EASTERN AND
SOUTHERN AFRICA

DEMOCRATIC REPUBLIC OF CONGO (DRC)

World Bank Group

COUNTRY CLIMATE AND DEVELOPMENT REPORT

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DEMOCRATIC REPUBLIC OF CONGO

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Acknowledgments

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

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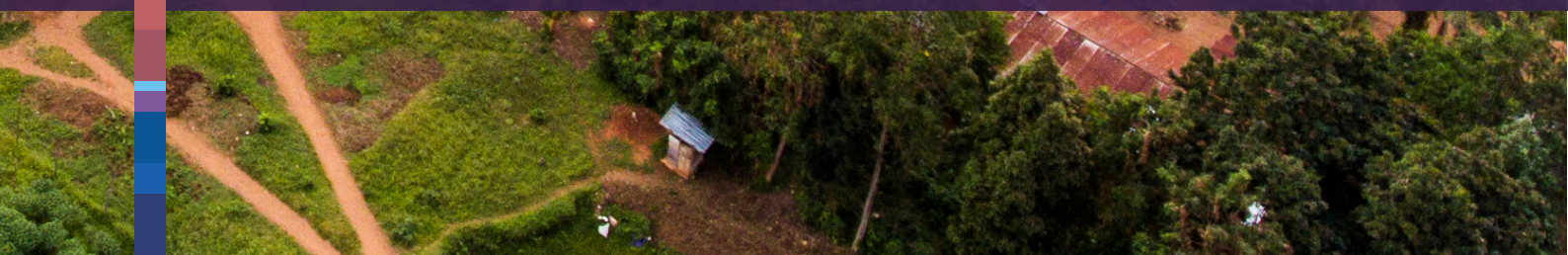
Acronyms

ACE	Congolese Environmental Agency
ADALY	avoided disability-adjusted life year
ADS	adaptation scenario
ASP	aspirational development
BAU	business-as-usual (scenario)
BC	black carbon
CAFI	Central African Forest Initiative
CCDR	Country Climate and Development Report
CCIA	Climate Change Institutional Assessment
CEM	Country Economic Memorandum
CO_2e	carbon dioxide equivalent
CPF	Country Partnership Framework
CSA	climate-smart agriculture
CSNGHC	National Solidarity Fund for Disaster and Humanitarian Management
CSO	civil society organization
DRC	Democratic Republic of Congo
DRE	Direction des Ressources en Eau
DRM	disaster risk management
EV	electric vehicle
FCV	fragility, conflict, and violence
FLID	Farmer-Led Irrigation Development Diagnostic
FONER	National Maintenance Road Fund
GBV	gender-based violence
GCAM	Global Climate Change Assessment Model
GDP	gross domestic product
GHG	greenhouse gas
Gt	gigatons
HA	hectares
HCI	Human Capital Index
HPP	hydroelectric power plant
IDP	internally displaced person
IEc	Industrial Economics Incorporated
IFC	International Finance Corporation
INFF	Integrated National Financing Framework
kWh	kilowatt-hour
LCDF	Least Developed Countries Fund
LMIC	lower middle-income country
LTGM-NR	Long-Term Growth Model Natural Resource Extension
LULUCF	Land Use, Land Use Change, and Forests
m^3	cubic meters
MAAH	Ministry of Humanitarian Actions and Affairs
MECS	Modern Energy Cooking Services (Programme National d'Eau, Hygiène et Assainissement)
MEDD	Ministry of Environment and Sustainable Development
MIC	middle-income country
MIGA	Multilateral Investment Guarantee Agency
MRV	monitoring, reporting, and verification
MSMEs	micro, small, and medium enterprises
Mt	megatons
NAP	National Adaptation Plan

NAPA	National Adaptation Program of Action
NBS	nature-based solutions
NDC	Nationally Determined Contribution
NPIA	National Agricultural Investment Plan
NPIA	National Agricultural Investment Plan
OCE	Office Congolais des Eaux
OCHA	Office for the Coordination of Humanitarian Affairs
ORSEC	Disaster Relief Organization Plan
PDP	Provincial Development Plan
PIMA	Public Investment Management Assessment
PNEHA	Programme National d'Eau, Hygiène et Assainissement
PNIA	National Agricultural Investment Plan
PNSD	National Strategic Development Plan
PPP	public–private partnership
PSW	private sector window
RCP	Representative Concentration Pathway
REDD+	Reducing emissions from deforestation and forest degradation
RES	resilience scenario
RP	return period
RST	Resilience and Sustainability Trust
SDG	Sustainable Development Goal
SGBV	sexual- and gender-based violence
SMEs	small and medium enterprises
SNEL	Société Nationale d'Électricité (National Electricity Company)
SSA	Sub-Saharan Africa
SSP	Shared Socioeconomic Pathway
tCO_2e	tons of carbon dioxide equivalent
UMIC	upper middle-income country
UNDP	United Nations Development Programme
UNISDR	National Strategy for Disaster Risk Reduction and Prevention
VCM	voluntary carbon market
WASH	Water Supply, Sanitation and Hygiene
WSI	Water Scarcity Index

EXECUTIVE SUMMARY



Executive Summary

The DRC needs to pursue structural transformation and diversify its economy in a manner that both reduces poverty and promotes inclusive sustainable development, while tackling regional disparities. Despite episodes of vigorous Gross Domestic Product (GDP) expansion, DRC's growth levels have not lived up to the full potential of its natural resources, strategic location, and young growing population, failing to reduce poverty. Highly dependent on mineral exports, the economy has been inhibited by poor natural resource management, numerous binding constraints on sustainable inclusive growth, and inadequate institutions.[1] The country's long history of conflict and political instability has hampered economic growth, undermined state capacity, entrenched corruption, and hindered the delivery of basic services to its people. In such a context, economic diversification (especially that of exports) is vital to building economic resilience, sustaining high growth, and reducing inequality.[2]

The country faces formidable climate risks that stand in the way of achieving sustainable development. These risks require immediate attention and persistent commitment for the country to achieve its objective of becoming a middle-income economy. DRC has one of the world's highest concentrations of mineral wealth. The world's fifth-largest copper producer, it also produces more than 70 percent of the mined global output of cobalt and holds almost half of the world's mineral reserves, with more than 1,000 different substances, including 20 strategic ores. With 5.6 percent average growth over 2002–2021, the DRC economy ranked among the fastest-growing Sub-Saharan African (SSA) economies during the last decade. Yet, the last two decades of economic performance have not translated into improvements in living conditions and has made little progress in increasing its GDP per capita. Thus, the benefits of DRC mineral wealth are not being widely distributed and are not enhancing DRC's human capital nor promoting a diversified economy. As a primary export economy, DRC is also exposed to the volatility of global commodity prices when global demand shifts.

Renewable natural capital is, after minerals, the second-most important component of DRC's national wealth. DRC's hydropower potential could supply the current energy consumption of the entire Sub-Saharan Africa (excluding South Africa). The Congo Basin peatlands hold 29 gigatons (Gt) of subsoil carbon; and the country's forests which contain around 85 gigatons of CO_2e accumulated and stored above ground, offer a wide variety of private, regional, and global public goods. However, forest biomass accounts for nearly 94 percent of the country's total primary energy supply, leading to leading to 18.4 million hectares of forest loss between 2001–2022. Additionally, despite its huge agricultural potential, DRC is a net food importer, raising its vulnerability to food insecurity due to climate impacts and external trade shocks.

This Country Climate and Development Report (CCDR) aims to support DRC's efforts to achieve its development goals within a changing climate by quantifying the impacts of climate change on the economy and highlighting policies and interventions needed to strengthen the country's climate resilience on many different levels. The report captures the interplay between DRC's development, climate challenges, and climate policies, with the objective of identifying synergies and tradeoffs. The CCDR supports the strategic vision

[1] Reyes Aterido, Alvaro Gonzalez, Dino Merotto, Carly Petracco, and Javier Sanchez-Reaza, Democratic Republic of Congo: Jobs Diagnostic (Washington, DC: World Bank, 2018).

[2] World Bank, Democratic Republic of Congo Systematic Country Diagnostic: Policy Priorities for Poverty Reduction and Shared Prosperity in a Post-Conflict Country and Fragile State (Washington, DC: World Bank, 2018).

of the Government of DRC as articulated in its 2030 National Strategic Development Plan ("Plan National Stratégique de Développement" (PNSD)) to reach middle-income country (MIC) status by 2035, and by 2050, become a diversified inclusive economy spurred by sustainable growth. It identifies the priorities needed in order to launch the most impactful, cost-effective actions to boost adaptation, build resilience, and foster low-carbon growth, while delivering on broader development goals. These are critical objectives, especially in fragile countries such as the DRC.

Why and how climate change matters: The compounding effect of DRC's climate and development risks

The DRC suffers from the combined effect of a large vulnerable population, a surge in the frequency of climate extremes, and low provision of services and infrastructure. At 234 million hectares the largest country by surface area in Sub-Saharan Africa (SSA) and one of the world's poorest, with an estimated population of 95.3 million people and a poverty rate of 62.3 percent in 2022, DRC ranks 178 out of 182 on the 2020 Notre Dame Global Adaptation Index.[3] Climate-related shocks, including floods, and droughts, are expected to rise in both frequency and intensity over time, with the poor bearing the brunt of the impacts. Increased infrastructure damage and connectivity issues due to climate change are expected to worsen fragility, conflict, and violence by intensifying competition over food and jobs, increasing internal migration, reducing economic opportunities and social cohesion, and straining public institutions and trust in the state.

Most poverty drivers in DRC are climate change sensitive. Three acutely sensitive socioeconomic factors drive poverty and social exclusion rates in the DRC -low access to water, electricity, and sanitation; the inadequate quality of housing; and poor transport connectivity. The impacts of climate change on poverty and human capital accumulation can negatively reinforce one another, further deepening poverty. In short, DRC's long-term poverty alleviation and development goals will be harder to achieve in the context of a changing climate.

Climate change could reverse DRC's hard-won gains in human capital, with a disproportionate impact on the poor, and especially on women and excluded populations. Climate-sensitive Ebola outbreaks, malaria, cholera, and other diarrheal and vector-borne diseases are expected to increase as flooding and droughts intensify and affect labor productivity. Malaria is a leading cause of morbidity and mortality in the DRC and, it is projected, will extend in seasonality and geographical coverage. In already malaria-prone areas, malaria cases are projected to triple by mid-century. Extreme climatic events could also degrade and destroy health, education, and sanitation infrastructure, compromising the population's access to services. The rural and urban poor, women and children, indigenous peoples, and people with disabilities all have heightened vulnerability to the negative impacts of climate change. There is a strong link between poverty and climate change in the DRC.

DRC is expected to experience higher heat stress and increased extreme events[4] with notable temporal shifts in its hottest conditions up till mid-century, with significant increases occurring towards the end of the century (see figures ES1 and ES2). The biggest direct impact of the changing climate may come from heatwaves and hydrological changes

[3] https://gain.nd.edu/our-work/country-index/.

[4] Climate and Development Knowledge Network (CDKN), African Climate and Development Initiative (ACDI), "The IPCC Sixth Assessment Report", 2022, https://cdkn.org/sites/default/files/2022-03/IPCC%20Regional%20Factsheet%203_Central%20Africa_web.pdf.

affecting agriculture and—through flooding and subsequent damage to settlements—roads, communications, and infrastructure. Kinshasa, for example, is particularly prone to flooding and rainfall-triggered landslide hazards, with the largest built-up areas exposed to pluvial flooding. The agriculture sector is likely to face the adverse consequences of climate change across its value chain and its labor force, and notably at the crop production, processing, storage, and transport stages. Risks to DRC's productivity include crop damage, reduced yield potential, greater pest damage, declining animal health and fish catches, rising production costs, and decreasing labor productivity caused by heat stress. One of the main drivers of poverty in the DRC is rising food prices because of the already reduced agricultural yields and poor soil management, worsened by decreased productivity because of current climate variability and change. Climate change is therefore likely to heighten vulnerabilities in the energy, transport, communications, and water supply sectors, create disruptions to their infrastructure, and impede urban development and growth.

Figure ES.1: Projected number of tropical nights with minimum temperature >20°C, 2080–2099, SSP3[5]-7.0

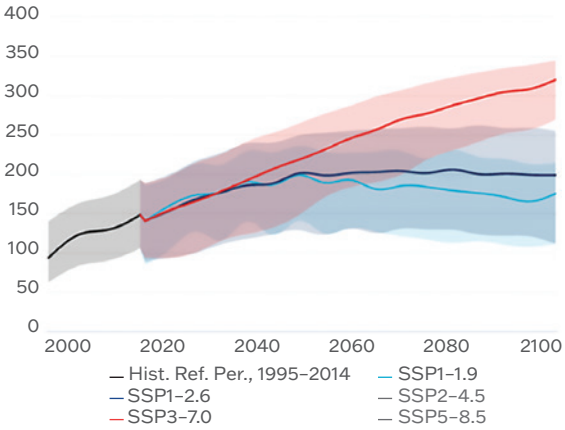
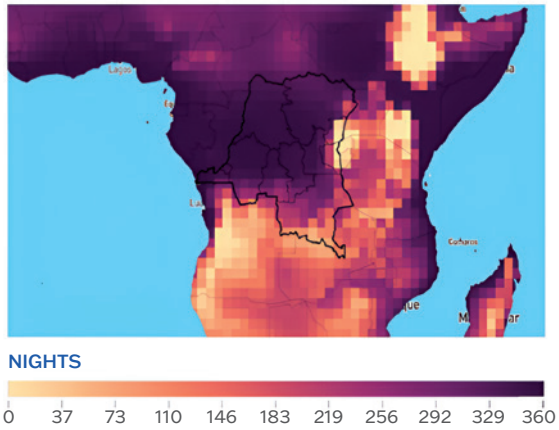


Figure ES.2: Spatial distribution of the number of nights with minimum temperatures > 20°C, 2080–2099, SSP3–7.0



Source: World Bank Climate Change Knowledge Portal — DRC Profile, 2022

The impact of climate change on DRC's growth prospects and structural transformation highlights the importance of building resilience.

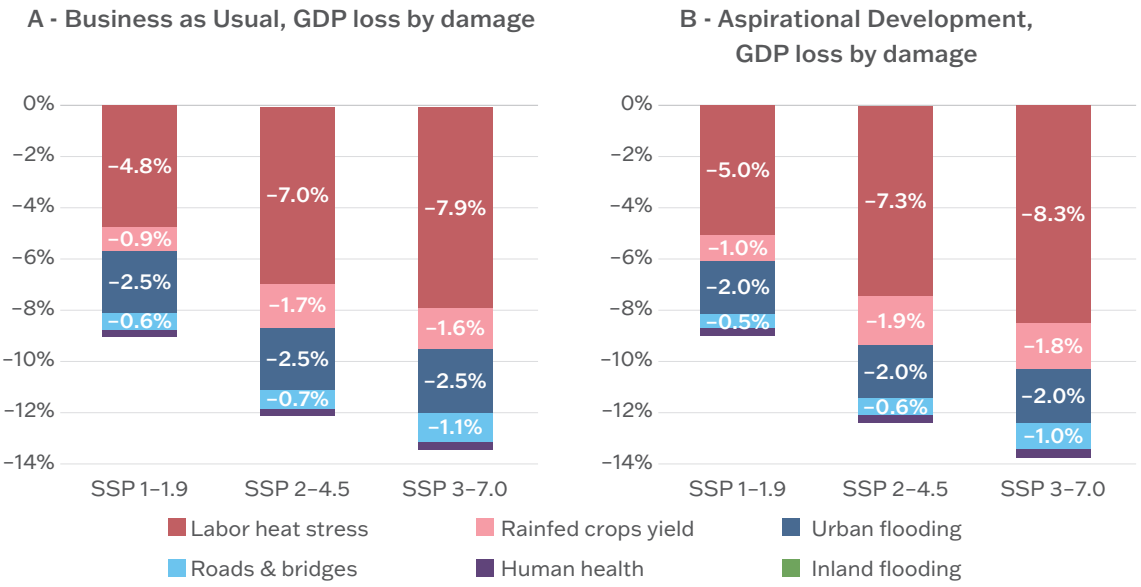
Under different development scenarios, climate change without adaptation could result in up to a 13 percent loss in GDP. Through thus CCDR analysis, the possible impact of climate change on the economy was simulated under four different climate and development scenarios. The macroeconomic impacts of climate change were estimated with and without adaptation, under a business-as-usual (BAU) and a faster-growth aspirational development scenario yielding four scenarios in all. The results highlight the significant impact of adaptation measures in reducing economic damage. More specifically, selected adaptation measures could reduce the economic damage of climate change by more than 40 percent—not only under BAU scenario but also under a "resilient development" scenario that combines adaptation and ambitious development reforms.

[5] Modeling for this CCDR used the CMIP6 suite of climate models, in line with the latest Intergovernmental Panel on Climate Change assessment, examining scenarios that combine Shared Socioeconomic Pathways (SSPs) with representative concentration pathways.

If not addressed, climate change will impose large costs on the economy and exacerbate household vulnerability. Economic development and growth in the DRC will help build its overall resilience but will not suffice. If DRC stays on its current growth trajectory, by 2050 climate change could result in GDP losses ranging between 4.7 and 12.9 percent—under a range of climate scenarios (figure ES3). The largest economic impacts from climate change are projected to come from the heat stress of rural workers experiencing extreme heatwaves, with losses amounting to 4.8 percent of GDP and, under the most pessimistic climate scenario (SSP3–7.0), 8.0 percent. Another important contributor is significant urban damage from flooding, with losses amounting to 2.5 percent of GDP. A BAU pathway could exacerbate the country's vulnerability by causing further environmental degradation, eroding livelihoods, displacing people, deepening inequality, and, for citizens who feel hopeless, decreasing the opportunity costs of engaging in already ongoing conflicts over resources. As a result, under the most pessimistic of the climate scenarios (SSP3–7.0), an additional 16+ million people could be pushed into poverty by 2050 (relative to a BAU scenario with 'no climate change'). Development with climate-resilient investments and with additional inclusive policies is therefore critical to achieving economic growth and sustainable livelihoods.

The analysis evaluated six specific economy-wide damage channels.[6] In order of importance: (i) labor heat stress, (ii) urban flooding, (iii) rainfed crops, (iv) roads and bridges, (v) human health, and (vi) inland flooding. The analysis does not fully reflect the extent of all possible damage pathways. Some were modeled only partially because of the assumptions and limitations of the model, and a lack of data to quantify longer term damage infrastructure costs. The simulated damage (GDP loss) from climate change is thus only a first approximation, and likely represents a lower-bound of costs to the country.

Figure ES.3: Climate change impacts by damage channel, 2050: GDP under climate scenarios (SSPs), as % deviation from counterpart (baseline or development) without climate change



Source: World Bank modelling results

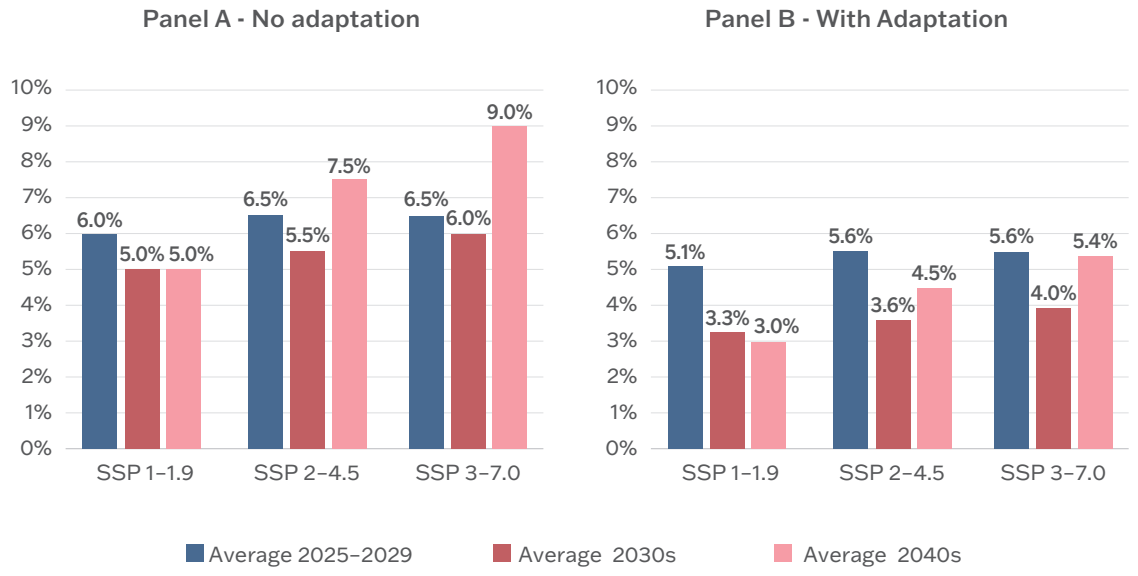
[6] These damage channels represent some of the ways in which climate-related shocks are already impacting DRC and are likely to affect its future development.

The CCDR analysis shows that pursuing a development path alone, without adaptation, cannot reduce all impacts of climate change, although it would strengthen climate resilience in some areas. If DRC were to accelerate the implementation of policies and programs included in its current Development Strategy, that would help shift its economy to a higher growth path. As DRC develops, reduced vulnerability to climate impacts would help the country reach its aspirational development scenario, because growth improves livelihoods, infrastructure, food security, and energy access. Climate change, however, would still produce large impacts, given the negative effects of the damage channels on the overall economy.

An ambitious development pathway coupled with adaptation strategies that build greater climate resilience will involve doing entirely different things as well as doing development initiatives differently. New investments need to be climate-resilient and inclusive, and additional policies and investments will be needed. By supporting higher-quality infrastructure and greater diversification, economic development, in and of itself, is a powerful form of adaptation and underscores the need for DRC to adopt an economy-wide, resilient development path. A push to achieve DRC's development objectives would also protect the vulnerable from the economic impacts of climate change, and in some scenarios would reduce the number of households that would have fallen into poverty by as much as 75 percent.

Additional adaptation measures could, by 2050, reduce the impact of climate change on GDP and public investments by about 40 percent to 7.8 percent of GDP under the most pessimistic climate scenario. The fiscal cost rises if no adaptations are undertaken. In fact, while DRC would need to invest an additional 9 percent of its GDP to offset climate change impacts by 2050, investing today in climate-resilience adaptation policies would reduce that needed investment to just 5.4 percent to cover for residual damage (figure ES.4).

Figure ES.4: Public investment needed to offset climate change damages (all climate shock channels combined, incremental investment, percent of GDP, period average)



Source: World Bank modelling results

The need for stronger institutions and substantial financing to fulfill Government's ambition to become a "solutions country".

The Government has indicated its strong commitment to climate change action through its National Adaptation Strategy (NAP) and measures and anchoring its medium-term climate strategy framework in the country's Nationally Determined Contributions (NDCs). With half of Africa's forests and water resources, and mineral reserves worth a trillion-dollars, DRC intends to establish itself as a global *"climate solutions country"* and generate revenues to enhance its own climate resilience and sustainable low carbon growth. DRC has a critical role to play in the future of global climate action, especially in the uptake of GHG through the conservation and management of its forests, the generation of renewable energy, and the supply of clean energy. DRC's per capita emissions are high for a country at its income level, and this is a clear challenge for the country. In its updated NDC, the DRC has conditionally committed to cutting its GHG emissions by 21 percent by 2030.

The international mining industry is undergoing deep transformation because of the global energy transition toward a low-carbon future, and DRC is well positioned to become a leading global player. The development of DRC's cobalt mining-intensive industry could place the country at the forefront of the green industrial revolution. If exploited sustainably, DRC's minerals could create pivotal opportunities for economic growth and private sector development—primarily by implementing green technology, creating green jobs through the value chain, defueling conflict and violence, and supporting the transition to a low-carbon economy (especially through the development of the country's copper and cobalt mining value chain, all the while sustainably managing natural wealth). Robust actions are needed to ensure a just, inclusive process in any expansion of DRC's green minerals,[7] including fostering supply chain transparency, improving working conditions, eradicating child labor, and promoting gender equality.

DRC's copper- and cobalt- mining facilities are among the world's least GHG intensive practices because they use hydropower energy in their operations, a key consideration for private investors seeking to support the green energy transition. Under global efforts to decarbonize trade, such as the carbon border adjustment mechanism, climate smart mining can help position the DRC as a "supplier of choice" and enhance the private sector investments. As DRC develops and adapts to climate change, the country must be more ambitious, in its attempt to instate a virtuous cycle of mineral and natural wealth, welfare, and decreasing conflict.

The DRC's large hydro resources could significantly contribute to the country's low-carbon development path by providing extensive, competitively-priced, and flexible sources of renewable energy, while enhancing the resilience and sustainability of the population's livelihoods through greater access to energy. However, this can be implemented at scale only by addressing the weak performance, poor governance, and lack of flow creditworthiness of DRC's leading institutions. The Government can encourage and scale up private investments in hydro resources by improving regulatory governance, reducing tax barriers, subsidizing the hefty connection costs, and easing access to finance to adaptation actions while increasing synergies for low-carbon growth actions.

[7] Green minerals such as cobalt, copper, and lithiumll abundant in DRC—are minerals needed to facilitate the global transition away from fossil fuels and toward low-carbon clean energy technologies. Many of them are critical components in battery technology, wind turbines, and electric-vehicle motors. Other green minerals include bauxite, chromium, granite, manganese, molybdenum, nickel, and several rare earth elements. Please refer to the latest Country Economic Memorandum for DRC. October 2023.

DRC's forest cover has important impacts on global and domestic ecosystem services. The value of DRC's 143 million hectares a of standing forest is estimated at up to US$6.4 trillion, with an estimated annual rental value of US$383 billion at a 6 percent discount rate. In addition, DRC's forests can generate an estimated value of US$223 billion–398 billion per year from stored carbon and associated ecosystem services, including nature-based solutions (NBS) needed to mitigate the impacts of disasters and enhance the resilience of DRC communities. This estimate refers to both the local and global benefits, including timber production, non-timber forest services, and the global value of carbon storage. Under current policies, the estimated rate of deforestation is 6 percent, which by 2030 will result in a loss of 4.75 billion megatons (Mt) of CO_2e stored in these landscapes. Considering only the LULUCF sector, if DRC loses another 57 million hectares of forests the remaining one will no longer be enough to offset DRC own emissions from the LULUCF sector. Which means that with the loss of 40 percent of its current extent, DRC's LULUCF sector becomes a net source of carbon and no longer a sink. The total cost to the world of such a loss in carbon stock—and therefore the capacity of the forests to provide carbon sequestration services—*would be about US$95.3 billion*, based on a $75/ton shadow price of carbon and a 6 percent discount rate.

To guarantee the sustainable management of its forests and protection of its peatlands, DRC needs to prioritize the conservation and restoration of its degraded forest landscapes by prioritizing and managing its timber concessions in a more integrated way to ensure that ecosystem services are maintained while increasing the number of forest-dependent jobs. Improved management and conservation could, by 2030, increase the value of DRC's forest-based ecosystem services by US$1.76 billion/year[8] over the BAU scenario, and by US$3.8 billion/year by 2050. A comparison of net present values of costs and benefits shows that for *every $1 invested today in landscape and forest restoration, DRC stands to gain $15 in benefits by 2050.* As a core player in the management of global public goods, DRC has entered into an alliance with Brazil and Indonesia, the three largest forest countries, to collaborate on conservation, restoration, and the use of forest resources.[9] This trilateral South–South partnership is a pledge to cooperate to support the sustainable management and conservation of tropical forests, bioeconomy for healthy forests, and the restoration of critical ecosystems to benefit world's the climate and peoples. The World Bank is supporting the three countries to deepen their cooperation, mobilize new sustainable funding for tropical forests, and share best practices.

Implementing this "climate solutions" vision and its associated adaptation strategies will require considerable financing. Building resilient infrastructure and improving labor conditions and energy access for cooling conditions, are among the key stepping-stones to ensure that DRC properly tackles its climate change challenges. Based on the modelled adaptation actions, the initial public investments needed to partially offset climate change risks are estimated at around US$10.9 billion by 2050, mainly to (i) build improved transport infrastructure, (ii) bring cooling options for health impacts on labor productivity, and (iii) reduce risks to infrastructure and livelihoods from urban flooding. Additional investments will be needed to ensure adaptation measures are integrated in areas such as agriculture, health, clean cooking adoption to reduce deforestation, water sanitation, urban planning, and nature-based solutions. For example, an estimated additional US$43 million/year will be required from government financing to implement a low irrigation expansion adaptation

[8] Depending on the assumed market price of carbon, this value ranges from US$980 million to US$2.5 billion.

[9] In November 2021, Indonesia, Brazil, and DRC launched a "Forest Power for Climate Actions" initiative at COP 26, followed by trilateral discussions in 2022 which included UNGA, COP27 and G20 meetings. The tripartite cooperation was formalized through a Joint Statement on "Tropical Forests for Climate and People," signed at a G20 side event on November 14, 2022.

scenario of only 200,000 hectares by 2040, leveraging farmers' investments of US$8 million/year.[10] Restoring and conserving recommended forest and landscapes could cost DRC an additional US$3.19 billion by 2030. A public investment of US$234 million a year, and an additional US$21.7 million a year from the private sector, would also be needed to reach DRC clean cooking targets by 2030, as outlined in the 2016 Sustainable Energy for All (SEforALL) National Strategy.

Given DRC's limited financial capacities, engaging the private sector and identifying other sources of finance is crucial. The involvement of global and regional players is essential, as is an enabling environment that includes stronger institutions, more transparency, and a functioning financial market to attract external investments and enhance private sector engagement in renewable/clean energy and climate smart agribusiness. Critical to this is responsible private sector investment in resource intensive sectors that undertakes a 'do no harm' conflict sensitive approach and identifies and manages risks related to climate-fragility challenges with local communities and seeks to maximize positive impact on the ground. Awareness of green finance could also be strengthened among local financial players, as well as the development of risk finance mechanisms and improved transparency via the publication of public expenditure efficiency reports. Grant and highly concessional financing from public sources and new inflows from private sources are needed to meet the very large investment needs that will deliver results over the medium and long terms.

To help address the funding gap for adaptation and low carbon growth, DRC should seek international payments for its global ecosystem services, by leveraging various public and private streams of climate finance. In the short term, payment for DRC's global ecosystem services could be raised within a dedicated international fund through grants or international climate tax. The proceeds could be used to protect DRC's standing forests, develop renewable energy projects, and improve livelihoods, because lack of access to energy is the main driver of deforestation. In the medium term, the development of international carbon markets could provide additional resources to meet DRC's climate goals and resilient livelihood goals. As a current carbon-negative emitter, DRC can benefit from the development of climate finance, especially by building frameworks for accessing international carbon markets and schemes (Article 6 of the Paris Agreement). Projects related to forest conservation, renewable energy or protection against oil concession lands could generate tax revenue for the Government and fund conservation outcomes and community development. However, unlocking these sources of funding will require DRC to offer a more transparent framework of project structuring, project issuance, and the exchange of carbon credits as well as a transparent framework for how carbon tax revenues are used. The credibility of a fund to collect grant-based payments for ecosystem services will also hinge on DRC governance, and the readiness of its governance to access new and innovative financial mechanisms.

Government's commitment to a resilient and low-carbon development pathway is strong, but it needs to be sustained

The Government has made a firm commitment to combatting climate change by building resilience in key adaptation areas identified in the 2006 National Adaptation Program of Action and the 2022–2026 National Adaptation Plan (NAP). Among the essential building blocks of the "solutions country" vision are explicit political

[10] Assuming a mix of small-scale low-cost individual (US$ 1500/ha), small group schemes (US$ 3,000/ha) and some larger schemes (US$ 12,000/ha), with an average costs of US$ 4,350/ha.

commitment, well-aligned multi-level governance, clear institutional frameworks, robust laws, policies and strategies, well-managed oversight and financing, and robust data gathering, storage and retrieval. The core elements of DRC's climate agenda have adequately been defined, but the country now needs to increase its focus on operationalizing climate action and addressing governance challenges. DRC is also positioning itself to increase conservation and protection of its peatlands, as well as sustainable development and via the *New Climate Economy* country initiative.

DRC needs a wide array of investments and policy packages to build resilience and, recognizing its fiscal constraints and low institutional capacity, also needs to carefully prioritize measures. The priorities must focus on enhancing the country's adaptation capacity cost-effectively. This requires, first, an emphasis on building institutions and policy reforms to maximize the impact of capital investments and the climate solutions vision. Second, prioritized measures should aim at increasing the country's long-term climate resilience and at achieving high developmental impact. Third, measures that can crowd in additional climate financing and investments, should be prioritized. Finally, supporting the poorest and most vulnerable should be prioritized when managing climate impacts and low-carbon transitions, because they will be the most affected.

Below, the CCDR sets out four urgent action areas aligned with the requirements above. All four action areas are relatively affordable in that they will cost substantially more if they are implemented later.

Action Area 1: Underpin the vision of DRC as a climate "solutions country" through climate smart mining, hydropower development, the preservation of forests, and integrated landscape management.

In the short term, DRC stands to benefit tremendously from the energy transition if the country is supported to seize its mineral value chain opportunity. Faster growth through economic structural transformation and value addition would have a positive impact on alleviating current and future climate change damage. Beyond the generation of foreign exchange, fiscal revenue, local procurement, value addition, and jobs, the rising demand for critical minerals could significantly increase domestic economy benefits from the sector. Further development of the mineral mining sector should be reinforced with measures to reduce conflict, social exclusion, and environmental safeguards.

To build climate resilience, enhance productivity and reduce the risk of disasters, DRC urgently needs to slow and reverse landscape degradation and forest loss. Investing in improved integrated landscape management will help reduce the risks to existing and new public and private infrastructure in both urban and rural areas during heavy rains that lead to flooding. Healthy forests and other natural landscapes can absorb and store large amounts of water, reducing flood and landslide risks and soil erosion, and protecting agricultural productivity and jobs. Investing now in integrated approaches to restoring forests and riverbank areas and promoting the sustainable management of ecosystem services while enhancing livelihoods and jobs, could lead to significantly higher economic benefits by 2050 and the monetization of forest ecosystem services. DRC also needs to reduce the enormous pressure on its forests and protected areas from the collection of firewood and the unsustainable production of charcoal. To make livelihoods more climate-resilient, landscape restoration activities need to start now because the benefits accumulate gradually over many years.

