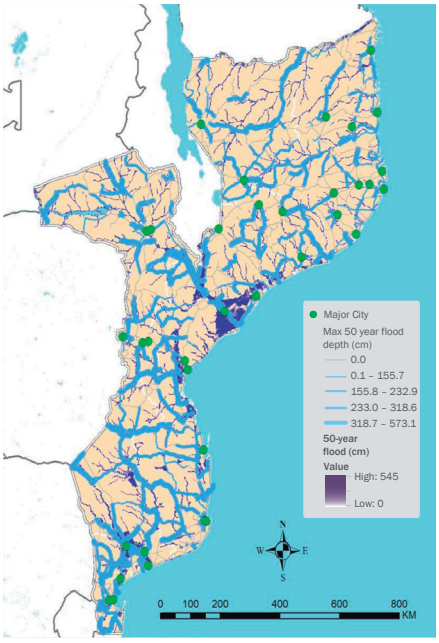
and livelihoods. Furthermore, Mozambique has a severe lack of storage infrastructure development which is insufficient to buffer against cyclones, floods, and droughts, and to minimize the impact of the country's high-water dependency. An increase in droughts in central and southern regions as well as more floods during rainy seasons are expected. In the central zone, this could cause per capita water availability falling from about 1,900 $m^3$/capita/year in 2000 to about 500 $m^3$ by 2050.[41] Spillover effects from neighboring countries also pose challenges. Mozambique is particularly vulnerable to change in water dynamics in neighboring countries, as it is situated downstream of nine major river systems that are already affected by climate variability. Projections from future climate scenarios suggest significant water conflicts originating from reduced availability coupled with increased population growth.

**Figure 10: Water demand change in 2040 for Business-as-usual scenario — SSP2**




*WRI Aqueduct, Water Risk Atlas, 2019*

**Figure 11: Roads exposed to high flood risk**




*World Bank, Transport Team*

**Temperature rise, droughts and extreme weather events could imperil Mozambique's rich natural habitat and capital, adversely affecting its nature-based tourism (NBT) sector.** The country has outstanding biodiversity, consisting of more than 10,000 species, 10 percent of which is endemic or nearly endemic,[42] and its 2,700 km of coastline is characterized by a variety of ecosystems. Mozambique's forests, land, coastal and marine biodiversity provide key ecosystem services on which rural communities depend for food, energy, medicine, and tourism revenues. A projected sea level rise of 0.68 m from 2019 to 2099[43] increases vulnerability to erosion and flooding of ecosystems and land. In freshwater ecosystems, saline intrusion due to sea level rise can reduce fish populations. Warmer temperatures and droughts can also increase forests' vulnerability to forest fires, which affect 40 percent of the country every year, with up to 74 percent of the northwest and central parts of Mozambique burnt annually.[44] Climate change, undermining natural assets,

[41] The international water scarcity threshold being 1,000 $m^3$/capita/year.

[42] World Bank, 2018, Mozambique Country Forest Note, Washington, DC.

[43] According to the RCP 8.5 scenario.

[44] USAID, 2012, Climate Change Adaptation in Mozambique Fact Sheet.

exacerbating biodiversity losses, and damaging tourism infrastructure, risks jeopardizing Mozambique's NBT sector, whose role is key for poverty reduction and economic growth, as it tends to employ more unskilled labor while creating new market opportunities for local producers and scope for off-farm diversification.

**Climate change threatens Mozambique's energy and transport infrastructure.** Hydropower is particularly vulnerable to climate change, as more frequent and intense extreme weather events such as droughts and floods may lead to more variability in generation output. Consequently, the economic performance of the Cahora Bassa (existing) and Mphanda Nkuwa (projected) hydropower plants, which are the dominant sources of hydro-energy in Mozambique, will be negatively affected. Mozambique's transport network is also highly susceptible to climate shocks, which reduce connectivity between rural and urban areas, and between the north and the rest of the country, a key condition to trigger spatial and structural transformation. About 60 percent of the total road network is in flood-prone areas, and about 60 percent of roads in Mozambique are exposed to the risk of traffic disruptions caused by flood (Figure 11). The lack of redundancy in the transport network amplifies the impact of climate change. Roads and bridges have been frequently damaged by cyclones. The total road infrastructure damage of Cyclone Idai in March 2019 is estimated at US$ 489 million. Disruptions of the road network impact access to domestic markets, increasing post-harvest losses and food insecurity. The total economic risk of climate events to the road network is estimated at US$ 160 million per year, equivalent to about 1.1 percent of the country's GDP, with estimated disruption costs of US$ 139 million.[45]

**Exposure of education and health infrastructures to climate impacts particularly affect the most vulnerable population.** Every year, disasters caused by natural hazards damage school buildings in the already fragile infrastructure. It is estimated that 70 percent of schools in Mozambique are in high-risk areas to one or more hazards. The results of a nation-wide multi-hazard risk assessment[46] for schools conducted in 2018 showed that school infrastructure suffers more than US$ 2 million damage on average per year. This corresponds to 540 classrooms and 57,000 students affected annually. Similarly, impact of climate disasters to health infrastructure is very high, with expected average annual damage varying between US$ 6.4 and US$ 20.1 million per year. It is estimated that more than 125,000 patients daily make use of different health care facilities that are at risk. In 2020, Cyclone Chalane completely destroyed 11 health facilities that serve a total population of about 3,000 families[47] and in 2022 Cyclone Gombe destroyed well over 60 health facilities in the Nampula province.[48]

**Climate-related hazards, alongside other factors such as low access to improved sanitation, water sources and health facilities, contribute directly or indirectly to poor health in Mozambique,[49] which in turn results in decreased productivity, especially among rural poor people.** The spread of malaria is correlated with rising temperatures and increased flooding.[50] Floods are also likely to increase the risk of cholera, as evidenced by the 2023 flood-related cholera outbreak in several provinces.[51] Heavy rains and flooding severely impact the availability and quality of sanitation and

[45] WB calculations. Additional details on the methodology are provided in the Background Note, available upon request.

[46] Christophe Briere, João de Lima Rego, Andreas Burzel, Conceição Leite, Dana Stuparu, Maaike Maarse Mark de Bel, "Multi-Hazard Risk Assessment for the Schools Sector in Mozambique, Global Facility for Disaster Reduction and Recovery", World Bank, 2018.

[47] Ministério da Saúde (MISAU), 2020, "Relatorio Anual de Balanço do Sector da Saúde", Maputo.

[48] World Health Organization (WHO 2022), 2022, "O Ciclone Gombe Traz Luz os Verdadeiros Herois do Sector", https://www.afro.who.int/pt/countries/mozambique/news/o-ciclone-gombe-traz-luz-os-verdadeiros-herois-do-sector-da-saude.

[49] World Bank, 2010, Economics of Adaptation to Climate Change: Mozambique, World Bank, Washington, DC.

[50] USAID, 2018, Climate Change and Health in Mozambique Impacts on Diarrheal Disease and Malaria.

[51] International Federation of Red Cross (IFRC), "Mozambique: Cholera Outbreak and Floods Readiness'" January 2023.

access to safe drinking water, increasing the risk of water-borne diseases. After Cyclone Idai, in April 2019, 6,768 suspected cholera cases were registered at a rate of 571 per 100,000 inhabitants, while 48,724 confirmed malaria cases were reported in Beira, Buzi, Dondo, and Nhamatanda districts.[52]

**The impact of climate change is particularly significant on Mozambican women, increasing the incidence of poverty and widening gender inequalities.** The share of women in non-agricultural employment has slightly increased but remains considerably low (34.8 percent in 2019 against 31 percent in 2010[53]), indicating that Mozambique's women are still highly exposed to climate hazards. Furthermore, gender-specific divisions of labor and responsibility are evident in water resource access. For instance, with increasing drought, women need to walk longer distances to collect water, increasing risks related to Gender-Based Violence (GBV), Sexual Exploitation and Abuse (SEA), and Sexual Harassment (SH) (GBV/SEA-SH risks). Decreased rainfall amounts as well as increases in temperatures and flash floods impact on women also in terms of food distribution, the absorption of nutrients by pregnant women and their overall health conditions. Sixty three percent of households headed by women are poor and exposed to food insecurity, while this figure goes down to 52 percent among households headed by men.[54]

**The lack of investments to improve urban infrastructure, land-use planning, and housing have created new climate risks for cities.** Urbanization in Mozambique has occurred mainly informally and has not been accompanied by adequate investments. This has led to a serious public infrastructure deficit, dysfunctional urban land markets, and a marked deprovision of adequate and resilient housing in high-risk areas, accelerating urban dwellers' vulnerability to climate events.[55] The impacts of conflict, including displacement, has also contributed to accelerated urbanization in the north of Mozambique. On average, 60 percent of the urban population build their own houses without any assistance,[56] using cheap non-durable materials such as adobe, wooden sticks, and bamboo, which are often damaged by heavy rains and cyclones. For instance, it was estimated that 240,000 houses were damaged or destroyed by Cyclone Idai and an additional 50,000 houses by Cyclone Kenneth.[57] In addition, the lack of formal land tenure acts as a disincentive for poor households to invest in improving the resilience of their houses as they constantly fear the risk of eviction.

## 1.4. Challenges and Opportunities for Resilient, Green and Low-Carbon Growth

**While Mozambique's contribution to global warming is negligible, it is still key to promote a low-carbon growth path, with the aim of preparing the country to the global low-carbon pathways, successfully managing climate and transition risks, capitalizing on huge energy renewable potential, and thus contributing to advancing the development agenda.** Mozambique's GHG emissions are low in absolute and relative terms. In 2019, its total GHG emissions including land use change and forestry (LUCF) were

[52] Ministério da Saúde (MISAU), Instituo Nacional de Saúde (INS), World Health Organization (WHO). Tropical cyclones Idai and Kenneth Mozambique — National Situation Report 7, from 17th July 2019.

[53] United Nations Development Programme, Mozambique, Country profile, https://hdr.undp.org/en/countries/profiles/MOZ.

[54] Ministério de Género, Criança e Acção Social, 2016, "Perfil de Género em Moçambique", Maputo, Mozambique.

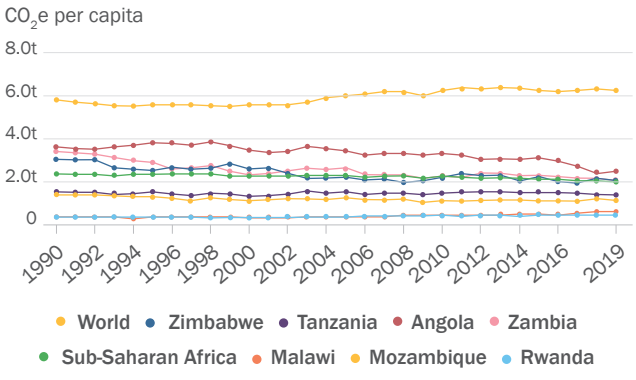
[55] A. Herzog, V. Lall, Somik, 2017, "Mozambique urbanization review: Accelerating urbanization to support structural transformation in Mozambique (English). Washington.

[56] INE, Census 2017.

[57] United Nations Development Programme (NDUP), 2019, "Mozambique Cyclone Idai Post-Disaster Needs Assessment".

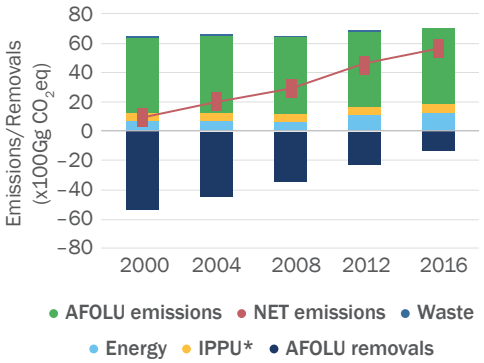
106.74 million tons (metric tons) of carbon dioxide equivalent ($MtCO_2e$), about 0.21 percent of global emissions. The figure is reduced to 35.40 $MtCO_2e$ without LUCF. Mozambique's 2019 per capita emissions were just 1.17 $tCO_2e$ without LUCF and 3.52 $tCO_2e$ including LUCF.[58] Figure 12 compares Mozambique's emissions footprint with its neighbors' and with the world and sub-Saharan African average.

**Figure 12: Per capita annual GHG emissions in Mozambique, neighboring countries, and the world**




*Source:* Climate Watch, 2022.

**Figure 13: Total GHG emissions, removals, and net emissions (total minus removals), 2000–2016**




*Source:* Mozambique/MTA, 2022.

**The majority of Mozambique's GHG emissions are caused by the agriculture, forestry, and land use (AFOLU) sector, contributing slightly more than half (59 percent, the equivalent of 39.26 $tCO_2e$) of the country's total GHG emissions[59] (Figure 13).** The main source of AFOLU GHG emissions is deforestation from conversion of native forests to cropland, and to a lesser degree forest degradation related to biomass use for energy. Direct agriculture emissions emanate from release of soil carbon for agriculture production, savannah burning for crop production, fertilizer use, livestock production, and crop residue burning.[60] In 2007, Mozambique had 40 M ha of natural forest, extending over 50 percent of its land area.[61] From 1990 to 2002, Mozambique lost 2.85 M ha of forest, with a deforestation rate of 0.58 percent per year, equivalent to a seven percent decrease in tree cover since 1990, and 413 $MtCO_2e$.[62] Between 2003 and 2013, the rate of deforestation increased from 0.58 percent to 0.79 percent.[63] Within the same period, Mozambique lost 2.94 M ha of forest, equivalent to an average of 267,000 ha per year,[64] and representing 38.7 $MtCO_2e$/year emitted into the atmosphere.[65] In 2018, Mozambique had 34 M ha of natural forest.[66] Miombo, Mozambique's predominant forest ecosystem (65 percent), has suffered disproportionately. Out of the 2.94 M ha of forest lost, 2.2M were from this ecosystem.[67]

[58] Climate Watch. 2022. "Global Historical Emissions." Washington, DC: World Resources Institute. https://www.climatewatchdata. org/ghg-emissions.

[59] World Resource Institute. 2016. Climate Data Explorer (CAIT). Available at: http://cait.wri.org/.

[60] FAO. 2017. FAOSTAT: Mozambique. Rome: FAO.

[61] Marzoli. 2007. National Forest Inventory. Ministry of Agriculture, Italian Cooperation, and Agriconsulting.

[62] Ibidem.

[63] MITADER (2018), Desflorestamento em Moçambique (2003–2016). MITADER. Maputo. 42p.

[64] Ministry of Land, Environment and Rural Development (MITADER). 2018. Mozambique´s Forest Reference Emission Level for Reducing Emissions from Deforestation in Natural Forests. 55pp.

[65] Ibidem.

[66] MITADER (2018), Inventário Florestal Nacional. MITADER. Maputo. 124p.

[67] MITADER (2018), Desflorestamento em Moçambique (2003–2016). MITADER. Maputo. 42p.

### 1.4.1. Managing transition risks: a growth model highly dependent on mining and natural gas for export

**Non-renewable natural resources play a major role in the Mozambican economy.** Mining and the exploration of natural gas have been a long-standing important employer and a major source of income for the state. Since 2018, the coal sector has been the largest contributor to export earnings (33 percent),[68] making Mozambique the tenth largest coal exporter in the world.[69] While investor interest in developing new coal project has declined over the last years due to the global low-carbon transition, the hydrocarbon sector is anticipated to become the largest sector of the economy over the next decade, due to vast natural gas reserves in the Cabo Delgado province. LNG projects are expected to reach over US$ 60 billion in investment and have the capacity to generate revenues of approximately US$ 300 billion for the accumulated duration of the projects until 2050.[70] Furthermore, Mozambique is rich in minerals central to the clean energy transition, with significant deposits of graphite, ilmenite, iron ore, vanadium, titanium, copper, gold, tantalum, and bauxite. Mozambique is the third largest producer of natural graphite, holding high-grade world-class graphite deposits and is home to two main graphite mining companies.

**While phasing out coal, revenues from hydrocarbon and mineral resources can play a key role in supporting Mozambique's path towards a more inclusive growth.** They can be leveraged for Mozambique's economic and social development through investments in human capital, climate resilient infrastructures, adaptation measures, and other key priorities towards resilient green growth (see Chapters 4 and 5). There is also considerable potential to use natural gas in the local economy to improve living conditions and quality of life, particularly in remote, rural areas not connected to the grid. Containerized, affordable, locally-produced gas could be used to displace the prevalent use of firewood and charcoal for cooking as well as more polluting and more expensive, imported oil products such as diesel for decentralized power generation, and provide the basis for growth of small— and medium-sized enterprises. Furthermore, the exploration of minerals central to the energy transition with higher demand and greater economic value can provide additional revenue in the longer term. This is very important in terms of job creation, especially for those who will be affected by coal mine closures.

**With global low-carbon trends accelerating, transition risks in the hydrocarbon and mining sectors need to be managed and other opportunities for green growth promoted.** Given the decline in financing and growing restrictions from international markets, this provides an opportunity for the GoM to transition out of coal extraction and exports, while considering social implications. Driven by the clean energy transition, Mozambique is well positioned to capitalize on its critical mineral resource endowment. However, such an approach would require sound land-use planning and impact assessments, since these resources are concentrated in sensitive areas and can cause, if not properly mitigated, significant environmental impact. Furthermore, Mozambique's GDP and fiscal contribution of the nascent gas sector is at risk from the potential fall in gas prices in a net-zero world scenario, posing transition risks to a Mozambican economy aiming for gas revenue-driven development. Despite this, CCDR estimates show that even in a world that moves to net-zero by 2050, the gas sector could generate significant fiscal

[68] E. Egger, M. Keller, and J. Mouco, 2021, "The socioeconomic impact of coal mining in Mozambique". UN WIDER Working paper No. 2021/108.

[69] EIA (U.S. Energy Information Administration (2020a). 'Coal Export Data by Country'. Available at: https://www.eia.gov/international/overview/world.

[70] World Bank, 2021, Assessment of the Legal and Regulatory Framework for Foreign Direct Investment: Mozambique, Washington DC.

space to finance growth-protecting public investments.Lastly, Mozambique is likely going to be impacted by trading partner mitigation policies (for example regarding its aluminum exports), such as the European Union's CBAM.

**The revenue windfalls from the LNG sector risk being jeopardized by weak institutions, which lack the capacity to arbitrate elite disputes in a consistent manner to ensure an equal and transparent distribution of benefits.** Acknowledging this risk, it is crucial, well ahead of the revenue windfalls, to establish an adequate policy and institutional framework and clearly identify investment priorities in the management of the natural resource revenues. Accordingly, Mozambique's authorities are in the early stages of establishing a SWF to generate savings and the fiscal stabilization of resource revenues from LNG. It is important to combine this SWF with effective and accurate monitoring and oversight mechanisms. This fund, if combined with institutional building and prudent macroeconomic management, has the potential to help the country achieve short-term stabilization and long-term savings for future generations, and may address risks related to the natural resource curse.[71] Support from the World Bank as well as from other international partners is key to underpin Government's reform agenda and efforts to strengthen governance and build inclusive institutions, providing services for the majority of the population in a transparent and accountable manner.

[71] This expression refers to when the endowment of natural resources leads to low economic performance. This can be explained taking into consideration that the resource boom can generate excessive government expenditure during the boom period and drastic cuts when the boom ends; detrimental impacts on non-boom tradable sectors, while increasing inefficient investment beyond the absorptive capacity of the country and fostering rent seeking behaviors.

# 2 MOZAMBIQUE'S CLIMATE COMMITMENTS, POLICIES, AND INSTITUTIONS

# Chapter 2: Mozambique's Climate Commitments, Policies, and Institutions

**This chapter reviews Mozambique's climate change legal, regulatory, and institutional frameworks, as well as the existing commitments of the country.** It focuses on the set of policies to achieve these commitments, assesses the institutional context, and takes stock of social protection policies to protect local populations and support a just transition. Finally, it provides recommendations to develop and enhance the climate change legal, regulatory, and institutional frameworks.

## 2.1. Climate Change Legal and Regulatory Framework

**The legal and regulatory portfolio for climate change in Mozambique has expanded over the last 20 years, providing the legal and strategic context for climate change actions in the country.** In 2003, the GoM submitted its Initial National Communication (INC) on climate change to the UNFCCC, and in 2008, the National Adaptation Programme of Action (NAPA) was issued with the objective of outlining urgent and immediate needs with regards to climate change impacts and adaptation priorities. In 2012, Mozambique launched the National Climate Change Adaptation and Mitigation Strategy (NCCAMS) to provide strategic and priority guidelines for adoption and implementation of climate action for the period 2013–2025. The NCCAMS expanded from the initial focus on adaptation to also include mitigation, capacity building, and financing. In the legislative arena, Law 15/2014 serves as the national framework law for disaster prevention, mitigation, and management. It emphasizes the importance of strategic readiness and systematic preparedness to prevent the impacts of climate change and reduce vulnerability to disasters.

**The GoM intensified climate change-related planning efforts after the ratification of the Paris Agreement in 2018, when Mozambique issued its first Nationally Determined Contribution (NDC) and the former Ministry of Land, Environment and Rural Development (MITADER) submitted the roadmap for its implementation.** Simultaneously, the World Bank and the NDC Partnership supported the GoM to prioritize the operationalization of NDC goals in sectors such as agriculture, energy, water, transport, and early warning systems, and align them with the GoM policies and priorities.[72] In 2021, Mozambique formulated its long-term, low-emission development strategy (LT-LEDS), which provides long-term strategic vision for the country's mitigation goals, defining short-term actions in the context of the structural changes required for the maintenance of a low-carbon economy and for the transition to a resilient economy by 2050. It establishes that the land-use, agriculture, energy, and waste and industrial processes sectors have the greatest mitigation potential and recognizes that with these mitigation actions the country can create 240,000 new green jobs by 2050.[73]

**The GoM submitted its first updated NDC in December 2021.** The updated First NDC includes various proposals to address the recent negative impacts to the country's economy such as the COVID-19 pandemic and defines adaptation and mitigation strategies. From 2020 to 2025, the country intends to focus on increasing climate change resilience and adaptation through planning and budgeting at the provincial level, and at the national level.

[72] Mozambique First Updated Nationally Determined Contribution to the United Nations Framework Convention on Climate Change 2020-2025.

[73] CAEP Support: Mozambique's Long-term, Low Greenhouse Gas Emissions Development Strategy (LT-LEDS), September 2021.

The NDC highlights finance, technology transfer, training, and capacity building as priority areas for international support. According to the NDC, the total investment needed for the period 2020–2025 is estimated at US$ 7.586 billion (which represents more than 50 percent of the country's GDP in 2026). The expected reduction of GHG emissions is estimated at 40 million metric tons equivalent ($MtCO_2e$) between 2020 and 2025.

**Given the importance for livelihoods and biodiversity conservation, as well as for the potential of carbon sinks, forests have a key role for Mozambique's resilient development.** The country's National Strategy for REDD+ (2016–2030) aims to reduce Mozambique's emissions by 170 million tons of $CO_2$ per year by 2030.[74] In November 2021 the country received the first REDD+ payment for the Zambezia Emission Reduction Program supported by the World Bank Forest Carbon Partnership Facility. Currently, the GoM is reviewing the draft of the Forest Law with the main objective of contributing to the sustainable use of forest resources and ensuring the participation of citizens and local communities in the protection, conservation, enhancement, and management of forest ecosystems. This law creates the (FFF), a government mechanism for mobilizing resources for public, private and community investments, and the National Forestry Forum (FNF) as a multisectoral consultation and coordination body of the government for forest management and related matters.

**Given the need for Mozambique to address the impacts of climate change, it is key to create a framework law on climate change.** Mozambique currently lacks an overarching regulatory and legal instrument that articulates general principles and defines the institutional framework for policy implementation.[75] The NCCAMS identifies legal and institutional reforms as a critical crosscutting issue, and provides recommendations to strengthen the national legal framework, improve the institutional framework, and develop and enhance knowledge and capacity on climate change.

## 2.2. Institutional Framework on Climate Change Adaptation and Mitigation

**The Ministry of Land and Environment (MTA) is the central government institution responsible for ensuring the preservation and responsible use of natural resources, the coordination of environmental activities, and climate change mitigation and adaptation.** MTA directs, plans, coordinates, controls, and ensures the implementation of policies in the fields of land administration and management, geomatics, forests and wildlife, environment, climate change and conservation areas. MTA has Provincial and District Directorates for Coordination of Environmental Action. MTA has defined climate attributions among its divisions and there is a dedicated climate change directorate within MTA, signaling that the GoM recognizes the autonomy and interdependent nature of the climate change sector.

