EASTERN AND
SOUTHERN AFRICA

KENYA

World Bank Group

COUNTRY CLIMATE AND DEVELOPMENT REPORT

2023

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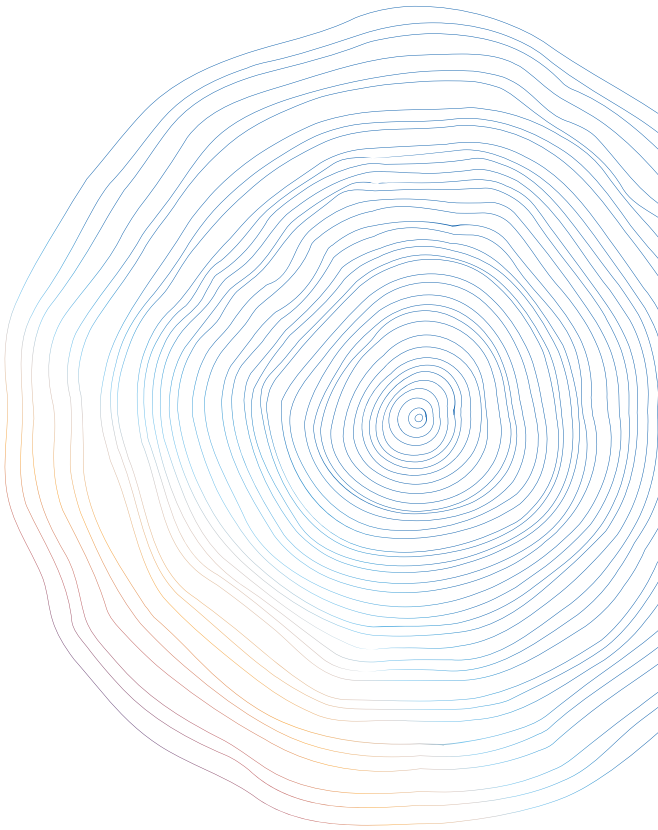

KENYA

COUNTRY CLIMATE AND DEVELOPMENT REPORT

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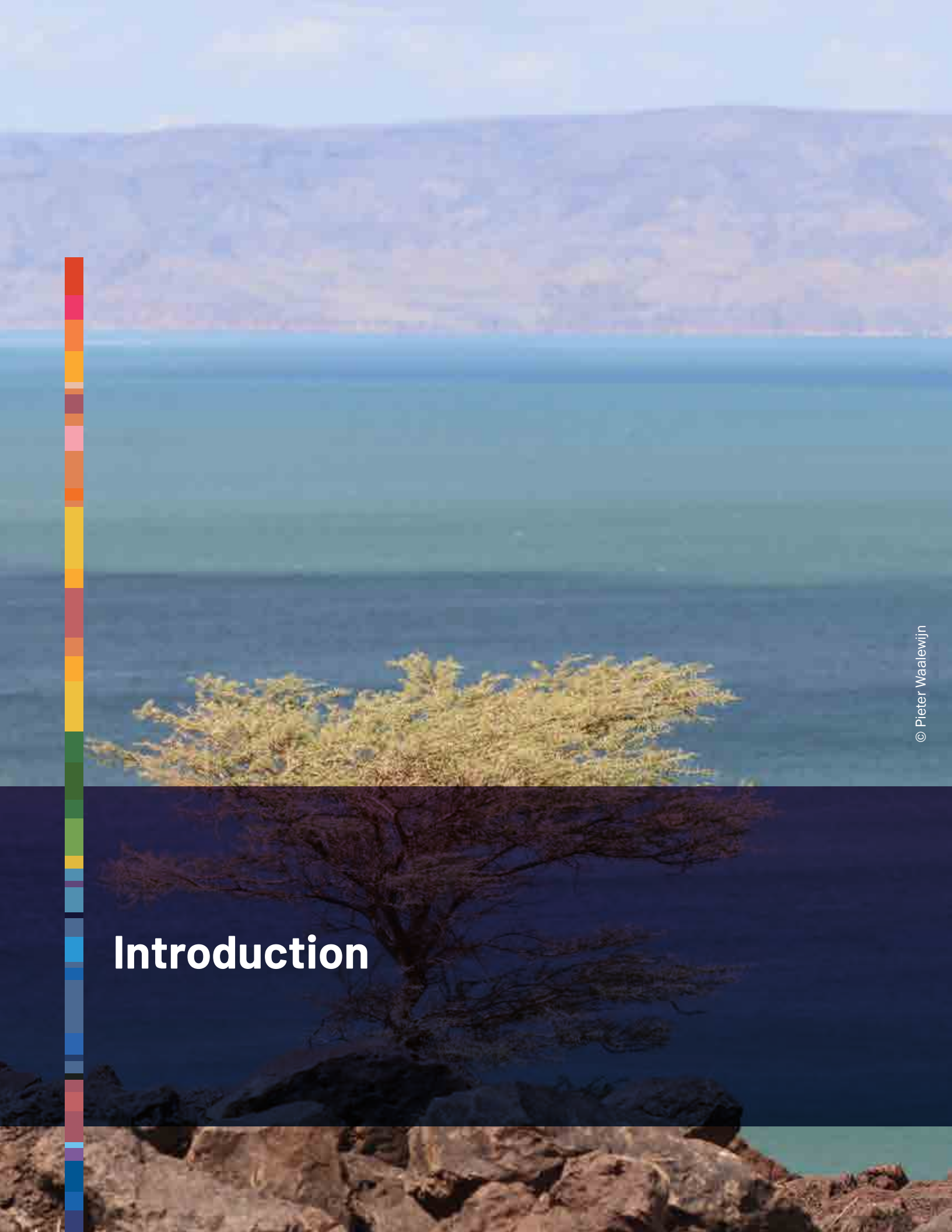
Abbreviations and Acronyms