DRC's hydropower resources could provide large, competitive, and flexible sources of renewable energy nationally and regionally under a changing climate. Hydropower not only remains the lowest-cost source of electricity worldwide but has the advantage of being flexible and providing large-scale energy storage through reservoirs.[11] A large portion of DRC's hydropower capacity could be harnessed through the construction of the Grand Inga Hydropower dam on the Congo River, with support from the private sector. In the short to medium term, greater focus on developing small and medium hydroelectric power plants (HPPs) closer to the electricity load is the most realistic approach to meeting DRC's growing electricity demand and achieving universal access. Increased access to renewable energy is a major development need to reduce the demand for fuel biomass and to give more Congolese access to cooling resources in anticipation of future projected heatwaves.

Action Area 2: Increase agriculture productivity and food security through climate smart agriculture, and support to farmer-led irrigation.

Climate change will affect labor productivity, particularly through heat stress, and will negatively impact agriculture. The CCDR model shows that the biggest impact on the economy is through shocks to labor productivity. This, in turn, affects livelihoods, food security—already tenuous at best—and the country's ability to recover from shocks. The worst-affected are likely to be poor rural households, precisely those already least able to withstand shocks, including from extreme weather. Near-term investments in agriculture need to promote and incentivize increased sustainable production—including by improving irrigation efficiency as a major adaptation action—promote market access, knowledge and financing services in the rural economy, and create backward/forward links.

Irrigation, besides the improved soil and crop management it brings, is one of the vital prerequisites for improving DRC's climate-smart agriculture (CSA) value chains for both food crops and higher-value horticulture. Expanding farmer-led irrigation can be pursued gradually, starting in high-potential areas such as those where farmer's demand is strong, market access relatively good, water resources easily accessible, impacts of dry spells are increasing, and soil conditions/slope are favorable. A certain prioritization of the agriculture value chains by the government can be envisaged by first considering the support to most water-demanding crops (like rice, maize, and all market-gardening and horticultural crops) and where food security benefits can benefit most vulnerable areas.

DRC needs to guide its agriculture economy toward further diversification, greater value creation, and a longer-term integration of the various links within its agricultural value chains. To improve the functioning and integration of CSA value chains, two obstacles must be overcome: weak governance of the agricultural sector, and the question of the appropriate agricultural policy. The country needs to have a single, coherent policy on cross-cutting aspects of agricultural development that integrates climate change, growth, land tenure security, irrigation, seed sector, integration of sylvopastoral practices, and access to public and private funding.[12]

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[11] World Bank, Increasing Access to Electricity in the DRC: Opportunities and Challenges (Washington, DC: World Bank, 2020), https://doi.org/10.1596/33593.

[12] Several policy documents have governed the agriculture sector, including the National Agriculture Investment Plan (NAIP, 2014–2020), the Agricultural Law, and the Agro-industrial Recovery Strategy, but ownership of these policies has been weak.

Action Area 3: Develop climate resilient transport and cities, enhance digital access, and improve access to basic services.

Improving in-country and regional connectivity will require rehabilitating, upgrading, and maintaining existing infrastructure to climate-resilience standards and promoting the integration of transport mode to create a seamless network that facilitates the safe and efficient movement of people and goods. Infrastructure maintenance also needs to be commensurate with climate risks. DRC's transport network of roads, railway, aviation, inland waterways, and maritime transport is among the world's least dense, most dilapidated, and impassable. To improve connectivity, the country needs to upgrade the priority road network to paved standards, create drainage systems in flood-prone areas, and install slope protection measures in mountainous areas. DRC has one of the world's largest river systems, yet inland waterway transport is hindered by high levels of silting and long waiting times at ports owing to inadequate infrastructure and governance. There is high potential demand for multimodal transportation systems in DRC—particularly for road and river transport—, including at the regional level.

Investments in urban climate action and digital integration could secure and strengthen hard-won progress in access to shelter and communication services in already developed urban infrastructure and thereby further address urban poverty and fragility. The most vulnerable segments of the urban population—the poor and those living in high-risk often informal settlements—could benefit the most from the development of resilient urban communities because of the climatic challenges of the urban environment, such as heat islands. Urban climate action can further leapfrog towards a "green" and sustainable development growth path, all the while improving access to services, including the water supply and sanitation, urban livability, and upward socioeconomic mobility. The still embryonic digital sector has immense potential, and further developing it would create opportunities for governments, businesses, and citizens. DRC should integrate the digital sector into the Government's vision for climate change and plans for adaptation and reduction of emissions as the digital sector develops.

Finally, it is important for DRC to stimulate private sector investment in infrastructure resilience and low-carbon development. Needed macroeconomic reforms include improving currency convertibility, reducing administrative bottlenecks, strengthening contract enforcement, shifting from unsolicited to solicited bids, creating a project preparation fund, and routine screening and management of contingent liabilities based on a fiscal commitments and contingent liabilities framework. Sector-level reforms such as greater transparency and regular financial reporting by energy sector state-owned enterprises are a first step to restoring cost-reflective tariffs and building creditworthy off-takers. The partial unbundling of DRC's electricity sector has yet to lead to a credible off-taker for independent power producers. In cities and peri-urban areas, private sector participation in water supply services could explore lower-risk engagements through non-revenue water performance-based contracts, and design-build-operate contracts, while enforcing a broader regulatory environment (for example, economic regulation) to complement and facilitate the restructuring of REGIDESO, the national water utility, to enhance its performance.

Action Area 4: Enhance governance and boost human capital by reducing poverty, increasing social inclusion, and enhancing security

Climate change can deepen socioeconomic exclusion by impeding improvements in human development outcomes. The already marginalized are likely to be disproportionately affected and risk having their vulnerabilities multiplied, pushing them further into poverty. The potential of climate impacts to compound existing vulnerabilities will make DRC's poverty alleviation and development goals harder to achieve. The conflict-affected have additional vulnerabilities that further complicate their adaptation to climate impacts. DRC's 6.3 million internally displaced persons (IDPs), who often have complex humanitarian needs, are a cause for concern. Demobilized combatants face challenges in reintegrating into society and may be at risk of re-mobilization due to climate pressures. DRC's development policies must ensure that its resources serve the needs of its people, who have been underserved by years of conflict and political turmoil, under-investment, and poor service delivery, despite providing a global good in the protection and management of its natural wealth. DRC must comprehensively tailor resilience programs to the needs of already vulnerable groups to ensure they are included in, and will benefit from, adaptation measures.

Enhancing institutions, building capacity, and improving governance are important preconditions for climate change action and becoming a "solutions country". The World Bank's Climate Change Institutional Assessment (CCIA) review of DRC identified core strengths and weaknesses in the country's institutional configuration and capacity for effective climate action. DRC has a comprehensive set of international climate commitments, with a new National Adaptation Plan (NAP) for 2022–26 guiding implementation. The Ministry of Environment and Sustainable Development (MEDD) and the Congolese Environmental Agency (ACE) have general expertise and leadership on climate change, but coordination with other government actors remains inconsistent and often focused on technical-level initiatives as opposed to implementation and capacity building on the ground. Climate-related technical capacity and understanding remain challenges for line ministries and provinces.

As DRC advances its climate agenda implementation, the next steps include aligning institutional frameworks and practices to international standards. This CCDR proposes to operationalize three best practice areas: (i) Concretize the legal framework by establishing a dedicated and comprehensive Framework Law on Climate Change; (ii) Enhance the enabling environment by building technical capacity and improving institutional coordination mechanisms; and (iii) Strengthen the financial underpinnings of climate smart development by designing an Integrated National Climate Finance Strategy. In addition, the DRC should pursue country-specific priority areas. Three key levers that can help DRC augment its authorizing environment for climate action and implement concrete medium-term steps: Confirm political leadership for climate at the national level by operationalizing the National Council for Environment & Sustainable Development; expand climate monitoring, transparency, and accountability at the center of government by mainstreaming and monitoring Financial Climate Management, monitoring Climate Investment Spending, and strengthening Climate Oversight and Public Disclosure; and continue supporting rollout of capacity building activities for the integration of climate across the provinces through the Provincial Development Plans, and through climate training for sector-planning units and the Public Financial Management Department.

1 DRC CONTEXT AND DEVELOPMENT PRIORITIES IN A CHANGING CLIMATE

Chapter 1: DRC context and development priorities in a changing climate

1.1. Context and Development Challenges

The Democratic Republic of Congo (DRC) is one of the world's poorest[13] and most densely populated countries[14] with an annual population growth rate of more than 3 percent and a poor human capital accumulation. Nearly 64 percent of Congolese (about 60 million people) live on less than US$2.15 a day.[15] Additionally, because of DRC's prolonged and complex humanitarian crisis, an estimated 27 million people have acute essential and food security needs. Poverty and social exclusion, concentrated in the South and East DRC, are particularly pronounced among the rural poor and urban poor, women, children, those with disabilities, indigenous peoples, and the conflict-affected. Poor human capital accumulation[16] in the DRC is largely the result of: (i) a weak education system (poor school environments and infrastructure and lack of teaching); and (ii) a high child-stunting rate of about 42 percent during the past two decades. Gender inequalities exacerbate the situation, especially on human capital components such as education and health.[17] Health access is limited, aggravated by recurring crises such as Ebola outbreaks, and there is distressing prevalence of sexual and gender-based violence, that affects more than half of females aged 15 and over.

Fragility, conflict, and violence (FCV) has plagued DRC's modern history. Conflict flareups are an ever-present concern, primarily in the east but with multiple new hotspots appearing across the country since 2016. DRC's social vulnerability and exclusion issues both contribute to conflict and stem from it. Multiple armed groups operate in eastern DRC,[18] exploiting inter-communal tensions, the existence of valuable land resources, limited alternative economic opportunities,[19] and the state's limited presence and reach. The re-emergence of conflict is creating a new wave of displacements, with nearly 2.7 million IDPs in 2021, bringing the total to 6.3 million. As of 2022, DRC has more than 525,000 refugees, mostly from neighboring countries.[20] Any discussion of climate change in DRC is therefore incomplete without considering the social dynamics and impact of conflict-induced forced displacement.

DRC's economic outlook has improved since 2000, but it has not grown enough to significantly reduce poverty rates or significantly advance toward the sustainable development goals (SDGs). DRC is exposed to the volatility of global commodity demand because of its high commodity dependence and few positive spillovers from good value

[13] DRC is one of the five poorest nations in the world, according to World Bank data. World Bank, "The World Bank in DRC," World Bank website, last updated March 29, 2023, https://www.worldbank.org/en/country/drc/overview.

[14] Institut National des Statistiques (INS), Enquête par grappes à indicateurs multiples - Rapport de résultats de l'enquête, 2017–2018

[15] World Bank, "The World Bank in DRC."

[16] DRC's 2020 Human Capital Index (HCI) score was 0.37, below the 0.40 average for Sub-Saharan Africa.

[17] In DRC, returns to primary education are not that high compared to no education. This suggests the importance of ensuring that primary students go on to complete secondary school. The pattern is similar when considering other poverty indicators, including the Multidimensional Poverty Index (MPI), the incidence of chronic poverty and vulnerability, the prevalence of stunting among children under age 5, and school attendance rates. In all cases, returns are significantly higher when the household head has at least a secondary school education. The fact that school attendance among children ages 6 and 15 years of age has decreased from 84 to 79.2 percent between 2014 and 2018 is of serious policy concern. School attendance among this age group remained stable in Kinshasa, at around 91 percent, but in rural areas it decreased by more than 7 percentage points.

[18] More than 120 armed groups currently operate in the region—up from around 70 in 2015.

[19] In 2022, significant gains by a leading armed group around areas with green mineral reserves, raised tensions between DRC and Rwanda to its highest point in two decades, International Crisi Group (ICG)," Easing the Turmoil in the Eastern DR Congo and Great Lakes", 2022.

[20] UNHCR, "Democratic Republic of the Congo — Monthly Statistics of Refugees and Asylum Seekers — 31 December 2022," UNHCR Data Portal, https://data.unhcr.org/en/documents/details/98631.

chain development.[21] Despite pandemic-related uncertainties, GDP growth rebounded to 6.2 percent in 2021 and reached 8.6 percent in 2022.[22] However, the economy has not grown enough to significantly reduce poverty rates or significantly advance toward the sustainable development goals (SDGs). According to the 2022 Sustainable Development Report, DRC faces "major challenges" in achieving 14 of the 17 goals and is on track to achieve only two.[23] The sluggish growth stems from DRC's dependence on megaprojects and foreign direct investment in the extractive industries, with few benefits to the poor and vulnerable, and limited links to the rest of the economy.

Despite episodes of strong GDP expansion, DRC's growth levels have not lived up to the full potential of its natural resources, strategic location, and young growing population. This is because of slow growth that has failed to reduce poverty, currently highly dependent on mineral exports, poor natural resource management, numerous binding constraints on sustainable inclusive growth, and inadequate institutions.[24] In such a context, economic diversification (especially that of exports) is vital to build economic resilience, sustain high growth, and reduce inequality.[25]

DRC has one of the world's highest concentrations of mineral wealth and renewable natural capital is the second-most important component of DRC's wealth. DRC is the fifth-largest copper producer, and produces over 70 percent of the world's cobalt, with 46 percent of global reserves.[26, 27] Copper and cobalt constitute over 90 percent of DRC's exports, of which 40 percent is absorbed by China.[28] Weak enforcement of environmental standards and governance issues, such as poor transparency, are key limitations in the processing of these minerals. In addition, hydropower potential of the DRC alone is estimated to be sufficient to supply the current energy consumption of the entire Sub-Saharan Africa (excluding South Africa). The Inga Falls alone, with a potential capacity of 42 GW, could produce some of the world's least expensive hydroelectricity, at US$2 cents/kWh. Yet, hydropower development has been extremely limited, with DRC generating less than 3 percent of its potential. In 2018, 37.8 percent of DRC's wealth was renewable natural capital (made of water resources, forests, cropland, wildlife,[29] fisheries and protected areas), compared to 60.0 percent in 2000. This sharp decline has complemented a steady rise in human capital, from 30.9 percent in 2000 to 48.2 percent in 2018 (figure 1.1).

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[21] A focus on adding value aligns with the DRC presidency's ambitions to promote agroindustry and industrialization and ensure the long-run sustainability of production systems. This will require the full development of value chains such as timber, mining, and agriculture. Domestic processing and value addition in these value chains will also promote employment, income growth, and infrastructure buildup, and could potentially stop conflicts.

[22] World Bank, *Macro Poverty Outlook for Congo, Republic of: April 2023* (Washington, DC: World Bank, 2023), https://documents.worldbank.org/en/publication/documentsreports/documentdetail/099600304122332859/idu13af3407d10dbc144301b9791b8081d9c281a.

[23] SDR Dashboard data extracted from J. Sachs, G. Lafortune, C. Kroll, G. Fuller, and F. Woelm, Sustainable Development Report: From Crisis to Sustainable Development, the SDGs as Roadmap to 2030 and Beyond (Cambridge: Cambridge University Press, 2022).

[24] Reyes Aterido, Alvaro Gonzalez, Dino Merotto, Carly Petracco, and Javier Sanchez-Reaza, Democratic Republic of Congo: Jobs Diagnostic (Washington, DC: World Bank, 2018).

[25] World Bank, Democratic Republic of Congo Systematic Country Diagnostic: Policy Priorities for Poverty Reduction and Shared Prosperity in a Post-Conflict Country and Fragile State (Washington, DC: World Bank, 2018).

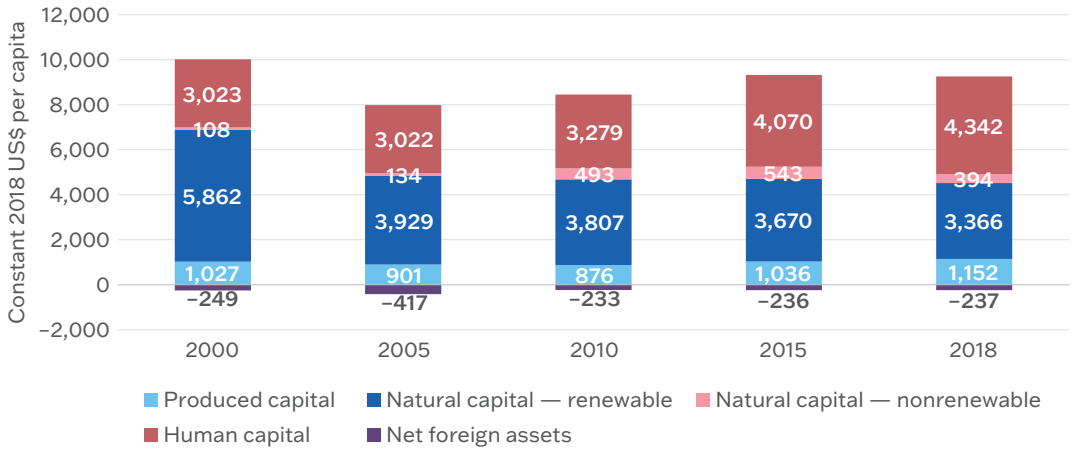
[26] See US Geological Survey, Mineral Commodity Summaries 2022. These reserves are mostly concentrated in the Southern region (ex-Katanga).

[27] Gold, diamonds, crude petroleum, and zinc are also produced throughout the country.

[28] A major supply constraint is the rise of Indonesia as a battery grade nickel processing country, as well as its rise as a cobalt mine production. The larger point, however, is that Indonesia's rise would be much less of a problem for DRC if DRC's economy were diversified.

[29] DRC is one of the world's 17 mega-biodiverse countries. It is home to over 400 species of mammals, over 1,000 bird species, over 400 fish species, and over 10,000 plant species. This includes numerous species that live nowhere else. However, the country's rich biodiversity, history of instability, and high levels of corruption also make it a top target for criminal networks seeking to poach, pillage or otherwise extract ivory, pangolin scales, rhino horn, and other illegal wildlife products to other countries and continents. "Disrupting Wildlife Trafficking in the DRC," Voice of America, January 24, 2022.

Figure 1.1: DRC's wealth per capita components, in constant 2018 US$ per capita, 2000–2018



Source: Calculated from the database from The Changing Wealth of Nations 2021: Managing Assets for the Future, World Bank, 2021

Forest biomass constitutes DRC's most important source of energy, accounting for around 94 percent of its total primary energy supply.[30] Biomass accounts for 98.8 percent of the country's total household energy consumption, of which fuelwood represents 81.8 percent and charcoal 17.0 percent. In 2010, Kinshasa's charcoal market was estimated at US$143 million (about US$150 million today), 3.1 times the value of softwood lumber exports (US$46 million in 2010,[31] or about 0.2 percent of GDP). As the population grows and neighboring countries like Rwanda adopt conservative wood policies, deforestation pressure[32] on the remaining North and South Kivu forests is expected to increase.[33] The pressure could be reduced by promoting the use of cleaner household energy sources and developing sustainable harvesting of charcoal through agroforestry investments on plantations on bare savannah and degraded land. Despite its huge agricultural potential, DRC is a net food importer, which raises its vulnerability of food access to external and climatic shocks and leaves 26.4 million Congolese highly food-insecure.[34] The agriculture sector employs some 70–75 percent of the economically active population[35] and represents 20 percent of GDP.[36] The demand for food stemming from urban growth is expected to put additional pressure on the rural areas surrounding several megacities.[37]

[30] Renewable sources account for 98 percent of DRC's total energy supply, with hydropower contributing only about 3 percent of this. Source: Energy Profile, DRC, International Renewable Energy Agency (IRENA), 2019.

[31] Food and Agriculture Organization (FAO), FAOSTAT, (Rome, Italy: FAO), 2011.

[32] An estimated at 6 million ha were deforested between 1992 and 2020, 67 percent of it for cropland expansion. It is expected that between 2020 and 2030 deforestation will total 8.4 million ha, with an additional 4.5 million ha deforested by 2050, 60 percent of this for cropland expansion.

[33] UNCDF (United Nations Capital Development Fund), What does the clean cooking market look like in the DRC? A Business and Health Assessment of the clean cooking market in the DRC (New York, New York: UNCDF 2020), https://www.uncdf.org/article/5341/what-does-the-clean-cooking-market-look-like-in-the-drc.

[34] World Food Program, "Achieving Long-term Food Security in DRC is all About Building Resilience", October 2022.

[35] FAO (Food and Agriculture Organization), "Food and agriculture data," *FAOSTAT*, (Rome, Italy: FAO), last accessed September 20, 2023, https://www.fao.org/faostat/en.

[36] In rural areas, 16 million Congolese smallholder farmers are the backbone for food security and agriculture, with an average landholding of 1.6 ha.

[37] UN-HABITAT, *Democratic Republic of the Congo: Overview,* https://unhabitat.org/democratic-republic-of-the-congo; In addition to the megacity of Kinshasa, there are now seven other cities with a population of over 1 million.

Given persisting fragilities, conflict and constraints, DRC's main development issues are to trigger structural transformation and promote inclusive growth. The economy is characterized by virtually no labor movement to high-productivity sectors.[38] Manufacturing's employment share remains stagnant, and its output share has been falling. Additionally, the gradual shift of labor from agriculture to industry and services has not been evenly distributed, with the western region registering the greatest growth in industry and services, while the poorer central and eastern regions are still dominated by agriculture.

Achieving high-growth rates that significantly reduce poverty and inequality will require unlocking investments in sustainable infrastructure and human capital. Limited connectivity exacerbates social and economic inequalities across and within provinces and between urban and rural areas. DRC's transport network is among the world's least dense, most dilapidated, and impassable. This isolation contributes to weak service provision, poverty, malnutrition, and fragility. In urban areas, there is no appropriate infrastructure for non-motorized transport, and high levels of congestion result in high fuel consumption, GHG emissions, and air pollution.[39] Between 2005 and 2012, improved access to the network transport was found to contribute to a 13.2 percent drop in observed poverty.[40] The lack of transport infrastructure affects the country's industrial development, particularly in manufacturing. The DRC's digital potential is hugely underexploited, with implications for the economy, economic competitiveness, and job creation.[41]

The Government has laid out its vision for the country's development and mapped out near term steps in the 2030 National Strategic Development Plan[42] which aims for DRC to reach Upper middle-income country (MICs) status by 2030 and become a diversified and inclusive economy by 2050. The plan, costed at US$25 billion, has five pillars: (i) human capital; (ii) good governance and peacebuilding; (iii) economic growth and diversification; (iv) territorial development and infrastructure; and (v) environmental protection, climate change, and sustainable development. This vision focuses on the valuation of natural resources to promote the creation of the fiscal space needed to finance public investments in infrastructure and human capital, and overcoming institutional and structural weaknesses, including the lack of financial resources. Resulting gains in productivity could have positive implications for the production sectors and structural transformation. Under this vision, climate change is presented both a challenge and an opportunity for DRC's development and growth.

1.2. Climate-related impacts

DRC shows high vulnerability to, but low readiness for climate change and impacts. Ranking 182 of 185, DRC is the 4th most vulnerable country on the 2021 ND-GAIN Country Index[43] and one of the least climate-ready countries (185th out of 192 countries).[44] DRC

[38] Most agricultural income is in the form of self-consumption and to a lesser extent through the sales of their own production, and yet many households remain food insecure.

[39] Democratic Republic of Congo, *Revised Nationally Determined Contribution*, 2021. See United Nations Climate Change, *Nationally Determined Contributions Registry* (Bonn, Germany: UNFCC Secretariat), https://unfccc.int/NDCREG.

[40] World Bank, *Democratic Republic of Congo Systematic Country Diagnostic* (Washington, DC: World Bank, 2018), http://documents.worldbank.org/curated/en/171101529346675751/Congo-Democratic-Republic-of-Systematic-country-diagnostic.

[41] DRC, Revised Nationally Determined Contribution.

[42] In French, Plan National Stratégique de Développement (PNSD).

[43] The ND-GAIN Country Index (https://gain.nd.edu/our-work/country-index/rankings) summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. It aims to help governments, businesses and communities better prioritize investments for a more efficient response to global challenges.

[44] ND-GAIN Country Index Ranking, "Dem. Rep. of the Congo," last accessed September 23, 2023, https://gain-new.crc.nd.edu/country/dem-rep-of-the-congo.

ranks 56th out of 192 countries in overall natural disaster risk vulnerability according to the 2022 World Risk Report.[45, 46] Situated in the Congo River Basin, the country is heavily exposed to river floods—especially during equatorial heavy rain events. Yet despite its many water sources, the risk of wildfires has risen with variations in temperatures—particularly in already drought-prone areas.

DRC is expected to experience higher heat stress and increased extreme climate events[47] with notable temporal shifts in its hottest conditions up to mid-century, with significant increases occurring toward the end of the century. An increase in extreme climate events is exacerbating DRC's development challenges, with devastating consequences. Annual temperatures are projected to increase by +1.7°C to +4.5°C by century's end. In the northern, western, and central areas, nearly every day of the year will have nighttime temperatures exceeding this range (figure 1.2 and 1.3). Higher, more prolonged nighttime temperature creates relentless heat with no ability for livestock, environment, or humans without access to active cooling to recover from intense day time temperatures. The greatest increases in temperature are projected for Grand Bandundu, Kasai Occidental, Maniema, and Kananga. Hot days and nights are projected to increase 13–58 percent and 33–86 percent, under the range of climate scenarios. For the 2040–59 period, under the more pessimistic climate scenario SSP3–7.0, the number of nights surpassing 20 °C per month is expected to nearly double from the historical reference period.

Figure 1.2: Projected number of tropical nights with minimum temperature >20°C, 2080–2099, SSP3–7.0

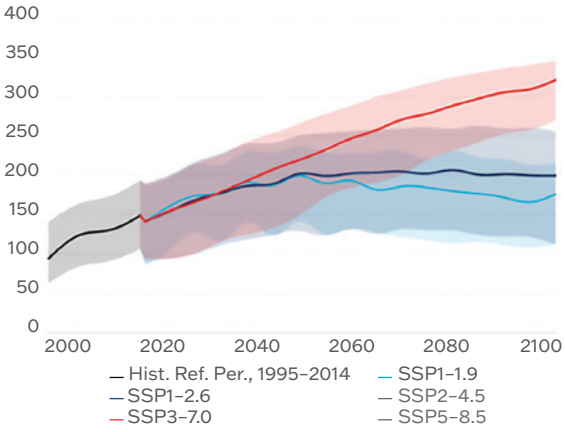
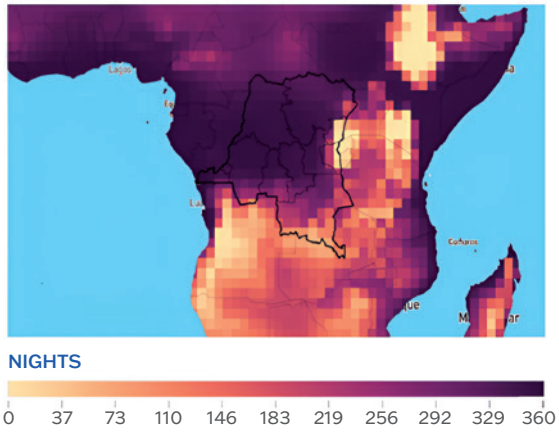


Figure 1.3: Spatial distribution of the number of nights with minimum temperatures > 20 °C, 2080–2099, SSP3–7.0



Source: Climate Change Knowledge Portal — DRC Profile, World Bank, 2022

DRC will also experience significant seasonal and subnational rainfall variation. While projections point to no significant changes in overall annual precipitation, rainfall is becoming substantially more variable within seasons, with a likely increase in the frequency and intensity of extreme rainfall events. While more hydropower could be

[45] World Risk Report, *Bündnis Entwicklung Hilft* (Ruhr University Bochum, Institute for International Law of Peace and Conflict, 2022), https://weltrisikobericht.de/weltrisikobericht-2022-e.

[46] In addition to natural disasters, DRC faces the highest rates of population displacement in Africa—spurred by conflict and instability. Natural disasters, pandemics, and food insecurity further fuel the population movements. According to UNHCR, DRC has the highest internal migrancy in Africa, with 6.3 million IDPs.

[47] Climate and Development Knowledge Network (CDKN), African Climate and Development Initiative (ACDI), "The IPCC Sixth Assessment Report", 2022, https://cdkn.org/sites/default/files/2022-03/IPCC%20Regional%20Factsheet%203_Central%20Africa_web.pdf.

generated due to waterflow increase during seasons in the rivers, these gains could be compromised by increasing erosion and sedimentation from more intense rainfall in areas with increased deforestation. Seasonally, this will result in greater rainfall received on fewer days within the rainy season and a potential for longer-lasting dry spells in the drier season, rendering an additional crop rotation highly risky. The impacts will be most pronounced via changes in the country's intra-annual water balance and have the potential to increase the incidence of floods.[48, 49] Under the more optimistic climate scenario of SSP1–1.9, DRC can expect to experience 86.28 mm (100-year event based on historical baseline) of rainfall once every 70 years by 2085, more frequently than at present. However, for comparison, under a pessimistic scenario, the DRC can experience a 100-year rainfall event every 20 years by 2085, which would be an extremely significant increase in its frequency.[50]

1.3. The compounding effect of climate and development risks

The primary impact of a changing climate is likely to come from hydrological changes lowering agriculture productivity, reduced access to freshwater resources, and ecosystem degradation. Characterized by low productivity and lack of modernization, the agricultural sector faces risks from shifting precipitation, rising temperatures, floods, and other climate hazards. Intense rainfall can damage crops, erode soil, and increase crop diseases, while the South is particularly exposed to droughts. These changes exacerbate food insecurity, especially given the predominance of rainfed agriculture, and intensify the competition for food. In 2021–22, around 500,000 people lost almost all their food reserves because heavy rains resulted in flooding.[51] Poor infrastructure development and low connectivity amplifies the impact of climate risks as they affect processing, storage, and transportation along food value chains,[52] as in the Kasai provinces. The fishery stock is also exposed to climate risks, which impedes the expansion of the sector and further undermines food security. Regions that rely on lakes, such as Tanganyika, are less vulnerable to reduced catch than those dependent on rivers and floodplains, like the Kasai provinces,[53] but increasing water temperatures in the Great Lakes region leading to algal growth and reduced nutrients for fish.

The DRC suffers from the combined effect of a rapidly increasing population, a surge in the frequency of climate extremes, and poor provision of services and infrastructure.[54] Climate change is already threatening the country's energy, transport, water supply, and communications infrastructure. Its basic energy infrastructure is susceptible to climate variability: intense and frequent rainfall events and floods could

[48] For example, by century's end under SSP3–7.0, the maximum number of consecutive wet days is projected to decrease by about 15 days per year (median), but the average largest 1-day precipitation is projected to increase by 24 mm, and the average largest 5-day cumulative rainfall by 36 mm.

[49] Climate Services Center Germany (2016). Climate Fact Sheet — Democratic Republic of the Congo.

[50] Between 2040 and 2059, the top five provinces with increased exposure to 100-year floods magnitude will be Kongo-Central, Haut-Katanga, Haut-Lomami, Lualaba, Tanganyika.

[51] IMF, *Democratic Republic of Congo: Selected Issues* (Issue 211) (Washington, DC: International Monetary Fund, 2022). https://doi.org/10.5089/9798400214288.002.

[52] USAID, *Climate Risks to Resilience & Food Security in Bureau for Humanitarian Assistance Geographies — Democratic Republic of Congo* (Washington, DC: United States Agency for International Development, 2023), https://www.climatelinks.org/sites/default/files/asset/document/2023-02/BHA_Climate%20Risk%20Profile_DRC_2023_FINAL_508.pdf.

[53] C.H. Trisos et al., "Africa," in *Climate Change 2022: Impacts, Adaptation and Vulnerability* (Intergovernmental Panel on Climate Change (IPCC) Working Group II Report, 2022), https://www.ipcc.ch/report/ar6/wg2/chapter/chapter-9.

[54] In 2021, more than one percent (over 9.5 million) of DRC's population faced the destruction of their housing and property because of climate events. See Internal Displacement Monitoring Centre (IDMC), *Global Report on Internal Displacement 2022* (Geneva: IDMC, 2022), https://www.internal-displacement.org/global-report/grid2022.

potentially disrupt river flows and affect hydropower generation.[55] Erosion also presents a risk for infrastructure.[56] Increased flooding has damaged transport infrastructure, weakened connectivity including digital access to services, polluted water supply services, spread pathogens from poorly constructed sanitation facilities, and limited access to education and health service.[57] Droughts will create challenges in river and lake transportation, which will lead to a reduction in the supply of drinking water and potential massive displacement of rural population to urban areas.[58] The cost of disruption due to natural shocks to the power sector in 2019 was estimated at 1.9 percent of GDP.[59]

Climate change also hampers urban growth. Kinshasa's city population has been expanding at a constant rate and its GDP alone is more than one third of the national GDP. Recent floodings outside Kinshasa in December 2022 resulted in 169 deaths and the collapse of the main road linking the capital to the country's main seaport.[60] Ineffective land management has pushed the urban poor into unsuitable settlements, thus exacerbating their vulnerability and exposure to climate and economic shocks. The country's infrastructure deficit, often viewed as a constraint on development, now offers an opportunity to re-evaluate needs and priorities and build infrastructure differently. Retrofitting existing infrastructure to make it more climate-resilient is often the costlier route, but frequently new infrastructure investments can more cost-effectively be made resilient.[61]

1.4. Climate Change Impacts on the Most Vulnerable Populations

Climate change could reverse the country's hard-won gains in human capital development, with a disproportionate impact on the most vulnerable. The already poor, excluded, and marginalized are the least climate-resilient and are most likely to be disproportionately impacted. Women are particularly vulnerable to climate change, as they struggle to secure agricultural incomes due to educational, financial, and government service access disparities.[62] Moreover, weak land tenure security makes vulnerable Congolese at risk to dispossession from their land during land related climate disasters. This could be a trigger for displacement or involuntary migration and ensuing risks such as deepening impoverishment, exploitation, and sexual violence. Climate sensitive malaria, cholera, and other diarrheal and vector-borne diseases are expected to increase as flooding and droughts intensify and impact labor productivity.[63] In existing

[55] World Bank, *Climate Risk Country Profile: Congo Democratic Republic* (Washington, DC: World Bank, 2021), https://climateknowledgeportal.worldbank.org/sites/default/files/2021-06/15883-WB_Congo%2C%20Democratic%20Republic%20Country%20Profile-WEB.pdf.

[56] DRC, *Revised Nationally Determined Contribution.*

[57] Over 97 percent of DRC's current road network is gravel and earth, with nearly no drainage systems. This makes it extremely vulnerable to flooding and erosion from heavy rainfall, making them virtually impassable.