**Mozambique has also taken steps to improve inter-sectoral coordination.** Within MTA, the Climate Change Directorate has been established as the main coordinating entity on climate change. Through this Directorate, the GoM has been strengthening the institutional framework and coordination on climate action since the adoption of NCCAMS in 2012. Furthermore, an Inter-Institutional Group for Climate Change (GIIMC) was set up to address the crosscutting nature of climate change and the need to involve both state and non-state actors, including representatives from the public and private sectors and civil society.

[74] Draft Mozambique Second National Communication to the United Nations Framework Convention on Climate Change, December 2021.
[75] World Bank Reference Guide to Climate Change Framework Legislation, World Bank Group, December 2020.

**The Ministry of Agriculture and Rural Development (MADER) also has important responsibilities related to climate change and climate finance.** One of MADER's subordinate institutions is the National Fund for Sustainable Development (FNDS) which is responsible for mobilizing investment and infrastructure projects in the agricultural sector. In addition, the FNDS mobilizes resources and finances programs and activities related to environmental management, adaptation and mitigation, sustainable forest management, and biodiversity conservation, including technology transfer in rural areas. Within the scope of REDD+, the FNDS is the managing entity responsible for defining methodological standards, evaluating, registering, and issuing technical opinions, monitoring, and coordination. Also, MADER is the supervisory institution for the agricultural hydraulics sector, responsible for preparing proposals for policies, strategies and legislation on hydrology, development programs, and monitoring and inspection of hydro-agricultural infrastructure.

**Although the GoM has taken concrete steps to improve its climate change institutional framework, there are still areas for further institutional development.** It is key to reinforce, by law, the MTA as the central body of the GoM responsible for the coordination/integration and supervision of climate actions. There is a need to strengthen capacity of MTA's entities and better define the attributes of the decentralized bodies. The National Council for Sustainable Development (CONCES), whose mandate is to promote dialogue on environment issues during the preparation of sector policies and which integrates academia and civil society organizations, currently does not have the instruments to integrate all the key players for sustainable development. Additionally, there is no inter-institutional coordinating entity or unit responsible for cross-sector climate change matters and there is little clarity in the attributions of the decentralized governance bodies. This represents an obstacle for the integration of various sectors in climate action and NDC implementation.

## 2.3. Policies and Institutions for Climate Change Financing

**Mozambique has developed medium-term and long-term strategies and plans for climate change adaptation and mitigation, but key challenges remain in the operationalization of these plans in terms of annual budgeting and project execution.** In the short to medium term, it is key to build on existing public financial management (PFM) and government systems, and mainstream climate risk throughout all PIM stages,[76] boosting inhouse government capacity on technical issues, data analysis, and management.

**A key component of climate-oriented PIM in Mozambique refers to building resilient infrastructures.** Despite natural hazards and climate events presenting a constant threat to the country, the risk posed by climate change is generally not included in capital expenditure budgeting. Consequently, many infrastructure projects are vulnerable to the effects of climate change, both in terms of infrastructure degradation and disruption to service delivery. Climate resilient infrastructure is needed to ensure efficient capital expenditure, prevent inefficiencies in public resource management and service delivery, and to foster Mozambique's economic and sustainable development. According to a recent World Bank study, climate-smart infrastructure projects incur on average three percent more cost than the traditional approach to infrastructure development, but their benefits outweigh capital and life cycle cost by 4:1.[77]

[76] World Bank Group. Emerging Messages from World Bank's Rapid Stocktaking Survey: "Country Institutional Arrangements and Capacities for Climate-Smart Public Investment Management in Africa", 2021.

[77] Climate Smart Public Investment Management in Mozambique, internal WBG PPT presentation, White Paper — Climate Smart PIM in Mozambique.

**Despite some progress in mainstreaming climate change aspects into the overarching PFM legislation, the PIM system lacks climate-sensitive standards and methodologies.** In 2021, the institutional framework for PIM was advanced by merging the national planning and budgeting systems, "Sistema Nacional de Planificação e Orçamento" (SPO). In 2021, the expenditure planning process was enhanced by the World Bank-supported Electronic National Public Investment Subsystem (E-SNIP). E-SNIP includes a climate resilience identifier at the project profile phase but contains basic information only. Finally, Mozambique's authorities also adopted PIM rules in the 2020 Public Financial Management (PFM) law and its regulations (2021), including climate considerations. The revised overarching PFM legislation introduced climate considerations in public investments but without guidance on how to do it. Climate change resilience is neither a 'must-have' criterion nor a binding legal requirement for the approval of infrastructure investment projects. Specific methodologies, standards, and processes are yet to be established.

**Suboptimal climate-resilient investments affect all levels of government, requiring a coordinated approach led by the central government, as local governments and municipalities are on the frontlines of climate change and the solutions to build a resilient economy.** Identifying local needs and developing local-level adaptation plans is essential to fight climate change effectively. The country has made a significant effort to mainstream climate change considerations into local development planning. As a result, most districts (>70 percent) and some municipalities (approximately 40 percent) have already developed local adaptation plans. These plans should estimate the long-term need to invest in change adaptation measures. The estimate should focus on the cost of improving infrastructure resilience while considering the government's ability to design, procure, and implement resilient infrastructure projects.[78] Because most infrastructure in Mozambique is financed or initiated by the central government, it is critical to establish national-level processes and systems cascading to subnational governments.

## 2.4. Policies and Programs to Protect the Vulnerable

**Given that climate change and natural hazards disproportionately impact the poorest and the most vulnerable, social protection policies are an important tool to protect Mozambique's local populations and support a Just Transition.** Social protection delivery systems, and in particular Adaptive Social Protection (ASP), can help people prepare for, cope with, and adapt to climate-induced disasters, slow onset climate-induced changes, and adverse impacts from climate policy.

**Mozambique's social protection strategy is aimed at addressing poverty and consumption resilience, human capital, social risks, and institutional capacity.** The social protection system is grounded on the National Strategy for Basic Social Security 2016–2024 (ENSSB II) targeting the poorest and most vulnerable population. The key objectives are to (i) strengthen their consumption level and resilience; (ii) contribute to the development of their human capital through improved nutrition and access to health and education services; (iii) prevent and respond to the risks of violence, abuse, exploitation, discrimination, and exclusion through social services; and (iv) develop institutional capacity for the implementation and coordination of the social assistance system.

[78] The net present value of damages can reach US$ 7.6 billion, equivalent to an annual payment north of US$ 400 million. Without adaptation strategies, GDP is estimated to fall between four percent and 14 percent relative to the baseline between 2040 and 2050. (WB, 2010).

**The National Institute of Social Action (INAS) implements several social protection programs.** The key three programs with larger coverage are the Basic Social Assistance (PSSB), Productive Social Assistance (PASP), and the Direct Social Assistance for Emergency Response (PASD-PE). These three programs vary in terms of the duration of the benefits received and the target population. Overall, INAS covered 595,000 households with regular programs in 2019, equivalent to 20 percent of the poor households, which is below the target proposed by the PQG 2020–2024 of 28 percent of the population living under the poverty line. An additional 120,000 households were covered by emergency social assistance during 2019.[79]

**The current coverage of social protection remains limited, and therefore should be further expanded.** To target the poorest and the most vulnerable households, it is crucial to analyze the vulnerabilities of different socioeconomic groups (children, women, youth), and expand specific programs to provide a pathway out of poverty. The PSSB, the program with broader coverage, could be used for shock responses, including vertical expansions (top up benefits to current beneficiaries) and horizontal expansion (temporary expansion to cover new beneficiaries affected by shocks).

**It is key to ensure financial sustainability and reliability of the social protection budget.** The GoM allocates about 2.4 percent of government budget (0.9 percent of GDP) to the social protection sector.[80] However, the full implementation of the planned ENSSB II for a 5-year period requires about US$ 270 million, equivalent to 3.9 percent of government budget, and 1.3 percent of GDP. It is estimated that full implementation of the ENSSB II could reduce poverty incidence by 7.5 percent at a cost of 2.2 percent of GDP.[81] Although the implementation of the ENSSB II and the safety net programs has received significant external technical and financial support, it has been affected by the recent economic downturn. To reduce the uncertainty of social protection budget it is key to establish a multi-year budget to facilitate operational planning of the sector and ensure regular service delivery and payments to beneficiaries.

**The delivery of social benefits (cash transfers) must be enhanced to rapidly respond to shocks and the expansion of digital payments is an important step in not only accelerating those transfers but also to increase financial literacy and savings which in turn will increase economic resilience.** Digital payments can help reduce the overall carbon footprint of programs through digital delivery of support services or use of e-wallets, reducing travel and transport. The ENSSB II faces policy and operational challenges regarding the set of complementary services needed in social protection programs, from health services support in PSSB-Child Grant to technical assistance in graduation mechanisms under PASP. The increased adoption of a hybrid model for payments that includes digital payments, as well as cash in hand, provides an opportunity for improving access to and utilization of financial services such as mobile bank accounts aligned with the GoM National Financial Inclusion Strategy (2016).

## 2.5. Mechanisms to Support Effective Disaster Risk Management

**Given the magnitude of climate risks, the GoM has made DRM a policy priority and has achieved considerable improvements in its DRM policy and institutional framework.** To operationalize its DRM policy framework, the GoM adopted in October 2017 its second DRM

[79] World Bank, "Social Protection and Economic Resilience Project" (P173640), Project Information Document, 2021.
[80] Ibidem.
[81] Government of Mozambique, 2016, "National Basic Social Security Strategy (2016–2024)", Maputo.

Master Plan 2017–2030 (PDRRD) with specific actions to strengthen financial protection against disasters and improve the understanding of disaster risk. The plan proposed the development of systems for collecting and managing data on the occurrence and impacts of disasters, as well as initiatives to insert risk reduction and resilience-building criteria into the processes of planning at all levels of government. Despite recent advances, in the face of high and increasing exposure to disasters, funding gaps persist, as well as sub-optimal processes in the mobilization and execution of financial resources for post-disaster interventions.

**To overcome these gaps, the GoM adopted in August 2022 a National Strategy for Financial Protection against Disasters (ENPFD).** The strategy is divided into six strategic pillars: (i) identification and quantification of economic and fiscal risks of disasters; (ii) establishment of a portfolio of financial and budgetary instruments for the retention and transfer of risks; (iii) execution of focused, timely, transparent and resilient post-disaster interventions; (iv) support for the development of the private disaster insurance market; (v) protection of public and private investment against disasters, and (vi) strengthening the national capacity for financial protection against disasters. It covers all threats as defined in the Disaster Risk Management and Reduction Law and highlights some remaining challenges. Firstly, robust economic and fiscal disaster risk models are not yet available, and data for designing models and risk assessments is limited. Furthermore, the use of disaster insurance is still very low. There are pilots in progress in the field of agrarian microinsurance, but on a small scale. Additionally, criteria for resilience and risk reduction in public investment still need to be defined and institutionalized in several sectors.

**Acknowledging the importance and the magnitude of climate risks and the need to enhance its capacity in terms of DRM, the GoM created in October 2017 the National Disaster Management Fund (FGC).** The FGC aims to increase the availability and predictability of resources for emergency preparedness and response and allow scope for financing post-disaster recovery. Creating this structural ad-hoc fund, could overcome the delays in emergency response, and consequently higher economic costs,[82] resulting from budget reallocations and sourcing for funds occurring in the aftermath of each disaster. The establishment of the FGC by the GoM is considered a best practice and has benefitted from global expertise mobilized by the World Bank.

## 2.6. Recommendations to Strengthen Capacity

**Connection between national, sectoral plans and NDCs in Mozambique could be improved.** Mozambique would benefit from balancing its foundational institutional and administrative capacity with its ambitious program conducted in an environment of extreme climate exposure. Minimal rules, rather than creating a long list of actions across multiple areas, are needed. Three focus areas include: the legal and regulatory framework; the institutional mechanisms of steering; and mobilizing and using climate financing. Table 1 summarizes recommendations to strengthen Mozambique's institutional capacity to address climate change.

**Mozambique's constitution guarantees the protection of the environment; therefore, the environment law needs to be updated and merged with a new environment and climate change law (for approval by the Council of Ministers by 2024).** This law would provide detailed legitimization of the various policies, decrees and strategies that have been issued. As a signatory of international conventions, treaties, and agreements, Mozambique must

[82] World Bank, 2018, "Financial Protection against Disasters in Mozambique", Washington, DC.

ensure the implementation of a climate legal framework that converges with the international scenario. Currently, expressly binding normative commands on climate action are missing in several key topics (i.e., data collection) and climate principles contained in ratified international instruments have not been framed in the national legislation. Consequently, there is a legal impossibility of binding natural and legal persons, as well as public entities, to certain climate adaptation or mitigation actions. To solve this, Mozambique could build on regional and global experiences with robust and adjusted institutional frameworks for the implementation of ratified international instruments.

**The approach would be further strengthened by integrating the technical concepts relating to climate change in the national legal framework.** Key climate change concepts (i.e., vulnerability, resilience, emissions recording, mitigation, GHG, etc.) have not been defined in a national legal provision. This, as well as the adjustment of the different sectoral regulations, is necessary to guarantee the effective implementation of the ratified conventions and treaties.

**On the institutional side, the capacity of MTA's entities and other national entities dealing with climate change should be augmented, and the attributes of decentralized bodies need to be better defined.** It is important to redefine sectorial structures and competencies to guarantee their alignment with the national structure and their capacity of executing the goals defined at the national level. For this, it is key to guide the different organic units in the elaboration of instruments for climate planning and operationalization through the definition of integrated sectoral goals. Additionally, fostering administrative and financial decentralization in DRM would be key to ensure that local actors are empowered to provide early response.

**The steering role at the center of government would be strengthened by creating a dedicated, high-level Committee on Coordination of Climate Action (CCCA).** A whole-of-economy approach is required to address climate change effectively. Such a committee would provide high-level leadership on planning, implementing, and evaluating climate action, thereby reinforcing its prime role at the center of government. Committee membership would need to be inclusive and reflect relevant government agencies. This wider group could be assisted by a smaller bureau or executive, involving the key ministries, such as: the Ministry of Economy and Finance; Land, Environment and Rural Development; and Public Works and Water Resources. In line with Mozambique's national climate change strategy NCCAMS, as well as the country's NDC documentation, the existing GIIMC could be formalized by adopting appropriate by-laws and transformed to serve as the CCCA secretariat. The Climate Change Directorate (within MTA) could provide technical support.

### Table 1. Clustered recommendations on the legal and institutional framework

| | Main Recommendations |
|---|---|
| | **Overarching legal and regulatory framework** |
| 1 | **Creation of a framework law on climate change.** This law should: (i) integrate technical concepts and definitions related to climate change; (ii) reinforce the MTA as the central technical body responsible for the coordination/integration and supervision of climate actions; (iii) establish sanctions (criminal and administrative) for activities that violate international and national climate legislation; (iv) define the legally permitted sources of climate finance in the country. |
| 2 | **Establishment of subsidiary legal action to create legal empowerment and incentives for:** (i) green intergovernmental grants; (ii) the construction/use of resilient infrastructure; and (iii) consideration of a climate-based tax regime. These should enhance budget credibility and strengthen linkages between NDC priorities and budget allocations. Incentives include, , for green building; R&D; creation of carbon sinks; green urban redesign. |

| Main Recommendations | |
|---|---|
| **Institutional strengthening for steering** | |
| 3 | **Establishment of a Cabinet Co-ordination Committee for Climate Action (CCCA) to be chaired by the Prime Minister and supported by the formalized GIIMC and MTA executive structures.** A subsidiary structure within the Committee would be designated to monitor and supervise GHG emissions in various sectors, as well as track the NDC implementation and climate finance reporting. The Cabinet would create and implement its planning mechanisms. |
| 4 | **Definition and establishment of revised arrangements to deal with the requirements to participate in Cooperative Approaches contained in the Article 6 of the Paris Agreement,** including by (a) defining the legally permitted ways to participate in cooperative approaches; (b) defining mechanisms for the participation of government institutions and other private entities in cooperative approaches; (c) establishing management, transparency, and auditing mechanisms for participation of government institutions and other private entities in cooperative approaches, including to deal with the "correspondent adjustments" and its associated fiscal risks and institutional guarantees that Mozambique's NDC will be implemented; and (d) establishing the National-designated Authority to Participate in Article 6.4 Mechanism of Paris Agreement. |
| **Climate change financing – mobilization and use** | |
| 5 | **Finish and implement a National Policy on Climate Finance** that sets out how to attract and promote climate finance including: (i) develop a climate finance strategy; (ii) implement robust and flexible public financial mechanisms; (iii) establish innovative mechanisms for additional resource mobilization such as green bonds; (iv) promote investor confidence. |
| 6 | **Develop a portfolio of possible investment projects** aligned with development and climate priorities capable of generating emission reductions and enhancing resilience towards climate change impacts, while establishing a competent entity for the mobilization of financial resources in line with international treaties and agreements. |
| 7 | **Define mechanisms for the participation of other entities in the mobilization of climate finance and to increase coordination among the international development partners** as well as a robust mechanism that would make resources available to subnational administrations in timely manner, to increase their capabilities to deliver services and to be held accountable for potential maladaptation measures—thus contributing to the national climate actions and commitments. |
| 8 | **Create additional mechanisms to encourage technological investments with climate adaptation/mitigation approaches in the various sectors,** exploring innovative sources of finance such as results-based finance, climate-related risk transfers tools and guarantees, green bonds and carbon pricing. |
| 9 | **Further implement the Climate-smart PIM, budget tagging and green reporting tools to enhance integration with the budgeting practices and resource management at all government levels** as a way to further generate co-finance to leverage additional international climate finance resources. This change will need to be socialized across the levels of government, and throughout the wider public sector estate. |

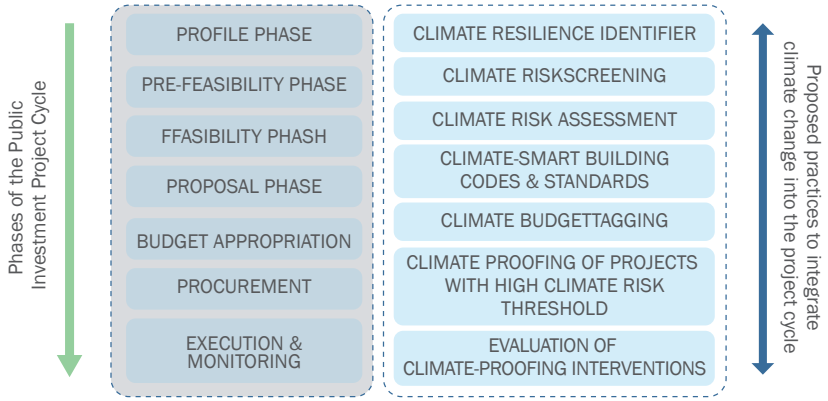
**Subnational governments (SNGs) are a key stakeholder in the implementation of climate change adaptation and mitigation policies.** They are commonly in charge of activities such as urban transportation, land management, housing, and building local infrastructure. The constitutional decentralization arrangements should facilitate climate-friendly local initiatives by enabling the SNGs to access the necessary resources, namely transfers, local taxes, bonds.

**Finally, it is crucial to adopt a transparent climate-smart PIM framework, that can help unlock the much-needed international financing required to meet the NDCs, critical adaptation investments.** In this regard, the proposed framework for climate-smart PIM being discussed with authorities represents a key to document to capitalize on.[83] It consists of three parts: (i) screening projects for climate change risks; (ii) determining the need to climate-proof a project given its vulnerability and exposure to climate change; and (iii) assessing the economic viability of climate-proofing projects that are subject to unacceptable climate risk

[83] The proposed framework draws on climate-smart PIM diagnostic assessment. Additional details are provided in the Background Note, available upon request.

threshold. Integrating climate change risks at the project conception stage include screening for vulnerability/exposure to climate change, as well as screening for projects' potential impacts on regional and local climatic conditions[84] [85] (Figure 14). This framework will allow the Ministry of Economy and Finance to prepare a pipeline of projects that indicates the climate change risks associated with each project and the cost of mitigating these risks. This pipeline can help to access development partners' funds by, for instance, tapping into the multilateral institutions' targets to increase climate lending. Further, the climate-smart PIM framework will incentivize private sector participation, increasing investors' confidence and likely leading to increased FDI in climate-related investments in Mozambique, enabling more sustainable growth opportunities.

**Figure 14: Overview of the proposed climate-smart PIM framework in Mozambique**




*Source:* Cambridge Resource International (CRI).

[84] White Paper — Climate Smart PIM in Mozambique.

[85] Projects exposed and vulnerable to climate change are screened for their geographic location in the view of data from the climate projection models for the area. For projects exposed to a high degree of climate risk, possible implications of a climate event on the project cost are to be studied and modeled in terms of cost incurred due to infrastructure rehabilitation and service disruption. In projects evaluated as posing negative impacts on local climatic conditions, such impacts are to be identified, quantified, and assessed. At the project appraisal stage climate change risks are included in the Cost-Benefit Analysis, which includes the following steps: (i) assessment of the economic viability of a regular infrastructure investment project; (ii) estimating benefits of climate-proofing; (iii) designing and assessing climate-proofing options; (iv) assessing economic viability of climate proofing; and (v) making a decision. For projects with negative impacts on climate change, the cost of such impacts will be valuated and added to the overall operational project costs. Measures of climate-proofing include adaptation measures (such as drainage systems for roads, for instance); resilience measures (irrigation systems for farmers, drought resistant crop varieties, water and soil management, or capacity development); and mitigation measures (energy efficiency, clean energy, green infrastructure development). Projects that progress to the selection and budgeting phase are to include documentation with regards to overall cost and the cost of climate proofing, and the Treasury will keep track of capital expenditure on climate proofing in every sector to collect data for assessment and future project management. During the economic life of the project, climate change risks considerations are to be integrated into implementation and maintenance, according to the required standards for optimal performance and service delivery. Finally, during ex-post evaluation feedback and lessons learned from project design and implementation will be collected to articulate any contingency measures (as needed) to address residual project risks, and to inform future project management and revision of climate policy.

# 3 MACROECONOMIC IMPLICATIONS AND POLICIES FOR CLIMATE

# Chapter 3: Macroeconomic Implications and Policies for Climate

**This chapter analyzes the macroeconomic implications of various climate and disaster scenarios, and policy options to address climate change.** Specifically, it addresses the following questions: How do climate scenarios affect productivity, growth, and debt dynamics? What are the macroeconomic impacts of climatic disasters under different scenarios? Considering varying prices and global demand for natural gas, how could Mozambique be affected by transition risks? What are the economic benefits of adaptation policies and investments? The chapter mainly uses the World Bank's standard macroeconomic model, which places climate as the central factor in the analysis. This model enables estimation of the impact of climate on the economy, the economy's impact on climate, and the implications of selected policies.[86]

## 3.1. The LNG Sector: Opportunities and Transition Risks

**The LNG sector is expected to significantly contribute to growth and fiscal revenue, providing essential financing for investments in climate adaptation.** One of the most anticipated gains from the sector is an increase in fiscal revenues when the three main LNG projects start exporting (Figures 15 and 16).[87] With these projects coming online, Mozambique's real GDP is projected to be 80 percent higher by 2040, while its export earnings will almost triple over the same period (as compared to baseline scenarios). Similarly, fiscal revenues are projected to be 55 percent higher. Mozambique's LNG exports are expected to help create fiscal space for climate change adaptation in Mozambique. However, fiscal revenues from the gas industry will be substantial only in the early 2030s as the bulk of revenues would be used for debt repayment during the initial years of gas production.

**Mozambique's debt trajectory is deemed sustainable but partly depends on developments in the LNG sector.**[88] Mozambique is at high risk of debt distress, with debt assessed to be sustainable in a forward-looking perspective.[89] The sustainability conclusion reflects the fact that a significant share of projected borrowing will finance the state's participation in sizable LNG projects, which will be repaid directly from future gas revenues. The external debt sustainability indicators are projected to reach prudent thresholds by the end of the decade (Figure 17). The present value (PV) of external debt-to-GDP is expected to remain above the prudent threshold until 2027, reflecting debt issuance to finance state participation in the LNG projects. The present value of the debt-to-export ratio drops below prudent thresholds in 2022, reflecting LNG exports and higher prices than those assumed in the previous DSA (2020).

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[86] Additional modules have been incorporated into the standard macro model covering: (i) disaggregated energy module; (ii) emissions and pollution module that help map out how economic activity affects the environment and has been used to model low-carbon strategies; (iii) damage functions that reflect the impact of a changing climate on the economy; (iv) adaptation and capital protection functions that show how investments can reduce the damages that might otherwise occur.

[87] These estimates assume that all three major LNG projects (Coral South, Mozambique LNG, and Rovuma LNG) proceed. Specifically, Figures 15 and 16 assume a ramp up of LNG exports starting with 3 mtpa in 2023 going to 16 mtpa in 2026 (for the Coral South and Mozambique LNG projects). The Rovuma LNG project is projected to add another 15 mtpa from 2028 onwards if it goes ahead.

