WESTERN AND
CENTRAL AFRICA

Guinea-Bissau

World Bank Group

COUNTRY CLIMATE AND DEVELOPMENT REPORT

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Abbreviations and Acronyms

AFOLU	Agriculture, Forestry, and Other Land Use
BAU	Business As Usual
CAPEX	Capital Expenditure
CCDR	Country Climate and Development Report
CH_4	Methane
CO_2	Carbon Dioxide
DRR	Disaster Risk Reduction
EAGB	Electricity and Water of Guinea-Bissau (*Eletricidade e Águas da Guiné-Bissau*)
EWS	Early Warning System
FAO	Food and Agriculture Organization
GCM	General Circulation Model
GDP	Gross Domestic Product
GHG	Greenhouse Gas Emissions
HFO	Heavy Fuel Oil
IMF	International Monetary Fund
LCGP	Least-Cost Generation Plan
MEBCA	Ministry of Environment, Biodiversity, and Climate Actions
NDC	Nationally Determined Contribution
N_2O	Nitrogen Dioxide
NOx	Nitrogen Oxides
OMVG	*Organisation pour la Mise en Valeur du Fleuve Gambie*
OPEX	Operating Expenditure
PPP	Public-Private Partnerships
PV	Photovoltaic (Solar)
RCP	Representative Concentration Pathway
REDD+	Reducing emissions from Deforestation and Forest Degradation
SO_2	Sulfur Dioxide
SSP	Shared Socioeconomic Pathways
TFP	Total Factor Productivity
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
US$	United States Dollars
WAEMU	West African Economic and Monetary Union
WASH	Water Supply, Sanitation, and Hygiene

Executive Summary

Guinea-Bissau is endowed with a wealth of natural resources, with the highest natural capital per capita in West Africa (US$3,874 per capita), which could be leveraged for sustainable and resilient growth. However, **Guinea-Bissau faces significant development hurdles**, such as high poverty rates, political instability, and economic challenges, including an over-reliance on cashew nuts. Rural poverty has increased, and the nation's infrastructure, education, and health care systems are underdeveloped.

Climate change poses a severe threat, potentially impacting agriculture, fisheries, and infrastructure. Without adaptation, it could lead to a significant cut in real GDP per capita (minus 7.3 percent by 2050) and increase in poverty (with up to over 200,000 additional poor by 2050—that is, 5 percent of the expected population, in the worst scenario). The country's low greenhouse gas emissions are expected to rise, mainly due to agriculture and land-use changes, with deforestation being a major contributing factor.

Although Guinea-Bissau is a low emitter, it has high mitigation ambitions, targeting a 30 percent reduction in greenhouse gas emissions by 2030. The Nationally Determined Contribution outlines significant climate actions, with initiatives focused on forest conservation, sustainable agriculture, and community development. However, the country's political instability, institutional weaknesses, and limited financial resources pose challenges to implementing these climate commitments, which depend heavily on external funding. The financial sector's underdevelopment and vulnerability to external shocks limit its ability to support green investments, though reforms could enhance resilience.

Guinea-Bissau must consider its climate financing as development financing and vice-versa, engage the private sector, and integrate climate goals with national development plans to ensure a sustainable future. Concessional climate financing is vital due to the underdeveloped financial sector and the government's limited borrowing capacity. The BioGuinea Foundation (a conservation trust fund) and Reducing Emissions from Deforestation and Forest Degradation initiatives offer opportunities for biodiversity preservation and financial benefits from forest conservation, but proper frameworks for carbon finance transactions need to be put in place.

Addressing Guinea-Bissau's vulnerability to climate change and its structural issues requires a cohesive approach that integrates development and climate strategies. This could involve improving governance, diversifying the economy, protecting natural capital, developing human capital, and investing in sustainable agriculture and infrastructure.

The transition to a more sustainable and inclusive development pathway that supports economic growth is possible, but requires focusing on key strategic sectors, enhancing institutional capacity, and creating the conditions to mobilize finance. As a highly vulnerable country, there are myriad needs in the different sectors; however, to be more efficient and effective, Guinea-Bissau should prioritize actions in a few sectors, especially actions on biodiversity, agriculture, and social protection. Low-carbon development, especially in energy and forestry sectors, could provide cost-efficient solutions and attract climate finance, including from the private sector, which will support the overall development agenda.

Reform efforts are more likely to succeed if they build on existing strengths. Guinea-Bissau's main sources of resilience emanate from its natural as well as its societal assets: its youthful population; capacity for interfaith and interethnic coexistence; thriving informal market; and greater legitimacy accorded to its social institutions, namely, its traditional authorities, communal associations, religious leaders, and nongovernmental organizations. Accordingly, efforts to address climate change could rally a broad variety of social groups in the country.

Agriculture is a cornerstone of Guinea-Bissau's economy, providing vital sustenance and income for most of its citizens, but climate change might affect productivity. Cashew exports, which account for 90 percent of the country's total export earnings, underscore the economy's heavy reliance on this single commodity—a dependency that exposes the agricultural sector and the national economy to significant risks. Projected temperature rises and longer drought periods could severely impact agricultural output, especially in the interior regions, potentially reducing GDP by up to 4.1 percent by 2050. To address these challenges and support further economic development, immediate action is required to implement climate-smart agricultural practices, focusing on diversifying crops and developing resistant crop varieties. Over the medium term, it is crucial to invest in the construction of irrigation and dike systems, taking into local knowledge and strengthening women-led structures.

Forest conservation and restoration are vital for sustainable development, including water retention, soil fertility, and the revival of ecosystems. Forests provide critical ecosystem services and are particularly important for the livelihoods of the most impoverished communities. Historically, these forests have enabled Guinea-Bissau to act as a carbon sink. The mangrove forests, which constitute 9 percent of Guinea-Bissau's land area, are integral to the country's ecological framework and crucial for coastal resilience. Mangroves are significant for climate change mitigation, with a storage capacity of over 300 million tons of CO_2 equivalent, and for climate adaptation as a nature-based solution. They protect against coastal erosion and are essential for the sustainability of fisheries. However, deforestation in recent decades has altered this dynamic, with a loss of nearly 18 percent of the forest cover since 2000, resulting in the emission of over 74.8 million tons of CO_2 since 2001.

By adopting **improved land management practices and reversing current deforestation trends, Guinea-Bissau could reestablish its status as a carbon sink**, potentially qualifying for carbon credits. This shift would also help create more resilient and productive landscapes. In the short term, it is imperative to promote alternative livelihoods to reduce reliance on activities such as fuelwood collection and slash-and-burn farming. Forest monitoring and the governance of protected zones would prevent overexploitation and illicit timber harvesting. For the medium term, it is essential to develop comprehensive landscape management strategies that involve local stakeholders. Environmental preservation will be combined with socioeconomic growth, leveraging Guinea-Bissau's natural capital for sustainable development. The country must also establish the necessary legal, institutional, and technical frameworks to effectively participate in the carbon market.

With only 31 percent of the population having electricity, energy access in Guinea-Bissau is among the lowest in the region and impedes the nation's development. Donor-funded projects already contribute to cleaner, more affordable, and reliable electricity, but widespread energy poverty continues to obstruct economic advancement. The national electrical grid, confined to Bissau and its outskirts, limits the expansion of electricity access through grid extension. There is a compelling case for increasing the share of renewable energy and access to clean energy by implementing a least-cost production plan for urban and rural areas. This plan suggests a short-term diversification strategy, including improved connectivity with the region and the already existing connection to the West Africa Power Pool and off-grid systems. This would enable access to hydropower from neighboring countries, potentially meeting over 20 percent of national energy needs by the medium term (2025). Furthermore, in the medium term, scaling up renewable energy use—particularly solar, which is expected to reach up to 46 percent by 2033 in a high growth scenario—would facilitate low-carbon development. This transition would provide the population with more affordable and reliable electricity access while reducing carbon emissions.

Guinea-Bissau's social protection framework is insufficient, leaving its communities vulnerable to the impacts of disasters. There is a pressing need to devise adaptive social protection strategies. While some initiatives provide temporary relief after disasters, they tend to be sporadic and lack a cohesive, strategic approach. It is imperative to formalize and broaden these safety nets to assist vulnerable populations in recovering from climate-related shocks and help break the cycle of poverty.

Conclusions

The Country Climate and Development Report (CCDR) for Guinea-Bissau presents a strategic framework for aligning development goals with climate change objectives amid the country's delicate political and institutional landscape. This alignment is crucial for fostering positive sectoral transformations and mitigating the negative effects of climate change.

The report's key recommendations include strengthening institutional and financial systems to effectively implement the proposed strategies. Establishing political stability, good governance, and a favorable business climate is essential for enhancing climate resilience and promoting sustainable development. Immediate priorities for the next three years involve the adoption of climate-smart agricultural practices, conservation of natural resources, improvement of energy access, and preparation for future policy reforms. These initiatives are designed to provide immediate benefits to vulnerable populations and conserve natural resources.

In this unstable environment, it is crucial to prioritize activities that capitalize on the robust informal market, the legitimacy of traditional authorities, and the efficacy of community-driven approaches. Such activities may encompass community-led forest conservation, the provision of off-grid renewable energy, decentralized services, cooperative methods for adding value to cashew nut production, and community-driven development strategies for water management, agriculture, and social services.

While the CCDR avoids defining longer-term actions due to the high degree of uncertainty, it highlights that climate action is not only compatible, but also fully intertwined with development objectives, and that the best adaptation is high socioeconomic development. Climate strategy should be regularly reviewed to evaluate its effectiveness and adapt the approach as necessary, ensuring that it continues to serve the best interests of Guinea-Bissau's economy and its people.

Table 1 List of Identified Highest Priorities for the Short Term (2024–26), with Estimated Associated Costs

Activities	Complexity	Potential for private sector	Adaptation / mitigation	Estimated cost (in 2023 US$, millions)
Enhance institutional capacities for monitoring and reporting on the states of forests	+		Both	3.8
Support the management of protected areas	+		Both	5.7
Promote more productive, agro-ecological cultivation techniques, with the development of extension services and digital advisory services	+	Yes	Both	9.4
Expand and develop innovative irrigation and drainage solutions	+	Yes	Adaptation	27.5
Develop selected, more climate-resilient species and improve value chains to diversify agriculture	+	Yes	Adaptation	9.4
Least-cost electrification plan to reach Sustainable Development Goal 7, with associated business plan and strategy for market engagement	+		Both	2.8
Power grid climate resilience analysis	+		Adaptation	1.9
Institutional and policy strengthening for clean energy enablement; creation of a renewable energy asset management entity	++		Mitigation	4.7
Clean energy development for basic services (health, education, communications, security)	++	Yes	Both	9.4
Public infrastructure investment: grid resilience	++	Yes	Adaptation	47.1
Develop adaptive social protection and social safety nets; build a registry for social protection	++		Adaptation	9.4
TOTAL cost				**150.0**

NB: This table only contains the activities identified as the highest priority in the short term.

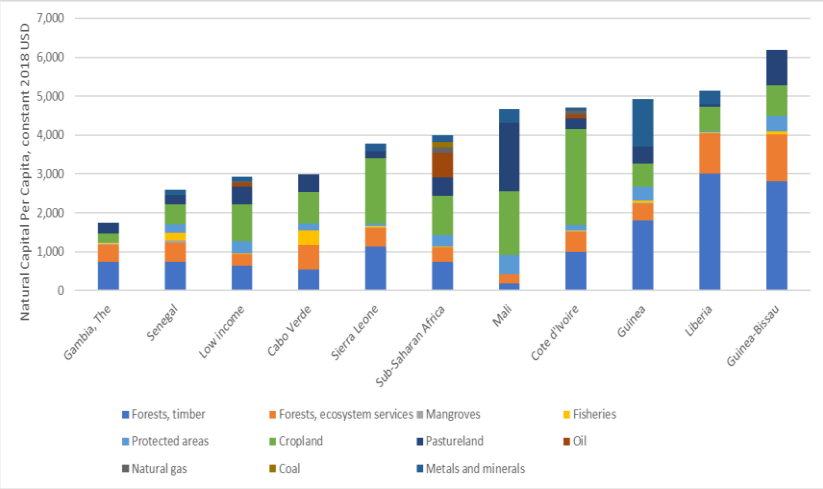
Chapter 1: Climate and Development

1.1 Development context

Guinea-Bissau is endowed with a wealth of natural resources. Situated in West Africa, it ranks among the smaller nations in the region, with a population of roughly 2 million spanning an area just over 36,000 square kilometers. Approximately 80 percent of its residents live in coastal zones, which are rich in mangroves and valuable fisheries. Just off the mainland coast lie the dozens of islands that make up the Bijagós Archipelago, which has been declared a biosphere reserve because of its diverse and rich marine flora and fauna. In addition, the nation's flat and low-lying plateaus boast fertile soils and extensive forests, while offshore territories harbor oil reserves.

These abundant natural resources provide Guinea-Bissau with the highest natural wealth per capita in West Africa, estimated at approximately US$3,874 per person.[1] This wealth encompasses agricultural land, fisheries, forests, and natural habitats, as well as extractable resources such as bauxite and phosphate deposits (Figure 1).

Figure 1 Comparison of Natural Capital Per Capita with Peers in the Region



Source: The Changing Wealth of Nations 2021

Guinea-Bissau, despite its significant natural resources, remains underdeveloped with high poverty rates, lagging development indicators, and slow economic growth. The GDP per capita stands at US$775, and about one-fifth of the million population lives on less than US$2.15 daily. From 2010 to 2018, poverty increased in rural areas while declining in urban areas. The country's literacy rates are lower than those of its peers, and the average real economic growth from 2000 to 2021 was only 3.1 percent annually, below the Sub-Saharan African average of 4 percent.

The underdevelopment of Guinea-Bissau can be attributed to political instability and weak institutions. Since gaining independence in 1973, the country has experienced 17 coups or attempted coups, contributing to its status as one of the most fragile states in the West Africa subregion and significantly hampering economic progress. For instance, the civil war in the late 1990s cut the GDP per capita by half compared to its potential value today. If political stability were at the global average, Guinea-Bissau's economic output could have been 6.4 percent higher. The 2024 update of the World Bank Risk and Resilience Assessment highlights various drivers of fragility, such as inequitable administration of justice and social exclusion, which perpetuate a cycle of poverty and vulnerability.

[1] World Bank (2021). The Changing Wealth of Nations 2021: Managing Assets for the Future
All natural wealth estimates are in US$ at 2010 prices.

Box 1 Drivers of Fragility, Conflict, and Violence in the 2024 Update of the Risk and Resilience Assessment

Guinea-Bissau ranked 31st (lower=more fragile) of 179 countries in the 2023 Fragile State Index, with particularly negative scores related to state legitimacy and factionalized elites. According to the 2024 update of the Risk and Resilience Assessment, the key drivers of fragility, conflict, and violence include:

1. Fragmentation of the rent-seeking elite, the involvement of the security sector in the political sphere, and the politicization of the justice sector contribute to impunity and a lack of accountability of state institutions to the people.
2. Guinea-Bissau's economic model remains vulnerable to shocks and insecure land tenure with greater strides to diversify the economy being subject to vested interests and an inconducive environment for private sector development, which prevent commensurate job creation.
3. Social exclusion and a rural-urban divide are exacerbated by a weak state presence, sparse service delivery, and limited infrastructure.

Guinea-Bissau's economy is insufficiently diversified and heavily dependent on the production of raw cashew nuts, which subjects it to vulnerability from external shocks. Largely characterized by subsistence farming and manual labor, the agricultural sector accounts for approximately 50 percent of GDP and employs around 80 percent of the workforce. Addressing poverty and food insecurity is crucial, particularly for the 120,000 smallholder farmers within the nation. The sector is predominantly focused on cashew nut production, which provides the primary source of cash income for about two-thirds of households and constitutes **90–98 percent of the country's exports**. Moreover, many service-related activities, representing nearly 40 percent of GDP, are indirectly associated with the cashew industry.

The utilization of arable land and pasture in Guinea-Bissau is not optimal, largely due to insufficient public and private investment. In 2019, public investment in agriculture was one of the lowest in Sub-Saharan Africa, at just 1 percent of GDP, which is significantly below the 10 percent benchmark set by the Comprehensive Africa Agriculture Development Program.[2] Consequently, agricultural performance in Guinea-Bissau is below regional standards, with productivity hampered by the lack of investment. This underinvestment not only contributes to a persistent cycle of low productivity but also heightens the sector's susceptibility to climate-related challenges such as floods, droughts, and other effects of climate change.

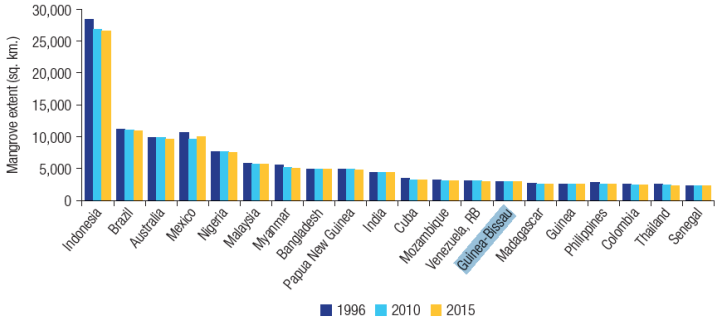
Beyond raw cashew nuts, the country has few alternatives in the short term for generating jobs, foreign exchange earnings, and broad economic growth. The agri-food sector has experienced minimal technological advancement and is stuck in a cycle of low investment and low yield. Diversifying agriculture both horizontally (by broadening crop variety) and vertically (by enhancing the value chain of products, especially raw cashew nuts) has the potential to be transformative. Such diversification could bolster economic resilience and tackle some fundamental factors contributing to the country's fragility.

Indiscriminate deforestation in Guinea-Bissau has precipitated a loss of biodiversity and altered the nation's status from a carbon sink to a net emitter of CO_2. Following the military coup in 2012, deforestation rates, along with overexploitation and illegal logging activities, have escalated markedly. Land-use changes for agricultural purposes are the predominant cause of deforestation, contributing to over 90 percent of the total. From 2001 to 2021, Guinea-Bissau experienced a significant reduction in tree cover, estimated at 188,000 hectares, which represents an 18 percent decline in forest areas since the turn of the millennium. The regions most severely impacted are Tombali, Bafatá, and Quinara, where poverty rates surpass the national average.

Despite these challenges, Guinea-Bissau possesses considerable mangrove forests, ranking 14th globally and 2nd in Africa in terms of size (Figure 2). Mangroves cover 9.4 percent of the country's territory—the highest proportion worldwide. These mangrove ecosystems are crucial for sustaining coastal livelihoods, supporting a rich diversity of species, and providing protection against coastal erosion, flooding, storms, wave surges, and the impacts of sea level rise.

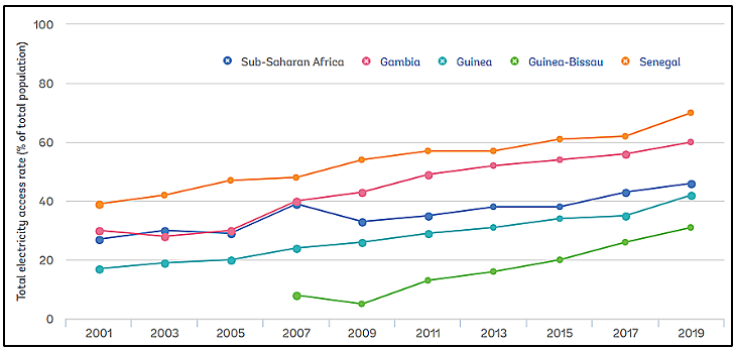
[2] World Bank Group (2023). *Systematic Country Diagnostic Update for Guinea-Bissau : Addressing Fragility for Sustained Poverty Reduction and Shared Prosperity (English).*

Figure 2 Guinea-Bissau Mangrove Area Extent (1996–2015)



Guinea-Bissau's infrastructure and public services are in a state of disrepair and are insufficient despite attempts to enhance accessibility. The country is ranked 43rd out of 50 on the Africa Infrastructure Development Index, indicating lower quality infrastructure compared to neighboring countries such as Liberia, Togo, and Guinea. Access to electricity is limited, with only 35.8 percent of the population connected to the power grid, which is below the Sub-Saharan African average of 50.6 percent (Figure 3). The country also has a sparse network of paved roads, with just 10 kilometers per 100 square kilometers, which hinders development efforts. The power sector is plagued by poor governance and inefficiency, and the road infrastructure is challenged by limited institutional capacity, insufficient funding, and the increasing frequency of climate-related events, particularly floods. The electricity network is primarily concentrated in the capital city of Bissau, leaving those outside the capital with little to no access. Furthermore, the existing network is overstretched and unreliable, resulting in high technical losses and frequent power outages that disrupt businesses, households, and public services.

Figure 3 Electricity Access Rate in Guinea-Bissau and Neighboring Countries (2001–19)



The underinvestment in education and health sectors in Guinea-Bissau has aggravated inequalities. About one-third of children ages 6 to 11 are not attending school, with girls facing more significant barriers to completing their education than boys. High incidences of child marriage and early parenthood in the country compel many girls to leave school early, further entrenching gender disparities in education. The overall quality of education is also below par. In the health sector, as per World Bank estimates, only 24 percent of the population had access to safely managed drinking water in 2020,[3] and a mere 18 percent had access to at least basic sanitation services.[4] Many open wells are contaminated with fecal coliform bacteria,[5] and a considerable number of water pumps are dysfunctional. Access to health care is particularly limited in rural areas, with the United Nations Children's Fund estimating that there is only one health center for every 13,500 people. These shortcomings contribute to the country's low life expectancy, which is estimated at 60 years for individuals born in 2020.[6]

[3] https://data.worldbank.org/indicator/SH.H2O.SMDW.ZS?locations=GW.
[4] https://data.worldbank.org/indicator/SH.STA.BASS.ZS?locations=GW.
[5] https://www.unicef.org/guineabissau/water-sanitation-and-hygiene#:~:text=Guinea percent2DBissau percent20has percent20made percent20large,to percent20improved percent20drinking percent20water percent20source.
[6] https://data.worldbank.org/indicator/SP.DYN.LE00.IN?locations=GW.

The business environment in Guinea-Bissau is challenged by political instability and limited institutional capacity. The private sector's activities are largely concentrated on the production and export of raw cashew nuts, and there is a heavy reliance on imports for consumer goods. Key factors that hinder the development of businesses and the expansion of economic opportunities include regulatory obstacles, the scarcity and high cost of electricity, and inadequate logistics and telecommunications infrastructure.

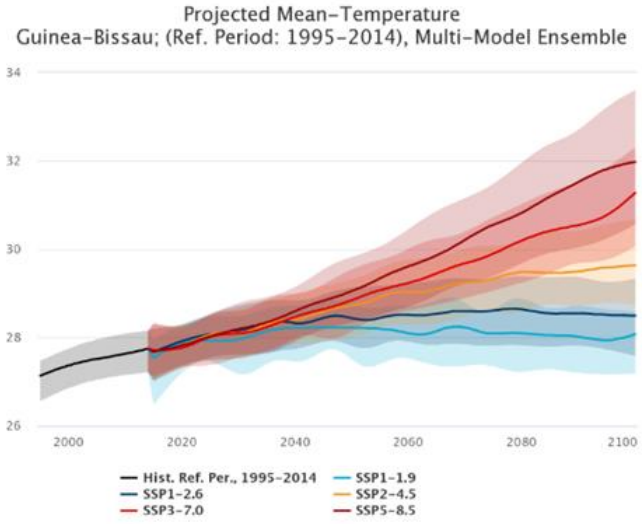
Access to financial services in Guinea-Bissau is significantly lower than in other countries within the West African Economic and Monetary Union (WAEMU). The nation's financial sector is not only small but also notably underdeveloped, which presents a considerable barrier for entrepreneurs seeking start-up capital. Governance issues and a pronounced risk aversion further characterize the sector. While there has been an uptick in domestic credit to the private sector—reaching 12.4 percent of GDP in 2018—it still falls short of what is needed. Formal banking services are scarce, and Guinea-Bissau has fewer banking institutions than most of its regional counterparts.

1.2 Climate change risks

1.2.1 Vulnerability to climate and other shocks

Temperatures are projected to continue to rise in Guinea-Bissau through the end of the century across all emission scenarios (Figure 4), while precipitation trends are less clear. In the short-term climate scenario (2016–45), temperatures are expected to rise by 1.2°C (Representative Concentration Pathway (RCP) 4.5) to 1.3°C (RCP8.5) in the coastal zone, and between 1.4°C (RCP4.5) and 1.5°C (RCP8.5) inland. Average daily precipitation is expected to stay the same (RCP8.5) or slightly increase by 3 percent (RCP4.5), except in the Southwest and the Bijagó Archipelago, where increases might be 5–10 percent (RCP4.5) or 2–5 percent (RCP8.5). In the medium term (2046–75), temperatures are projected to increase by 1.5°C (RCP4.5) or 2.9°C (RCP8.5). Average daily precipitation is expected to increase by 5–10 percent (RCP4.5) or 2–5 percent (RCP8.5) in the south, while slight decreases of 2–5 percent (RCP4.5) and 2–10 percent (RCP8.5) are anticipated north of Cachéu.[7]

Figure 4 Projected Temperatures for Guinea-Bissau



Source: World Bank, Climate Change Knowledge Portal[8]

The precipitation patterns in Guinea-Bissau from 1954 to 2000 have shown a decline and become more unpredictable, with the rainy season now limited to five months, from June to October.[9] These changes, along with the intrusion of saline water, have reduced water availability. This has negatively impacted

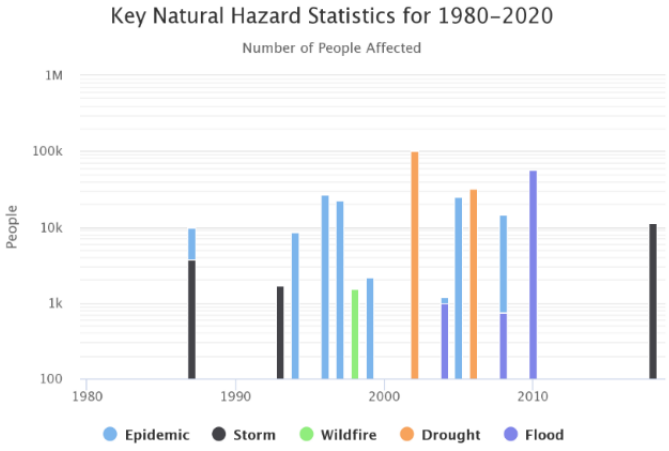
[7] Republic of Guinea-Bissau (2021). *Updated Nationally Determined Contribution in the Framework of the Paris Climate Agreement*.
[8] https://climateknowledgeportal.worldbank.org/country/guinea-bissau/climate-data-projections.
[9] Republic of Guinea-Bissau (2018). *Third National Communication: Report to the United Nations Framework Convention on Climate Change*.

agricultural production, particularly for rice and other cereals grown in the small valleys and uplands of the north and east. In the south, center, and islands, crops that depend on water, such as rice and millet, have also seen decreased yields. Additionally, strong winds during heavy rains, especially in August and September, have led to significant grain production losses.

Floods are a recurrent natural disaster with significant impacts on infrastructure, agriculture, public health, and livelihoods. Annually, high tides and heavy rains lead to flooding that damages public infrastructure, homes, and food production, affecting both rural and urban families. These events often result in temporary or permanent displacement of people from their homes. In many coastal regions, increased flooding and coastal erosion have caused the loss of rice paddy fields due to saltwater intrusion. In the capital city Bissau, the risk of flash floods is heightened by poor urban planning and inadequate maintenance of drainage systems. Floods can also disrupt or damage electricity generation, transmission, and distribution. In the future, unpredictable and extreme rainfall patterns could exacerbate damage to infrastructure, lead to soil erosion, reduce crop yields, cause pasture loss, and increase the risk of waterborne diseases among the population.

Droughts are a critical threat to agriculture and livestock production, with far-reaching consequences for water resources and food security. On average, droughts currently affect about 74,000 people each year. Significant drought events impacted 100,000 people in 2002 and 32,000 in 2004.[10] Looking ahead to future climate conditions (2050–2100), the number of people affected by droughts is expected to rise dramatically, potentially by as much as sevenfold,[11] which could affect up to 38 percent of the population. Droughts are most prevalent in the northeastern plains and eastern highlands, where they severely affect human health, agriculture, and livestock. The anticipated countrywide increase in drought hazard will especially affect areas already highly vulnerable to such events.[12] The more severe and prolonged droughts expected as a result of climate change will likely increase the mortality of woody plants, promote the spread of pests and parasitic plants, and inhibit forest regeneration due to wildfires. Climate change is also expected to negatively affect biodiversity, leading to the migration and extinction of various plant and animal species, and will impact the livelihoods of those who depend on agriculture and natural resources, such as cashew farmers.

Figure 5 Overview of Occurring Natural Hazards and Their Impacts on the Population in Guinea-Bissau[13]



Source: World Bank, Climate Change Knowledge Portal

[10] https://climateknowledgeportal.worldbank.org/country/guinea-bissau/vulnerability.

[11] Climate models are consensual on the steady rise in future temperatures. However, they depict divergent trends for future rainfall patterns, particularly in the West African Sahel region. Some models indicate a drier future while others suggest a wetter future, exhibiting high uncertainty and conflicting projections. The intricate interplay of factors influencing West African climate patterns becomes apparent through the initial rise in precipitation expected by the 2030s, followed by a subsequent decline towards the 2050s.

[12] United Nations Office for Disaster Risk Reduction (2018). *GNB: Guinea-Bissau Disaster Risk Profile - Floods & Droughts*. Available in GNB: Guinea-Bissau Risk Profile - Floods & Droughts (2018) — GeoNode (riskprofilesundrr.org).

[13] https://climateknowledgeportal.worldbank.org/country/guinea-bissau/vulnerability.

Guinea-Bissau's disaster preparedness, response, and recovery capabilities are virtually non-existent and heavily dependent on donor assistance. The country lacks comprehensive national climate data. Its weather, hydrometric, and tide observation networks are not capable of providing accurate weather, sea level rise, and climate projections, and the country lacks an early warning system (EWS). In addition, the government has not acted on implementing disaster management frameworks such as the Hyogo Framework for Action prepared between 2009–11 and 2013–15, the Disaster Risk Management Strategy in West Africa and the Sahel formulated by the Food and Agriculture Organization (FAO) in 2011, or the Sub-Regional Action Program to Combat Desertification in West Africa.[14] As a result, the population is highly vulnerable to climate-induced hazards and extreme weather events. However, there is some progress in the initiation of a United Nations Development Programme (UNDP)/Global Environment Facility project aimed at establishing an EWS for the very first time.

Most of Guinea-Bissau's population (approximately 80 percent) lives in low-lying coastal areas that are highly susceptible to the impacts of sea level rise. Constituting two-thirds of the nation's land area, the coastal zone is not only economically significant but also extremely vulnerable to the consequences of rising sea levels, storm surges, and flooding due to intense rainfall. Projections indicate that by 2040, sea levels could rise by 0.2 meters under the conservative RCP2.6 scenario, with an increase of up to 0.3 meters by the century's end.[15] Such changes are likely to result in considerable damage to infrastructure, widespread land erosion, increased water salinization, degradation of ecosystems, and challenges to food security and public health. The physical, human, and economic ramifications could be substantial without the implementation of effective adaptation strategies.

1.2.2 Climate change impacts on human development and well-being

Guinea-Bissau's susceptibility to climate change and variability is significant, and the country's capacity to prepare, respond, and adapt is limited. The 2018–19 Harmonized Survey on Households Living Standards (*Enquête Harmonisée sur le Conditions de Vie des Ménages*) indicates that climate shocks are already directly affecting around 20 percent of households. The situation is projected to deteriorate by 2030, further compounding existing challenges and increasing the population's vulnerability, particularly in rural areas where education levels are lower and marginalization more pronounced.

Climate change presents considerable risks to health and education sectors. Guinea-Bissau's development is already hindered by its poor performance in these areas, stemming from prolonged underinvestment. The escalation of extreme weather events is likely to exacerbate these challenges by heightening the prevalence of diseases, undermining food security, and impeding children's access to education.