ASAL	arid and semi-arid lands
ASP	aspirational (economic scenario)
ASTGS	Agricultural Sector Transformation and Growth Strategy
BAU	business-as-usual (economic scenario)
BETA	Bottom-up Economic Transformation Agenda 2022–27
BPS	Budget Policy Statement
CAPEX	capital expenditure
cat bonds	catastrophe bonds
CCA	Climate Change Act
CCCF	County Climate Change Fund
CO_2	carbon dioxide
CSA	climate-smart agriculture
ESR	enhanced single registry
EU	European Union
EV	electric vehicle
FLLoCA	Financing Locally Led Climate Action
GCM	general circulation model
GDP	gross domestic product
GHG	greenhouse gas
HCI	Human Capital Index
ICT	information and communication technology
IFC	International Finance Corporation
KenGen	Kenya Electricity Generating Company PLC
KNBS	Kenya National Bureau of Statistics
KPLC	Kenya Power and Lighting Company
LCPDP	Least Cost Power Development Plan
LMIC	lower-middle-income country
LPG	liquefied petroleum gas
MCDAs	ministries, counties, departments, and agencies
MSME	micro, small, and medium scale enterprises
MRV	monitoring, reporting, and verification
$MtCO_2e$	million tonnes (metric tons) of carbon dioxide equivalent
MTP	medium-term plans

NCCAP	National Climate Change Action Plan
NCCC	National Climate Change Council
NCCF	National Climate Change Fund
NDC	Nationally Determined Contribution
ND-GAIN	Notre Dame Global Adaptation Initiative
NDMA	National Drought Management Authority
OPEX	operational expenditure
PIM	public investment management
PPP	public-private partnership
RCP	Representative Concentration Pathway
SGR	standard gauge railway
SOE	state-owned enterprise
SSP	Shared Socioeconomic Pathway
tCO_2e	tonnes (metric tons) of carbon dioxide equivalent
UMIC	upper-middle-income country
WASH	water, sanitation, and hygiene

All dollar amounts ($) are US dollars



Introduction

Introduction

Kenya is the fourth-largest economy in Sub-Saharan Africa and aspires to be an upper-middle-income country (UMIC) by 2030. It recently achieved lower-middle-income country (LMIC) status and although poverty was trending downward pre-COVID, 36.1 percent of its population still lived under the international poverty line in 2021.[1] Kenya's real gross domestic product (GDP) grew at an average annual rate of 4.8 percent from 2015–19, due to robust growth of private consumption at an annual average rate of 5 percent complemented by ambitious public investment focused on closing the large infrastructure gap and implementing the devolution mandate under the 2010 constitution. The agriculture, industry, and services sectors contributed 21.2 percent, 25.4 percent, and 45.4 percent, respectively, in 2022 (Kenya National Bureau of Statistics 2022). In terms of regional contribution to national GDP, as of 2020,[2] major urban agglomerations—including include Nairobi, Kisumu, Mombasa, Kiambu, Machakos, and Nakuru—accounted for nearly 48 percent of Kenya's GDP (Kenya National Bureau of Statistics 2021). But only 28.5 percent of the population lived in urban centers in 2021.