[88] The state-owned oil and gas company Empresa Nacional de Hidrocarbonetos (ENH) is a partner in the LNG projects led by Total energies (Area 1, Golfinho), ENI (Area 4, Coral) and ExxonMobil (Area 4, Rovuma), holding shares of 15, 10 and 10 percent, respectively. A US$ 2.25 billion (15 percent of GDP) sovereign guarantee covers ENH's share in the LNG megaprojects' financing package for Golfinho and lapses within about a year after the start of LNG production, currently expected in 2026. While the full amount is gradually included in PPG debt, the guarantee is activated only as project financing is disbursed. No other public guarantees are extant.

[89] According to the April 2022 IMF-World Bank Debt Sustainability Analysis.

### 3.1.1. The implications of transition risks

**Mozambique's vast LNG reserves could be a major source of growth and fiscal revenue in the coming years, but there are transition risks.** The LNG sector is expected to help accelerate growth and could even create the fiscal space needed for investments in climate adaptation. However, the growth and revenue contributions of the nascent gas sector are dependent on the global transition to net zero emissions and the effect on the price of natural gas. A sharp decline in gas prices because of the shift to net zero could pose major risks as the expected benefits from LNG projects may not fully materialize.

**Figure 15: Mozambique: Real GDP with and without LNG (US$ bn)**

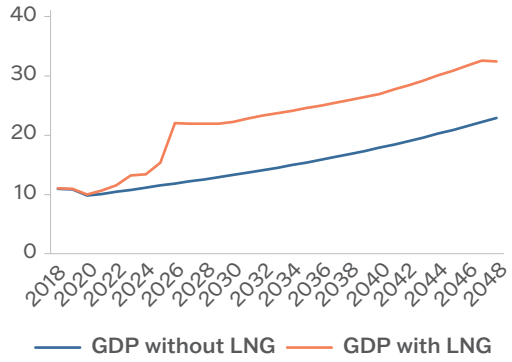



**Figure 16: Mozambique: Exports with and without LNG (US$ bn)**

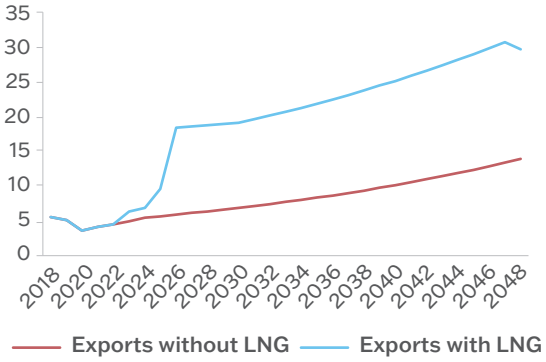
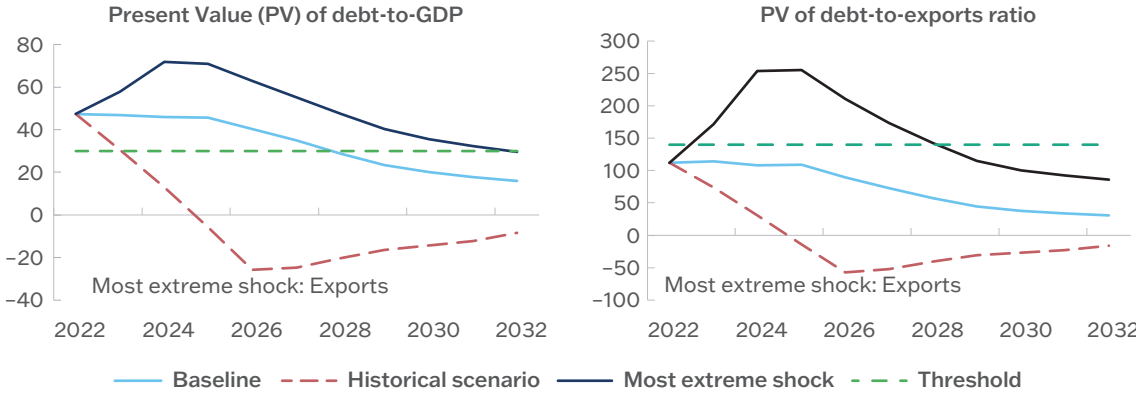



**Figure 17: Indicators of PPG external debt under alternative scenarios, 2022–2032**




*Source:* IMF-World Bank Debt Sustainability Analysis (DSA).

**This sub-section models the LNG sector under three climate futures with different gas prices (Table 2).** It assesses the impacts of LNG investments on growth, the fiscal and external accounts with several world gas price assumptions by 2030 and 2050 in several jurisdictions under three different global climate ambitions (Table 2): (i) current policies, (ii) announced pledges, and (iii) a net-zero scenario. The first scenario assumes that existing climate policies will remain unchanged, implying highly unfavorable climate outcomes but high gas prices owing to elevated demand. The second considers that the world implements recent climate commitments and targets stated in the NDCs with moderate gas prices. The third scenario assumes net zero by 2050 with successful

low-carbon growth, limited global warming, and lower gas prices.[90] It is important to mention that these scenarios do not consider risks related to additional delays in starting exploration related to security concerns or others.

**Table 2. Gas prices based on three different climate futures[91]**

| | | Stated policies | | Announced pledges | | Net-zero by 2050 | |
|---|---|---|---|---|---|---|---|
| Real terms (US$ 2020) | 2020 | 2030 | 2050 | 2030 | 2050 | 2030 | 2050 |
| **United States** | 2.0 | 3.6 | 4.3 | 3.1 | 2.0 | 1.9 | 2.0 |
| **European Union** | 4.2 | 7.7 | 8.3 | 6.5 | 6.5 | 3.9 | 3.6 |
| **China** | 6.3 | 8.6 | 8.9 | 8.5 | 8.1 | 5.3 | 4.7 |
| **Japan** | 7.9 | 8.5 | 8.9 | 7.6 | 6.8 | 4.4 | 4.2 |

*Source:* World Bank price scenarios.

**The results underscore the likely positive effects of LNG investments in Mozambique even under the least favorable market scenario.** Figure 18a analyzes the stated-policies scenario and assumes that all three LNG projects are developed given high global demand and prices. The analysis compares the macro-fiscal impact under this scenario with those under a hypothetical baseline case without the three LNG projects. The growth, fiscal, and debt impacts are substantial. Compared to the no-LNG baseline scenario, by 2028 (when all three LNG projects would start production), GDP would be 40 percent higher, reflecting maximum output and high gas prices. Gas revenues could be between 5–10 percentage points of GDP higher throughout the forecast period. Further, greater fiscal revenues mean that the debt-to-GDP ratio is expected to be substantially lower. However, this picture would be significantly different in a net-zero world with lower gas prices and assuming that the Rovuma LNG project is not developed (Figure 18b). Under this scenario, GDP growth and fiscal revenue would be significantly lower than the stated-policies scenario. By 2028, GDP would be 20 percent higher compared to the no-LNG baseline. On average, gas revenues would be 1.5 percent of GDP higher between 2035 and 2050 compared with the baseline scenario without the three LNG projects; and the debt-to-GDP ratio would only be around eight percent lower by the end of 2050.[92] Nonetheless, results from both the stated-policies and the net-zero climate futures show that LNG projects generate significant fiscal space that could be spent on adaptation and mitigation investments, as discussed in Section 3.3.

**Transition risks to the broader private sector are less widespread due to the high level of the informality (corresponding to about 80 percent of employment).** The informal sector is large but has lower levels of productivity and income than the formal economy. Almost two-thirds (61 percent) of these performance gaps can be explained by differences in firm characteristics: informal firms are smaller with fewer skills, have less access to capital and production inputs, and are less likely to have access to finance and to markets.[93] In the formal sector, exports of non-ferrous metals (aluminum) and ferrous metals, will be affected by more stringent environmental regulations.[94] Notably, for the non-ferrous metals group, Mozambique's carbon intensity of exports is lower than that of China as well as other developing country exporters such as Kazakhstan and India, but higher than that of the U.S. and Germany.

[90] The bulk of Mozambique's gas is destined for export, and thus not considered from the perspective of the country's emissions.

[91] Additional details are provided in the Background Note, available upon request.

[92] Additional scenarios and results are provided in the Background Note, available upon request.

[93] Informal firms are typically small, often run by or within households with lower levels of assets and education, making 17 times lower profits than formal micro enterprises. There is a small but significant group of informal enterprises (7.6 percent of informal firms, representing 10.6 percent of employment in the informal sector) that have similar characteristics and productivity levels to formal micro enterprises.

[94] The principal sources of carbon emissions in these sectors are those directly related to production and those most directly under the control of the producers. Methane emissions are an important factor in exports of coal, gas and petroleum and coal products.

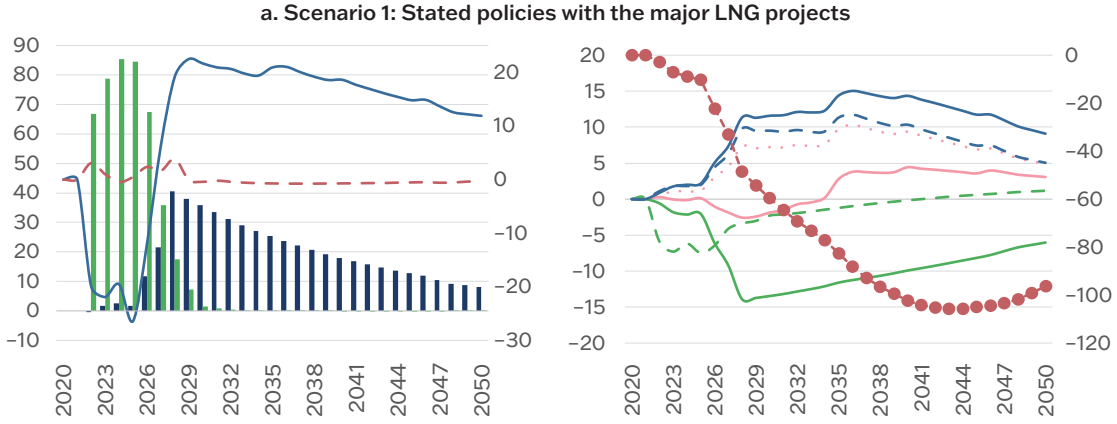
**Private sector transition to a low-carbon economy is hampered by tariff and non-tariff barriers.** Mozambique is primarily an importer of environmental goods (EG), for which the key groups are Management of Solid and Hazardous Waste and Recycling Systems (MSHW) and Renewable Energy Plants (REP). The main suppliers of EGs to Mozambique are China and South Africa. The main barriers to imports include: (i) tariffs: Mozambique imposes higher tariffs on EG than the global average and some regional partners. Natural Risk Management (NRM) and Renewable Energy Plants (REP) are subject to average tariffs of 6.4 percent and 5.7 percent respectively at Mozambique customs, considerably higher than the global average tariff for these sectors; (ii) non-tariff barriers: Mozambique lacks adequate local testing facilities to establish a quality standard program. It also does not have a national accreditation program that can minimize the duplication of re-testing and reduce trade costs. There is also a gap in the dissemination of Mozambique Standards to the public.

### Box 1: Regulation in export markets and the case of Mozambique

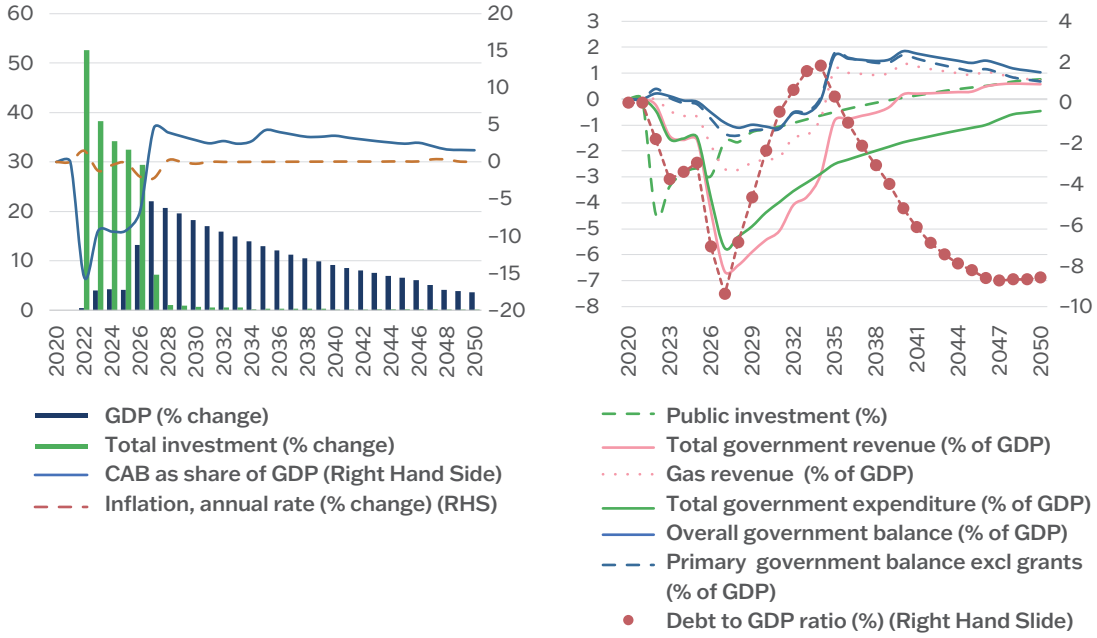
Given the importance of aluminum exports to the EU, Mozambique is heavily exposed to the impact of the EU's CBAM. In 2020 Mozambique exported just over US$ 1 billion worth aluminum, of which 85 percent went to the EU market. Economy-wide modeling of EU CBAM impacts suggests that for fossil fuel exporters and exporters of GHG intensive products, the principal impact will come from their own and overseas countries domestic measures to achieve their NDCs rather than the trade measures.

Notably, Mozambique's exports of aluminum may be carbon competitive relative to the main developing country competitors, such as China, India, and Kazakhstan. Hence in principle, and if the input-output data used to derive sector emissions intensities accurately reflects emission realities, exports of aluminum from Mozambique will require fewer certificates and hence a lower carbon border tax than other major developing country exporters to the EU. Mozambique will also need to adapt to the CBAM and similar measures as other countries pursue low-carbon strategies.

### Figure 18: Real, external, and fiscal sectors (in percentage point differences to a no-LNG scenario)



b. Scenario 2: Net-zero without the Rovuma LNG project




*Source:* World Bank estimates.

**Another obstacle for a more efficient transition is the relatively 'shallow' nature of Mozambique trade agreements.** Among Mozambique's trade agreements, the Southern African Development Community (SADC)-EU Economic Partnership Agreement (EPA) addresses environmental protection in terms of trade activities. The EPA, signed in June 2016 and entered into force in 2017, is an agreement that establishes provisions for environmental protections in trade and sustainable development. Both parties confirm that any new or modified legislation on labor conditions or environmental practices adopts the internationally recognized standards and cannot weaken labor or environmental protection to encourage trade or investment.[95] Notably, the African Continental Free Trade Area (AfCFTA) does not currently feature a Protocol on the Environment and Sustainable Development. However, as the AfCFTA negotiations are ongoing, it would still be possible for the AfCFTA State Parties to include such a protocol. Since Mozambique has not ratified the deal, it could consider the inclusion of provisions that address climate change related concerns.

### 3.1.2. LNG and poverty reduction

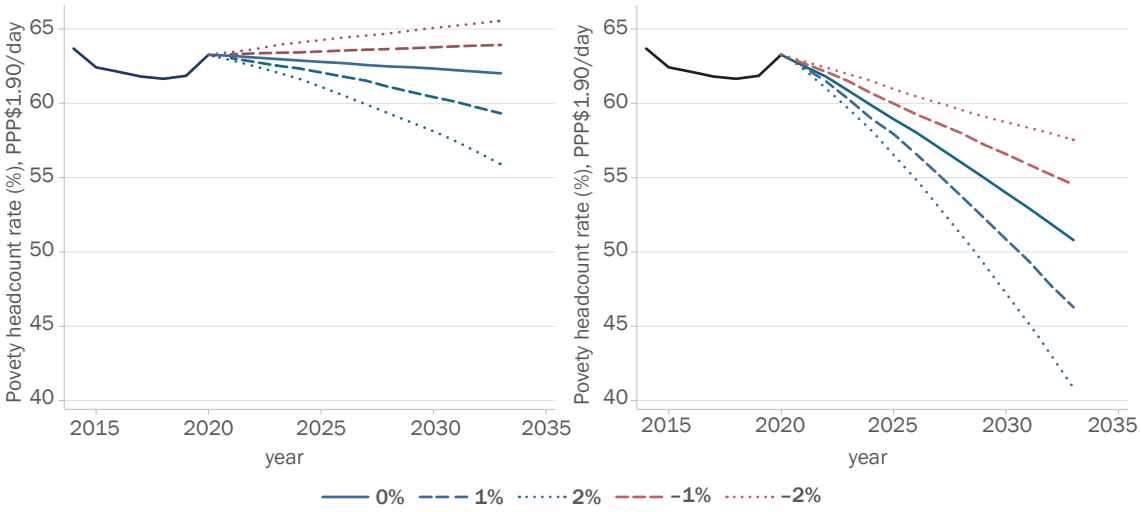
**This section illustrates how poverty in Mozambique could evolve under various scenarios for growth and distribution of growth over the next decade.** To assess the potential impact of growth on poverty reduction, the economic projections from Mozambique's Country Economic Memorandum (CEM) from 2020 to 2033 and population growth from the World Development Indicators (WDI) are used. Under a scenario of no new natural gas resources, GDP per capita growth was expected to be 2.2 percent per year. Under the revised scenarios which incorporate projected revenues from LNG, GDP per capita is projected to grow at 2.8 percent per year. Such projections entail significant uncertainty but provide a useful baseline for the growth of the economy overall. The simulation tools are deployed to illustrate the distribution of growth. Simulations were

[95] SADC-EU EPA text, https://trade.ec.europa.eu/doclib/docs/2015/october/tradoc_153915.pdf.

conducted where the bottom 40 percent of the income distribution grows at a different rate from the mean, while maintaining overall growth rates consistent with projections. The simulations show scenarios where the poorest 40 percent grows one and two percentage points faster and slower than the mean.[96]

**Poverty projections based on real per capita GDP growth with all LNG projects coming into production show substantial potential reductions, with poverty falling from 63.3 percent (2020) to 50.8 percent (2033).** This contrasts sharply to the baseline scenario without new LNG production, which would barely reduce poverty to 62.0 percent (2033) as projected real per capita GDP growth rates remain marginally above the population growth rate in the period up to 2033. Figure 19 displays poverty simulations for 2020–2033 without and with LNG production for different changes in inequality, other things equal. The central simulation in both diagrams represents distributionally neutral growth, whereas the curves above (below) show the poverty trajectory with the poorest bottom 40 percent of the population growing below (above) average and inequality thus increasing (decreasing). Given that the translation of natural gas derived revenues into inclusive growth does not occur automatically, it is crucial to examine the potential impact of distributional changes on the long-term trajectory of poverty. Figure 19 illustrates that addressing inequality, specifically how gas revenues are distributed across income brackets, is essential for poverty reduction. Poverty in 2033 changes by five percentage points for every 1 percentage point difference in mean consumption growth between the bottom 40 percent of the distribution and the average citizen. This highlights the importance of ensuring that gas revenues disproportionately benefit the poor.

**Figure 19: Poverty simulations following projected GDP without (left) and with (right) LNG production**




*Source:* World Bank estimations based on Povsim simulations, Mozambique's CEM GDP projections and WDI population growth.

[96] The simulation of these growth scenario and its impact on distribution of income and poverty was implemented using the povsim command in Stata, based on the method developed by Lakner, Christoph and Mahler, Daniel Gerszon and Negre, Mario and Prydz, Espen Beer, How Much Does Reducing Inequality Matter for Global Poverty DOI: 10986/33902. Journal of Economic Inequality. Forthcoming.

## 3.2. Macroeconomic and Poverty Impacts of Climate Change

**This section discusses Mozambique's climate vulnerabilities and how they affect growth, productivity, and its development potential through two types of risks: climate and disaster risks.**

### 3.2.1. Climate impacts on the economy

**The analysis examines the overall macroeconomic and sectoral impacts of different climate scenarios.** Five channels through which climate impacts the economy are considered: (i) labor productivity, (ii) rainfed crop yields, (iii) livestock yields, (iv) urban flooding, and (v) damages to roads and bridges. Temperature directly affects labor productivity, where the effect intensifies for labor types that are outdoors and with more intense physical work. In addition to direct labor productivity loss due to temperature rises at the workplace, climate change is projected to indirectly impact labor productivity through increased sickness, which results in time away from work. Under climate change, rainfed yields will be affected by changes in rainfall patterns, increasing evaporative demands, and extreme heat as temperatures rise. Climate change may impact livestock yields from both increases in direct temperature impacts and reduced availability of feed. Under climate change, projected increases in the frequency and severity of storm events will worsen urban flooding impacts, which are already challenging in Mozambique because of urbanization, land use degradation, and inadequate flood protection. These different channels are brought together in the macroeconomic model, and the overall impact on GDP and other macroeconomic variables is evaluated.

**Five climate futures are considered.** The climate modeling literature uses general circulation models (GCMs) to provide standardized scenarios for possible futures. These climate futures consider alternative emissions pathways but also differentiate themselves in other aspects, such as the assumptions which affect the degree of additional precipitation expected from climate change. Table 3 summarizes the chosen scenario combinations. The extent to which the selected scenarios and different GCM scenarios affect the two most critical climatic statistics—change in mean annual temperature and precipitation—is shown in a scatterplot in Figure 20.

- **Dry 119.** "Dry" scenario that is 10$^{th}$ percentile of mean precipitation change across SSP1-RCP1.9 GCMs.
- **Wet 119.** "Wet" scenario that is 90$^{th}$ percentile of mean precipitation changes across SSP1-RCP1.9 GCMs.
- **Dry 370.** "Dry" scenario that is 10$^{th}$ percentile of mean precipitation change across SSP3-RCP7.0 GCMs.
- **Wet 370.** "Wet" scenario that is 90$^{th}$ percentile of mean precipitation changes across SSP3-RCP7.0 GCMs.
- **Hot 370.** "Hot" scenario that is 90$^{th}$ percentile of mean temperature change across SSP3–7.0 GCMs.

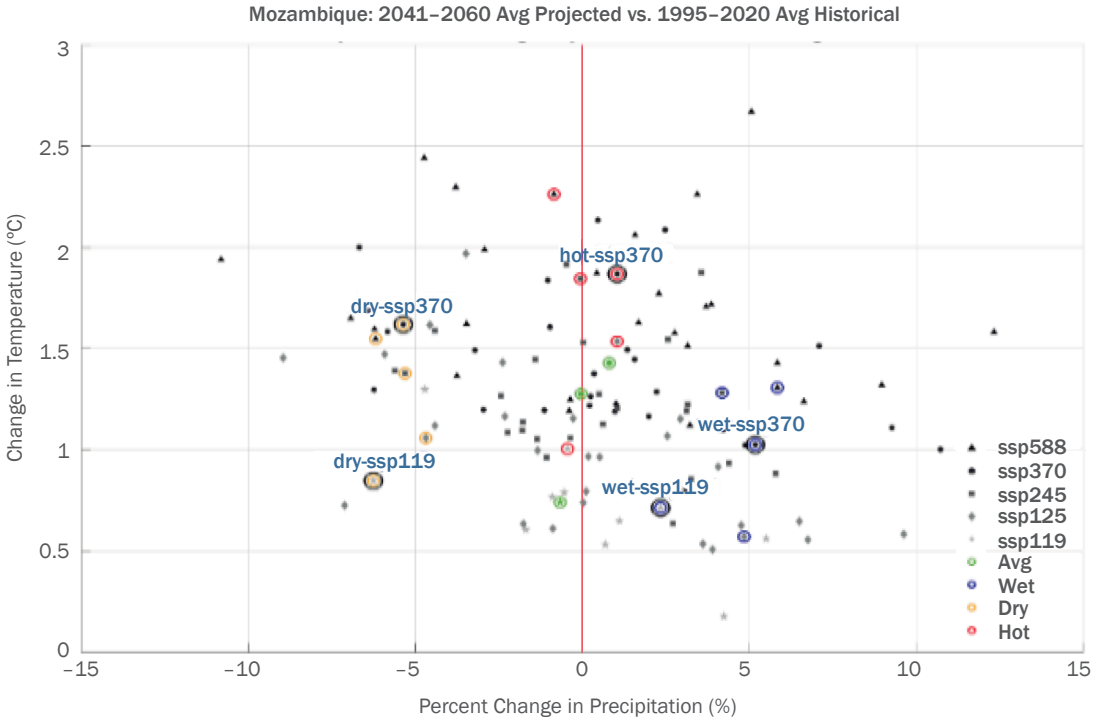
Table 3. Climate scenarios selected for the analysis

| SCENARIO | SSP | RCP | GCM |
|---|---|---|---|
| Dry — 119 | SSP1 | RCP1.9 | CANESM5 |
| Dry — 370 | SSP3 | RCP7.0 | CNRM-CM6-1 |
| Wet — 119 | SSP1 | RCP1.9 | IPSL-CM6A-LR |
| Wet — 370 | SSP3 | RCP7.0 | MIROC6 |
| Hot — 370 | SSP3 | RCP7.0 | ACCESS-CM2 |

RCP = Representative Concentration Pathway

*Source:* World Bank CCKP.