Loss of labor and productivity is another significant concern. The productivity of subsistence farming is already on the decline, partly due to the over-reliance on cashew monoculture, and this issue is exacerbated by the impact of climate change on vital crops such as rice. Furthermore, climate change is likely to compel pastoralists to travel greater distances to find suitable grazing lands for their livestock, which could heighten existing tensions between cattle owners and farmers. Heat stress presents a substantial challenge to both humans and animals, with a projected reduction of 32.8 percent in total labor capacity for outdoor activities in Sub-Saharan Africa.[16] In the long term, climate change may cause irreversible damage to agricultural fields, homes, and assets.

Climate change poses heightened risks and increases the burdens for women, further exacerbating existing gender inequalities. In Guinea-Bissau, women are pivotal to the economy, contributing significantly through their involvement in the production of goods and services, especially within the informal sector and small-scale subsistence farming. Beyond their economic participation, women are also the primary caretakers of households, responsible for child-rearing and ensuring the welfare of their families and communities.[17] Despite their critical roles, women face restricted access to essential resources such as land, livestock,

[14] World Bank (2021). *Guinea-Bissau: Building Resilience for Vulnerable Populations*.

[15] World Bank Climate Change Knowledge Portal.

[16] Shouro Dasgupta et al (2021). The effects of climate change on combined labour productivity and supply: an empirical, multi-model study, The Lancet, Vol 5,7; DOI: https://doi.org/10.1016/S2542-5196(21)00170-4.

[17] International Monetary Fund (IMF) (2011). Guinea-Bissau: Second Poverty Reduction Strategy Paper.

and financial capital. They also encounter obstacles to participating in decision-making processes and community engagement, which diminishes their capacity to withstand the impacts of climate change. Addressing gender inequality and bolstering women's resilience to climate change is a complex challenge, compounded by the scarcity of country-specific data on gender and climate issues.

1.2.3 Various sectors of the economy suffer the compound effects of climate change

Climate change poses a significant threat to agriculture, with the country's reliance on rainfed agriculture and smallholder subsistence farming making it particularly susceptible to the impacts of climate variability. The 2006 National Programme of Action of Adaptation to Climate Changes report anticipates a 20–30 percent reduction in agricultural yields due to floods, droughts, higher temperatures, land degradation, increased pests, and salinization from rising sea levels.[18] Addressing these challenges is difficult due to a lack of advanced technology and equipment, insufficient knowledge of regenerative and sustainable agricultural practices, and limited access to quality seeds, rural infrastructure, and financial resources.

The marine fisheries sector is also at risk. Fisheries in Guinea-Bissau provide 255,000 jobs and contribute to 6 percent of national GDP.[19] However, with half of the fish stocks off the West African coast already overexploited, and projections suggesting a decrease in maximum catch potential of 14–21 percent by 2050 due to rising sea temperatures, the sustainability of this sector is in jeopardy.

Water resources are equally at risk. Increasing temperatures and decreasing precipitation are adversely affecting groundwater reserves, which are a primary source of drinking water, and are reducing river flows. Additionally, rising sea levels are causing increased coastal salinization. These problems are exacerbated by outdated water policy frameworks, inadequate data, malfunctioning monitoring networks, and fragmented water-related programs, making it challenging to effectively manage and mitigate these issues.

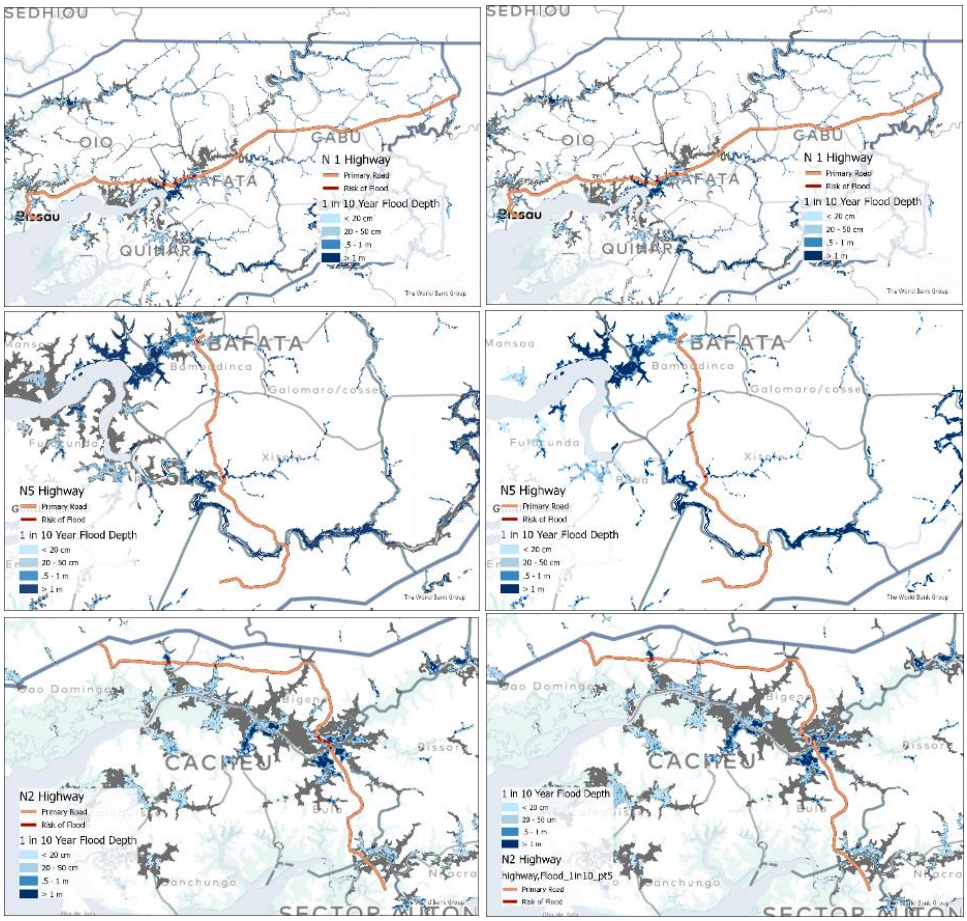
The electricity sector is acutely susceptible to the repercussions of climate change. Climate-related events have already inflicted damage on power infrastructure, including generation facilities, transmission networks, and substations, causing disruptions in electricity supply. Variations in precipitation patterns could impact river flows and water levels, leading to inconsistencies in hydropower generation, which is a concern for both Guinea-Bissau and Guinea, from where power is expected to be imported. With rising temperatures, there will be an increased need for cooling and air conditioning, further straining the energy system. It is therefore vital to ensure a reliable electricity supply and efficient distribution to adapt to evolving demand patterns, which is essential for the sector's sustainable development and resilience.

Climate change is anticipated to exacerbate flood events, which will likely lead to increased damage and disruptions within Guinea-Bissau's road network. Particularly at risk are segments of the national roads, especially along the N1, N2, and N5 corridors, which are vulnerable to flooding (Figure 6). Climate change intensifies the difficulties faced by rural transportation networks, with a significant portion of these roads becoming impassable for motorized vehicles during the rainy season, which spans five months from June to October. Consequently, many rural inhabitants are forced to travel by foot, which severely restricts their access to markets, water sources, schools, health care, employment, and other vital services. Women often bear the brunt of these limitations. As the effects of climate change worsen, the challenges of transporting cashews to ports for export and rice from farms to urban centers are likely to increase. The current inadequacies in road and surface transport infrastructure are estimated to result in losses of about US$22 million annually.

[18] National Program of Action of Adaptation to Climate Change.

[19] Intchama, Jeremias Francisco, Dyhia Belhabib, and Raul Joaquim Tomás Jumpe (2018). Assessing Guinea-Bissau's Legal and Illegal Unreported and Unregulated Fisheries and the Surveillance Efforts to Tackle Them. *Frontiers in Marine Science* 5. https://doi.org/10.3389/fmars.2018.00079.

Figure 6 Road Sections Exposed to 10-Year Flood Events with a Flood Depth of 20cm and 50cm



Source: Author's estimates

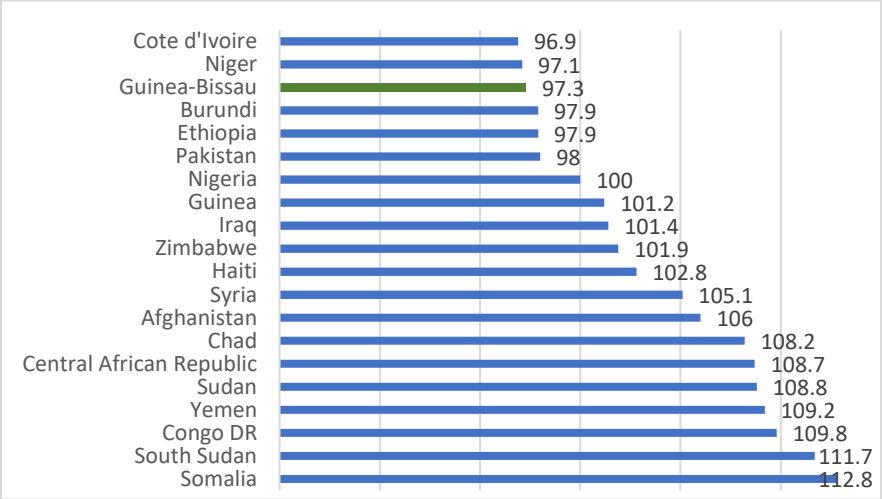
1.2.4 Climate change and fragility

Guinea-Bissau faces challenges from population growth and rapid urbanization, which are increasing demands for food, employment, basic education, and health care services. This surge in demand is placing pressure on natural resources and urban housing. From 2002 to 2021, the population grew at an annual rate of 2.5 percent, reaching 2.15 million in 2023, with projections indicating a rise to 3.4 million by 2050. Guinea-Bissau's urbanization rate has also increased significantly, with the urban population growing from 14 percent in 1960 to 45 percent in 2021. The capital city Bissau has been a focal point of this growth, with its population expanding from 109,000 in 1979 to 664,000 in 2023.

The demographic shifts in Guinea-Bissau have resulted in the unregulated transformation of mangroves, mixed forests, and salt marshes to accommodate agricultural expansion and infrastructure development. This unchecked conversion is intensifying the effects of coastal erosion, jeopardizing socioeconomic development, undermining food security, and threatening the livelihoods of communities in coastal areas, particularly those in the northwestern coastal zones.

Additionally, climate shocks are likely to intensify the drivers of fragility, conflict, and violence in Guinea-Bissau. During the 2010s, the country consistently ranked among the 20 most fragile nations according to the State Fragility Index (Figure 7). Although there was a slight improvement in the early 2020s, the underlying issues persist, including the overexploitation of natural resources, illegal logging of hardwood trees, a poorly diversified economy, weak and inequitable administration of justice, social exclusion, and entrenched poverty that leads to resentment. The impacts of climate change may further exacerbate these causes.

Figure 7 The Twenty Most Fragile States between 2011 and 2022 (Average Score, 2011–22)



Source: Based on the Fund for Peace's State Fragility Index

There is widespread public concern over the country's environmental deterioration. A significant majority (94 percent) identify illegal logging as a major issue, while 90 percent are troubled by harmful fishing practices. Additionally, over 80 percent are worried about the pollution from plastic waste, the extinction of wildlife, and the impacts of climate change.[20] These widespread concerns present opportunities for environmental action; however, challenges such as the remnants of authoritarianism, a patronage-based state, political instability, and clientelism hinder progress.

For the past 30 years, Guinea-Bissau's economy has relied heavily on natural resource exploitation and commodity exports, leading to wealth accumulation among a small group of elites with political connections. Accounting for 90–98 percent of exports, cashew nuts are the primary employment source for 80 percent of the rural workforce. Yet, a disproportionate share of the wealth—up to 60 percent—ends up with national exporters and foreign importers, which stifles economic growth and contributes to the country's fragility.

The development of a robust private sector is stymied by the political elite's economic control. Politician-entrepreneurs leverage their positions to conduct personal business with or under the protection of the state, perpetuating corruption and the monopolization of natural resources by the politically powerful.

1.2.5 Climate change and migration

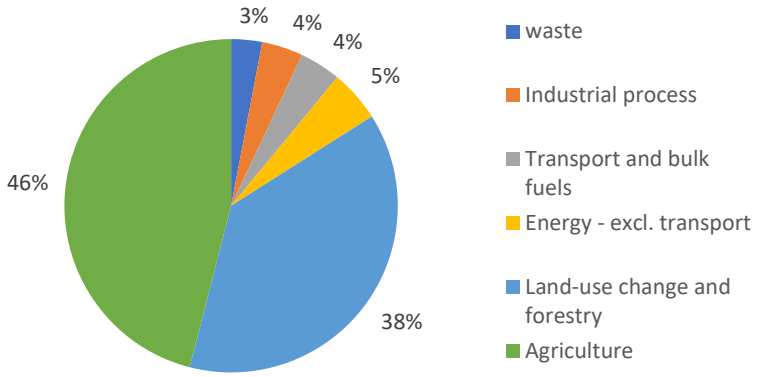
Coupled with other non-climatic factors, climate change is already hastening human migration. Typically, people move for improved economic or educational opportunities or to flee conflicts. However, as climate change progresses, it is likely to exacerbate migration and mobility, leading to increased forced displacements and intensifying disputes over land and resources. For example, the entire village of Djobel is being forced to retreat from the coast due to rising sea levels, which is reigniting historical interethnic conflicts over land use and resources. In the Northeast, exacerbated droughts and heatwaves—expected to be seven times more severe by 2100—[21]are driving livestock herders to seek new territories. Flash floods in both urban and rural settings frequently displace marginalized communities, leaving them with scant resources to rebuild or relocate. The state's response to these challenges is often limited, and existing support measures to promote adaptive capacity are either insufficient or have minimal impact.

[20] Carter, Miguel (2023b). Public opinion study in Guinea-Bissau: Highlights and methodology, *Voices of the People: Society, Politics and Public Opinion*, edited by Miguel Carter and Carlos Cardoso. Forthcoming book.
[21] United Nations Office for Disaster Risk Reduction (2018). GNB: Guinea-Bissau Risk Profile – Floods & Droughts — GeoNode. riskprofilesundrr.org/documents/1087.

1.3 Greenhouse gas Emissions trends

While Guinea-Bissau's contribution to global greenhouse gas (GHG) emissions is minimal, at less than 0.1 percent, projections indicate a rise both in absolute terms and per capita. The nation's annual GHG emissions total 4.2 million tons, in contrast to the global sum of 49.76 billion tons.[22] Along with forest and land-use change, agriculture is responsible for 84 percent of these emissions (Figure 8). From 1990 to 2019, there was a 33 percent surge in absolute GHG emissions. Although energy, transport, waste, and industry currently account for only 16 percent of total emissions, the growth rate of emissions in these sectors is outstripping that of agriculture and forest and land-use changes (Figure 9).

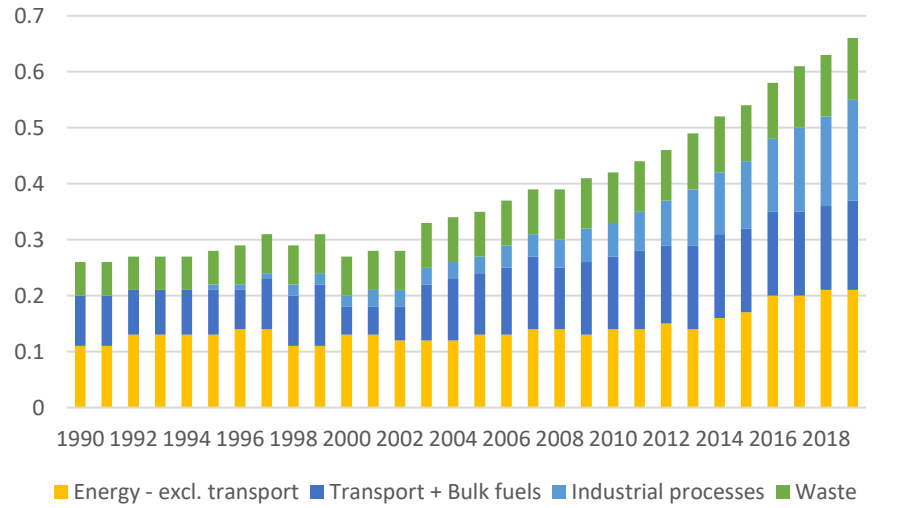
Figure 8 Emissions by Sector in 2019



Source: Climate Analysis Indicators Tool historical GHG emission[31]

The energy sector has a major role to play in achieving Guinea-Bissau's GHG emission reduction targets. A sectoral breakdown of national emissions indicates that agriculture, forestry, and other land use (AFOLU) excluded, the energy sector as the largest emitting-sector in the country, accounting for 63 percent of total emissions. This is primarily attributed to the reliance on heavy fuel oil (HFO) power plants, which are significant sources of carbon dioxide (CO_2), sulfur dioxide (SO_2), and nitrogen oxides (NO_x). The combustion of HFO also releases pollutants that raise environmental and health concerns.

Figure 9 Historic GHG Emissions in Guinea-Bissau, by Sectors (Excluding AFOLU)



Source: Climate Analysis Indicators Tool historical GHG emission

[22] Climate Watch (2024) Washington, DC: World Resources Institute. Available online at: https://www.climatewatchdata.org.

Deforestation poses a dual challenge as both a critical environmental issue and a major source of GHG emissions. According to Global Forest Watch, Guinea-Bissau experienced a loss of roughly 188,000 hectares of tree cover from 2001 to 2021, representing an 18 percent decline in forest cover and resulting in the emission of approximately 74.8 million metric tons of CO_2. The pressure on forests escalated after the 2012 *coup d'état*, with political instability contributing to the widespread felling and export of African rosewood. Other factors contributing to deforestation and forest degradation include: (i) unregulated agricultural expansion, primarily for cashew monoculture by smallholders employing slash-and-burn techniques; (ii) the use of wood for energy through fuelwood and charcoal production, which, along with agricultural biomass, constitutes 90 percent of the country's energy consumption; and (iii) illegal logging for timber and other valuable species, such as African rosewood.

Chapter 2: Country's Enabling Environment for Managing Climate Change

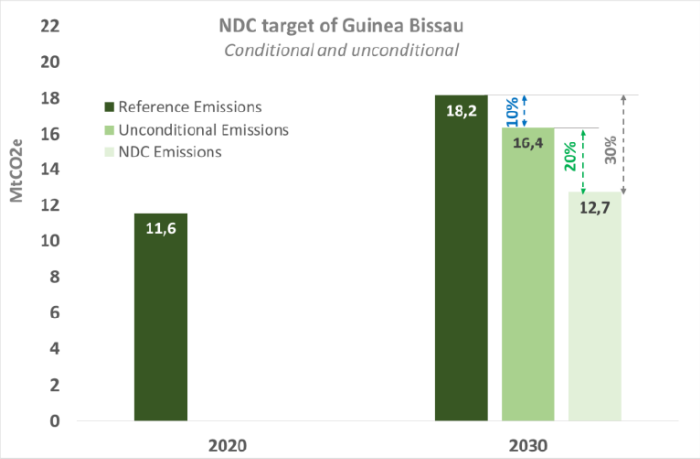
2.1 Guinea-Bissau's climate commitments on mitigation and identified adaptation needs

As a nation with one of the lowest GHG emissions (contributing less than 0.01 percent to global emissions), [23] Guinea-Bissau's climate strategy focuses on reducing the carbon footprint of its development, conserving national carbon sinks, and improving predictions of climate change impacts. Guinea-Bissau ratified the Paris Agreement in 2015 and, with its updated Nationally Determined Contribution (NDC) submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in 2021,[24] has pledged to significantly cut its emissions by 2030 and strengthen adaptation measures.

Guinea-Bissau's NDC prioritizes three main objectives: (i) mitigating deforestation and forest degradation; (ii) enhancing the sustainability of renewable natural resources, notably forests and agricultural soils; and (iii) adopting green development practices to improve the living conditions of communities, particularly those dependent on forests.

The NDC pledges an unconditional reduction of GHG emissions by 10 percent by 2030 using domestic resources, and a conditional reduction of 30 percent with international support. The anticipated reductions are primarily expected from the land use, land use change, and forestry and energy sectors (Figure 10). The NDC addresses emissions of methane (CH_4) and N_2O, along with CO_2, from the energy sector, AFOLU, and waste.

Figure 10 Guinea-Bissau NDC's GHG Mitigation Targets



Source: NDC

[23] Ritchie, H., Roser, M., & Rosado, P. (n.d.). CO_2 and Greenhouse Gas Emissions. Our World in Data. https://ourworldindata.org/co2/country/guinea-bissau#what-are-the-country-s-annual-co2-emissions.

[24] Guinea-Bissau submitted its Intended Nationally Determined Contribution in 2015, but did not present a quantified GHG mitigation target. Instead, the Intended Nationally Determined Contribution focused on reforestation, sustainable forest management, and long-term low-carbon energy development.

Table 2 Priority Mitigation Actions in Updated NDC

Sector	Priority mitigation actions in updated NDC
AGRICULTURE	**4 percent emissions reduction by 2030 compared to baseline** by (i) improving dairy productivity of cows by 10 percent, (ii) improving rice production practices through enhanced water management, and (iii) reducing burning of crop residue through improved agricultural practices and presence of herds in harvested areas.
ENERGY	**44 percent emissions reduction by 2030 by reducing primary energy demand by 20 percent, increasing the share of renewable energy in the generation mix to 58 percent, and achieving approximately a 44 percent reduction in emissions in the sector by 2030** by (i) installing 90 MW of renewable energy capacity, (ii) reducing electricity grid losses to 20 percent, (iii) improving energy efficiency in public and commercial buildings as well as industry, (iv) increasing access to improved stoves for cooking to reduce fuelwood consumption, and (v) undertaking large-scale distribution of prepaid meters to incentivize efficient electricity consumption.
FORESTRY	**40 percent emissions reduction by 2030 by curbing illegal deforestation, increasing reforestation, and enhancing effective management of protected areas.** Specific actions include: (i) conduct a nationwide forest inventory and forest monitoring system; (ii) strengthen existing capacity to develop a Reducing Emissions from Deforestation and Forest Degradation (REDD+) program; and (iii) develop an agro-ecological zone and forest management.
WASTE	**7 percent emissions reduction by 2030 compared to baseline** by (i) reducing waste in landfills through increased recycling of paper and cardboard and textiles, (ii) diverting 10 percent of food waste to composting, (iii) stabilizing the breakdown between open and managed landfills, and (v) recovering 1 percent of CH_4 generated by 2030.

The NDC highlights the importance of adaptation for Guinea-Bissau and a need to focus on measures aimed at strengthening adaptive capacity and resilience and reducing vulnerability to climate change. Building on the National Programme of Action of Adaptation to Climate Changes (submitted in 2006), the First NDC (submitted in 2015), the Third National Communication (submitted in 2018), and other sectoral strategies, agriculture and livestock, energy, forestry, biodiversity, fisheries, and water resources are among the main priority sectors identified for adaptation. While a list of specific adaptation measures and investment needs for adaptation is not presented in the updated NDC, references to some adaptation strategies in certain sectors is made. For example, on agriculture, the NDC mentions support for measures such as supplying seeds to compensate for food shortages in emergencies, building capacity for farmers and their organizations, improving water management, making agriculture more sustainable, developing new agricultural enterprises, preventing and managing food crises and other natural disasters (with strategies such as EWSs), and reinforcing institutions.[25] Other sectors identified as crucial for adaptation, include human health, capacity development, disaster risk management, and infrastructure; however, progress and/or efforts to improve the resilience of these sectors continues to lag due to gaps in financing.

Implementing the country's NDC for mitigation will require significant investments, which exceed the country's own resources and current level of climate financing (estimated at US$18 million/year in 2019). The cost for implementing the mitigation component has been estimated by the country at around US$694 million over the period 2021–30, including US$664 million to cover investments and US$30 million for capacity-building actions. About US$531 million would be needed to achieve the conditional mitigation contribution over the period 2021–30.[26] The basic assumption is that international support will cover 80 percent of the cost, while the national budget would cover 20 percent, which might not be feasible in the short term given the country's fiscal constraints. Table 3 shows the distribution among the different sectors.

[25] https://climateknowledgeportal.worldbank.org/country/guinea-bissau/.

[26] Republic of Guinea-Bissau (2021). *Updated Nationally Determined Contribution in the Framework of the Paris Climate Agreement*.

Table 3 Investment Needs for Mitigation Estimated in the Updated NDC (in 2020 US$, millions)

Sector	Total amount	International support need
Energy	300	240
Renewable energies	180	
Strengthening the electricity grid	20	
Energy efficiency measures	100	
Forest and land use	330	264
Agriculture	28	22
Waste	6	5
Total	664	531

2.2 National strategies and plans for climate change

Guinea-Bissau has initiated efforts to address climate change, which include formulating various plans and strategies and consistently submitting relevant documents to the UNFCCC:

- Established in 2006, the **National Adaptation Programme of Action** recognizes Guinea-Bissau's limited capacity to mitigate the adverse effects of climate change and outlines key strategic actions to manage climate risks. These actions aim to bolster food security, alleviate pressure on forests and fisheries, and enhance the availability of clean water. The strategies include:
  - Enhancing climate resilience and promoting adaptation measures in agriculture, water resources, and coastal areas.
  - Expanding economic opportunities beyond traditional agriculture by developing fisheries, non-timber forest products, and diversified agricultural systems, such as agroforestry.
  - Strengthening knowledge bases and monitoring systems, including the implementation of EWSs.
  - Establishing EWSs to minimize the risks associated with floods, particularly in coastal regions.

- **Guinea-Bissau's National Communications** to the UNFCCC (submitted in 2005, 2011, and 2018) have detailed the impacts of climate change on various economic sectors and environmental systems. The First (2005), Second (2011), and Third (2018) National Communications have been pivotal in pinpointing the country's adaptation requirements, especially in key sectors such as agriculture and livestock, energy, forests, biodiversity, fisheries, and water resources. The Third National Communication further outlines a comprehensive suite of adaptation measures to tackle these challenges.

- The 2019 **Biennial Update Report** to the UNFCCC underscores the need for financial backing in the following domains:
  - Provision of funds to research institutions for collecting, archiving, and analyzing climate data and renewable natural resources.
  - Financial support for the acquisition of data and software critical to vulnerability assessments and the development of adaptation strategies.
  - Investment in capacity building for conducting vulnerability assessments and devising and executing adaptation and mitigation programs and strategies.[27]

The government of Guinea-Bissau has mainstreamed climate change in the successive several national strategies, such as the National Development Plan 2020–23,[28] the National Strategy for Poverty Reduction, and local development plans with an emphasis on agriculture, hydrologic resources, and livestock. Key priorities have been identified, which include advocating for sustainable forest management, fostering the development of a productive and resilient climate-smart agricultural system, and encouraging the adoption of clean energy.

[27] Republic of Guinea-Bissau (2019). Guinea Bissau First Biennial Update Report to the United Nations Framework Convention on Climate Change https://unfccc.int/sites/default/files/resource/FINAL_GNB_BUR1.pdf.

[28] In April 2024, the government began preparation of a new development plan.

The government of Guinea-Bissau has initiated measures to integrate climate action into its national agenda; however, the absence of a national climate change policy framework and a formal national adaptation planning process poses significant challenges. These challenges are compounded by a lack of technical capacity to incorporate climate considerations into national and sectoral planning, as well as by deficiencies in the climate-related information that is essential for informed adaptation planning.[29] A critical shortfall that must be addressed is the lack of a thorough cost-benefit analysis of adaptation measures, which is vital for guiding decision-making processes.

2.3 National climate change institutional and legal arrangements

The responsibility for addressing climate change in Guinea-Bissau is distributed among various public sector institutions, thus highlighting the need for enhanced coordination. Reflecting the interdisciplinary nature of climate change, several entities are involved in this area. The Ministry of Environment, Biodiversity and Climate Action (MEBCA) holds the overarching responsibility for leading the climate change agenda, which encompasses the development of climate change policies, conservation, environmental protection, and the sustainable management of natural resources and minerals. MEBCA is supported by other key ministries, including the Ministry of Finance, the Ministry of Economy, Planning, and Regional Integration, and sector-specific ministries such as the Ministry of Agriculture and Rural Development, the Ministry of Energy, and the Ministry of Natural Resources.

The National Climate Change Committee, which operates within the MEBCA, is tasked with overseeing the monitoring of activities under the UNFCCC. Working in close collaboration with other relevant entities, it is also responsible for the preparation of National Communications, Biennial Update Reports, and NDCs. The National Climate Change Committee strives to raise awareness and mobilize stakeholders involved in climate change issues, including government institutions, the private sector, nongovernmental organizations, civil society organizations, and universities. The committee provides scientific and technical advice and convenes on an ad hoc basis to prepare UNFCCC-related documents. Recognizing the need for improved coordination and enhanced technical capacity on climate issues, there is a call to strengthen these aspects across various ministries and departments to ensure more effective synergies, coherence, and impact of climate-related activities.

Marked by instability, the political landscape of Guinea-Bissau poses significant challenges to the effective implementation and sustainability of comprehensive strategies aimed at addressing climate change impacts and fulfilling long-standing developmental needs. Despite intermittent phases of stability, the nation continues to confront endemic corruption, and a political elite often engaged in self-serving practices. To surmount these obstacles, it is imperative to actively engage local traditional leaders who represent the country's diverse ethnic groups, local government bodies, local nongovernmental organizations, and civil society in the climate-related decision-making processes. In a move toward fostering such involvement, Guinea-Bissau ratified the United Nations Economic Commission for Europe Convention on Access to Information, Public Participation in Decision-Making, and Access to Justice in Environmental Matters in early 2023. This convention advocates for effective and inclusive public engagement in environmental governance, including matters pertaining to climate change.[30] This accession is anticipated to be a foundational step toward enhancing inclusive governance, accountability, and transparency, thereby contributing to the sustainable development necessary to address escalating climate challenges.

Guinea-Bissau does not have specific laws or policies that directly address climate change. While the country has established laws and regulations related to environment, such as the Basic Law on the Environment and the Environmental Assessment Act, there are significant challenges related to the understanding and implementation of these laws. Additionally, there is a lack of specific legal and policy frameworks for addressing climate change and promoting renewable energy infrastructure. Laws should include elements to promote information and transparency and reporting requirements and mainstream climate change in national strategies.

[29] UNDP-UN Environment National Adaptation Plan Global Support Programme. *National Adaptation Plans in Focus: Lessons from Guinea-Bissau*. https://www.adaptation-undp.org/sites/default/files/resources/guinea_bissau.pdf.
[30] https://unece.org/climate-change/press/guinea-bissau-accedes-aarhus-convention-opening-new-horizons-environmental.

2.4 Role of the financial sector in climate change

In general, the financial sector has a critical role to play in supporting the Paris Agreement and addressing climate change by addressing financing gaps and reallocating resources to facilitate the transition to a sustainable, low-carbon economy. Nonetheless, the sector is also vulnerable to climate-related risks, which can manifest physically as direct impacts of climate change and disasters on asset values, or as transition risks associated with potential policy changes, technological shifts, or the economic transition to a low-carbon model. In addition to its role in capital allocation, the financial sector is instrumental in managing financial risks related to disasters.

2.4.1 Financial sector in Guinea-Bissau

The financial sector in Guinea-Bissau is predominantly banking-focused, relatively small, underdeveloped, and exhibits a high level of concentration. As a participant in the WAEMU, the sector is regulated and supervised by the Central Bank of West African States. The banking landscape consists of six banks, with foreign ownership dominating four of them. In comparison to other countries within the WAEMU, Guinea-Bissau's sector is notably smaller, with assets constituting just 0.7 percent of the total assets in the WAEMU region, which equaled CFAF 381.5 billion at the end of 2021. Sight deposits amounted to CFAF 126.1 billion, and term deposits totaled CFAF 88.2 billion at the end of the same year.[31] The proportion of domestic bank deposits to GDP was 18.5 percent in 2020, which falls short of the regional median of 27.2 percent. Additionally, private credit provided by the banking sector represented 15.7 percent of GDP, compared to the regional average of 17.4 percent.[32]

The financial sector is susceptible to external shocks, including those stemming from the growing frequency and severity of climate-related disasters. These events can lead to substantial economic harm through effects on vital infrastructure, interruptions in supply chains, and consequent inflationary pressures. In Guinea-Bissau, for instance, the economy's heavy reliance on cashew production, coupled with a significant proportion of commercial lending (60 percent) being allocated to cashew exporters, leaves the banking sector particularly exposed to fluctuations in demand and prices, as well as to the risks associated with natural disasters.[33]

The financial services sector in Guinea-Bissau is notably more constrained when compared to its WAEMU peers. The sector is not only small but also significantly underdeveloped, which presents a major hurdle for entrepreneurs in securing start-up capital. Additionally, the sector is characterized by weak governance and a strong aversion to risk. While domestic credit to the private sector has seen some increase in recent years, it remains low overall. The accessibility to formal banking services is extremely limited, and Guinea-Bissau has a smaller number of banks than most other Sub-Saharan African nations.