[58] Democratic Republic of Congo, *National Adaptation Plan to Climate Change 2022–2026* (Kinshasa, DRC: Ministry of the Environment and Sustainable Development, 2021), https://unfccc.int/sites/default/files/resource/DRC-NAP_EN.pdf.

[59] Stephane Hallegatte, Jun Rentschler, and Julie Rozenberg, Lifelines: The Resilient Infrastructure Opportunity (Washington, DC: World Bank, 2019), https://openknowledge.worldbank.org/entities/publication/c3a753a6-2310-501b-a37e-5dcab3e96a0b.

[60] Sammy Westfall, "More than 100 killed by floods and landslides in Congo's Kinshasa," *Washington Post*, December 13, 2022, https://www.washingtonpost.com/world/2022/12/13/floods-democratic-republic-congo-killed.

[61] Hallegatte et al., *Lifelines: The Resilient Infrastructure Opportunity*.

[62] Bramka Arga Jafino, et al., *Revised Estimates of the Impact of Climate Change on Extreme Poverty by 2030* (Washington, DC: World Bank, 2020), https://doi.org/10.1596/1813-9450-9417.

[63] See World Bank, *Climate Change Knowledge Portal — Democratic Republic of Congo*, https://climateknowledgeportal.worldbank.org/country/congo-dem-rep/vulnerability. Malaria is a leading cause of morbidity and mortality in DRC and is projected to extend in seasonality and geography.

malaria-prone areas and in a BAU scenario, malaria cases are projected to triple by mid-century.[64] Extreme climatic events also degrade and destroy health, education, and sanitation infrastructure, compromising the population's access to services.

The conflict-climate change nexus needs careful consideration in DRC given that persistent violence and country fragility has affected nearly 40 million Congolese, threatening country stability and development.[65] Indeed, armed conflict, predominantly in the east, was found to be the primary driver of food insecurity in 2022, causing displacement and reliance on aid from humanitarian organizations.[66] Under climate impacts on food security and increased vulnerability, competition for basic resources and resource predation by armed groups of local civilians are likely to be compounded, leading to an increase in the number of civilians turning to conflict as an income strategy.[67] High-risk provinces for climate change impacts could lead to an increased militarization in Eastern DRC (Ituri, North Kivu and South Kivu) but also Haut-Katanga, Kwilu, and Kinshasa.

1.5. Low-carbon development

DRC's per capita emissions are high for a country at its income level, and it is a clear challenge for the country. Land-use change, and forestry are the primary contributors to DRC's GHG emissions (92 percent), followed by agriculture (4 percent), waste (2.3 percent), and energy (1.5 percent). Including Land Use Change and Forestry, DRC's 2020 per capita emissions are 7.68 tCO_2e, 21st in the world, and compared with its neighbors DRC's emissions footprint remains the second highest (figure 1.4).[68] Emissions are expected to increase some over the coming decades—particularly from energy and transport—in line with population growth to around 220 Mt CO_2e. Approximately 30 percent of total GHG emissions are generated directly in urban centers, dense and semi-dense urban clusters, as well as suburban or peri-urban areas. In addition, half of CH_4 (methane) emissions are generated directly in urban areas.[69] The DRC only counted 1.31 million tons, yet urban centers made up nearly half, 0.65 million tons of CH_4 emissions.

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[64] Democratic Republic of Congo, *Second National Communication to the UNFCCC: Executive Summary* (Kinshasa, DRC, 2009), https://unfccc.int/sites/default/files/resource/Executive%20Summary.pdf.

[65] Pervasive use of violence has also contributed to an erosion of social cohesion. The conflict–climate change nexus in DRC manifests in two main ways: conflict-affected persons, especially women and girls, are particularly vulnerable to climate change impacts; second, climate impacts often compound the drivers of conflict, leading to a further entrenchment of the conflict cycle.

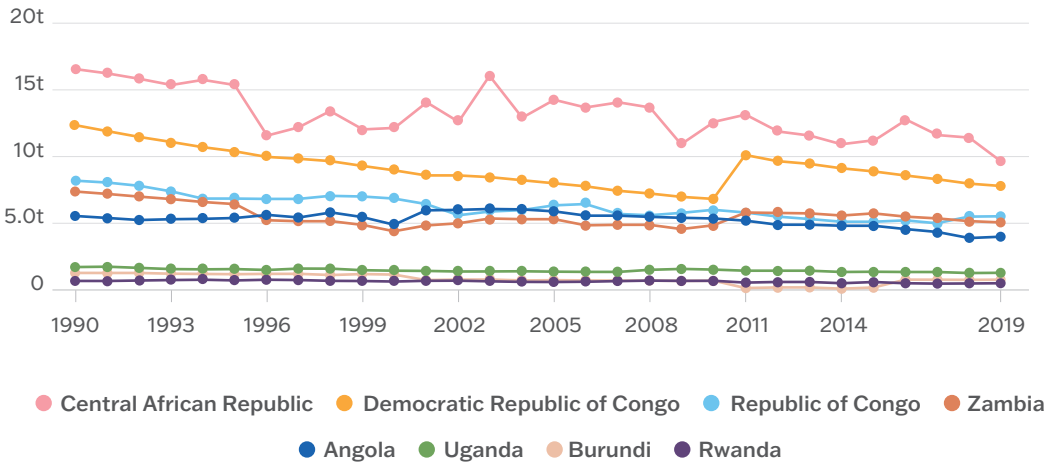
[66] Integrated Food Security Phase Classification (IPC), *Democratic Republic of Congo: Acute Food Insecurity and Acute Malnutrition Situation, September 2021—August 2022* (2022), https://www.ipcinfo.org/ipc-country-analysis/details-map/en/c/1155280/?iso3=COD.

[67] Demobilized combatants, small-scale artisanal miners, IDPs, pastoralists, and indigenous communities are particularly vulnerable to such incentives. See Stijn Van Weezel, "Local warming and violent armed conflict in Africa," *World Development* 126 (2020): 104708, https://doi.org/10.1016/j.worlddev.2019.104708.

[68] Climate Watch, 2023.

[69] Based on EDGAR (Electronic Data Gathering, Analysis, and Retrieval) data for 2015. The EDGAR dataset, produced by the European Commission (EC), is a series of global gridded maps of GHG and air pollutant emissions from 1970 onward. Using mainly international data sources, the EDGAR model estimates national emissions based on activity data and emissions factors. For each GHG and pollutant, the EC has summarized emissions from the EDGAR system by settlement type within each country, based on the Global Human Settlement typology (urban centers, towns, suburbs, and so on), for the years 1970, 1990, 2005, and 2015.

Figure 1.4: GHG emissions per capita in the DRC and its neighboring countries, CO_2e per capita, 1990–2019



Source: World Resource Institute Climate Watch, 2022

For DRC, the key challenge is to reduce the current emissions trajectory and avoid locking itself in carbon-intensive development pattern, that is inefficient and costly to reverse. DRC has reiterated its intent to position itself as a "solution country"[70] for reducing global GHG emissions, with a potential for high carbon sequestration due to its vast forest resources,[71] a large hydropower generation essential to meet the predicted increase in energy demand, and for becoming a low carbon supplier for clean energy transition minerals (mostly copper and cobalt). Realizing these aspirations will require leveraging sectors with high growth potential (mining, energy) and applying related revenues in investments that enable and build resilience of sectors with high employment and medium-term growth potential (namely agroforestry, commercial agriculture, agroindustry, clean cooking, and services). Clean Cooking is a key climate mitigation measure in the DRC's 2021 National Determined Contributions (NDCs), aligned with achieving the UN SDG 7 along SDG 1, 3 and 13. Private sector growth will also be an important enabler to create a sustainable and resilient economy that meets the country's development needs.

[70] République Démocratique Du Congo, Pays Solution au Changement Climatique, COP26, https://medd.gouv.cd/wp-content/uploads/2022/07/magazine_COP_env1.pdf.

[71] Estimated at around 85 billion tons, See: Xu, L., Saatchi, S.S., Shapiro, A. et al. Spatial Distribution of Carbon Stored in Forests of the Democratic Republic of Congo. Sci Rep 7, 15030 (2017).

2 DRC'S CLIMATE COMMITMENTS, POLICIES, AND INSTITUTIONS

Chapter 2: DRC's climate commitments, policies, and institutions

Effective climate action requires a whole-of-economy and whole-of-government response that takes a dynamic triangulation approach to the triple challenge of development, climate, and institutional strengthening. Despite this, the involvement of central planning and finance agencies on climate change issues is rare to non-existent in DRC because of its complex colonial history and political geography, which have hindered effective state consolidation. The country also faces challenges in extending state infrastructure, given its vast size and population concentrations in border regions. Subnational governments are therefore a critical entry point for mainstreaming climate action—especially in forestry—because they provide on-the ground knowledge, data, and program opportunities to roll out national adaptation measures. Building on Provincial Development Plans (PDPs), dedicated Climate Partnerships could be formed between provinces and the Ministry of Environment and Sustainable Development (MEDD), as well as among the provinces themselves, to disseminate climate policies and facilitate knowledge transfer and peer learning. A decentralization process can also help increase the competences and responsibilities of provincial authorities in overall governance, including the prioritization, planning, budgeting, implementation, and monitoring of development processes—plus adaptation planning.

Making earnest progress in decentralization is critical, because Kinshasa-based political structures continue to amass and control power and resources. In a country as vast as the DRC, with distinct regional differences and relatively few commonalities between the center and periphery, decentralization to the provincial and local levels is vital for service delivery and to give voice to citizens. This can come at the cost of further possible fragmentation in a country that already lacks the capacity to control its extensive state apparatus and needs to fund and staff provincial governments. Governance failures go hand in hand with corruption, especially in the exploitation of mineral wealth.[72]

2.1. Existing policies, and institutional arrangements for resilience and climate risk management

The Government is committed to combating climate change by building resilience through five key areas identified in the National Adaptation Program of Action.[73] The NAPA has five adaptation areas water resources, coastal zones, health, agriculture, and land and ecosystem degradation. Recommendations included establishing a climate risk inventory, developing measures to mitigate these risks, and pursuing the REDD+ program. Through donor support and the Least Developed Countries Fund (LDCF), DRC implemented most of the NAPA actions between 2010 and 2015, including improving weather monitoring and forecasting and improving resilience planning at the local level. Between 2010 and 2012, the United Nations Development Programme (UNDP) also supported the development of a Climate Adaptation Program[74] aimed at strengthening DRC administrative capacity and, its ability to develop of long-term planning mechanisms and to address development planning under a range of uncertainties.

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[72] It is estimated that, between 2010 and 2012, DRC lost out on $1.36 billion in potential revenue in five mining deals involving Gécamines. See Africa Progress Panel, *Equity in Extractives: Stewarding Africa's natural resources for all* (Geneva: APP, 2013), https://reliefweb.int/report/world/africa-progress-report-2013-equity-extractives-stewarding-africa-s-natural-resources.

[73] National Adaptation Plan of Action of DRC, 2006.

[74] The program falls under a support grant financed by the Green Climate Fund, the National Adaptation Plans Readiness in Democratic Republic of the Congo grant, managed by the UNDP. https://www.adaptation-undp.org/GCF-NAP-DRC.

DRC's medium-term climate strategy framework is anchored in its NDC.[75] The Government has indicated its commitment to tackling climate change by reducing emissions and building resilience through adaptation measures. The Intended Nationally Determined Contribution (INDC) submitted in 2015 cited several impacts of climate change in DRC: damage to infrastructure, destruction of habitat, increased water-borne diseases, and severe disruption of crop cycles due to seasonal droughts. DRC's first NDC submitted in 2015 set a 17 percent target for emissions reduction by 2030, compared to a business-as-usual (BAU) scenario, fully conditional on external financial and technical support. The updated NDC from 2021 raised the country's GHG emissions reduction levels to 21 percent by 2030 with new contributing sectors including waste management and transport, responsible forest management and land use, renewable energy, and sustainable agriculture efforts. In the updated NDC, 19 percent of emissions reduction is conditional on external financing and 2 percent is planned to be financed by domestic resources. The update NDC strengthened not only DRC's GHG reduction target, but also associated sector targets, policies, actions and adaptation plans.[76]

The most recent National Adaptation Plan (NAP 2022–2026) has 9 adaptation objectives and includes sectoral-level targets for adaptation and climate change resilience: (i) managing forest ecosystems and biodiversity; (ii) strengthening the agriculture sector's resilience; (iii) managing climate risks in smallholder farming; (iv) reducing the risk of disasters; (v) managing water resources and sanitation; (vi) strengthening the health sector's climate resilience; (vii) guaranteeing people's access to energy; (viii) protecting energy production infrastructure; and (ix) improving energy efficiency. These priorities have been integrated under priority NAP programs and included in provincial development plans (PDPs) and for the implementation of SDGs. Currently, DRC is considering how to integrate the priorities and activities into a comprehensive financing and monitoring and evaluation framework. A National Solidarity Fund for Disaster and Humanitarian Management (CSNGHC) has also been created to support the planning, mobilization, and channeling of all financial flows and equipment necessary to cover climate-induced humanitarian crises.[77] However, the lack of operationalization of the disaster risk monitoring and data management framework creates a missing critical element to inform a comprehensive, successful approach to risk management, reduction, and preparedness.

The DRC's budget does monitor explicit DRM funding, but overall disaster risks for DRC remain difficult to project, with limited data tracking and information. According to the IMF Climate PIMA, there are two mechanisms for ex ante funding—one budgetary and one extrabudgetary—of infrastructure exposure to climate risks. The budget of the Ministry of Humanitarian Actions and Affairs (MAAH), includes a specific allocation to disaster risks titled "Reserve for accidents and disasters" and is executed each year according to the occurrence of unforeseen events, including climate-related disasters.[78] At the same time, the National Solidarity Fund for Disaster and Humanitarian Management (CSNGHC) aims to enhance coverage for the costs of damage related to natural disasters, principally due to a strategic resource mobilization plan that is currently being finalized.[79] Government does not publish any overall comprehensive report on past natural disasters and does not track

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[75] Republique Democratique du Congo, *Contribution Déterminée à l'échelle Nationale révisée* (Kinshasa, DRC: Ministère de l'Environnement et Développement Durable, 2021), https://unfccc.int/sites/default/files/NDC/2022-06/CDN%20Revis%C3%A9e%20de%20la%20RDC.pdf.

[76] Climate Watch, "Democratic Republic of the Congo," NDC tracker, https://www.climatewatchdata.org/countries/COD.

[77] This will ensure that victims of disaster and other catastrophic events are protected, and humanitarian actions and interventions are coordinated.

[78] This budget allocation represented CDF 65 million in the 2021 LFI and CGF 90 million in the 2022 draft budget law. The fiscal risk statement, published for the first time in September 2021, mentions climate change-related risks, but they are presented only briefly and qualitatively, and the impacts on infrastructure are not assessed.

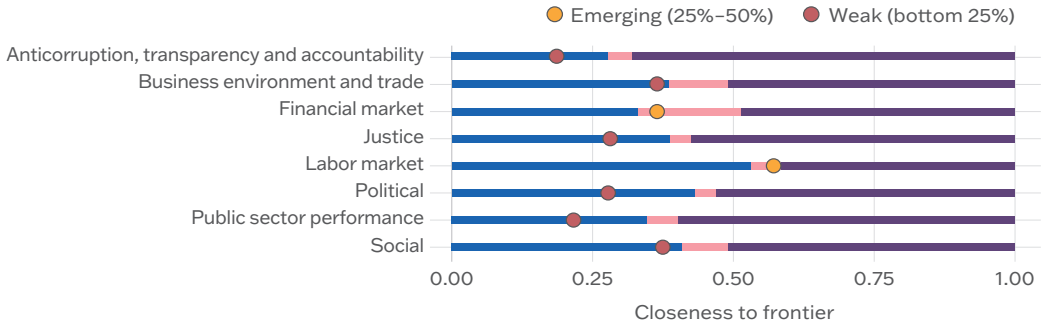
[79] IMF, *Democratic Republic of the Congo: Technical Assistance Report on Public Investment Management Assessment (PIMA) and Climate PIMA (C-PIMA)* (Washington, DC: International Monetary Fund, 2023), https://www.imf.org/-/media/Files/Publications/CR/2023/English/1CODEA2023001.ashx.

their actual cost. Prevention, emergency, and post-disaster responses are not yet fully part of the budgetary process, and the financing of Government disaster responses is treated as a traditional public expense.

The 2017–2023 National Strategy for Disaster Risk Reduction and Prevention (UNISDR) is currently the main instrument for implementing the country's vision and priorities for disaster risk management (DRM) to date. Since many strategic intervention axes are linked with climate change, the NAP was developed to ensure complementary to the UNISDR. Similarly, a new DRM strategy is expected to build on this, but risk and vulnerability assessments are not coherently undertaken for DRM. While the Ministry of the Interior has a unit on disaster management, responsibilities are divided between three ministries: Ministry of the Interior, of Defense, and of Environment, which leads vulnerability analysis. Cross-cutting challenges include technical coordination and working protocols, data availability and ownership, and differences in analytical models and reporting requirements.

The CCIA for this CCDR reviewed how well-designed DRC's institutional framework is for the effective implementation of climate action. A comparison with low and middle-income peers in SSA and globally highlights for example DRC's weak institutional capital (see figure 2.1). Consistently scoring in the bottom 25 percent in all but two governance clusters, DRC has limited institutional depth and capacity for executing sound climate actions. DRC fares poorly in areas particularly relevant to climate change implementation public sector performance, and anticorruption, transparency, and accountability.

Figure 2.1: DRC's institutional capacity benchmarked against 15 peers along eight dimensions.



DRC is shown as the red dot. X line represents the rating as distance to the performance percentiles

Source: World Bank, Global Governance Benchmarking Database - Country-Level Institutional Assessment and Review (CLIAR)

Despite these challenges, the core elements are in place to define the DRC's climate agenda. In the context of the COP26 and COP27 frameworks and their dedicated focus on forests and Africa, DRC has made important strides in establishing climate focus around several axes:

» ***DRC's regulatory framework includes a range of environmental and climate relevant legislation.*** The country has ratified international climate commitments, and the 2011 Environment Law is set as the basis for all legislation pertaining to sustainable development. Previously lacking specificity, the law has just been amended (awaiting full parliamentary ratification) to include some climate parameters notably on NDC implementation and considerations for creating a carbon tax and Carbon Market Authority.[80]

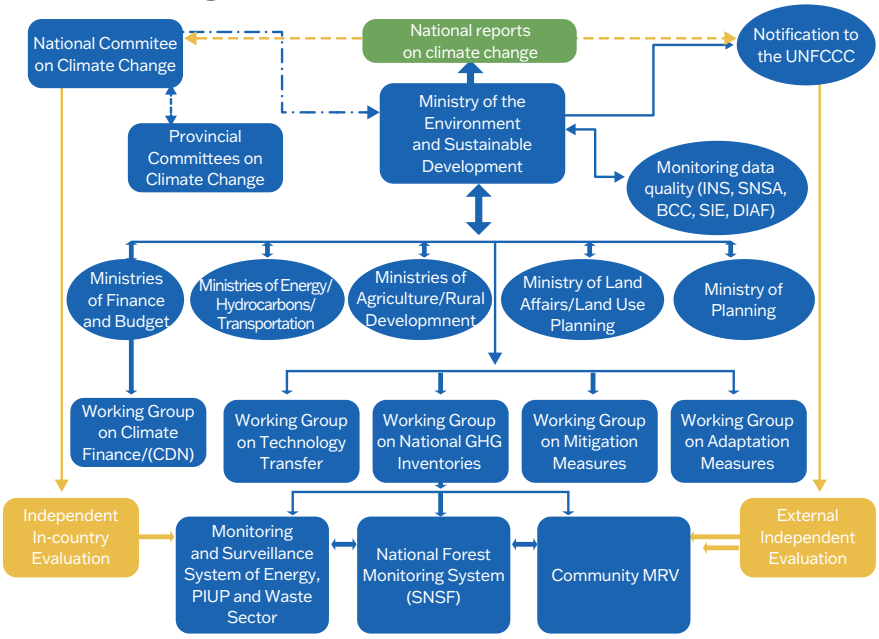
[80] As one of DRC's primary climate-affected sectors, forestry has the most advanced, active, and specific climate-related regulation, and the country has been active in implementing the REDD+ framework.

» ***The MEDD and the ACE lead on climate action.*** Decreed as national climate change focal points in March 2020, MEDD[81] and ACE[82] coordinate the preparation, oversight, and assessment of national plans—in collaboration with other ministries, local authorities, the private sector, and civil society (figure 2.2). Inter-ministerial sectoral thematic groups, including a dedicated group on climate matters, could play a prime role in helping facilitate climate actions throughout the government but there is not much momentum yet. Top issues for MEDD and ACE remain climate data collection and monitoring.

» ***Strengthening risk and vulnerability assessments, as well as DRC's national monitoring, reporting, and verification (MRV) system, is a NAP priority.*** However, much remains to be done. In 2021, as part of its accreditation process with the Green Climate Fund, DRC's project execution agency for international partners and aid, BCECO prepared a draft environmental and social procedures manual, included a climate change vulnerability analysis procedure. Piloting MRV in the forestry sector through REDD+ with the establishment of the National Forest Monitoring Program has enabled DRC to comply with UNFCCC requirements—and serves as a good MRV example for other sectors.

» ***PDPs are tasked to reflect climate change and have started to do so.*** Article 48 of DRC's Environmental Law gives provinces overall authority to adopt climate change adaptation measures, just as the central government. A guide for integrating climate into PDPs was developed under the NAP in 2019, and the Ministry of Planning has been coordinating with provincial governments to incorporate increased climate attention in their development plans. The pilot provinces include Tshopo, Kwilu, Katanga, Kinshasa, Kongo Central, and Kasai Central.[83] DRC's PLT-145T decentralization initiative provides another entry point for enhanced climate focus at subnational level.

Figure 2.2: Climate Change Governance Framework



Source: DRC National Adaptation Plan 2022–2026

[81] Specifically, MEDD is responsible for coordination of international commitments, design of legislation and regulations, and implementation of sectoral policy.

[82] The Congolese Environmental Agency monitors the implementation of environmental laws and oversees legally required environmental impact assessments.

[83] The formation of provincial committees on climate change is also expected to help monitor implementation, but it is not yet operational.

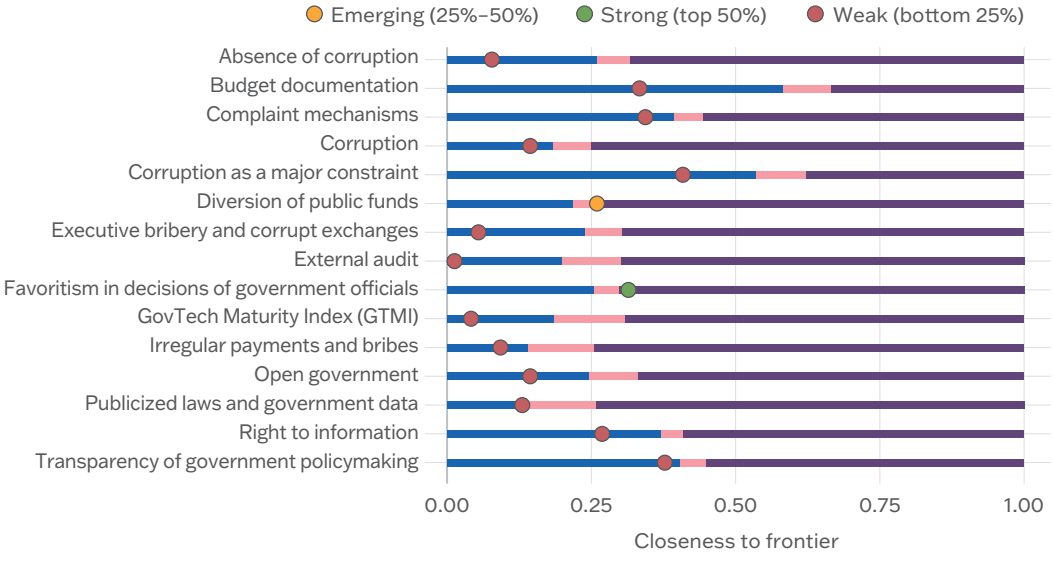
2.2. Opportunities to upgrade DRC's governance frameworks to address climate risks

Effective governance will be critical to successful climate action in DRC, yet significant institutional limitations exist. DRC's potential and ambition to become a "Climate Solutions Country"[84] require strong institutional capacity to manage climate risks and opportunities. Explicit political commitment, well-aligned multi-level governance, clear institutional frameworks, robust laws, policies and strategies, and well-managed oversight, finance, and data are essential building blocks. DRC performance in the anticorruption, transparency and accountability benchmark cluster shows an equally limited governance picture as a basis for climate action (see figure 2.3).

Consistent management and monitoring of climate actions, risks and opportunities is still missing in important governance areas.

» ***Climate change is yet to be integrated into PFM, PIM, and procurement processes, based on an IMF analysis[85] and MAPS review.[86]*** Climate targets are poorly reflected in national and sector-level strategies, hindering climate-aware planning and financial management. Nonetheless, climate considerations are expected to be integrated from national sectoral thematic groups and PDPs contributions. Likewise, there is to date no identification of public investment spending relating to climate change within the budget- but transitioning to program-based budgeting offers an opportunity for more climate-aware resource management. Fiscal risk statements mention climate considerations, and public investment planning for infrastructure/asset management includes environmental assessments, but no specific consideration of climate impacts is fully considered yet. Several bidding reviews are starting to mention environmental aspects, despite the absence of sustainable public procurement policies.

Figure 2.3: Anticorruption, transparency, and accountability in DRC benchmarked against peers along 15 dimensions of governance



DRC is shown as the red dot. X line represents the rating as distance to the aspired frontier

Source: World Bank, Global Governance Benchmarking Database - Country-Level Institutional Assessment and Review (CLIAR)

[84] Felix Tshisekedi, President Democratic Republic of the Congo, COP26, DDRC-CAFI Letter of Intent signed between CAFI and the Government of DRC in 2021 and expiring in 2031.

[85] IMF, *DRC PIMA and C-PIMA*.

[86] World Bank. *Methodology for Assessing Procurement Systems (MAPS): Report for Democratic Republic of Congo (DRC)* (French) (Washington, DC: World Bank, 2022), https://www.mapsinitiative.org/assessments/MAPS-DRC-Final-Assessment.pdf.

» ***Governmental transparency and oversight remain limited—including occasional but passing attention to audits on climate.*** Despite the launch of anti-corruption measures and agencies, state audit bodies have limited mandate and/or capacity to review climate policies and implementation. The 2021–25 Strategic Plan for DRC's topmost audit institution, the Court of Accounts, includes an annual environmental audit but without specific reference to climate, and no review has been carried out to date. However, independent reviews are starting to emerge. For example, the General Inspectorate of Finance (IGF) audit found forest governance insufficient and documented repeated violations of forest laws, such as the moratorium on logging concessions. In response, a ministerial commission was created to revisit all forest concessions—and a preliminary report was published on April 11, 2023, that recommended terminations, suspensions, and other rehabilitation measures for most concessions.[87]

» ***Local representatives, women, and socially excluded groups have limited representation in community and nation-wide conversations on climate change impacts and mitigation/adaptation efforts.*** National government needs to strengthen its support to local community governance engagement to increase resilience and low-carbon growth efforts. Awareness raising is only the first step; engaging local communities in adaptation policy formulation and implementation and consulting local communities on more globally-focused mitigation efforts, is the ultimate step to making climate policy efforts both inclusive and effective. This is particularly relevant for the forestry sector where both adaptation and mitigation elide, but also crucial for the highly vulnerable agricultural sector, and most affected urban communities.

2.3. Proposed institutional measures associated with Climate Change

Specific institutional factors should be considered by DRC when formulating a comprehensive and actionable plan for addressing climate change issues. The challenge is to implement a set of country-specific measures to support the Government as it seems to enhance its ability to cope with climate impacts, while underpinning its ambition to position itself as a climate solutions country. Successful climate action in DRC will involve strengthening core pillars of government action, on the one hand, while bolstering DRC-specific factors on the other. A suggested set of actions include.[88]

» **Social and informal:** Social behavior and economic interactions are often driven by societal norms and informal or culturally acceptable modes of behavior.[89] Ninety percent of economic activity in DRC takes place in the informal sector. While informality is often regarded as an economic ailment associated with limited development, the behaviors associated with informality may impact, and be impacted by, climate action.[90, 91]

» **Political (political-economy):** Understanding how the distribution and deployment of power in climate-sensitive areas enables institutions to perform their intended functions, or alternatively constrains them, is crucial for designing responses.[92] Different country adoption of reform-oriented institutions to deal with climate change show vividly how politics can shape institutional choice and performance.

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[87] République Démocratique du Congo, *Rapport préliminaire de révisitation des titres forestiers en RDC présenté et adopté au 89ème Conseil des Ministres* (2023), https://medd.gouv.cd/wp-content/plugins/download-attachments/includes/download.php?id=7394.

[88] World Bank, *Country-Level Institutional Assessment and Review (CLIAR)* Methodological Note, EFI Note-Governance (Washington, DC: World Bank, 2022).

[89] Franziska Ohnsorge and Shu Yu, *The Long Shadow of Informality: Challenges and Policies* (Washington, DC: World Bank, 2022), http://hdl.handle.net/10986/35782.

[90] Franziska Ohnsorge and Shu Yu, *The Long Shadow of Informality: Challenges and Policies* (Washington, DC: World Bank, 2022), http://hdl.handle.net/10986/35782.

[91] Pervasive informality is associated with significantly lower government revenues and expenditures, less effective policy institutions, more burdensome tax and regulatory regimes, and weaker governance.

[92] World Bank, *World Development Report 2017: Governance and the Law* (Washington, DC: World Bank, 2017), doi:10.1596/978-1-4648-0950-7.

- **Organizational:** Organizational structure and capability are a major issue in economic development.[93] Any proposal to devolve or decentralize decision-making to any degree raises issues about how motivated the decision makers will be, how decentralized decisions will be coordinated to prevent fragmentation, and how information will flow to support the entire web of decision makers at all levels.[94] Successful decentralization reforms require the collaboration and buy-in of multiple stakeholders, both at the central and the local government level. This might come at the cost of further possible fragmentation in a country that already lacks the capacity to control its extensive state apparatus and needs to fund and staff provincial governments.
- **Resourcing:** The nature of the climate challenge requires substantial resources. All societies struggle with scarcity.[95, 96] At a macro level, being able to raise budgetary resources through taxation is associated with stronger sustained levels of economic development.
- **Technological:** Not only does technology shape what institutions can do, but innovative technologies can extend, in new and unexpected ways, what institutions can do and how they think—creating shifts that allows them to bypass intermediary development stages.[97] DRC has two major opportunities for technology-based leapfrogging: One is digital development, which frequently bypasses traditional societal and spatial organization. The other lies in the development and application of technologies for carbon storage and capture, in line with DRC's ambition to become a climate solutions country. Both represent opportunities for DRC, rather than reinventing the wheel, to skip several steps and take a great leap forward by learning from other countries' mistakes, adopting best practices, adapting tried-and-true models, and leveraging the collective expertise and advisory know-how of the international development community.

[93] World Bank, *Transforming Central Finance Agencies in Poor Countries: A Political Economy Approach* (Washington DC: World Bank, 2013), https://doi.org/10.1596/978-0-8213-9898-2.

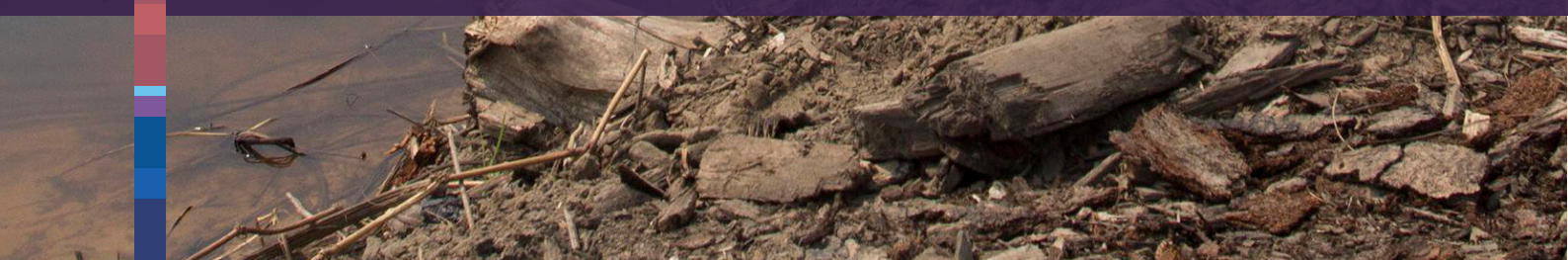
[94] Matthew S. R. Palmer, *Economics for Policy: Expanding the Boundaries, Essays by Peter Gorringe— edited by A Grimes, A Jones, R Procter and G Scobie Victoria University of Wellington Law Review* 32, no.4 (2001): 1087–1092 https://ojs.victoria.ac.nz/vuwlr/article/view/5860.

[95] Jean Tirole, *Economics for the Common Good* (Princeton, NJ: Princeton University Press, 2017), https://press.princeton.edu/books/hardcover/9780691175164/economics-for-the-common-good.

[96] For these forms of goods and services, some reliance on collective mobilization, allocation, and the use of the resources will be necessary, even if they do not rely on public provision.

[97] World Bank, *Overview: Strengthening the analog foundation of the digital revolution* (Washington, DC: World Bank, 2016), https://doi.org/10.1596/978-1-4648-0671-1_ov.

3 CLIMATE CHANGE VULNERABILITY, RESILIENCE BUILDING, AND LOW-CARBON DEVELOPMENT OPPORTUNITIES IN KEY SECTORS



Chapter 3: Climate Change Vulnerability, Resilience Building, and Low-Carbon Development Opportunities in Key Sectors

3.1. Managing climate change risks to promote resilient development

To understand the potential impacts of climate change on DRC's economy, detailed modeling was conducted, with different climate scenarios employed to reflect the large uncertainties. As noted in chapter 1, while there is consensus that mean annual temperatures will rise in DRC, projections of future precipitation vary significantly. A subset of three climate and socioeconomic scenarios was chosen for further analysis, reflecting a wide range of possible temperature and precipitation patterns through three Shared Socioeconomic Pathways (SSPs) and Representative Concentration Pathways (RCPs): (i) SSP1–1.9, representing an optimistic scenario with sustainable development, low GHG emissions, and global warming below 2 ºC by 2100; (ii) SSP2–4.5, or a midway scenario with a focus on economic development and warming of 2–3 ºC by 2100; and (iii) SSP3–7.0, a pessimistic scenario with high inequality and limited climate action, and global warming around 4 ºC by 2100.[98]

The sections below describe the main impacts and the policy actions that can be taken to build resilience to climate change in key sectors and nexus areas. The sectors include agriculture and water management, forest and integrated landscape management, energy, transport, urban, and social development in a fragile and conflict-affected state. The impact of four development scenarios on these economic sectors are further described in chapter 4.