Kenya is highly exposed to climate change, ranking 41st in the world's most vulnerable countries, according to the Notre Dame Global Adaptation Initiative (ND-GAIN) (2021). With its primarily rainfed agriculture sector, levels of informality in the economy, and slowdown in the structural transformation of the economy, Kenya is exposed to exogenous climate risks. To achieve and sustain UMIC status, it will need to accelerate the use of public policies, public investments, and private sector financing to increase productivity, reduce regional inequities, and align efforts to boost growth with its commitments to climate action, as reflected in its Climate Change Act (CCA), Nationally Determined Contribution (NDC)—which commits the country to reduce emissions by 32 percent of the expected 143 million metric tons of carbon dioxide equivalent ($MtCO_2e$) by 2030, and establishing a climate-resilient society—and National Climate Change Action Plans (NCCAPs).

The Kenya Climate Change and Development Report (CCDR) presents a set of priority action areas for the government to achieve its development and growth objectives in a climate-informed manner. The action areas are aligned with Kenya's NDC and place the country on a path toward net zero by 2050. To present the broadest range of climate effects, this CCDR explores the impact of climate shocks across the following:

- An *optimistic climate future scenario*, where greenhouse gas (GHG) emissions are in line with a 1.5°C by 2100 (working with the Shared Socioeconomic Pathways (SSPs)[3] associated with the means of SSP1–1.9)
- A *pessimistic climate future scenario,* where warming reaches 4°C by 2100 (working with the means associated with SSP3–7.0)
- The mean of three general circulation models (GCMs) that presents the 10th percentile of mean precipitation changes and 90th percentile of mean temperature changes (referred to as dry/hot)
- The mean of three GCMs that presents the 90th percentile of mean precipitation changes and the 10th percentile of mean temperature changes (referred to as wet/warm).

The CCDR modeling imposes these shocks on two macroeconomy and adaptation policy scenarios, via a set of impact channels. The macroeconomy scenarios are *business-as-usual (BAU),* which assumes

1 Poverty impacts background note prepared for the Kenya CCDR.

2 The latest available data on gross county product.

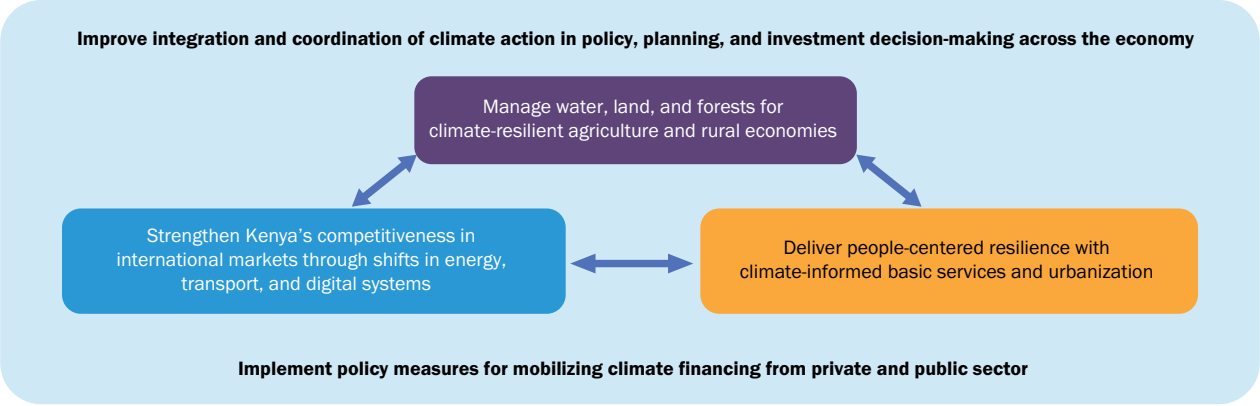
3 SSPs are different possible evolutions of the world in terms of demography, technology, economy, and so on. In turn, these socioeconomic conditions achieve certain Representative Concentration Pathways (RCPs), which are scenarios of emissions and concentrations of GHGs, aerosols, and land use/land cover that represent different intensities in the additional radiative forcing caused by human activities.