Banking penetration remains low, with only 6 percent of the adult population holding bank deposits, which is below the WAEMU average of 13 percent. This situation presents challenges, particularly for farmers who struggle to access credit for essential inputs like fertilizer and for marketing their cashew crops. Similarly, small enterprises face difficulties due to complex application procedures and the high collateral requirements for loans. Despite its potential, the microfinance sector, which could otherwise be instrumental in broadening access to financial services, has not yet flourished.

The microfinance sector in Guinea-Bissau is in its nascent stages, and the adoption of digital financial services is still at the beginning phase. Among the six microfinance institutions present, only two are currently operational. These institutions are struggling to stay afloat due to challenges such as low repayment rates, insufficient capital, and the lack of effective contract enforcement mechanisms. Although microfinance has the potential to significantly contribute to sustainable economic development by providing loans to small businesses and households, it has yet to become a significant source of capital for entrepreneurs. In 2012, the assets held by these institutions represented a mere 0.1 percent of the

[31] *Rapport de la Commission Bancaire de l'UMOA* (2021): https://www.bceao.int/fr/publications/rapport-de-la-commission-bancaire-de-lumoa-21.
[32] Central Bank of West African States Monthly Statistical Bulletin, July 2022.
[33] IMF (2022) Article IV Consultation, June 2022.

country's GDP. Furthermore, despite a relatively high mobile penetration rate of about 61 percent, the uptake of mobile money platforms remains minimal. Guinea-Bissau has the lowest number of mobile money transactions per 100,000 adults when compared to its WAEMU counterparts.

The financial infrastructure supporting the banking and microfinance sectors is underdeveloped, limiting credit access. Structural issues compound these challenges. Credit provision is hampered by insufficient borrower information, with credit bureau coverage at only 1.2 percent—well below the Sub-Saharan Africa average of 11 percent. Despite the 2017 WAEMU Credit Bureau Law enabling a regional credit bureau's formation by the Central Bank of West African States, its implementation remains nascent. Additional hurdles include a weak judicial system for debt enforcement and uncertainties in secured transactions. From the demand perspective, the lack of suitable collateral and poor-quality credit applications—often due to inadequate business plans, low financial literacy, and subpar accounting—further restrict credit availability.

The financial sector also includes two insurance companies and the National Institute of Social Security, which manages pensions. However, few insurance products are available (primarily focused on basic business) and most of the population is uninsured. A national strategy for disaster risk management created in 2013 has yet to be implemented,[34] and there is no real national social protection program other than contributory schemes managed by the National Institute of Social Security for private sector employees only.

The country does not currently issue sovereign debt and has no credit rating. In addition, Guinea-Bissau is currently inactive on the common regional stock exchange for members of the WAEMU (*Bourse Régionale de Valeurs Mobilières*). As a result, the country's ability to raise long-term capital through equity and debt markets is limited.

The financial sector in Guinea-Bissau is unprepared to assess its exposure to climate-related risks or to fund green investments. There are no adequate frameworks or incentives for the private financial sector to consider climate-related risks, and banks have yet to include such risks in their internal risk management processes. As a result, the financial sector is vulnerable to physical risks, which could lead to non-performing loans or loan defaults, thereby decreasing the available credit and, in the worst case, causing a financial crisis.

2.4.2 Financial sector's role in addressing the climate challenge

To enhance financial resilience at the local level, reforms aimed at improving financial infrastructure and access to credit are essential. Strengthening the solvency and resilience of the financial system is one aspect, while the expansion of microfinance and mobile money can significantly boost financial inclusion for micro and small enterprises. Further reforms to facilitate credit access could involve bolstering the credit information system via the WAEMU's Regional Credit Bureau initiative and recognizing movable collateral under regional practices like the Organization for Harmonization of Business Law in Africa's secured transactions law. Additionally, implementing a warehouse-receipt financing system could serve as an effective tool for the agricultural sector.

Financial sector depth, or financial inclusion, plays a vital role in empowering individuals, families, and businesses to become active participants in the economy. By improving access to financial instruments such as basic savings accounts, affordable credit, and insurance, Guinea-Bissau can foster inclusive economic development. Financial inclusion enables individuals to save, invest, and protect themselves against risks while also facilitating business expansion and entrepreneurship. Access to products and services for marginalized groups, including women, rural communities, and low-income households, would produce economic stability and generate opportunities that lead to improved living standards and reduced poverty.

Financial sector diversification and depth are key components that should be vital for Guinea-Bissau's development agenda. By promoting financial sector diversification, the country can expand the range of

[34] Republic of Guinea-Bissau (2013). National Strategy for Disaster Risk Management. https://www.fao.org/faolex/results/details/en/c/LEX-FAOC163718/.

financial sector providers and instruments tailored to the specific needs of its population. This diversification enables the financial sector to cater to a broader spectrum of economic activities, including agriculture, manufacturing, and small and medium-sized enterprises. By providing access to a diverse set of financial services, including credit, insurance, transactions, savings, and investment options, Guinea-Bissau can unlock new avenues for economic growth and reduce its dependency on a single sector, thereby fostering resilience and sustainability.

The underdeveloped and undiversified state of the financial sector in Guinea-Bissau limits its ability to support the transition to finance low-carbon and resilient investments in the short term. To address this, the government must prioritize financial sector development and inclusion to equip individuals and communities with coping instruments and mechanisms to mitigate financial risks, absorb shocks, and recover from disasters. Developing disaster risk financing tools and strategies will contribute to ensuring predictable and timely access to much needed resources and ultimately mitigate long-term fiscal impacts of climate and disasters risks. The authorities must carefully consider enhancing the climate financial information architecture and climate-related data collection mechanism in the financial sector as well as building financial resilience to climate and disaster risks as part of a holistic financial sector development strategy to facilitate the private sector financing of mitigation and adaptation activities.

2.5 Enabling the private sector

With supportive government policies, the private sector can play a major role by investing in key sectors. Improving the enabling environment for private actors is essential for creating a resilient business model and investment climate for climate action. There are many opportunities for private sector engagement, including investing in renewable energy to increase electricity access; providing climate-resilient crop varieties, irrigation systems, and more diversified crops in agriculture; developing agroforestry or ecotourism; providing improved cooking stoves in the forestry sector; adopting climate-smart practices for mining bauxite, phosphate, and other minerals; improving port logistics and roads to create more sustainable and efficient transportation systems; diverting waste from landfills; and providing private sector technical assistance to help banks expand and diversify their loan portfolios and to help relevant stakeholders use carbon market mechanisms. However, to encourage private sector participation, more work needs to be done to strengthen the country's existing adaptive capacity, for example, by improving access to climate information for decision-making. In addition, there is an opportunity to encourage consideration of climate risks in the private sector more systematically by promoting the development of private sector climate change action plans and business continuity plans.

The convergence of private investment in the energy and agriculture sectors in Guinea-Bissau presents a unique opportunity not only for economic growth but also for fostering social inclusion. By strategically channeling investments into projects that prioritize community engagement, women's empowerment, job creation, and access to finance, investors can contribute to a more equitable and sustainable future for the nation. More details are provided in the subsequent chapters.

Table 4 Sector Summary of Proposed Actions for Financial Inclusion

Activities	Priority (for climate agenda)	Time frame	Complexity	Potential for private contributions	Adaptation / mitigation
Promote financial sector diversification	Medium	MT			Adaptation
Provide access to a diverse set of financial services	Medium	MT	++	Yes	Adaptation
Improve access to credit through reforms to enhance the financial infrastructure	Medium	MT	++	Yes	Adaptation
Better equip individuals and communities with instruments and mechanisms to mitigate financial risks, absorb shocks, and recoup financial losses	High	MT	++	Yes	Adaptation

Chapter 3: Selected Development and Climate Priorities

3.1 Introduction

To effectively tackle climate change, Guinea-Bissau must undertake a transformative shift in its development approach. This entails tackling structural issues and political instability, as well as enacting significant institutional reforms. Priorities should focus on building resilient energy and transport systems, encouraging sustainable agricultural and agroforestry methods, and fostering private sector engagement. Additionally, enhancing access to vital services such as education and health care is crucial. By implementing comprehensive policies that prioritize population welfare, economic stability, and protection from climate effects and environmental harm, Guinea-Bissau can achieve substantial economic and social benefits.

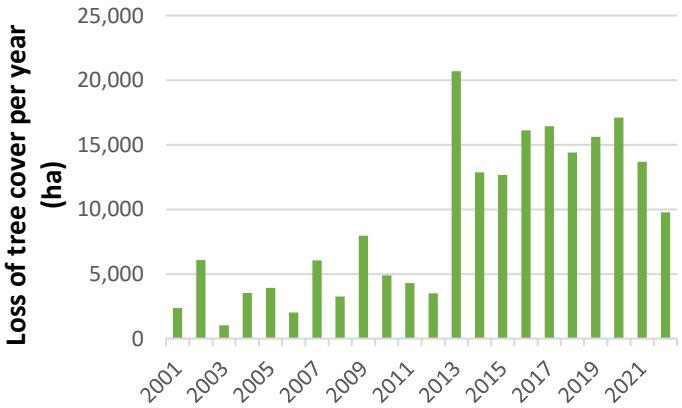
This chapter delves into essential transformations across various sectors, emphasizing the need for a unified strategy to develop sustainably, provide socioeconomic opportunities for communities, and acknowledge the obstacles of fragility and the country's limited capacity.

3.2 Adopt an integrated approach to agriculture, water, forests, and environment

3.2.1 Enhanced integrated landscape level planning for forest ecosystems

Guinea-Bissau's forests and mangroves support a rich biodiversity and provide crucial ecosystem services, including carbon sequestration, water regulation, and coastal erosion protection. Yet, as described in Chapter 1, deforestation, overexploitation, and climate change pose significant threats to the country's forest ecosystems and to the subsistence of rural communities. Tree cover has decreased by 18 percent since 2000 because of illegal logging, expansion of cashew plantations, unsustainable agricultural practices such as slash-and-burn, and the use of wood for energy (Figure 11). Despite being a signatory member of the UN Convention to Combat Desertification (which led to the Action Plan of the Fight against Drought and Desertification),[35] Guinea-Bissau continues to lag in protecting forests and promoting sustainable land use. Further, in 2022 Guinea-Bissau lifted (Decree 2022/12) the 2015 moratorium on logging.

Figure 11 Tree Cover Loss from 2001 to 2022

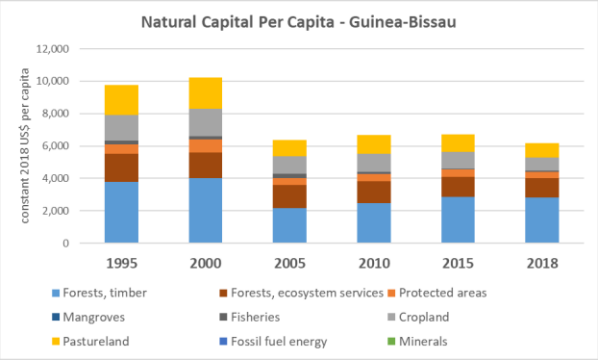


Source: Global Forest Watch[36]

[35] Ministry of Agriculture and Rural Development, Guinea-Bissau (2006). *National Action Plan of Fight against Desertification in Guinea-Bissau.*

[36]Global Forest Watch (2014). World Resources Institute https://www.globalforestwatch.org/

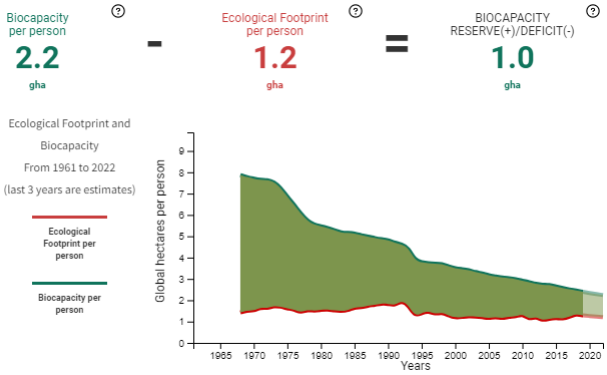
Figure 12 Evolution of Natural Capital Per Capita in Guinea-Bissau



Source: Adapted from The Changing Wealth of Nations

The total value of natural capital per capita declined by 40 percent between 2000 and 2018. The value of forests per capita, including protected areas, remains the highest and well above the average in Sub-Saharan Africa, but nevertheless declined by 31 percent from US$6,406 per capita in 2000 to US$4,413 in 2018 (Figure 12).[37]

Figure 13 Evolution of National Footprint vs. Biocapacity



Source: National Footprint and Biocapacity Accounts 2023[38]

There are four key underlying factors affecting natural asset depletion and degradation: (i) poverty and low access to markets; (ii) an incomplete legal framework for the sound management of natural resources, which also lacks enforcement due to limited human and financial resources; (iii) the maximization of economic rents captured by the elites and lack of contribution of such rents to poverty reduction and social improvement; and (iv) institutional and governance weaknesses in managing and monitoring resources, further fragilized by political instability and corruption.

Wood, charcoal, and agricultural biomass make up about 90 percent of primary energy consumption in Guinea-Bissau, while oil products and electricity account for 8 percent and 2 percent, respectively. This reflects the low access to clean fuels and technologies for cooking, estimated at about 1 percent. Elevated biomass use puts extreme pressure on forest resources, as does the illegal smuggling of wood to neighboring countries. This low access to clean fuels and technologies for cooking reflects the high poverty levels and affordability constraints, with the cost of cleaner fuels like liquefied petroleum gas more than double the monthly cost of charcoal. While the electricity subsector currently has the lowest share of primary energy consumption, the expected tendency over the next decade is for it to grow quickly to be the most-emitting subsector.

[37] World Bank (2021). *The Changing Wealth of Nations 2021: Managing Assets for the Future.* Washington, DC.
[38] Footprint Data Foundation, York University Ecological Footprint Initiative, and Global Footprint Network (2023). National Footprint and Biocapacity Accounts.

Approaches for land use are fragmented, with very limited coordination planning by authorities or through community engagement. To address those challenges:

- **Land-use plans and laws should be developed to foster opportunities for a diversified approach** to economic development. Implementing an intersectoral process of integrated land-use planning, based around the network of high-value protected areas, will relieve pressure on resources and support such an approach. There is a lack of coordination between sectoral strategies, which causes additional pressures on land-use, natural resources, and communities, in addition to underefficient development. Citizen engagement should be at the core of local development plans.
- **The protected areas network's management and financial capacity should be strengthened through the Institute for Biodiversity and Protected Areas** to preserve natural capital. Measures to relieve pressure on protected resources include accelerating the development of community development economic poles around the protected areas. This could include scaling up the integrated approach to park co-management with local communities through community engagement, which will in turn offer opportunities for green jobs.
- **Green infrastructure and nature-based solutions should be prioritized**, with priority given to mangrove ecosystem protection, to ensure sustained delivery of essential ecosystem services, including biodiversity, livelihoods, food security, fresh water, and the protection of coastal areas against climate change impacts (sea level rise, erosion, and flooding). International partnerships should be used to ensure that mangrove restoration is prioritized. Also, the value of ecosystem services should be monitored on a more regular and systematic basis, and the results should be considered in the decision-making process and in budget allocation to enable meaningful support on restoration and assisted regeneration efforts.
- **Reduction of fuelwood harvesting and use through improved cookstoves**. To accelerate access to clean cook stoves, high-level political commitment is needed to streamline the clean cooking agenda as part of broader energy access programs aligned with the energy poverty and energy efficiency agenda. This needs to be incorporated in planning, regulation, and business plans through multiple entry-points, including social protection, clean air, health, and climate change.

Guinea-Bissau is working on REDD+ initiatives. The country is aiming to establishing the necessary infrastructure and institutional framework. In the meantime, additional resources are needed to ensure proper management of the forestry sector. Guinea-Bissau developed a roadmap for REDD+ implementation for 2016–20, but never started its implementation. The recommendations from the roadmap, described in Chapter 5, remain relevant.

3.2.2 Promote climate-smart agriculture

The agricultural sector contributes 45 percent of Guinea-Bissau's GDP (primarily through cashew nut exports),[39] and is the main source of income for most of the population, with women making up most of the workforce. [40] The major economic activities are cashew nut production and rice cropping, complemented by livestock farming. The government has historically promoted cashew production,[41] which increased in area at a rate of 20 percent per year from 1986 to 1995.[42] At present, cashews occupy 34.4 percent of usable agricultural land and represent 80 percent of farmers' activities. Cashew is mainly sold as a raw product with limited processing. Other food crops include rice, maize, sorghum, millet, groundnuts, sweet potatoes, cassava, various vegetables and spices, and tropical fruits such as mangoes and bananas.

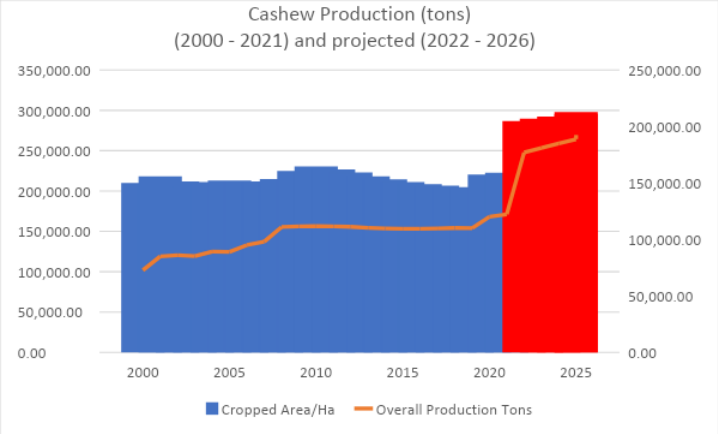
[39] IMF (2022). 'Guinea-Bissau: 2022 Article IV Consultation and Third Review under the Staff-Monitored Program; Press Release; and Statement by the Executive Director for Guinea-Bissau'. *IMF Staff Country Reports* 2022 (196). https://doi.org/10.5089/9798400213045.002.A001.

[40] FAO (2018). FAOSTAT database: http://faostat3.fao.org/download/Q/QV/E.

[41] Temudo, M. P., & Abrantes, M. (2014). 'The Cashew Frontier in Guinea-Bissau, West Africa: Changing Landscapes and Livelihoods,' *Human Ecology*, 42(2), 217–230. https://doi.org/10.1007/s10745-014-9641-0.

[42] Republic of Guinea-Bissau (2018). *Third National Communication: Report to the United Nations Framework Convention on Climate Change*.

Figure 14 Cashew Production Trend (2000–21) and Projections (2022–26)

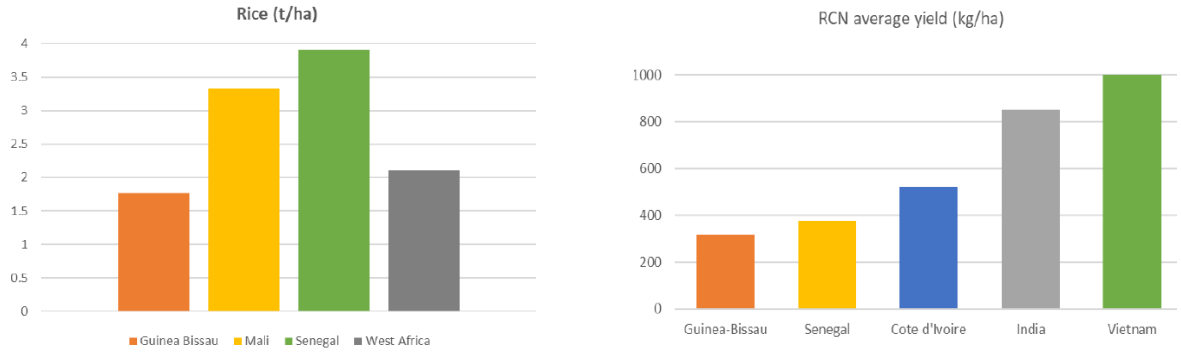


Source: FAOSTAT 2021

This heavy dependence on cashew monoculture makes smallholder farmers and the economy vulnerable to external shocks. In fact, the value of cashew nuts has dropped dramatically in recent years, with prices declining from CFAF 821 per kilogram in 2017 to just CFAF 230–260 per kilogram in 2020, putting increased strains on households' food security and the country's economy. Years with poor harvests due to climate impacts further undermine food security and farmers' coping capacity. The heavy reliance on a single crop subject to volatile markets and higher temperatures underscores the urgent need to diversify Guinea-Bissau's agricultural sector.

The country could regain self-sufficiency in rice production by expanding cultivation in suitable areas. Rice is the main stable crop and is cultivated on about 80,000 hectares, typically using traditional paddy or slash-and-burn techniques. About 45 percent of rice cultivation is on converted mangrove land, 18 percent is on small valley freshwater fields, and 37 percent is in rainfed forest and savanna ecosystems.[43] Rice could be grown on 305,000 hectares of current mangrove systems and lowlands, reducing the need to import rice, which now accounts for the largest share (22 percent between 2012 and 2016) of agricultural imports. [44] It is crucial, however, to avoid unsustainable mangrove clearance and slash-and-burn techniques and to begin using saltwater-tolerant and drought-resistant rice seeds. Meanwhile, challenges to rice production include irregular rainfall, sea flooding, runoff, and weak investment in rice production and infrastructure.

Figure 15 Comparison of Rice and Raw Cashew Nut Yields in Guinea-Bissau and Reference Countries

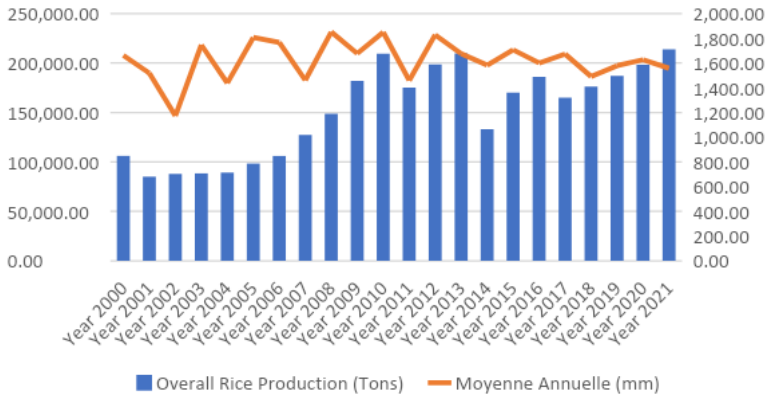


Source World Bank (2019). *Unlocking diversification to unleash agriculture growth*

[43] Steven Kyle (2015). 'Rice sector policy options in Guinea-Bissau,' working paper. Charles H. Dyson School of Applied Economics and Management Cornell University, Ithaca, New York.
[44] FAO and International Crops Research Institute for the Semi-Arid Tropics (2019). Climate-Smart Agriculture in Guinea-Bissau. *CSA Country Profiles for Africa Series*. International Center for Tropical Agriculture; International Crops Research Institute for the Semi-Arid Tropics; FAO. Rome, Italy.

Yields of both cashew nuts and rice are currently low. The average cashew nut yield in Guinea-Bissau is 320kg/ha, much lower than the 520kg/ha in Côte d'Ivoire. Similarly, the average rice yield is 1.7t/ha compared to 4t/ha in Senegal (Figure 15). Reasons for the low yields include: limited access to inputs and technology; lack of irrigation, making agriculture highly vulnerable to rainfall variability (Figure 16) and climate shocks; inadequate storage facilities, rural roads, and other infrastructure; scant capacity for agro-processing; and lack of access to finance. Financial intermediation is low, and the banking sector is hampered by high levels of non-performing loans. Despite the low yields and prices, most farmers continue to produce cashew over other crops, partly due to low labor intensity. This pattern of low inputs, low yields, and low prices undermines the sector's productivity and perpetuates poverty.

Figure 16 Rice Production Trend and Rainfall Pattern for the Period 2000–21



Source: World Bank (Climate Change Knowledge Portal, 2022); FAOSTAT 2021

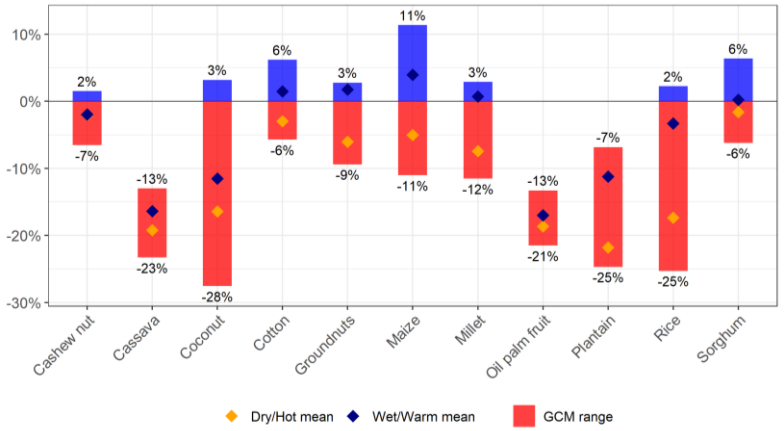
Livestock and fisheries are integral to the agricultural economy of Guinea-Bissau. Primarily consisting of 1.5 million cattle, the livestock sector contributes about 17 percent to national GDP and 32 percent to agricultural GDP.[45] However, it is susceptible to the impacts of climate change, such as droughts, which can negatively affect pastures. The fisheries sector, which accounts for 7 percent of national GDP and 13 percent of agricultural GDP, is largely based on the capture of wild fish along the coast, an area noted for its abundant fishing resources. Nevertheless, overfishing (partly due to illegal practices) has resulted in the overexploitation of nearly half of the fish stocks off the West African coast,[46] with inadequate monitoring of these activities. Rising sea levels and increasing water temperatures also threaten to diminish fish availability, adding economic pressure on coastal communities.

Guinea-Bissau's food system is likely to face increased pressure as the population is expected to double by 2050 and temperatures are projected to rise by more than 3 °C by 2075 under the RCP8.5 scenario.[47] These trends will exacerbate the existing issues within the food system, which include a lack of diversity and affordability, limited access to nutrient-dense foods, the necessity to import rice, and the diversion of locally caught fish to the export market. The population already experiences high rates of stunting, wasting, and micronutrient deficiencies, particularly among young children, women, and adolescent girls.[48] The effects of climate change will pose additional challenges to these problems.

Changes in precipitation patterns could reduce water resources for rainfed agriculture, while temperature increases may decrease the suitability and productivity of crops, further impacting overall water resource availability. The impacts on crop yields are expected to vary significantly, with coconut, plantain, and cassava being among the most affected and potentially experiencing up to a 31 percent yield loss due to dry and hot conditions. On average, a 12 percent reduction in crop yields is projected across all crops from 2040 to 2050 in the most pessimistic scenario (Figure 17), additional details can be found in the annexes).

[45] United Nations (2020). UN Common Country Analysis, Guinea-Bissau.
[46] Intchama, J. F., Belhabib, D., & Tomás Jumpe, R. J. (2018). 'Assessing Guinea-Bissau's legal and illegal unreported and unregulated fisheries and the surveillance efforts to tackle them.' *Frontiers in Marine Science,* 5. https://doi.org/10.3389/fmars.2018.00079.
[47] United Nations (2020). UN Common Country Analysis, Guinea-Bissau.
[48] Ministry of Health Guinea-Bissau and World Food Programme (2021). Fill the Nutrient Gap, Guinea-Bissau

Figure 17 Projected Changes in Yields by 2041–50 Due to Precipitation Changes, by Crop



Source: World Bank staff estimations and Industrial Economics, Incorporated

To effectively address the challenges, Guinea-Bissau must diversify its agricultural sector beyond the predominant cashew monoculture, modernize its farming practices, and increase values with in-country transformation of the raw products. Along with national and international consumption trends, the country's climate and geographic location provide opportunities to enhance the production of nutritious food crops such as fruits, vegetables, nuts, legumes, indigenous grains, and animal source foods. This diversification can lead to increased agricultural productivity, improved food security, reduced environmental impacts, and better livelihoods for farmers. Other critical steps include: providing small-scale farmers with access to credit and financing; developing markets for new crops; adopting agroforestry practices; boosting local production and seed distribution; investing in irrigation and drainage infrastructure; and strengthening agricultural research. It is also vital to value farmers' knowledge, learn from their traditions and experiences, and invest in their training. Approaches should be bottom-up, with activities implemented in the field. These actions would not only make the agricultural sectors more resilient and productive, but also provide more and better socioeconomic opportunities for rural populations, which have the highest portion of poor. Additionally, implementing social protection measures, targeted nutritional programs, and home-grown school feeding initiatives can improve nutritional levels and combat food insecurity.

Potential private sector contribution to sustainable agriculture

International private investors can play a pivotal role in modernizing farming practices, introducing advanced technologies, and creating sustainable supply chains, as the sector is currently dominated by smallholder farmers, with most agricultural production taking place on small plots of land. Moreover, investment in organic and fair-trade certification of cashews is increasingly in demand globally, and this presents an opportunity for Guinea-Bissau to tap into this growing market. Organic and fair-trade certification requires sustainable and socially responsible production practices, which can help support local communities and protect the environment.

Key policy bottlenecks to be addressed that inhibit private sector participation in sustainable agriculture practices include the following. This situation is compounded by strong elite competition for rents and a weak public administration.

1. **Lack of adequate infrastructure (transport, telecommunications, and digital):** The inadequate infrastructure in Guinea-Bissau, particularly in rural areas, poses a significant challenge to private sector investment in agriculture. Poor road networks and limited access to water and energy make it difficult for farmers to access markets and the necessary agricultural inputs. The persistent absence of these key public goods and services—through direct public investments or effective public-private partnerships (PPP)—severely limits the ability of private firms to invest and of poor households to participate in economic activity, either through more productive autonomous activities or by accessing the job opportunities that could be generated by a thriving private sector.

2. **Energy infrastructure** is underdeveloped, hindering the country's ability to meet its population's growing demands. Electricity is both scarce and very costly, making it among the most expensive in the African continent at present.
3. **Weak business environment**: The Heritage Foundation's business freedom indicator fell from 36.9/100 to 31.5/100 in 2021 and 2022, respectively, compared to a world average of 60.3/100. Access to land is a particularly big challenge, especially in terms of land tenure and property rights. Additionally, the lack of a robust legal and regulatory framework makes it difficult for investors to navigate the regulatory environment and secure the necessary permits and licenses.
4. **Limited access to finance:** Limited access to finance is a significant constraint to private sector investment in agriculture in Guinea-Bissau. The high risk associated with agricultural investments and the limited availability of credit discourages investment in new technologies, equipment, and infrastructure.

Way forward:

To address these constraints and promote private sector investment, targeted investments in rural infrastructure should be prioritized along with policies to improve the investment climate and targeted lending programs for small and medium-sized enterprises in the agricultural sector. By addressing these constraints, private sector investment in agriculture could contribute to both adaptation and mitigation efforts by promoting sustainable agricultural practices, reducing GHG emissions, and increasing the resilience of farmers and the agricultural sector to climate change. Guinea-Bissau also needs to invest in renewable energy technologies to leverage the agribusiness sector. Solar-powered irrigation systems can help to reduce the sector's dependence on fossil fuels and expand access to energy for farmers.

3.2.3 Improve reliability and quality of water delivery and wastewater management.

Protecting, managing, and monitoring water resources is crucial for safeguarding agriculture and domestic water consumption. The nation's water resources encompass the Gêba-Kayanga and Koliba Corubal Rivers, shared with Senegal and Guinea, respectively, along with their tributaries, various aquifers, wetlands, and lagoons. Among other protected areas, the Bolama-Bijagós Archipelago and Biosphere Reserve is vital for providing fresh surface water for agriculture and domestic use. Guinea-Bissau is estimated to have 14.3 billion cubic meters of surface water resources and 1.76 billion cubic meters of groundwater resources.[49] Despite receiving abundant rainfall (with 1,500 to 2,000 mm annually on the coast), the country faces droughts from December to April, and its water storage infrastructure is underdeveloped.