3.2. Increasing agriculture productivity and improving water management to enhance resilience

Despite DRC's varied agro-ecological zones and high agricultural potential, productivity is stubbornly low,[99] agricultural value chains are limited, and the rural economy faces significant constraints. Low yields result from poor infrastructure, poor connectivity, and the limited use of climate-resilient seeds and fertilizers. Only five percent of food-producing households use improved, more resilient seeds, and only four percent use fertilizers,[100] In short, there is farm-level under-investment. This is caused in part by insecurity and fear of displacement and by lack of governance of agriculture, public goods and services, especially for market access. In 2020, DRC's total cultivated land was estimated at 15.4 million hectares, just 6 percent of the country's surface, most of it under rainfed practice.[101] Cassava, the main crop, represents 40 percent of the harvested area and, from 2016 to 2020, accounted for 70 percent of DRC's total crop production.

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[98] While small-scale spatial resolution may not be essential for understanding impacts from temperature changes—given that the scenarios do not vary substantially across grid cells—the spatial distribution remains more relevant for understanding impacts from changes in precipitation and the discussion of floods impacts, where different geographic areas might be more affected than others.

[99] Agriculture productivity in the DRC has been declining compared to neighboring countries, with the productivity of cereals at 50 percent of the SSA average, and lower than the regional average for Central African countries (FAOSTAT, 2021).

[100] Adoho, Franck M. & Doumbia, Djeneba, 2018. "Informal sector heterogeneity and income inequality: evidence from the Democratic Republic of Congo," Policy Research Working Paper Series 8328, The World Bank.

[101] FAO (Food and Agriculture Organization), *AQUASTAT* Main Database, last accessed September 24, 2023, https://www.fao.org/aquastat/en.

Greater productivity is needed to reduce rural poverty and food insecurity in DRC, especially under a changing climate. Biophysical and economic modeling shows that by 2050, climate change, driven primarily by temperature shifts and changes in precipitation and soil management, will have an even more pronounced impact on DRC's agricultural productivity,[102] primarily driven by temperature shifts and changes in rainfall and soil management.[103] By 2040 and 2050, it is estimated that overall rainfed crop production will be reduced under all climate scenarios (figure 3.1). Cassava production is expected to decrease between 4 and 9 percent by around 2050.[104] Coffee yields could decrease between 5 and 11 percent a year and sweet potatoes yield from 3 to 13 percent. Plantains, another important crop for revenue, are expected to range yields from +2 to −7 percent. Avocado productivity could range from +8 to −4 percent depending on the climate scenarios (figure 3.2).

Despite no expected large change in overall annual precipitation, seasonal drought is expected to increase and already poses a significant climate threat in diverse regions.[105] The combined effects of drought and heat stress on workers could be devastating; it could reduce crop yields by as much as 50 percent in the entire country. Urgent action is needed to provide farmers with better risk management tools and access to climate-resilient production methods.[106] Although implementing CSA packages may entail farm-level costs that are 50–100 percent higher per hectare than current prices, the potential returns—between 40 percent and 1000 percent higher than current returns—are likely to far outweigh the costs.

Figure 3.1: Changes in DRC rainfed crop production, 3-year moving average, by moving average

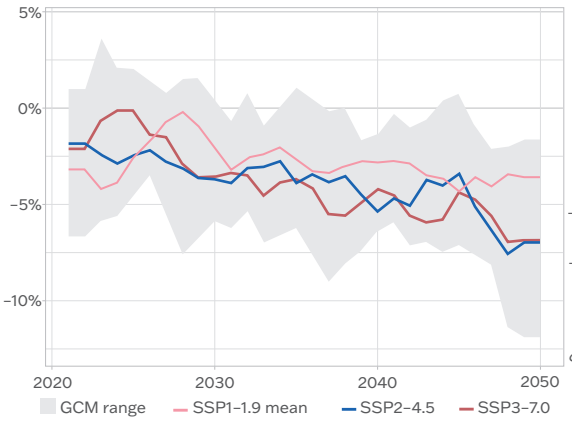
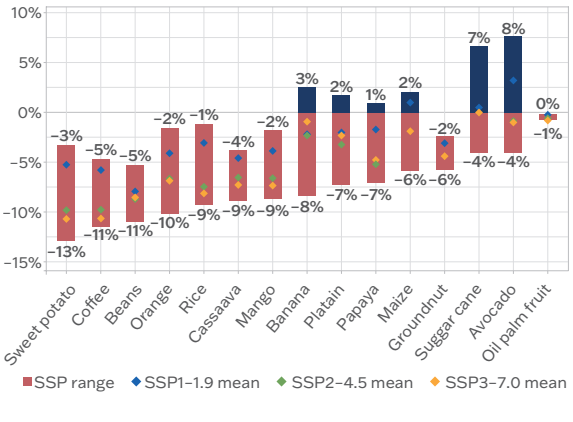


Figure 3.2: Changes in DRC rainfed production shock of 14 crops, 2041–2050



Source: World Bank modeling results

[102] Due to limited spatial and temporal granularity of the water scarcity modeling with available datasets, the analysis was unable to assess seasonal impacts from climate changes nor to detect meaningful seasonal impacts from climate change models.

[103] For agriculture and roads and bridges impact channels, climate projections were analyzed using General Circulation Models for each SSP that represent the 10th, 25th, 50th,75th and 90th percentiles in terms of combined annual temperature and precipitation changes for the decade 2041 to 2050. This ensured the capture of extreme variability within all models. The remaining impact channels used the GCM ensemble average because most climate models in DRC project a wet future and there is good agreement between them.

[104] The lack of diversification and the lack of integration of activities and actors within agricultural value chains is another major challenge for DRC agriculture. Cassava is an emblematic case of poor value creation in the sector. In the DRC, cassava is a staple cooked mainly in the form of fermented flour (*fufu*) or fermented dough (*chikwangue*). But cassava can yield a range of other by-products—including starch, alcohol, glue, granules, bread flour, livestock feed—yet little of these are produced in DRC. Low value creation characterizes other agricultural products as well, resulting in limited value addition, or pass-through of prices, particularly to the producers.

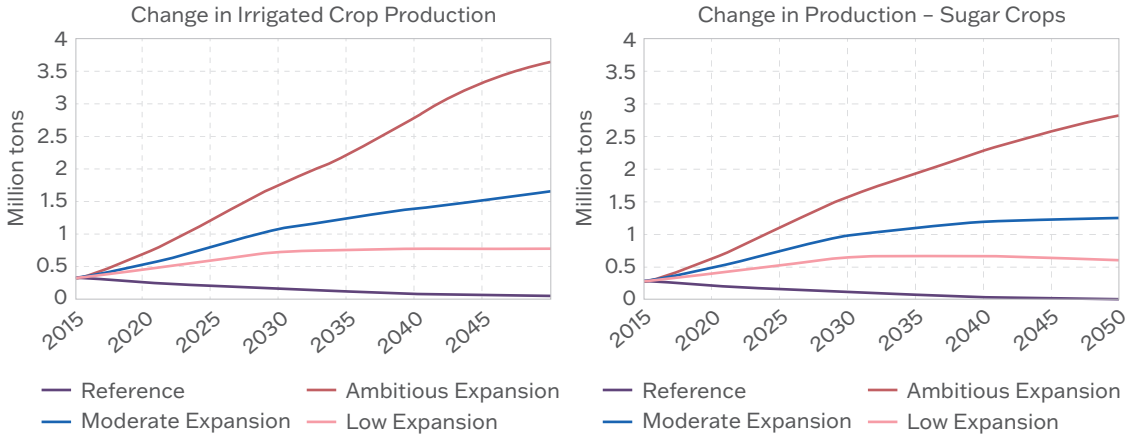
[105] The World Bank supports the DRC Government in the implementation of the National Agricultural Productivity Program, in partnership with the UN World Food Programme.

[106] This includes access to climate information and long-term forecasts, irrigation, improved fallow techniques, and access to resilient seed varieties.

Irrigation is a major underutilized adaptation strategy for DRC, which in 2015 had only an estimated 85,000 ha of land under irrigation. Especially under the changing climate, irrigation is an important boost to agriculture and food productivity without the need to expand cultivated land area or encroach on forests and ecosystems. Irrigation could help farmers increase production and grow higher-value, diversified crops including horticultural crops. Irrigated agriculture can be at least twice as productive as non-irrigated,[107] ensuring food security and fostering economic development. While private farmer-led investments in irrigated land are difficult to quantify, a rapid participatory *Farmer-Led Irrigation Development Diagnostic (FLID)* indicated a large expansion potential. The FLID diagnostic also revealed the need for investments and financial incentives to help farmers, financial institutions, and other stakeholders to overcome barriers to accessing financing, markets, value chains, affordable technology, and knowledge of climate-smart irrigation practices.

Demand for irrigation water can largely be met from within DRC. A Global Change Assessment Model (GCAM) exercise[108] indicates that DRC's future water resources are largely sufficient for sustainable irrigation development not only for higher-value vegetable crops but also for rainfed staples such as maize, cassava, and rice. The CCDR assessed three irrigation and agriculture adaptation modeling scenarios, evaluating the potential impact of expanding irrigation to different extents: the *Low Expansion irrigation scenario* targeted 200,000 ha, *a Moderated Expansion irrigation scenario* targeted 400,000 ha, and an *Ambitious Expansion irrigation scenario* 1,000,000 ha, compared to a 2015 baseline of 85,000 irrigated ha.[109] The projections showed that these changes in irrigation area significantly increased crop production, particularly under the *Ambitious Expansion* scenario (see figure 3.3). Although irrigated production for sugar cane, rice, and vegetables is only a small share of actual total crop production, the modelling shows that it can benefit other crops as well, including main staples like cassava and maize.

Figure 3.3: Irrigated annual crop production under various expansion scenarios



Source: GCAM Model

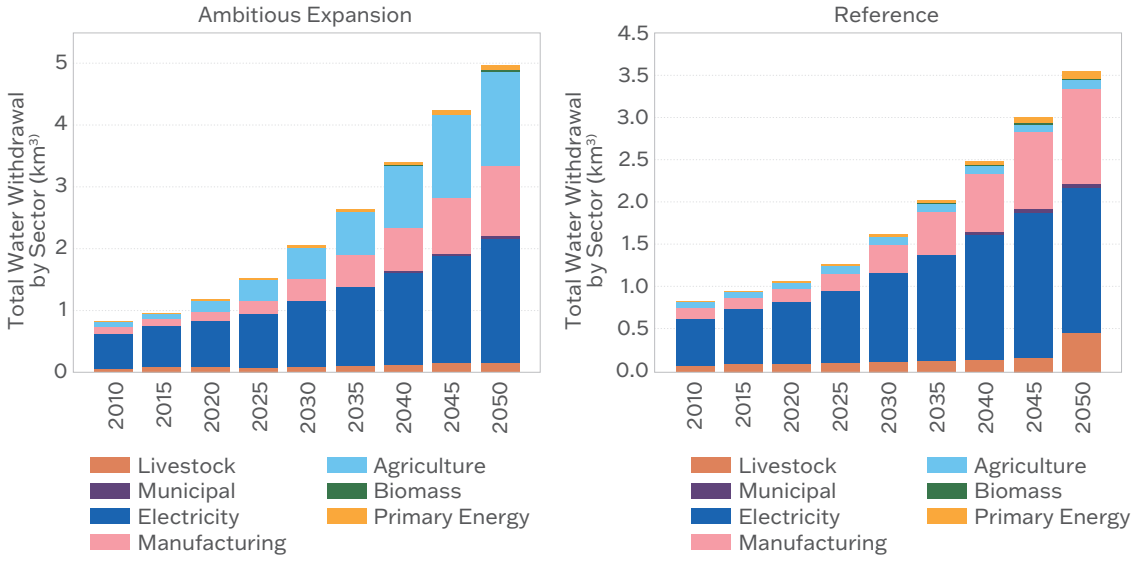
[107] World Bank, "Water in Agriculture," Understanding Poverty blog, World Bank website, 2022, last accessed September 24, 2023, https://www.worldbank.org/en/topic/water-in-agriculture#1.

[108] A Global Climate Change Assessment Model (GCAM) analysis was undertaken for DRC, supported with Xanthos open-source hydrological modeling. Three limitations, among others, are the time-step that does not allow for inter-annual variability, the limited crops that are assumed to benefit from supplementary irrigation, and pre-determined land allocation rules that do not match the DRC context.

[109] The allocation of the irrigated hectares was done based on expert judgement, considering the soils, climate change impact, and access to market, and gridded on a 50x50km scale.

As a tradeoff, modeling results showed that irrigation water demand increases substantially in all the irrigation expansion scenarios explored. For example, under the Ambitious Expansion scenario, the increase in irrigation demand is large enough to make irrigation the second-largest water user in DRC by 2050 (see figure 3.4).

Figure 3.4: Total water withdrawal by sector, in km³, 2010–2050



Source: World Bank modeling results

Nevertheless, the expansion of irrigation does not have a noticeable impact on water scarcity in the DRC. The water scarcity index (WSI) remains largely untouched, with less than a 1 percent impact countrywide even under the Ambitious Expansion irrigation scenario. However, given the substantial growth in water demand, careful management would still be advisable to minimize the impact of irrigation expansion on water demand. This would include minimizing water loss in canals and in the field, adopting efficient irrigation methods, and closely monitoring water quality because of the projected increase in the use of fertilizers. Although the WSI does not change substantially up to 2050, intra-annual rainfall variability may still warrant the need for small-scale storage to ensure that water is available for all uses during the dry seasons.

DRC is richly endowed with water resources but needs to improve its their management. The country has an estimated 1,320 million m³ of renewable freshwater resources of which around 900 million m³ is surface water and 420 million m³ is groundwater. DRC has a dependency ratio on external resources of 30 percent,[110] which represents around 15,260 m³ of freshwater resources available per capita. Yet less than 0.05 percent of its water resource is utilized. There is still a huge gap in Water Supply, Sanitation and Hygiene (WASH) access[111] and no national drinking water quality monitoring

[110] FAO, *AQUASTAT* (2005).

[111] Over 53 percent of DRC's population (48 million) lack access to basic water, and over 84 percent (76 million) to basic sanitation. Only 19 percent of rural households have access to basic water supply, only 9 percent to basic sanitation, and just 15 percent to basic hygiene service; 18 percent of rural households resort to open-air defecation.

programs are in place, resulting in the notable deterioration of human capital.[112] Women and girls are especially affected by the lack of access to WASH services. It increases their exposure to gender-based violence risks during water collection and open defecation.

Climate change will not drastically reduce water availability in DRC under various RCP-pathways. Modelling[113] shows that there are no significant annual trend (either upward or downward) in the total average available water volume, a finding that is consistent with other similar analyses globally.[114] However, in terms of the extremes, represented by the 10th and 90th percentiles, the annual water availability shows a considerable difference (up to 25 percent), which will be expressed through increased flooding and longer drier spells. However, since DRC's water storage infrastructure is limited compared with regional peers, the increasing inter-annual variability could still cause water scarcity in critical periods, such as a pronounced dry season (April–September).[115] In terms of whether annual supply can meet demand, none of the climate scenarios showed significant water scarcity in the DRC Congo Basin.

By 2050, total water demand in the DRC will more than triple as the country develops. The demand in the municipal sector will be more than double by 2050 due to population growth and greater access to water and sanitation services. Under the modelling scenario, freshwater demand is expected to increase from 1.1 km^3/year in 2020 to 3.6 km^3/year in 2050. By comparison, the installed storage capacity in the country in 2020 was only 0.05 km^3.[116] To be able to use the country's abundant water resources and allocate them to various purposes such as agriculture, energy, municipal, and industrial uses, new sotrage and other infrastructure may be needed. Modelling hydrology under the most pessimistic climate scenario RCP 8.5, showed large uncertainty in monthly run-off changes in the DRC Congo River Basin by 2060. Across the ensemble, run-off increases by 10–20 percent in the central and eastern parts of the country, while in the south-east, the west (around Kinshasa) and the north-west run-off decreases by up to 10 percent, which may negatively impact seasonal water availability, especially in May/June.[117]

DRC has joined the CAADP Malabo Declaration[118] agricultural commitments and has increased its national budget for CSA by up to 10 percent, following years of underinvestment in the sector. However, current sectoral spending remains insufficiently targeted, both in quality and efficiency, to the most important areas, including technology generation and adoption, strengthening of markets, and rural infrastructure. Up to US$2.5 billion of public agricultural productivity investments are still needed over the next 10 to 15 years to raise agriculture incomes and reduce rural poverty in a subset of priority provinces. In addition, US$1 billion in public investments is required in agriculture public goods and services, transport infrastructure for market access, animal and plant health, and

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[112] Global Burden of Disease, 2017, https://www.healthdata.org/research-analysis/gbd. Because of poor WASH services, the mortality rate is 60 percent among the Congolese. The infant mortality rate, 64 percent, is associated with extremely low access to safely managed sanitation.

[113] Including the GCAM and Xanthos. This modeling for the so-called "reference" scenario employs the SSP2 (middle of the road) scenario, representing the RCP 6.0 climate change trajectory. GCAM uses CMIP5 models and four RCPs.

[114] See: Neal T Graham et al, "Humans drive future water scarcity changes across all Shared Socioeconomic Pathways", *Environ. Res. Lett*, 2020. The estimations took into consideration total water availability in the DRC under three climate scenarios, while availability was computed as the sum of the runoff generated for the water basins covering the country, plus the renewable groundwater resources.

[115] Different modelling would be needed to analysis spatial storage needs to address seasonal water shortages.

[116] FAO, *AQUASTAT* (2023).

[117] Further spatial and crop water analysis is needed to determine the risks of intra-annual shortages, and whether micro storage infrastructure would be needed for supplementary irrigation. Moreover, storage development could harness DRC's hydropower development.

[118] The Malabo Declaration on Accelerated Agricultural Growth is a set of commitments to achieve a new agricultural vision for Africa. Made in Malabo, Equatorial Guinea in 2014, the Declaration articulates goals to end hunger, halve poverty, boost intra-African trade in agricultural commodities and services, enhance the climate resilience of livelihoods and production systems, and build mutual accountability. https://www.resakss.org/sites/default/files/Malabo%20Declaration%20on%20Agriculture_2014_11%2026-.pdf.

agriculture innovation. To realize the low irrigation expansion scenario of 200,000 ha by 2040, an estimated additional **US$43 million/year** of government financing will be required, leveraging farmers' own investments of US$8 million/year.[119]

The issues of land governance, land tenure security, and access to risk transfer solutions remain central to the debate around the development of climate-resilient and sustainable agriculture. Most farmed land in DRC, particularly land farmed by small producers, lacks titles and proper registration, which limits long-term investments. Lastly, climate risks can be transferred into global reinsurance markets to ensure sustainable development and increased access to social safety nets. Risk transfer solutions are a potentially valuable adaptation tool to protect both the Government and the country's most vulnerable. To that end, a risk transfer tool, the first of its kind in DRC, is being developed under the Government's National Agricultural Development Program. It will pilot a parametric solution triggered in the context of medium-/high-severity droughts or excess precipitation events[120] that impact the productivity gains of targeted farmers. It will also encourage farmers to transition higher-yielding and climate-adapted agricultural technologies and practices.[121]

3.3. Making DRC transport and urban areas climate-resilient

Climate change will impact DRC's infrastructure in many ways, and the three scenarios considered under this CCDR show an increase in capital infrastructure damage by 2050. This includes an increase in the frequency and magnitude of extreme climate events, long-lasting damage to assets, and faster crop deterioration caused by heat and precipitation levels. While capital infrastructure damage for 10-year flooding events is relatively low, with a decrease of –0.5 percent and –0.2 percent for the SSP3–7.0 and SSP1–1.9 climate scenarios, respectively, infrastructure capital is expected to decrease by up to 35 percent with the increase in frequency of 100-year flood events by 2050, from –2.0 to –2.7 percent losses, compared with historic baselines. Floods have already been devastating near the southwestern border and around Kinshasa. Between 2035 and 2064, losses are expected to be highest due to more frequent events, particularly the 20- and 25-year flooding events, with capital losses increasing up to 200 percent in some parts of the country (figure 3.5).

Under the extreme climate scenario, SSP3–7.0, transport infrastructure is expected to suffer the most annual flooding damage, estimated at around $3,500 per km a year, followed by SSP2–4.5 and SSP1–1.9 with annual damage of $2,100 and $2,000 per km, respectively. By the 2030s, modelling results show additional damage ranging between US$10 million and about US$390 million, with the range increasing to US$200 million–890 million by the 2040s. As DRC develops, new roads could include night adaptation and other safety measures that could start to reduce losses by 2050. On average, the model estimates additional economic damage of $450 million during the 2041–2050 timeframe and 6 million additional delay hours in transit at the national level.

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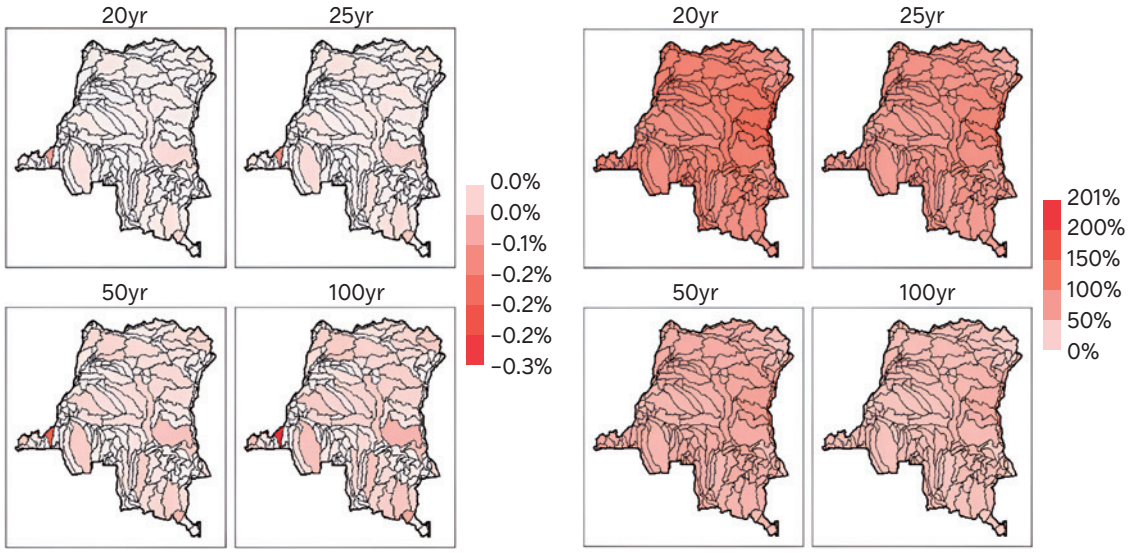
[119] Assuming a mix of small-scale low-cost individual (US$1500/ha), small group schemes (US$3,000/ha) and some larger schemes (US$12,000/ha), with an average costs of US$4,350/ha.

[120] Future improvements to the collection, storage, and dissemination of weather and yield data are needed to develop products that are even better attuned to farmers' needs and more climate-resilient. Currently, there are few working weather stations and rain gauges in DRC, which means only satellite data-based triggers can be implemented at this stage. Satellite data coverage can be expensive and impeded by forest cover, so investment in locally managed, good-quality hydro-meteorological and climate services—including the capacities, facilities and infrastructure for observation and forecasting—is essential.

[121] This financial protection strategy includes an innovative approach of risk layering through a pre-financed, prearranged, enhanced Contingent Emergency Response Component (CERC) focused on high-frequency, low-risk events and on non-insurable risks, in addition to the farmer-focused risk-transfer solution for infrequent, severe weather-related events. The planning of the response activities has also been defined for the first time in a Climate Contingency Plan, designed to address the implementation modalities of the response to climate shocks. Based on lessons from this effort, other risk-transfer solutions may be developed to address shocks such as disruptions among animals or plants, food prices, or social disruptions because of events such as Ebola or COVID-19. The insurance will safeguard smallholder counterpart contributions (farmer investments) and will reimburse each farmer's expenditures on inputs in case of a catastrophic weather shock.

Travel time delays caused by flood disruptions create substantial economic costs for local commuters. For instance, in Kinshasa, the estimated cost of flood disruptions to commuters' trips is US$1,166,000 a day. Workers' accesibility to jobs also decreases when floods occur, hindering the establishment of an integrated citywide labor market and particularly limiting opportunities for the most vulnerable.[122] The vulnerability of DRC cities is also influenced by climate impacts on supply chains and resource flows across the country that affect food security. Since 2020, the World Bank Group has financed US$1,714 billion of transport operations in the DRC.[123] Most of these have lacked continuous operation and maintenance investments, leading to the deterioration and/or destruction of the infrastructure, and the need for additional investments.

Figure 3.5: Inland flooding damage (% of total capital) from flood events, 1981–2010 (left) and 2035–2064 (right).



Against this backdrop, adapting infrastructure to climate change is fundamental in DRC. This includes transitioning from unpaved dirt roads and gravel road development to paved roads, implementing drainage systems in flood-prone areas, and introducing slope protection measures in mountainous areas. Zoning regulations should be enforced to discourage new developments in flood-prone areas while floodproofing existing infrastructure. Developing multimodal connectivity for passengers and freight is paramount, as is improving urban public transport, because it can enhance resilience and mitigate GHG emissions from the transport sector. Dedicated maintenance programs are also important to sustain the physical resilience of roads against climate and natural hazards. In short, using limited public resources efficiently is critical to developing a climate-resilient transport system in DRC while attracting substantial private investments, particularly to ensure appropriate maintenance.[124]

[122] He, P., S.M. Gleason, I.J. Wright, E. Weng, H. Liu, S. Zhu, M. Lu, Q. Luo, R. Li, G. Wu, E. Yan, Y. Song, X. Mi, G. Hao, P.B. Reich, Y. Wang, D.S. Ellsworth, and Q. Ye, 2020: Growing-season temperature and precipitation are independent drivers of global variation in xylem hydraulic conductivity. *Glob. Change Biol.*, 26, no. 3, 1833-1841.

[123] Based on team analysis of past investments by Transport Global Practice.

[124] World Bank, *Eastern DRC InfraSAP 2020: Main Report*, Draft for Decision Review Meeting (Washington, DC: World Bank, 2020).

Box 3.1: International Finance Corporation's Contribution to Private Sector Initiatives to Adapt to Climate Risks

IFC's support to climate risk adaptation should focus on transport infrastructure construction, rehabilitation, and upkeep by private operators/investors and/or on transport services provision. However, IFC's support is heavily contingent on the Government's ability to take on vested interests in the sector and design and implement sectoral reforms.

On the infrastructure side, the Government will need to bring to market bankable transport infrastructure deals. A low-risk approach would start with brownfield infrastructure assets that need upgrade and upkeep, with a proven track record of operations and well-known serviceable markets. The assets of certain state-owned enterprises in the port and airport transport subsectors meet these criteria. Transferring these assets to private operators could help the Government simultaneously achieve multiple goals: 1) reduce predatory pricing for these assets, 2) enhance sectoral governance, 3) obtain much-needed transfer of know-how, 4) increase payments to the Treasury and/or net financial exposure to these assets, and 5) make these infrastructure assets climate-resilient and more energy-efficient.

IFC's support to road projects is contingent on availability payment-type financing structures linked to extractives royalties' receipts rather than toll-based projects. This approach can attract large groups of investors/operators by substantially lowering the project's perceived risk. In turn, more competition would deliver climate-adapted road infrastructure at a lower cost to the country. A similar approach can be applied to secure private sector financing and know-how in the waterways sector. For example, private operators could be retained to dredge and mark a main portion of the Congo and Kasai rivers to ensure safe, year-round navigability between Ilebo, Kisangani, and Kinshasa. Their availability payments can be linked to extractives and free of Government's budgetary allocations and/or user-related fees. These two priority river corridors support the Government's domestic intermodal connectivity agenda

On the transport services side, IFC has the potential to stimulate investment in two critical areas: fleet renewal (that is, trucks and river boats) or fleet energy transition (that is, two or three wheelers EVs and/or E buses). This support can take various forms, including project-based initiatives, such as the Bus Rapid Transit (BRT) system, and can address urban mobility challenges while also facilitating concessional financing for the private sector. IFC could also offer local banks first-loss guarantees using its Private Sector Window (PSW) to support local financing of fleet renewal schemes. In the area of rail activities, IFC's involvement would be contingent on the Government's adoption of an open-access regime for rail operations. This regime would enable private operators to run their trains on existing rail networks and secure financing from development finance institutions and/or the Government to restore rail infrastructure operational safety standards.

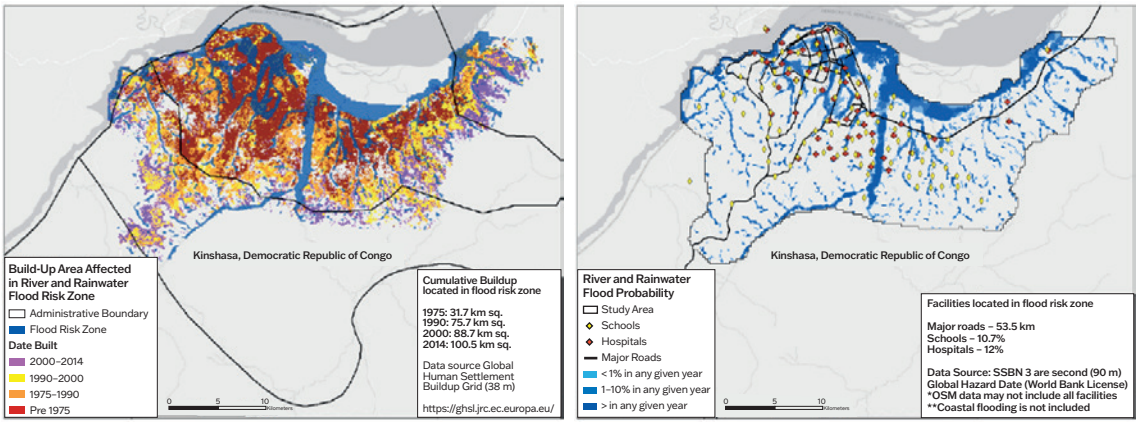
3.4. Urban Resilience

DRC's urban areas are particularly vulnerable to the increased in the frequency and magnitude of climate-induced natural disasters, especially floods. Poor spatial urban planning, land-use management and urban sprawl heighten the vulnerability of the urban population. Migrants and the urban poor often move to informal settlements in high-risk urban areas and build houses with non-climate-resilient materials, while also experiencing poverty, insecure jobs, and poor access to basic services. Informal

urbanization has been accelerating in DRC, compounding housing and livelihood vulnerability to climate events. Approximately 53.5 km of major roads, 10.7 percent of schools, and 12 percent of hospitals are currently exposed to rain and river flooding. Lack of sanitation, combined with urban floods, further worsens already poor health outcomes and poses additional challenges in containing infectious disease outbreaks.[125]

Instances of urban flood damage are projected to increase even in the very near term, with increases of 3–5 percent of historic damage levels expected. By end of the century, urban flood damage is expected to increase by 8–21 percent, depending on the climate scenario. Hundred-year floods will disproportionately burden the poor living close to riverain structures, and predominantly the residents of Tanganyika, Lualaba, Haut-Lomami, Haut-Katanga, and Kongo Central, totaling 12.5 million poor. Sud-Kivu and Kinshasa can similarly expect some of the worst floods, exposing another 10.2 million poor to risk. These risks would likely be aggravated in the event of increased climate-based migration into urban areas (figure 3.6).

Figure 3.6: Kinshasa built-up area exposed to river and rainwater flooding combined (left) and infrastructure assets exposed to rain and river water flooding combined (right)



Source: Flood and Erosion Risk Assessment and Mitigation: N'Djili Urban Watershed, Kinshasa World Bank, 2019

Urban adaptation will be essential. Modeling results indicate that, without adaptation, the proportion of capital damaged by floods will increase from around 0.035 percent in the 2030s to around 0.053 percent in the 2050s—a 51 percent increase—, compared to baseline. By introducing the adaptation measure of elevating enough high-risk structures by one meter by 2050, the proportion of capital damaged by floods shrinks from a little below 0.02 percent in the 2030s to around –0.01 percent in the 2050s, the latter indicating a level lower than standard constructions. Elevating enough high-risk structures at or below baseline ("high protection") would have an even greater effect, with capital damaged shrinking from around 0.013 percent in the 2030s, to –0.03 percent in the 2050s. The cost reduction assumes that DRC can build more climate-resilient buildings by then.

Expanding DRM platforms in DRC is essential to establish robust forecasting and MRV systems. DRM would greatly benefit from better hydrometeorological and climate services (observation and forecasting/projections infrastructure), which are critical data for flood

[125] In Kinshasa, less than 10 percent of the 8,000 tons of solid waste generated daily is landfilled; the rest ends up in uncontrolled dumpsites and eventually in rivers and the ocean.

preparation. MRV systems for underground and surface water could help create DRM early-warning networks for flooding and hydrologic hazards and increase the accuracy of forecasting natural disaster events. The World Bank-supported Kin-Elenda project is a good example of how to strengthen capacity in this area (box 3.2). Climate investments in DRC's cities may secure and strengthen already developed critical urban infrastructure and thereby address urban poverty and fragility. Key priorities include:

- **Developing long-term, climate-resilient urban communities and infrastructure, with a focus on the most vulnerable groups.**[126, 127] This is critical for capturing additional co-benefits, including better air quality, more green jobs, and support to the most vulnerable. Developing public transport schemes, improving solid and liquid waste management, energy supply, and access would also be primary mitigation measures.
- **Underpinning climate-smart spatial urban development planning and land use management, as well as strengthening capacities to manage and service DRC's urban areas.** Strengthening capacities at the local level would help the shift from climate disaster emergency management toward long-term multisectoral planning.
- **Integrating and employing NBS in urban areas** to address adaptation and mitigation, while providing additional co-benefits such as job creation, improvements in health and air quality, and maintenance of urban ecosystems and biodiversity, in line with the prime recommendations from the latest IPCC Climate and Development Assessment report (AR6 WGII).[128]

Box 3.2: World Bank Kin-Elenda project to strengthen DRM capacity in Kinshasa

The World Bank-supported, multi-sectoral development and urban resilience project of Kinshasa (PDMRUK), known as **Kin-Elenda**—meaning a stronger, more resilient Kinshasa—is a good example of the efforts needed to help improve hydrometeorological data collection capacity, early-warning systems, and urban risk reduction in support of a more comprehensive, informed DRM approach.