Figure 20: Climate scenarios modeled for Mozambique




*Source:* World Bank CCKP.

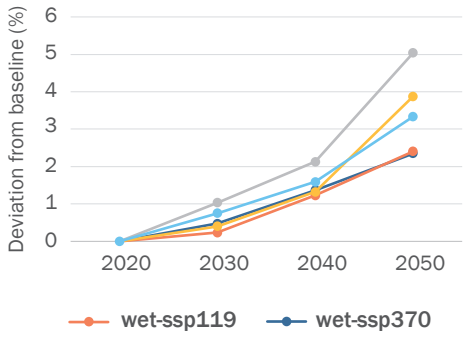
**The impacts of climate change, relative to a baseline in which the climate does not change any further, are expected to be significant, especially under hot and dry scenarios.** The largest impacts are felt under the "hot" scenarios (SSP3-RCP7), with GDP down nine percent by 2055 relative to the baseline. This is also the scenario with the most considerable impact on agriculture and agricultural labor productivity. Under the "wet" scenarios, GDP would decline by approximately four percent by 2055, with a significant portion of it accounted for by lower agricultural labor productivity.

### 3.2.2. Distributional impacts of climate change

**Climate change will increase the poverty rate in Mozambique.** In all the future climate scenarios, the economic losses from climate change impacts increase poverty. By 2050, under the worst-case "hot" scenario, the international poverty rate will increase relative to the baseline by five percent, which puts 1.6 million additional individuals in poverty. These

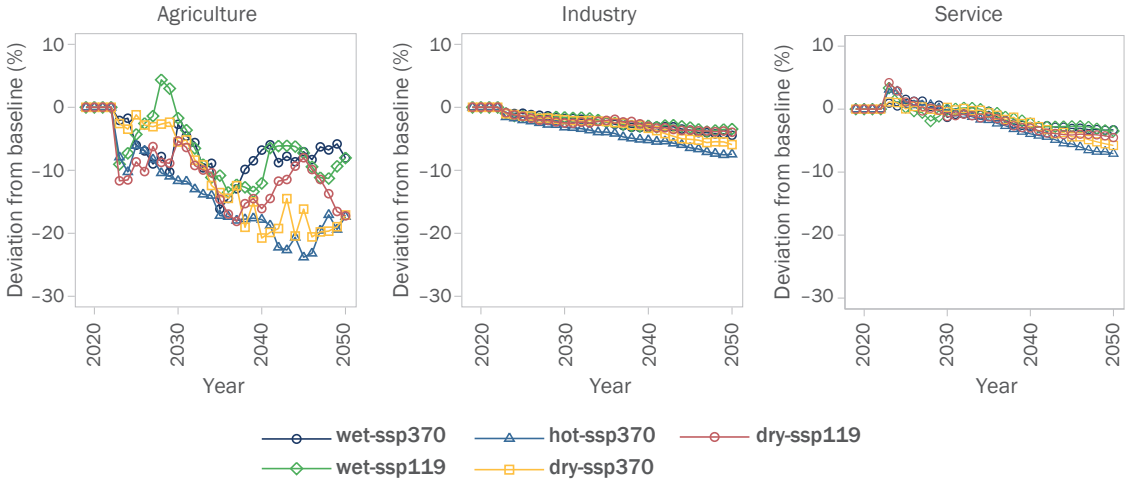
impacts are smaller under the two “dry” climate scenarios. Yet the smallest effects are seen under the two “wet” climate scenarios, where the poverty rate increases by more than two percent relative to the baseline scenario (see Figure 21). The impact on headline poverty is muted because the baseline poverty level is high and concentrated in the agriculture sector. The effects of climate shocks in the modeling are heavily concentrated in the agriculture sector (see Figure 22), which is the sector that accounts for the highest level of poverty in the country due to an important level of subsistence agriculture activities, as discussed in other parts of the report.

**Figure 21: Poverty impact (international poverty line)**




*Source:* World Bank estimates.

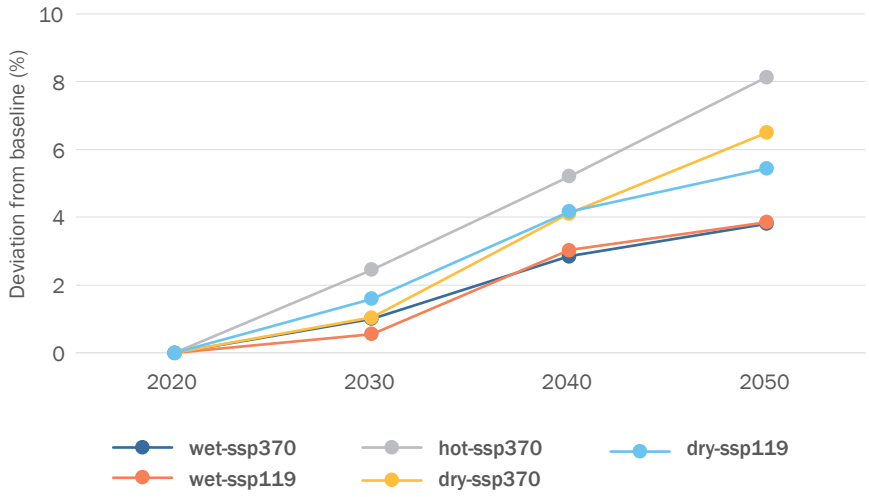
**Figure 22: Value-added by sector, deviations from baseline scenario (%)**




*Source:* World Bank estimates.

**The negative impacts of climate change are concentrated at the bottom of the welfare distribution.** The effect of all the future climate scenarios on the intensity of poverty (how proportionally far below the poverty line the poor fall) are larger than the equivalent impacts on the headline poverty. For example, by 2050, under the worst-case “hot” scenario, the poverty gap will increase relative to the baseline scenario by more than eight percent (see Figure 23).

Figure 23: Impact on the poverty gap (international poverty line)




*Source:* World Bank estimates.

**The poverty impacts of climate change are not evenly distributed across regions.** The increase in the poverty rate by region relative to baseline under the worst-case "hot" scenario ranges between three to 11 percent. The largest increase is seen in the province of Manica (11 percent), Niassa (nine percent), and Maputo province (nine percent) while the smallest impacts (approximately three percent) can be found in the provinces of Nampula and Zambezia. The impacts of climate change are proportionally higher in urban areas. In the most pessimistic scenario, the poverty rate in urban areas increases by eight percent but only four percent in rural areas. However, these differences are relative to a much lower level of poverty in urban areas at the baseline year and a baseline scenario showing declines in urban areas over time at a much faster rate than in rural areas. These results may also at least partially stem from the fact that urban areas are disproportionately located on the coastal region, and adjacent to the nation's main highway that traverses the entire country, an area increasingly hit by recurring cyclones.

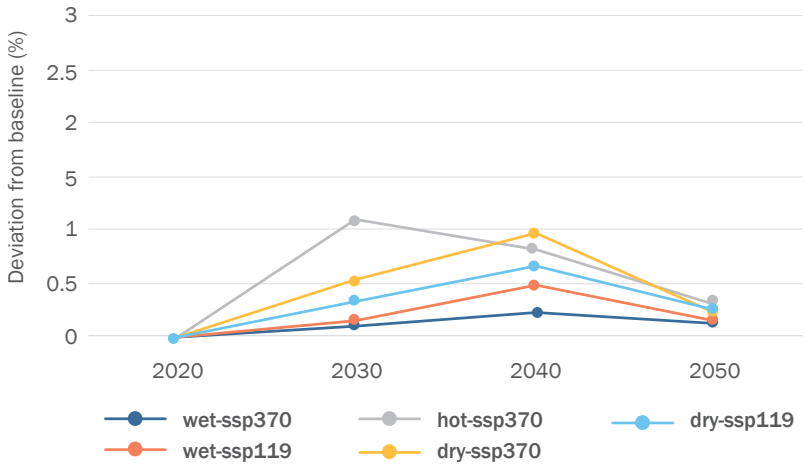
**Climate change will increase inequality in Mozambique only slightly.** If no significant structural transformation occurs, inequality as measured by the Gini coefficient will barely change by 2050 under all the climate scenarios analyzed (Figure 24).

**Mozambique poverty will also be affected through the impact of the global low-carbon agenda on its coal industry.** With an average production of 16 mtpa over the last five years, Mozambique ranks globally as the 20th coal producer, 9th as a coal exporter with an annual value of US$ 1.1 billion in 2021 and ranks 28th in terms of coal reserves.[97] Mozambique consumes marginal quantities of coal for its own electricity generation, and well over 90 percent of its coal production is exported to several key trade partners in the metallurgical and thermal coal industries. Mozambican thermal coal exports (52 percent of total production) go primarily to India, Poland, and South Korea for use in power generation, while metallurgical coal exports (48 percent of total production) are primarily traded to European steelmakers in Poland (ArcelorMittal) and the Netherlands (Tata Steel). Currently,

[97] Since 2011, the coal sector has contributed between 20 percent and 33 percent to the country's export revenue. There are only four producers in the country: Vulcan Resources (recently acquired Moatize mine and the 912 kilometers railway Nacala Logistics Corridor from Vale), Jindal Steel & Power Limited (JSPL), International Coal Ventures Private Limited (ICVL), and Minas de Moatize, all of them located in the Tete province, northwest of Mozambique. Vulcan operates the largest open cast mine, Moatize, being responsible for most of Mozambique's coal production around 14 mtpa.

there is zero installed capacity for coal-based energy generation. MIREME plans to assess and estimate fugitive emissions of GHG by mining projects to contribute to the reduction of greenhouse gas effects on mining associated with solid mineral resources. In a phasing out process, it is important to address the issue of how coal revenues can best be applied towards retraining and investment in cleaner energy technologies and a just transition.

**Figure 24: Impact on inequality measured with the Gini coefficient (deviation from baseline, %)**




*Source:* World Bank estimates.

**One of the provinces that can be affected by low-carbon efforts is Tete given the importance of coal mining for the local economy.** The province is home to one of the largest coalfields in the world. After 2015, coal exports grew to became one of the latest shares. The impact on poverty of very localized mining activities in Tete have been estimated in Egger et al. (2021).[98] Beyond the investment phase, the longer-term production period may have contributed to an overall reduction in poverty in the mining area of around 11 percentage points. A rough estimate based on this evidence would suggest that this may have contributed to some 40,000 people moving out of poverty. Conversely, if mining in Tete was to be eliminated or die out, poverty might increase by the same amount.

**The closing of coal mining in South-Africa may also affect poverty, through a decline in remittances and the return of mining workers.** Preliminary evidence suggests that 350,000 households, representing a total of 6.36 million people, have at least one family member in South Africa. With the available data it is not possible to identify the volume of remittances from Mozambican workers in South Africa's coal mining.

### 3.2.3. The impact of disasters on the economy

**Climate shocks severely impact the economy, increase fiscal pressure, and disproportionately affect rural households.** The perennial nature of climatic events such as cyclones, droughts, and floods jeopardize the country's development efforts as its stock of physical assets is eroded, among others. A climate-induced natural disaster that damages infrastructure can lead to substantial costs. These include direct costs associated with rehabilitation and reconstruction and indirect economic costs linked to

[98] Egger, E.-M., Keller, M. & Mouco, J. (2021) The socioeconomic impact of coal mining in Mozambique. WIDER Working Paper 2021/108. Helsinki: UNU-WIDER.

economic and social activity disruption. Based on the historical incidence, it is estimated that natural disasters caused an annual average loss of five percent of GDP in Mozambique. In 2019, losses amounted to 11.3 percent of GDP, highlighting the interannual variability in the incidence of natural hazards.[99]

**The macroeconomic impact of natural disasters, including cyclones, flooding, and droughts is significant.** The analysis accounts for the unpredictability of damages by using historical probabilities of climatic events as a likelihood measure of such events re-occurring. In the model, the annual damage to the capital stock from natural hazards is drawn from the historical probability distribution of such damages. In this distribution, the average annual damage is five percent of GDP, with low-damage years more likely to happen than high-damage years, in line with historical records. The analysis models the stochastic path of GDP consistent with such distribution of losses. The uncertainty in annual damage creates a range of possible economic outcomes, which widens with time (fan chart), with the most probable outcomes concentrated in a band around the median (Figure 25). The blue line represents the median outcome of the distribution over time—the most likely outcome used as the reference scenario and normalized around zero. The red line plots the hypothetical scenario in which no damages ever occur from natural hazards. It serves to visualize that, under this scenario, GDP by 2050 would be 15 percent higher than the median outcome.[100] A sequence of severely bad outcomes (the bottom edge of the fan chart) are unlikely to happen each year. However, if they do, cumulative GDP losses increase yearly. Similarly, a sequence of extremely favorable outcomes, which is also unlikely, results in diminishing GDP losses each year. These losses are reflected in the graphs as positive GDP deviation from the median.

**The business-as-usual (BAU) baseline scenario underscores the significant impact of natural disasters in Mozambique and that the range of outcomes is skewed towards bad outcomes.** The reference BAU scenario assumes natural disasters occurring at historical levels and no additional investments which might increase resilience and reduce the impact of natural hazards. Figure 7 plots GDP relative to the median scenario and shows two important results.[101] First, the impact of natural disasters on Mozambique is considerable. Even under the more optimistic scenario, GDP by 2050 would be almost eight percent lower than if Mozambique were completely spared from natural hazards for the next 28 years. Second, the range of outcomes is skewed towards unfavorable outcomes. Comparing the edges of the fan chart, which are equally likely, by 2050, the optimistic outcomes (top of the fan chart) are only seven percent above the median, while highly damaging outcomes (bottom) are 14 percent below the median. This implies that the GDP impact would be larger under a sequence of extremely favorable outcomes than under a series of severely bad outcomes (compared to the median). The results on consumption and investment bear out similar patterns.[102]

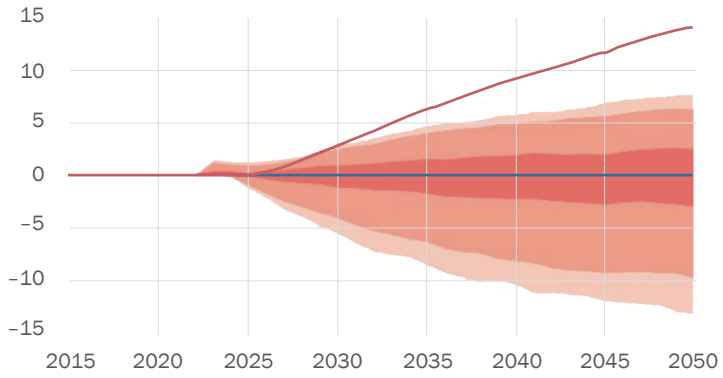
[99] World Bank (2018). Financial Protection against Disasters in Mozambique.

[100] The results do not capture the increased probabilities of significant events due to climate change. Data on how these exceedance curves shift as the climate changes are not available.

[101] Under a sequence of extremely favorable outcomes each year (95th percentile—top edge of the fan chart), by 2050, GDP would be seven percent greater than the median outcome.

[102] Additional details provided in the Background Note, available upon request.

Figure 25: BAU GDP relative to median (% change)

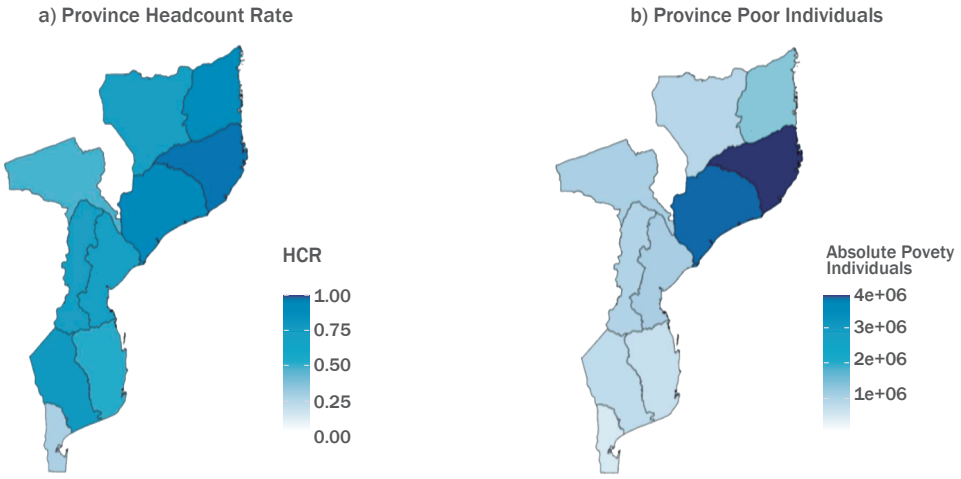



*Source:* World Bank estimates.
*Note:* The bands in the fan charts represent outcome windows that capture a certain proportion of possible outcomes as deviations from median outcome. The dark red area in the figures contains ±25 percent of outcomes around the median, meaning that 50 percent of disaster outcomes are within the band. The middle red share contains ±40 percent around the median, meaning that the middle red and dark red bands together comprise 80 percent of outcomes. Finally, the light red band share contains the ±45 percent around the median, implying that the whole fan chart contains 90 percent of outcomes.

### 3.2.4. Disaster impacts on poverty

**Lastly, the comparison between the impact maps for extreme events and those displaying the geospatial distribution of relative and absolute poverty (Fig.** 26) provides an opportunity to geographically identify areas with higher vulnerability to climate shocks. Poverty results illustrated in this figure correspond to a survey conducted during the COVID-19 pandemic and therefore strongly represent a shock rather than the poverty distribution that would have been observable otherwise. While this is reflected in high poverty rates in some southern provinces, it is apparent that the poor are concentrated in the north, in particular in Zambezia, Nampula and Cabo Delgado. In addition to housing the largest numbers of poor, Zambezia and Nampula are consistently among the worst affected by floods, cyclones, and landslides. In the case of droughts, Nampula is not among the most affected while Zambezia is the most affected. For cyclones and landslides, these two provinces top the ranking. Overall, this indicates that a large proportion of the Mozambican poor live in areas most affected by these natural events.

Figure 26: Percentage and number of poor at province level (2019/20)




*Source:* World Bank elaboration.

## 3.3. Policy Options

### 3.3.1. Adaptation investments

**Considering Mozambique's focus on adaptation, this report models two alternative policy options to the BAU that consider different measures to increase resilience to natural disasters.** The first policy option assumes investments in "adaptation capital". These are costly investments that, rather than generate additional productivity, make the existing capital stock more resilient to natural hazards. The modeling implements this as a protection function which reduces the incurred damages from natural disasters by a fraction. This fraction increases with the amount of accumulated adaptation capital and has decreasing marginal returns.[103] A second policy option models how financial resources earmarked for reconstructing damages are converted into physical capital. The quicker this happens, the less time the economy is deprived of highly productive infrastructure that was destroyed. To easily visualize the effect of these policy options, the fan charts in Figures 27 and 28 plot GDP relative to the median ofthe BAU scenario, keeping the blue line for the scenario-specific median. In this way, changes in the scenario median relative to the BAU median are easily seen as deviations of the blue curve from the zero line.

**Two scenarios are considered featuring adaptation investments, strengthened institutions, and a combination of the two.** The first scenario (S1) considers the economywide effect of investing one percent of GDP in adaptation capital and compares it to the BAU where these investments were not made (Figure 27). These investments are funded from existing investment budgets. The second scenario (S2) adds an institutional dimension to disaster preparedness and recovery analysis. This policy scenario focuses on speeding up reconstruction efforts, a proxy for strengthened institutions.[104] The scenario assumes that reconstruction resources to rebuild damaged infrastructure are mobilized 40 percent faster than in the BAU scenario (Figure 28).[105] This scenario has no direct financial cost as it only simulates the impact of institutions that would deliver more quickly on reconstruction without putting a cost on the improved institutions. The scenario also doesn't change the total amount that goes into reconstruction, but the speed at which the destroyed capital is rebuilt.

**The results indicate that the measures considered reduce the impacts of natural disasters but are particularly effective in reducing downside risk (persistently severe outcomes).** In Figure 27, the median outcome (blue curve) is slightly, but clearly above zero. The zero line in all these graphs represents the median outcome of the BAU scenario. This implies that, on average, committing one percent of GDP into adaptation capital is a modestly good investment. The more significant effect is at the bottom of the distribution. GDP in 2050 under S1 is 10 percent below the BAU median, while under BAU policies it is 14 percent under the BAU median (Figure 27). Gains from adaptation accrue almost exclusively in the bottom half of the distribution. Comparing the top of the fan charts in Figures 27 and 28 shows that the top of the distribution is barely affected by the adaptation investments.

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[103] In the absence of Mozambique specific data, the protection function was calibrated to the global estimate of the benefits of adaptation in "Global Commission on Adaptation. 2019. Adapt Now: A Global Call for Leadership on Climate Resilience. Washington, DC: World Resources Institute. © Global Commission on Adaptation. https://openknowledge.worldbank.org/handle/10986/32362 License: CC BY 4.0 International."

[104] What allows for speedier reconstruction includes: preparedness financing packages (e.g., government disaster funds, contingent lines of credit, or insurance), expedited procedures for reconstruction (e.g., rapid building permits), and pre-arranged contracts (e.g., pre-arranged contract for debris removal can accelerate reconstruction by six months or more).

[105] There are trade-offs with building back better: When reconstruction happens swiftly, there is little time to redesign a city or change technology. These trade-offs are also factored into the modeling.

**Improvements in institutional capacity, proxied by the speed at which existing resources can be mobilized to repair damages caused by natural hazards, can generate large cumulative gains.** Scenario S2 assumes that the speed of reconstruction is increased by 40 percent relative to the baseline. This results in even greater improvements to future outcomes than the one percent of GDP per annum adaptation investments modeled in scenario S1. This scenario quantifies the significant benefits of speedy reconstruction but might overstate the value since the analysis assumes that the institutions necessary for this can be created without additional cost.[106] The median outcome (blue curve) eventually deviates quite significantly from zero. Unlike S1, S2 generates a significant benefit over the BAU. As shown in S1, the more important benefit of S2 is at the bottom of the distribution: the 5th percentile (bottom of the fan chart) is only eight percent below the BAU median (the zero line), while the 5th percentile of the BAU scenario is 14 percent below the median (compare Figures 27 and 28. This is because damaged capital, like essential roads, bridges, and hospitals, has a higher use value than replacement cost. If it remains unrepaired for long, losses to GDP cumulate.

**Figure 27: S1 — GDP relative to BAU median (% change)**

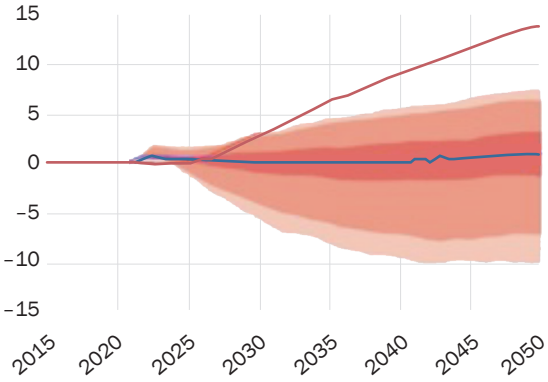
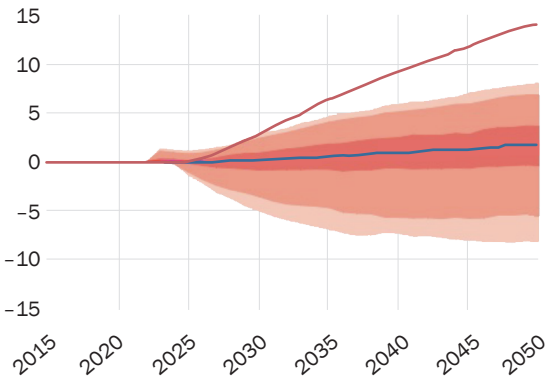



**Figure 28: S2 — GDP relative to BAU median (% change)**




*Source:* Mozambique MFMOD Standalone.