Effective water management is essential to mitigate contamination risks and enhance crop production amid the challenges of a variable and changing climate. However, groundwater resources are not adequately monitored or documented, underscoring the need for improved water management.

Strategies to enhance water management include investments in irrigation systems, rainwater harvesting, and water storage facilities. A comprehensive national water security approach would improve sector coordination and the capacity of the General Directorate of Water Resources to govern the water sector more effectively. Transboundary cooperation with neighboring countries is also vital to address growing water demands. Other important measures include implementing rainwater harvesting systems at homes, schools, and health facilities; developing regulations for sustainable water use; installing improved drainage systems; transitioning to salt-tolerant crop varieties; and enhancing the monitoring of groundwater resources, including the transboundary Maastrichtian aquifer.

In both urban and rural areas, there is an urgent need for safe water and basic sanitation. Key reforms include updating the Water Code, creating a more effective legal and regulatory framework for urban water supply services, and exploring a tariff structure that ensures cost recovery for the urban water utility (*Eletricidade e Águas da Guiné-Bissau* – EAGB) while improving water supply, sanitation, and hygiene (WASH).

[49] World Bank (2021). *Guinea-Bissau Evaluation du Secteur de l'Eau et de l'Assainissement, from* World Bank. World Development Indicators 2020 data.

Significant investments are necessary to expand WASH services in Bissau, secondary cities, and rural areas, including in schools and health facilities. The private sector could play a role in this expansion. Investments are needed in water treatment facilities and distribution networks to provide spare parts for rural water infrastructure and enhance repair capacities. Financing could come from PPPs or through the mobilization of private sector partners. Standardizing hand pumping systems and developing or updating water and sanitation master plans are also important. In Bissau, poor sanitation threatens environmental pollution and aquifer contamination. The city should consider how to improve fecal sludge management, construct a sewage treatment plant, monitor aquifers for contamination, and engage the private sector in building septic tanks and managing fecal sludge transport and disposal.

Table 5 Proposed Actions for the Environment, Agriculture, and Water with Some Costs Estimated (Based on Available Data)

Activities	Priority (for climate agenda)	Time frame	Complexity	Potential for private sector	Adaptation / mitigation	Estimated cost (in 2023 US$, millions)
Enhance institutional capacities for monitoring and reporting on the states of forests	Very high	ST	+		Both	3.8
Support the management of protected areas	Very high	ST	+		Both	5.7 (ST)
Promote more productive, agro-ecological cultivation techniques, with the development of extension services and digital advisory services	Very high	ST	+	Yes	Both	9.4 (ST)
Expand and develop innovative irrigation and drainage solutions	Very high	ST-MT	+	Yes	Adaptation	27.5 (ST-MT)
Develop selected, more climate-resilient species and improve value chains to diversify agriculture	Very high	ST	+	Yes	Adaptation	9.4 (ST)
Develop a water resource management plan to enhance sector and multi-stakeholder collaboration, agricultural productivity, and equitable access to clean water	High	ST	++		Adaptation	0.9
Map groundwater resources, including the transboundary Maastrichtian aquifer, and rehabilitate its monitoring system; conduct chemical and bacteriological analysis of aquifers	High	ST	++		Adaptation	2.8
Scale up community-level natural resources management committees and plans	Medium	MT	++		Both	1.3
Develop land-use plans with designated areas for conservation, logging, agriculture, and other land uses and associated integrated landscape management strategies	High	MT	++		Both	2.6
Support access to credit and financing options for farmers, including during climate shocks	High	MT-LT	++	Yes	Adaptation	16.3
Adapt the Water Code to current needs; control public water service operators; and ensure efficient oversight of public water	Medium	MT	++		Adaptation	0.9
Invest in WASH installations in schools, hospitals, health centers, businesses, and public infrastructures	Medium	MT	++	Yes	Adaptation	29.3
Assess and suggest reform to land tenure to encourage local communities and farmers to adopt natural regeneration and land restoration and engage in agro-forestry practices	High	LT	+++		Both	1.6

3.3 Turn around the electricity sector based on cleaner and cheaper sources

3.3.1 A fragile energy sector

Guinea-Bissau possesses considerable potential for renewable energy, yet this potential is largely underutilized. The country's primary renewable resource is solar energy. While biomass and hydroelectric power offer some prospects, their viability is somewhat constrained and subject to the vagaries of climate change. Despite significant cost reductions in solar photovoltaic (PV) and battery storage technologies over the past decade, the EAGB-managed national grid has yet to integrate any renewable energy capacity. Currently, solar energy is deployed on a small scale to power remote villages and for individual household systems on rooftops.[50]

The cost of electricity supply in Guinea-Bissau is notably high, primarily due to the reliance on imported HFO, which is expensive. The electricity sector depends on a 34MW HFO power barge, Karpower, which does not meet the country's estimated unsuppressed demand of about 63MW. The necessity to import fuel for the barges exposes the sector to oil price volatility and results in high generation costs, sometimes reaching US$0.25/kWh. Consequently, Guinea-Bissau has one of the highest electricity prices in West Africa, with an average end-user tariff of US$0.22/kWh, which is above the regional average of US$0.18/kWh, despite the country's low per capita GDP of US$775.8. This situation renders electricity unaffordable for many households and businesses.

The performance of the national water and power utility, the EAGB, is poor both financially and operationally, exacerbating high electricity costs. The EAGB struggles to recover its cost of service due to high generation costs, operational inefficiencies, and tariffs that are below the cost recovery level, despite being higher than the continental average. The sector is estimated to have aggregate technical and commercial losses of 37 percent, which is three times the norm, and a bill collection rate of only 65 percent. In 2021, the EAGB's electricity sales were approximately 90 GWh, compared to a net electricity generation of about 130 GWh.

Since 2017, the government of Guinea-Bissau initiated an action plan to expand electricity access and scale up renewable energy deployment. This includes the SE4All Action Agenda and Investment Plan, which outlines the country's roadmap for achieving Sustainable Development Goal 7; the National Action Plan for Renewable Energy in Guinea-Bissau, which sets a target of 75 percent renewable energy in the generation mix by 2030; the National Action Plan for Energy Efficiency in Guinea-Bissau, which promotes energy conservation across various sectors; and the Master Plan for Energy and Infrastructure Development for Electricity Generation (2020), prepared with World Bank support. Plans are in place for several solar PV power generation projects, including a 20MW project in Bor/Gardette, and 1MW projects in both Gabu and Cachungo. If pursued through a conventional independent power producer model, the success of these projects could be impacted by existing offtaker and network risks. To develop solar PV resources on a larger scale, the country will require an improved policy and regulatory environment, risk mitigation to minimize offtaker risks, and enhanced procurement and planning capacity.

This already-fragile situation is exacerbated by the dependence on imported fuel prices and by the increasing impacts of climate-related events. Guinea-Bissau's transport and electricity sectors are entirely reliant on imported fossil fuels, with the energy mix in the power sector currently 100 percent HFO-based. Consequently, the high level of public subsidies to these sectors is directly tied to international oil price volatility. Moreover, increasing power grid outages are associated with flooding, coastal erosion, and other climate-related events, which underscores the growing importance of the power system’s resilience to climate events for the reliability of electricity supply in the country. On the supply side, higher rainfall seasonality could impact the power sector in the future. Although Guinea-Bissau does not have significant hydroelectric potential, it is poised to import hydropower from neighboring countries.

Due to its critical role in the country’s sustainable development, the energy sector has substantial donor support with several infrastructure projects under construction that should play a pivotal role in helping to

[50] The use of PV and battery storage for power backup is increasing in Bissau, due to the comparative advantage of this solution when compared with backup diesel gensets.

reduce the cost of electricity, improve service quality, and transition toward greener electricity. Among these projects are: (i) the *Organisation pour la Mise en Valeur du Fleuve Gambie* (OMVG) project, financed by several donors (including the World Bank), which is expected to be finalized by 2024 to provide Guinea-Bissau with access to cheap imported hydroelectricity; (ii) the Bissau City Power Supply Improvement Project, funded by the African Development Bank, which is completing the transmission lines enabling electricity import from the OMVG; (iii) the World Bank-financed Economic Community of West African States Regional Electricity Access Project, which will extend the grid to connect 66 localities in Guinea-Bissau's rural areas; and (iv) the 14 Localities Project, financed by the West African Development Bank, to electrify the most populated cities outside of Bissau.

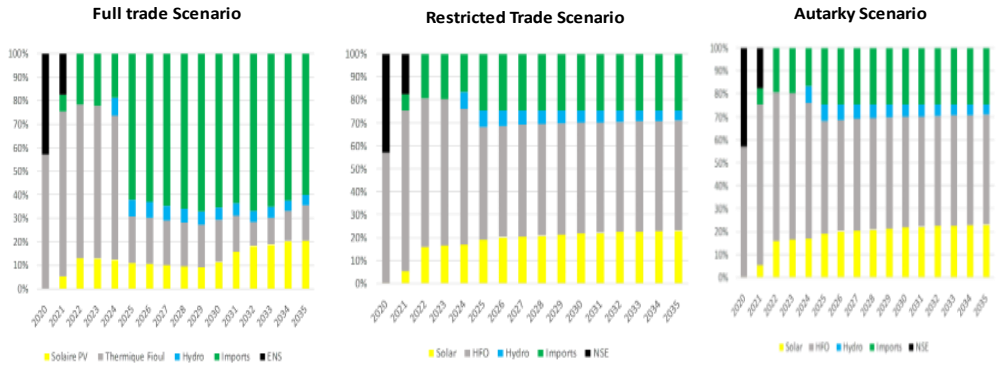
3.3.2 Approach the scale-up of clean energy differently

Developing renewable energy and power trade is an essential strategy for addressing power demand and reducing energy costs in Guinea-Bissau, as indicated by the Least-Cost Generation Plan (LCGP) that extends to 2035. Finalized in 2020, the LCGP provides guidance for system expansion and investment in the electricity sector. It forecasts an electricity generation mix that includes domestic solar PV with storage, hydropower, thermal power plants, and imports, with an objective of reaching an 80 percent access rate by 2030. The LCGP delineates three principal scenarios: "full autarky," "restricted power trade," and "unrestricted power trade" (Figure 18).

- The **"full autarky" scenario** anticipates Guinea-Bissau phasing out electricity imports to achieve self-sufficiency, with domestic generation from solar PV with battery energy storage systems, hydropower, and HFO-powered thermal plants projected to account for 70 percent of electricity generation by 2035.
- In the **"restricted trade" scenario**, imports are limited to a maximum of 25 percent to supplement domestic generation. In this scenario, HFO-powered thermal power plants would provide nearly half of the generation needs, while solar with battery energy storage systems and domestic hydropower would each be expected to meet 25 percent of the power requirements.
- **The "unrestricted power trade"** scenario removes any limitations on power imports, which would then fulfill approximately 60 percent of electricity demand, comprising 55 percent hydropower and 45 percent gas-fueled power from Senegal. In this scenario, 35 percent of demand would be met with hydropower from Guinea (35MW) and Senegal (18MW), raising the share of renewables in the generation mix to about 55 percent under a low demand forecast and around 30 percent under a high demand forecast.

In the short term, if power imports from the OMVG replace HFO generation, the monthly cost of power purchased would decrease from US$3 million to less than US$1.5 million and power generation would be 100 percent renewable energy. The drastic energy cost reduction would significantly improve the sector's financial sustainability and ideally bring down the electricity tariff. An electricity tariff study/strategy is planned under the Solar Energy Scale-Up and Access Project to identify a roadmap to revise electricity tariffs in line with changing sector circumstances, notably the phasing out of HFO-based generation.

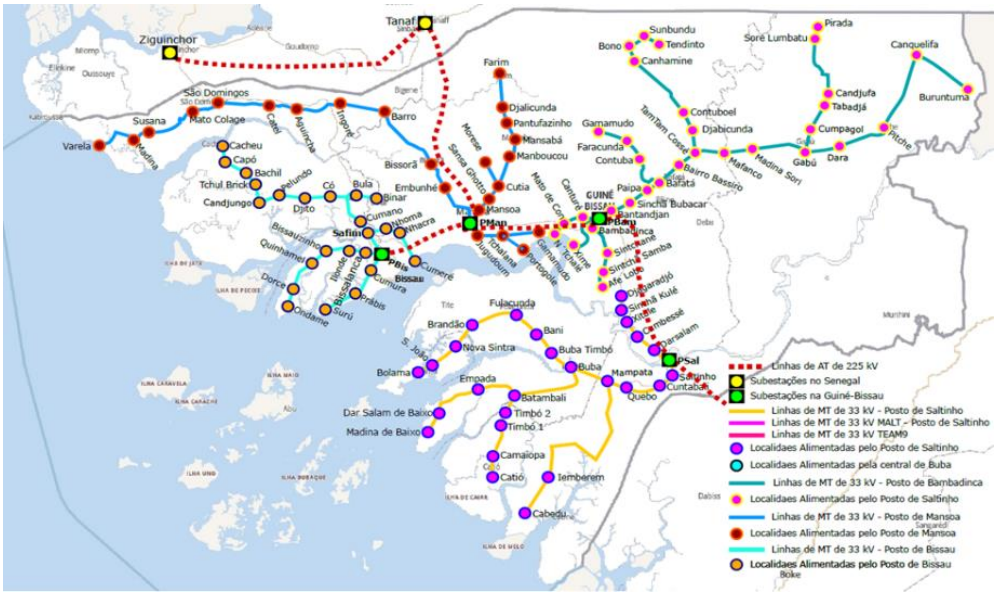
Figure 18 Results of Least-Cost Generation Plan



Energy imports will be the cornerstone of meeting GHG emission targets in Guinea-Bissau. Across all three LCGP scenarios, the deployment of solar PV plants is constant but the share of thermal power plants in the generation mix is directly dependent on the import and demand levels. The completion and operationalization of the OMVG interconnector will enable power imports to Guinea-Bissau from Guinea and Senegal, which is expected to increase the share of renewables in the generation mix significantly and lower energy costs in the country, with positive economy-wide spillover effects. While recent political instability and geopolitical challenges in the region have heightened energy security concerns (especially among net-importers), power trade remains a critical option for countries such as Guinea-Bissau.

Trade arrangements between Guinea-Bissau and its neighboring countries are advancing, building on the substantial progress made in the creation of the West Africa Power Pool and regional power market. A notable achievement is the signing of a power purchase agreement in December 2019 between the EAGB and Electricité de Guinée (Guinea's electricity utility) for 167 GWh of power annually. Recent discussions between the government of Guinea-Bissau and Electricité de Guinée indicate the possibility to increase annual contracted energy.

Figure 19 Planned Energy Grid Investments



Guinea-Bissau's energy sector faces several challenges in its transition to a decarbonized and resilient power system. Addressing these challenges is crucial for a successful energy transition.

a) The country needs an integrated energy policy that includes a mandate to phase out HFO-based generation and sets clear targets and timelines for renewable energy development and energy efficiency, in line with the LCGP. Decommissioning existing HFO power barges promptly will facilitate the importation of more affordable and cleaner electricity from Senegal and Guinea. The policy should also establish explicit renewable energy deployment goals and incorporate energy efficiency as a key component to manage demand and increase the share of renewables in the energy mix.

b) Policy and institutional reforms are necessary to encourage private sector involvement in renewable energy development. Accelerating the deployment of solar PV with storage and other renewable sources requires a comprehensive approach, including: (i) a regulatory framework for renewable energy standards; (ii) PPP frameworks; (iii) competitive procurement for private projects; and (iv) end-user subsidies to improve service affordability. Policies should also promote access expansion through mini-grid and off-grid solutions, the development of grid codes, fiscal incentives for importing renewable energy equipment, and potentially designating a public entity to oversee renewable energy development. Financing options should encompass instruments to de-risk projects, such as site screening, transaction advisory services, and climate and concessional financing.

c) As part of the LCGP, the national electrification strategy should outline least-cost, low-carbon pathways to expand electricity access. This includes grid-based electrification where feasible and off-grid solutions using clean energy in areas where grid extension is not cost-effective.

d) Least-cost planning and modernization of the power network are essential. The power grid's development should align with the LCGP and consider curtailment risks to maintain system stability with increased variable renewable energy penetration.

e) Improving the corporate governance and operational performance of the EAGB is vital for the power sector's development and sustainability. A comprehensive plan to enhance governance, management capacity, and investments to reduce technical and commercial losses is needed. This may involve deploying smart meters for large consumers, installing prepaid meters to improve bill collection, and establishing payment plans for public sector customers to settle arrears and prevent further accumulation.

f) Compliance with regional power market regulations and enforcement of payment discipline is expected. The upcoming Grid and Market Code will define operational practices and rules for the West Africa Power Pool market, including pricing methodologies for power transmission services. Guinea-Bissau must comply with the code's requirements, enforce regional rules, adapt to regional standards for network synchronization, and improve payment discipline for power imports. This could involve measures like ring-fencing electricity sales, setting up an escrow account, and implementing cash-waterfall mechanisms prioritizing import payments.

g) Climate resilience and adaptation must be explicitly integrated into national energy policies. Given Guinea-Bissau's high vulnerability to climate change, these considerations should be central to the sector's development and infrastructure design.

Opportunity for private sector in energy

Private investment in renewable energy sources, such as solar and wind power, presents a promising avenue for addressing this challenge.

Investors can leverage Guinea-Bissau's abundant sunlight and consistent wind patterns to establish solar and wind farms. The government has shown commitment to promoting renewable energy, offering incentives and creating a conducive regulatory environment. Private companies can contribute to electrifying rural areas, powering agricultural initiatives, and supporting industrial growth. Moreover, investing in energy-efficient technologies can reduce the nation's carbon footprint and contribute to global climate change mitigation efforts. Additionally, in the energy sector, incorporating climate-resilient technologies such as energy storage solutions can enhance power supply reliability and stability in the face of climate-induced challenges.

Private investment in renewable energy infrastructure is a key avenue for development in Guinea-Bissau. Given the country's abundant natural resources, solar and wind energy projects have immense potential. Investors can establish solar and wind farms, providing clean and affordable energy to both urban and rural areas. This not only addresses the energy deficit but also contributes to environmental sustainability.

Rural areas in Guinea-Bissau often lack access to electricity. Private investors can focus on developing mini-grids powered by renewable sources, ensuring that even remote communities have reliable access to energy. Beyond just electricity provision, this initiative can stimulate economic activities, improve health care services, and enhance overall living standards, fostering social inclusion by narrowing the urban-rural energy divide.

Table 6 Proposed Actions for the Energy Sector with Some Costs Estimated (Based on Available Data)

Activities	Priority (for climate agenda)	Time frame	Complexity	Potential for private contribution	Adaptation / mitigation	Estimated cost (in 2023 US$, millions)
Least-cost electrification plan, with associated business plan and strategy for market engagement	**Very high**	**ST**	**+**		**Both**	**2.8**
Power grid climate resilience analysis	**Very high**	**ST**	**+**		**Adaptation**	**0.9**
Institutional and policy strengthening for clean energy enablement; creation of a renewable energy asset management entity	**Very high**	**ST**	**++**		**Mitigation**	**4.7**
Clean energy development for basic services (health, education, communications, security)	**Very high**	**ST**	**++**	**Yes**	**Both**	**47.1**
Public infrastructure investment: grid resilience	**Very high**	**ST**	**++**	**Yes**	**Adaptation**	**27.5**
Energy transition stakeholders analysis	High	ST	+++		Both	0.5
Public pilot solar PV and battery storage 10 MW plant	High	MT	++	Yes	Mitigation	20.0
Commercial and industrial credit line for rooftop PV and energy efficiency	High	LT	++	Yes	Mitigation	16.2
Clean energy capacity strengthening and vocational training	High	LT	+		Mitigation	4.1

3.4 Build sustainable communities and infrastructure systems

3.4.1 Improve urban development

Guinea-Bissau's capital Bissau faces significant challenges with low-quality housing and public infrastructure, which heightens the vulnerability of its residents and critical facilities to flooding. This is exacerbated by heavy rainfall, high tides, and storm surges. Neighborhoods such as Cuntum Madina, Quelelé, Bolola, Bissak, and Empantchá are already severely affected by flooding, disrupting daily life and posing risks to administration buildings, educational institutions, health care centers, factories, energy installations, telecommunication networks, roads, and transportation hubs. During the rainy season, flooding renders many city arteries impassable, leading to community isolation. Projections indicate that by 2100, approximately 30 percent of Bissau's population could face devastating impacts from flooding.[51]

The increasing flood risks are attributed to several factors, including unchecked urbanization, the absence of effective urban planning, waste accumulation in drains and urban streams, and the mismanagement and poor operation of coastal infrastructure. Population growth in Guinea-Bissau's flood-prone areas is outstripping that in safer regions. The annual average growth rate is higher in areas with a high hazard of flooding (10-year return period) compared to those with a lower risk (100-year return period). This trend is particularly noticeable in urban centers, where the limited availability of suitable land restricts options for the poorer residents (Figure 20 and Figure 21).

Figure 20 Guinea-Bissau Population Exposed to Flooding

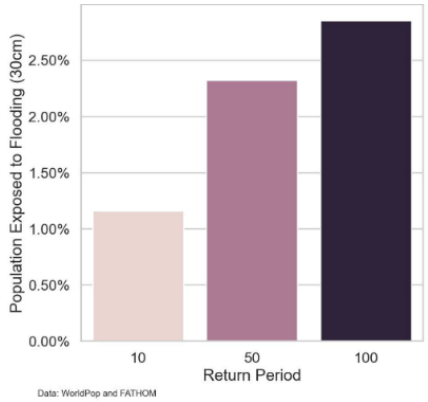
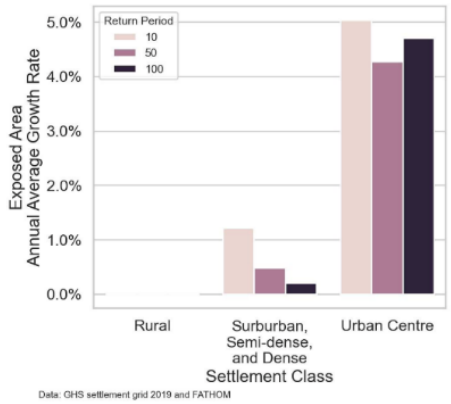


Figure 21 Guinea-Bissau Flood Exposure Growth Rate (2000–15)



To mitigate these risks, it is crucial to develop and implement comprehensive urban plans that integrate flood risk scenarios, thereby preventing construction in flood-prone zones. Additionally, there is significant potential for utilizing "green" infrastructure, such as parks designed to capture stormwater, known as nature-based solutions. Wetland preservation and restoration would also serve as a natural buffer, absorbing excess water and reducing the impact of floods.

3.4.2 Improve road designs and management of transport assets

Guinea-Bissau's transportation infrastructure is heavily dependent on its road network, since the country lacks railway systems. Over 96 percent of all travel within the nation is conducted via roads. However, the condition of these roads is a cause for concern; they are often poorly maintained, inadequate for the volume of traffic, and sometimes completely impassable. Among the five main national roads, the N3 is noted for its particularly poor condition,[52] while the N4 is little more than a track. The situation is exacerbated in the western part of Bambadinca in the Bafatá region and in the northern areas along the Cachéu and Gêba

[51] Morto Baiém Fande (2020). 'Alterações climáticas e comunidades costeiras: avaliação de risco e adaptação à erosão e inundação costeira em cenários de elevação do nível do mar na Guiné-Bissau,' doctoral thesis, Lisbon: University of Lisbon, p. 91.

[52] As part of the Guinea-Bissau-Rural Transport Project (P161923), approximately 110 km of unpaved trunk roads and connecting feeder roads in rural areas of the Cacheu and Oio regions. between the towns of Ingoré, Bigene, and Farim in Northern Guinea-Bissau, will be improved.

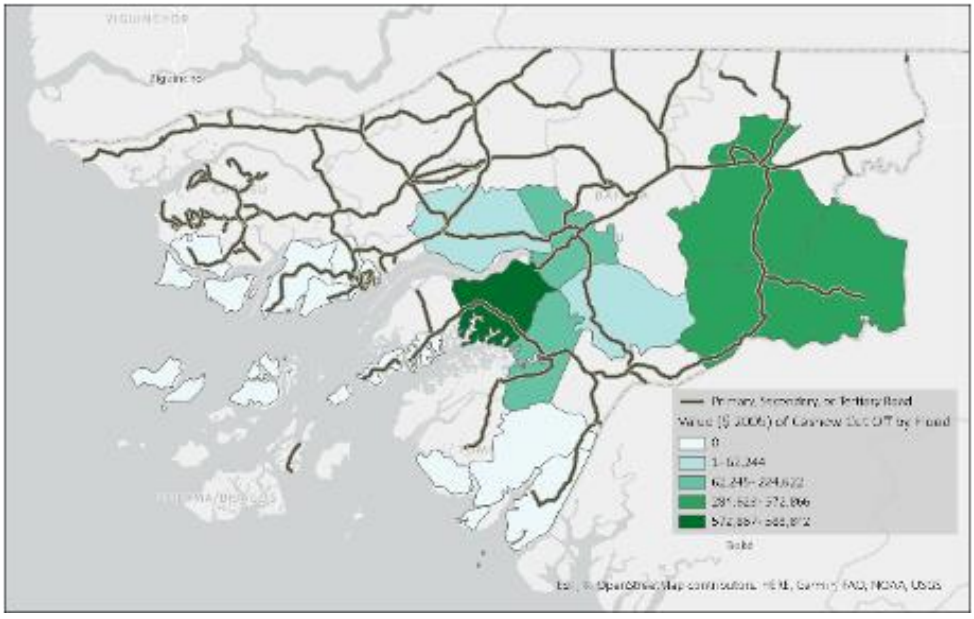
rivers, which are highly susceptible to flooding. This vulnerability of the road network has significant economic implications, particularly for the cashew nut trade, which is a major export for Guinea-Bissau. The bulk of this trade is channeled through the N1, N2, and N5 corridors, as depicted in Figure 22. These routes are crucial for the transport of cashew nuts and are negatively impacted by adverse weather conditions, which can disrupt the flow of goods and affect the country's economy.

Figure 22 Primary and Secondary Road Network in Guinea-Bissau

Guinea-Bissau's transportation sector endures a range of challenges and limitations. Water transport is limited, with traditional dugout canoes still in operation, and the main port of Bissau is hampered by issues such as channel silting and berthing constraints, which are likely to worsen with climate change and rising sea levels. The airport in Bissau is also not adequately equipped to handle increased air traffic.

These transportation inefficiencies are estimated to cause annual losses of around US$22 million related to the transport of cashew nuts for export alone. Approximately US$10 million worth of cashews—equating to 12 percent of total production value—fail to reach the port of Bissau due to inadequate road infrastructure. Additionally, cashews valued at US$5 million are at risk of being cut off by expected annual floods (Figure 23). Improving the transportation infrastructure is thus vital for Guinea-Bissau's economic growth and prosperity.

Figure 23 Value of Cut-Off Cashew Production (Value in 2005 US$)



Source: Author's estimates

Guinea-Bissau is anticipated to experience increased damage to its infrastructure due to climate change between 2031 and 2050, with the most severe impacts likely under scenarios of higher precipitation and temperatures, particularly from flooding. The estimated damage could reach up to US$13,500 per kilometer. Annually, the additional damage to roads and bridges from climate change is expected to cost between US$20 million and US$25 million. Furthermore, climate change is likely to cause significant travel delays, potentially totaling up to 13.5 million hours, especially under wet and warm conditions.

To improve the climate resilience of its transport infrastructure and reduce economic losses, Guinea-Bissau needs to make targeted investments to strengthen its road transportation systems. Critical actions include: (i) conducting a comprehensive assessment of the current road and bridge infrastructure, taking into account its condition, exposure, and vulnerability; (ii) creating a detailed database of road assets and their exposure risks; and (iii) developing methodologies for predicting risks to roads and bridges. These assessments will inform the revision of technical specifications, design guidelines, and maintenance protocols to enhance infrastructure resilience throughout their entire lifecycles, including design, material selection, and maintenance.

3.4.3 Support the adaptation of coastal communities

Guinea-Bissau's coastal areas are already facing the detrimental impacts of global sea level rise, with increased flooding and saltwater intrusion affecting livelihoods. [53] The legal, policy, and administrative frameworks in place for coastal zone management are insufficient, lacking an integrated and coordinated approach to effectively manage climate-related risks and impacts. These frameworks do not adequately consider the specific vulnerabilities of the coastal zone, and coastal zone planning is not effectively utilized as a governance mechanism. This makes the implementation of integrated coastal zone management or other strategies to reduce climate risks challenging. There is also a lack of comprehensive understanding of how climate change will affect the coastal economy, and coordination among relevant agencies and actors is poor.

Guinea-Bissau lacks a comprehensive coastal protection and investment strategy. Most coastal infrastructure, including fishery wharfs, bridges, roads, coastal hotels, and public buildings, suffers from a lack of maintenance and designs that do not account for the impacts of climate change, making them increasingly vulnerable to impacts such as sea level rise and higher storm surges.

Moreover, there is a critical shortage of scientific and technical information and capacity needed to identify, plan, design, assess, prioritize, implement, and monitor economically important coastal protection options. The country's network of meteorological stations was destroyed during the 1998–99 political-military conflict and has not been rebuilt. Consequently, critical information and data on coastal processes, such as sea level rise projections and meteorological conditions, have not been collected for almost two decades. This lack of data makes it very difficult for national agencies to set priorities and develop effective policies.

In addition, the potential of coastal ecosystems to help communities adapt to climate change is not being fully realized. For example, mangroves are one of the most cost-effective solutions for reducing coastal disaster risks, while also functioning as a carbon sink. Mangroves cover 9 percent of the territory in Guinea-Bissau, the highest proportion of mangroves of any country in the world. They play a vital role in sustaining the livelihoods of coastal communities by hosting a vast number of species, reducing erosion, and providing protection from storms and flooding. Yet, mangroves have declined in Guinea-Bissau by 32 percent over the past 80 years, and the country currently lacks policies and regulations for their sustainable protection and management or for other forms of ecosystem restoration. In developing such strategies, it is essential to identify community needs and engage community members.

[53] NDC Update (2022), Adaptation, p. 53.

Table 7 Proposed Actions for Urban Areas and Infrastructures with Some Costs Estimated (Based on Available Data)

Activities	Priority (for climate agenda)	Time frame	Complexity	Potential for private contribution	Adaptation / mitigation	Estimated cost (2023 US$, millions)
Strengthen the legal, policy, and institutional framework related to urban development and the preparation and enforcement of adequate urban planning instruments, which also address climate change and variability	High	ST	++		Adaptation	1.9
Develop technical specifications/designs for roads, drainage, bridges, and transport infrastructure to take into account resilience and climate impacts based on climate data	High	ST	+	Yes	Adaptation	2.8
Adopt a national transport and logistics strategy taking into consideration climate change	Medium	ST	++		Both	0.9
Protect and restore coastal ecosystems such as mangroves and wetlands as a cost-effective option to act as natural barrier to environmental risks and contribute to carbon sequestration	High	ST-MT	+		Both	13.7
Improve road infrastructures, prioritizing the N1, N2, and N5 corridors	High	ST-MT	++		Adaptation	366.2
Invest in stormwater drainage infrastructure and climate-resilient urban services	High	MT	+++		Adaptation	43.1
Foster PPPs and private sector partnerships for road and bridge maintenance and solutions	Medium	MT-LT	+++	Yes	Adaptation	122
Develop a pipeline of infrastructure investments projects	Medium	MT	++		Both	4.3
Strengthen governance structure for integrated coastal zone management, including with monitoring system	Medium	MT	+++		Adaptation	1.3

3.5 Protect the population by boosting the disaster risk management system and the human capital

3.5.1 Disaster risk management

Since 2010, under the Sendai Framework, Guinea-Bissau has been proactive in developing its disaster risk reduction (DRR)/disaster risk management capabilities. This has resulted in the formulation of the National Strategy for Catastrophe Risk Reduction and the establishment of the National Service for Civil Protection.[54] Despite these efforts, the strategy and service have not been updated, and government engagement in these initiatives is minimal. Aligning with the Sendai Framework for Disaster Risk Reduction 2015–2030 by adopting a national DRR strategy is essential to address the current lack of DRR legislation and formal frameworks in Guinea-Bissau.