Kin-Elenda aims to improve urban management and access to infrastructure, services, and socioeconomic opportunities. It is employs the concept of spatially and socioeconomically "inclusive and resilient cities" and resilience against hazards. The investments are concentrated in the eastern and western watersheds of the N'djili River.

One project focus is on laying the foundation for improved vulnerability analysis in the N'djili watershed by establishing more capacity for collection and use of hydrometeorological baseline data, as well as alert procedures. To strengthen the response capacity of civil protection agencies, the project facilitates collaboration among the main institutions involved in early-warning systems for flooding, including MettelSat, the Civil Protection Department, Ministry of Interior, and City of Kinshasa. Building on a wider network of observation stations and through signed agreements, Kin-Elenda also establishes connection with other sectors and data collection agencies (INERA for agriculture, AVA for aviation) and global databases (like WMO) to achieve a more comprehensive data picture, improved transmission and better collaboration protocols.

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[126] This includes an understanding of the cities' climate risks and hazards and identification of urban hot spot areas through the development of climate-risk assessments covering social, natural, and economic capital.

[127] Examples of such development might include 1) heatproof housing materials and the development of corresponding building standards; 2) cooling measures across cities, particularly in their high-risk areas; 3) improved and enlarged drainage infrastructure; 4) improved waste management systems to avoid clogged drainage and efforts to stabilize hillsides and avoid runoff; 5) introduction of climate change projections in the design and construction or rehabilitation of infrastructure, particularly for the transport network; and 6) addressing water demand and supply holistically over the long term.

[128] Climate and Development Knowledge Network (CDKN), African Climate and Development Initiative (ACDI), "The IPCC Sixth Assessment Report", 2022, https://cdkn.org/sites/default/files/2022-03/IPCC%20Regional%20Factsheet%203_Central%20Africa_web.pdf.

3.5. Urban water supply and sanitation, and water resources availability

DRC's water and sanitation sector faces numerous challenges, including underperformance, fragmentation, incomplete decentralization, and a chronic lack of investment, aggravated by low consumption losses related to poorly developed hydropower. From 2017 to 2021, domestic public expenditure in the WASH sector totaled only 0.2 of public expenditure, around US$9 million year (equivalent to US$1 per person), with only 15 percent earmarked for investments.[129] By contrast, the estimated cost to achieve universal access to basic services exceeds US$1.1 billion, highlighting the substantial challenge ahead.[130] The Government's 2020–2030 National Program for Water, Sanitation and Hygiene (*PNEHA*) outlines priorities and investments, complemented by the ongoing sector reforms and the implementation of the 2015 Water Law. However, although envisioned under the Water Law, the Congolese Water Agency has not yet been operationally established, sub-basins and watersheds remain undefined and basin management entities/councils are yet to be established. Against this backdrop, integrated watershed and basin planning and investments approaches are critical for DRC's adaptation and development. Watershed management measures to control catchment degradation, sedimentation loads, and measures to curb pollution -especially in the mining sectors- are needed to preserve the resources.

Ensuring access to WASH services, as indicated by the IPCC, would fundamentally improve community resilience and reduce vulnerabilities to climate-related shocks. To achieve this, it is crucial to implement climate-resilient measures in designing water and sanitation infrastructure. This includes infrastructure such as solar-pumped water systems, adequate flood protection, site selection, drainage, and erosion control.[131] Maintenance contracts with the private sector, such as for solar-pumping systems are also recommended. Additionally, developing a comprehensive business continuity plan for REGIDESO, the national utility operating in urban areas, is a prudent step to ensure uninterrupted water service delivery.

3.6. Clean cooking and increased access to liquefied gas

With more than 90 percent of households in DRC's households relying on biomass and wood, investing in cooking services is important for developing DRC's human capital and preserving its natural capital base. Firewood and charcoal are the main cooking fuels, with 88.7 percent of rural households and 20.5 percent of urban households using firewood as their primary cooking fuel. Modeling results[132] showed that an aspirational development scenario[133] with increased clean cooking could result in gains of over 8 hours per day per household by 2050, primarily from reduced time needed to collect fuelwood and biomass (figure 3.7). This aspirational patch could result in a 0.56 percent increase in labor supply by mid-century(figure 3.8).

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[129] BOOST database; authors estimates.

[130] SWA (Sanitation & Water for All), WASH SDG Costing Tool (2020), https://www.sanitationandwaterforall.org/tools-portal/tool/sdg-costing-tool.

[131] Nathan Lee Engle et al., *Resilient Water Infrastructure Design Brief* (Washington, DC: World Bank, 2020), https://documents.worldbank.org/en/publication/documents-reports/documentdetail/868981599035366969/resilient-water-infrastructure-design-brief.

[132] The reduced effects of indoor air pollution from improved cooking services were compared to a base case in which current trends continue. Figure 3.7 shows the change in the total number of weekly hours per household devoted to cooking activities for a BAU and an aspirational scenario. BAU, in this case, represents virtually no change in the share of fractions using each type of cooking energy source —traditional, improved, and modern.

[133] The aspirational development scenario assumes that urban households shift from 42 and 11 percent relying on improved and modern energy cooking services, to 60 and 20 percent, respectively, and that rural households shift from 12 and 2 percent to 40 and 10 percent.

Reaching the clean cooking targets outlined in the 2016 Sustainable Energy for All (SEforALL) National Strategy by 2030 will require a public annual investment of US$234 million.[134] In addition, US$21.7 million is required from the private sector to install downstream infrastructure and US$273 million from households' direct contributions. To achieve universal access to the Modern Energy Cooking Services (MECS) program in DRC by 2030, the estimated annual investment would be higher, approximately US$3.2 billion per year. The overall benefits of the SEforALL targets total US$4 billion a year, which is more than 7 times the estimated total investment (US$529.4 million a year) and 17 times the annual public financing requirement. The health co-benefit is estimated at US$2 billion a year linked to avoided deaths and avoided disability-adjusted life years (ADALYs). The gender co-benefit of US$4.3 billion a year results from time saved in performing cooking-related tasks such as collecting fuel and cooking. The climate co-benefit of US$483 million per year comes from reduced GHG and black carbon (BC) emissions through cleaner cooking. The Government is currently developing a National Energy Policy that acknowledges the importance of clean cooking.

Figure 3.7: Weekly hours spent on cooking activities per household, 1995–2050

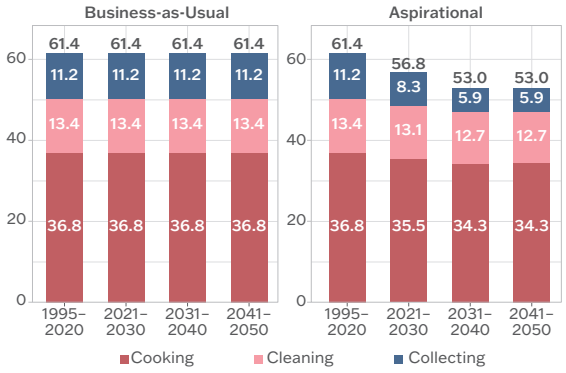
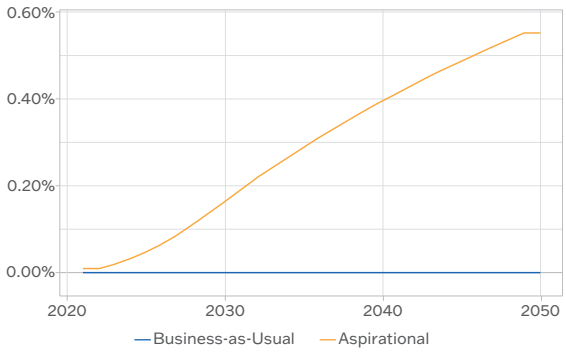


Figure 3.8: Labor supply shock from clean cooking investments, in %, 3-year moving average, 2020–2050



There are ongoing initiatives in the DRC to promote the use of gas for clean cooking. Natural gas production is concentrated in the eastern region, where the Ruzizi and Lake Kivu gas reserves are. An ongoing initiative for methane extraction from Lake Kivu is expected to start generating 30 MW of electricity.[135] At the institutional level, within its Provisional Energy Policy, the DRC targets the increasing utilization of liquefied petroleum gas (LPG) for clean cooking,[136] with a focus on transitioning coal users to gas. Although DRC has natural gas, its production and utilization are still limited. Current subsidies on LPG are relatively low and do not address its affordability issue. Moreover, safety concerns and limited awareness discourage its use for cooking. Lastly, the LPG national market is not as organized or developed as the informal fuelwood value chain, affecting availability, perceived attractiveness, and affordability.

[134] World Bank, *Clean Cooking Planning Tool (CCPT)*, ESMAP-WBG-MECS website, https://energydata.info/cleancooking/planningtool.

[135] Kivu Power is a PPP project now in its financial closing phase and to be completed by 2026. DRC has formulated a comprehensive plan for the development and exploitation of natural gas reserves in the deep waters of Lake Kivu, on the DRC–Rwanda border. The plan was developed in collaboration with international partners and aims to establish a sustainable gas industry that generates economic and energy benefits while mitigating environmental and social risks. Critical stages of the plan include gas reserve exploration and evaluation, construction of extraction and transportation infrastructure, implementation of safety protocols, job creation for local communities, and promotion of natural gas as a clean, renewable energy source to reduce reliance on fossil fuels. However, the exploitation of gas from Lake Kivu poses significant environmental and social hazards because of the emission of toxic gases such as hydrogen sulfide.

[136] The Government has launched a program to encourage the use of LPG for cooking, aiming to provide affordable gas cylinders to households, particularly in urban areas.

Since the clean cooking market is still nascent, it is important that the Government and its partner stakeholders work together across sectors to address supply, demand, and the enabling environment for clean cooking market growth. Specifically, DRC should integrate clean cooking into its broader energy policy and regulatory framework to encompass wood, charcoal, alternative fuels, health and safety, and ease of doing business. Finalizing and adopting the 2022 Provisional National Energy Policy needs to be prioritized to assess the investment needs and identify funding sources for clean cooking-related objectives. Further, adopting a ministerial resolution for the Clean Cooking Working Group launch would enable the design of a Clean Cooking Strategy that would promote awareness and accelerate exploration of alternative clean cooking solutions like electricity, pellets, LPG/natural gas, biogas, and ethanol. Three other essential strategies are to ensure affordability via financing, to monitor progress, and address the obstacles to access in rural areas.

3.7. Digital infrastructure

Improving digital infrastructure in the DRC is essential to enhancing national connectivity and resilience. The DRC heavily relies on a single undersea cable, the West Africa Cable System (WACS) on the western coast. Other access includes an under-river cable connecting Brazzaville and Kinshasa and two indirect terrestrial cross-border links connecting to Rwanda (via microwave) and to Zambia (via fiber). A second submarine landing station connecting DRC to the Africa cable is planned for 2023 to address a single point of failure risk, However, the proximity of these stations to the coasts exposes them to flooding, sea-level rise, storms, earthquakes, and subsea landslides. Moreover, river floods are expected to impact highly populated cities with concentrated cell towers like Kinshasa, Lubumbashi, Beni, and Bakavu, damaging connectivity infrastructure, and interrupting or preventing local communities' access to critical digital services.

The disruption of network infrastructure has far-reaching impacts beyond communication, including hindering economic growth, hampering responses to natural disasters, suppressing free speech, and inhibiting the development of civil society. The loss of internet and mobile connectivity due to extreme weather events would disrupt both government and private sector operations, resulting in significant economic consequences. Over 6,000 mobile cells and more than 500 kilometers of fixed fiber optic networks are at risk, underscoring the need to strengthen the climate resilience of DRC's digital infrastructure. Furthermore, maintaining digital connectivity is essential for efficient disaster response, aid distribution, and the prompt identification of affected populations, ensuring their protection during crises.

3.8. Positioning DRC as a "solutions country" and pursuing the opportunities of a low carbon growth path

3.8.1. Minerals

The international mining industry is undergoing deep transformation because of the global energy transition, and DRC is well positioned to be a critical player in the move to a low-carbon future. The transition creates opportunities for DRC's companies and Government as interest rises in developing supplies of energy transition minerals. But the transition also poses regulatory and technological challenges as countries and companies seek to decarbonize their value chains in support of their Paris Agreement commitments. Exploited and managed sustainably, DRC's minerals could create vital opportunities for

economic growth, private sector development, green technology adoption, job creation, and DRC's own shift to a low-carbon economy. Demand for cobalt and copper will continue to rise, especially for batteries.[137] In 2019, for example, revenue rose to US$1.78 billion. Yet mining sector governance remains a persistent challenge.

DRC's cobalt-intensive industry positions it at the forefront of the green industrial revolution, offering significant growth opportunity.[138] DRC's role in the upstream cobalt ore mining and dressing sector is already substantial, but for the sector to benefit the entire economy, the country needs to develop the midstream processing sector and improve transparency. Further, participation in the downstream industry would expand DRC's presence in global value chains.[139, 140, 141] In addition, with no foreseeable reduction in water resources, and with most of its mining operations already relying on hydropower sources, DRC's mining industry can enhance its emission reduction agenda by transitioning to entirely renewable resources. The Kamoa-Kakula Copper Mine, for instance, is planned to have one of the cleanest environmental footprints among tier-one copper mines worldwide. To be powered by hydroelectricity, it will be one of the world's lowest GHG emitters per unit of copper produced.[142]

Exploited sustainably, DRC's minerals could create substantial opportunities for economic growth and inclusive job creation. With artisanal and small-scale mining (ASM) and industrial mining offering higher incomes, the rural poor are progressively shifting to this sector and away from low-productivity agriculture, a trend expected to accelerate. To ensure an inclusive transition, DRC needs to foster supply chain transparency, improve working conditions, eradicate child labor, enhance environmental responsibility, and promote gender equality. Achieving social inclusion and sustainability in DRC's green mineral mining is not only pivotal for a successful global energy transition but would replace exploitation and conflict with resilience and prosperity. A healthy, skilled labor force is essential to take advantage of the global mining resource boom.[143]

Evidence suggests that the opportunity cost of engaging in conflict decreases in places where livelihoods are being further eroded. Negative income shocks can increase the labor supplied to appropriation through lowered opportunity costs to engage in conflict. For instance, in Colombia, a fall in coffee prices during the 1990s lowered wages, making it more tempting for plantation workers to join gangs, which in turn increased violence in coffee-cultivating municipalities. This finding that workers' wages are the opportunity cost of fighting is consistent with previous cross-country evidence that growth reduces the risk of civil war by raising its opportunity cost.[144]

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[137] See: https://eiti.org/countries/democratic-republic-congo.

[138] Lynda J. Pickbourn, Janvier D. Nkurunziza, and Léonce Ndikumana, *Growing the good and shrinking the bad: Output emissions-elasticities and green industrial policy in commodity-dependent developing countries* (United Nations Conference on Trade and Development (UNCTAD) Research Paper no. 84, 2022), https://unctad.org/system/files/official-document/ser-rp-2022d4_en.pdf.

[139] "China Cobalt Market Report 2021–2025: Mining and Dressing (Upstream), Smelting and Processing (Midstream) and Terminal Utilization (Downstream)," *CISION PR Newswire*, June 4, 2021, https://www.prnewswire.com/news-releases/china-cobalt-market-report-2021-2025-mining-and-dressing-upstream-smelting-and-processing-midstream-and-terminal-utilization-downstream-301305243.html.

[140] World Bank, *Republic of Congo's Road to Prosperity: Building Foundations for Economic Diversification* DRC Country Economic Memorandum (Washington, DC: World Bank, 2023), https://thedocs.worldbank.org/en/doc/61714f214ed04bcd6e9623ad0e215897-0400012021/related/P177056082c4ca01c08bdf0912daa5d3470-1.pdf.

[141] The Africa Export-Import Bank (Afreximbank), United Nations Economic Commission for Africa (UNECA), African Development Bank (AfDB), Africa Finance Corporation (AFC), Arab Bank for Economic Development in Africa (BADEA) and African Legal Support Facility (ALSF) have asked BloombergNEF to conduct a study on the production of battery precursors in the lead-up to the DRC–Africa Business Forum. The objective is to determine the cost of producing lithium-ion battery precursors in DRC and compare the cost to that of the US, China and Poland. The study also assesses the emissions associated with the production of precursors for the global EV market in the DRC, compared with producing them in China or Poland.

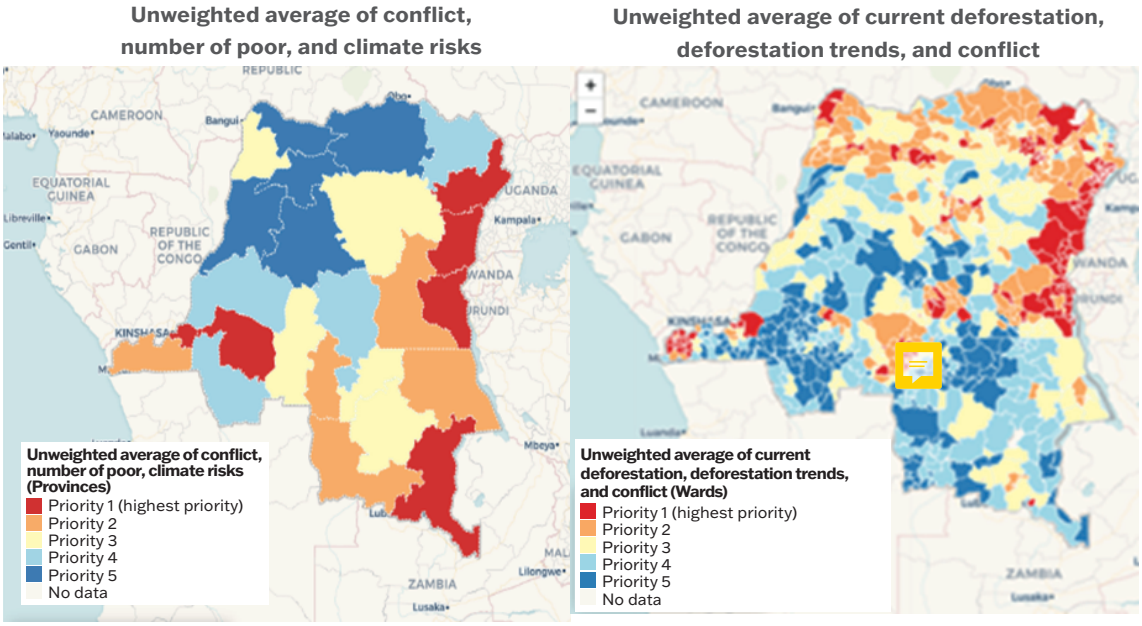
[142] Kamoa-Kakula also will have a relatively small surface footprint; about 55 percent of the mine's tailings will be pumped back into underground workings.

[143] There are significant returns to education in the DRC in terms of increasing the likelihood of gaining wage employment and escaping poverty.

[144] Miguel, Edward, et al. "Economic Shocks and Civil Conflict: An Instrumental Variables Approach." *Journal of Political Economy*, vol. 112, no. 4, 2004, pp. 725–53. *JSTOR*.

Most mining areas, conflict areas, and areas at risk of climate-impact degradation spatially overlap. They are mostly in the east—Ituri, North Kivu and South Kivu—but also Haut-Katanga, Kwilu, and Kinshasa (figure 3.9). DRC needs to protect and manage its natural forests because if climate-related impacts—declining vegetation, soil degradation, biodiversity threats, abnormal rainfall, and excessive heat exposure—accelerate the erosion of livelihoods, it will likely lower the opportunity cost for earning money through conflict. This climate-mining-conflict-poverty confluence is a powder keg situation.

Figure 3.9: Number of poor people, priority areas for reforestation, and conflict hotspots



Source: Poverty & Equity DRC Observatory's Project Targeting Index (left), and IPIS[145] (right)

With lucrative lootable resources in the vicinity, conflict can further escalate because of the higher gains that can be acquired from appropriation through the rapacity effect. The mining landscape is characterized by predominantly artisanal but also large-scale industrial mining, concentrated in Ituri, Nord and particularly South Kivu. DRC's ongoing conflict, notably in the eastern provinces, offers parallels to the past conflict in Colombia's forest areas. When economic shocks from oil prices in Colombia in the 1990s are compared to economic shocks from mineral prices in DRC, it can be seen that differential increases in violence—due to rising prices on the international market because of a rapacity effect (namely, appropriating resources violently because miners are making money and handling lucrative resources) and the opportunity cost effect (namely, appropriating resources violently because wages have fallen, leaving many with few options)—work in opposite directions, as follows.[146] Artisanal mining, typically exploited with minimal infrastructure, is easily lootable but relatively labor-intensive, with low entry barriers. By contrast, when positive income shocks (due to the capital-intensive nature of the sector) are concentrated and do not benefit the larger population, gains from joining violent activity to engage in expropriation rise with a positive price shock to the commodity.[147] Industrial mining requires

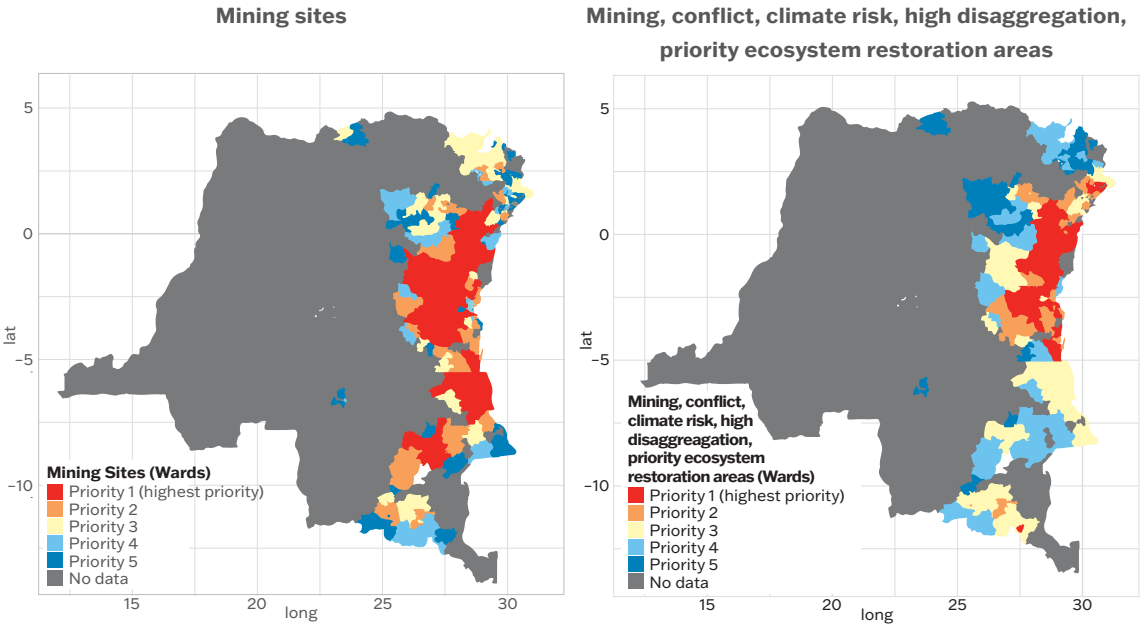
[145] IPIS (International Peace Information Service), *Maps & Data*, website last accessed September 24, 2023, https://ipisresearch.be/fr/home/cartes-donnees.

[146] Dube, Oeindrila, and Juan F. Vargas. "Commodity Price Shocks and Civil Conflict: Evidence from Colombia." The Review of Economic Studies, vol. 80, no. 4 (285), 2013, pp. 1384–421. JSTOR.

[147] In Eastern DRC, price shocks to gold and coltan were initially associated with spikes in violence as armed actors sought control over the territory where the commodities were mined. Raul Sanchez de la Sierra, 'Bandits or States? Evidence on Armed Groups' Motives to Attack or Protect Civilians from Eastern Congo, International Peace Research Association, 2013.

high-cost machinery and investments but often benefits only a small number of people engaged in the extraction process. As in Sierra Leone and Liberia, alluvial diamonds have been used to fuel the war, given the ease of looting them.[148] As such, areas with the largest number of artisanal mining sites are particularly at high risk of additional conflict spikes. This includes South Kivu, North Kivu, and Ituri, closely followed by mines on the South-Eastern border (Tanganyika, Haut-Katanga) (figure 3.10).

Figure 3.10: Conflict, mining areas, priority restoration areas and number of poor



Source: Poverty & Equity DRC Observatory's Project Targeting Index (left), and IPIS[149] (right)

To harness the potential of mining, appropriate institutional frameworks need to be put in place. Certification processes that are currently being planned will uphold metal quality standards among producers. Plans are under way to build Africa's largest smelting works in Bukavu to undertake some of the up-scale mineral processing in-country. Recent reforms aim to ensure that mining royalties benefit local communities. A sovereign wealth fund is planned to absorb new resources from mineral wealth, possibly in the spirit of the Norwegian sovereign wealth fund. However, DRC also needs to implement and enforce stringent environmental and social standards to ensure responsible mining practices and sustainable value chains. Artisanal and small-scale mining (ASM), is fraught with challenges, including human rights abuses, gender-based violence (GBV), and social exclusion. As global demand for these minerals rises, there's an urgent need for a "just transition" that ensures both environmental sustainability and social equity. This includes upholding human rights and labor regulations, enhancing supply chain transparency, addressing complex governance issues that can lead to exploitation and conflict, implementing proper waste management, and reducing carbon emissions.

[148] While lootable resources are generally associated with greater conflict, a nuanced view suggests that price spikes in minerals can lead to the creation of sophisticated taxation systems, depending on goals and motives of the violent actor. Evidence from Eastern DRC between 1990s and 2017 shows that depending certain criteria, in some cases stationary bandits emerge who tax the local population and provide protection in return.

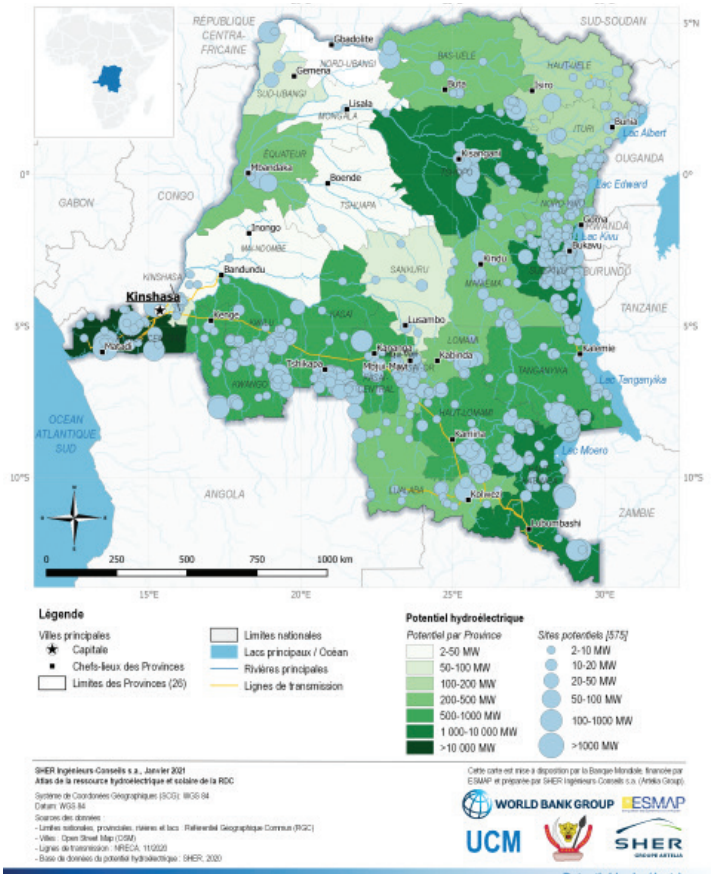
[149] IPIS, *Maps & Data*.

As DRC develops and adapts to climate change, it must strive for a virtuous cycle of mineral and natural wealth, welfare, and decreased conflict potential. Considering the empirical evidence linking mineral price hikes and conflict, DRC needs to raise the opportunity costs of picking up arms, by promoting broader gains through formal jobs creation along the value addition chain, and by implementing taxation and certification schemes tailored to minerals' properties. It is also important to contain the reduced opportunity cost effect to ensure that groups of people are not further marginalized due to the loss of livelihoods, that is, through continuous deforestation and loss in agriculture productivity. Second, DRC needs to ensure that the gains from a global energy transition benefit all by leveraging the growth of the mining industry as a vital opportunity for poverty alleviation and local development, emphasizing in-country value addition to generate jobs and unlock opportunities for community development through socially inclusive, equitable benefit-sharing. DRC also needs to empower communities to actively participate in decision-making along the mining value chain and related sectors, thereby increasing the opportunity costs of resorting to violence, and decreasing the rapacity effect.

3.8.2. Hydropower

As a large, competitive, flexible source of renewable energy, hydropower in DRC could contribute significantly to the country's low-carbon development path. It is the lowest-cost source of electricity worldwide, averaging of 5 cents/kWh, and has the advantage of also providing large-scale energy storage through reservoirs.[150] DRC's hydrological potential is estimated to be around 100 GW, of which 70 GW has already been localized, with 64 GW concentrated in the Kongo-Central Province (figure 3.11). The construction of the Grand Inga dam on the Congo River, with private sector support, would achieve much of this potential. The dam is expected to produce around 42 GW at completion at 2 cents/kWh.

Figure 3.11: DRC's hydroelectric potential in MW, 2021



Source: World Bank, Report on prioritization and mapping of hydroelectric and photovoltaic sites in the DRC, 2021

[150] World Bank, *Increasing Access to Electricity in the DRC*.

In the short to medium term, a sharper focus on developing small and medium-sized hydroelectric power plants (HPPs), closer to the electricity load, is the only realistic approach to meeting the growing electricity demand. However, rehabilitation of existing hydro facilities is currently the lowest-cost energy option (estimated at around 2.5 UScents/kWh) with potentially fewer environmental and social impacts and shorter project development time than new greenfield HPP.[151] Integrating medium-size hydropower projects with solar PV generation projects (in the Katanga mining region) could address the growing energy needs of mines, while simultaneously expanding access to low-cost, carbon-free electricity. However, this can be achieved at scale only by addressing the issues of poor performance and governance and the lack of creditworthiness and credibility of the national utility Société Nationale d'Électricité (SNEL), which operates Inga and the national power grid.

In addition to further improvements in the legal and regulatory framework of the electricity sector, a restructuring of SNEL seems warranted because the efforts made over the last 15 years to improve SNEL as a vertically integrated utility have produced little progress. Outside of SNEL's geographical perimeter, only a few private operators—local and international—have entered DRC's minigrid market. To scale up private investment, the Government can operationalize the regulator and the rural electrification agency, reduce tax barriers, subsidize connection costs, and facilitate access to finance.

Box 3.3: INGA: Potential for a multi-generational development program built on a globally unique energy resource.

INGA is a globally unique energy asset. Its full potential of 42 GW is about twice more than the world's current biggest power station, 3 Gorges in China, and could produce at a highly competitive cost of about 2 cents/kWh. However, it presently generates less than 2 GW (0.35 GW from Inga 1, 1.4 GW from Inga 2)—70 percent of DRC's total electricity supply. The next stage is to develop Inga 3 in one of two ways: a) a Low Head—representing 4,800 MW, small reservoir, no resettlement, or transboundary impacts; and b) a High Head—representing 7,800 MW, large reservoir, major resettlement, and transboundary impacts. Either requires either an export arrangement or a significant new domestic customer.

Three models are under discussion for the development of INGA 3:

1. **Electricity Export**
    - Commitment in 2013 of 2,500MW to South Africa. Model includes around 1,300 MW for mines in the DRC—but not necessarily close to the Inga site.
    - Requires long transmission lines across several countries; offtake risk associated with Eskom plans and credit-worthiness; joint venture to develop up to 11,000 MW in 2018.
    - No 'on the ground' progress or mobilization to date, and unclear if any legal agreement still exists.
2. **Green Embedded Energy Export**
    - To reduce their carbon footprint, energy-intensive industries—including hydrogen, ammonia, and metals production—are seeking locations with large amounts of 'green' energy.

[151] World Bank, *Increasing Access to Electricity in the DRC*.

- Several entities have identified Inga as a site for green energy-intensive industries producing goods for export. This model includes less transmission infrastructure, fewer transboundary complications, and a likelihood of more domestic 'value added' industry and jobs—but it may also require a variety of new port and export infrastructure.
- Fortescue Future Industries (FFI) has signed an agreement with the Government and spent more than US$80 million for development projects, studies, and the recruitment of 80 staff.

3. **Scaled-Down Local Development**
    - The low-head version of Inga 3 might be a scaled-down 'local project' for domestic household electricity and industrial/mining customers.
    - Includes an installed capacity option of roughly 2,500 MW—effectively a first phase of the bigger development.
    - It would cost roughly US$3.7 billion, with possible future expansion.

To ensure sustainability, DRC needs to reestablish a functional national utility sector and acceptable grid governance. Grand Inga will be a massive project, with technical and engineering challenges, and requiring large-scale finance mobilization for lumpy investments in dam construction, generation, and transmission (as opposed to smaller hydro or sola photovoltaic generation projects).

3.8.3. Improving Landscape Management and Reversing Forest Degradation

If DRC is to preserve its natural capital, boost crop productivity, conserve and restore forests, and build climate resilience, while contributing to reducing GHG emissions, restoring degraded landscapes is a must. DRC's development path depends on careful forest and landscape management and improved livelihoods, striking a balance between conservation and wealth generation.[152] Planned policies, regulations and investments in integrated landscape management that are currently part of the Government's development plans should substantially improve land conditions. Improving the implementation of such policies would also help meet DRC's NDS and NDC objectives, by conserving its forests and reducing emissions from land-use change.