**Naturally, when both adaptation investments and enhanced institutions are factored in, the adverse outcomes improve even further, with the 5th percentile scenario only five percent worse than the BAU median.**

## 3.4. Fiscal Considerations in Managing Climate Change Impacts

### 3.4.1. Fiscal constraints

**Considering the sizable LNG sector, adaptation investments could be financed by proceeds from the expected LNG revenues.** The resilient infrastructure reconstruction assumptions considered in Scenario 1 at one percent of GDP are modest and could be financed by the sizable revenue windfall expected from the LNG investments. Mozambique would not need to redirect new investments to reconstruction, preserving their

[106] Yet, many institutional reforms and policy improvements can be undertaken without major fiscal costs. Some of those reforms are discussed in Chapter 4.

growth-inducing effects while enhancing disaster-preparedness. The results show that, even in the most conservative scenario, the gas sector, on average, could generate annual fiscal space of 1.5 percent of GDP between 2035 and 2050.

### Box 2: Clean-cooking scenarios and underlying assumptions

A clean-cooking intervention is modeled under various scenarios, resulting in reductions in land-use change, biomass use, and fewer emissions. Climate calculations are derived for the 2020 baseline, a 2030 BAU, and 2030 aspirational and realistic scenarios. The analysis presents $CO_2e$ emissions per household depending on fuel type, disaggregating them with and without black carbon. Two more scenarios are considered (2030 aspirational and 2030 realistic scenarios) that feature the transition from traditional or improved cookstoves (ICS) to Modern Energy Cooking Services (MECS).

The analysis underscores that the realistic scenario is a win-win proposition. By 2030 the intervention will result in a one percent increase in GDP relative to baseline, combined with a reduction of one percent in emissions. The economic impact is the result of a higher direct cost (in the realistic scenario over the baseline) combined with a labor-saving of over 300 million person-hours (or 60 thousand additional workers), the net effect of which raises GDP by one percent (as well as consumption by 2.5 percent) in 2030.

Under an aspirational technology replacement scenario, there is a trade-off between the additional labor supply and the cost of implementing the policy. Over 8.3 billion working hours are freed up from the intervention because significant amounts of people no longer require two hours a day for wood collection (over three million workers by 2030). The costs are also much larger, reaching over US$ 1 billion by 2030, compared to US$ 325 million for the realistic intervention. The scenario results in considerable emission reductions worth almost 10 percent of Mozambique's current $CO_2$ emissions, drawing primarily on Liquified Petroleum Gas (LPG). Under this intervention, GDP could be about three percent higher than the BAU by 2030.

**Sound resource revenue management and a robust climate-smart public investment management system are essential to expand fiscal space for adaptation investments.** Parliament is considering a bill establishing a SWF for managing resource revenues. The proposed SWF law foresees domestic investments financed by resource revenues through the budget. At the same time, the GoM has strengthened its PIM system and the regulatory framework with World Bank support. An electronic national public investment system for project selection and appraisal has been introduced, and a climate-smart public investment management framework has been adopted. Building on these efforts, it will be essential for Mozambique to implement the SWF law effectively, establishing adequate fiscal rules to protect some fiscal space for effective adaptation investments through the public investment management system. Finally, it will be critical for the government to continue developing public investment processes and systems, drawing on the LNG revenues to finance well-appraised projects that are resilient to climate change.

**Although LNG revenues would help provide much-needed financing for adaptation investments in the long-term, Mozambique needs to create fiscal space and leverage other sources of financing in the medium-term.** It will take time for the LNG sector to generate significant fiscal revenues and lower the debt burden, as the peak production is

expected to be achieved in the late 2020s.[107] Furthermore, the impact of the expected LNG resource windfall will largely depend on how they are managed. In addition, as underlined above, transition risk could affect foreign financial and investment flows into the sector. In this regard, it is key for Mozambique to put in place an adequate policy and institutional framework for sound management of resource revenues. Simultaneously, the country could accelerate fiscal consolidation to create the necessary fiscal space to support climate adaptation.

### 3.4.2. Private capital mobilization

**The private sector could play a critical role in accelerating climate-smart investing in key sectors.** These include renewable energy, transport, green buildings, urban wastewater, climate-smart agriculture, and municipal solid waste management. Currently, Mozambique stands out among SSA countries for its low level of private capital stock: while public capital stock is marginally higher than the SSA average, private capital stock is far below average. Mozambique's private investment rate averaged 18 percent of GDP during 2010–2016, lower than those of its structural peers and the SSA average. For Mozambique to attract more private participation and FDI, the GoM will need to continue to streamline administration process, enhance fair and transparent tax treatments, improve regulations and procurement systems, and tender projects competitively under a PPP framework. One example is the potential for private sector participation in the provision of renewable electricity from hydro, solar, wind, and biomass. However, for this to be achieved, regulatory reforms will be needed.[108] Overcoming institutional challenges and having an enabling regulatory environment will be key to enhance the role of the private sector in creating pathways to climate resiliency and low-carbon development.[109]

**The private sector could also be key in enabling cost effective mitigation and adaptation in the country through their engagement, investment, and providing services and products in other sectors of the economy as highlighted in the NDC.** Other areas of focus for the private sector include development of tourist areas and coastal zones in the western Indian Ocean region to reduce climate change impacts, construction of agro-hydraulic infrastructure on major surface watercourses, rainwater harvesting and conservation mainly in the south, improved technologies for agricultural production e.g. irrigation, reducing people's vulnerability to climate change disease vectors, strengthening the Early Warning System for dissemination of timely meteorological and hydrological information, and strengthening data processing and storage systems.

**Overcoming institutional challenges and having an enabling regulatory environment will be key to enhancing the role of the private sector in creating pathways to climate resiliency and low-carbon development.** Some of the challenges to be addressed include: (i) improving capital markets regulation, market valuation of investment potential and sector prioritization to identify bankable projects; (ii) overcoming the lack of institutional capacity to manage, structure and negotiate power concessions; (iii) adopting legislation to support circularity and promote competition around waste management services; (iv) reviewing

[107] World Bank, 2020, Mozambique Country Economic Memorandum, Washington, DC.

[108] For example, on the off-grid side, the private sector continues facing significant barriers of high VAT and import duty on solar products This continues to be a major barrier, as all renewable energy products, including for solar panels, are charged at a high 17 percent VAT. Additionally, solar products are charged an import duty of 7.5 percent, regardless of their application. For example, solar panels used in the agriculture sector (e.g., water pumping for irrigation) must pay the duty, even though agricultural equipment is exempt. When fees for facilitation services are considered, these charges could add 30–40 percent to the total cost of installation.

[109] Some of the challenges to be addressed include: (i) improve capital markets regulation, market valuation of investment potential and sector prioritization to identify bankable projects; (ii) overcome the lack of institutional capacity to manage, structure and negotiate power concessions; (iii) adopt a legislation to support circularity and promote competition around waste management services; (iv) review and update building codes, and upgrade construction methods.

and updating building codes; and (v) upgrading construction methods. With a visible, organized private sector entity, it would become easier for Mozambique to engage or attract international climate finance or formulate a climate investment strategy. There can also be a facilitated link with informal or Micro, Small and Medium Enterprises (MSMEs) to involve private sector players. Exchanges of lessons learned, business ideas, and experiences with other developing or African countries would facilitate fast learning on implementation of climate change opportunities.

### 3.4.3. Financial sector vulnerabilities to climate-related and environmental risks

**Physical climate risks in Mozambique, such as extreme weather events, can damage financial infrastructure, directly impacting the operation of individual financial institutions.** Even a temporary suspension in operations, cutting off access to financial services, can have devasting effects on a financial institution's clients and counterparts, especially in the aftermath of a severe weather event where the need to access funds, loans and means of payment in a timely fashion can be crucial. This is in line with the country's recent experience, with temporary branch closures observed by the Bank of Mozambique (BoM) in the aftermath of the Idai cyclone in affected parts of the country. Financial institutions most exposed to the direct impact of physical climate risks are those operating in regions prone to cyclones, namely Nampula, Zambezia, and Inhambane, followed by Sofala and Cabo Delgado.

**Mozambique's financial sector is more broadly, albeit indirectly, exposed to climate-related and environmental risks through lending and investment portfolios.** Physical climate risks, whether extreme or gradual, can impact non-financial businesses by damaging infrastructure, disrupting operations, or otherwise affecting profitability. Similarly, transition risks can displace certain businesses that are not willing or able to adapt and can result in losses for investors who are unable to recoup the cost of their investment when assets suffer devaluations due to changes in policy, consumer/investor appetite, and technology. The risk of "stranded assets" can discourage prospective investment in Mozambique's GHG-intensive sectors, such as coal, and potentially to a lesser extent, gas, (which may benefit from demand as a transition fuel).

**Both risks can translate into increased credit risk, hindering non-financial businesses' ability to meet loan obligations, as well as market risk and result in a devaluation of corporate assets or profits.** Financial institutions whose lending or investment portfolios are exposed to sectors vulnerable to climate-related and environmental risks, for instance through corporate bonds or equities, are therefore themselves indirectly vulnerable. With respect to credit risk, certain characteristics of the loan instruments, and in particular their tenor, may somewhat insulate financial institutions from transition risk. For instance, shorter term loans may enable financial institutions to repay and adjust their portfolios in response to changes in climate policy. In the Mozambican context, the financial sector's vulnerability to physical climate risks is related to its exposure to the agriculture, fisheries, forestry, tourism, and hydropower sectors, whereas its vulnerability to transition risks is tied to its exposure to GHG-intensive sectors, including coal and natural gas extraction, as well as sectors that strongly rely on these sectors for primary materials and energy, such as manufacturing, or share strong commercial links, such as services. Concerns over the indirect impact of physical climate risks on the soundness of banks' lending portfolios came up in the aftermath of the Idai cyclone, with the BoM monitoring non-performing loans more closely.

**The insurance sector is also exposed to underwriting risk related to extreme weather events.** Insurance policies can cover losses from natural disasters and extreme weather-related events. An unexpected or unaccounted for increase in frequency and intensity of these events can overwhelm the liabilities of insurers. A sound understanding of climate risks, and appropriate levels of reserves are crucial to preserve the resilience of the insurance sector. A well-developed and resilient insurance sector contributes to the resilience of the economy at large, reducing household losses and the government's fiscal burden following an extreme weather event. Conversely, climate risks can be exacerbated in the absence of a well-functioning insurance market where losses are born exclusively by households or banks. In Mozambique, climate-related policies (fire and natural events) account for roughly 17 percent of all gross premiums paid in 2020 (20 percent of only non-life insurance gross premiums), or MZN 3,156 million (approximately US$ 49 million). 33,895 climate-related insurance policies were sold in 2020, almost double the number sold in 2019 (18,548), with around 1,100 fire and natural events claimed each year.[110] It is unclear the extent to which insurance products are available to help individuals and businesses operating in highly exposed sectors (e.g., agriculture, fisheries) mitigate against climate risk.

**Finally, the impact of climate risks on macro-economic conditions can have repercussions on the financial sector.** Significant weather events can have wider repercussions for a country's macro-economic conditions; for instance, by damaging essential infrastructure and as a result depressing GDP growth. Considering the significant exposure of Mozambique's road network to floods, and the central role it plays in connecting the country's different regions, an increase in frequency and intensity of floods rendering key roads inoperable for prolonged periods of time would widely affect the economy, including the financial sector. Fiscal pressure on the government to rebuild damaged infrastructure could also affect sovereign risk ratings and the cost of government debt, with repercussions for financial institutions exposed to sovereign bond holdings. Transition risk could affect foreign financial flows and investment, notably in Mozambique's GHG-intensive extractive sectors, impacting financial institutions exposed to these sectors.

[110] Source: Insurance Supervision Institute of Mozambique (ISSM), 2020 Annual Report of Insurance Activity.

# 4 CLIMATE CHANGE VULNERABILITY, RESILIENCE BUILDING AND LOW CARBON DEVELOPMENT OPPORTUNITIES IN KEY SECTORS

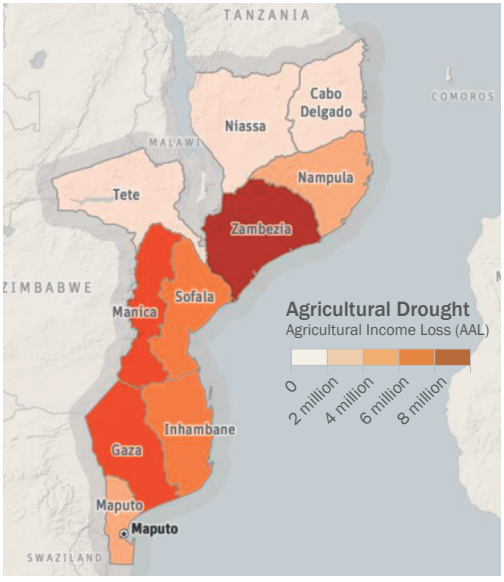
# Chapter 4: Climate Change Vulnerability, Resilience Building and Low Carbon Development Opportunities in Key Sectors

**This section discusses the key sectoral issues and developmental challenges in Mozambique that need to be addressed in the context of climate change, as well as presenting a framework for adaptation and resilience building and discussing opportunities for low-carbon development.** It lays out the key sectoral contributions to the economy while discussing their vulnerability to climate and/or potential for contribution to Mozambique's resilience building, low-carbon development, income generation, and job creation. The four major themes/sectors discussed are: integrated land management, energy, urban and transport, and human capital. These themes have been selected based on the following criteria: (i) the vulnerability of the sector to climate change; (ii) the significance of the sector to adaptation and resilience building and low-carbon pathways and the need for socio-economic shifts; and (iii) the relevance of the sector to advance Mozambique's development agenda in a changing climate.

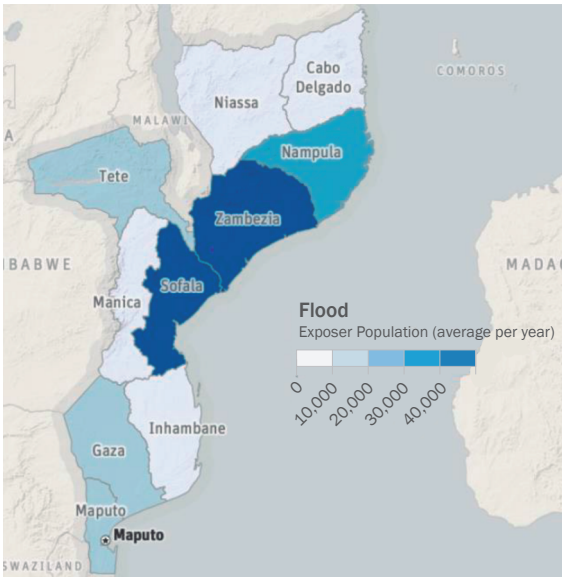
## 4.1. Promoting Integrated Management and Resilience of Mozambique's Agriculture, Landscapes, Coastal and Water Systems

**The agriculture, forestry, fisheries, and livestock sectors are key for livelihood development in Mozambique but are being impacted by climate change.** 70 percent of the population lives in rural areas and depends on these sectors for their livelihoods, which constitute a quarter of GDP.[111] Mozambique is gradually becoming more urbanized, but it is estimated that more than half of the population will live in rural areas through 2040.[112] Most agriculture producers are subsistence, smallholder farmers, depending on rainfed production, which makes the sector highly vulnerable to droughts, floods, and cyclones. Rural livelihoods systems are already affected by changing and more variable climate. The southern and central regions are the most prone to drought, where the return periods are four out of 10 years in the central region and seven to 10 years in the south (Figure 29). The coastal, northern, and central regions are prone to increasing flooding events (Figure 30).

### Figure 29: Agricultural income losses to drought by province




### Figure 30: Population at risk from flooding




*Source:* Mozambique Disaster Risk Profile, GFDRR 2019.

[111] World Bank 2020, Rural Income Diagnostic.

[112] Ibidem.

### 4.1.1. Strengthening resilience of agriculture system

**Analysis done for this CCDR finds that the impact of climate change on rain-fed crop yields from changes in precipitation and temperature (see Chapter 1) will be significant.** Under climate change, rainfed yields will be affected by changes in rainfall patterns, increasing evapotranspiration, and extreme heat as temperatures rise. Factors such as soil erosion and land degradation induced by climate change coupled with unsustainable practices would further erode agricultural productivity. The impacts of climate change on rainfed crop yields under the BAU scenario (i.e., without any adaptation efforts) for each crop are illustrated in Figure 31.[113] Each bar indicates the spread of values between the scenarios with the lowest and highest impact across the five selected climate scenarios. As it can be noted from the graph, the lack of adaptation investments is estimated to be particularly impactful on main crop yields, especially bananas, sesame and teas, but also cassava and potatoes can reach a very low yield.

**CCDR analysis also shows that adaptation investments will build climate resilience of the sector.** The analysis considered irrigation investments as proactive resilience building measures to mitigate the negative impact in crop yield from changes in temperature and precipitation. Both the rehabilitation of irrigation infrastructure for high value crops (banana, cashews, cotton, groundnuts, sesame, sugar cane, tea, tobacco, fruits), as well as construction of shallow groundwater pumps for smallholder irrigation for high value and vital food crops (maize, cassava, vegetables) were considered[114]. Figure 32 shows the minimum and maximum across the selected climate scenarios without and with adaptation, with the mean across these scenarios in the center line. BAU is presented in red, adaptation in green, and the overlap between the two in brown. The bottom line is clear: when including these adaptation investments, crop revenues rise above current levels.

**Figure 31: Change in crop yield from baseline to 2040s, across five climate scenarios, under the BAU scenario**

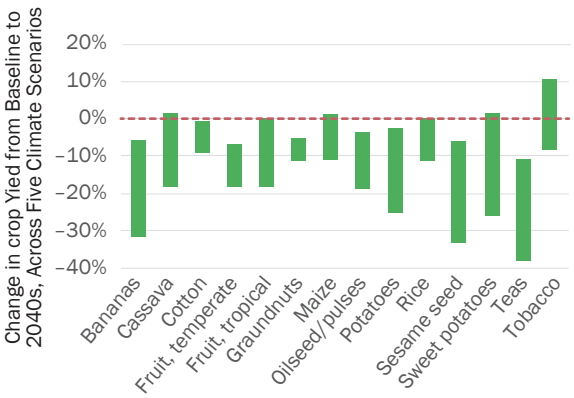
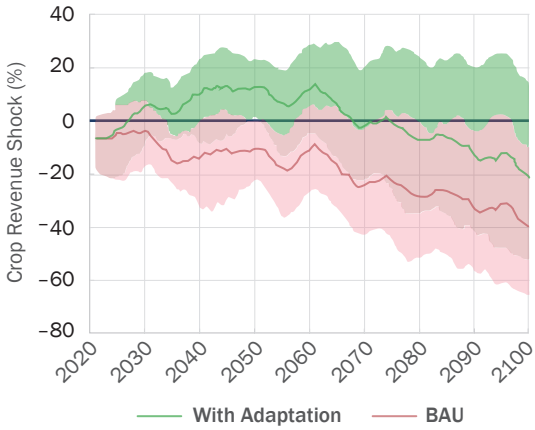



**Figure 32: Crop revenue shock with adaptation and under BAU**




*Source:* World Bank CCDR modeling result provided by Industrial Economics.

[113] The 5 climate scenarios are five separate GCM runs selected from two emissions ensembles (SSP1–1.9 and SSP3–7.0). Additional details provided in the background Paper provided by industrial Economics, available upon request.

[114] For irrigation rehabilitation, it is assumed that 50 percent of the current gap between the area equipped for irrigation (118,000 ha) (see: FAO 2022. "FAOSTAT.", https://www.fao.org/faostat/en/#data/QCL and the area irrigated (62,000 ha) is closed, resulting in investments to cover 28,060 ha. For new construction, an investment in 10 percent of the total area with irrigation potential (3.3 million ha) is assumed (330,000 ha).

**Key interventions[115] to strengthen resilience in agriculture until 2026, including investments in irrigation infrastructure, all at a cost of US$ 1.2 billion, are as follows:**

» **Productive territorial planning:** Based on the National Development Plan (PNDT)[116] zoning will be supported at provincial/district levels to manage the trade-off between increasing agricultural production and potentially increasing exposure to climate risks, and conservation of natural capital (forests, key biodiversity areas, watersheds) to build greater resilience to climate change.

» **Irrigation development:** Investments to increase uptake of irrigation systems benefitting 1.2 million producers by 2025, to increase agricultural production while addressing climate variability.

» **Improved climate information for farmers:** provide seasonal climate outlooks by agro-climate zone to allow farmers to adapt to climate variability through the development of tools to easily reach farmers and disseminate information (for instance, a database to consolidate relevant information, such as the planned , CUPA, ICT and other tools to reach rural farmers and communities).

» **Improved integrated water, pest, and landscape management practices:** supporting integrated farming systems (including crops, water, livestock, forests, and restoration of degraded lands) and climate smart agriculture (CSA) practices with a focus on diversification of livelihoods and increased value addition to strengthen resilience.

**Climate Smart Agriculture (CSA) technologies and practices included in the National Agricultural Investment Plan (PNISA) II build resilience while promoting growth of the agriculture sector.** Several CSA-related initiatives have been implemented, including conservation agriculture, agroforestry, organic farming, sustainable soil fertility management, and integrated pest management as part of World Bank supported operations.[117] These interventions have shown that strengthening of extension services both in terms of quantity (the number of extensions) and quality of their service (frequency of visits and content development) is key to the adoption of CSA technologies. In addition, fostering farmers' organizations and cooperatives' collective bargaining capacity is also needed to augment market power. Expanding access to credit, policies to enhance availability and access to improved seeds and affordable high-quality inputs, and infrastructure development for common needs such as irrigation and postharvest are also essential elements to build the resilience of the sector. Generating market information for inputs and outputs, adequate cost-benefit analysis as well as sensitizing and improving the capacity building of microfinance institutions on different CSA practices are instrumental to de-risking agriculture finance for smallholder farmers.

**Given Mozambique's high vulnerability to climate impacts, additional consideration should be given to increasing the uptake of climate risk insurance products.** Cyclones, floods, and droughts have significant irreversible impacts on agricultural production. For example, in 2016 the prolonged drought due to El Niño led to food insecurity for

[115] República de Moçambique, Ministerio da Agricultura e Desenvolvimento Rural (MADER), Plano Nacional de Investimento Do Sector Agrario (PNISA) II 2022–2026.

[116] The National Development Plan (PNDT), approved the Council of Ministers in 2019 and supported by the World Bank is a national strategic planning instrument to guide the sustainable development of the national territory, https://pndt.gov.mz/index.php/apresentacoes/.

[117] MioBio I (P131965), MozBio II (P166802), Mozambique Agriculture and Natural Resources Landscape Management Project (P149620), IRRIGA (P164431), Zambezia Integrated Landscape Management Program (P164524), Mozambique Dedicated Grant Mechanism (DGM, P161241), the Sustainable Rural Economy Program (P174002).

1.5 million people.[118] Uninsured households affected by climatic shocks experience a drop of 25–30 percent in per capita food consumption.[119] Cyclone Idai in 2019 caused US$ 513 million of losses in the agriculture sector.[120] There are potentially significant benefits from the broader uptake of agricultural insurance products. Insured households can sustain productivity levels and better plan for each growing season even when faced with climate shocks. This would also allow households to make additional investments in other revenue generating activities leading to higher incomes and improvements in human capital. Currently the availability of insurance products is limited, however. The absence of data on agricultural risk has been cited by domestic insurers as a limiting factor for expansion into rural smallholder farming areas.[121] Furthermore, farmers' liquidity constraints, lack of trust, and a strong need for financial education and training programs on agricultural risk are identified as obstacles for crop insurance to become inherent to agriculture resilience strategies.[122]

### 4.1.2. Promoting a landscape approach for climate adaptation

**Mozambique is rich in forest, which covers 40 percent of its territory and is an important contributor to the country's economy and a source of employment, income, and livelihoods in rural areas.** The predominant forest ecosystem is miombo woodlands, which provide important goods and services to rural communities, including food, energy, medicine, construction materials and other non-timber-forest products. In some rural communities, forests are estimated to contribute around 20 percent of household cash income and 40 percent of household-subsistence non-cash income.[123] They also provide significant ecosystem services of both local and global value, particularly climate and water regulation, carbon sequestration and storage, watershed protection, reduction of soil erosion, reduction of flood risk, as well as habitat to globally important species. Finally, combined with Mozambique's unique biodiversity and wildlife, they are underlying assets for Mozambique's tremendous NBT potential.[124] The total above-and-below ground carbon stock in Mozambique is estimated at more than 5.2 billion $tCO_2e$.[125]

**Due to unsustainable exploitation, Mozambique's forests are being rapidly depleted.** The country lost around 267,000 ha of forest annually between 2003 and 2013. This led to the release of around 46 million tons of $CO_2e$ emissions (accounting for 69 percent of Mozambique's GHG emissions). Even though deforestation was reduced significantly between 2015–2019,[126] it has risen again since 2020 (see Figure 33). Forest loss is also accompanied by significant land degradation, which is showing an increasing trend.[127] The main causes of forest loss and land degradation in Mozambique are slash and burn agriculture (65 percent), urban expansion (12 percent), illegal logging (eight percent), and

[118] Plano Director para Reducao do Risco de Desastres (PDRRD) 2017–2030; World Bank 2019, Disaster Risk Profile.