Kenya remains as an LMIC, maintains its current average annual GDP growth of 5 percent up to 2050, and maintains the average historical rates of change of all macro indicators—that is, sector shares in the economy, productivity, urban and rural population—up to 2050; and *aspirational (ASP),* which assumes that Kenya is a newly industrializing, middle-income country providing a high quality of life to all its citizens by 2030 in a clean and secure environment, GDP grows at an average of 7.5 percent per annum, industry and services constitute a bigger share of the economy, and Kenya is more urbanized. The ASP growth rate compares with the growth rate needed to achieve the *Kenya Kwanza Plan: Bottom-Up Economic Transformation Agenda (BETA) 2022–27*[4] plan of 7.2 percent (Breisinger et al. 2022). We consider measures such as expanded irrigation, and improved access to water supply, sanitation, and hygiene (WASH) facilities, education, clean cooking technology, which offers labor savings, and so on to be development actions that are part of the ASP scenario. The economy is impacted through climate shocks to:

- Human capital, including from heat stress on labor, impacts to human health, and impacts to clean cooking
- Agriculture and natural resources, including from changes in water supply, crop production, erosion, carbon storage in forests and soil, livestock production and hydropower generation, and
- Infrastructure and services, including from inland flooding, and impacts to roads and bridges.

Based on a whole-of-economy framing, this CCDR identifies five interconnected action areas that could help Kenya achieve inclusive and climate-resilient growth (figure I.1), and UMIC status by 2050. The five action areas include three multisectoral areas focused on: managing water, land and forests for climate resilient agriculture and rural economies; delivering people-centered resilience with climate-informed basic services and urbanization; and strengthening Kenya's competitiveness in international markets through shifts in energy, transport, and digital systems and two crosscutting areas: improving integration and coordination of climate action in policy, planning, and investment decisions across the economy; and policy measures for mobilizing climate finance from private and public sector.

Figure I.1: A climate-resilient, inclusive, and quality growth path for an UMIC Kenya



This CCDR is divided into five chapters:

- Chapter 1 focuses on Kenya's development context and the risks and opportunities presented by climate change, analyzing the characteristics of key sectors of the country's economy that could allow it to achieve green, inclusive growth that is also resilient to climate change.

4 https://africacheck.org/sites/default/files/media/documents/2022-08/Kenya%20Kwanza%20UDA%20Manifesto%202022.pdf

- Chapter 2 offers an analysis of Kenya's current policy and institutional structures for addressing climate change, suggesting ways of harmonizing policy and action across government levels for an integrated effort to address climate change and mobilize finance.
- Chapter 3 presents the detailed analyses underpinning the multisectoral action areas and their contribution to inclusive growth, climate resilience, and maintaining a low-carbon growth path in the face of changing climate and domestic and international contexts.
- Chapter 4 lays out the macrostructural modeling results of climate change impacts on Kenya's economy in the short term through to 2050. It presents results for various damage channels, and different climate scenarios and illustrates ways in which the country can sustain growth and mitigate damage from climate change under the different scenarios.
- Chapter 5 identifies key priority areas and cost estimates for select investments that could contribute to the growth of Kenya's economy while boosting its resilience to climate change and remaining on low-carbon pathway. It also presents options for scaling up climate finance, especially from the private sector, through diverse range of innovative instruments.