DRC's forests, which contain around 85 gigatons of CO_2e accumulated and stored above the ground,[153] offer a wide variety of valuable private, regional, and global public services. They are still one of the few areas in the world that act as a net carbon sink, removing an estimated 822 Mt CO_2e/year, although this will decline at the current rate of forest loss, 55 million has/year. Besides carbon sequestration, services include timber production, food production, and fuelwood, preventing erosion and sedimentation, regulating and purifying water, as well as providing 50 percent of the annual rainfall that falls in surrounding areas.[154] These services result in significant private values, regional public values, and global public values.

[152] Increased land degradation is reducing land fertility and vital ecosystem services such as water regulation, flood mitigation, erosion control, biodiversity, and carbon storage.

[153] L. Xu et al., *Spatial Distribution of Carbon Stored in Forests of the Democratic Republic of Congo*. Sci Rep 7 (2017): 15030, https://doi.org/10.1038/s41598-017-15050-z.

[154] R. Sorí et al., "A Lagrangian perspective of the hydrological cycle in the Congo River basin," *Earth System Dynamics* 8, no. 3 (2017): 653–675, https://doi.org/10.5194/esd-8-653-2017.

The Government has committed to supporting and enhancing forest livelihoods and services. The strategy includes improving forest management, reforesting some 3 million hectares by 2030, and maintaining the forest coverage at 63.5 percent of DRC's territory by 2030, while improving the population's socioeconomic conditions. As a signatory to the Bonn Challenge, DRC has also committed to restoring 8 million hectares of degraded and deforested lands. To reach its goals, the Government has established a national REDD+ investment plan[155] coordinated by FONAREDD with interventions in sectors such as agriculture, energy, forestry, land use planning, land governance, and demography. The country's climate mitigation strategy is anchored in the expansion of its carbon absorption capacity through REDD+ projects.[156] The World Bank-financed 'Forest and Savanna Restoration' project, approved in 2023, will support the promotion of sustainable landscape management practices in areas along the southern border.[157]

That said, DRC's forests are degrading, with sizeable impacts on their climate-regulating function and other ecosystem services, including biodiversity. Since 2000, 3 million ha of forest have been converted to other land uses, primarily cropland for shifting cultivation, reducing the total forested area to an estimated 59.3 percent (or 142,39 million hectares).[158] If these trends continue, DRC will lose another 7.7 million ha by 2030 and 12.9 million ha by 2050 (or 7 percent of its carbon storage),[159] reducing the overall forest cover to only 56.1 percent of what it was in 2000. This would represent a deforestation rate of 6 percent between 2020 and 2030 and result in a loss of 4.75 billion Mt of CO_2e (or 5 percent or its carbon storage) stored in DRC by 2030 and 6.1 billion Mt $C0_2e$ by 2050, (nearly 7 percent of total storage in 2020). This is equivalent to twice the 2019 emissions reported for all European Union countries.[160] Under this scenario, aside from the carbon released through loss of standing forest stock, DRC emissions would increase by about 35 Mt CO_2e/year by 2030, and 185 Mt CO_2e/year by 2050, from there being less forest to offset emissions. The CCDR estimates that if DRC loses another 57 million hectares of forests, the remaining forest would no longer be able to offset emissions from the LULUCF sector. Which means that with the loss of 40 percent of its current extent, DRC's LULUCF sector becomes a net source of carbon and no longer a sink. The threshold of becoming a net source comes even sooner if you consider the emissions of DRC's economy as a whole.[161]

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[155] The REDD+ investment plan strategy aims to (i) reform the allocation and use of land, (ii) design policies integrating the sustainability of the use of space and resources (energy, agriculture, forest), energy efficiency, and investments in agriculture, savannahs, and degraded forest areas, and iii) develop subnational and provincial climate mitigation strategies with the help of development partners.

[156] Total financing mobilized for DRC's National REDD+ Investment Plan up to 2023 is estimated at US$1.2 billion. A detailed assessment by FONAREDD is ongoing. See World Bank, "Second DRC Foundational Economic Governance Reforms Development Policy Financing," World Bank Projects & Operations website, last updated March 30, 2023, https://projects.worldbank.org/en/projects-operations/project-detail/P179141.

[157] World Bank, "DRC Forest and Savanna Restoration Investment Program," World Bank Group Investment Project (2023), https://documents1.worldbank.org/curated/en/099041723210512838/pdf/P1786420c82f8d02089cc026cbfa8bdf04.pdf.

[158] In addition, DRC has experienced a decline in productivity and vegetation health in an additional 8.9 million ha of forests, 7.5 million ha of croplands, 2.5 million ha of grasslands, 0.2 million ha of shrublands, and 0.14 million ha of wetlands.

[159] Beyond the 8.4 million ha predicted to be deforested by 2030, there are 14 million ha (10 percent of DRC's entire forest area) that will remain as forest but degraded from good to poor condition. The predicted loss of forest by 2050 is 12.9 million ha under BAU.

[160] European Environment Agency, *EEA Greenhouse Gases—Data Viewer*, EEA dashboard, last updated April 18, 2023, https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer.

[161] Each 1.1M hectares of forest lost is equivalent to a year of annual emissions for DRC, assuming all of that carbon went straight into the atmosphere, which can be the case if the forest is burned. If the forest is harvested and sold as timber than only a fraction of the carbon is released right away, roughly estimated at 50%. Even assuming conservatively that a large portion of deforestation goes to timber production, at the current rate of forest loss DRC could become a net source of carbon rather than a net sink in less than 3 years.

Based on the Shadow Price of Carbon, and using a 6 percent discount rate, the cost to the world of this loss in carbon sequestration would total about US$95.3 billion,[162] *based on the Shadow Price of Carbon, and using a 6 percent discount rate.*

The carbon stock value of DRC's 143 million hectares of standing forests is estimated at up to US$6.4 trillion,[163] **with an annual rental value of between US$207 and US$383 billion at a 6 percent discount rate, which represents the global public good value of DRC's forests.** Private and regional public values of additional ecosystms services—including timber and other non-wood forest services—are estimated at US$15.9 billion per year. The total annual value of the forest's carbon and its associated ecosystem services is thus estimated at between **US$223 and 398 billion per year, depending on the methodology used.**[164] By comparison, a recent report estimated the total stock value of Brazil's 350 million ha Amazon rainforest at US$7 trillion, with an annual rental value of US$210 billion.[165] That study included a more comprehensive set of ecosystem services than were evaluated for DRC (and utilized the social cost rather than the shadow price of carbon) but comparable results are presented below in table 1.

The global benefits from conserving DRC's carbon sinks in the form of avoided future damage will only increase over time. A one-percentage-point decrease in DRC's carbon sequestration would have led to the loss of 1.4 and 2.4 percent points in World GDP in 2020 under the conservative scenario and the baseline scenario respectively.[166] Over the long run, the damage from emitting an additional ton of carbon, and thus the benefits of avoiding emissions, increases over time. These results suggest that there would be large gains from greater policy intervention and international partner support for DRC's forests and peatlands management over time. Access to climate finance provides an opportunity for the world to support DRC to achieve its conservation and sustainable forest management goals and commitments. Chapter 5 briefly discusses carbon markets and climate finance for DRC's forests.

DRC has partnered with Brazil and Indonesia in a global alliance to discuss and pursue the conservation, restoration, and sustainable use of forest resources.[167] The partnership pledges to support sustainable forest management and conservation, promote bioeconomy for healthy forests, and restore critical ecosystems through South-South cooperation.[168]

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[162] To arrive at the value of carbon storage, we consider both the value that the total carbon stored in DRC's forests brings to the world (using the shadow price), and the value DRC may be able to access through carbon markets that may help finance the cost of restoration, using average market prices. The impacts of avoided sedimentation and peak flow mitigation on key population centers and infrastructure are also estimated in biophysical terms but not in monetary terms because of data limitations.

[163] The stock value is derived by multiplying the total carbon stored (85 Gt CO_2e) by the shadow price, $75, as provided in the World Bank's Guidance note on the shadow price of carbon in economic analysis, Nov 2017, https://thedocs.worldbank.org/en/doc/911381516303509498-0020022018/original/2017ShadowPriceofCarbonGuidanceNoteFINALCLEARED.pdf.

[164] The range reflects different methodologies for estimating current carbon stored in DRC's forests. A low estimate (77 Gt CO_2e stored) is a result of literature-based values for carbon stored in different vegetation classes and the European Space Agency (ESA) World Cover land use/land cover dataset for 2020. The high-end estimate (85 Gt CO_2e stored) is reported in Xu et al. 2017.

[165] Jon Strand, "Valuation of the Brazilian Amazon Rainforest," background note to *A Balancing Act for Brazil's Amazonian States: An Economic Memorandum*, edited by Marek Hanusch (Washington, DC: World Bank, 2023), https://documents1.worldbank.org/curated/en/099051223180528189/pdf/P1734570eeae930e90bce9093c01a8427c3.pdf.

[166] Democratic Republic of the Congo: Selected Issues, IMF Staff Country Reports, 2022(211), A001. Retrieved Sep 25, 2023, from https://doi.org/10.5089/9798400214288.002.A001.

[167] In November 2021, the governments of Indonesia, Brazil, and DRC initiated a "Forest Power for Climate Actions" initiative at COP 26, followed by trilateral discussions in 2022 at UNGA, COP27 and G20 meetings. The tripartite cooperation was formalized through a Joint Statement on "Tropical Forest for Climate and People" signed at a G20 side event on November 14, 2022. A South–South Knowledge Exchange was organized by the World Bank in Brazil in May 2023.

[168] The World Bank is supporting the countries to deepen cooperation to promote tropical forest and climate action, mobilize new sustainable funding for tropical forests, and share best practices.

Table 1. Comparing DRC's forest values with the Brazilian Amazon rainforest

Ecosystem services valued in DRC's Congo Forest and Brazil Amazon forest			
Ecosystem service	***Estimated annual values***		***Notes***
	Amazon	***DRC forest***	
Area in standing forest *(million hectares)*	350 M hectares	143 M hectares	
Timber production *(billion US$)*	$ 1	$ 0.4	Slightly different methodology for areas considered to be not harvestable
Non-timber forest services (water regulation, tourism, habitat) *(billion US$)*	$ 19.7	$ 15.5	Amazon study covered a wider range of forest products, Congo uses CWON[169] data
Global value of carbon storage *(billion US$)*	$ 210	$ 207.1 to 382.5	Amazon used social cost of carbon at $40/t and 3% discount rate. DRC study used shadow price of carbon at $75/t and 6% discount rate. The range reflects different estimates of total carbon stored in DRC's forests
Total standing forest stock value *(trillion US$)*	7	6.4	
Agriculture production	$ 7.5	not estimated	
Regional climate regulation	$ 2.3	not estimated	
Fire protection	$ 1.5	not estimated	
Existence value	$ 65	not estimated	
Biodiversity option value	$ 10	not estimated	
TOTAL annual value (all ecosystems services including carbon) (billion US$)	***$ 317***	***$ 223 to $398***	

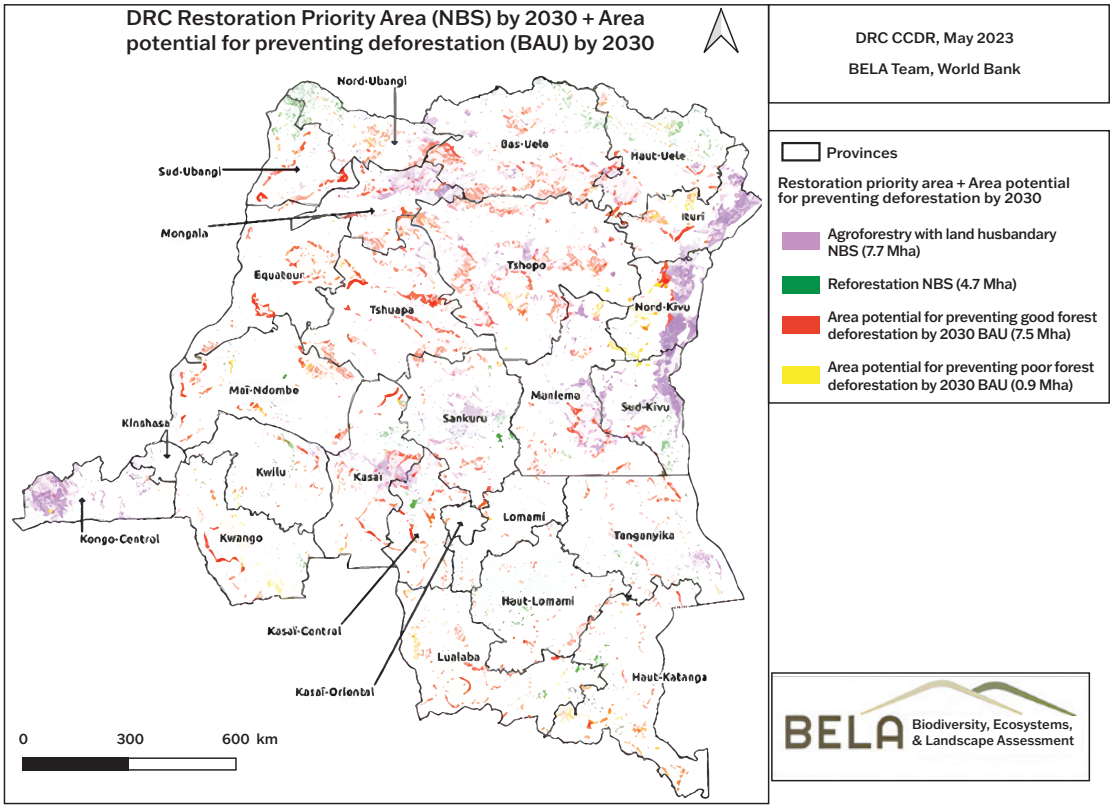
Managing its forests is critical to DRC's development. Improved landscape management enhances ecosystem services but also meets human needs and reduces the risk of disasters. Modeling results from a Forest Restoration Scenario[170] shows that, by 2030, improved landscape management and conservation could increase the annual value of DRC's ecosystem services from forests up to *US$1.76 billion* annually compared to the BAU scenario (depending on assumed market price of carbon, this value ranges from US$0.98 billion to US$2.5 billion).[171] By 2050, it increases to US$3.8 billion annually (figure 3.12). ***This means that for every US$1 invested in landscape and forest restoration, DRC stands to gain nearly US$3 in benefits relative to BAU over the next 10 years, and US$15 by 2050***. This number could be even higher if it considered the value of merchantable timber from agroforestry interventions outside existing timber concessions—an additional US$186 million/year.

[169] World Bank, *The Changing Wealth of Nations 2021: Managing Assets for the Future* (Washington, DC: World Bank, 2021), http://hdl.handle.net/10986/36400.

[170] A deep-dive study for the CCDR estimated the value of forests and associated ecosystem services in DRC, considering their potential value for *carbon storage, sustainable timber production, non-wood forest products, water regulation, and tourism*. In addition, past trends in deforestation and land degradation were analyzed over a 20-year period to develop a picture of what DRC's landscapes will look like by 2030 and 2050, if past trends continue. Two scenarios were employed to assess the current value of standing forests and how their condition and associated ecosystem services are likely to be impacted by climate change, deforestation, and degradation. Scenario 1 reflects BAU trends, in which past trends are projected forward to 2030 and to 2050. Scenario 2 represents an ambitious restoration (REST) scenario in which timber production in existing forest concessions is maintained at a sustainable rate (13.2 million ha), forest cover is increased and then maintained at 63.5 percent of the land area as per the national REDD+ strategy, and the country achieves its Bonn challenge commitment through the development of agroforestry, improved crop varieties, and improved rangeland management.

[171] Valued services are considered local to DRC. Monetary values reported are relative to local communities and/or DRC. The values of carbon storage and sequestration are global and were calculated both for the value of standing forests and the potential market value of restoring forest cover.

Figure 3.12: Land-use land cover and condition for a restoration scenario (2030)



Source: Ecosystems Modeling Analysis World Bank Team

Another benefit of improved landscape management is a reduction in flood risks. Under BAU, the decline of DRC's forests—coupled with more extreme rain events from climate change—is likely to lead to a significant increase in surface runoff and sedimentation, both of which will impact downstream urban areas by increasing the risks of flooding and infrastructure damage from excess sediment. Under the pessimistic climate scenario (SSP3–7.0), surface runoff could rise by as much as 110 percent in the upslope catchment area of Kinshasa (population nearly 6 million),[172] and sediment washing off the catchment and into the city's infrastructure could increase by 45 percent.[173]

Targeted restoration actions in at risk catchment areas could greatly reduce these risks of flooding and sedimentation. For example, under the Forest Landscape Restoration scenario, restoration actions in the upland catchment landscapes areas of Kinshasa and Bunia urban areas can significantly reduce flooding and sedimentation risk to populated areas at national scale. Targeted restoration actions in these catchment areas, such as those recommended in a forest targeted restoration scenario, can greatly reduce these risks of flooding and sedimentation, prolonging the life of infrastructure and reducing maintenance costs. With such interventions, by mid-century rapid runoff from storms could be reduced by between 9 percent and 18 percent and sedimentation reduced by 20 percent to 24 percent (for SSP3–7.0 and SSP1–1.9 climate scenarios, respectively).

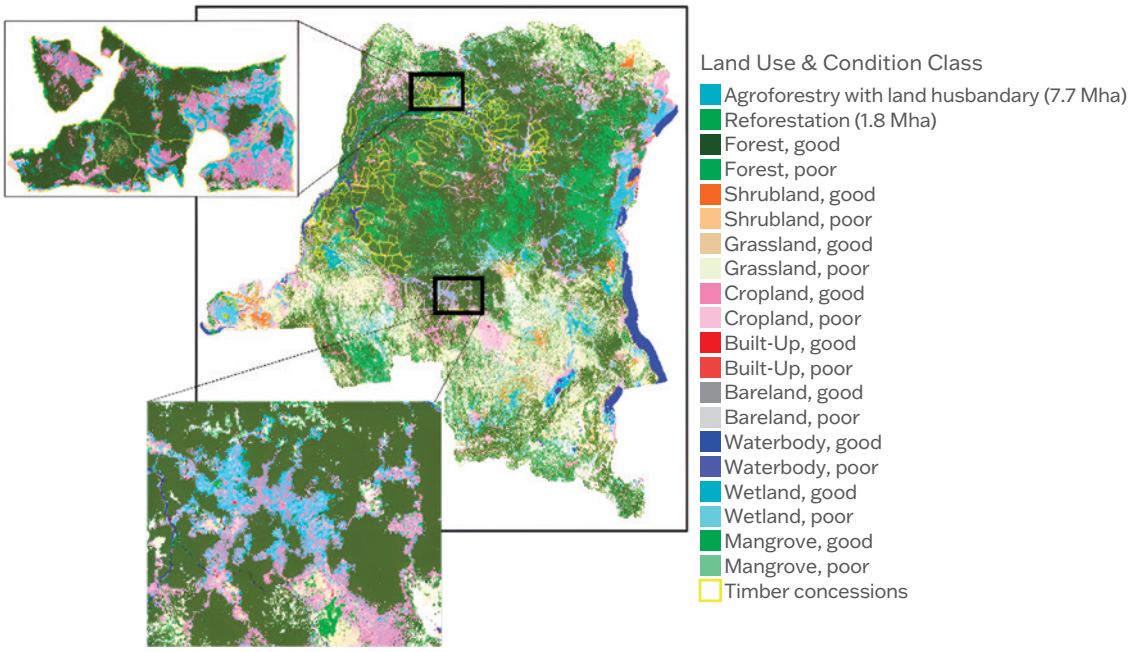
[172] 90th percentile of model ensembles; median 11 percent increase.

[173] 90th percentile of model ensembles; median 14 percent increase.

Sustainable forest restoration and landscapes conservation initiatives require extensive local engagement. Forests provide livelihoods for many of the 59 percent of DRC's population who are rural. Neglecting disadvantaged rural communities can complicate deforestation mitigation and cause knock-on effects that compound vulnerabilities. Excluding them from economic engagement in protected areas and failing to provide viable alternatives for agricultural land expansion and access to biomass for domestic energy use, can worsen their already precarious condition and compound their climate vulnerabilities. Any robust climate adaptation strategy must therefore include appropriate agroforestry options for landscape restoration that generate multiple livelihood and environmental benefits.

To ensure such benefits, DRC will need to invest in the sustainable management of existing concessions, restore degraded lands, and conserve standing forests (figure 3.13). Both the public and the private sectors need to be engaged in the implementation of integrated landscape management programs.

Figure 3.13: Spatial distribution of restoration priority areas in the REST 2030 scenario



Source: Bela Modelling Team, CCDR DRC in collaboration with European Space Agency-Climate Change Initiative
Note: Purple areas indicate the 7.7million ha recommended for agroforestry interventions on existing croplands and rangelands, and green areas indicate the 1.7million ha to be reforested/managed to meet the country's REDD+ commitment. Red and yellow are areas that need additional policy actions and forest protection enforcement to prevent further predicted deforestation by 2030 under BAU

Achieving the recommended aspirational landscape restoration investments for a restorative and integrated land management scenario will cost US$3.2 billion by 2030.[174] The public sector typically takes the lead in implementing integrated landscape mana gement. However, given DRC's fiscal constraints, it is crucial to engage the private sector and identify other sources of finance to support this work.

[174] This is based on an average per-hectare cost of US$336 for activities under the recently approved DRC Forest and Savanna Restoration Investment Program (P178642), which includes agroforestry, reforestation, landscape restoration and protection, and community forestry.

4 BRINGING IT TOGETHER: ECONOMIC IMPLICATIONS OF THE POLICY PACKAGES

Chapter 4: Bringing it together: economic implications of the policy packages

Addressing climate change impacts on DRC's economy and future development and strengthening resilience will require substantial investments in prime development sectors like infrastructure and human development. Using the Long-Term Growth Model Natural Resource Extension (LTGM-NR), this chapter builds on the sectoral analysis in chapter 3 to demonstrate the importance of climate change to DRC's development through economic impact assessments and, second, to help integrate related policy recommendations and priority actions into the DRC's development agenda. The emphasis is on the medium- to long-term, economy-wide effects of climate change, and the distributional welfare and social impacts. The chapter also examines fiscal sustainability challenges that constrain DRC's ability to make investments to build resilience.

The biophysical and economic modeling described in chapter 3 was used to estimate the impacts of climate change and the effectiveness of potential adaptation measures in forest, agriculture, water/hydropower, transport, and urban areas.[175] Although it was not feasible to model the impacts of climate change on all sectors, or examine several adaptation options and their costs for those sectors, the economic analysis considered estimated impacts on them via factors of production: labor, land, and capital; including shocks to productivity. The shocks caused by climate change through impact channel were calculated based on changes in climate variables for the 2021–2050 30-year period (the period covered in the CCDR), relative to a 1995–2020 climate baseline using a climate model ensemble analysis.[176]

4.1. Macroeconomic impacts of climate change and DRC's future growth

To understand the interplay of climate change and development and the impacts on the DRC economy, this CCDR selected four policy scenarios. The policy scenarios identified measures to build resilience in key sectors and nexus areas. The first scenario is *Business-As-Usual Development*, defines what the economy will look like leading up to 2050 if DRC continues a growth trajectory like the one observed in the recent decades. The second *Aspirational Development* incorporates the investments, programs and limited NDC policies envisioned. The third, the *Adaptation Scenario* includes proactive adaptation interventions that seek to reduce the negative effects of climate change experienced through a particular economic sector envisioned to fulfill DRC NDC and long-term climate-related vision goals. The fourth one is the *Resilience Scenario* that integrates the Aspirational Development and the Adaptation to Climate Change from main climate impact channels. A *business-as-usual* pathway was compared with the aspirational development scenario (faster growth given

[175] The LTGM-NR augments an otherwise standard neoclassical growth model (with capital, labor, and total factor productivity) with a natural resource sector. It is based on the Solow-Swan growth model, adapted to developing and emerging economies. It decomposes the economy into resource sectors (mining in the DRC) and non-resource sectors. It allows thus sector-specific calibration of key parameters, initial conditions, and exogenous future paths. It keeps track of the effects of discoveries of, and depletion of, natural resource reserves on growth, and estimates the effects of commodity price shocks on investment and long-term growth. Second, the model analyzes how standard growth fundamentals, like human capital, demographics, and productivity, affect growth in resource-rich economies. The model can thus track implications for gross domestic income and poverty. As the standard LTGM, the model is designed for simplicity (few sectors) and transparency (an easy-to-learn spreadsheet format without macros). It covers only the long-run supply side/productive side of the economy (not short-run demand). To analyze the economic impacts of climate change on DRC, the LTGM-NR has been augmented to include both existing channels—labor productivity and supply; agricultural total factor productivity; capital stock—and novel channels (mining prices and investment) through which climate may affect long-run growth.

[176] The analysis of all climate models in DRC depicted small variability in terms of average future precipitation changes. With the exception of impact channels for agriculture and roads/bridges, impact channels were analyzed using the ensemble mean of precipitation changes across all models. Road/bridges and agriculture were both analyzed using the 90th and 10th percentiles of the climate ensemble for all models to capture dry/wet extreme variability.

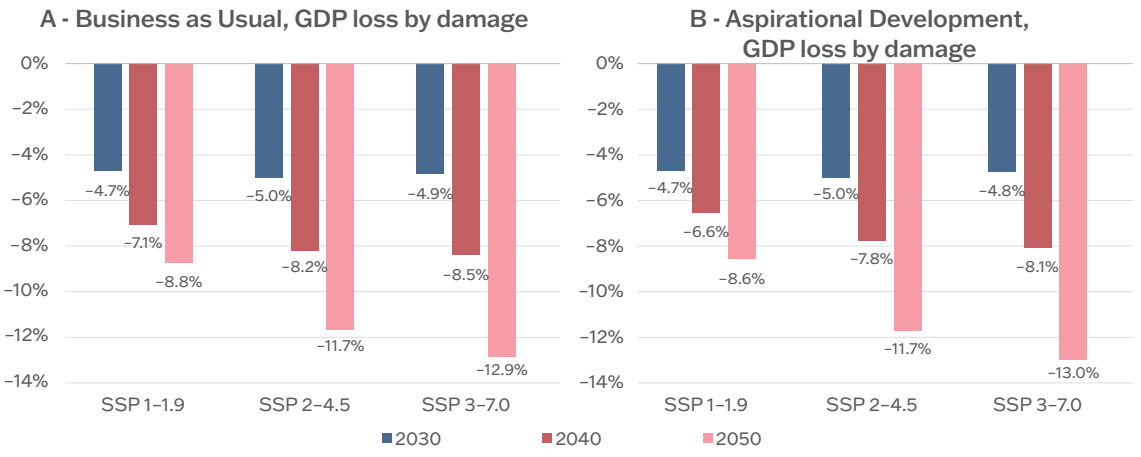
ambitious reforms supporting diversification and structural transformation[177]), as well as with and without the integration of adaptation actions. A development scenario that includes adaptation was analyzed to assess impacts under a resilience development scenario and fiscal capacity to adapt. The ambitious reform packages that support economic development through diversification and structural transformation are derived from the complementary growth analysis of the Country Economic Memorandum (CEM)—prepared in parallel to this analysis—, which could allow DRC to reach lower middle-income country status by 2050.

The economic and poverty impacts of climate-related shocks in DRC was analyzed using SSPs climate scenarios and policy packages. The modeling considered two growth pathways in DRC: a baseline scenario which assumes current trends will continue until 2050, and a development scenario which considers the ambitious economic reforms to productivity, human capital, investment, and workforce participation. The analysis does not fully reflect the extent of all possible damage pathways because some were modeled only partially because of the model's assumptions and limitations, and the lack of data to quantify longer-term damage infrastructure costs. The simulated damage (GDP loss) from climate change is thus only a first approximation and likely a lower-range boundary of the actual costs to the country.

4.1.1. Macroeconomic impacts of climate without adaptation

The model shows that climate change impacts could result in large GDP losses as high as about 13 percent without adapting to climate induced impacts. Overall GDP losses are assessed from all six damage channels combined in 2030, 2040, and 2050. Losses from climate change are measured as the percentage deviation of GDP under climate scenarios from its counterpart without climate change.[178] Results under baseline growth fundamentals, or business as usual (BAU) (for both climate scenarios and the counterpart) show that GDP losses from the combined channels under SSP3 are simulated at 4.9 percent in 2030, 8.5 percent in 2040 and as high as 12.9 percent in 2050 (figure 4.1; panel A).

Figure 4.1: GDP losses from climate change damage without adaptation: GDP under climate scenarios as % deviation from counterpart (baseline or development) without climate change, all damage channels combined



Source: World Bank modeling results

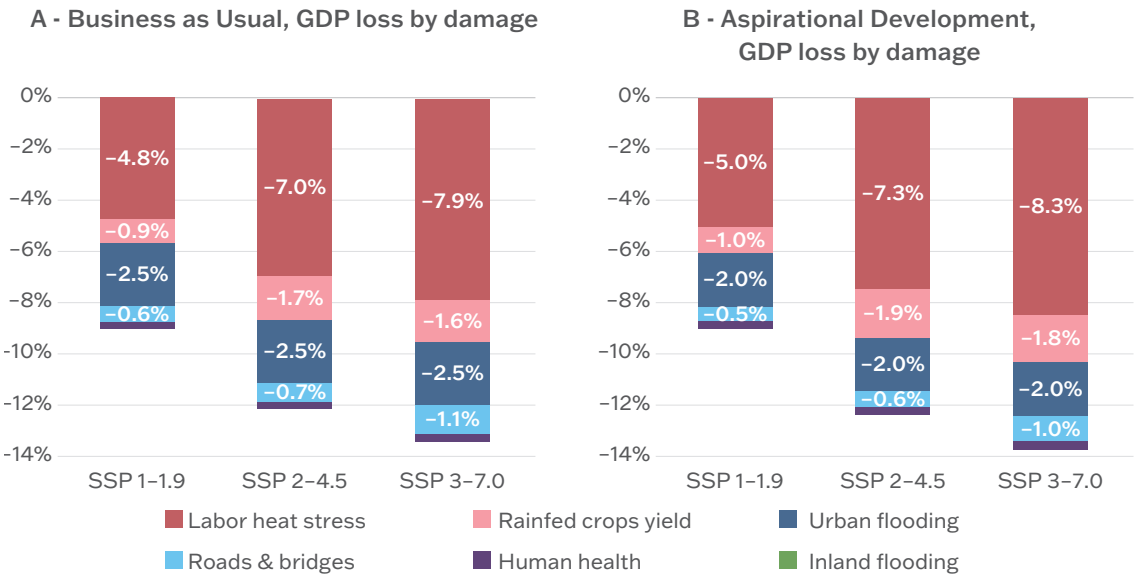
[177] The reforms target productivity, human capital, investment, and labor participation. They result in further diversification and *ad hoc* structural transformation.

[178] More specifically, $Loss_{BAU} = 100 \times \left(GDP_t^{BAU\_SSP} / GDP_t^{BAU} - 1\right)$ where $GDP_t^{BAU\_SSP}$ is GDP in period t under baseline growth and climate scenario SSP, and GDP_t^{BAU} is the baseline GDP without climate change.

When broken down by climate channels (figure 4.2; panel A) simulations show that labor heat stress is the most important shock, accounting for about two-thirds of total damage; followed by urban flooding, rainfed crops, and then roads and bridges. The damage to human health is minimal, assuming already low access to health and services, and inland flooding is insignificant at the macro level by 2050. Under the development scenario, losses are similar, with slight improvements in 2030 and 2040 (–4.8 percent in 2030, –8.1 percent in 2040 and –13 percent in 2050, under SSP3).[179]

Combined economic impacts conceal the wide diversity of climate disaster events. As discussed below, aspirational development through diversification raises the share of the labor-intensive non-mining sector, resulting in damage from labor heat stress that increase substantially with development, from 7.9 percent of GDP loss under the baseline to 8.3 percent under the aspirational development scenario (under SSP3). On the other hand, damages from urban flooding decline from 2.5 percent under the baseline to 2 percent under a development scenario assuming that inherent resilience is built in. These two changes roughly offset each other in the modeling exercise, resulting in total damage of similar magnitude across the growth scenarios.

Figure 4.2: Climate change impacts by damage channel, 2050: GDP under climate scenarios (SSPs), as % deviation from counterpart (baseline or development) without climate change



Source: World Bank modeling results

The impacts broken down by channel and estimated in the model are explained as follows:

» **The labor heat stress.** GDP losses from climate change arising from this channel are the highest, and they are further deepened under the development scenario, which is very specific to DRC's transition from a mining to a non-mining sector. Heat stress affects both indoor and outdoor workers, with a more significant impact on outdoor workers, potentially reducing their productivity by up to 20 percent, compared to 12 percent for indoor workers. Overall, under SSP2 and SSP3, DRC is estimated to face a 10 percent

[179] Analogously, $Loss_{AMB} = 100 \times \left(GDP_t^{AMB\_SSP} / GDP_t^{AMB} - 1\right)$ where $GDP_t^{AMB\_SSP}$ is GDP in period t under development growth and climate scenario SSP, and GDP_t^{AMB} is the development GDP without climate change.

reduction in labor productivity across all worker types by 2050. As a result, GDP losses due to labor heat stress range from 4.8 percent under the optimistic scenario (SSP1) to about 8.0 percent for the most pessimistic one (SSP3) under the BAU.

Economic development would reduce the impact of increased heat issues, but in two opposing ways:

(i) **Structural transformation (which attenuates the shock).**[180] Labor heat shocks vary by occupation, depending on physical activity and heat exposure. The agriculture workforce, largely outdoor, is particularly affected by heat stress. But development and structural transformation would reduce the share of employment in agriculture and, hence, the impact of labor heat stress on aggregate labor productivity.

(ii) **Diversification away from mining and labor intensity of production (which aggravates the shock).** This channel has two aspects. First, development accelerates diversification away from mining because the underlying economic reforms—such as total factor productivity, human capital, labor force participation—primarily benefit the non-mining sector.[181] Second, the non-mining sector is labor-intensive, and the mining sector is capital-intensive. As diversification accelerates with development, the economy becomes more labor-intensive,[182] intensifying the impact of the labor heat stress shock.