[119] World Bank, 2020, Cultivating Opportunities for Faster Rural Income Growth and Poverty Reduction: Mozambique Rural Income Diagnostic, Washington DC.

[120] United Nations Development Programme (NDUP), 2019, "Mozambique Cyclone Idai Post-Disaster Needs Assessment".

[121] International Growth Centre 2019, Managing Agricultural Risk in Mozambique.

[122] Ibid.

[123] The World Bank, 2018, Forest Country Note.

[124] African Nature-based Tourism Platform, "Country Summary Report: MOZAMBIQUE", April 2022 https://naturebasedtourism.africa/wp-content/uploads/2022/03/African-NBT-Platform-Mozambique-Summary-Report.pdf.

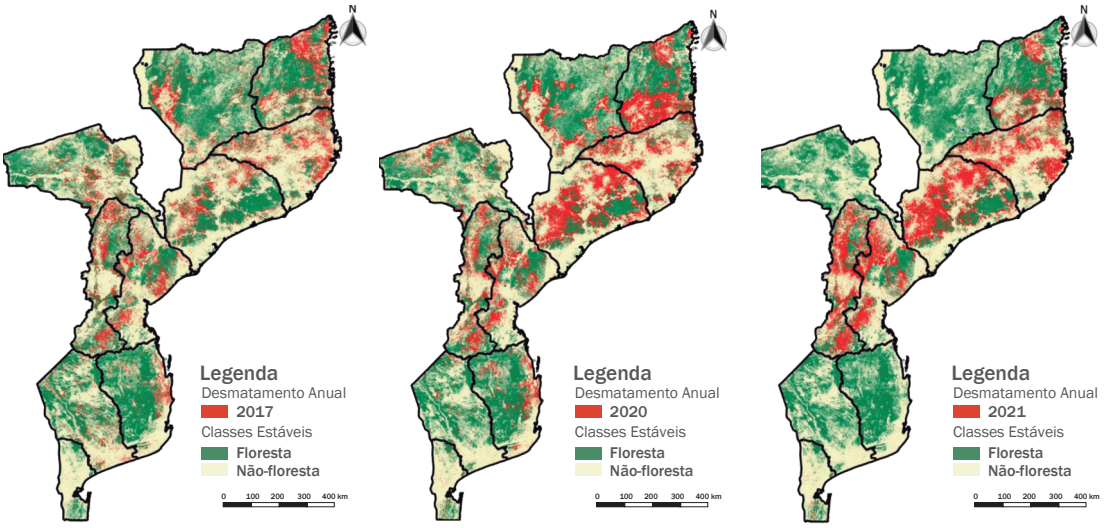
[125] Based on the 2018 National Forest Inventory, NFI Report, DINAF (2018).

[126] Deforestation rates have been 90,135 ha (in 2015), 55,599 ha (in 2016), 87,378 ha (in 2017), 93,275 ha in 2018, 119,909 ha in 2019, and 242,085 ha in 2020.

[127] Nitidae/CIRAD 2019, An Analysis of Land Use Changes and Land Degradation in Mozambique.

biomass use (seven percent).[128] Lack of institutional capacity for the enforcement of forest and conservation law and a low level of land rights registration, especially of community lands, are some key underlying challenges for sustainable natural resource management.

**Figure 33: Deforestation in 2017, 2020 and 2021**




*Source:* FNDS 2022.

**Mozambique is strongly committed to reducing deforestation and enhancing biodiversity conservation.** Mozambique leads the regional initiative on the sustainable and integrated management of the miombo forest with the declared goal to halt and reverse miombo loss by 2030.[129] In addition to the REDD+ Strategy, which aims to reduce deforestation by 40 percent by 2030, Mozambique pledged to restore one million ha of degraded land by 2030 under the Bonn Challenge.[130] In its updated NDC, Mozambique also pledges to strengthen conservation areas and secure (transboundary) biodiversity corridors in order to identify and mitigate risks of key biodiversity loss. The World Bank[131] supports interventions across the land use sectors, helping the country implement a landscape approach and strengthening policy, institutions, and investments on the ground. The GoM recognizes the effectiveness of this approach and the need for further scaling, given increased and increasing demographic, commercial and natural pressures on the country's natural capital.

**Investing in the maintenance of ecosystem services and ecosystem resilience supports community adaptive capacity and natural capital sustainability, while reducing land use GHG emissions.** The measures foreseen in government plans to scale the integrated landscape management approach are complementary to the measures for supporting agriculture system resilience (discussed in section 4.1.1) and those supporting clean cooking (discussed in section 4.2.4). Priority policy and investment measures would require an estimated US$ 800 million until 2030, and include:

[128] Forests of Mozambique: A Snapshot, https://www.worldbank.org/en/news/infographic/2018/12/12/forests-of-mozambique-a-snapshot.

[129] The miombo initiative convened by the Government of Mozambique was attended by delegations of ten Southern and Central African countries (Mozambique, Zimbabwe, Angola, Botswana, DRC, Malawi, Tanzania, Zambia, South Africa, and the Republic of Congo). It culminated in the adoption of the Maputo declaration on the Sustainable and Integrated Management of the Miombo Forest that mandates the Government of Mozambique to lead this regional effort.

[130] https://unfccc.int/sites/default/files/NDC/2022-06/NDC_EN_Final.pdf.

[131] See the World Bank's Mozambique's Integrated Landscape Management Portfolio (ILM) https://www.worldbank.org/en/programs/mozambiques-integrated-forest-and-landscape-management-portfolio.

» Scale up land use practices such as agro-forestry systems, organic fertilizer/pesticide use, climate and forest smart land-use planning, soil carbon enhancement, etc., that build land and livelihood resilience against climate shocks and generate GHG emission reductions.

» Identify and promote investments in sustainable rural products and value chains focused on expanding markets and exports (organic shade-grown coffee, wildlife economy, organic honey, among others), accelerating the shift from unsustainable to sustainable agriculture practices.

» Invest in infrastructure (including roads), energy, health, and education in and around conservation areas, and improve management of CA (including through inclusive co-management arrangements), to promote NBT in Mozambique, leveraging that physical infrastructure with a green-grey approach132 to increase development benefits, reduce lifecycle costs, contribute to carbon sequestration, and improve environmental outcomes.

» Invest in land rehabilitation, restoration, and sustainable (commercial) reforestation.

» Uphold and scale-up woodlot plots and planted forest schemes to revert dependence on native charcoal.

**Policy and institutional strengthening priorities to reduce deforestation include** (but are not limited to):

» Finalize the new forest law and develop its regulation.

» Reform the forest concession framework, towards a model that recognizes the value of forest beyond timber and that provides a basis for community-managed forest areas.

» Implement the Forest Information System (SIF) nation-wide and license/monitor concessions through SIF.

» Promote public-private partnerships for effective management of conservation areas.

» Update the conservation law and regulation to promote the creation of community conservation areas.

» Promote community land delimitation efforts.

» Strengthen capacity of the National Agency for Environmental Control (AQUA) and the National Agency for Conservation Areas (ANAC) to carry out effective forest and conservation law enforcement.

[132] This approach combines conservation and/or restoration of ecosystems with the selective use of conventional engineering approaches to provide people with solutions that deliver climate change resilience and adaptation benefits.

### 4.1.3. Promoting resilient water systems

**Mozambique suffers from water scarcity and the lack of infrastructure to store and safely utilize water.** Only 63.3 percent of the population has access to basic drinking water supply, and 37.2 percent access to basic sanitation.[133] Climate change will exacerbate the high spatial and temporal variability of water resources, especially in rural areas where access to basic drinking water is already low, close to 49 percent.[134] Water storage infrastructure is insufficient to buffer against cyclones, floods, and droughts, and to minimize the impact of the country's water scarcity. This situation is further exacerbated by rising water demand, which is expected to increase by over 1.7 times by 2040 (baseline year 2010), putting more strain on existing infrastructure. All scenarios, including optimistic (SSP2 RCP4.5), BAU (SSP2 RCP8.5) and pessimist (SSP3 RCP8.5), predict an increase in water demand in most of Mozambique, particularly in coastal areas and the northern region.[135] This is largely due to population growth, which will increase domestic consumption and require increased agricultural and industrial water for food and livelihoods.

**Sectoral coordination for integrated water resource management is a challenge.** Institutional responsibilities for water are distributed across the water sector and its subsectors (water supply, sanitation, and water resources management), and intersect with other economic sectors including energy, agriculture, and food production, disaster risk management, inland transport, health, and environment with more than 30 institutions at the central, regional, and local levels, having relevant roles for water use and conservation. The GoM has developed more than ten subsector-specific strategies and plans to achieve goals set out in the National Water Policy 2016. The fragmentation can limit the contribution of the water and water-related services to promote integrated water management and planning.

**There is a need to focus on developing instruments, influencing behavioral changes, and promoting climate resilience practices for better integrated water management.** Particularly, service delivery infrastructures are not designed for climate impacts or other stressors leading to shutdowns when extreme climate events such as prolonged droughts, heavy rainfall, or cyclones occur.[136] The absence of a sector-specific climate change policy or adaptation strategy limits the development and implementation of climate-smart investments that could contribute to improved resilience of the sector. In addition, the sector lacks instruments that could contribute to reducing the financial gap for investments in climate-proofing and climate resilient infrastructure, including the polluters-payer mechanism and a methodology for timely raw-water tariffs adjustments (see below).

**Key investment and policy priorities to build resilience through better, integrated water resource management amount to estimated investment needs of US$ 4.6 billion until 2030.**[137]

**Key investment priorities include:**

» Implement the second phase of investments in the expansion and modernization of the hydromet network.

[133] WHO (World Health Organization), and UNICEF (United Nations Children's Fund). 2020. link.
[134] Ibidem.
[135] Luck, M., M. Landis, F. Gassert. 2015. Technical Note. Washington, D.C.: World Resources Institute. link.
[136] EY (Ernst & Young). 2020.
[137] MOPHRH. 2017.

» Increase green and grey storage capacity to better buffer against floods and droughts and meet increased demands, specifically in drought prone regions.

» Invest in multipurpose infrastructures for rural growth centers.

» Implement a watershed management, aquifer recharge, and sediment management initiative.

» Promote the use of solar in water supply and irrigation and multiuse solar powered water points.

**Key policy and institutional strengthening priorities include:**

» Approval, implementation, and enforcement of polluters-payer mechanisms.

» Develop a mechanism for regular raw water tariffs update to support the revenue generation capacity of Regional Water Administrations and their ability to better operate and maintain existing dams, dikes and other flood and drought protection and mitigation infrastructure.

» Support the establishment of drought management units at regional water bodies and the development and implementation of basin drought management plans.

» Develop open access platforms for sharing hydrological data and information.

» Update the design codes for dikes, drinking water supply, rainwater, wastewater drainage, and irrigation infrastructure for climate resilience.

» Expand the modeling capacity of Regional Water Administrations (ARAs) beyond the current hydrological and flood modeling.

» Develop guidelines on water harvesting and water conservation techniques.

### 4.1.4. Coastal Resilience: opportunities to develop a resilient blue economy

**Mozambique is particularly vulnerable to the coastal impacts of climate change and extreme events, particularly tropical cyclones, and storm surges, which will continue to affect Mozambique's coastal habitats, resources, and infrastructure assets.** It has one of the longest coastlines in Africa (c. 2.7 thousand km), characterized by low-lying areas (below sea level) and a variety of ecosystems of high ecological importance and economic value. About 40 percent of the population of Mozambique lives in coastal districts and depends on coastal and marine resources for their livelihoods (MIMAIP, 2021). Many urban centers are located along the coast, including highly populated cities such as Maputo, Matola, Beira, Nacala, and Quelimane.

**Coastal climate resilience options include ecosystem-based adaptation and nature-based solutions, which have been identified as promising strategies to reduce disaster risk, adapt to climate change, and strengthen community resilience in the country.** A key area of intervention is coastal protection, since coastal ecosystems can serve as offshore and nearshore breakwaters, minimizing the effects of storm surges and waves, and protecting coastal areas from erosion. In addition, seagrass beds and coral reefs

are natural sand producers contributing to beach nourishment, which is the last natural barrier between the land and sea and serves as an important asset for coastal tourism. Therefore, coastal ecosystems restoration has been further identified as a smart solution to support coastal resilience. Establishing no building zones in more dynamic coastal areas (including sandy beaches) would allow habitats to migrate inland while increasing the resilience of coastal communities. Furthermore, safeguarding ecosystem services is crucial for Mozambique; for example, decreasing other human local stressors (e.g., marine pollution), is an effective strategy to support climate resilience. Establishing marine protected areas that limit destructive fishing activities and pollution, or protecting climate refugia,[138] contribute to the resilience of local ecosystems to climate change.

**It is key for Mozambique to seize the opportunities for low-carbon development arising from the coastal resilience building.** Salt marshes, mangroves and seagrass meadows contribute strongly to carbon sequestration and storage in Mozambique. Raising revenue from blue carbon markets would be an important climate change mitigation option that could also bring socio-economic and ecological co-benefits.

**Another crucial step towards enhanced coastal resilience is improving fisheries management.** As some species are redistributing due to ocean warming there is the need for identifying and establishing dynamic marine protected areas that accommodate fish and ecosystem migration.[139] Mozambique is yet to develop national plans for climate-resilient fisheries and needs to do so urgently. Resilience of the fisheries sector can be increased by promoting sustainable aquaculture, while reducing pressures on wild fisheries, and regenerating key nursery and spawning areas for fish species (e.g., mangroves, seagrass meadows, coral reefs). This should be accompanied by improving knowledge and skills of small-scale fisheries and reinforcing control and management measures.

**Blue sectors (tourism, ports and shipping, and offshore extractives) could also play a role in the climate change mitigation and adaptation through the preservation and restoration of marine ecosystems.** Maximizing biodiversity, and climate resilience benefits through nature-based solutions would help sustain the coastal tourism sector overtime. Moreover, nature-based solutions could be incorporated in port and shipping lanes development to reduce maintenance needs (e.g., dredging and navigation).

**Key investment priorities include:**

» Implement green/nature-based and coastal adaptation solutions, including in areas identified in national (e.g., National Marine Spatial Plan) and subnational plans (Local Adaptation Plans).

» Restore mangroves and implement protective measures for seaweed and seagrass, corals and other fish breeding and feeding areas.

» Develop management and service-related infrastructure in current and future marine protected areas.

[138] Climate refugia refers to areas that remain relatively buffered from contemporary climate change over time and enable persistence of valued resources, including of an ecological nature.

[139] Cashion T, Nguyen T, ten Brink T, Mook A, Palacios-Abrantes J, Roberts SM (2020) Shifting seas, shifting boundaries: Dynamic marine protected area designs for a changing climate. PLoS ONE 15(11): e0241771. https://doi.org/10.1371/journal.pone.0241771.

**Key priorities for institutional strengthening and policy reform include:**

» Update and embed climate change aspects into the National Fisheries Policy, which dates to 1996.

» Implement new local fisheries co-management areas, in line with the updated 2020 Marine Fisheries Regulations (REPMAR).

» Promote sustainable aquaculture in line with the 2020–2030 National Aquaculture Development Strategy, reducing pressures on wild fisheries.

» Establish marine protected areas, and institute other policies to protect marine and coastal species and habitats by decreasing human local stressors, including no-building zones in dynamic coastal areas such as sandy beaches.

» Implement payment for coastal and marine ecosystem services partnering with local communities.

» Embed blue carbon considerations into applicable mitigation and adaptation policy instruments.

## 4.2. Energy Sector Priorities

### 4.2.1. Ensuring affordable and reliable energy access to support economic development

**Access to electricity stands at 41 percent with an impressive increase of 15 percent points in the last five years, but additional work is required to reach the whole population and services.** The GoM has made a concerted effort by increasing three times the connection rate from the historical average of 100,000 until 2018 to an average of 320,000 connection per year as of 2022, through the National Energy for All Program. At the current rate of electrification, Mozambique will connect 6.2 million users, reaching 63–65 percent of its population by 2030, through grid connections.

**Considering the ambitions and challenges in achieving universal access in Mozambique, adopting multiple modalities for electrification is required.** As envisaged under the National Electrification Strategy (NES), 70 percent of the population can be reached by expanding the electricity grid. 14 percent of the population (four million) are in the proximity of the national grid and could potentially be connected through grid-densification.[140] To strengthen resilience of the electricity grid, a strong emphasis needs to be placed on modified technical specifications and quality assurance during construction of grid infrastructure. In parallel, off-grid electricity services through mini-grids and standalone solar-home systems (SHSs) can be provided as a complementary solution, particularly for some rural areas. The benefits of off-grid solar power are not limited to household consumption, and development opportunities exist particularly in the agricultural sector, for example though the provision of power for irrigation. Overall, the recommended strategy is to implement the NES through the program in the most efficient manner, with tailored technical on-and-offgrid solutions based on distance, cost, and electricity demand forecasts.

[140] Mozambique Geospatial Options Analysis towards Universal Electrification.

### 4.2.2. Alternative pathways to affordable and reliable power

**Mozambique has a current installed capacity of 2,889 MW.** 76 percent is supplied by hydropower, 17 percent by gas, six percent by fuel and one percent by solar. There is no coal-based generation in Mozambique. In comparison, in the South Africa Power Pool (SAPP) about 70 percent of electricity generation is based on coal plants (72 percent in South Africa). The (HCB) power plant on the Zambezi River provides over 90 percent of all hydro-energy generated for the country and the rest is exported to South Africa, Zimbabwe and SAPP members. The existing hydro capacity and future potential is located near the south-western border, or on smaller rivers originating from Zimbabwe and South Africa. Due to its strategic location and natural resources, Mozambique has a strong role in the SAPP, particularly to meet the growing demand related to increase access to electricity in the region as well as for the low-carbon efforts of the SAPP. The 2018 Power Sector Master Plan, however, foresees the expansion of the power sector by including up to 18 percent of coal resources and the reduction of hydropower to 48 percent of the total mix (compared to currently 76 percent). Recognizing the needs to harness cleaner energy resources and changes in demand and technology, the GOM is conducting the update of the Master Plan expected to be finalized in 2024.

**The Bank conducted a preliminary assessment for the expansion of the power sector between 2020–2040 to identify policy priorities for clean energy transition pathways while ensuring reliable electricity cost.**[141] The analysis considers the following scenarios: least-cost expansion without any carbon consideration, defined as business as usual (BAU), advanced technology adoption (ATA) considering a larger adoption of renewables with different carbon constraint scenarios, including a 40 percent and 80 percent cut from baseline,[142] as well as full regional integration scenarios in which all neighboring countries of Mozambique can be connected if it is economic to do so from the system perspective, with the different carbon constraints scenarios. Sensitivity analyses were performed considering the potential impact of climate change on hydropower.[143]

**The analysis shows that Mozambique can achieve a low-carbon expansion of the sector and remove any need for coal-based generation in the domestic and regional scenarios.** As illustrated in figure 34, under the BAU, which is the least-cost expansion for Mozambique without any carbon constrain, the expansion will not include coal-based generation to meet Mozambique's energy needs nor for the region. Mozambique's installed generation capacity could increase from the current 2.9GW to about 6.6GW by 2040 in the BAU scenario, relaying substantially on hydropower generation and, in lesser extent, a combination of solar and gas generation capacity as the least cost option, with a total cost of US$ 11 billion[144]. Wind power generation is marginally selected as least-cost in BAU scenario. If carbon constraints are imposed as part of the expansion of the power sector, additional generation capacity will be required reaching 8.5–8.7GW ATA scenarios, with a total cost of US$ 12–17.7 billion, respectively.

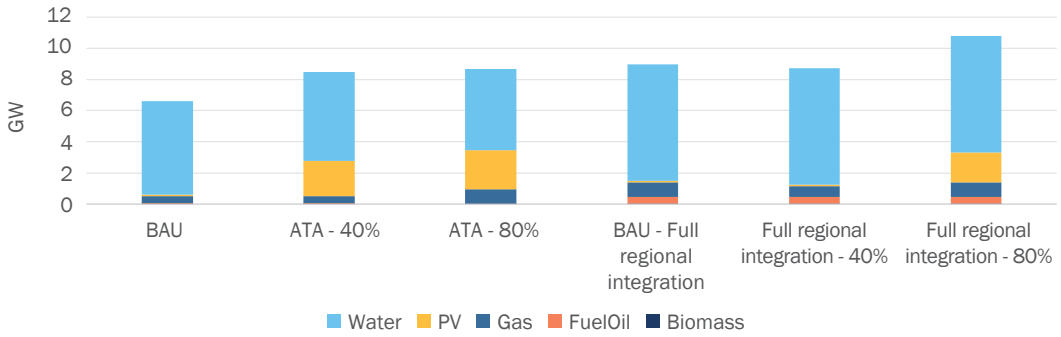
[141] Additional details provided in the Background Note, forthcoming.

[142] Technologies considered in the analysis to expand the system include Combined Cycle Gas Turbine (CCGT) and Gas Turbine (GT) (no capacity limit), PV (no capacity limit), onshore wind (no capacity limit), offshore wind (no capacity limit, Battery Energy Storage System (BESS, up to 1500 MW), hydropower (no limit), fuel oil (no capacity limit), biomass (no capacity limit).

[143] In the sensitivity on hydropower scenarios, a climate change scenario with adverse impact on hydropower was considered leading to a decrease of hydropower outputs from 2030–2040.

[144] Total costs are calculated at 6 percent discount rate.

## Figure 34: Scenarios for 2040 expansion plans




*Source:* World Bank elaboration.

**Mozambique energy resources have a key role in the low-carbon growth of the SAPP power pool.** In recent years, supply issues, particularly in South Africa, have resulted in rapidly widening demand-supply gap in the SAPP, with the shortfall increased fivefold between 2020 (2000 MW of deficit in meeting peak demand in the region) to an expected shortfall of up to 10,000 MW in 2023. South Africa has been facing increasing power supply shortages due to underutilization of its old and under-maintained coal generation fleet. The current on-grid power supply gap in South Africa is estimated to be between 4 to 6 GW. The supply demand gap is also noticeable in other SAPP members. With only about 50 percent of the SADC population currently connected to electricity, the supply-demand gap may widen with expansion of electricity access and increase in demand across countries. The increasing supply shortage can be best addressed by concerted efforts across the SAPP member countries, particularly by leveraging low-cost and renewable energy resources in the region, and shared infrastructure.

**Investment in Mozambique's electricity generation and transmission systems can play a crucial role in meeting electricity demand in the SAPP region while lowering the carbon footprint of the region's power system and reducing investment requirements in other SAPP member countries.** Analysis conducted for the CCDR demonstrates that full regional integration of Mozambique's power system with the SAPP members can reduce power system emissions in the region by 7 percent. Complementing regional integration with higher investments in Mozambique, including strengthening of the domestic transmission system to evacuate Mozambique's renewable electricity resources (particularly hydropower), will substantially reduce total decarbonization investment needs in the SAPP. For instance, to achieve 80 percent emission reduction in power generation in the SAPP by 2040, investing US$ 8 billion more in Mozambique's electricity generation base in a scenario of full regional integration will reduce the overall investment requirements in the SAPP by US$ 42 billion compared to a scenario with limited regional integration (see Table 4).

## Table 4. Investment cost needs for SAPP decarbonization

| Scenarios | Mozambique Investment Needs (US$ billion) | SAPP Investment Needs (US$ billion) |
|---|---|---|
| BAU | 11,1 | 192 |
| ATA-40% | 12,0 | 229 |
| ATA-80% | 11,7 | 292 |
| BAU-Full integration | 18,1 | 174 |
| Full regional integration-40% | 17,9 | 198 |
| Full regional integration-80% | 19,6 | 250 |

*Source:* The World Bank 2022.