The country's ability to make climate-responsive decisions is significantly hindered by the lack or absence of climate and weather information, forecasts, and analyses. Guinea-Bissau does not have climate information systems in place, and investment in weather stations and rain gauges is lacking. These tools are vital for quantifying and predicting weather and climate-related events. The importance of such information is growing as the country experiences more frequent and unpredictable heavy rains, which have detrimental effects on crop yields, cashew harvesting, infrastructure integrity, and housing security. The absence of an EWS greatly impedes informed decision-making regarding climate-related issues and hampers disaster prevention and management.

3.5.2 Advance adaptive health and social protection system

Climate change intensifies the spread of infectious diseases, including those transmitted through water and vectors. Guinea-Bissau's already-fragile health care system faces difficulties in effectively managing disease outbreaks, which disproportionately affect women and children. Currently, health care access is a significant barrier, with 60 percent of the population residing more than five kilometers from a health facility.[55] This hinders the response to diseases such as diarrhea, lower respiratory tract infections, cholera,[56] and malaria.[57] The escalation of climate change is expected to amplify these health challenges or spread them across larger geographical areas.[58]

Moreover, climate change poses a threat to food and nutrition security directly via floods, droughts, heat stress, and land degradation and indirectly through economic shocks and adverse health outcomes. In 2019, dietary diversity was low among Guinean women, with only 18 percent meeting the minimum standards, and less than 10 percent of children under two years old received an adequate diet based on all three infant and young child feeding practices. Climate change is likely to exacerbate this issue, leading to reduced calorie availability and a less nutritious diet from the crops cultivated in Guinea-Bissau.[59] The COVID-19 pandemic in 2020 further exposed Guinea-Bissau's susceptibility to external disruptions, exacerbating food insecurity and limiting access to health care and education for much of the population.[60]

As already described in the agricultural section, possible solutions include: increasing the cultivation of cereal crops such as rice, millet, and sorghum; rehabilitating degraded lands; transitioning to crops that are more resistant to extreme weather (for example, cassava); and diversifying livelihoods and income sources.

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[54] Green Climate Fund (2022). Readiness and Preparatory Support.
https://www.greenclimate.fund/sites/default/files/document/20220428-guinea-bissau.pdf.

[55] MICS 6 (2020). 'Inquérito aos Indicadores Múltiplos (MICS6) 2018–19, Relatório Final.' Bissau, Guinea-Bissau: Ministério da Economia e Finanças e Direção Geral do Plano/ Instituto Nacional de Estatística.

[56] Luquero FJ, Banga CN, Remartínez D, Palma PP, Baron E, Grais RF (2008). 'Cholera epidemic in Guinea-Bissau: the importance of "place".' PLoS One. May 4;6(5):e19005. doi: 10.1371/journal.pone.0019005. PMID: 21572530; PMCID: PMC3087718.

[57] Paulo Djata, Coordinator (2012). 'Prevalência Nacional do Paludismo na Guiné-Bissau, INASA, adaptado do Programa Nacional de Luta contra o Paludismo (Plano Estratégico Nacional de Seguimento e Avaliação 2013–17).'

[58] Ryan SJ, Lippi CA, Zermoglio F. (2020). Shifting transmission risk for malaria in Africa with climate change: a framework for planning and intervention. Malar J. May 1;19(1):170. doi: 10.1186/s12936-020-03224-6. PMID: 32357890; PMCID: PMC7193356.

[59] World Food Programme (2021). Climate Response Analysis Guinea-Bissau.

[60] UNDP Guinea-Bissau (2020). Socio-economic impact assessment of Covid-19 in Guinea-Bissau, p.11–12.

In the face of escalating climate change hazards and concurrent crises, Guinea-Bissau must adopt an adaptive social protection strategy. This strategy should aim to fortify social protection systems and improve their readiness for significant shocks, concentrating on bolstering the resilience of impoverished and vulnerable households. Within the adaptive social protection framework, Guinea-Bissau should consider (i) implementing a regular cash transfer program, (ii) establishing a national registry that includes households in high-risk "hot-spot" areas, and (iii) creating a climate change hazard recovery fund to guarantee prompt and accessible funding for response initiatives.

3.5.3 Education

Guinea-Bissau's education system has been significantly impacted by political instability, which has stymied efforts to achieve inclusive education despite considerable foreign aid.[61] Nearly 28 percent of children are not enrolled in primary school, and 23 percent of adolescents are out of lower secondary education—some of the lowest rates in West Africa. Girls are particularly vulnerable to dropping out due to marriage and early pregnancies. In recent years, strikes by teachers and students for better pay, improved working conditions, and dignified education have been frequent. In 2021, strikes combined with COVID-19 school closures resulted in up to five months of lost education, exacerbating the risk of children dropping out.[62] Civil society is pivotal in operating and funding many educational institutions, including community, religious, and private schools. The sector faces numerous challenges, such as inadequate infrastructure and resource scarcity.

The impacts of climate change are set to further complicate the education sector's challenges. Extreme weather events are likely to reduce crop yields, intensify food scarcity, and increase disease incidence, leading to higher rates of school absenteeism and placing additional financial strain on families to afford school fees and sustain community-led schools. Moreover, 20 percent of schools are at high risk of flooding and 33 percent are at medium risk,[63] yet there are no specific government-led funds dedicated to repairing educational infrastructure.

3.5.4 Gender and climate change dynamics

Women in Guinea-Bissau are central to the workforce, playing a critical role in strengthening local food systems, upholding food sovereignty, and contributing to the socioeconomic well-being of their families and communities. They navigate the complexities of triple roles, engaging in market labor, household labor, and reproductive labor. Despite their contributions, women face limited access to essential resources such as land, livestock, financial capital, and mobility, with climate change threatening to deepen these gender disparities. To enhance household resilience to climate shocks, gender inequalities must be addressed and women empowered by expanding their rights and control over assets. Facilitating women's access to clean energy and water is essential for cooking, agro-processing, and food preservation, which can also alleviate their manual labor burden. Moreover, gathering gender-specific environmental and climate data is vital for crafting effective, gender-responsive measures that cater to women's unique needs and priorities. Potential measures include allocating climate adaptation funds to support girls' education and promote voluntary family planning.

Table 8 Proposed Actions for Human Capital with Some Costs Estimated (Based on Available Data)

Activities	Priority (for climate agenda)	Time frame	Complexity	Potential for private contribution	Adaptation / mitigation	Estimated cost (in 2023 US$, millions)
Develop adaptive social protection and social safety nets; build a registry for social protection	**Very high**	**ST**	**++**		**Adaptation**	**9..4**
Develop standard and design for public infrastructure adapted to risk and higher temperatures (energy-efficient design, climate-friendly infrastructure)	High	ST	+	Yes	Both	1.9

[61] Silva, R. da, & Oliveira, J. (2017). '40 years of educational research in Guinea-Bissau: Mapping the terrain.' *International Journal of Educational Development*, 57, 21–29. https://doi.org/10.1016/j.ijedudev.2017.09.003.

[62] UNICEF (2021) Country Office Annual Report https://www.unicef.org/media/117031/file/Guinea-Bissau–21-COAR.pdf.

[63] Information provided by the Department of Statistics, Ministry of National Education, Bissau, as of March 10, 2023.

Develop and adopt a national DRR policy aligned with the Sendai Framework for Disaster Risk Reduction 2015–2030	High	ST	++		Adaptation	0.5
Set up flood and high-tide EWSs and weather information services for urban and rural communities; train farmers on DRR and anticipatory action	High	ST	++		Adaptation	4.7
Create a national registry that prioritizes the inclusion of high-risk households residing in "hot-spot" areas	High	ST	++		Adaptation	1.9
Improve the quality and increase the number of school infrastructures	High	ST	+		Adaptation	37.7
Collect gender-specific environment and climate data to design effective gender-responsive interventions	High	ST	+		Adaptation	1.9
Invest in infrastructure, equipment, and health care professionals to respond to the growing demand of health care needs	Medium	ST	+		Adaptation	94.3
Establish a regular cash transfer program	High	MT	++		Adaptation	tbd
Establish a climate change hazard recovery fund to ensure timely and accessible funding for response programs	High	MT	+++	Yes	Adaptation	tbd

Chapter 4: Aggregate and Distributional Effects of Climate Change & Selected Policies

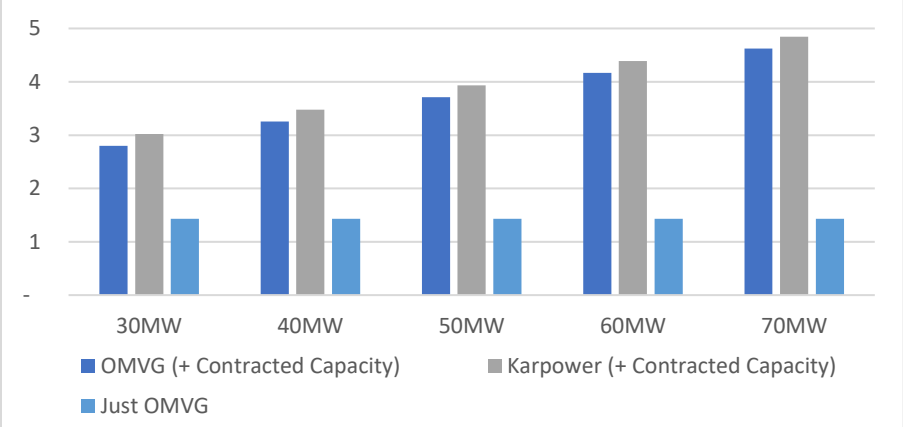
4.1. Macroeconomic context

Guinea-Bissau is one of the world's most underdeveloped countries and is plagued by limited infrastructure, a small private sector, and weak public financial management owing to constant political instability. With low levels of capital stocks due to chronically tight fiscal space and weak public financial management systems, Guinea-Bissau has been perennially underdeveloped since independence in 1974. Most economic activity is directly or indirectly based around the cashew campaign and, consequently, the private sector in Guinea-Bissau is small and limited. The Country Economic Memorandum (2020) outlines several reasons for this, including extremely limited access to an electricity grid that provides one of the highest electricity tariffs in Africa as well as persistent political instability and fragility.

However, conversely, being one of the world's most underdeveloped countries offers opportunities for leapfrogging in the face of the climate change challenge. Economic activity has become more concentrated around the raw cashew nut trade over time despite potential opportunities to increase the commodity value chain through processing. This is partly due to the energy infrastructure limitations mentioned in the preceding chapter, which mean that the manufacturing sector remains extremely nascent, and energy needs are currently estimated to average at just 20 megawatts and peak at 24 megawatts. This almost non-existent manufacturing sector and the extremely limited power demands mean there are seemingly low exit costs associated with decarbonization. Guinea-Bissau then, perhaps uniquely, has the advantage of skipping expensive and technically difficult steps on its green economy and climate change adaptation trajectory and could begin to see the benefit of these investments almost immediately, especially if the current and future engagements outlined in the energy section are realized.

Overcoming political economy challenges in the energy governance space and moving to green energy will also create fiscal space that can be used for other development investments. Years of mismanagement and a lack of transparency has made the public utility EAGB a fiscal drain for a number of years. Non-budgeted overspending on Karpower-related expenses has driven a high fiscal deficit and increased the debt stock. Beginning to integrate the energy provided by the recently completed regional hydroelectric project OMVG into the country's energy consumption framework will yield fiscal savings. Annulling the fixed cost capacity contract with Karpower will further increase these savings (Figure 24) and, in conjunction with other expenditure rationalization and domestic revenue mobilization efforts, will enable the government to invest in its own development. The cheaper tariffs offered by OMVG will also remove one of the commonly identified binding constraints to private sector development in Guinea-Bissau, which should result in higher fiscal revenue.

Figure 24 Karpower vs. OMVG Costs (US$, Millions/Month)



Source: Government of Guinea-Bissau and World Bank

Implementing the country's NDC will require significant investment. Chapter 5 outlines the NDC financing challenges. Tight fiscal space limits domestic resources available for climate financing (estimated at $US18 million/year in 2019), and private investment is one of the lowest in the world at 2 percent of GDP (Country Economic Memorandum, 2020) owing to the chronic political instability plaguing the country. The donor community historically provides over 90 percent of the financing for the Public Investment Program, with this support tending to withdraw during political crises.

Domestic revenue mobilization measures as part of the fiscal consolidation effort can support these financing needs and reduce political instability and crowd-in private sector investment and further donor support. Typical of fragile countries, Guinea-Bissau has one of the lowest tax-to-GDP rates in the world, with indirect taxation accounting for a greater share of overall tax revenue than direct taxation. Execution consistently falls below potential and is highly variable, correlating with internal cashew prices. The variable nature of tax collection means that average execution remains well below the established "tipping point" of the 12.75 tax-to-GDP ratio at which a country can begin investing in its own development and growth accelerates.[64] Additional work in the area concludes that developing countries on average need to improve their tax-to-GDP ratio by an average 5 percentage points,[65] which is the exact difference between 2021 tax revenue execution (11.4 percent) and potential (16.4 percent). Should the country exceed the tipping point, it could then begin to contribute toward its climate change and development objectives.

Work in the fiscal space to improve direct tax revenue include the development of an online tax payment platform for the private sector and work to operationalize the value-added tax law. Value-added tax is estimated to raise 2.6 percent of GDP in a four-year period after operationalization. There are established links between value-added tax and an improved social contract, which could reduce fragility. Political instability is one of the main drivers of stunted private sector development and private investment in the country. It also crowds out crucial donor support, which the NDC calculates will account for 80 percent of financing needs to achieve Guinea-Bissau's targets. Consequently, reform and continued efforts in the domestic resources mobilization space in Guinea-Bissau could catalyze much needed development and growth prospects and help climate-proof the country.

There is untapped potential for economic diversification and additional revenue sources. The government has revisited the possibility of allowing the mining of bauxite and phosphate reserves in the country, which will help diversify exports and has the potential to positively impact the country's growth and fiscal revenue. However, there is reluctance to begin investment and extraction as there is no legal framework in place to ensure environmental protection due to the location of the reserves in the bend of a river. Nevertheless, a mining project with an investment of US$200 million has begun near Farim. The company has started building temporary accommodation for workers and relocating locals, but progress has halted because of changes to the mining agreement. Although uncertain, if the project does go ahead, estimates suggest that it could increase GDP by 8–16 percent and fiscal revenues by about 50–80 percent during the exploration years, both in terms of nominal increases. Improved environmental safeguards and cheaper, greener, and more reliable energy would stimulate job production and potentially open new sectors and a longer value chain in areas such as smelting.

4.2. The model

In this chapter, we first quantify climate-induced GDP damages over the period 2023–50 through relevant climate-to-GDP impact channels relating to labor and sectoral productivity, labor stock, and capital stock. Second, we estimate the impact of selected adaptation investments whose benefits (in terms of reduced GDP damages) outweigh the implementation costs (operating expenditure (OPEX) and capital expenditure (CAPEX)). Third, we quantify the poverty aggregate and distributional implications of the damages and adaptation interventions.

In conducting these counterfactual analyses, we account for the layers of uncertainty in future (2023–50) climate and growth scenarios. The climate scenarios include: (1) a climate baseline that captures the

[64] Gaspar et al. (2016). Tax Capacity and Growth: Is there a Tipping Point? Working Paper, IMF
[65] Gaspar et al. (2019). Fiscal Policy and Development: Human, Social, and Physical Investment for the SDGs, IMF Staff Discussion Note

effects (of climate change) as of end-22, that is, no further climate change beyond the changes recorded at the end of 2023; (2) a dry/hot mean (or "extreme dry conditions") that captures a "most pessimistic" climate future; and (3) a wet/warm mean (or "extreme wet conditions") that captures a "least pessimistic" climate future. Three growth scenarios are also considered, including (1) a medium growth scenario, which generally extends recent growth trends; (2) a low growth scenario characterized by institutional and political fragility, economic stagnation, narrow fiscal space, and limited climate investments; and (3) an aspirational high growth scenario characterized by institutional stability, significant changes in the structure of the economy (with labor mobility away from the primary sector), and fiscal space for public investments, including into more resilient climate adaptation policies and growth-enabling, sustainable, and lower carbon development policies.

The simulations produce trends under the three alternative growth and climate scenarios. In the following paragraphs, we describe the estimated effects of extreme dry and wet climate conditions on macroeconomic aggregates, poverty, and inequality with the baseline climate scenario and medium growth scenario as benchmarks. Results from lower and higher growth scenarios are also included (see Annex) to highlight the sensitivity to alternative growth pathways of the estimated impacts of climate change and policies.

The chapter should be viewed on the understanding that all models have limitations owing to both the inputs that drive the model and the assumptions made. For example, of the seven channels used as inputs for the model,[66] only five have adaptation measures,[67] and even with adaptation, damages from climate change can never fall to zero. Additionally, there is a fixed cost assumption over time for adaptation measures which means that economies of scale, learning effects, and costs associated with inputs such as electricity prices (which could lead to cost reductions in the future) are not factored into the model. Examples include the establishment of local supply chains, increased competition, positive externalities from international technology spillovers, and workers becoming more familiar with any new technology that is rolled out and operationalized to mitigate the deleterious effects of climate change.

On the limitations of the model, due to modeling assumptions, adaptations can only account for first-round benefits and not second-round benefits, which could add significant amounts of savings via damage limitation by making the economy more resilient to, probably more frequent, extreme shocks. Furthermore, the investment made into adaptation measures is considered to be non-productive in the sense that it does not contribute to additional capital stocks for the country—a driver of GDP growth—and that these investments are funded by the public sector. This means there is an implicit assumption that adaptation investment will crowd out traditional public investment. Alternative debt funding, creating potential additional fiscal space through ongoing fiscal consolidation efforts, and receiving increased grants were not modeled. Also, adaptation investment provides no other co-benefits, such as reduced depreciation rate efficiency gains beyond the reduced damages. Finally, the model only accounts for adaptation polices without considering potential mitigation options that could boost growth and job creation (for example, investing in renewable energy or reforestation).

One final consideration is that the estimated impacts of climate change presented by the model use the annual expected damage of natural disasters, which accounts for the probability of different types of extreme events occurring each year.[68] This study should be supplemented with further qualitative analysis of one-off impacts of extreme events and/or stochastic modeling of climate damages.

4.3. Growth scenario

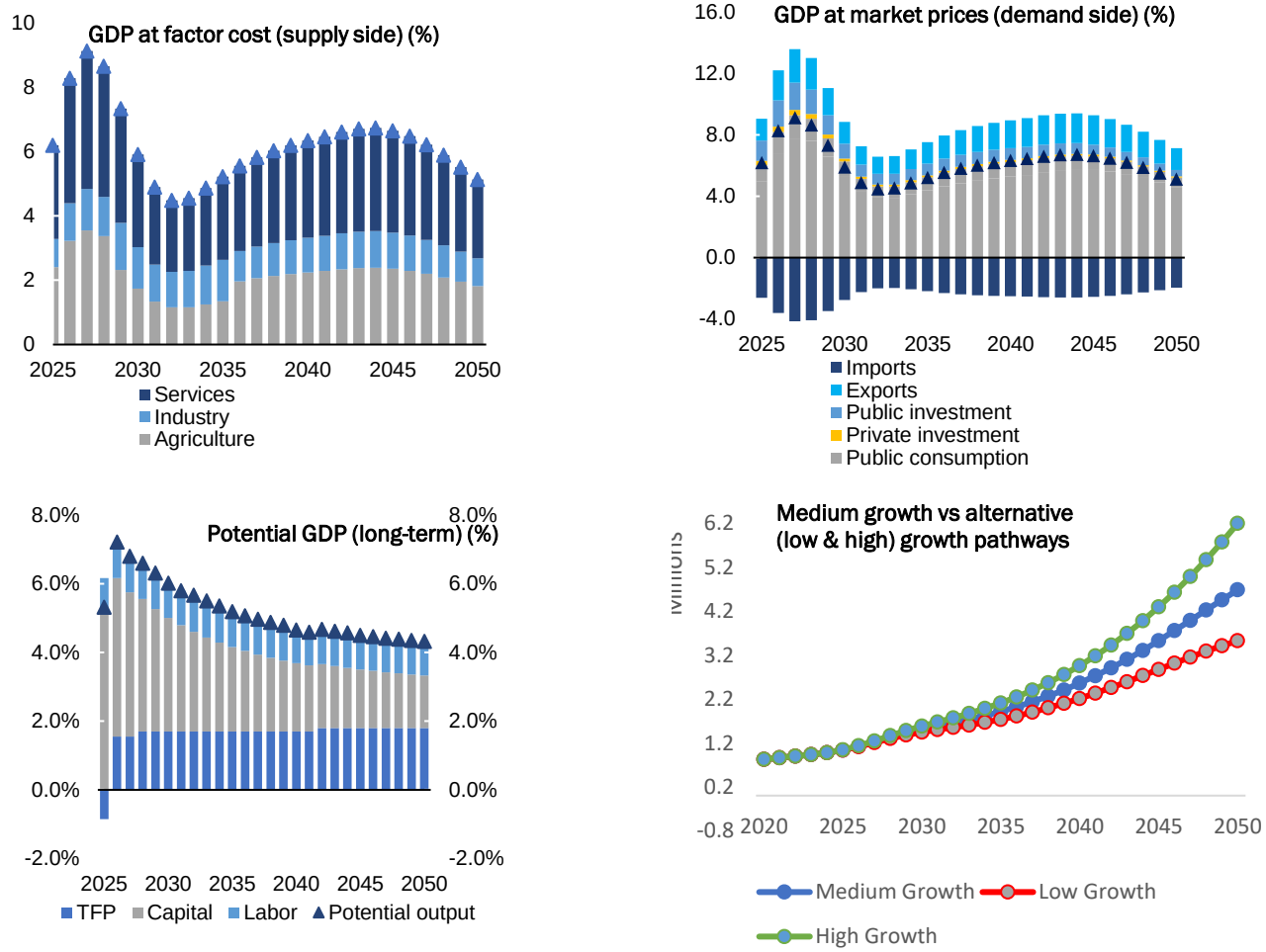
The medium growth scenario developed for this CCDR follows recent growth trends: the income per capita would more than double (2.7x) over 2023–50, with an average annual growth of 3.5 percent. Per capita

[66] Channels include crop erosion, rainfed crops, heat stress, roads and bridges, inland flooding, health and sea level rises. The latter two had no adaptation measures included in the model.
[67] The unit costs of air conditioning, building more resilient roads and bridges, and irrigation systems are based on international data and then localized with additional information.
[68] For example, a severe 1-in-200-year flood has a probability of 1/200, or 0.5%, of occurring in any given year. If this flood causes 20 percent of capital stock damage, then the annual expected damage is 0.5 percent * 20 percent = 0.1 percent damage to capital stock.

economic growth would slightly outperform historical trends. Improved political stability would translate into relatively higher growth, which will still not be enough to address large development needs. Annual GDP growth would average 5.8 percent over 2023–50 alongside a relatively high population growth (2.4 percent average). Exports would grow faster and contribute rapidly to early GDP growth, while private consumption's contribution to growth would stabilize close to historical trends. Investment would grow relatively faster, although inadequate regulatory and governance frameworks would impede the efficiency of new investment despite moderate total factor productivity (TFP) improvements as the country continues to address barriers to trade and investment, including contracting bottlenecks in mining and restrictions on wood/timber exports.

Limited investment in human capital will remain a major impediment to inclusive development. Improved political stability, combined with the continued support of development partners, would translate into some improvements in public finance management and modest investments in the social sectors. This would mean a gradual decline in the fertility rate alongside decelerating growth in the working-age population. Meanwhile, labor participation would improve slightly, and the employment rate would stabilize around historical levels. Given the low productivity gains, sectoral structural shifts will be limited. The GDP share of agriculture would continue to decline, although the sector would remain the main engine of economic growth. In contrast, manufacturing would expand, as a few fish and cashew processing plants are expected to come on stream over the next decade, also supported by improved electricity access and road infrastructure consistent with stronger development support. The services sector would also grow moderately as support services to the cashew sector continue to expand alongside a scale-up of the sector.

Figure 25 Growth Decomposition over 2025–50 (Medium Growth Scenario)



It should be noted that the sector composition and economic restructuring in the different growth scenarios are assumed under different macroeconomic baselines. The assumed economic structure of the Guinea-Bissau economy interacts with climate shocks to produce different macroeconomic outcomes. For example, the main channels of climate change damages are heat impacts, which disproportionately affect outdoor agricultural workers, and crop yield losses from droughts. In the high growth baseline, the economy diversifies from being heavily agriculture-based to services-based. These damage impacts at the macroeconomic level are therefore smaller since agriculture contributes a smaller share of GDP.

4.4. Macroeconomic impacts climate change

4.4.1. Medium and low growth without adaptation[69]

Without adaptation, climate change is expected to reduce real GDP, with the impacts ranging from -7.3 percent (medium growth scenario) to -7.7 percent (low growth scenario) by 2050 in the most pessimistic scenario (dry/hot).

Assuming no additional adaptation investments, the macroeconomic impacts of climate shocks will be determined by climate outcomes, the growth pathways, and associated structures of the economy. Under the medium growth scenario and depending on the climate scenarios considered, real GDP losses are estimated to increase steadily from 3.6–4.8 percent[70] in 2040 (vs. 4.0–5.2 under low growth) to 6.0–7.3 percent by 2050 (vs. 6.4–7.7 under low growth) due to climate change effects through the main channels. The losses are significantly larger under the dry/hot climate scenario, reflecting greater damage to agriculture and outdoor workers compared to the wet/warm climate condition.

Climate change is set to affect growth, mainly through agricultural and labor productivity.

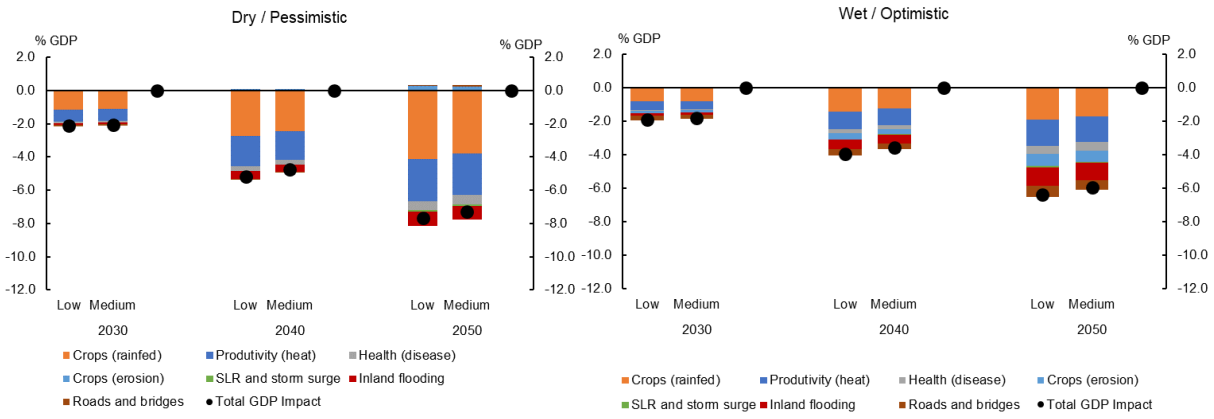
The most significant consequences of climate change in Guinea-Bissau are linked to declines in crop yields. Six of the seven channels generate negative results on GDP over 2021–50, regardless of the climate scenario. By far, agricultural productivity is the largest impact channel in related economic damage, projected to result in GDP losses ranging from 3.8–4.1 percent in the dry/hot scenario and 1.7–1.9 percent in the wet/warm scenario. The second most impactful channel is labor productivity. The reduction of labor productivity intensifies outdoor labor and more intense physical work, often associated with the agriculture sector. In the most pessimistic scenario (dry/hot), labor productivity is expected to decline in agriculture, industry, and services by 9.5 percent, 5.5 percent, and 3.6 percent, respectively. Even under the more favorable climate scenario, heat impacts on labor productivity across sectors would still remain relatively large (around 1.5 percent of GDP). Other labor productivity losses due to climate change, linked to the impacts of diseases on human health, are estimated to be about 0.5–0.6 percent of GDP by 2050.

Rainfall variability represents the other main channel through which climate change would affect Guinea-Bissau's economy. This reflects the economy's structure, with agriculture accounting for 40 percent of GDP, 60 percent of total employment, and more than 80 percent of exports. First, changes in precipitation patterns and resulting impacts on water availability affect the productivity of rainfed crops. Estimated effects vary across different crops, with coconut, plantain, and cassava being the most affected crops and damages rising to a 31 percent yield loss under the dry/hot climate scenario. On average, across all crops, yields would decline up to 12 percent by 2050 in the most pessimistic scenario. Additional results of climate change on crops arise from changes in soil conditions and topsoil erosion due to rainfall patterns. Under a wet climate scenario (considered to be the worst for soil erosion), crop yields could decline by up to 2 percent by 2050, with cashew nuts and millet yields experiencing the most severe productivity declines (up to 8 percent). However, under a dry future climate scenario, crop yields are expected to improve by 0–2.5 percent due to lower soil erosion damage.

[69] Annex 3 presents the impact channel-specific direct impact of climate change.

[70] The first value is under the wet/optimistic scenario and the second under the dry/pessimistic scenario

Figure 26 Breakdown of Impact Channel's Contribution to GDP Impacts as Percentage Differences from No Further Climate Change Baseline under Alternative Growth Baselines



Source: GNB-ccMFMod. **Note**: See additional charts in Annex 4

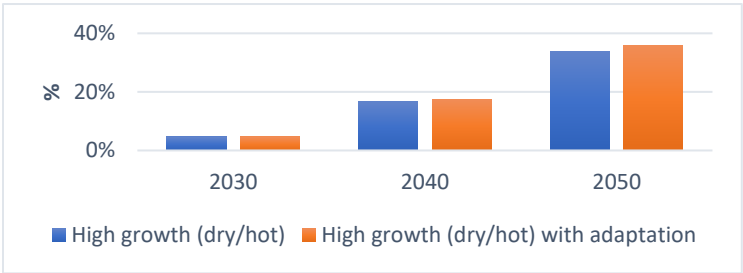
Climate change is also expected to damage physical capital through various impact channels.

The damage caused by climatic shocks on capital stocks is estimated to reduce real GDP by 1.7–1.8 percent in 2050 relative to the baseline of no additional climate change. The projected losses are linked to inland flooding events, projected to damage on average (that is, the sum of the probability of each event times its magnitude) around 0.15 percent of Guinea-Bissau's physical capital stock every year. The effects of sea level rise and storm surges, expected to increase by 0.1 meters by 2030 in Guinea-Bissau, would be noticeable around 2050 and become more severe toward the end of the century. Under the most pessimistic scenario, the estimated damages to capital stock from sea level rise and storm surges amount to 0.1 percent of GDP. Meanwhile, damage to roads and bridges linked to higher temperatures, precipitation, flooding, and road disruption will also impact working hours. By 2050, it is estimated that additional annual damage relative to the baseline under a wet future will be US$60 million in 2021 dollars on capital stock, causing up to 8 million delay hours.

4.4.2. High growth with adaptation

Investing in development measures increases GDP and reduces exposure to future climate change through diversification, thereby reducing the country's reliance on the agriculture sector, which is particularly vulnerable to climate change damages. Under a high growth scenario with a hot and dry climate future, GDP is expected to be 34 percent higher in 2050 compared to a medium growth scenario under the same climate conditions. Furthermore, investing in climate adaptation measures could reduce the climate impact on GDP losses to 4.7 percent in 2050 for the high growth, dry/hot pessimistic scenario, compared to 7.3 percent in the medium growth scenario without adaptation. These estimates do not account for the secondary benefits of adaptation, which would enhance growth by strengthening resilience and boosting productivity across multiple sectors.

Figure 27: Real GDP Impacts from Development and Adaptation Investment (Percentage Increase from the Medium Growth, Dry/Hot Scenario)



Source: GNB-ccMFMod

In addition to its already substantial development investment needs, Guinea-Bissau requires significant investment in adaptation. Adaptation measures have been shown to reduce the size of shocks (economic damages) and generate better economic outcomes than no adaptation. However, funding for adaptation investment (CAPEX) is assumed to come at the opportunity cost of existing productive public investment due to the limited financing options available to the government, which means that resources may be diverted away from immediate development priorities. Additionally, adaptation operation costs (OPEX), such as higher electricity bills for air conditioning units, translate into higher consumer prices in a country that currently has the second highest electricity tariffs in Africa. On average, the CAPEX and OPEX of all combined measures considered amount to about US$72 million annually (US$22 million in CAPEX and US$50 million in OPEX, mostly from air conditioning) or 1.75 percent of GDP. However, as outlined in the energy section of the previous chapter, a suite of investments in the energy sector are either already underway or potentially in the pipeline to substantially reduce energy production costs, increase electricity access and thus offset the public utility company's operating costs with higher revenue, and improve the "greenness" of the energy mix in the country. If these investments see fruition, they may mitigate some of the adaptation costs. As mentioned in the model limitations section, our analysis made a strong assumption about fixed adaptation costs without considering potential future cost reductions through learning and economies of scale. Therefore, the results are likely to overestimate the costs and underestimate the benefits of adaptation. Table 9 shows the potential benefits (without secondary and indirect benefits beyond the reduced size of the damage) without accounting for costs, to give an approximation of the potential ceiling that could be expected.