Under a development scenario, the overall impact of the labor heat shock will thus depend on the relative magnitude of these two channels. Quantitatively, the structural transformation channel is weaker because, in the DRC, where many other activities are undertaken outdoors, labor heat stress affects all sectors roughly similarly, with agriculture only marginally more affected.[183] In contrast, the labor intensity channel is quantitatively strong because diversification away from mining is more rapid under development, which increases the magnitude of the heat shock on total GDP by 7 percent relative to the baseline. Overall, the labor intensity channel is stronger, explaining why the scale of damage increases with development. But there are caveats. First, this result is specific to the DRC and may not hold beyond 2050 as diversification from mining slows but structural transformation continues. Second, this result relies on estimates that may not fully capture the total impact of heat on different sectors of the economy. Third, as analyzed below, this result would be reversed with an adaptation policy that expands the coverage of cooling measures.

A closer look at non-mining GDP strongly reflects the impact that development has on mitigating the negative effect of labor heat stress on GDP losses. When focusing on losses attributed to non-mining GDP, we find that losses proportional to non-mining GDP are higher than losses to overall GDP, reaching nearly 15 percent in 2050 (SSP3). This is because climate damage, especially labor heat stress, hits the non-mining sector particularly hard. This is problematic since the non-mining sector is DRC's main source of employment, income, and livelihood and is directly related to poverty rates. But notice that, at higher development levels, losses to non-mining GDP decline slightly. This is because only the structural transformation channel affects non-mining GDP, attenuating the heat shock in the development scenario.

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[180] The LTGM-NR has two sectors: mining and non-mining. The non-mining sector is not further disaggregated in the model, but conceptually it incorporates agriculture, non-mining manufacturing, and services. Structural transformation is defined as a fall in the share of employment in agriculture and a corresponding increase in services.

[181] Results show that in 2050 the share of mining in GDP under baseline (12.6 percent) is nearly twice the share under development (7 percent).

[182] Because mining is typically a highly capital- and technology-intensive activity, the LTMG-NR makes the simplifying assumption that there is only labor in the non-mining sector.

[183] For example, the labor heat shock is -11 percent in agriculture and −9 percent in services in 2050, under the SSP3 (Industrial Economics Incorporated (IEc), https://indecon.com).

- **Urban flooding.** Urban flooding slows GDP growth by reducing net investment because a portion of the investment serves only to replace urban capital destroyed by floods. The effect is weaker under the Development scenario because of higher investment rates, faster capital accumulation and diminishing returns in physical capital.[184] Thus, a reduction of investment caused by urban flooding has a stronger effect on the baseline owing to scarce physical capital relative to the Development scenario. As a result, when considering SSP3, GDP losses resulting from urban flooding are estimated at 2.5 percent under BAU while damage resulting under the development scenario is reduced to 2.0 percent.
- **Rainfed crops:** This shock is assessed by computing[185] crop-specific yield response functions to (i) rainfall and (ii) heat stress.[186] By 2050, GDP losses due to rainfed crop yield damage are estimated at 0.9 percent under SSP1–1.9 and 1.6 percent under SSP3–7.0. The results could be conservative because the combined negative impacts may be more significant through various additional channels not covered in this first CCDR analysis, such disease/pest incidence and geographical factors. In addition, the modeling does not account for the potential missed growth of developing supplemental irrigation for horticulture crops, which is extremely underdeveloped.
- **Roads and bridges:** Climate damage through roads and bridges shows a moderate impact on long-term growth, primarily through the increased maintenance costs of faster deterioration. The additional annual maintenance cost of US$600 million by 2050 is underestimated because the climate damage assessment methodology is applied to current infrastructure, but future growth will create more roads and bridges. If we adjust for this, we find that the additional cost could exceed US$2 billion by 2050 (1.2 percent of GDP).[187] As a result, additional maintenance costs reduce net investment in the LTGM. By 2050, this leads to a moderate decline in GDP relative to baseline of around –0.6 percent under SSP1-SSP2, and –1 percent under the SSP3, under BAU. Similar results are found under the development scenario.
- **Human health:** Malaria and other water-borne diseases account for nearly all major negative climate-related impacts on human health. However, the aggregate shock to labor supply is very small compared to a high baseline in the BAU scenario (less than 0.1 percent), resulting in a negligible impact on GDP. Estimates show small GDP losses due to this channel—0.2 percent under SSP1 and 0.3 percent under SSP3. Income is thus only slightly affected—less than 0.5 percent lower by 2050 than baseline.
- **Inland flooding:** Under SSP3, by 2050, the share of damaged infrastructure will be less than 0.1 percent of the total stock of capital. Thus, the estimated asset damage is minimal, with no impact on long-term growth. Additional knock-on effects such as increased risk of cholera outbreaks may worsen the impact of flooding, as large population segments lack climate-resilient water and sanitation services.

[184] The investment rate is 17 percent of GDP under baseline and 28 percent under development. In 2050, the capital to output ratio (inversely related to the marginal product of capital) is 2.8 under development and 2.4 under baseline.

[185] Methodology from IEc. Total agriculture is an average of crop-specific shocks weighted by revenue shares. Main commodities are cassava (52 percent of revenues), plantain (17 percent), and rice (5 percent), with plantain benefiting from climate change.

[186] Notably, the combined effects of drought and heat stress are typically higher and may be experienced more frequently together in the era of climate change. This CCDR was unable to use a full crop models attempt to factor in important dimensions such as intensity of exposure, rate of increase of stress, duration of stress, and stage of crop development (both stressors are known to be most impactful during the reproductive stages). We therefore wonder if the model used here could be underestimating the negative impacts of these combined effects—noting also that, as this paper describes, the effects of climate change are experienced through multiple additional channels that are not addressed, including disease incidence, pest incidence, and so on.

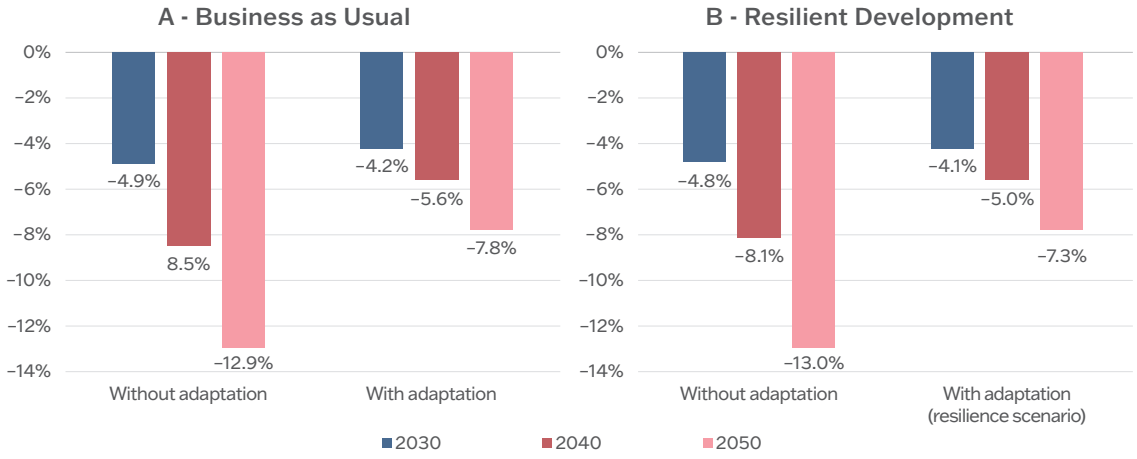
[187] The IEC estimate of US$600 million in annual maintenance cost considers that the capital stock (which includes infrastructure) will remain constant until 2050. In our projection, we assumed that this cost would increase in proportion to the capital stock. In the LTGM baseline, the capital stock will increase 3.5 times (US$130 billion in 2020 to US$460 billion in 2050). Hence, in 2050, the maintenance cost will reach about US$2 billion (3.5 x 600 million).

4.1.2. Adaptation is key to reducing economic damage[188]

As mentioned in chapter 2, DRC has limited quantification of climate sectoral policies and/or quantitative adaptation targets at the national level to be considered in the modelling exercise. This issue represented a major challenge for the analysis on how to quantify key policy packages. Thus, discrete climate adaptation options were identified and assessed directly within the economic LTGM-NR. The analysis confirms that adaptation can significantly reduce the damage from climate-related shocks. Adaptation policies are represented through higher public investment, more resilient infrastructure (better quality of roads and proper maintenance and urban planning), crop management, and higher cooling exposure for indoor workers.

Under a Business-as-Usual scenario, implementing adaptation actions can reduce climate damages by about 40 percent, from –12.9 percent to –7.8 percent (figure 4.3, panel A). Under a resilient scenario (adaptation plus development), the climate damage falls further with development, hitting –7.3 percent in 2050 under SSP3 (figure 4.3, panel B).

Figure 4.3: GDP losses from climate change under SSP3 with and without adaptation, as % deviation from counterpart (baseline or development) without climate change, 2030, 2040, and 2050



Source: World Bank modelling results

As anticipated in the discussion above, development through diversification and structural transformation shows opposing effects on different damage channels but estimates confirm that a resilient scenario coupling ambitious development reforms and adaptation has a positive, albeit quantitatively small, mitigating impact on GDP losses. This is possible because, in the adaptation scenario, the expansion of access to cooling benefits more workers in services (who work mostly indoors) than in agriculture (who work mostly outdoors). The adaptation policy generates heterogeneity in the impact of heat stress across sectors, which enhances the structural transformation channel enough to outrun the labor intensity channel. Finally, development becomes even more noticeable when the focus is on the non-mining GDP. In 2050 damage to non-mining GDP will nearly halve with adaptation, from –14.7 percent (under BAU, SSP3) to –8 percent in the resilience scenario (aspirational development with

[188] While adaptation is key, mitigation co-benefits is also important given DRC's commitment as a "solution country" (as highlighted in the next chapters).

adaptation, SSP3). Thus, policies aimed at better adapting to climate change—especially through building resilient infrastructure and improving labor conditions—are among the most promising strategies for successfully tackling climate change challenges.

Adaptation, which is critical to reducing climate damage, is most effective when targeted along three channels: labor heat stress, roads and bridges, and urban flooding.

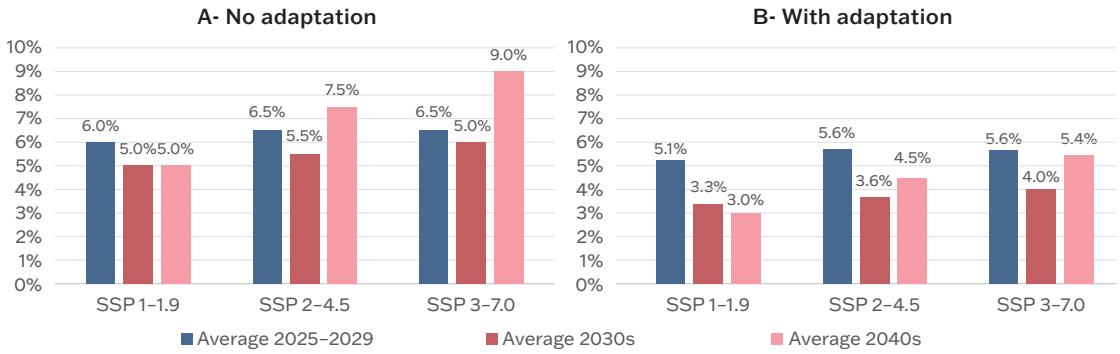
- **Labor heat stress:** Adaptation through cooling to dampen labor heat stress is the strongest of the three channels. An adaptation policy based on access to cooling leads to a moderate reduction in climate change damage by mitigating labor heat stress for indoor workers. One-third of DRC workers work indoors, but only 1.3 percent have access to cooling. Under BAU, GDP losses in 2050 resulting from labor heat stress decline significantly, from 8.3 percent without adaptation to 5.1 percent with adaptation, under SSP3. When adaptation is coupled with ambitious development reforms, hence considering the resilience scenario, damage to growth is almost halved, with GDP losses lowered to 4.7 percent, from 8.3 percent under the development scenario without adaptation with opposing forces.
- **Roads and bridges:** This channel is the only one that annuls the negative benefits when adaptation is considered. Under BAU, without adaptation, GDP losses from damage associated with this channel are around -0.6 percent of GDP under SSP1 and –1.1 percent under SSP3, by 2050. Under SSP3, these losses are completely offset with adaptation—0 percent in 2050. Similarly, adaptation in the resilient scenario also offsets all damage to nil, instead of an GDP loss of 1 percent under aspirational development alone (SSP3). Adaptation here includes climate-resilient repair and maintenance as well as construction. New, higher-quality road infrastructure is constructed to resist high temperatures, heavy precipitation, and future flooding events.
- **Urban flooding:** With adaptation investments, GDP damage associated with urban flooding almost halved. Under the baseline, GDP losses amount to about 2.5 percent in 2050, reduced to 1.4 percent with adaptation. When considering ambitious development, the damage is further mitigated, halving from 2 percent in 2050, with development alone without adaptation, to 1.1 percent when adaptation is considered, under the resilient scenario.

4.2. Fiscal considerations

To offset GDP losses from climate impacts and to build resilience, additional investments are needed. The fiscal cost[189] of climate change can also be measured indirectly as the required increase in public investment to offset climate damage to GDP. The analysis provides an initial assessment when all climate shocks are combined. When the adaptation scenario is compared to the baseline, the incremental investment required to offset the impact from climate change and match GDP growth is more important in the long run. Under the baseline, increasing GDP losses and diminishing returns to investment imply that by 2050 the required extra investment to offset climate change shocks could reach 9 percent of GDP under SSP3–7.0 (figure 4.4, Panel A). Results show this cost is substantial and increasingly large. However, investing today in adaptation policies aimed at building climate resilience would reduce by 40 percent the fiscal burden needed to address climate shock by 2050 (figure 4.4, panel B)—lowering the fiscal cost associated with higher investment to 5.4 percent under SSP3—and this prevails under all climate scenarios.

[189] The fiscal impacts are not based on aggregating the various sectoral investment needs mentioned in the previous section of Chapter 4 (given data limitations), but rather an induced estimate from the LTGM of the fiscal cost (in percentage of GDP) of reducing climate damage to zero.

Figure 4.4: Public investment needed to offset climate change damage: all climate shock channels combined, incremental investment, percent of GDP, period average



Source: World Bank modelling results

In monetary terms, public investments needed to partially offset climate change risks are estimated at around US$2.3 billion by 2030 and US$8.5 billion for 2030–2050 —**a cumulative total of at least US$10.9 billion by 2050**—mainly to build improved infrastructure (new and improved roads and bridges), create cooling options for positive health impacts on labor productivity, and reduce flooding risks to urban infrastructure and livelihoods. This amount spanning over 27 year (until 2050) is realistic[190] for the country and can be gathered through government spending for climate adaptation actions (through public investments), private investments, revenue generated from carbon markets, and international financing.

Developing the carbon market in DRC, with its 150 million ha of forest and large hydropower potential,[191] could help generate public revenue and ensure long-term fiscal sustainability, supported by public-private partnerships (PPPs), while also securing funds for greater investment in resilient programs and actions. Despite improvement in domestic revenue mobilization (reaching 15.3 percent of GDP in 2022 versus 11.3 percent in 2021), revenues are still insufficient to offset needed expenditure, thus shrinking the Government's fiscal space (despite a contained budget deficit estimated at 1.6 percent of GDP in 2022 against 0.5 percent in 2021). Chapter 5 presents further discussions on climate finance options for the forest sector.

According to the latest Debt Sustainability Analysis of June 2023, DRC's debt is sustainable, and the risk of external and public debt distress remains moderate, with substantial space to absorb shocks. Vulnerabilities stem from weak revenue mobilization and external commodity price shocks related to DRC's dependence on mining exports. Generally, all external debt is owed or guaranteed by the Government. With improved access to concessional external financing, external public debt-to-GDP decreased from 16.8 percent at the end of 2021 to 15.5 percent at the end of 2022, thanks to strong GDP growth, with about half of public external debt owed to official creditors. The present value of external debt, estimated at 11.7 percent of GDP in 2022, is significantly lower than the benchmark of 30 percent and reflects the extent of concessional debt, projected to remain broadly unchanged, given the prudent non-concessional borrowing limit (an FY22 and FY23 Sustainable Development Finance Policy PPA (Policy and Performance Action). Despite higher debt issuance resulting from the catalytic effect of the ECF arrangement and

[190] The country The Government, in collaboration with the IMF SDR has already planned a 3-year investment development programme over 145 territories estimated at US$1.66 billion from 2021–2023 (half financed by the government and half by the SDRs) for enhanced climate resilience. In addition, the public government could cover up to 2 percent of public funding for climate change actions from NDCs commitments. Additional finance will have to be secured through concessional finance, grants, and contributions from private sector.

[191] As part of the Global Climate Solutions approach.

the temporarily larger fiscal deficits reflecting higher investment needs, the medium-term trajectory of external and public debt, under the currently favorable medium-term growth outlook, does not give rise to debt sustainability concerns. In the long term, the debt should remain contained and expected to be able to absorb climate-related shocks.

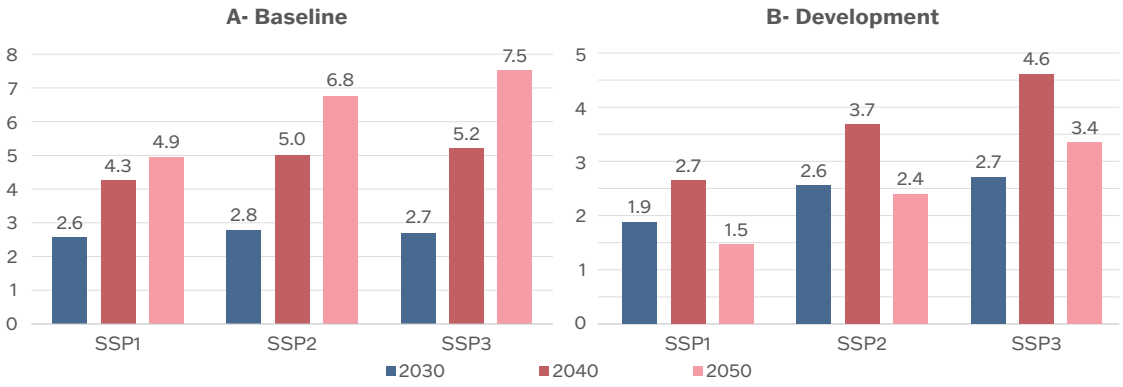
4.3. Implications for poverty, inequality, social outcomes

4.3.1. Increase in Poverty Headcount due to Climate Change

Without targeted adaptation measures, climate change impacts could push more people into poverty. Given the assumption of low resilience and low adaptation capacity among the poorest, climate damage could significantly increase poverty if it slows GDP growth (relative to the scenario without climate change). In 2050, under the baseline BAU scenario and SSP3, the poverty rate could increase by 7.5 percentage points over a baseline without climate change (figure 4.5, panel A). Under an aspirational development scenario, climate change's impact on poverty is smaller, with the poverty rate in 2050 about 3.4 percentage points above the scenario without climate damage (figure 4.5, panel B). The reason poverty is less affected by climate in the development scenario is that poverty strongly depends on non-mining GDP per capita, which is negatively related to climate damage.

Overall about 16 million additional people could be pushed into poverty under the BAU scenario and SSP3 (relative to a baseline without climate change), if no adaptation and no ambitious reforms are undertaken[192] (figure 4.6). This number can be reduced to 7 million people under an aspirational development scenario without targeted adaptation (relative to the development scenario without climate change) by 2050.

Figure 4.5: Poverty rate increase, (% of population), percentage point (ppts), difference between SSP scenarios and counterpart (baseline or development) without climate change



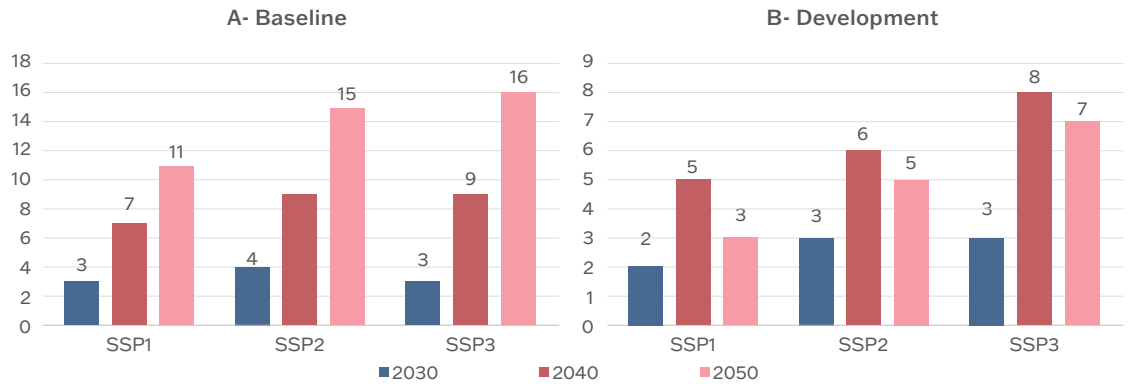
Source: World Bank modelling results

The top-five provinces most affected by increased heatwaves will impact 6.4 million poor who will have limited to no adaptation strategies, typically living in precarious shelters fully exposed to hot nights. The next two most attained provinces,

[192] In DRC, as of 2017/18, 58 million individuals are considered poor. Spatially, the largest share of the poor is in the capital (6.7 million), Sud-Kivu (3.5 million), Nord-Kivu (3.2 million), Tanganyika (2.8 million), and Kasai Central (2.7 million).

Kongo-Central and Kinshasa, will add another 9.6 million poor by 2050. Impacts from recurrent extreme floods will burden the 12.5 million poor living close to riverain structures in Tanganyika, Lualaba, Haut-Lomami, Haut-Katanga, Kongo Central.[193]

Figure 4.6: Poverty increase, millions of people, difference between SSP scenarios and a counterpart (baseline or development) without climate change



Source: World Bank modelling results

Higher temperatures would further deteriorate the learning environment in DRC. Heat and floods could have major negative impacts on the physical infrastructure of schools and on learning capacity. Education plays a vital role in escaping poverty. For households headed by someone with no education, the multidimensional poverty headcount is about 90 percent, and decreases sharply to 53 percent for households headed by someone with secondary or higher education. Alarming is the decline in school attendance among children ages 6–15, from 84 percent to 79.2 percent between 2014 and 2018. Improving the resilience of schools and creating better learning conditions with cooling measures is crucial to ensuring access to education, and thus to reducing poverty.

Around 5 percent of small enterprises in DRC will be affected disproportionately by higher temperatures. According to a 2019 enterprise census, DRC has over 620,000 enterprises. Almost 95 percent are micro-enterprises, 5 percent are small or medium, and less than 0.5 percent (131) are large enterprises. Almost 98 percent are informal, mainly in commerce (73 percent), manufacturing (10 percent), transport (5 percent) and finance (3 percent). The largest number of firms (185,000) are in the capital. With higher heat both night and day, 5 percent of firms in Kinshasa and Congo Central are likely to suffer disproportionately from exposure because they operate mainly.[194]

[193] As Sud-Kivu and Kinshasa are to expect some of the worst floods, with another 10.2million poor living in those provinces, will be furthermore exposed. Only the five provinces with the highest exposure to 100-year floods and tropical nights during the period 2040–2059 will attain 18.9 million poor. Since some of the most populous provinces—notably Kinshasa, Sud-Kivu, and Kongo-Central—are the next in line regarding worst impacts, an additional 13.6 million poor will be affected by some of the top-range climate change impacts.

[194] Among the top quintile of provinces witnessing the most prominent heat increases, a total of 1774 firms (not including informal MSMEs, are likely to be disproportionately hit (provinces with the highest heat increases have some of the lowest numbers of enterprises in the country). Yet, the next two worst hit provinces, Kinshasa and Kongo Central, total 230k of enterprises or 36 percent of all enterprises in the country. Among these, also close to five percent will be disproportionately hit due to their higher outside exposure with rising temperatures. Analysis was performed by the Poverty & Equity DRC Observatory Project.

4.3.2. Increase in Social Exclusion and Vulnerability

The social and economic costs of climate impacts disproportionately affecting the already marginalized in DRC are extensive and not fully quantified. If unaddressed, climate impacts will have other intangible but profound social and economic consequences. Approximately 700,000 to 2 million (1–3 percent) of DRC's population, indigenous communities, who are dependent on rainforest and biodiversity resources, face increased poverty due to droughts and heatwaves. They are shifting to an itinerant lifestyle, which increases the potential for conflict with other communities and complicates the process for land titles recognition. At the same time, indigenous people also hold valuable traditional knowledge and practices vital for climate mitigation and adaptation, with indigenous women playing a key role in preserving this traditional knowledge. Diminishing this cultural heritage as a resource for climate resilience would be an unquantified but profound loss in DRC's climate resilience development pathway.

The risk for climate change impact to drive further conflict in DRC would also have poverty impacts and social cost. Should the climate change conflict nexus play out, it would increase the numbers of those displaced, rates of gender-based violence, those suffering psychological trauma and loss of assets. All of this has poverty alleviation and social development consequences. There is a need to strengthen efforts to prevent and respond to GBV, particularly during periods of climatic stress, including the provision of GBV services, and launching community-based education and awareness-raising initiatives.

5 FINANCING CLIMATE-RESILIENT DEVELOPMENT

Chapter 5: Financing climate-resilient development

5.1. Financing the packages: the role of the Government

The government has engaged in an ambitious roadmap for sustainable development and NDC goals but is short of at least US$54.8 billion (estimated at around 88 percent of 2022 GDP) to finance these strategies by 2030.[195] For example, the government plans to invest in its hydropower installations and renewable energy infrastructure to improve energy access needs estimated at US$8.3 billion. This includes the installation/construction/renovation of hydropower plants (US$7.5 billion), the construction of 418 mini-grids (US$105 million until 2023) and high-priority rural electrification projects (US$671 million).

With limited local sources, access to international climate finance is vital. Banking credit is only 7 percent of GDP, and local capital market issuances are 0.5 percent of GDP. Additional mechanisms to mitigate the risk of investing in renewable energy are therefore required to raise local finance. Voluntary carbon markets could ultimately play a role in enhancing the bankability of renewable energy projects and in financing forest action. However, this will necessitate time and the establishment of a stronger regulatory framework for structuring, issuing, and exchanging carbon credits.

In the short term, DRC should work with the international community to properly value and protect the ecosystem services provided by its standing forests through the creation of an international fund. A first rough estimation sets the value of the global carbon sink services rendered by DRC's forests between US$40.3 billion and US$100 billion. A dedicated international fund could be created to mobilize external funding through grants or international climate tax. The proceeds could be used to protect DRC's forests and develop clean energy projects through large-scale de-risking instruments because the lack of access to energy is the main cause of deforestation.

5.1.1. Institutions and financial markets for socioeconomic transitions and impacts

The financial sector, mainly for structural reasons, is only marginally exposed to physical risks. The reasons for this limited physical exposure lie not only in the sector's low rates of inclusion and its use of short-term financing, but also (i) in the high geographical concentration of bank credit portfolios in regions less prone to natural disasters (Kinshasa and Haut-Katanga) and (ii) in the financial sector's low exposure to vulnerable sectors such as agriculture (2 percent of bank credit exposure as of December 2021).[196] The microfinance industry, despite a similar exposure to agriculture (3 percent at the end of 2019), appears more exposed to physical risks because of its important activity in areas regularly affected by natural disasters (figure 5.1). The client profile of microfinance institutions is also less shock-resilient because of their unstable livelihoods[197] and meager savings, especially farmers.

[195] Based on initial DRC NDC's own estimates.

[196] All these risks are currently transferred to offshore reinsurers that have a better appreciation of these risks.

[197] At the end of 2019, 75 percent of their clients worked in the trade sector. Central Bank of Congo, *Microfinance Sector Report 2019* (2021).

Exposure to transition risks appears more significant, especially for banks and insurance companies. The financial sector appears more exposed to transition risk, especially through credit or insurance provided to mining, cement manufacturing and oil[198] sectors. They are quite exposed to the mining sector (cobalt, copper, gold, and diamonds[199] and its value chain, which uses pollutants severely damaging the ecosystem and negatively impacts population health).[200] Some of these minerals like copper, and cobalt are however fundamental for the diffusion of carbon-reduction technologies. Regarding the forestry sector, financial institutions seem to have shied away from insuring/financing it because of the reputational risks associated with illegal logging.

The Central Bank of Congo (CBC) is developing its capacity on climate-related risks but still lacks a clear roadmap, action plan, and effective data collection. The bank has trained a small team on climate-related risks and has applied for NGFS membership. During a self-assessment it undertook to try to benefit from the Green Climate Fund's financing opportunities for central banks, several shortcomings emerged, including the lack of a dedicated climate change risk unit and the inclusion of climate change risks in monetary policy and banking supervision. The CBC also identified levers to accelerate DRC's plans to establish financial markets for carbon trading, enhance regulation for sustainable financing, and bolster regulatory capacity to develop the country's debt capital markets. These steps will enable greater participation from private sector issuers and domestic and foreign institutional investors. In the short term, the CBC should work with its partners to strengthen its data collection process and lay the groundwork for climate risk stress tests. These are required to qualify for, among other things, a Resilience and Sustainability Trust (RST) facility[201] and are necessary in the IMF Climate-PIMA process, in which DRC is interested. The data currently collected, particularly on sectoral and geographic exposures, seem inadequate for estimating the exposure of banks and microfinance to climate risks.

5.2. Mobilizing private investment for climate action

5.2.1. Climate finance options

Green finance awareness is currently minimal among local financial stakeholders, which leads them to take a cautious, opportunistic approach when evaluating projects. Green finance does not yet exist in DRC, nor is there a taxonomy defining green assets. Lacking a specific strategy, financial institutions therefore look at renewable energy deals with an opportunistic approach similar to regular loans. As DRC's energy sector has never been profitable and financially reliable, banks consider energy projects risky. Considering their average capitalization, financial institutions often demand a substantial credit track record and guarantees from energy start-ups, which frequently exceed the start-up's capability. Additionally, the local financial sector cites the absence of de-risking instruments as a major obstacle to investing in renewable energy infrastructure. Regarding reforestation and biodiversity projects that generate revenue from carbon/biodiversity credits, the financial sector has not yet been approached to finance them.

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[198] Banks and insurance mainly finance traders and distributers. DRC has a small oil production of only 7.5 mm barils/ year vs 1.1 mm/day for Angola. Central Bank of Congo, *Bulletin D'informations Statistiques Decembre 2022*, Statistical Bulletin, December 2022, https://www.bcc.cd/publications/bulletin-de-statistiques/bulletin-dinformations-statistiques-decembre-2022.

[199] The DRC has no coal mines.

[200] A. Muimba-Kankolongo et al., "Impacts of Trace Metals Pollution of Water, Food Crops, and Ambient Air on Population Health in Zambia and the DR Congo," Journal of Environmental and Public Health 2022 (July): 4515115, doi: 10.1155/2022/4515115.

[201] The IMF's Resilience and Sustainability Trust (https://www.imf.org/en/Topics/Resilience-and-Sustainability-Trust) helps low-income countries build resilience against external shocks and ensure sustainable growth.

Box 5.1: Developing the local financial sector and MSME finance are among preconditions to developing climate finance.

The financing needs for MSMEs remain largely unmet, as 62 percent reported having unmet credit needs in 2022. Recent diagnostics conducted by the IMF and the World Bank, including the 2022 Financial Sector Assessment Program, identified the limitations and vulnerabilities preventing the financial sector to further develop. These include (i) the quality of the banking system's capital base, (ii) the strong asymmetry of information on credit; (iii) the difficulty in evaluating nonperforming loans; (iv) the lack of credit risk-sharing mechanisms, and (v) the ineffectiveness of insolvency and debt resolution mechanisms. However, several projects and technical assistance from the World Bank and the IMF are ongoing to address some of these challenges. The World Bank Project TRANSFORM for instance has a component on access to finance for MSMEs and intends to (i) improve the credit reporting system and finance movables collateral registry, and (ii) increase availability of credit and risk-tolerance for private financial institutions by providing a partial credit guarantee (PCG). Since these credit infrastructures develop over time, financial institutions will have more incentives to support MSMEs' efforts to build resilience and adapt to climate risk; they could also be leveraged to serve small renewable energy/off-grid firms.

The domestic banking sector has limited capacity. The informal sector represents over 90 percent of DRC's economy and financial inclusion is limited —only 26 percent of the active population even have a bank account. Banks, which hold approximately 97 percent of the financial sector's assets—microfinance institutions hold 3 percent—are highly liquid but contribute minimally to the economy. Credit to the private sector represented only 7 percent of GDP at end-2021, compared to 38 percent for the SSA region in 2020. Moreover, the maturities offered are essentially short-term. The IMF has identified several vulnerabilities, including low capital adequacy (12.1 percent aggregated as of December 2021), a potential overestimation of credit quality (6 percent ratio of non-performing loans to total gross loans for the sector as of December 2021) and a highly dollarized economy (96 percent of total credits and 85 percent of total deposits are in foreign exchange). These vulnerabilities weaken banks' resilience to absorb economic shocks resulting from natural disasters and hinder their ability to invest in long-term infrastructure. Developing capital markets becomes pivotal for funding climate-related investments. Initiatives such as the credit guarantee fund are underway to de-risk bank lending to small businesses.

Local capital markets require structural reforms. To date, the capital markets have been used primarily by the Government to issue short- and medium-term bonds (12- and 24-month—bonds are only 0.5 percent of GDP) and by a limited number of companies to release commercial paper. However, trading volumes remain limited. Maturing this market is essential for issuing and exchanging climate finance instruments such as green and blue bonds, which are two of DRC's two main options for funding its climate finance needs. Attracting international investors to engage with these instruments requires macroeconomic stability, a well-developed banking system, and a robust legal environment. In the short term, this means strengthening the regulatory and supervisory framework for capital markets. It also entails establishing either a dedicated supervision team within the central bank or, over time, a dedicated capital markets supervisor.

Foreign direct investment will be an important part of the financing mix. DRC's updated NDC from 2021 raised the country's GHG emissions reduction targets to 21 percent by 2030. Of this, 19 percent will be conditional on external financing, while only 2 percent is planned

to be financed by domestic resources. The external component will rely in part on foreign direct investment, which to date has been heavily concentrated in DRC's extractives sector. The renewable energy sector, notably off-grid and distributed energy solutions, is emerging as an attractive area for foreign investment in DRC, with potential to expand these activities and leverage positive demonstration effects to mobilize foreign private capital for climate action in other areas.