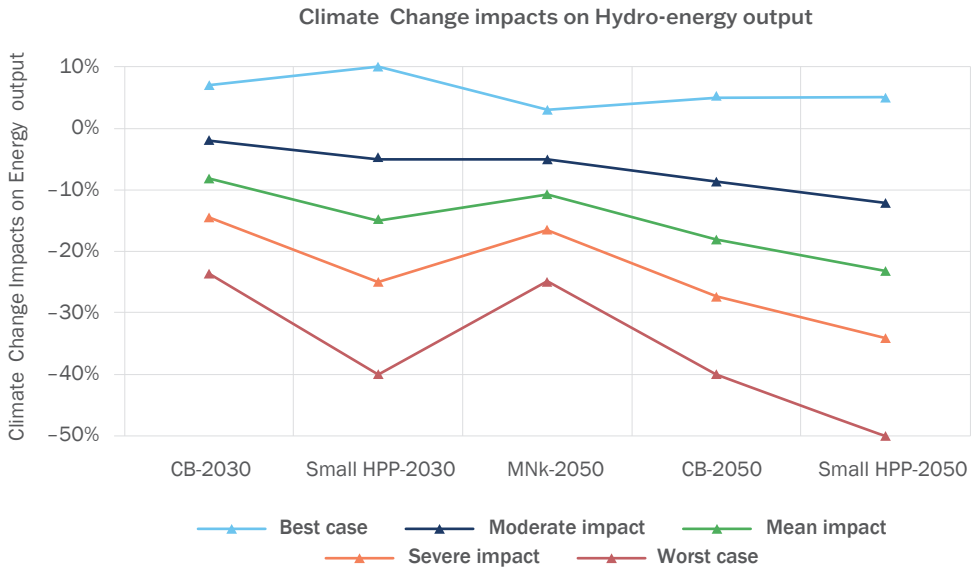
### 4.2.3. Energy sector vulnerability to climate, Including hydropower generation

**Mozambique's power sector has already been severely impacted by climate change and natural hazards.** Recent cyclones Kenneth and Idai affecting Sofala, Manica, Tete, and Quelimane provinces damaged hydropower plants, a transmission line, primary/secondary substations, distribution lines, transformers, and standalone solar PV systems. It is estimated that 570,000 EDM customers were affected. The cost of the physical damage to the electricity infrastructure is conservatively estimated to be US$ 130 million. Non-technical costs, including the value of lost goods and services produced because of the power cuts as well as the impact of the emergency response efforts by EDM to other parts of the grid would add significantly to this number.

**Mozambique's energy supply is already dominated by hydropower, and its role in the energy mix is set to increase.** At present, hydropower accounts for 80.5 percent of all grid-based energy generation. The (HCB) power plant on the Zambezi River provides over 90 percent of all hydro-energy generated for the country. Other hydropower plants include the expansion of HCB, Mphanda Nkuwa, Mavuzi, Chicamba and Massingir located near the south-western border, on smaller rivers originating from Zimbabwe and SA.

**Hydropower is particularly vulnerable to climate change impacts.** Increased evaporation and variable rainfall, combined with upstream irrigation demands, are likely to negatively impact hydropower production, with four out of five GCMs projecting more than 10 percent reduction in generated hydro-energy by 2050. A significant reduction in Zambezi River Basin runoff is expected in the near to medium term, with an average decrease of 13 percent by 2030 and 21 percent by 2050, compared to the reference period 1985–2004. For this CCDR, five hydropower generation scenarios have been developed[145] as depicted in Figure 35.

**Figure 35: Hydro-energy scenarios for power system planning: 2030 and 2050**




*Source:* The World Bank 2022.

[145] The World Bank, 2022, Climate Change Impacts on Hydropower Planning — Case study Mozambique: Integrated climate and development for enhanced power sector planning, in the context of Country Climate and Development Reports (CCDR).

**Interventions to increase resilience and address the potential future variability of hydropower generation in Mozambique include:** (i) reviewing and adjusting institutional and normative mechanisms for coordination across multiple uses of water; (ii) adjusting power system operation and expansion planning processes to incorporate the physical and economic risks of changing hydrological behavior; (iii) improving operations planning (hydrology forecasting and scenario-building; hydropower reservoir operation and scheduling; unit commitment and dispatch); and (iv) including adjustments to strike a satisfactory balance between the goals of attracting reasonably priced capital to power generation and providing agents with incentives to efficient investment and operation decisions.

**The complementarity of gas and solar renewable energy can play an important role not only to displace coal power generation but also to contribute to building more resilient systems to hydrometeorological impacts.** In addition to its hydro potential, Mozambique has significant potential for solar, wind and bioenergy.[146] However these currently only provide 41 MW of installed on-grid capacity.[147] Under the updated NDC, the GoM has identified as crucial the need to improve access to renewable energy, committing to increasing its capacity in photovoltaic and wind energy to around 500 MW by 2025.[148] As part of the Energy for All program, the GoM is promoting PPPs and increased investment in solar and wind energy and has launched a renewable auctions program (PROLER)[149] to gain private sector confidence and attract FDI. In addition, the regulations to the recently approved Electricity Law, as well as the Public-Private Partnership law are being revised to clarify and simplify requirements for renewable energy projects. Finally, expanding transmission will be key to bring online more solar energy as it is currently constrained by weak transmission capacity in the north. As a result, EDM designed solar power plants of lower scale (20–40 MW), preventing economies of scale and lower cost through larger utility scale projects (>80 MW).

### 4.2.4. Capitalizing on the co-benefits from promoting clean cooking

**Access to clean cooking is a development issue, fundamental to reducing energy poverty while improving health, fostering gender balance, and reducing pressure on biomass resources.** Mozambique's progress in meeting the UN Sustainable Development Goals (SDGs) is constrained by the high dependence on biomass for cooking. More than 95 percent of households use biomass for cooking, particularly in rural areas, leading to forest degradation and deforestation, and respiratory diseases.[150] The total cost of inaction on the clean cooking agenda in Mozambique is estimated to be US$ 17 billion per year stemming from the negative externalities for health, gender, and climate.[151] The health impact is estimated at US$ 7.9 billion per year linked to deaths and disability-adjusted life years (DALYs) from household air pollution. The gender impact associated with the time spent performing cooking-related tasks, such as fuel collection, cooking, and stove cleaning, and lost productivity is estimated at US$ 7.3 billion per year. The annual cost of inaction on climate and environment is estimated to be US$ 1.3 billion per year, with an estimation of polluting fuels and inefficient technology leading to about 12 million $tCO_2eq$ per year. Fostering the shift towards clean cooking replacing traditional stoves and fuels has the potential to generate huge environmental gains and development opportunities for Mozambique.

[146] https://proler.gov.mz/renewable-energy/.

[147] Associacao Lusofona de Energias Renovaveis (ALER)/Associacao Mocambicana de Energias Renovaveis (AMER), 2021, Briefing renewables in Mozambique, https://www.lerenovaveis.org/contents/lerpublication/aler_mar2021_resumo-renovaveis-em-mocambique-2021.pdf.

[148] https://unfccc.int/sites/default/files/NDC/2022-06/NDC_EN_Final.pdf.

[149] https://proler.gov.mz/.

[150] Instituo Nacional de Estatística. 2021. Inquérito de Orçamento Familiar (IOF Survey), 2019/2020. Mozambique, Maputo.

[151] World Bank Estimates. Additional details on methodology are provided in the Background Note, available upon request.

**The GoM has recently adopted programs and policies creating the enabling environment and setting targets for clean cooking.** Mozambique's NDCs for 2020–2025 recognize the potential for mitigation and low-carbon development to promote resilience and sustainable development. A key target to promote low-carbon urbanization is to increase the number of people with access to cooking gas by 309 percent compared to the current baseline. MIREME is also undertaking a National Clean Cooking Strategy and Investment Prospectus, financed through the World Bank's ProEnergia Plus, which will cover the sector goals, targets, implementation pathways from 2021–2030.

**Despite this commitment, significant challenges remain ahead.** The market for clean cooking technologies and alternate fuels is nascent and does not exist beyond key urban areas, and there are few alternatives to traditional and inefficient stove technologies in the form of improved biomass technologies and a limited supply chain and scale. The biomass sector is impeded by the informality of the operations that are geographically spread, and no systematic recording of the resource as well as lack of databases on institutions, and service providers. The regulatory framework on clean cooking needs strengthening, as indicated by the latest report on the Regulatory Indicators for Sustainable Energy (RISE) 2020.[152] The Energy Regulatory Agency — (ARENE), the independent agency responsible to set, monitor and enforce standards for cooking technologies and fuels, is lacking resources and no mandatory standards or labeling schemes have been developed for emissions, efficiency, and safety of cooking fuels and technologies. Decision making for duty exemptions for clean cooking technologies is not transparent or standardized. Furthermore, there are no specific financing facilities available to address the lack of distribution of cooking resources to rural areas, another important barrier which policymakers should prioritize to improve access to clean cooking.

**To achieve the clean cooking target set out by the GoM to increase the number of people with access to cooking gas by 309 percent compared to the current baseline, a total investment of around US$ 127 million is needed each year.**[153] Specifically, it is estimated that approximately US$ 54 million is needed from the public sector to fund awareness raising and technical assistance as well as subsidies to ensure that improved or modern cooking solutions can be afforded by the poorest. Additionally, US$ 8.1 million would be needed from the private sector to install downstream infrastructure for the functioning of modern energy cooking markets. The remainder, US$ 65 million, would come from households' direct contributions.

**By achieving the clean cooking targets, the overall benefit of transition totals US$ 390 million each year.**[154] The health co-benefit is estimated at US$ 280 million per year linked to avoided deaths and avoided disability-adjusted life years (ADALYs) from reductions in exposure to household air pollution (HAP). The gender co-benefit is estimated at US$ 110 million per year, associated with time savings in performing cooking-related tasks such as collecting fuel and cooking. Finally, the climate co-benefit is estimated at US$ 6.5 million per year, due to reductions in GHG and black carbon (BC) emissions by switching the targeted population to cleaner cooking solutions (Table 4). Achieving these clean cooking targets will contribute to Mozambique's climate adaptation through reducing

[152] Energy Sector Management Assistance Program. 2020. Regulatory Indicators for Sustainable Energy 2020: Sustaining the Momentum. World Bank, Washington, DC. World Bank. https://openknowledge.worldbank.org/handle/10986/34937.

[153] Additional details provided in the Background Note, available upon request.

[154] Additional details provided in the Background Note, available upon request.

reliance on only charcoal and fuelwood, providing vulnerable populations with alternative clean cooking solutions, and aligning policies, data, institutions, behaviors, and finance for more green, resilient, and inclusive development.

**Table 5. Annual Co-benefits for health, climate, and gender by achieving clean cooking targets**

| Health co-benefits | | | Climate co-benefits | | Gender co-benefits | | Total |
|---|---|---|---|---|---|---|---|
| Benefits of transition (US$, billion) | Avoided DALYs in 2030 | Avoid Deaths in 2030 | Benefits of transition (US$, billion) | Emission savings ($tCO_2eq/yr$) Urban | Benefits of transition (US$, billion) | Time saved Urban (hrs) | US$ billion |
| 0.28 | 31,655 | 819 | 0.065 | 1,413,899 | 0.11 | 204,596,975 | 0.39 |

*Source:* World Bank calculations.

**Key investment priorities for the energy and clean cooking sector, totaling US$ 7.5 billion[155] until 2030 include:**

» Invest in on-grid and off-grid electrification to reach universal access to electricity by 2030.

» Invest in modern transmission designed to manage variable renewable energy integration, and to connect major consumption centers with the concentration of energy resources in the central and northern regions.

» Invest in clean cooking technologies, awareness raising and technical assistance as well as subsidies to ensure that improved or modern cooking solutions can be afforded by the poorest, especially in rural areas.

**Key priorities for institutional strengthening and policy reform for the energy and clean cooking sector include:**

» Define the regulations of the recently approved Electricity Law to implement key elements for transparency and competition in the electricity sector, and to provide clarity and predictability to the private sector (both domestic and foreign) for renewable energy investments.

» Support MIREME capacity for climate sensitive and resilient planning of electricity sector expansion, updating Master Power Plan every two years to adapt to market conditions, technology evolutions and climate policies/conditions.

» Reform electricity tariffs to send the right price signals to consumers to moderate energy consumption and to ensure that revenue requirements are based on full cost of supply.

» Support a well-coordinated energy strategy for a shared vision among key energy sector stakeholders to promote lowest cost electricity expansion, while using the regional market to make new investments in low carbon and resilient energy expansion financially viable.

» Establish modified technical specifications and quality assurance during construction of grid infrastructure to strengthen its resilience.

[155] Estimated US$ 6.5 billion to achieve universal access to electricity by 2030 National Electrification Strategy and Plan (2018), and US$ 1 billion to switch to clean cooking technology. These estimates are drawn from the Industrial Economics, Incorporated (IEc), 2022, "Mozambique Climate Change Economic Damage Estimations" prepared for the CCDR.

» Strengthen ARENE capacity to set, monitor and enforce standards for cooking technologies and fuels.

» Establish duty and value-added tax exemptions for clean energy technologies.

## 4.3. Promoting Resilient Cities and Transport Infrastructures

### 4.3.1. Increase climate resilience through urban planning

**Although Mozambique is projected to be mostly rural until 2040, urbanization remains a fundamental leverage for the country to accelerate spatial and structural transformations, reduce poverty reduction and increase climate resilience.** This structural transformation can be driven by the higher density in urban areas and the subsequent reduction of transport costs for goods and access to services.[156] Urban residents have better access to basic infrastructure and social infrastructure, such as health centers, than rural dwellers. This increase in well-being is not only present amongst most (well-established) urban dwellers, but also among rural migrants who have moved into cities in the past five years. The census 2017 (INE) shows similar levels of well-being for people that moved into urban areas five years prior to the collection of the census data (2012–2017) compared with those urban dwellers that have not moved in this period.

**While urban growth could enhance climate resilience for Mozambique, the lack of investments and adequate urban planning frustrate this opportunity, leaving increasing numbers of people exposed and vulnerable to climate-related hazards.** Without effective land-use management, most urban expansion occurs in an unregulated manner, often occupying risk areas such flood plains, fragile coastal zones, and hillsides, increasing flooding risk up to 70 percent on average through 2050 (Figure 36). In this context, resilient growth would reduce such risk considerably. In particular, this CCDR estimated that both climate change and expanded growth will significantly increase flooding risk in Maputo up to 70 percent on average, through 2050 (Figure 36)[157].

**Steering Mozambique's urbanization along a sustainable path means also addressing the challenges of solid waste management.** Compared to low-income countries and sub-Saharan African region, where on average respectively 93 percent and 69 percent of the waste is dumped, Mozambique fares worse: 99 percent of its waste is currently dumped, and only one percent is recycled, while 60 percent of the waste production is organic.[158] Some municipalities have achieved almost 100 percent coverage of solid waste collection, but across all Mozambique's urban areas only 27 percent of the population has access to waste collection services.[159] Most of the solid waste that is not collected or illegally dumped ends up exacerbating urban floods, particularly in informal peri-urban neighborhoods. Significant investment will be needed to sustain the current level of waste management in the country and reduce waste-generated methane emissions.

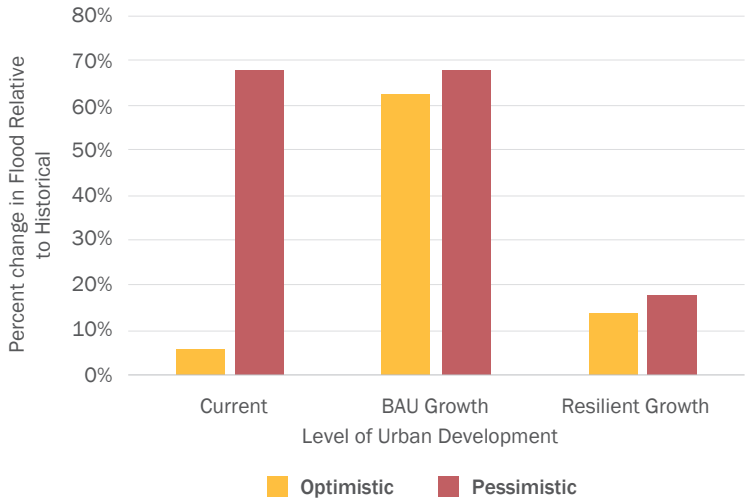
[156] World Bank. 'Mozambique Urbanization Review: Accelerating Urbanization to Support Structural Transformation in Mozambique'. Washington, DC: World Bank, June 2017.

[157] These estimates are drawn from the Industrial Economics, Incorporated (IEc), 2022, "Mozambique Climate Change Economic Damage Estimations", which has been prepared for this CCDR.

[158] Associação Moçambicana de Reciclagem and Carbon Africa Limited Li, 'A Comprehensive Review of the Municipal Solid Sector in Mozambique'. Maputo, 2014.

[159] INE, Census 2017.

Figure 36: Expected annual flooding risk in Maputo through 2050 compared to historical levels (% change)




*Source:* World Bank CCDR modeling result provided by Industrial Economics.

**Cities in Mozambique are yet to conceive climate action plans and strategies with clear commitments, timelines, and dedicated budgets.** The lack of a unified national strategy to manage urban growth and the weak implementation at local level translates into slow action against climate change in urban areas. Implementation capacity at the municipal level remains weak, as most municipalities do not have updated territorial planning instruments, digitalized cadasters, and geospatial land management information systems. Furthermore, financing at municipal level remains inadequate.[160] Although the decentralization reforms grant municipalities greater fiscal autonomy, municipalities rely mostly on national transfers, which are still unpredictable and insufficient. Only 1.5 percent of the national public expenditure is annually distributed to municipalities. Fostering an administrative and financial decentralization process would be key to promote sound bottom-up urban policies, enabling municipalities to promptly address climate impacts and to improve their early response systems and capacity. Moreover, sharing information among municipalities is still limited, while it would be fundamental to extract best practices and apply lessons learned.

**Key priority investments until 2030 to promote resilient urban development amount to US$ 5.78 billion and include:**

» Municipal spatial data infrastructure, including the quality of data, systems and capacity for climate resilient planning and investment.

» Priority stormwater drainage, coastal protection, and prevention of land erosion investments.

» Improving resilient housing within low-income settlements including land tenure regularization.

» Improving municipal cadaster systems with an emphasis on digitalization and linking to the national cadaster.

» Climate-proof urban infrastructures and nature-based solutions.

[160] World Bank, 'Project Appraisal Document (PAD) — Northern Urban Development Project'.

» Develop climate risk insurance mechanisms for built heritage.

» Increase waste collection coverage, funding, and improved cost recovery.

» Support sub national governments to transition from dumpsites into sustainable landfills.

**Key policy and institutional strengthening priorities include:**

» Mainstream the re-use, reduce, and recycle principles (3R) by incentivizing environmental awareness, waste sorting and increase local technical capacity for waste utilization for sustainable waste management.

» Support the development of medium term spatially informed capital investment planning and budgeting at sub national level, with a focus on prioritizing climate resilient investments.

» Strengthen the capacity of the Ministry of Public Works, Housing and Water Resources to develop, institutionalize and implement a National Urban Policy.

» Fostering effective decentralization, empowering municipalities to provide climate resilient action, especially in the area of DRM.

» Promoting information and best-practices sharing among municipalities.

» Develop national and local sustainable urban strategies with dedicated budgets and boost fiscal incentives for sub national governments to prioritize climate resilient investments.

### 4.3.2. Increasing transport network resilience as an effective pathway to overall climate resilience

**Transport infrastructures in Mozambique are exposed to significant climate change risks, while being a key component to foster spatial and structural transformation of the country.** This CCDR presents three modeled scenarios including potential transport resilience measures, assessing their implementation costs, and resulting avoidance of economic losses.[161]

**The first scenario envisions all classified roads (paved and unpaved) to be maintained in good condition.** By maintaining the current road network in good condition, the potential economic losses caused by flooding could be reduced to US$ 116 million, a 27.5 percent reduction compared to the current scenario. The annual cost of maintaining all classified roads in good condition is estimated at US$ 401 million per year on average.

**The second scenario involves paving all classified roads and keeping them well maintained.Paved roads are more resilient to potential damage than unpaved roads and can serve as a more efficient alternative route.** Thus, both potential damage and disruptions could be minimized. By paving all classified roads, the potential climate risk could be mitigated further, by 58 percent. The potential risk of traffic disruptions could be minimized

[161] For simplicity, each scenario is considered separately. The methodology is illustrated in in the Background Note, available upon request. The total economic risk of climate events to transport infrastructure in Mozambique was calculated, including two potential losses: (i) infrastructure damages and (ii) disruption costs of the traffic. The damage to specific transport assets is primarily dependent on the level of potential climate exposure and the degree of resilience of each infrastructure asset. The cost of traffic disruptions is also determined by climate exposure and the resilience of the network. The carbon price is assumed to be US$ 60 per ton.

to US$ 18 million under this scenario, an enormous reduction of over US$ 90 million on a yearly basis. Paving roads is an important intervention to enhance the resilience of the road network, as it adds redundancies to the network and offers more alternatives. Paving all roads, however, may be far from affordable. The annual cost of paving and maintenance is estimated at US$ 807 million per year on average, equivalent to about 5.7 percent of current GDP.

**The third scenario involves implementing transport multimodality, which may be able to contribute to strengthening the resilience of transport network overall.** Mozambique has important rail assets that are not effectively connected to other transport modes. While road transport predominates in passenger transport, rail transport plays a role in freight transport. By connecting the two modes seamlessly, redundancies in transport infrastructure could be increased, reducing the risk of disruption in theory. The critical analysis with multimodality confirms that both rail and road are important to build general climate resilience. By integrating road and rail transportation seamlessly, the economic risk of climate events can also be reduced to US$ 143 million, a 10.3 percent reduction compared to the baseline scenario. The modal shift toward rail could bring a climate benefit of US$ 12.2 million per year. It is estimated that about 203,000 tons of emissions could be reduced per year. The inclusion of this GHG benefit in the multimodality scenario could reduce the net economic potential risk by 17.9 percent.

**Key investment priorities until 2030, amounting to US$ 16–18 billion include**

» Prioritize maintenance expenditure to preserve the existing infrastructure assets.

» Retrofit existing infrastructure and upgrade/pave key infrastructure assets.

» Build more resilience in infrastructure according to DRM norms, such as bridges, culverts and paving, to reduce life cycle cost (higher investments but lower maintenance).

» Develop efficient multimodal connectivity to seaports, dry ports and railways corridors to complement road corridors for more resilient and efficient freight movements.

» Develop greener public transit systems, including passenger train and bus services, especially in urban and sub-urban areas.

**Key policy and institutional strengthening priorities include:**

» Adopt climate resilient construction and maintenance norms and standards for infrastructure.

» Adopt and implement a solid road asset management system for maintenance and asset preservation as a no regret policy, including periodic and routine maintenance.

» Implement a multiyear budget programming to prioritize key infrastructure investments, while maximizing efficiency in budget execution.

» Increase and diversify road-sector revenues, such as fuel levy, vehicle registration and inspection fees, and tolls.

» Develop a multimodal transport strategy to integrate road, rail and maritime transportation.

» Develop emergency procedures for operations during emergencies.

## 4.4. Developing Human Capital in a Changing Climate

**Climate change harms human health, jeopardizes education progress, and triggers broader social and economic implications.** The impact is considerably higher for the poor and the most vulnerable since, as discussed in Chapter 2, social protection coverage in Mozambique is extremely low, well below the sub-Saharan African average. One of the impacts of climate change on human capital is the reduction of labor productivity directly through temperature increases at the workplace. This is especially concerning for labor types that are outdoors and with more intense physical work such as those in the agriculture sector, which for these reasons shows the largest impacts, followed by industry and then services. This CCDR estimates that in 2050 under the hot SSP370 scenario, impacts are as high as 12 percent, 10 percent, and 3 percent in agriculture, industry and services sectors, respectively (Figure 37). In addition to direct labor productivity lost due to heat stress, climate change is projected to indirectly impact labor productivity through increased sickness, which results in time away from work. This impact is estimated to be arounf one percent in the hot SSP370 scenario by 2050[162].

**Mozambique needs to take proactive action to prepare the country for the health risks of climate change.** Drawing on the framework for Public Health Adaptation for Climate Change adopted in 2012 by the Minister of Health, Mozambique needs to work on the establishment of real time health surveillance, early warning system (EWS), events-based surveillance (EBS), and a comprehensive emergency response system. Systems such as those for the prevention and treatment of diarrheal and other infectious diseases should be upgraded. Developing and deploying an EWS and EBS would increase population resilience to future disease outbreaks.[163] Improving the evidence and understanding of the current associations between weather/climate and health outcomes will help the health sector's preparedness and response. It is essential to improve cross-sectoral coordination and carry out adequate and sustainable investment to strengthen the climate resilience of the health system through training of workforce, building informed decision-making capacity and providing financial inputs to cover needs.[164]

**Retrofitting and building resilient schools is critical to minimize the impact of climate change on human capital.** Classrooms need to be designed to withstand the locally mapped cyclone winds and ground shaking, and to include rainwater harvesting systems. Although resilient schools might be more expensive in the future due to prices reflecting market changes and logistics,[165] it is still fundamental to strengthen the commitment to follow resilient standards as well to upgrade classrooms which were built without any resilient standards,[166] as the cost for non-resilient schools would be much higher. Resilient schools proved to withstand climate hazards, being also used for shelter. For instance, it was observed across the entire province of Zambezia that schools retrofitted under the Emergency Resilient Recovery Project remained

[162] Details provided in the background Paper provided by industrial Economics, available upon request.