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Development and Climate Challenges and Opportunities

1. Development and Climate Challenges and Opportunities

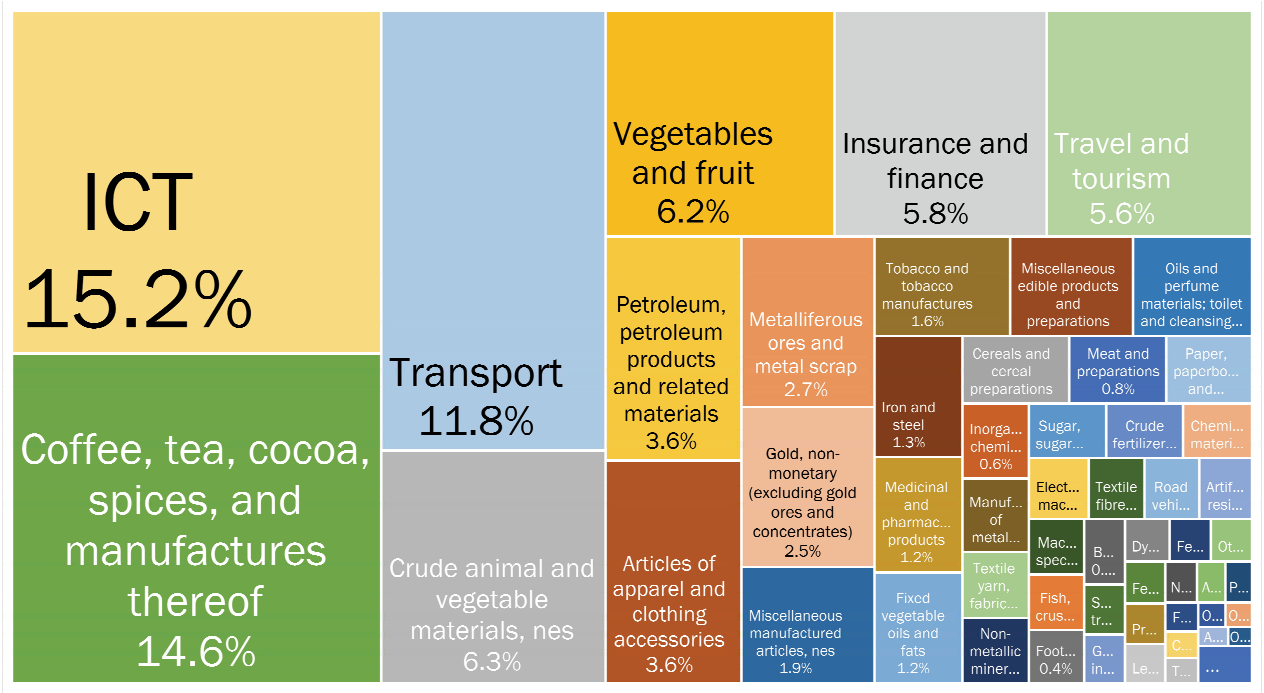
1.1. Kenya's growth has been strong, but not stellar

With robust economic growth over the past decade, Kenya has outperformed its peers in Sub-Saharan Africa. Annual GDP growth averaged 5 percent from 2010 to 2019 and is projected to remain above 5 percent in the medium term. The economy has shown considerable resilience to recent shocks. Although the COVID-19 pandemic caused real GDP to contract by 0.3 percent in 2020, it subsequently rebounded by 7.5 percent in 2021 and an estimated 5.2 percent in 2022. This was driven by broad-based expansion of services, led by the recovery of tourism and industry. On the expenditure side, growth has been driven mainly by private consumption and public spending, including on large infrastructure projects. The revived business confidence following the smooth transition of power after the August 2022 elections is expected to contribute to greater private sector participation. But pressing fiscal challenges threaten to undermine these growth prospects, with public debt estimated to reach 64.8 percent of GDP in June 2023 (World Bank 2023a), and debt repayments consuming a substantial share of total revenues.

Trade and industries based on natural resources (agriculture, livestock, tourism) form a significant part of Kenya's economy. The agricultural sector, although volatile, has grown by an average of 3.2 percent per year since 2010, and vegetables and food products made up 55.2 percent of exports in 2021.[5] Adverse weather conditions, including a long-term drought affecting much of Eastern Africa, caused the sector's growth to decelerate from 5.2 percent in 2020 to a contraction of 0.1 percent in 2021 (World Bank Group 2022) with the sector continuing to contract in 2022 as the drought continued (Central Bank of Kenya 2023).

Although the composition of Kenya's exports has changed over the last decade, they are still largely composed of natural products. In 2020, 25 percent of total exports comprised tea, cut flowers, fruits, vegetables, meat products, and unroasted coffee (figure 1.1), while services, including tourism, made

Figure 1.1: Kenya's exports (2020) are dominated by agriculture and services



Source: Atlas of Economic Complexity (https://atlas.cid.harvard.edu/).