De-risking instruments for green infrastructure investment are crucial. The Government, donors, and their partners should create an enabling environment for project developers, streamlining their operations and enhancing their creditworthiness, particularly through concessional instruments. Sectoral ministries should work with the private sector on reforms that could facilitate private sector operations and develop a systematic approach to the public sector's use of concessional finance (equity, guarantees, concessionary loans, and carbon credits) to facilitate private sector profitability. Some instruments have already been identified by the Government, such as the Mwinda Fund, which should be expanded with donor support to facilitate private sector operations. Donors should also consider setting up a de-risking instrument that offers the financial sector partial credit guarantees against its commitment to reduce collateral requirements for climate- and energy-related investments. Such enablers would strengthen the credit profile of renewable energy companies and attract bank funding.

The role of sovereign financial instruments is central. Regardless of the stage of development of local financial markets, a first sovereign green eurobond issuance would likely attract international interest and raise awareness among local actors. Given the investment needs and limited local capacities, DRC should take steps to position the country in the green bond market to attract offshore funding. In the short term, the Government could use the International Capital Market Association (ICMA) framework to issue a eurobond or a local green bond to which local commercial banks could subscribe to fund selected renewable energy projects. This approach would also serve to raise awareness among local actors and international investors about such opportunities. It would require identifying a pipeline of priority climate investment projects. In the medium term, issuance of forest bonds[202] or blue bonds for mangroves could also be envisioned. Debt-for-nature swaps do not appear to be an appropriate solution at this stage given the amount and structure of DRC's public debt, which includes a substantial portion held by creditors unlikely to engage in such instruments.

Development of a national green bank: DRC's government is setting up a new national development bank, which could address market failures in green finance. It is important that the design and roll out build on lessons learned and international good practices to avoid crowding-out private finance.[203]

The development of voluntary carbon markets (VCMs) offers promising avenues for the country in the medium term. By leveraging VCMs, the DRC could fund conservation projects and pre-finance renewable energy projects, increasing their bankability. On the forest conservation side, REDD+ initiatives could help absorb up to 190 million tCO_2 per year, which under the Government's proposed 50–50 benefit-sharing model with private sponsors, could generate annual revenue between US$135 million and US$400 million. It is important to note that these estimates are based on prices in the voluntary market (carbon

[202] With forest bonds, investors are paid in cash or carbon credit coupons or a combination of the two.

[203] Eva Gutierrez and Tatsiana Kliatskova, *National Development Financial Institutions: Trends, Crisis Response Activities, and Lessons Learned* (Washington, DC: World Bank, 2021), https://doi.org/10.1596/36467.

prices in the US$5–15/ton range), which is significantly lower than the carbon shadow price used to value carbon offsets. Fetching higher prices is imperative, but this can happen only by developing adequate compliance mechanisms while improving governance, which remains the major obstacle to VCMs. DRC's electrification with renewable energy sources could potentially reduce deforestation and fossil fuel usage, thereby meeting the additional criteria for issuing carbon credits. With a hydropower potential estimated at 100 GW, these projects could generate more than US$1.3/$tCO_2$ per year[204] from carbon credits.

Unlocking this source of funding requires a more transparent policy and regulatory framework and institutional capacity for carbon credit project structuring, issuance, exchange, and revenue utilization. So far, only five transactions have issued carbon credits and the time required from project development to crediting takes years (Box 5.2). A challenging aspect of REDD+ carbon credits lies in establishing the baseline to meet the additionality criteria as to what would have happened without the carbon project. Leakage is another concern because the zoning for REDD+ can unintentionally promote deforestation outside designated areas. Adopting a jurisdictional approach at the province level for REDD+ activities, as has been done in Mai-Ndombe province, would address those issues. Existing experience and new prospective projects using results-based climate finance in the forest and energy sectors can generate new sources of finance while enhancing the technical know-how and infrastructure for increased VCM engagement. However, significant capacity strengthening efforts are needed to fully leverage these opportunities.[205]

Box 5.2: Voluntary carbon markets in DRC: issuances

In DRC, the two main verifiers or standards Verra and Gold Standard have together registered 30 projectts on REDD+ and on renewable energy, but only five of them have effectively issued carbon credits.

Number of projects	Under development	Under validation/ Listed	Design certified*	Registered/ certified	Rejected	Total	Out of which issued carbon credits	Estimation of annual carbon credits (CC) issuances in US$ by projects currently issuing CCs
Energy projects	*1*	*9*	*7*	*4*	*0*	*22*	*2*	*US$0.5 million***
Agriculture Forestry and Other Land Use	*1*	*3*		*3*	*1*	*8*	*3*	*US$62 million****

Notes: REDD activities are less developed than renewable energy projects in DRC. The amounts of carbon credits issued for both remains small and well below the amounts needed to finance climate needs and preserve standing forests. Only one project (in Mai-Ndombe) has successfully issued and sold carbon credits through DRC's regulatory process. Because of weak governance and centralization until at least 2022,[206] several private initiatives have been spotlighted by media for important governance issues , creating a significant reputational risk.
**Only applies to Gold Standard projects; **with a price of US$5 per carbon credit; ***with a price of US$10 per carbon credit*
Source: World Bank with Verra and Gold Standard public registries.

[204] This is assuming that carbon credits have a minimum conservative value of US$5/$tCO_2$ and that installations are running 2800 hours in a year.

[205] The World Bank's new Forest and Savanna Restoration Investment Program includes a substantial capacity-building component to enhance national-level MRV systems and capacities, and to develop a more coherent policy and regularly framework for carbon crediting and VCM engagement. It also aims to facilitate additional results-based climate/carbon finance, including through new instruments such as the Bank's SCALE trust fund.

[206] Among these private initiatives, one firm has managed to issue carbon credits despite bypassing regulatory procedures while another has been denied (by Verra) the right to issue credits due to the total absence of benefits and right access for local communities to the project areas. On the first, see "The jungles of Congo, irregularly in European hands," The Limited Times, March 3, 2022, https://newsrnd.com/news/2022-03-03-the-jungles-of-congo--irregularly-in-european-hands.rkl3n52ax9.html, reporting that, in 2020, an area of DRC forest the size of Belgium, which partly overlapped with indigenous lands, was reassigned to the Lichtenstein-registered Norsudtimber group, which proceeded to convert the concessions, without public consultation, into projects for the sale of carbon credits.

DRC has not benefited from carbon credit revenues because of the absence of a centralized process for authorizing conservation projects and missed tax collections on carbon credits issued by undeclared projects. The Ministry of Environment's attempt in 2018 to regulate this market lacked and implementation measures and completeness, focusing only on carbon forestry. A second bill, passed in February 2022 under the World Bank's Development Policy Operation, set out the creation of a carbon market authority and a carbon tax, but this initiative needs to be shared with the relevant sectoral ministries, and a detailed strategy should be drawn up to ensure their effectiveness. An organized exchange with trading rules and a data infrastructure to allow for the centralization of projects and reporting would also support this market. The level of the carbon tax and its tax base (on carbon credits or project revenues) should be determined to continue to incentivize the private sector to use this instrument. DRC could also explore transacting REDD+ carbon credits with other countries under article 6 of the Paris Agreement, which allows NBS. Despite efforts to strengthen the standards for the VCM,[207] ultimately, the DRC market depends on the preferences of buyers in advanced countries and any regulations they might be subjected to.

5.2.2. Valuing natural capital to foster DRC's development

DRC's forests and ecosystems render sizeable global services. There is an opportunity for DRC to value its natural capital to raise funding for both the protection of its standing forests and its socioeconomic development needs. As stated in chapter 3, the stock value of DRC's 143 million hectares of standing forest is estimated at up to US$6.4 trillion, with an annual rental value of up to US$383 billion at a 6 percent discount rate. The annual value of the DRC forest's carbon and associated ecosystem services is estimated at between US$223 to 398 billion per year. While forest exploitation may generate revenues in the short-term, it results in the permanent loss of carbon sequestration capacity, a resource that is highly valuable but not yet priced.

In this context, the international community has a critical role to play to complement private sector funding and value DRC's ecosystems services, which are a global public good. The COP26 pledged US$19 billion in public and private funds to favor the role of forests in carbon capturing and storing. The Congo Basin Pledge also promised US$1.5 billion in financing between 2022–2025 to protect and maintain the Congo Basin forests. Other sources of funding such as international taxation of carbon-intensive activities, could be explored.

The proceeds from payments for DRC's ecosystems services could be placed within a dedicated fund, to catalyze private investments through blended finance initiatives. Such activities could include de-risking large-scale energy infrastructure projects to attract private investment in urban and peri-urban areas, supporting the expansion of clean cooking solutions and mini-grids near national parks, and facilitating REDD+ activities. Such a fund should (i) provide support to communities as they engage in REDD+ through payment for environmental services deliverable upon MRV; and (ii) facilitate access to credit from financial institutions for small and medium enterprises (SMEs) willing to engage in REDD+. Finally, the fund could help the Government enforce the protection of national parks through grants using a result-based approach.

[207] For more on the VCM, refer to the Core Carbon Principles (CCPs), a global benchmark for high-integrity carbon credits that sets rigorous thresholds on disclosure and sustainable development. The CCPs were issued in March 2023 by the Integrity Council for the Voluntary Carbon Market (https://icvcm.org).

The credibility of such a fund to collect grant-based payments for ecosystem services hinges on its governance, as discussed in chapter 2. DRC would need to increase the readiness of its governance to access additional innovative financial mechanisms. The solution adopted should comply with several core principles aiming to ensure the financial and operational transparency of the activities funded, especially where government agencies are involved. Such a fund could build on previous and ongoing regional initiatives, such as such as Congo Basin Forest Fund (CBFF) and the Central African Forest Initiative (CAFI). Pre-requisites for mobilizing this fund include (i) implementing the land reform bill currently being examined by DRC, and which would allow the acknowledgment of customary rights to facilitate REDD+ activities; (ii) strengthening national parks and biodiversity protection through ICCN policies and cooperation with nongovernmental organizations (NGOs) and the private sector through PPPs; (iii) establishing a carbon market agency with high standards of integrity; and (iv) enforcing actions against illegal deforestation and wildlife trafficking, backed by a robust MRV system.

5.2.3. Financing post disaster recovery

DRC has suffered more than US$44 billion in losses since 1952 from damage caused by climate related impacts.[208] Estimating the funding gap in the absence of a national database on natural disasters and disaster-related damage, losses, and expenditures is challenging, if not impossible. In addition to natural disasters, DRC faces one of the highest rates of population displacements in Africa and should consider emergent risk-finance approaches to displacement. The Stabilization and Recovery in Eastern DRC project[209] plans to support a risk-responsive scale-up of project component activities via a pre-financed component, a Conflict Crisis Response Mechanism,[210] which is inspired by the highly successful Displacement Crisis Response mechanism set-up in Uganda to respond to the displacement impact on both refugee and host communities' access to public services.[211]

DRC does not presently have risk finance mechanisms and instruments. The Government currently retains all financial risks related to natural disasters and absorbs the cost of all emergency response in the budget line dedicated to exceptional expenses on own resource of the Humanitarian Actions and National Solidarity (HANS) Ministry (US$36.6 million in 2023), with access to the budget reserve (US$43.9 million in 2023) if necessary. DRC does not have contingency credit lines or increased taxation plans to help with reconstruction, which is covered in the budget of whatever sectoral ministry is designated by the Government.[212] Some mechanisms for ex ante funding of infrastructure exposure to climate risks[213]—including a specific MAAH budget allocation for disaster risks, and planned CSNGHC strategic resource mobilization plan and coverage for the costs of natural disaster damage—seem to be developed- but detail expenses and recipients remains difficult to track. There is no comprehensive publication of the financial costs of impacts from natural disaster events.

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[208] EM-Database, The International Disaster Database, 1952–2022, https://www.emdat.be.

[209] *DRC, Projet de Stabilisation et Relèvement de l'Est (Stakeholder Engagement Plan: Stabilization and Recovery in Eastern DRC)*, Washington DC: World Bank, 2021), https://documents1.worldbank.org/curated/en/099231511252113309/pdf/Stakeholder0En0stern0DRC000P175834.pdf.

[210] Bernard Harborne, *Concept Project Information Document: Stabilization and Recovery in Eastern DRC* (Washington, DC: World Bank, 2021), http://documents.worldbank.org/curated/en/780401610097427703/Concept-Project-Information-Document-PID-Stabilization-and-Recovery-in-Eastern-DRC-P175834.

[211] Property insurance against fires is mandatory in DRC, but the lack of control of the insurance process by authorities prevents widespread subscription.

[212] That includes public buildings and infrastructure which are currently not insured.

[213] IMF, Democratic Republic of the Congo: Technical Assistance Report on Public Investment Management Assessment - January 30, 2023, https://www.imf.org/en/Publications/CR/Issues/2023/01/30/Democratic-Republic-of-the-Congo-Technical-Assistance-Report-Public-Investment-Management-528748.

International assistance, therefore, plays a significant role in emergency response financing. As per the Office for the Coordination of Humanitarian Affairs (OCHA), total humanitarian expenditures amounted to US$1.06billion in 2022 (out of US$1.89 billion required).

Since most Southern African countries have developed disaster risk finance strategies, DRC could rely on regional efforts to address disaster risk finance. Angola, Namibia, and Zimbabwe are finalizing disaster risk finance diagnostics, and several Southern Africa Development Community (SADC) countries—Madagascar, Malawi, and Mozambique, for instance—have disaster risk finance strategies and instruments available. Relying on regional financial instruments and capacity would allow DRC to acquire the capacity more rapidly to be financially prepared for disasters.

Uptake of non-life insurance products is low in DRC, and the sector lacks specific products to cover climate risks which hinders risk transfer. The insurance sector was liberalized in 2016, and the number of companies is growing, but penetration is still low (0.4 percent of GDP in 2023 vs. 3 percent in Africa). The non-life sector represents 97 percent of the premia of the US$226 million collected in 2021. Insurance against natural disasters is bundled with fire insurance and remains largely subscribed by companies. While parametric insurance, micro-insurance and agriculture insurance are not yet authorized in the country, regulatory changes are being reconsidered, but their adoption will be challenging given their affordability, complexity, and distribution costs. Insurance companies' partnership with banks should be extended to microfinance institutions that serve vulnerable populations. DRC needs to develop a readiness roadmap to facilitate and ensure its low carbon development goals. The roadmap should consider the following guidelines:

- **Mobilization of private finance for climate action to include** building frameworks for accessing international carbon markets (Article 6 of the Paris Agreement); supporting the financing of green investments locally; and considering the issuance of a sovereign green bond.
- **Valuation of natural capital to foster DRC's socioeconomic development** by considering setting up a dedicated fund and requesting ecosystem services payments from the international community for the services rendered by DRC's standing forests; and developing a strong governance framework for the fund itself and for the activities financed to ensure credibility.
- **Disaster Risk Finance engagement and support to the Ministry of Finance:** Review the legal standing of existing risk financing instruments; conduct a public expenditure review of disaster-related expenditures in DRC to better understand the scope and breath of expenditures for emergency response, recovery and reconstruction; explore regional initiatives to strengthen disaster risk finance; creation internal guidelines on a climate budget tagging system to identify and tag climate mitigation and adaptation expenditures, specifically, disaster response expenditures; and the drafting and adopting a National Disaster Risk Finance Policy to lay out the financing instruments the Government can use to finance disaster response, and the delivery channels.

6 CONCLUSIONS AND PRIORITIES FOR ACTION

Chapter 6: Conclusions and Priorities for Action

Based on the analytical assessment of this report, climate change is already impacting DRC's economy and social development and will continue to. These findings underscore the critical importance of adaptation investments for DRC's development, resilience, and sustainability. Pursuing the implementation of DRC's NAPA and the NDS can accelerate growth and reduce poverty, while making the country more resilient against climate change impacts. It is also important for DRC to mainstream climate resilience and opportunities for low-carbon development in all national and subnational development plans and policies. This requires doing things differently and doing different things urgently.

6.1. Key areas and policy actions

DRC needs a wide array of investments and policy packages to build resilience, but it also needs to prioritize measures, recognizing the country's fiscal constraints and low institutional capacities. Chapters 2–5 identified a range of issues as well as interventions DRC will need to make to meet its development goals with a changing climate. Policies aimed at better adapting to climate change, mostly through building resilient infrastructure and improving labor conditions, are among the main stepping-stones to tackling climate change challenges. This CCDR sheds light on fundamental challenges and implementation options for climate-smart development related to the following primary areas of action:

Action Area 1: Underpin the vision of DRC as a climate "solutions country" through climate smart mining, hydropower development, the preservation of forests, and integrated landscape management

With half of Africa's forests and water resources and trillion-dollar mineral reserves, DRC has a unique regional and global role to play in the world's climate future. However, to ensure that DRC's natural resources can help build resilience and sustainable development while serving as a public good, the country must augment its capacity to manage the harmful interplay between climate change, mineral exploitation, conflict, and ecosystem degradation, with its impacts on agricultural productivity, food security, and rural livelihoods. Without adequate stewardship of resources, together with sound governance, smart growth choices, and effective resolution of conflict and insecurity, this unique regional and global role is at risk. Indeed, DRC's growth path must be set against this backdrop of immense opportunities and grave challenges.

Climate-smart mining

DRC could significantly benefit from the global energy transition by capitalizing on the potential of its mineral value chain. As highlighted in the modeling section, faster growth through structural transformation and value addition has a positive impact on alleviating damage from climate change, while generating foreign exchange, fiscal revenue, local procurement, and jobs. Furthermore, investing in DRC's ability to seize mineral value chain opportunities aligns with the Paris Agreement, enhancing DRC's contribution to global decarbonization. The World Bank Group is uniquely positioned to support the following mining reforms:

» **Increase DRC's supply-response capabilities.** A necessary step toward achieving this is to enhance the knowledge of the country's geological characteristics. This will need to be complemented by sectoral governance reforms to strengthen public financial

management. IFC/MIGA support would also be important to catalyze private sector investments not only in critical minerals, such as cobalt, but in other minerals such as gold, which generates significant fiscal revenue for host countries.

- **Support investments in renewable energy to decarbonize value chains, achieve the country's NDCs, and alleviate rural energy poverty.** The growth of an energy-intensive mining, smelting, refining and value addition sector, accompanied by renewable energy generation and storage investments in rural communities, can achieve multiple development objectives, including freeing up existing generation and transmission capacity for other sectors of the economy. This agenda item combines governance and budgetary reforms with direct state and private sector investments in critical energy infrastructure.
- **Support value addition beyond mining.** Both mining and manufacturing companies are increasingly moving vertically along the value chain. This, together with the global demand for diversified and resilient supply chains, creates opportunities in DRC for increased economic diversification and value addition. Improved regional trade infrastructure (hard and soft) would permit the adoption of an integrated value chain approach—starting in DRC but spanning several countries in the region—that makes it possible to combine a number of mineral products and intermediate manufactured products into a final value-added product.[214]
- **Invest heavily in human capital formation** to meet the rising demand for skilled workers across the value chain. This would equip DRC with the workforce it needs (from fresh university graduates to skilled tradespeople) to support its growing mining industry, capture the benefits of value addition, and take advantage of new economic trade corridors. It would also promote job creation, reduce recruitment for armed conflicts and illegal activities, and enhance the incentives for sustainable, green development.
- **Strengthen governance, mining-impacted communities, and environmental stewardship to pursue green development.** Automobile manufacturers such as Tesla, Mercedes Benz and others are currently all concerned about their Environmental, Social and Governance (ESG) credentials and need solutions several of which are in the form of products produced in DRC. DRC should thus prioritize green minerals due diligence and certification schemes and enhance the livelihoods of small-scale artisanal miners. Improved governance, transparency, and environmental stewardship will help ensure inclusive benefits for all Congolese citizens within a context of sustainability and ultimately reduce conflict and violence.

Preserving DRC's forests and integrated landscape management

While diversifying its economy, DRC urgently needs to stem and reverse land degradation and forest loss to build climate resilience and enhance productivity. Healthy forests and other natural landscapes, by absorbing large amounts of water, can reduce flood and landslide risks and soil erosion. As highlighted in section 3, investing now in integrated approaches to restoring forests and riparian area ecosystem services could lead to significantly higher resilience and economic benefits by 2050, including the monetization of forest ecosystem services. Land restoration activities need to start now because the benefits accumulate gradually over time.

[214] The lithium-ion battery value chain uses lithium, copper, manganese, cobalt, nickel, and titanium, all six of which are abundant in Africa. It is foreseeable that the South African Development Community (SADC) countries could collaborate to create a complete value chain that leverages existing manufacturing capacities while simultaneously developing and consolidating new capacities. Value addition opportunities exist for iron ore and aluminum in West Africa and for hydrogen in South Africa.

DRC also needs to reduce the enormous pressure on its forests from the collection of firewood and the production of charcoal. This requires accelerating the transition to clean, efficient cookstoves and scaling up forest management certification schemes. The reduction in air pollution will bring health benefits particularly to women and children and address a leading cause of premature death. Land restoration investments, which create opportunities for carbon credits, will require targeting investments to the watershed to optimize carbon capture. Analysis done for this CCDR shows that the potential value of additional carbon sequestered that could be linked to the voluntary carbon markets is in the US$540 million–US$2.7 billion per year range (for prices per ton of carbon in the US$3–15 range). Besides stronger legal and institutional frameworks to support climate financing—including establishing MRV systems for climate and carbon finance—DRC needs to revise its management guidelines to better target land restoration activities under the Bonn Challenge, to increase carbon capture.

To create much-needed fiscal space, DRC needs to develop its secondary market to increase revenues from the carbon market. The Government could develop a VCM by (i) designing a climate finance strategy to explore the role of VCMs in meeting climate finance needs; and (ii) establishing a clear framework for the VCM with defined process, rules, guidelines, and recognized methodologies and standards, ensuring project transparency and tax-related information disclosure. To ease green financing investments, the Government could define (i) a more systematic approach to upscaling renewable energy and conservation projects and (ii) the supporting role of a National Development Bank (expected to be created in 2023) in financing these initiatives. Partner countries could also contribute to this fund and possibly be remunerated with carbon credits they can use to offset their own emissions. Finally, the central bank, development agencies, and donors could train the Credit and Risk staff of commercial banks and build awareness among them about green finance topics.

Hydropower

DRC's unique hydropower resources could provide large, competitive, and flexible sources of renewable energy nationally and regionally. Hydropower remains the lowest-cost source of electricity worldwide and has the advantage of providing large-scale energy storage through reservoirs.[215] A large portion of DRC's hydropower capacity could be harnessed through the construction of the Grand Inga dam on the Congo River, with private sector support. In the short to medium term, a sharper focus on developing small and medium HPPs closer to the electricity load is the only realistic approach to meeting growing electricity demand.

The private sector could play an important role by addressing service gaps in access to electricity. The renewable energy sector—independent power producer (IPP) renewable energy, off-grid power, and solar mini-grids—offers significant growth opportunities and is an emerging focus of foreign direct investment into DRC. It could provide accessible, sustainable power to benefit households and SMEs and to offer businesses affordable solutions.

Action Area 2: Increase agriculture productivity and food security through climate-smart agriculture, and catalyze farmer-led irrigation

The ambitious growth scenarios sketched out in this report depend on successful transformation of the economy and a reduction, over time, in the share of the workforce employed in more traditional, high labor-intensity agriculture, with a shift in both jobs

[215] World Bank, *Increasing Access to Electricity in the DRC*.

and share of value to the non-farm rural economy. At the same time, considering the imperative to safeguard DRC's food security, and given its great infrastructure deficits, there is an urgent need for significant investment in rural infrastructure and climate-smart approaches to agriculture practices. Intensification of on-farm efforts increases land and labor productivity, potentially doubling or tripling output,[216] and improving specialization, greater market orientation, and food security.

Developing priority agricultural value chains is an essential step toward addressing food security. Among these value chains, cassava stands out as an opportunity for DRC to reduce its dependence on grain exports. However, climate change poses challenges to the productivity and profitability of such value chains, often inducing smallholder farmers to seek short-term solutions that may not provide them with sustainable outcomes when it comes to crop rotation, disease outbreak control, land fertility, water management, flood prevention, and weather forecasting. Thus, policy recommendations aimed at building climate resilience include: (i) expanding competitive access to sustainable development solutions for both climate change adaptation and mitigation (from high-quality seeds and disease prevention to water management and irrigation); (ii) modernizing national infrastructure to facilitate market access; and (iii) improving broadband access, affordability, and quality to keep smallholders productive.

Irrigation is vital to improving CSA value chains for both food crops and higher-value horticulture. Different CSA technologies can and should be applied according to the context. They include climate-resistant varieties, rainwater harvesting, water conservation, (bed) furrow irrigation, drip irrigation, soil conservation (mulching, organic fertilizers, and adapted varieties). Accelerating farmer-led irrigation can be done gradually, starting in areas with strong demand, good market access, water resource accessibility, high exposure to dry spells, and favorable soil conditions. Prioritizing value chains can involve initially expanding irrigation for those crops where supplemental irrigation yields the highest returns, such as for all market gardening and horticultural crops, as well as for food crops that are the most susceptible to climate impacts, like maize and rice.

Recognizing that most financial institutions may not fully meet the financial needs of small and medium producers, climate-smart policies should consider a mixed public-private investment approach. This includes matching grants to producers or public investments to facilitate access to commercial financing through risk reduction strategies. Larger-scale/commercial approaches could also be considered, incorporating private investments that ensure benefits to small producers. In this regard, contract farming, specifically for staple crops and others like sugar cane, becomes particularly significant.

Changes in land management are needed to protect and improve land conditions, generating climate co-benefits and bolstering the resilience of rural populations. Recent progress to harmonize and update the legal framework are positive. It will be important to approve and implement the 2020 National Land Use Planning law and finalize the revised National Land law, which promotes a secure land tenure system recognizing sustainable land use and customary community rights. A further priority is to revise the National Agricultural law to respond to the 2023 National Sustainable Agricultural Policy. This will also help harmonize legislations to ensure improved land use planning and prevent further land conversion.

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[216] Aihounton, Ghislain; Christiaensen, Luc. "Does Agricultural Intensification Pay?" *Jobs Working Paper*; Issue No. 73., (Washington, DC: World Bank, 2023), https://openknowledge.worldbank.org/server/api/core/bitstreams/ed503be8-972e-4ccf-8643-d1d413651cbb/content.

Action Area 3: Develop climate-resilient transport and cities, enhance digital access, and improve access to basic services

To improve in-country and regional connectivity, DRC needs to rehabilitate, upgrade and maintain existing infrastructure to climate resilience standards and promote mode integration. DRC has a widely cast multimodal transport network, but the infrastructure is sparce, in poor condition, poorly interconnected, and vulnerable to climate change impacts. There is a pressing need to rehabilitate and upgrade national roads, followed by regional and local roads, to climate resilience design standards, but this will likely add to infrastructure capital costs. The deployment of multimodal platforms and of climate-smart investments in railways, waterways, ports, and airports can complement road transport and improve the redundancy and efficiency of the transport network.

Infrastructure planning and investments also need to target the mining sector's needs. Poor infrastructure results in significant transportation delays and limits the potential not only for mining sector development but also for value addition where "just-in-time" manufacturing practices are being adopted. Other important measures to consider are investments in infrastructure maintenance, early-warning systems, and emergency contingency plans. Additionally, private sector engagement ought to increase to transfer port and airport assets to private operators, which would help the Government achieve multiple goals.

Strengthening infrastructure maintenance needs to be commensurate with climate risks, which requires financial mechanisms and the deployment of dedicated maintenance programs to sustain the physical resilience of infrastructure against climate and natural hazards. Road maintenance funding could be achieved by increasing the fuel levy that replenishes the National Maintenance Road Fund (FONER), established in 2008, and through toll road revenue. Maintenance of roads, of associated structures (bridges, culverts, and drains), and of slope protection work must ensure that these are functional and unobstructed and thus able to cope with climate impacts. In DRC, as in the rest of the region, systematic assessments to identify and incrementally address vulnerable and critical road sections as a first defense against climate risks. As a no-regret solution, they are an effective way to manage climate change uncertainty.[217]

Investments in urban climate action could secure the hard-won progress achieved through earlier investments, and strengthen already developed critical urban infrastructure, thereby addressing urban poverty and fragility. The most vulnerable urban residents—the poor and those who live in high-risk, often informal, settlements—could benefit the most from the development of resilient urban communities because of the climatic challenges inherent to built-up urban environments such as heat islands. In pursuing a green and sustainable development growth path, urban climate action in DRC could take advantage of best practices and knowledge already available globally and leapfrog over several intermediate steps, improving access to services, enhancing urban livability, and facilitating upward socioeconomic mobility through integrated co-benefits.

In the short and medium term, it is crucial to prioritize support to the most vulnerable. This means strengthening short-term disaster prevention in high-risk areas and instituting an effective emergency response system at the local level, while enabling and supporting

[217] Raffaello Cervigni et al., *Enhancing the Climate Resilience of Africa's Infrastructure: The Roads and Bridges Sector* (Washington, DC: World Bank, 2017), https://documents1.worldbank.org/curated/en/270671478809724744/pdf/110137-WP-PUBLIC-ECRAI-Transport-CLEAN-WEB.pdf.

long-term adaptation planning at the city level. Such planning in DRC cities could involve actions in the following areas: (i) utilizing heat-proof housing materials and developing corresponding building codes; (ii) implementing cooling measures across cities, particularly in high-risk areas; (iii) improving and enlarging drainage infrastructure; (iv) improving waste management systems and scaling up efforts to stabilize hillsides to avoid runoff; (v) expanding drinking water and sanitation services to reduce public health risks; (vi) incorporating climate change projections in the design, construction, or rehabilitation of critical infrastructure, particularly for basic services like water supply and sanitation, and for critical road segments of the transport network.

DRC's still nascent digital sector holds significant untapped potential to achieve greater climate resilience and low-carbon development. As the sector evolves, the Government should integrate it into its vision on climate change as well as its plans for adaptation and emissions reduction. The Government should also coordinate investments to build up its data management and analysis frameworks to enable proper data governance and analytical capacities, including digital weather monitoring systems, early-warning systems, access to remittances, and other safety net and monitoring capabilities. Investments in the digital sector would also permit diversification to create other economic opportunities. For example, it is estimated that just the passing of the recent 2020 telecoms law will permit the investment of over US$200 million in the economy by private sector holders.[218]

Action Area 4: Enhance governance and boost human capital by reducing poverty, increasing social inclusion, and enhancing security

The intertwined dynamics of conflict, fragility, poverty, food insecurity, and natural resource management could fuel intergroup strife, particularly among those most susceptible to climate hazards. Climate change impacts could deepen this pattern of lack, conflict, and exclusion because they create new risks, magnify existing ones, and hamper improvements in human development outcomes. The already marginalized are disproportionately affected by climate change and risk having their existing vulnerabilities multiplied, pushing them further into exclusion. Climate change could therefore make DRC's poverty alleviation and development goals harder to achieve.

In the short term, DRC should strengthen its spatial tools for tracking poverty and social exclusion to pick up on the relationship between climate change, poverty and conflict. This is essential for substantiating the links but also for improved targeting of interventions in support of the most excluded. In addition, Social Safety Nets and complementary support packages—especially for survivors of GBV—will have to be expanded, with improved targeting and climate shock responsiveness.

DRC should also conduct a comprehensive assessment to understand the potential impacts and risks associated with increased mining of green minerals. This would provide insights that would inform interventions to foster socially inclusive practices, mitigate FCV risks, and ensure environmentally sustainable mining practices, while pursuing economic gains from mineral extraction. To bolster these efforts, DRC could establish a coalition of civil society organizations, private sector representatives, UN agencies, and other stakeholders. The objective would be to advocate for socially inclusive and sustainable green mineral value chains. By convening dialogues, the coalition could facilitate discussion

[218] World Bank, "Second DRC Foundational Economic Governance Reforms Development Policy Financing," World Bank Projects & Operations website, last updated March 30, 2023, https://projects.worldbank.org/en/projects-operations/project-detail/P179141.

on the impacts of green mineral mining and explore collaborative strategies for mitigating risks. This could create a platform for knowledge sharing, joint problem solving, and coalition-building among major stakeholders.

In the longer term, DRC needs to ensure that its climate mitigation and adaptation efforts prioritize social inclusivity and effective institutions. The first objective is to ensure resilience investments are targeted and tailored to the unique vulnerabilities of excluded groups. Pro-poor investments in agriculture, access to water, electricity and sanitation and in the quality of housing, transport improvement using climate resilient standards may all need to be adjusted to ensure that they can be accessed by women, people with disabilities, conflict-affected communities and indigenous peoples. Second, inclusion can be achieved by prioritizing the provision of resources, capacity-building, and direct funding opportunities to local communities for effective climate action. Effective local institutions are central to countries' ability to respond to the impacts of climate change. The World Bank's CCIA provides recommendations to establish the institutional underpinnings of a country's climate change framework that can define, implement, guide, enforce, and monitor climate targets effectively. Moreover, DRC's approach to DRM has also been evaluated as a cross-cutting area—given its importance in the country's climate vulnerability response.

As DRC advances and implements its climate agenda, it is essential to refine institutional practices to the level of international standards. This DRC CCIA proposes to operationalize three best practice areas: (i) Concretize the legal framework by establishing a dedicated and comprehensive Framework Law on Climate Change; (ii) Enhance the enabling environment by building more technical capacity & improving institutional coordination mechanisms; and (iii) Strengthen financial underpinnings by developing an Integrated National Climate Finance Strategy. Moreover, the DRC should also focus on specific priority areas identified in the CCIA.

Climate change poses a transversal risk to DRC's development and exacerbates existing fragility. Additional policy and institutional reforms will be needed to integrate and mainstream climate action across government institutions and support implementation. Key measures include: (i) develop and adopt new, coordinated legal frameworks on climate change and disaster risk management and (ii) empower communities and civil society organizations to shape climate actions and to monitor and evaluate results.

Despite the limited time and scope of this CCDR, the key message from this CCDR is clear: in DRC, development and climate resilience are inextricably linked. Across multiple climate scenarios, the analysis shows that pursuing DRC's development agenda with additional adaptation investments will yield the best outcomes for economic growth, poverty reduction, and climate resilience. Several measures that advance development and climate resilience can also slow GHG emissions growth, mainly by enhancing natural carbon sinks through investments in land restoration and forest protection. DRC faces serious fiscal and development challenges that will limit the country's ability to implement such adaptation measures. But as the analysis makes clear, the country can tap into potential revenue sources by supporting a global transition for low-carbon growth, and leveraging its carbon sequestration potential, large hydropower generation capacity, and green mineral production.

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