[163] USAID 2018. Climate Change and Health in Mozambique: Impacts on Diarrheal Disease and Malaria (Technical Report).

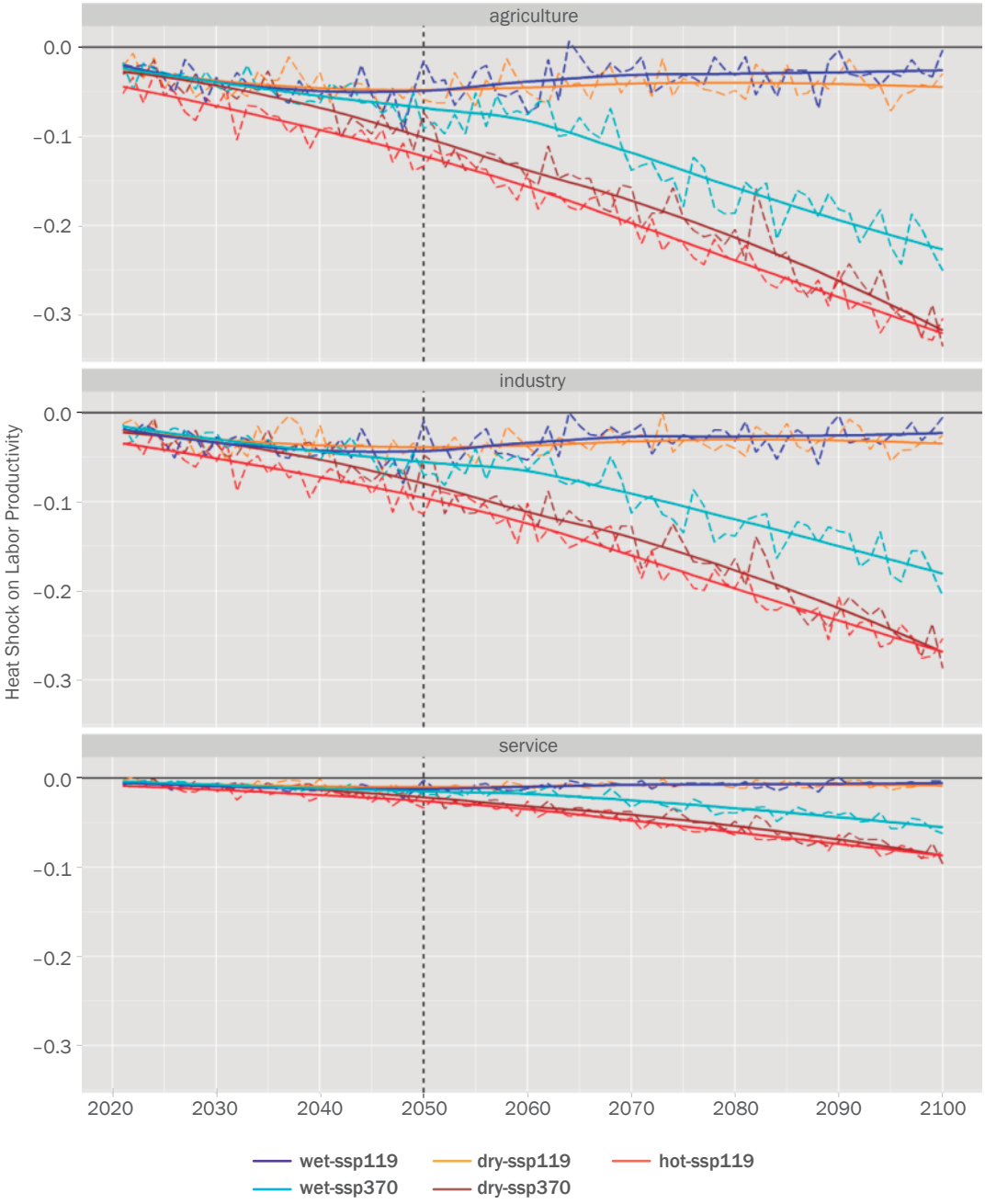
[164] Loffreda, G., Chikovani, I., Mocumbi, A.O, Asmar, M., Blanco, M.L., Grant, L. and Ager, A. (2021) Informing adaptation strategy through mapping the dynamics linking climate change, health, and other human systems: Case studies from Georgia, Lebanon, Mozambique, and Costa Rica. Institute for Global Health and Development: Queen Margaret University, Edinburgh. Available: https://bit.ly/3nEQZ0j.

[165] The prices vary over time reflecting market changes: (US$ 8,000 per classroom in average in 2018, to an average US$ 10,300 per classroom in 2022, with a potential to reach an average of US$ 11,500 in 2024. Prices also vary regionally reflecting logistics and access to market of construction materials: lower princes in Maputo region (US$ 9,600 per classroom in 2022, to US$ 13,000 in 2024).

[166] The World Bank through the Mozambique Disaster Risk management and resilience program (P176437) is supporting the MINEDH to retrofit 3,000 vulnerable classrooms out of 5,000 classrooms built by the Ministry between 2005–2009 without any resilient standards. The selection of 3,000 classrooms out of the 5,000 classrooms was based on assessment of structural vulnerability of each classroom.

intact during the passage of Cyclone Freddy, with winds speed between 148 km/hour to 210 km/hour. Moreover, the recovery of classrooms, particularly in remote areas can gradually contribute to reduce the incidence of dropouts in primary education of up to 1.9 percent.[167]

**Figure 37: Labor productivity shocks due to temperature increases at the workplace**




*Source:* World Bank CCDR modeling result provided by Industrial Economics.

[167] Mambo, et al., "An analysis of school dropout in Mozambique 2014–2015", 2019. https://www.wider.unu.edu/sites/default/files/Publications/Working-paper/PDF/wp-2019-49.pdf.

**The education sector can also contribute to climate change mitigation providing those skills relevant to trigger and harness the benefits of the green transition.** Compared to non-green jobs, green occupations exhibit a stronger intensity of high-level cognitive skills. An equitable transition to a carbon neutral economy as envisioned in this CCDR will require strengthening foundational skills of disadvantaged children, changes in school curricula and skills training programs to improve students' ability to compete for jobs in a more carbon-neutral economy. Furthermore, increasing investment in education would generate significant co-benefits in terms of private sector development and gender empowerment, as the private sector will require new skilled workers for the green jobs of the future in adaptation and mitigation sectors. In this regard, it is key to ensure that Mozambique's universities and Technical and Vocational Education and Training (TVET) courses are ready to equip youth with these skills, while encouraging women to engage in Science, Technology, Engineering and Mathematics (STEM) courses to take advantage of the transition to new green jobs.

**Investments in health and education should be combined with an effort in upscaling social protection programs and policies,** without which no real pro-poor and resilience-building human capital advancement would be possible (see also Chapter 2).

**Investment needs for human capital development by 2030 are estimated at US$ 400 million and include:**

» Retrofit and build new resilient schools and health centers.

» Establish EWS and mechanism for health conditions, including surveillance, monitoring, and responding to health conditions resulting from climatic effect.

» Strengthen emergency response and disaster management programs for local public health facilities to provide rapid health needs (infrastructure, human resources, logistics).

» Strengthen communication for health promotion and disease prevention.

» Climate risk and response trainings for directors, trainers, and students.

» Improve INAS delegations' infrastructure systems and implement joint Agriculture-Social Protection activities aimed at reducing food insecurity.

» Improve targeting and coverage of social protection programs and scale the shock response of PASD-PE Program to overcome vulnerabilities generated by droughts, cyclones, floods among other hazards.

» Incentives skills development for green jobs

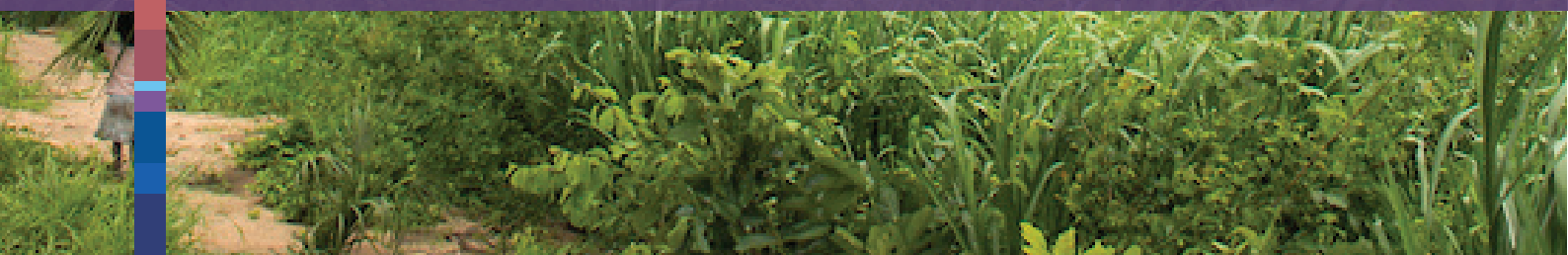
**Policy and institutional strengthening priorities by 2030 include**

» Ensure health systems are an integrated component of Mozambique's emergency preparedness strategy.

» Establish budgetary flexibility protocols for rapid response at INAS.

» Ensure the application of climate resilience building standards for health and education infrastructure.

# 5 CONCLUSIONS AND CLIMATE PRIORITIES FOR MOZAMBIQUE



# Chapter 5: Conclusions and Climate Priorities for Mozambique

**Climate change and climate hazards increasingly undermine growth and affect livelihoods in Mozambique.** Climate change impacts on productivity and growth is expected to be significant, especially in the hot and dry scenarios. The direct and indirect costs of climate induced natural disasters in Mozambique are also considerable, lowering growth by almost 15 percent for the worst set of outcomes. They disproportionally affect the most vulnerable, and erode Mozambique's human, natural and physical capital, which are crucial for a structural transformation of the economy. Climate change has serious implications for many sectors of Mozambique's economy, impacting, among others, agriculture, water, natural habitat, health, infrastructures, and cities. The effects of climate change as a 'threat multiplier' are exacerbated by weak institutions and tight fiscal space. The conflict in the north contributes to further compound the debilitating impacts from natural disasters on already lagging infrastructure, housing, and services.

**With tight fiscal space, Mozambique needs to prioritize policies and investments that enhance the country's resilience while tapping into opportunities of global low-carbon trends.** This CCDR assesses that the investment needed to achieve climate resilience of human, physical and natural capital by 2030 amounts to US$ 37.2 billion. Therefore, priorities for short-term impact need to be identified. These priorities need to focus on enhancing the country's adaptation capacity in the most cost-effective way. This emphasizes institutional building and policy reforms to maximize the impact of capital investments. A second criteria is to prioritize measures that increase the country's long-term climate resilience and have high developmental impact. Thirdly, measures should be prioritized that promote green growth and low-carbon development and can crowd in additional climate financing and investments. Finally, it is key to support the poorest and the most vulnerable in managing climate impacts and low-carbon transitions, including promoting a just transition. This CCDR points to four priorities aligned with these criteria that are affordable and urgent in the sense that they will cost more if implemented later.

## PRIORITY 1: Adopt Economy-wide Measures to Enhance Adaptative Capacity

**Consolidate Mozambique's legal and institutional framework, strengthen institutional capacity to steer climate action, and mobilize and attract additional sources of financing.** This provides the opportunity to effectively integrate climate change challenges into the country's development strategy. A key recommendation is to create a framework law on climate change, and to strengthen the country's coordination capacity on climate change at the highest level of government. This needs to be accompanied by greater efforts in training staff and upgrading equipment for regulation, monitoring, and enforcement. Furthermore, institutional capacity for improved data availability and quality needs to be strengthened, not least to position the country to mobilize additional climate funding sources that require sound monitoring, reporting and verification (MRV) of GHG emissions. A sound institutional framework is also crucial to manage future LNG revenue flows.

**Mainstream climate risk into public expenditure planning to ensure the efficiency of capital expenditure and foster sustainable growth.** To deal with climate risks proactively, Mozambique is committed to reforming its Public Investment Management (PIM) systems to fully integrate climate change risks into the decision-making process.

Managing climate risks should be considered not only with regards to PIM, but also in public sector management more broadly, from national planning to procurement, among others. This will also require a careful choice between the types of investments within this sector: for instance, investments in more resilient roads pays off as compared to efficient maintenance in 30 years.

**Continue strengthening institutions for disaster preparedness.** Simulations indicate that significantly higher returns (in terms of foregone growth rates) are obtained by reducing the time of recovery of damaged assets (a proxy for response preparedness). This calls for continued support for the implementation of the Disaster Risk Management (DRM) Master Plan, while fostering administrative and financial decentralization to empower local institutions in the early response. Further action is also required to further reduce existing risks of climate disasters (through, for example, the retrofitting of public infrastructure) and future risks (through the systematic inclusion of resilient and affordable standards in the planning and construction of public infrastructure). The education sector is among the most advanced to integrate risk reduction in infrastructure provision, but this needs to be mainstreamed across all institutions commissioning public infrastructure, including water, energy, health, transport, and agriculture.

**Enhance the role of the private sector and FDI to accelerate climate-smart investments in key sectors, overcoming public budget constraints and slow onset of LNG revenues.** Some of the challenges to be addressed include: (i) improve capital markets regulation and market valuation of investment potential and sector prioritization to identify bankable projects; (ii) strengthen institutional capacity to manage, structure and negotiate concessions and profitable public-private partnership (PPP); (iii) support conditions for the private sector to adjust to Carbon Border Adjustment Mechanisms (CBAM), (iv) adopt legislation to support circularity and promote competition for waste management services; (v) adjust import duties for clean technologies, (vi) review and update building codes, and (vii) upgrade construction methods. A visibly organized private sector entity would allow Mozambique to more readily engage or attract private sector finance.

## PRIORITY 2: Prioritize Critical Infrastructure Development and Management

**Improve transport infrastructures in Mozambique to reduce the impact of climate change risks, while boosting development in rural poor regions.** Analysis done for this CCDR shows that maintaining the road network in good condition could reduce economic losses caused by flooding by 27.5 percent. By paving all classified roads, the potential climate risk could be mitigated by 58 percent. Paving roads would enhance the resilience of the road network and add redundancies offering more alternatives, thereby further reducing economic disruption. The annual cost of maintaining all classified roads in good condition is estimated at US$ 401 million per year on average. This measure is achievable; however, paving all roads may be less affordable, with an average cost estimated at US$ 807 million per year on average.

**Build climate-smart social infrastructures for human capital development.** This mainly means building resilient schools and health centers, which have proved to withstand cyclones and other climate hazards, as well as retrofit those built not in accordance with resilient standards. It is key to combine this effort by training school management teams and teachers in disaster preparedness. Sensitizing communities on the importance of building resilient social infrastructures is also important to ensure a participatory process.

The cost of building new schools on sites not prone to droughts, resilient to intense weather-related events and ensuring good maintenance of equipment is estimated at US$ 100 million by 2030.

**Improve water resource management to address high spatial and temporal water resource variability, as Mozambique is affected by both droughts and floods.** Integrated water resource management amount to estimated investment need of US$ 4.6 billion until 2030. This includes investments in climate resilient water supply and storage infrastructure, and improved flood protection infrastructure including large investments in urban stormwater drainage. It also includes improved watershed, aquifer recharge, and sediment management. In addition, demand-side measures for the water sector are critical, including measures to improve metering, implementation of a polluters-payer mechanism, and development of methodology for water tariff adjustments. Finally, institutional strengthening and improved coordination are key to manage multiple sectoral demands on water use.

## PRIORITY 3: Protect the Most Vulnerable while Promoting Green, Resilient and Inclusive Growth

**Promote climate smart agriculture (CSA) and human capital development in order for structural transformation to reduce impact on those most exposed to climate change.** Adaptation investments, such as increasing the uptake of irrigation infrastructure, coupled with the promotion of CSA practices, such as conservation agriculture, agroforestry, organic farming, sustainable soil fertility management, and integrated pest management, would enhance the productivity and the resilience of the sector. Increasing the uptake of climate risk insurance products in the agricultural sector can enable insured households to better manage climate shocks and stabilize their productivity and income levels, allowing for better planning and investments. Overall, key interventions to strengthen resilience in agriculture until 2026 are estimated to cost US$ 1.2 billion.

**Promote the integrated management of land and ocean resources to build terrestrial and coastal resilience, while unlocking Mozambique's green and blue growth potential.** Mozambique is very well endowed with renewable natural resources key to building terrestrial and coastal resilience against climate shocks. Integrated management of these resources will not only protect global public goods and Mozambique's natural capital base but also unlock opportunities to foster green and blue growth. These include conservation friendly and export-oriented agriculture products (shade coffee, honey, etc.). Mozambique also has enormous eco— and wildlife tourism potential, as well as potential for sustainable aquaculture, mangrove restoration and mariculture. Such activities can also generate significant climate finance streams from reduced land use emissions and blue carbon or be the basis of innovative mechanisms to crowd in more private funding such as blue or green bonds, the proceeds of which can be used to re-invest in climate adaptation and resilience.

**Support the most vulnerable households through adaptive social protection programs.** Mozambique's current social protection coverage is still below the planned targets and requires a strategic expansion to ensure the poorest and most vulnerable households are included. Win-win solutions can also be promoted by tailoring cash for work programs to productive land restoration activities. The Basic Social Subsidy Program (PSSB), a program with broader coverage, could be used for shock responses, including vertical expansions (top up benefits to current beneficiaries) and horizontal expansion (temporary expansion to cover new beneficiaries affected by shocks). Cash transfers can be enhanced through

the expansion of digital payments. It is also important to start planning for a just transition in Tete, a coal-dependent region. Lastly, the focus on the most vulnerable could consider investing in clean cooking which has a positive impact on the health of the poorer segments of the population while also helping to contain deforestation. This CCDR estimated that the total cost of inaction on the clean cooking agenda, stemming from the negative externalities for health, gender, and climate, is about US$ 17 billion per year.[168]

## PRIORITY 4: Leverage Mozambique's Energy and Mineral Wealth

**Increase access to energy and foster clean energy solutions for Mozambique and the region.** Mozambique's location as a gateway to global markets and natural resources endowment provide a unique opportunity to drive a low-carbon energy transition in domestic and regional markets. Expanding energy access to 65 percent of the population by 2030 is a core priority agenda for the country. Achieving this while increasing the sector's climate resilience requires investment in renewable on-grid and off-grid electrification (hydro, solar, and wind) as well as in modern and climate-proof energy transmission. This should be combined with effective demand-side measures and risk-based planning to ensure greatest cost effectiveness of energy investments. The scenario analyses conducted in this CCDR show that Mozambique's clean energy potential has a key role in the low-carbon growth of the SAPP. Achieving 80 percent emission reduction in the SAPP with regional integration will require significant investments in Mozambique (US$ 20 billion) but cost 14 percent less than without regional integration. Mozambique could leverage climate finance support dedicated to SAPP low-carbon growth to promote these clean energy investments. Continued promotion of public-private partnerships and improved regulation to clarify and simplify requirements for renewable energy projects will also help attract much needed private investment to the sector.

**Harness the country's natural gas reserves while managing transition risks.** After 2028, revenues from LNG sales will enhance the country's debt sustainability and can generate significant fiscal space to support investments in adaptation needs and climate resilient infrastructures. This requires the right institutional framework and the decision by the Government of Mozambique (GoM) to establish a Sovereign Wealth Fund (SWF) to ensure sound management of LNG revenues, including effective oversight mechanisms that would provide transparency and accountability. This would help balance the needs of present and future generations, as well as mitigate the risk of macroeconomic imbalances. Measures to manage the transition risks related to global low-carbon goals include the application of strongest environmental and social standards to the LNG operations, including the options of offsetting any GHG emissions generated by natural gas exploration, and the parallel pursuit of green growth opportunities from renewable natural resources and renewable energies.

**Plan for a just transition from coal mining, and harness Mozambique's mineral wealth in a sustainable way.** Given the decline in financing and the growing restrictions from international markets, the GoM should plan to transition from coal extraction and exports, while considering social implications. This should happen in a way that protects workers, communities, and the environment. National and regional governments need to be supported in developing clear roadmaps to phase out coal, including design of social protection, reskilling and job transition programs as well as developing comprehensive

[168] World Bank Estimates. Additional details on the methodology are provided in the Background Note, available upon request.

environmental remediation plans that present possible pathways for economic transition. On the other hand, Mozambique is well positioned to benefit from the critical mineral boom driven by the energy transition, by attracting FDI, fostering economic diversification, and accelerating the creation of formal and well-paid jobs. In this regard, Mozambique's existing coal mining capacity could be shifted to critical mineral extraction, providing significant job opportunities, especially for mine workers affected by the coal phase out. Nevertheless, these resources are concentrated in environmentally sensitive areas; therefore, the extraction of these minerals requires sound land-use planning and impact assessments.

## Final considerations

**Improving adaptation and resilience building is a development priority for Mozambique.** Key actions were identified in each of the most affected sectors; land-use, coastal resilience, disaster risk management, transport, energy, health, water, and social protection. These interventions and policies need to be prioritized until 2030 to render Mozambique more resilient to climate shocks, while reducing poverty and supporting the most vulnerable.

**Mozambique cannot finance these climate-resilient measures alone, and support from international community is fundamental to deliver results over the short and medium terms.** Significant LNG revenues will in fact not be available before 2028. Preparing PPP projects is likely to take a few years and will be limited by the country's capacity to generate bankable projects. Carbon financing is promising but faces the challenges of technical complexity, the need to accelerate funding commitments, delayed development of an international compliance carbon market under Article 6 of the Paris Agreement, regional imbalances in accessing climate financing, and high transaction costs to navigate the existing voluntary carbon markets and offset schemes. For these reasons, crowding in grant and highly concessional financing, such as very long maturity loans, is likely to be the most effective way to meet the very large investment needs. Leveraging partnerships with donors remains essential to cover the funding gap required to improve climate resilience.

**The implementation of the recommendations articulated in this CCDR can benefit highly from programs and projects that have already been successfully implemented in Mozambique and could be used as a leverage for the country to further scale up these efforts.** For instance, as mentioned above, the World Bank's global initiative "Supporting Energy Transition in Coal Regions" could be explored to support Mozambique in the effort of phasing out coal. Mozambique could also scale up the positive experience of REDD+, which has demonstrated the potential of the country's forests as carbon sinks and Mozambique's capacity to leverage much-needed climate financing. Other opportunities include green and blue bonds to leverage and crowd in private investment to attain sustainability targets and resilience objectives. On urban resilience, for instance, the country could capitalize on lessons learned from the World Bank project in Beira,[169] which shows how innovative green approaches can be combined with conventional gray infrastructure to protect residents and assets from climate hazards. Leveraging such successful initiatives, as well as coordinating with donors and other countries in the region, would allow Mozambique to take some concrete and actionable steps to pave the way for a structural transformation of the economy, while addressing main climate challenges.

[169] World Bank Blog, "Building Resilience Through Green-Gray Infrastructure: Lessons from Beira" https://www.worldbank.org/en/news/feature/2022/01/31/building-resilience-through-green-gray-infrastructure-lessons-from-beira.

**Mozambique would benefit from additional research to explore areas that could not be addressed by this CCDR.** Adaptation and resilience building are development issues in Mozambique, and this has clearly emerged from the analysis conducted in major sectors of the economy but, due to the inherently limited scope of this CCDR, there is room to conduct additional studies and analyses to develop evidenced-based policies, strategies, and intervention prioritization. For instance, it would be important to further investigate the role of digitalization in addressing climate change in the country, as well as the transformative potential of Mozambique's blue economy, to enable further economic transformation, foster job creation, and enhance the resilience of local communities. Furthermore, to capitalize on its critical mineral and metal resources endowment, it is crucial for Mozambique to improve its geological knowledge to assess mineral resources and identify potential new areas for mineral exploration, while considering and addressing its environmental impact.

**These development and climate priority areas represent an opportunity to strategically lay the groundwork to support the structural transformation of the country while steering Mozambique towards a sustainable, inclusive, and climate-resilient development path, including with support from the international community.**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