Table 9 Benefits of Adaptation vs. No Adaptation (% of Potential Output) (2050)

Comparing supply-side benefits: adaptation vs. no adaptation	
Dry/pessimistic	Wet/optimistic
4.0	1.9

Without adaptation, GDP falls by almost 8 percent in the dry/hot scenario and 6.4 percent in the wet/warm scenario under the low growth baseline. However, the risks can be reduced with adaptation to 6.9 percent in the hot/dry scenario and 5.3 percent in the wet/warm scenario. Depending on macro baselines, in the low growth scenario, the biggest contribution to reduced macro risks comes from rainfed crop adaptation measures. On the other hand, in the medium to high macro baselines, air conditioning helps to improve macro-outcomes the most due to the sectoral composition assumed for the Guinea-Bissau economy, but only for office workers. The adaptation investment cost for roads and bridges is slightly higher than the damages. Since the analysis ends in 2050 and there is no operation costs associated with better quality roads and bridges, the payoff is expected to be evident in the longer term beyond 2050.

Table 10 Modeling Selected Adaptation Measures Can Indicate the Potential Effect on GDP

Damage channel	*Adaptation measure*	*Hypotheses*	*Costs assumptions*
Heat stress	Increased air conditioning coverage for the indoor workforce	Increase air conditioning coverage for indoor workers from 3 percent by +30 percent to 33 percent across all sectors. Adaptation ramps up linearly between 2021–50, reaching the target by 2050.	Capital cost of the new air conditioning units required by year (CAPEX) + annual energy consumption costs (OPEX). CAPEX considers a low-end and high-end value. The low end corresponds to a standard window unit, and the high end to a split system. CAPEX is annualized during 15 periods at a 3 percent discount rate. **Costs modeled (annual average): US$14 million CAPEX, US$49.8 million OPEX**
Crop erosion	Combination of (1) conservation tillage and (2) crop residue	1. Crop tillage: excessive tillage can increase erosion by breaking up the soil too much and leaving it vulnerable to erosion. 2. Crop residue: sheet and rill erosion are reduced by leaving adequate residue on the ground after the harvest. 3. The adoption rate will be 20 percent by 2050, and adaptation will start in 2025.	Crop tillage: assumed to be cost-neutral to farmers since labor and/or tractor use decline, while this intervention may increase the need for pesticides or other inputs. Crop residue: also assumed to be cost-neutral and often used alongside conservation tillage practices.
Rainfed crop yields	Combination of (1) new irrigation, (2) crop switching, and (3) heat-tolerant varieties	1. Add new irrigated areas to meet 20 percent of the estimated irrigation potential in the country (that is, 33,700 new hectares). Areas ramp up linearly up to 2050. Crops are allocated into new irrigated areas based on their current share of hectares. 2. Increase the relative size of the selected crops by 2 (that is, a 100 percent increase). 3. Substitute 50 percent of the current production of the selected crops for a heat-tolerant variety that increases resistance +2°C.	1. Capital costs of developing new irrigated hectares (CAPEX) + annual operation and maintenance costs (OPEX). Costs consider low-end and high-end values, corresponding to simple flooding (1,200 US$/hectare) and improved flooding/sprinkler (3,500 US$/hectare) irrigation. CAPEX is calculated assuming a 15-year payment period and infrastructure lifetime, discounted at a 3 percent rate. Maintenance costs are assumed at 2 percent of total investment costs. 2. Not considered. 3. Not considered (very small). Reference research and development cost of developing a new variety = US$60,000 (Porch et al. 2007). **Costs modeled (annual average): US$4.2 million CAPEX, US$0.4 million OPEX**
Inland flooding	Combination of (1) additional protection to existing infrastructure and (2) new infrastructure	1. Additional protection to existing infrastructure: diverting floodwater, dry floodproofing buildings, or other protection. 2. Build new infrastructure away from most hazardous areas and/or raise first-floor elevations.	1. Not considered due to uncertainty: international relationships between cost and improved design standards are specific to site and building type. 2. Costs to construct new infrastructure (already in the baseline).
Roads and bridges	Multiple road/bridge engineering options	Multiple road/bridge engineering options within the IPSS model, for example, upgrade unpaved to paved, upgrade asphalt binder, enhance the road base layer to address precipitation and flooding, and/or improve bridge design.	Unit costs per kilometer of road or bridge for each adaptation option. Cost estimates based on international sources. **Cost modeled (annual average): US$4.2 million CAPEX, no OPEX cost**

Climate change may present an opportunity for a long-overdue structural shift in the economy as part of its adaptation strategy. Guinea-Bissau is a primarily agrarian economy characterized by low levels of capital, which makes labor the primary factor of production. As climate change accelerates, increased heat and humidity will reduce labor productivity in primary sector jobs that are more exposed to the elements. Concurrently, as labor productivity for indoor jobs improves owing to adaptation measures such as air conditioning, a natural shift in the economy may occur with labor becoming more concentrated in the secondary and tertiary sectors (Table 11). Therefore, climate change may act as a catalyst for long sought diversification in the economy if Guinea-Bissau begins investing in its human and economic capital to be better able to adapt.

Table 11 Climate Change Impact on Labor Productivity from Heat in 2050

		Labor productivity % (from heat)
Dry/pessimistic	With adaptation	-2.1
	Without adaptation	-10.3
Wet/optimistic	With adaptation	-1.2
	Without adaptation	-3.8

4.5. Climate change and poverty impacts

The poverty and distributional impacts of the different climate and macroeconomic scenarios in Guinea-Bissau are derived using simulations that link the 2018–19 household survey data with the macro projections. The macro projections from GNB-ccMFMod are used as inputs to simulate changes in demographics, employment, labor productivity, and prices using survey data. In addition, to account for spatial variation, we use the estimated damages due to heat stress and disease on labor productivity and crops to assess spatially disaggregated impacts on poverty. These damages are estimated at the grid level for each climate scenario before aggregating them as inputs to the macro model. Damages to labor productivity due to heat stress vary by sector of employment and region; damages due to disease vary by region; and damages to crop productivity vary by type of crop being cultivated and by region. These heterogeneous effects are differentially applied to each household depending on their employment sector, the crops they produce, and their location. The resulting spatially differentiated changes in well-being are consistent with the macroeconomic scenarios. Annex 6 provides more details on the poverty analysis methodology.

4.3.1. Without adaptation

A. *Main impact channels of transmission*

Household welfare is expected to be affected by three main channels: first, by the impact of daily workday temperatures on labor productivity (heat stress channel); second, spreading diseases leads to mortality and morbidity and affects the labor supply (human health channel); and finally, the change in crop production from changes in topsoil erosion from rainfall intensity (the crop production channel). In the following, we discuss each of these main channels.

The impact of heat stress on labor productivity is higher (in absolute value) for the agricultural sector, especially under extreme dry climate conditions. Overall, rising workday temperatures are expected to negatively affect labor supply in Guinea-Bissau across all years, regions, and growth scenarios—in low or high growth. As expected, the heat stress vulnerability values are higher (in absolute terms) for agriculture than for industry and services, with the latter sector presenting the lowest value in absolute terms. For instance, on average, rising temperatures under extreme dry climate conditions are estimated to result in an 11 percent reduction in work hours in the agriculture sector, compared to a 5 percent reduction for industry and under 5 percent for the services sector. Under extreme wet climate conditions, the largest reduction in work hours due to rising temperatures is expected in the industry sector, where work hours are expected to decline by 9 percent on average.

Rural areas are particularly vulnerable to the negative effects of heat stress on labor supply to agriculture in extreme dry climate conditions and industry and services in extreme wet conditions. In rural areas, rising temperatures under extreme dry conditions are expected to reduce work hours in agriculture by about 15 percent by 2050. Under extreme wet climate conditions, the effect of heat stress on labor supply to agriculture in rural areas is slightly lowered, reducing labor supply by 9 percent by 2050. However, the effect remains highest for the rural area's industry and services sectors relative to other parts of the country. In the capital city Bissau, the effects of heat stress on labor supply to industry and services sectors are high, but only under extreme dry conditions, reducing labor supply by 8 percent and 7 percent, respectively, by 2050. In the poorest regions, such as Bafatá and Cachéu, rising temperatures are expected to result in large declines in labor supply. For instance, in both regions, increasing temperatures under dry conditions are expected to reduce labor supply to agriculture by over 14 percent by 2050. However, in the regions of Quinara and Tombali, heat stress is estimated to result in a more than 16 percent decline in labor supply to agriculture under extreme dry conditions by 2050.

In contrast, the impact of disease spread on labor supply is small and slightly higher under extreme dry conditions. Disease spread is estimated to reduce labor supply by 0.46 percent under extreme dry conditions and 0.43 percent under extreme wet conditions by 2050. The effect of disease spread on labor supply is highest in the regions of Tombali and Cachéu. The shock considers the changes in the transmissibility of vector-borne (malaria and dengue) and waterborne (diarrheal) diseases and increases in the incidence of noncommunicable heat-related diseases. We model the effect of the resulting mortality on the labor force, absenteeism of the labor force from work due to illness, and absenteeism caused by caring for sick children under 15. Effects are weighted based on the relative prevalence of the disease in the population.

Finally, the effect of topsoil erosion on crop production is larger under extreme dry conditions, reducing the production of cassava, coconut, plantain, and rice by over 15 percent by 2050. Under extreme dry conditions, topsoil erosion is expected to result in a large decline in the production of major food crops by 2050: coconut (23.5 percent), cassava (22.8 percent), plantain (22.6 percent), palm oil (22.5 percent), rice (18 percent), and maize (14.8 percent). The effect on cashews (a significant source of livelihood and exports) is estimated to be a 1.9 percent reduction in production by 2050. Under extreme wet conditions, the effects are much more moderate and mixed. For instance, certain crops, such as cassava, are expected to decline by 18.9 percent by 2050. However, cotton, maize, and millet are expected to experience an increase in production of over 5 percent by the same year.

B. *Aggregate impact – all channels combined*

Climate change is projected to lead to substantial welfare and distributional impacts.

Under the baseline climate scenario that assumes no further climate change, economic growth is expected to lead to substantial welfare improvements in Guinea-Bissau. Under the current growth trajectories and climate conditions of Guinea-Bissau, poverty using the international absolute poverty line of US$3.65[71] per person per day in 2017 purchasing power parity is expected to decline from an estimated 58.9 percent in 2018 to 32.4 percent (equivalent to 810,000 poor) by 2030, declining further to 2.7 percent (equivalent to about 110,000 poor) by 2050. As expected, lower (higher) growth relative to current growth trends (that is, business as usual (BAU) growth trends) under current climate conditions is expected to result in higher (lower) incidences of poverty over the years. The following paragraphs describe the estimated effects of extreme dry and wet climate conditions on poverty and inequality with the BAU climate scenario and current growth trends as the benchmark. Results from lower and higher growth are also included to highlight the sensitivity of the estimated impact of climate change on growth.

Extreme dry/hot climate conditions are estimated to have a negative effect on poverty, pushing an additional 80,000 people into poverty by 2050 under BAU growth and up to 200,000 or more additional

[71] In this subchapter, the absolute poverty line (with US$3.65/day threshold) (that is, middle-income country poverty line) is used as opposed to the extreme poverty line of US$2.15/day. This decision was premised on the fact that continuing to use US$2.15 for estimates in 2030, 2040, and 2050 may not be realistic, especially when the growth numbers are considered. Guinea-Bissau may have graduated from low-income country by then.

poor under low growth. Under the dry/hot mean climate scenario, poverty is estimated to increase by 2.1 percentage points by 2050 under current growth trends, equivalent to an additional 80,000 poor people relative to the baseline climate scenario. The effects become even larger under lower-than-usual GDP growth, with poverty increasing by 12.7 percentage points (more than 200,000 additional poor) by 2050 relative to the BAU climate scenario. However, higher-than-usual GDP growth is expected to cushion the adverse effects of dry climate conditions, with a poverty decline projected at 0.86 percentage points by 2050 relative to BAU climate conditions. Large negative effects of extreme dry climate conditions are expected in 2040. Poverty is estimated to increase by 4.2 percentage points under BAU growth trends and up to 13.4 percentage points under low growth.

Similarly, extreme wet/warm climate conditions are expected to undermine poverty reduction, pushing an additional nearly 60,000 people into poverty by 2050 under BAU growth and up to 160,000 or more additional poor under low growth. Under the wet/warm climate scenario, poverty is estimated to increase by 1.5 percentage points by 2050 if current GDP growth patterns continue, equivalent to an additional 60,000 poor. Lower-than-usual growth is estimated to amplify the negative effects of extreme wet climate conditions, increasing poverty by 11.52 percentage points in 2050 relative to BAU climate conditions. This is equivalent to 160,000 additional poor. However, higher-than-usual growth under extreme wet climate conditions is expected to result in a moderate decline in poverty of 1.1 percentage points by 2050.

Estimates of climate effects on inequality also show an increase in inequality under both extreme wet and dry scenarios, particularly under higher-than-usual growth conditions. With BAU economic growth, inequality is estimated to decrease gradually, with the Gini coefficient rising from 0.32 in 2018 to 0.36 by 2050 under the current climate conditions. Under extreme climate conditions, the inequality effects are larger when assuming a higher growth scenario. For instance, under both extreme wet and dry conditions, high growth is estimated to result in a decrease in inequality by 0.02 Gini points. In contrast, the estimated level of inequality is similar under both low and BAU growth scenarios. This effect is driven by the fact that extreme climate conditions are expected to negatively affect growth in the agricultural sector (where most of the poor work), such that higher growth under such climate conditions will widen inequality levels.

Across space, extreme climate conditions (notably dry/hot weather conditions) have a larger well-being effect on rural than urban households. Under the BAU growth scenario, extreme dry climate conditions are estimated to increase poverty in rural areas by 3.9 percentage points by 2050 compared to a 0.5 and 0.3 percentage point increase in urban and Bissau areas, respectively. Similar patterns (albeit to a lesser extent) are observed in the case of extreme wet conditions. Extreme weather conditions under the low growth scenario are expected to have an even larger effect on poverty, widening poverty gaps between rural and urban areas. Extreme dry conditions under low growth are expected to result in a 21-percentage point increase in poverty in rural areas by 2050 compared to an increase of 5 and 3 percentage points in urban areas and Bissau, respectively. Similarly, the estimated poverty rate in rural areas under extreme wet conditions and low growth by 2050 is nearly four times higher than in urban areas and Bissau.

The region of Bafatá is the most vulnerable to extreme climate conditions. Across Guinea-Bissau's nine regions, Bafatá is expected to have the highest poverty impacts across the various growth and climate scenarios. This is partly due to Bafatá's socioeconomic characteristics. This region has the highest incidence of extreme poverty—25.9 percent—which is more than 10 percentage points higher than the national average of 13.2 based on 2018 survey data and the national poverty line. Moreover, 76 percent of households in Bafatá are employed in agriculture; only 9 percent of workers are wage employed; and 91 percent are self-employed, mostly (89 percent) in the informal sector. Extreme dry conditions in this region are expected to result in declines in labor and crop productivity, leading to a poverty rate of 15.4 percent (based on a US$3.65 poverty line) by 2050 under current growth trends (that is, 6 percentage points higher than the baseline climate scenario). Low economic growth is expected to further increase the adverse effects of extreme dry conditions in Bafatá, increasing poverty by 24.4 percentage points (to reach 33.8 percent) by 2050. Other regions where extreme dry climate conditions are estimated to adversely affect households (especially under the low growth scenario) are Gabu (20 percentage point increase in poverty by 2050), Oio (19 percentage point increase in poverty by 2050), Quinara (18 percentage point increase in poverty by 2050), and Cachéu (16 percentage point increase in poverty by 2050). Comparatively, in

Bissau, even under the low growth scenario, extreme dry climate conditions are expected to result in a moderate increase in poverty of 3 percentage points by 2050.

4.5.2. With adaptation

Investments in climate adaptation are expected to reduce the impact of climate change on the well-being of Guineans, especially under low economic growth scenarios in rural areas.

The large negative effects of extreme climate conditions are partially mitigated by investments in adaptation, with an estimated gain of nearly 30,000 fewer poor people by 2050 under current growth trends. Adaptation interventions are modeled for seven impact channels—clean cooking, crop production, erosion and land use, inland flooding, roads and bridges, and sea level rise—and incorporated into the macro model, leading to a quantification of their impact on the economy and poverty, in terms of reduced economic damages, poverty, and/or inequality. Adaptation investments under current growth trajectories are estimated to reduce the impact of extreme conditions on poverty, with 28,000 fewer poor people under extreme dry and 24,000 fewer poor people under extreme wet conditions by 2050. The investments are also expected to reduce the impact on inequality, lowering the Gini index by 0.005 points under extreme wet conditions and 0.004 under extreme dry conditions relative to the scenario without adaptation investments by 2050.

Under a low growth scenario where the impact of extreme climate conditions is amplified, gains from adaptation investments are larger, resulting in about 50,000 fewer poor persons—potentially mitigating the combined distributional effects of low economic growth and negative effects of climate shocks. Although investments in adaptation are expected to mitigate the effects of climate change on poverty under both low and high growth scenarios, the effects on the former are larger. The impact of extreme climate conditions on poverty under the low growth scenario is lower under adaptation, with 48,000 fewer poor people under extreme dry and 50,000 fewer poor people under extreme wet conditions by 2050. The corresponding estimates of the gains from such investments under a high growth scenario are 7,000 fewer poor and 10,000 fewer poor under extreme dry and wet conditions, respectively. The larger gains from investments in adaptation under a low growth scenario relative to a growth scenario highlight the importance of climate adaptation for an economy highly vulnerable to external shocks, exposing it to the risk of volatile economic growth. With investments in climate adaptation, when extreme climate events occur during periods of economic downturn, the combined effects of both events may be partially mitigated.

Across space, potential gains from investments in adaptation are larger for rural dwellers, who are more vulnerable to climate change. Comparing the effect of adaptation investments in mitigating climate change impacts across space shows larger potential gains in rural areas than in Bissau and other urban areas. Estimated poverty rates in 2050 in rural areas under both extreme wet and dry climate conditions and low growth are over 1 percentage point lower with adaptation than without. In other urban areas and around the capital Bissau, the gains are lower (under 0.5 percentage point reduction in all years from estimated levels without climate adaptation). The estimated gains from investments in adaptation are further amplified for rural households under the low growth scenario. Estimated poverty rates in 2050 in rural areas under both extreme wet and dry climate conditions and low growth are over 2 percentage points lower with adaptation than without. The gains in urban areas are much smaller (under 0.5 percentage points reduction in other urban areas and under 0.1 percentage points reduction in Bissau by 2050).

Across regions, adaptation investments are expected to reduce the impact of extreme climate conditions, especially in some of the areas that are expected to be adversely affected. Under low growth (where adverse climate conditions are estimated to have the largest impact), investments in adaptation are expected to mitigate the impact of extreme dry conditions, resulting in a decline in the incidence of poverty from the scenario without adaptation by nearly 3 percentage points in Gabu and about 2 percentage points in Oio, Tombali, Cachéu, and Quinara by 2050. Similarly, in the regions of Cachéu and Biombo, investments in adaptation are expected to mitigate the effects of extreme wet conditions, reducing the incidence of poverty by over 2 percentage points by 2050. In Bafatá, where the largest effect of extreme climate conditions is expected, investments in adaptation are expected to reduce the incidence of poverty by 1.2 percentage points under extreme dry conditions and 1.6 percentage points under extreme wet conditions by 2050.

Chapter 5: Climate Financing

5.1. Analysis of current level of climate financing

Financing for climate action is currently insufficient, and the capacity for public financing will continue to be limited. Given the estimated investment needs, the low level of development and sophistication of the Guinea-Bissau financial sector, the government's limited capacity to borrow (due to debt vulnerabilities and limited fiscal space), concessional finance from multilateral and development financial institutions, bilateral partners, and green financing facilities is the most viable option to bridge the gap.

Based on data from IMF and consumer price index for Guinea-Bissau in the years 2019–20, the overall views of climate finance reveal that Guinea-Bissau has prioritized adaptation measures (US$15 million or 75 percent of the total funds). While this focus is justified given the country's vulnerability to climate change impacts, it is crucial for Guinea-Bissau to balance its investments in both adaptation and mitigation efforts and adopt an integrated approach to addressing climate change challenges. Meanwhile, the allocation for mitigation (US$2 million or 10 percent of the total climate funds) and projects with multiple objectives (US$2 million or 10 percent of the total funds), though modest, represents a critical acknowledgment of the importance of a comprehensive environmental strategy. Additionally, improving the tracking and reporting of climate finance projects will enhance transparency and enable more informed decision-making in the future. It is essential for the country to balance its efforts in both adaptation and mitigation, as investing in low-carbon technologies and practices can provide long-term benefits in terms of sustainable development and climate resilience.

The analysis of climate finance sources in Guinea-Bissau shows a heavy reliance on international financing, particularly from multilateral development finance institutions. While the government's domestic contribution demonstrates its commitment to addressing climate change, the relatively small share of domestic financing highlights the need for continued support from international partners. Strengthening collaborations with bilateral development finance institutions and multilateral climate funds and exploring innovative financing mechanisms can help Guinea-Bissau mobilize additional resources to tackle climate change challenges effectively.

To achieve its 2030 target of reducing CO_2 emissions in accordance with the Paris Agreement, Guinea-Bissau's NDC has estimated that it will require investments totaling US$664 million. Of this amount, approximately US$300 million will be needed for investments to adapt the country's energy matrix. Guinea-Bissau is already a participant in a regional hydroelectric power distribution plan, the OMVG Energy Project, and four high-voltage substations are expected to be built in Guinea-Bissau. The government of Guinea-Bissau will need to implement a national electrification strategy that addresses investment planning, institutional and contracting arrangements, financing, and regulations. In this context, the EAGB might be an important vehicle to pursue opportunities for green investments but current uncertainties about its financial sustainability would need to be resolved, and an investment plan would need to be elaborated to make any opportunity viable.

Overall, the analysis highlights the relatively significant allocation of grants toward climate-related initiatives in Guinea-Bissau, indicating the country's commitment to addressing climate change and promoting sustainable development. Out of the total US$40.3 million grant received in 2019–20, US$12 million (29.7 percent) were allocated to climate-related initiatives. By allocating resources toward climate-focused projects while maintaining a balanced approach to grant allocation, stakeholders can work toward a more sustainable and resilient future for Guinea-Bissau. However, it is essential to acknowledge that the remaining 70.3 percent of the grant was allocated to other development sectors such as education, health, and infrastructure. This highlights the need for a balanced approach to grant allocation, where resources are distributed across different sectors while addressing climate change and promoting sustainable development. It also shows the need to mainstream climate change in all sector development, including along the 70.3 percent.

However, given the high debt-to-GDP ratio, the country should prioritize sustainable debt management and explore alternative financing mechanisms, such as grants and concessional loans, to address climate change effectively without jeopardizing fiscal stability. The climate-related debt of US$8 million represents approximately 0.87 percent of the total debt and 2.67 percent of the net increase in debt from 2018 to 2019. This relatively small percentage indicates that there may be potential for Guinea-Bissau to allocate more resources to climate-related initiatives in the future.

5.2 Options for diversification of climate and development financing

The total cost for implementing the proposed activities in the CCDR is estimated around US$1 billion in 2023 dollars for the next six years (Table 12)—more than US$165 million per year (around 13.7 percent of the GDP), which far exceeds the available climate financing. Accordingly, Guinea-Bissau should mobilize additional resources to support its climate and development agenda.

Table 12. Estimation of the Investment Needs from the CCDR (2023 US$, millions)[72]

		Priority			TOTAL
		Very high	High	Medium	
Period	Short-term (2024–26)	150.0	71.1	95.2	**316.3**
	Medium-term (2027–29)		462.8	157.8	**620.6**
TOTAL		150.0	533.9	291.0	**974.9**

Diversification of funding sources is critical to address not only climate challenges, but also development challenges, and should form part of a medium-term development vision. The current over-reliance on public international funding will not meet the funding needs to address climate challenges. Although many of the climate financing options (see Annex 8) will not be available to Guinea-Bissau because of high debt, political instability, and other considerations, there are some actionable steps that can be taken. These include developing private sector engagement frameworks for climate finance and building on high-integrity national funds, such as the BioGuinea Foundation,[73] which is already in existence and could be used to manage carbon finance, while also engaging in discussions to swap existing debts for climate investments.

5.2.1 Debt-for-nature/climate swap[74]

In the case of Guinea-Bissau, debt-for-nature swaps could provide a valuable opportunity to address both its debt burden and environmental conservation needs, contributing to the country's sustainable development and the protection of its natural resources.

- ***Debt relief:*** Guinea-Bissau has a significant external debt burden, which can hinder its ability to invest in environmental conservation and sustainable development. Through a debt-for-nature swap, a portion of Guinea-Bissau's debt could be forgiven or restructured, providing the country with financial relief.
- ***Conservation commitments***: In exchange for debt relief, Guinea-Bissau would commit to using the freed-up funds to invest in conservation efforts, such as protecting biodiversity, preserving natural habitats, and promoting sustainable resource management. This could involve initiatives like establishing protected areas, implementing sustainable forestry practices, or supporting community-based conservation projects.
- ***Partnership with conservation organizations***: Debt-for-nature swaps often involve partnerships between the debtor country, conservation organizations, and international donors. These partnerships help ensure that the funds freed up through debt relief are effectively used for

[72] Using a 3% discount rate.
[73] The BioGuinea Foundation is an independent and nongovernmental institution registered in the United Kingdom and headquartered in Bissau. Its objective is to provide financial resources and mobilize partnerships to benefit biodiversity conservation, sustainable community development, and environmental education in Guinea-Bissau. https://www.bioguinea.org/.
[74] An example of a successful debt-for-nature swap is the agreement between the United States and Peru in the 1990s. The United States forgave a portion of Peru's debt in exchange for the Peruvian government's commitment to invest in the conservation of the Amazon rainforest. This initiative led to the establishment of protected areas and sustainable resource management practices in the region.

conservation purposes and provide technical expertise and support for conservation initiatives. The BioGuinea Foundation could play a role in that regard.

- ***Long-term impact***: By investing in conservation and environmental protection, Guinea-Bissau could benefit from improved ecosystem health, sustainable natural resource management, and enhanced resilience to climate change. These benefits can contribute to the country's long-term economic and social development.

5.2.2 Access to carbon financing

Targeted sectoral investments in sectors like AFOLU and energy are critical for adaptation and could have mitigation dividends. Actions to be taken involve increasing investments in renewable energy and energy efficiency to increase access and reduce emissions and integrating low-carbon pathways into national development plans. This effort could lead to access to the carbon market.

Guinea-Bissau's legal and institutional frameworks currently lack specific provisions for carbon trading, presenting a major barrier to the country's engagement in international carbon markets and REDD+ project implementation. There is a widespread lack of understanding among key stakeholders, including government bodies, the private sector, and civil society, regarding carbon credits, which hampers the country's capacity to meet the complex demands of these markets. The absence of monitoring, reporting, and verification systems further complicates the tracking of emission reductions and the validation of carbon credits. Additionally, Guinea-Bissau has yet to establish rules for authorizing internationally transferred mitigation outcomes in accordance with the Paris Agreement. The creation of a national registry and corresponding adjustments is essential to manage carbon credit transactions and prevent double counting. To effectively participate in carbon markets, the country must also regulate carbon rights and develop legal frameworks for emission reductions transactions. Finally, equitable benefit-sharing mechanisms are crucial for REDD+ projects to ensure that all stakeholders, particularly local communities, receive a fair share of the benefits from carbon trading.

Addressing these gaps and implementing the necessary frameworks and systems will be critical for Guinea-Bissau's readiness to access carbon markets.

Recommendations:

- **Develop specific climate change legislation** and detail the country's approach to carbon markets and REDD+ activities.
- **Build institutional capacity** by strengthening institutional knowledge and capacity for managing carbon market mechanisms and ensuring compliance with international standards.
- **Establish robust monitoring, reporting, and verification systems** to accurately monitor, report, and verify emission reductions from REDD+ and other carbon market activities.
- **Create authorization and accounting procedures for internationally transferred mitigation outcomes** in line with the Paris Agreement.
- **Establish a national registry system for carbon credits and procedures** for making corresponding adjustments to ensure transparency and prevent double counting.
- **Define and regulate carbon rights, establish legal frameworks for emissions reductions transactions**, and ensure that the country has the capacity to engage in these transactions.
- **Develop fair and transparent benefit-sharing mechanisms** for REDD+ projects to ensure that all stakeholders, especially local communities, receive their fair share of benefits from carbon trading.

Chapter 6: Conclusions and Priorities

The analysis of this CCDR demonstrates how Guinea-Bissau can take up and build synergies between development and climate objectives, since the two cannot be separated. It is framed within the country's fragile political and institutional context. Objectives should be aligned to maximize the positive impact of sectoral transformations and minimize the damage and impacts that climate could entail.

The fragility context must remain at the forefront of decision-making, driving realistic recommendations. Central to these suggestions is the need to bolster institutional and financial foundations, which are essential to realize the proposed pathway. However, in the meantime, no-regret activities should be undertaken, relying on local actions, and implemented by communities, which will provide job and socioeconomic outcomes for the population.

The most effective option for Guinea-Bissau to tackle the climate crisis is to grow sustainably and reduce poverty, and climate actions can support these dual goals. All other things equal, fast-growing and prosperous countries will be much better positioned than others to protect themselves from the most harmful effects of climate change. Therefore, political stability, sound governance, adequate institutional capacity, and a conducive business environment are key foundations for building climate resilience and sustainable growth.

Climate-friendly actions can support the transition toward a sustainable and inclusive future that can deliver significant socioeconomic benefits and reduce damage caused by climate change. Guinea-Bissau must seize the opportunity to improve its political and business environment and act now to avoid addition risks, irreversible environmental losses, and costly lock-ins.

6.1 Immediate priorities (next three years, 2024–26)

In the **short term**, given the current political context, institutional capacities, and financing constraints, Guinea-Bissau should prioritize: (i) investing in local, no-regret actions that deliver direct benefits to the most vulnerable communities, especially in terms of food security, while preserving its natural capital to support both resilience and future development; (ii) expanding cheaper and more reliable energy access; and (iii) developing the enabling environment by strengthening institutions and actors, including community members, to improve the business-enabling environment and lay the ground for future policy reforms and preparation of resilient investments.

In particular, the following specific no-regret actions are recommended:

- ***Develop climate-smart agriculture practices*** with (i) crop diversification and crop resistant alternatives, as well as (ii) more productive agriculture and livestock practices, to provide food for the population while reducing pressures on the water resources and the environment.
- ***Protect natural capital*** through (i) strengthened support to the national system of protected areas, (ii) development of forest cover monitoring capacity to track deforestation and land-use changes, and (iii) support to natural regeneration or forest restoration, especially mangroves.
- ***Support the development of cheaper, more reliable, and less-carbon intensive energy systems,*** especially with the (i) scale-up of solar, (ii) connection with the regional energy pool to provide more reliable access to low-carbon energy, and (iii) micro-grid development for communities and businesses/private sector.
- ***Continue to build human capacity and knowledge systems***, with capacity building of institutions on key topics related to the climate agenda and data collection and management to inform future plans. Women need to be central to this, and a strategy to improving the education system needs to be implemented to ensure the next generation is better equipped to be part of the transition.

Improving the business-enabling environment should be a key priority to be implemented in the short term and achieved in the medium term. Key elements are the implementation of a PPP taskforce/framework and bylaws, access to land, business licensing and registration, and an investment code, among others.

6.2 Medium-term priorities (before 2030, 2027–29)

In the medium term, the focus should be on building on the short-term institutional foundation and no-regret investments to support the transition toward the long-term vision. The actions in the medium term are focused on:

- ***Developing and implementing participatory integrated landscape management plans and projects*** with adequate local structure that align the objectives of nature conservation and socioeconomic development. The plans should include: (i) the expansion of sustainable agriculture and irrigation programs and agriculture sector organization, including strengthening women-led structures; (ii) programs to enhance forest protection, including mangroves, that integrate climate mitigation and adaptation; and (iii) a water expansion program that includes both investments and the enhancement of sector regulation.
- ***Further scaling up the use of renewable energy (especially solar, up to 46 percent expected by 2033 in a high growth scenario)*** to support electricity access for the population in a more affordable and reliable form while reducing carbon emissions.
- ***Promoting integrated coastal zone management***, including improved marine and spatial planning and enforcement capacities for protecting and managing coastal ecosystems, while facilitating participatory and decentralized coastal communities' development to advance local community welfare and ecosystem integrity.
- ***Setting up flood and high-tide EWSs and weather information services*** for urban and rural communities and ***enhancing social protection systems to protect the most vulnerable*** in the event of climate and other shocks.
- ***Embarking on more complex infrastructure projects in rural and urban areas*** with a focus on climate resilience and improved asset management practices and funding mechanisms to target limited capital investments strategically to maximize resilience in the future physical investments.

6.3 Way forward

The CCDR refrains from elaborating longer-term actions given the high uncertainty about the national political context, unfavorable business environment, and an uncertainty in predicting costs, benefits, affordability, and suitability of specific interventions in this context. Any estimates for the post-2030 period embed a high degree of uncertainty, including those in this report.

This report demonstrates that climate action is not only compatible with foundational development goals, but highly complementary and beneficial to keep Guinea-Bissau on track to meet its development ambitions. It identifies actions that are good for the country's development, build resilience, and set the foundations for future decarbonization when conditions will be in place, while flagging risks of costly lock-ins into obsolete or risky development directions and opportunities to leapfrog to more a more sustainable and inclusive development pathway. Even though only a small subset has been selected as the main priorities for immediate actions based on impacts, feasibility/complexity, and costs, as described in Chapter 3, a longer list of climate-related actions has also been proposed for each sector to pave the way toward a sustainable, resilient, and inclusive development.

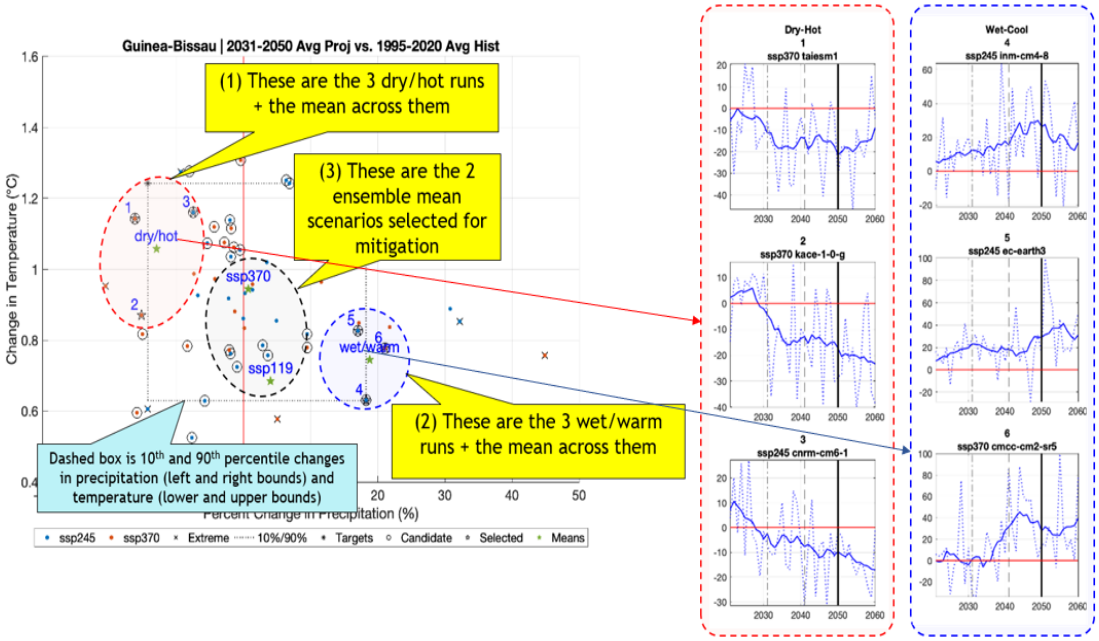
Guinea-Bissau should consider revisiting its climate strategy at regular intervals to take stock of how such developments and outcomes from interim climate actions have impacted the feasibility and attractiveness of various future options. Assessing, monitoring, and evaluating the impact of previous actions will be key to identify the best options to maximize both climate and development outcomes. This analysis could also provide the data for the update of the country's NDC required in two years' time. But it should primarily be used in lockstep with key development actions to reduce the impacts of climate change on Guinea-Bissau's economy and population.

Pathway	Priority areas	Recommended actions		
Cross-cutting enabler	***Enhance the enabling environment***	Strengthen coordination of climate actions around the national committee on climate change	Revise laws, especially on PPPs, to improve the business-enabling environment for private sector investment Unlock access to finance for climate action and sustainable development	Strengthen climate data collection and sharing to build knowledge Finance to implement the transitions
Climate-resilient development	***Adopt an integrated approach to agriculture and the environment***	Foster integrated landscape management, with the development of community-based land-and-resource-use plans	Promote climate-smart agriculture, with diversification of crops and improvement of drainage systems	Improve the reliability and quality of water delivery, with a monitoring system, and adoption of national master plan
Low-carbon development	***Support new opportunities for carbon sequestration***	Support the protection of forests, including through the national system of protected areas, with a national forest monitoring system	Enable participation in carbon markets	
	Promote the development of renewable and clean energy	Scale up the share of renewable energy sources through the deployment of solar panels	Increase access to clean and efficient energy, with extension of mini-grids	Strengthen connectivity to regional energy markets

Annex 1 Description and Selection of Climate Scenarios

To address climate uncertainty in the future, results from numerous general circulation models (GCM)[75] of climate scenarios[76] were considered and shortlisted to those that fall within the 10th and 90th percentile of mean precipitation and mean temperature changes.

Figure 28 Climate Scenario Selections



Source: World Bank staff estimations and Industrial Economics, Incorporated

Table 13 Climate Scenario Summary

TYPE	*SCENARIO*	*SCENARIO DESCRIPTION*
Mitigation	SSP1-1.9 mean	GCM average of an optimistic future where global GHG emissions align with the limited 1.5 °C of warming pathway by 2100.
	SSP3-7.0 mean	GCM average of a pessimistic future where global warming reaches 4 °C by 2100.
Dry/hot future	SSP3-7.0 TAIESM1	Three scenarios selected to represent the dry and hot future: the 10th percentile of mean precipitation changes and the 90th percentile in mean temperature changes across SSP2-4.5 and SSP3-7.0 GCMs.
	SSP3-7.0 KACE-1-0-G	
	SSP2-4.5 CNRM-CM6-1	
	Dry/hot mean	Average across the above three dry and hot scenarios.
Wet/warm future	SSP2-4.5 INM-CM4-8	Three scenarios selected to represent the wet and warm future: the 90th percentile of mean precipitation changes and the 10th percentile in mean temperature changes across SSP2-4.5 and SSP3-7.0 GCMs.
	SSP2-4.5 EC-EARTH3	
	SSP3-7.0 CMCC-CM2-SR5	
	Wet/warm mean	Average across the above three wet and warm scenarios.

Source: World Bank staff estimations and Industrial Economics, Incorporated

[75] GCMs are a type of mathematical global climate model which cover physical processes of the atmosphere and ocean to simulate future climate changes as a result of increasing GHG emissions.
[76] Climate scenarios consider different combinations of shared socioeconomic pathways (SSPs) and representative concentration pathways (RCPs). RCPs set pathways for GHG concentrations and, effectively, the amount of warming that could occur by the end of the century, whereas SSPs consider whether reductions in emissions will be achieved.

The selection was reduced to those climate scenarios falling within the 10th and 90th percentile of mean precipitation and mean temperature changes. Out of all these shortlisted scenarios, a final set of ten climate scenarios was selected for this study (see Figure 28). The 10 climate scenarios include two focusing on emissions uncertainty, 6 capturing uncertainties across climate models, and 2 representing means over dry/hot and wet/warm climate futures (Table 13).

For each damage channel, the least and most pessimistic climate outcomes were selected based on the average size of the direct shocks over 2021–50. When combined, the dry/hot mean and wet/warm mean climate scenarios were chosen to analyze the impacts of all damage channels on macroeconomic and poverty aggregates.

Annex 2 Description of Low and High Growth Scenarios

Low growth scenario. This scenario replicates historical episodes that have impeded Guinea-Bissau's economic growth and development. A deterioration of political stability would set the country on a fragile path and prevent any meaningful governance or economic reforms. Annual GDP growth would average 4.8 percent over 2023–50, that is, one percentage point less than the average under the medium scenario and not enough to address the country's structural challenges. Investments will remain low and volatile, as has been historically the case during periods of political instability, contributing marginally to GDP growth. Governance reforms to boost domestic revenue mobilization and increase transparency would be insufficient, limiting prospects for investment in socioeconomic sectors. This would be further compounded by inadequate regulatory frameworks. Meanwhile, labor participation will stagnate, and the employment rate will stabilize around historical levels over 2023–50.

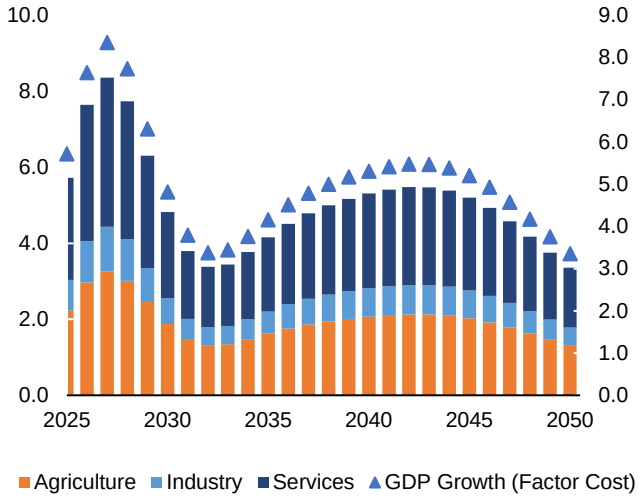
Low and volatile investments would constrain productivity gains and structural change. Sectoral shifts would remain limited due to low investment in manufacturing and agriculture, and the export base would remain concentrated in raw cashew nuts. The volatile patterns of investment would also halt annual productivity growth, while human capital accumulation would be disrupted by persistent strikes in the health and education sectors. Services would be predominantly geared toward commodities and represent a relatively smaller share of the economy compared to the medium growth scenario. With limited structural change, labor force participation would remain unchanged from 2022 levels. The lack of investment means that productivity growth falls to 1.2 percent since human capital accumulation is slowed by widening strikes in the health and education sectors, causing schools and medical facilities to grind to temporary halts.

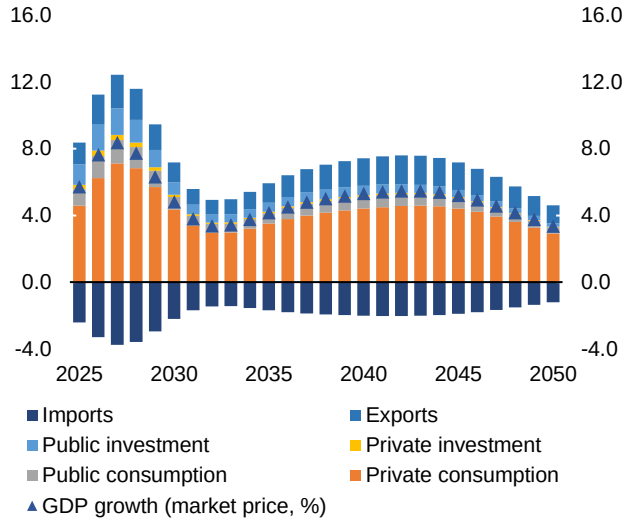
High growth scenario. Per capita economic growth would outperform historical trends. Supported by adequate public financial reforms to boost domestic revenue while improving the depth and efficiency of public investments, GDP growth would be stronger, averaging 7.0 percent annually over 2023–50. The public financial reforms would also improve efficiency and TFP and accelerate private investments. Sectoral policies will progressively shift away from subsistence agriculture to the promotion of new agrifood value chains, and the extraction of the rich bauxite and phosphate reserves would begin with smelting and possible processing into end products, further extending this value chain beyond the normal growth scenario.[77] As a result, exports would contribute relatively more to GDP growth while private consumption's contribution would stabilize close to historical trends.

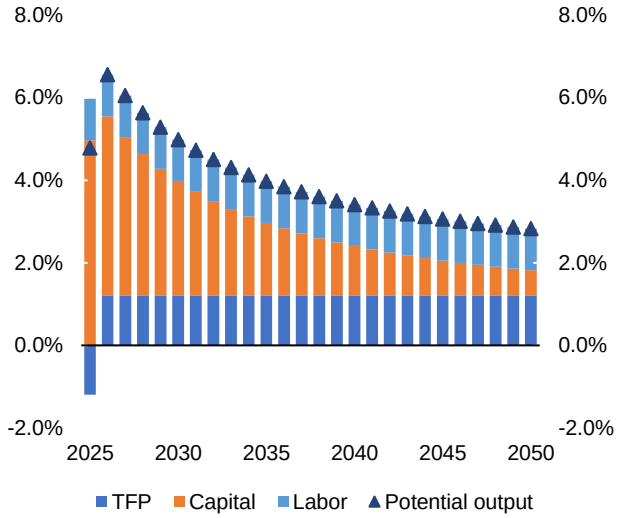
Investment in human capital will pave the way for improved development outcomes. Higher domestic revenue mobilization and political stability would be accompanied by greater donor support (including from climate financing) and translate into adequate levels of investments in social sectors, i.e., education and health. This, combined with a more favorable business environment, would result in a gradual decline of the fertility rate alongside a deceleration of the working-age population and moderate, gradual increases in labor participation and employment over 2023–50. Supported by productivity gains, the economy will experience major sectoral shifts. The decline of the agriculture share of GDP would accelerate over 2023–50 while manufacturing will expand as cashew processing and new agrifood opportunities emerge alongside infrastructure investments. The energy sector would also expand, reflecting expected investments over the next few years. The services sector will experience a less significant expansion but will deepen with a focus on logistic and information technologies industries.

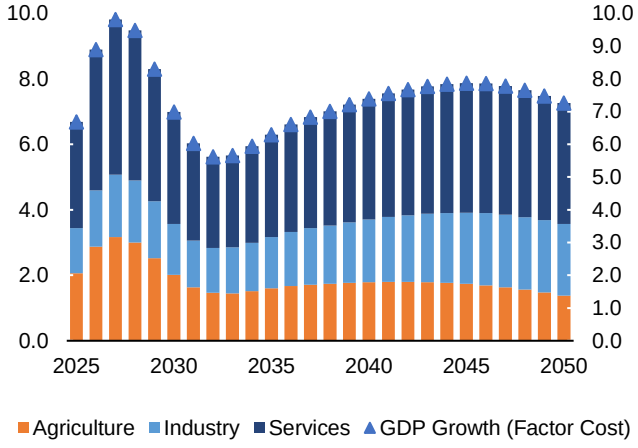
[77] Despite conditions for the high growth scenario not currently being met in Guinea-Bissau, on May 13, 2024, the government of Guinea-Bissau announced that two Russian firms would begin prospecting for bauxite and oil in Guinea-Bissau in 2024. However, similar announcements have happened historically over the course of several decades but extraction has yet to begin, suggesting other bottlenecks.

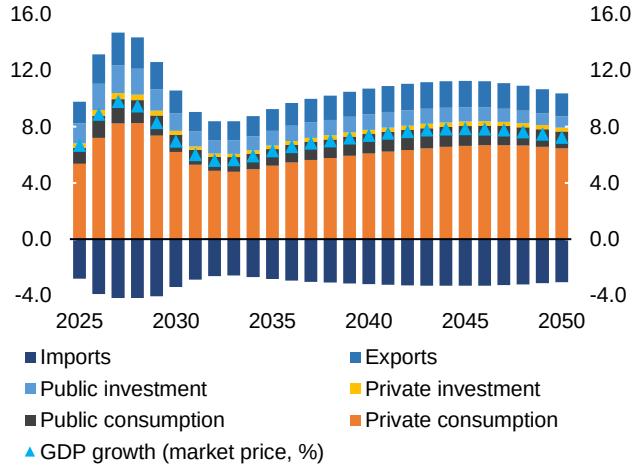
BOX. Growth Decomposition for the **Low Growth Scenario** (Top Three Charts) – *Average Per Capita Income Yearly Growth of 2.3 Percent (2x over the Period)* – and the **High Growth Scenario** (Bottom Three charts) – *Average Per Capita Income Yearly Growth of 4.6 Percent over 2025–50 (3.6x over the Period)*

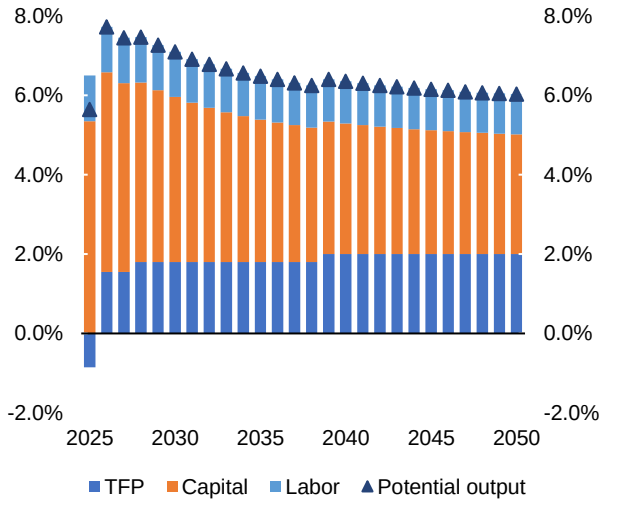












Annex 3 Methodological Consideration on the Impact Channels

The impact channels and related economic damages interact with the economy's structure to generate the aggregate macropoverty results. The modeled impact channels—crop productivity, labor productivity, human health (labor supply), and capital stocks—are key drivers of Guinea-Bissau's economic growth. Table 14 describes the structural components through which the estimated impact channels affect Guinea-Bissau's potential GDP under alternative growth scenarios.[78] Crop yield loss and heat's influence on labor productivity are projected to deliver larger GDP losses under the low growth scenario, since it features a relatively sizable agricultural sector. On the other end, labor supply and health damages will have bigger effects on an economy with a larger share of human capital. Capital stock damages from climate change tend to be larger (in absolute terms) under high growth scenarios due to higher levels of investments and capital stocks.

Table 14 Key Interactions between Damage Channel and Socioeconomic Structures and Projections

Impact channel	Key interactions with socioeconomic structures and projections	Growth baselines		
		Low	Trend	High
Crops rainfed	Share of agriculture sector in GDP			
Crops erosions	Share of agriculture sector in GDP			
Labor productivity (heat)	Share of agriculture workers in total employment			
Labor supply (health)	Size of human capital			
Sea level rise and storm surge	Size of capital stock (absolute)			
Inland flooding	Size of capital stock (absolute)			
Road and bridges	Size of capital stock (absolute) and size of human capital (delays)			

Higher shock impacts
Medium shock impacts
Lower shock impacts

The productive capacity or potential output of an economy is affected by climate change through three main channels: (a) through the TFP channel from temperature effects on labor productivity, droughts, and erosion impacts on agriculture yields and destroyed road and bridge effects on labor hours; (b) through loss or damages on capital stock from damages to capital stock from inland flooding, sea level rise and storm surges, and road and bridge damage; and (c) through loss or damage to human capital from impacts on human health from climate-related diseases. Climate damage reduces potential output through economic damage and creates a positive output gap that causes inflationary pressures. This, in turn, reduces real income for households and decreases profits for businesses. A reduction in real income leads to a reduction in demand for goods and services, while a reduction in profit reduces the incentive for companies to invest. Together, an economy will be operating in a lower equilibrium when climate damages are considered. Table 14 describes potential output hooks (TFP, capital, and labor stocks) through which climate change enters the macro model.

[78] It is important to note that the seven damage channels included in this study are by no means exhaustive, and the outcomes should be considered as a partial analysis of climate change effects in Guinea-Bissau. For example, some of the missing channels, such as wildfire, livestock, ocean, biodiversity, tourism, outdoor recreation activities, hydro energy, and climate migration, are not quantified and therefore not included in this analysis. Moreover, the analysis is limited to Guinea-Bissau. Global impacts from climate change will amplify the shocks through other channels such as trade, commodity prices, and the financial market.

Table 15 Summary of the Climate Impact Channels Considered in this Analysis

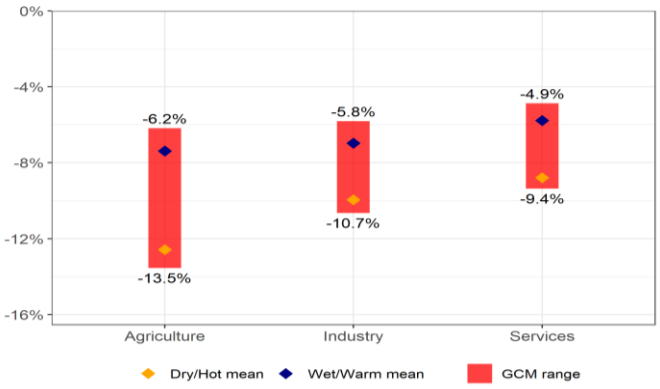
CHANNEL OF IMPACT		Description	HOOK TO POTENTIAL GDP			
			Aggregate and sectoral TFP		Human capital stock	Physical capital stock
			Sectoral productivity	Labor productivity	Labor supply	Physical capital
Human capital						
1	Labor heat stress					
2	Human health					
Agriculture and natural resources						
3	Rainfed crops					
4	Erosion crops					
infrastructure and services						
5	Inland flooding					
6	Sea level rise and storm surge					
7	Roads and bridges					

Annex 4 Direct Shocks from Climate Impact Channels: Detailed Description

1. *Heat impacts on labor productivity*

Higher workday temperatures affect labor productivity by decreasing the hours an individual can work. The labor productivity shocks are different among sectors and based on the sector's labor hours by occupation and the extent to which these occupations are exposed to outdoor work. Generally, heat stress intensifies for outdoor labor types and with the more intense physical work often associated with the agriculture sector. In the most pessimistic scenario, productivity of Guinea-Bissau's workers is expected to fall by 13 percent, 10 percent, and 9 percent in agriculture, industry, and services, respectively. It is worth noting that in more favorable climate scenarios, heat impacts on labor productivity are still significant (around 6 percent).

Figure 29 Labor Productivity Shock 2041–50

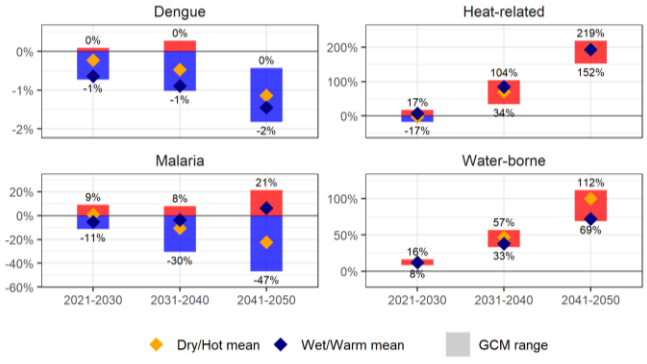


Source: World Bank staff estimations and Industrial Economics, Incorporated

2. *Vector-borne, waterborne, and temperature-related diseases impact human health*

Climate change can impact the labor supply through increased incidence and death rates of various diseases such as malaria and dengue (vector-borne), diarrhea (waterborne), and heat-related illnesses. This results in working days lost due to absenteeism or increased deaths. For Guinea-Bissau, these health impacts due to climate change can cause up to a -0.5 percent reduction in labor supply in 2050 in the most pessimistic scenario.

Figure 30 Projected Effect of Climate Change on Annual Death Rates Per 100,000 People by 2041–50

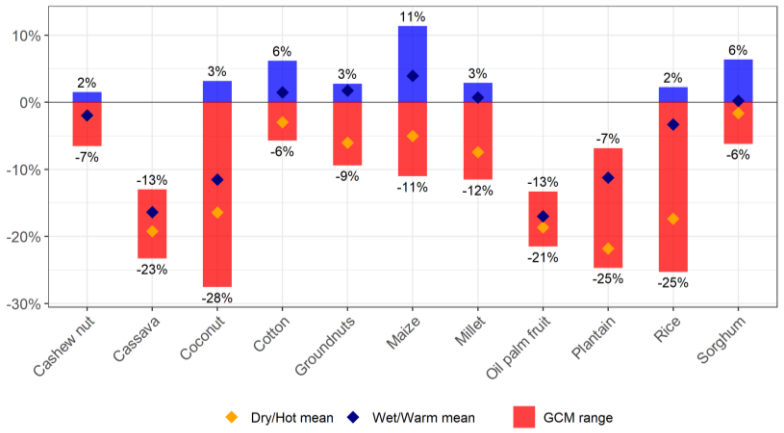


Source: World Bank staff estimations and Industrial Economics, Incorporated

3. *Changes in precipitation and temperature impact on crop yields*

Changes in precipitation patterns can reduce water resources for rainfed agriculture, while temperature increases are likely to reduce the suitability and productivity of crops and can produce additional impacts on overall water resource availability. Impacts vary significantly for different crops, with coconut, plantain, and cassava being the most affected crops, with up to a 31 percent yield loss from the dry/hot conditions. On average, yields will fall by 12 percent across all crops from 2040 to 2050 in the most pessimistic scenario.

Figure 31 Projected Changes in Yields by 2041–50 Due to Precipitation Changes, by Crop

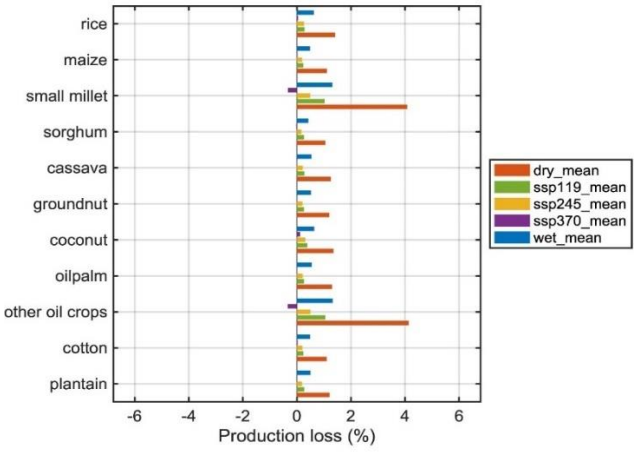


Source: World Bank staff estimations and Industrial Economics, Incorporated

4. *Erosion impacts on crop yields*

Changes in rainfall can also change soil conditions and topsoil erosion, resulting in crop productivity changes. Yield impacts vary significantly across crop types. For example, in the most pessimistic erosion case under a wet climate scenario, cashew nut and millet yields fall by almost 8 percent, with an average 2 percent loss across the crops between 2040 and 2050. Under a dry future climate scenario, crop yields are expected to improve from the current situation between a range of 0–2.5 percent with an average improvement of just under 1 percent across the crop types.

Figure 32 Projected Changes in Agricultural Output in 2050 as a Result of Erosion, by Crop

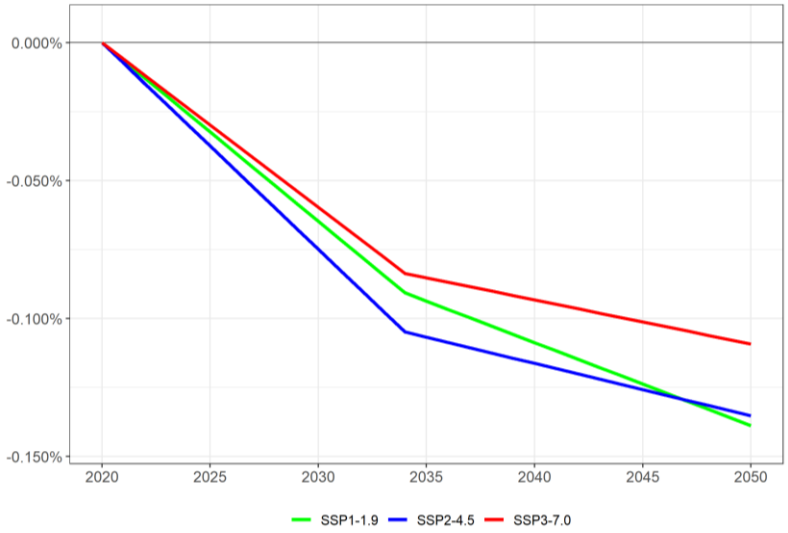


Source: World Bank staff estimations and Industrial Economics, Incorporated

5. *Inland flooding impact on capital stock*[79]

Inland flooding channel considers damages to capital stock across the country from changes in the magnitude and frequency of riverine (fluvial) flooding. Considering all future inland flooding events, the expected damages (that is, the sum of the probability of each event multiplied by its magnitude) from inland flooding is estimated to be 0.15 percent of Guinea-Bissau's capital stock.

Figure 33 Projected Inland Flooding Shocks



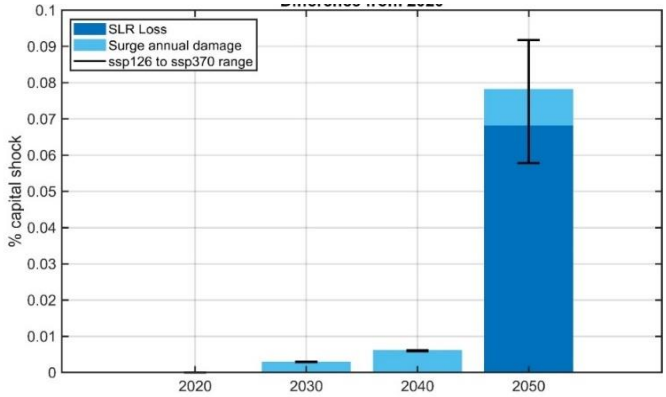
Source: World Bank staff estimations and Industrial Economics, Incorporated

6. *Sea level rise and storm surge impacts on capital stock*[80]

This channel considers shocks on coastal capital stocks from increases in mean sea level and changes in the frequency and magnitude of storm surge events. Damages are split into repairable and permanently destroyed coastal capital stocks, where the latter results in a permanent loss in the country's total capital stock and the former requires a divergence of public investment to non-productive spending on repairs. The change in mean sea level relative to baseline conditions is expected to increase throughout the period. Relative changes across selected scenarios are similar, with sea levels expected to increase by 0.1 meters by 2030. Damages from sea level rise become noticeable in the 2050s. Given the leap in the shocks between the 2040s and 2050s, damages from sea level rise and storm surges in Guinea-Bissau are expected become more severe toward the end of this century. The spread between the scenarios increases slightly by midcentury with SSP3-7.0 resulting in a shock of -0.07 percent incremental capital losses.

[79] The inland flooding analysis relies on data for the peak one-day precipitation magnitude and frequency rather than mean precipitation volumes. As a result, the analysis was performed on the SSP1-1.9 and 3-7.0 median (50th percentile) results.
[80] Analysis on sea level rise and storm surge relies on processed variables resulting from changes in global temperatures and other effects on atmospheric and oceanic phenomena from global climate change (that is, changes in global and regional mean sea levels and cyclone tracks, frequency, magnitude, and duration). These estimates utilize median (50th percentile) results for SSP1-1.9 and 3-7.0.

Figure 34. Projected Effect of Storm Surge on Capital Stock

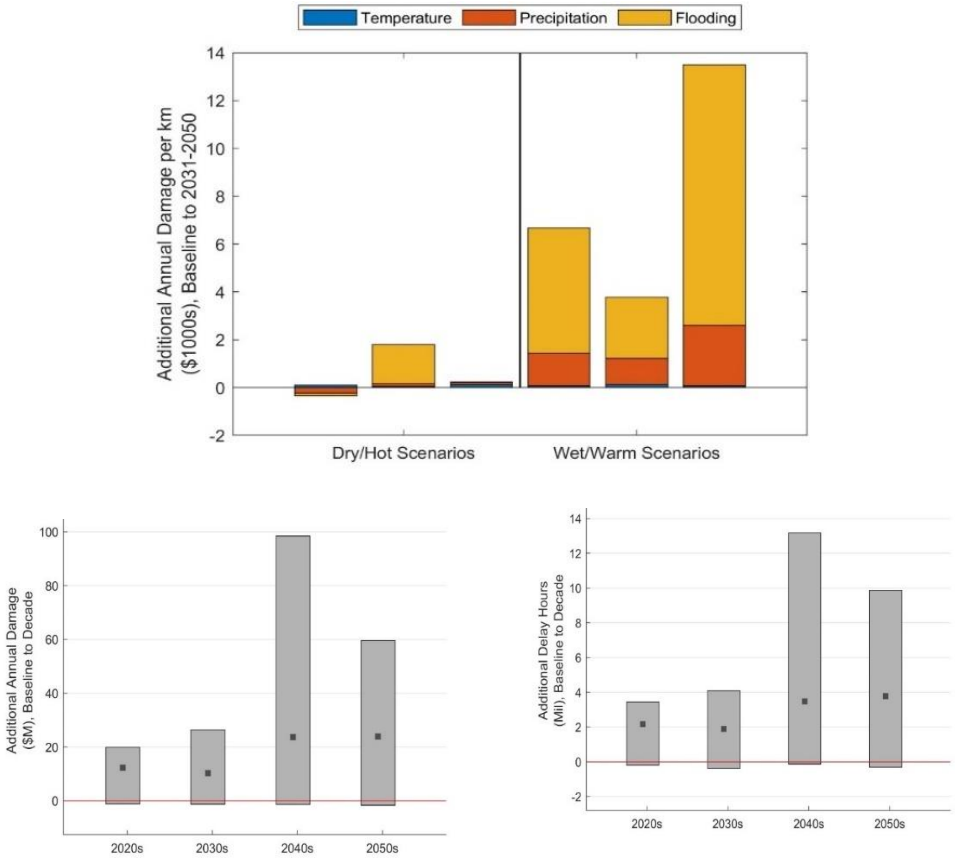


Source World Bank staff estimations and Industrial Economics, Incorporated

7. *Road and bridges impact on capital stock and productivity*

Road and bridge infrastructure are at risk of damage from higher temperatures, precipitation, and flooding recurrence, as well as road disruption effects on reduced working hours. By 2050, additional annual damages relative to the baseline under a wet future are estimated at around US$60 million—approximately 0.5 percent of Guinea-Bissau's projected capital stock. In addition, extra delay hours will range from -0.25 million to 13.5 million hours (about 0.5 percent reduction in overall productivity).

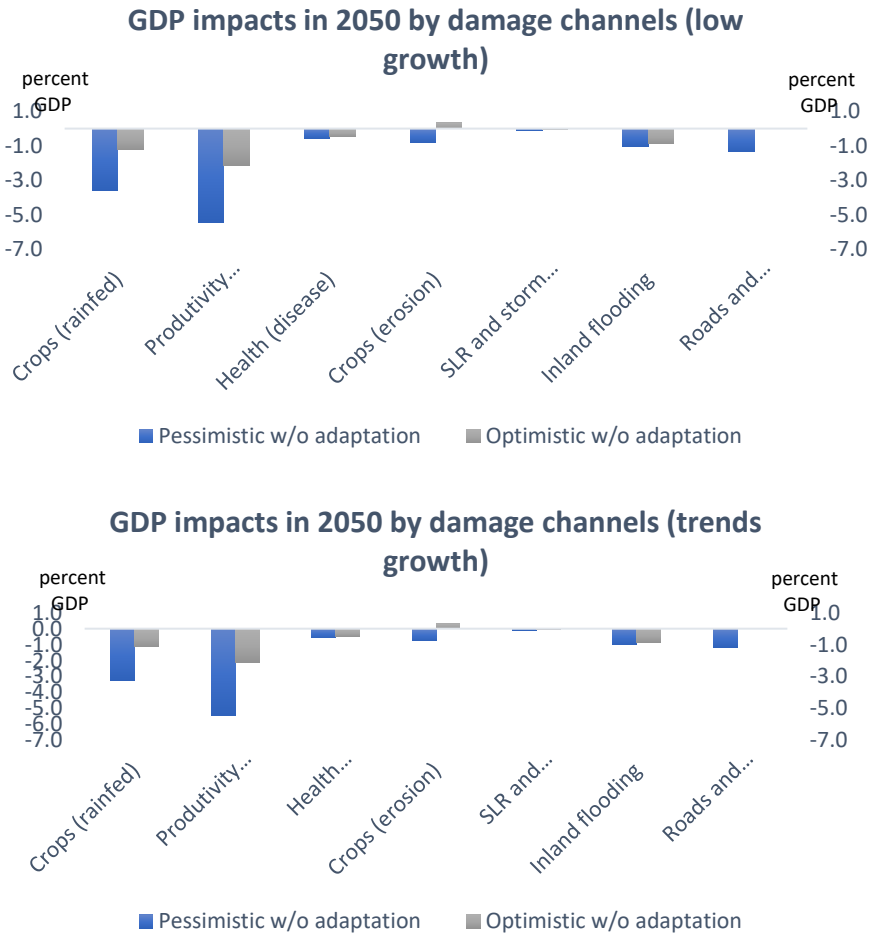
Figure 35 Projected Additional Annual Damages Per Km by Climate Hazard (Temperature Change, Precipitation, and Flooding)



Source: World Bank staff estimations and Industrial Economics, Incorporated

Annex 5 Channel-Specific Breakdown of GDP Impacts

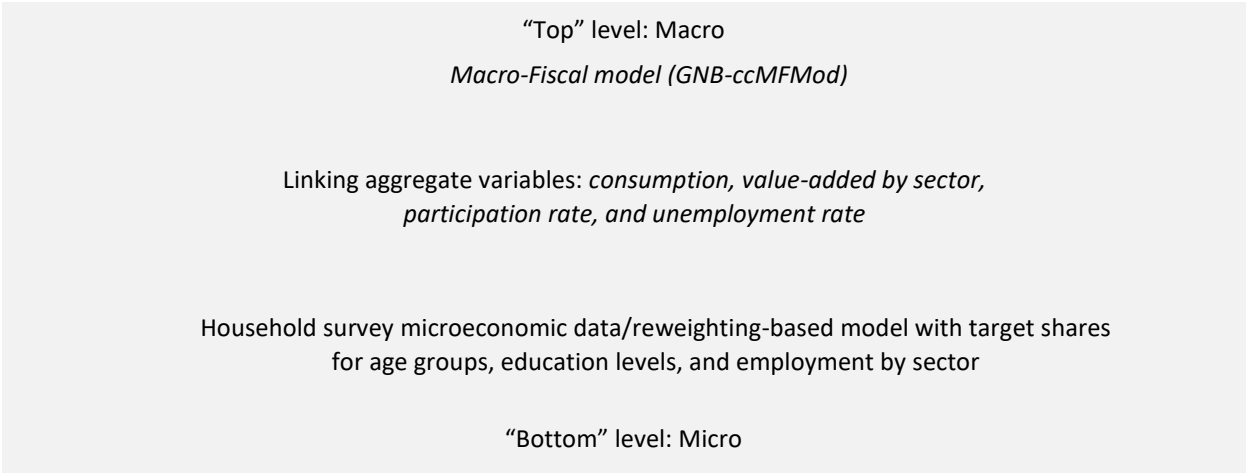
Figure 36 GDP Impacts of Individual Damage Channel in Channel's Specific Optimistic and Pessimistic Climate Outcomes as Percentage Differences from No Further Climate Change Baseline in 2050



Annex 6 Approach to Poverty Microsimulations

The welfare effects of the different climate-related scenarios are estimated using a top-down macro-micro model.[81] At the top, we use the Climate-Augmented Macro-Fiscal model (GNB-ccMFMod) and at the bottom, a reweighting-based approach to the 2018–19 Guinea-Bissau household survey (Figure 37).[82]

Figure 37 Reweighting-Based Approach for Top-Down Microsimulations with MFMod



MFMod generates a small number of macroeconomic time series that can be used as linking aggregate variables. Among them, we use aggregate consumption, value-added by sector (agriculture, industry, and services), participation, and unemployment rates. The 2018–19 Harmonized Survey on Households Living Standards contains consumption at the household level, income at the individual and household level, and status and employment sector. We use a Mincer regression equation to replace missing income values and outliers. We then generate the shares of labor and non-labor income in total household income and apply these to total household consumption to generate labor and non-labor consumption. Using a similar method, we distribute household consumption among employed household members according to their share of income in total household income.

We calculate changes in poverty and inequality from 2018 to 2050 by adjusting population weights and real consumption per capita in each year. We generate a new set of weights for each simulated year and scenario using Wittenberg's cross-entropy package (2010). This procedure regenerates the households' weights by choosing the minimum adjustment to match a specified population group target. In this case, the population targets are:

1. *total population by gender and age (grouped into 10-year cohorts) using data derived from the UN population projections,*

2. *total population by education levels, under the assumption that new young cohorts (20–30 years old) entering the population are as educated as the current 20–30 year-old group, and*

3. *the share of employment by sector (number of individuals in a sector over the total population). We create the target value for the latter using the change in value-added by sector and an employment-to-value-added elasticity by sector.*

[81] There is a large body of literature about macro-micro models, which typically considers linking a Computable General Equilibrium model to a microsimulation model. See Ahmed and Donoghue (2007); Bourguignon and Bussolo (2013); Ruijven, O'Neill, and Chateau (2015); and Savard (2003) for reviews of the literature on these methods.

[82] Similar strategies have been applied in the literature to link a macroeconomic model to a microeconomic dataset. See for example, Buddelmeyer, Hérault, Kalb, and van Zijl de Jong (2012); Ferreira and Horridge (2006); and Hérault (2010).

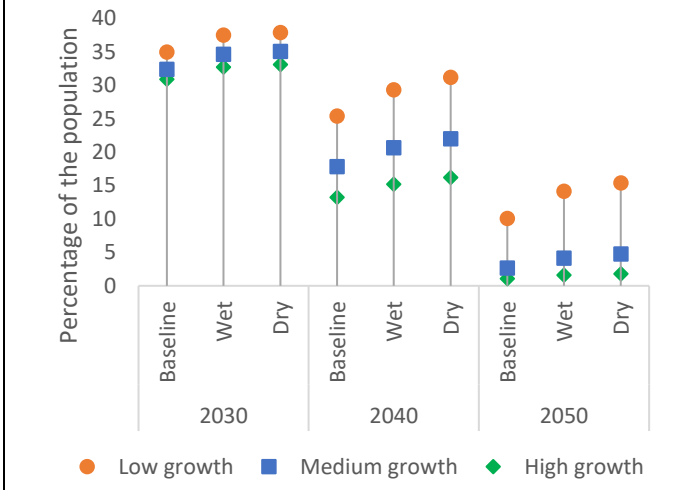
We allow employment to grow based on growth of the agriculture, industry, and services sectors. We then rescale the employment ratio to population up or down to match total employment according to the MFMod.

After we have a new set of weights, we modify consumption per capita of working individuals by sector, assuming that the wage bill is a constant share of value-added and deriving the necessary change in "wages" given the change in employment previously computed such that wage bill growth is as much as value-added. After we modify consumption for working individuals, we re-center the average consumption to its original mean (such that the ratio between average consumption of working individuals to non-working individuals remains constant) and compute household consumption per capita, including working and non-working individuals. Finally, we apply the growth rate of consumption per capita from GNB-ccMFMod to the entire population.

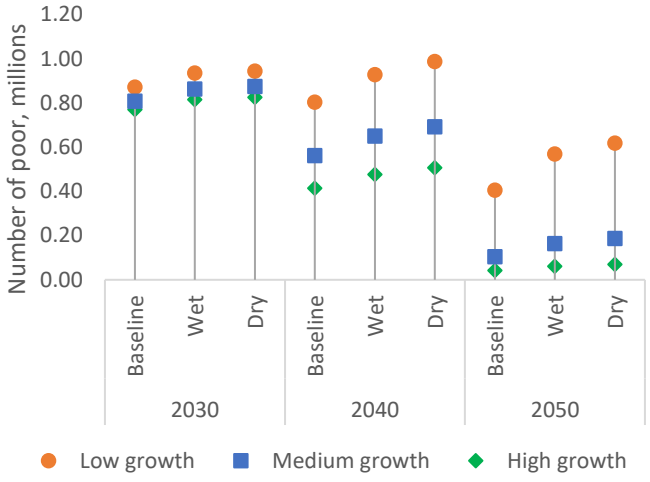
Annex 7 Quantifying the Impact of Climate Change on Poverty

Figure 38 Poverty Headcount (US$3.65 a Day), the Associated Number of Poor (US$3.65 a Day), and Gini Coefficient by Climate and Growth Scenario, 2030–50

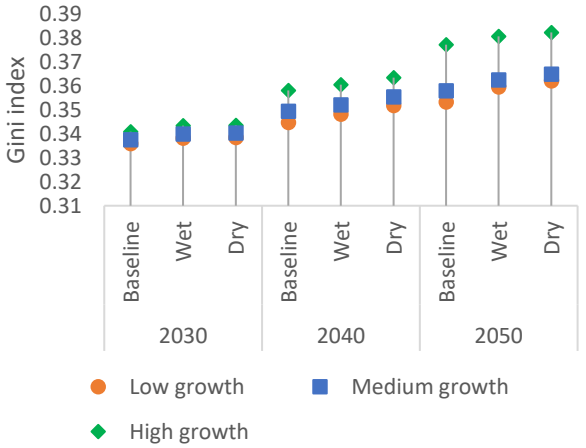
38a. Percentage of the population



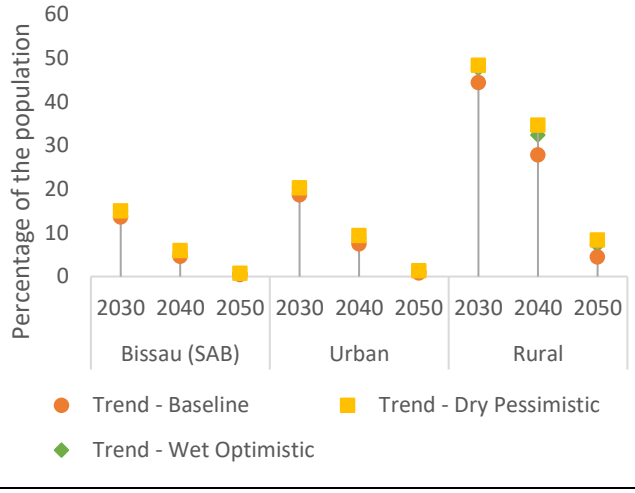
38b. Number of poor, millions



38c. Gini index

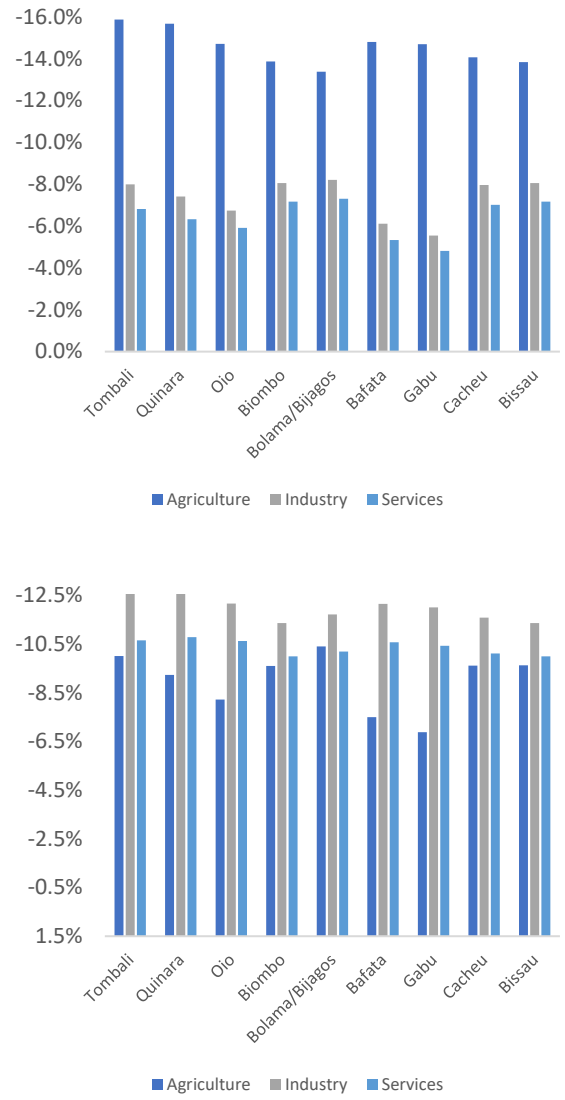


38d. Poverty rates by area, urban/rural, and agroclimatic zone

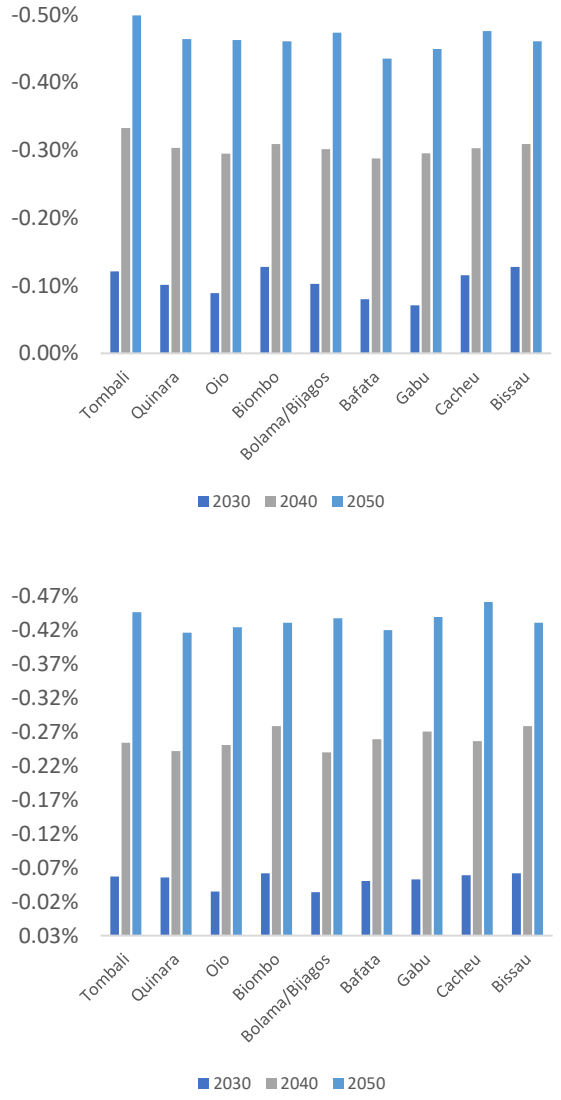


BOX. **POVERTY IMPACT OF CLIMATE CHANGE: MAIN IMPACT CHANNELS OF TRANSMISSION**

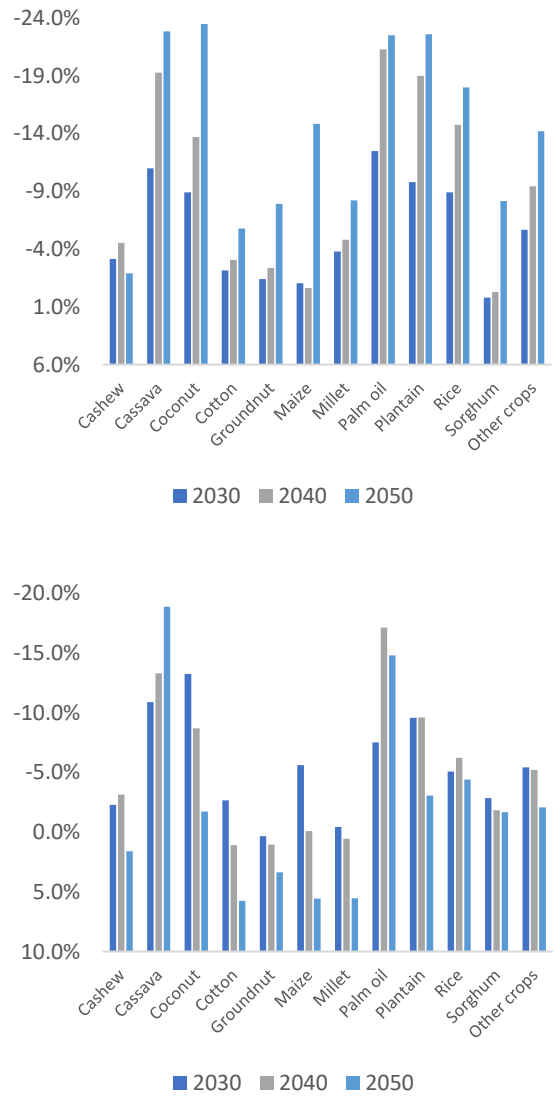
Estimated effects of heat stress on labor supply across sectors and regions by 2050
Dry/Dry (top chart) and Wet/Warm (bottom chart)



Estimated effects of disease spread on labor supply across regions and over time
Dry/Dry (top chart) and Wet/Warm (bottom chart)



Estimated effects of topsoil erosion on crop production across crops and over time
Dry/Dry (top chart) and Wet/Warm (bottom chart)



Annex 8 Sample Menu of Climate Financing Options

Option	Climate focus	Purpose	Providers	Most suitable for	Determinants	Pros	Cons
Grants	Mitigation and/or adaptation	Raise resources with no expectation of repayment, usually for non-revenue generating activities	National, bilateral, multilateral, and international organizations, climate funds, private foundations, and nongovernmental organizations	Most countries, but especially indicated for those in high debt distress	- Macroeconomic conditions - Match between country's priorities and types of grants available	- No fiscal burden to the government	- Dependence on donor support and funds availability
Concessional and non-concessional loans	Mitigation and/or adaptation	Raise resources that must be repaid with interest to finance projects and policies	National, bilateral, multilateral, and international organizations, climate funds, private financial institutions	Countries with borrowing capacity	- Macroeconomic conditions - Pipeline of projects and policies	- Well-known instrument - Flexibility in the use of resources - Main source of international funding	- Fiscal burden of repayment - Dependence on the credit lines available
Guarantees	Mitigation and/or adaptation	Mitigate or manage government- or project-related risks to attract private sector investment	National, bilateral, multilateral, and international organizations	Countries with limited ability in mobilizing private resources due to higher risks perceived by lenders and/or investors	- Macroeconomic conditions - Government institutional strength	- Crowd-in private investments - High-risk sectors can be financed	- Represent contingent liabilities in the government balance sheet - Some risks might not be covered by the market
Disaster risk management instruments	Adaptation	Transfer risks of low-frequency and high severity climate-related disasters from the government to the capital markets	National, bilateral, multilateral, and international organizations, climate funds, private financial institutions	Countries exposed to disaster risks and with fiscal space to support premium payments	- Macroeconomic conditions - Access to capital markets - Government knowledge and capacity	- Short-term liquidity in face of disasters, preventing fiscal insolvency	- Premiums impose a fiscal burden in the short run - Some risks might not be covered by the market

Option	Climate focus	Purpose	Providers	Most suitable for	Determinants	Pros	Cons
Thematic bonds	Mitigation and/or adaptation	Raise resources that must be repaid with interest to finance projects with measurable and reportable impacts	Capital market investors	Countries with borrowing capacity and market access	- Macroeconomic conditions - Access to capital markets - Government institutional strength	- Climate commitment signaling - Diversification of the investor base - Climate data disclosure improvements	- Dependent on market conditions and appetite - Costs of governance arrangements for issuance and reporting - Reduced flexibility in the use of the resources for use-of-proceed bonds with earmarked expenditures
Debt-for-climate swaps	Mitigation and/or adaptation	Raise resources from external debt service relief in return for local climate-related spending commitments	Bilateral, multilateral, and international organizations, nongovernmental organizations, private investors	Countries with eligible external debt, usually in debt distress	- Macroeconomic conditions - External debt profile - Government institutional strength	- No fiscal burden to the government	- Contingent upon the availability of eligible external debt - Dependent on creditors' or swap counterparties' willingness - Reduced flexibility in the use of the resources with earmarked expenditures
Carbon taxes	Mitigation	Raise resources and mobilize private sector investments in less intensive emission alternatives by levying a tax on emissions or on the carbon content of fossil fuels	Firms	Countries in which emission reductions are a major priority	- Country's emissions profile - Economic characteristics of key emitting sectors - Availability of technical mitigation options - Interactions with the climate, energy, and fiscal policy mix	- Additional revenue provides funding for other climate-related projects - Change incentives toward a more sustainable production process - Targeted at the highest emitters	- Difficult political economy in approving such measure - Challenges in establishing the appropriate tax rate and analyzing costs and benefits - Potential investment discouragement due to higher tax - No guarantee on the amount of emission reduction

Option	Climate focus	Purpose	Providers	Most suitable for	Determinants	Pros	Cons
Emissions trading scheme	Mitigation	Raise resources and mobilize private sector investments in less intensive emission alternatives by establishing a cap on emissions and issuing tradeable allowances	Firms	Countries in which emission reductions are a major priority	- Country's emissions profile - Economic characteristics of key emitting sectors - Availability of technical mitigation options - Interactions with the climate, energy, and fiscal policy mix - Government institutional strength	- Additional revenue provides funding for other climate-related projects - Change incentives toward a more sustainable production process - Prediction of the emission reduction outcome - Freedom for agents to choose the most cost-effective way of reducing emissions	- Complexity of the instrument requires high government capability
Carbon offsetting	Mitigation	Raise resources and mobilize private sector investments in less intensive emission alternatives by issuing credits from emissions reductions derived from certain projects or activities	Firms	Countries in which emission reductions are a major priority	- Country's emissions profile - Interactions with the climate, energy, and fiscal policy mix - Government institutional strength	- Additional revenue provides funding for other climate-related projects - Freedom for agents to choose the most cost-effective way of reducing emissions	- Complexity of the instrument requires high government capability - Challenges in establishing the accounting protocol due to lack of international standards for carbon offset - Difficulties in measuring emission reduction and the offset quality
Fossil fuel tax and subsidies reforms	Mitigation and/or adaptation	Raise resources and mobilize private sector investments in less intensive emission alternatives	Whole society	Countries dependent on fossil fuel subsidies	- Country's energy matrix and economic characteristics of the energy sector	- Additional revenue provides funding for other climate-related projects	- Difficult political economy in approving reforms - Potential negative effects on household income
PPPs	Mitigation and/or adaptation	Mobilize private sector investments in less intensive emission alternatives	Private investors	Countries with revenue generating projects capable to attract private investors	- Macroeconomic conditions - Pipeline of projects - Government institutional strength	- Additional source of funding and financing - Transfer of private sector innovation, incentives, and experience to public projects	- Complexity of the instrument requires government capacity - Hidden fiscal risks might impose a burden in the future

Option	Climate focus	Purpose	Providers	Most suitable for	Determinants	Pros	Cons
Regulatory and policy developments	Mitigation and/or adaptation	Mobilize private sector investments in less intensive emission alternatives	Private investors	All countries	- Macroeconomic conditions - Government climate commitment - Government institutional strength	- Additional sources of funding and financing	- Political economy challenges might hinder reforms

Annex 9 List of Proposed Activities in the CCDR

Activities	Priority (for climate agenda)	Time frame	Complexity	Potential for private sector	Adaptation / mitigation	Estimated cost (in 2023 US$, millions)[83]
Enhance institutional capacities for monitoring and reporting on the states of forests	Very high	ST	+		Both	3.8
Support the management of protected areas	Very high	ST	+		Both	5.7
Promote more productive, agro-ecological cultivation techniques, with the development of extension services and digital advisory services	Very high	ST	+	Yes	Both	9.4
Expand and develop innovative irrigation and drainage solutions	Very high	ST-MT	+	Yes	Adaptation	27.5
Develop selected, more climate-resilient species and improve value chains to diversify agriculture	Very high	ST	+	Yes	Adaptation	9.4
Least-cost electrification plan to reach Sustainable Development Goal 7, with associated business plan and strategy for market engagement	Very high	ST	+		Both	2.8
Power grid climate resilience analysis	Very high	ST	+		Adaptation	1.9
Institutional and policy strengthening for clean energy enablement; creation of a renewable asset management entity	Very high	ST	++		Mitigation	4.7
Develop adaptive social protection and social safety nets; build a registry for social protection	Very high	ST	++		Adaptation	9.4
Clean energy development for basic services (health, education, communications, security)	Very high	ST	++	Yes	Both	47.1
Public infrastructure investment: grid resilience	Very high	ST	++	Yes	Adaptation	28.3
Short term – Very high priority						**150.0**
Develop a water resource management plan to enhance sector and multi-stakeholder collaboration, agricultural productivity, and equitable access to clean water	High	ST	++		Adaptation	0.9
Map groundwater resources, including the transboundary Maastrichtian aquifer and rehabilitate its monitoring system; conduct chemical and bacteriological analysis of aquifers	High	ST	++		Adaptation	2.8
Energy transition stakeholders analysis	High	ST	+++		Both	0.4
Develop technical specifications/designs for roads, drainage, bridges, and transport infrastructure to take into account resilience and climate impacts based on climate data	High	ST	+	Yes	Adaptation	2.8
Develop standard and design for public infrastructure adapted to risk and higher temperatures (energy-efficient design, climate-friendly infrastructure)	High	ST	+	Yes	Both	1.9
Develop and adopt a national DRR policy aligned with the Sendai Framework for Disaster Risk Reduction 2015–2030	High	ST	++		Adaptation	0.5
Set up flood and high-tide EWSs and weather information services for urban and rural communities; train farmers on DRR and anticipatory action	High	ST	++		Adaptation	4.7
Create a national registry that prioritizes the inclusion of high-risk households residing in “hot-spot” areas	High	ST	++		Adaptation	1.9
Improve the quality and increase the number of school infrastructures	High	ST	+		Adaptation	37.7
Collect gender-specific environment and climate data to design effective gender-responsive interventions	High	ST	+		Adaptation	1.9
Protect and restore coastal ecosystems such as mangroves and wetlands as a cost-effective option to act as natural barrier to environmental risks and contribute to carbon sequestration	High	ST-MT	+		Both	13.7

[83] Discount rate is 3%

Strengthen the legal, policy, and institutional framework related to urban development and the preparation and enforcement of adequate urban planning instruments, which also address climate change and variability	High	ST	++		Adaptation	1.9
Short term – High priority						***71.1***
Invest in infrastructure, equipment, and health care professionals to respond to growing demand of health care needs	Medium	ST	+		Adaptation	94.3
Adopt a national strategy for transport and logistics taking into consideration climate change	Medium	ST	++		Both	0.9
Short term – Medium priority						***95.2***
Public pilot solar PV and battery storage 10 MW plant	High	MT	++	Yes	Mitigation	17.3
Scale up community-level natural resources management committees and plans	High	MT	++		Both	17.3
Develop land-use plans with designated areas for conservation, logging, agriculture, and other land uses and associated integrated landscape management strategies	High	MT	++		Both	2.6
Invest in stormwater drainage infrastructure and climate-resilient urban services	High	MT	+++		Adaptation	43.1
Support access to credit and financing options for farmers, including during climate shocks	High	MT-LT	++	Yes	Adaptation	16.3
Improve road infrastructures, prioritizing the N1, N2, and N5 corridors	High	ST-MT	++		Adaptation	366.2
Establish a regular cash transfer program	High	MT	++		Adaptation	tbd
Establish a climate change hazard recovery fund to ensure timely and accessible funding for response programs	High	MT	+++	Yes	Adaptation	tbd
Medium term – High priority						***462.8***
Adapt the Water Code to current needs; control public water service operators; and ensure efficient oversight of public water	Medium	MT	++		Adaptation	0.9
Invest in WASH installations in schools, hospitals, health centers, businesses, and public infrastructures	Medium	MT	++	Yes	Adaptation	29.3
Foster PPPs and private sector partnerships for road and bridge maintenance and solutions	Medium	MT-LT	+++	Yes	Adaptation	122
Develop a pipeline of infrastructure investments projects	Medium	MT	++		Both	4.3
Strengthen governance structure for integrated coastal zone management, including with monitoring system	Medium	MT	+++		Adaptation	1.3
Medium term – Medium term						***157.8***