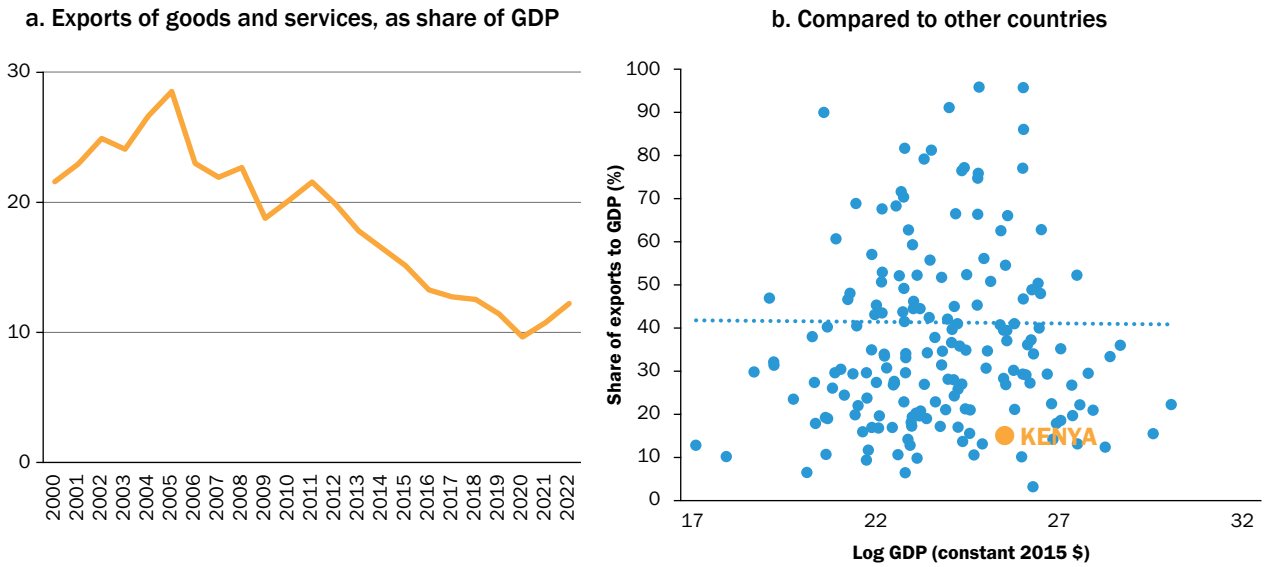
5 https://wits.worldbank.org/CountryProfile/en/Country/KEN/Year/LTST/Summary/ (accessed March 2023).

up approximately 36 percent. The largest contribution to export growth came from products of moderate complexity—precious metals, stones, and insurance and finance products— limiting the contribution of engaging in export markets for growth.

Manufacturing has had a limited role in economic growth, despite government efforts to boost competitiveness. Manufacturing output growth has averaged 3.5 percent per year, and its contribution to GDP has decreased from an average of 11.1 percent between 2010 and 2014 to 7.6 percent in the past five years (Kenya National Bureau of Statistics 2022). This is despite efforts such as the Kenya Industrial Transformation Program in 2015—which aims to revive manufacturing and industrial exports by developing region-specific clusters—and ratifying several trade agreements, such as the African Continental Free Trade Area Agreement, Common Market for Eastern and Southern Africa, East African Community, and Southern African Development Community, to advance international and regional integration. Efforts include creating industrial parks along infrastructure corridors, supporting the agro processing, textile, mining, and other sectors, and creating special economic and export promotion zones to promote export-oriented manufacturing. Nonmanufacturing secondary sectors, such as construction, on the other hand, have grown rapidly due to government infrastructure projects and strong residential construction. The service sectors have shown the fastest growth, led by information and communication technology (ICT), with an average annual growth rate of 10.4 percent from 2010 to 2021, and finance, with 7.8 percent.

The export sector's performance has not, however, been commensurate with Kenya's growth performance. The ratio of exports to GDP has declined, partly due to strong domestic growth, but also to sluggish export performance. The export-to-GDP ratio has halved over the last decade. Based on a comparison with other countries of similar economic size, the gap in the export-to-GDP ratio is large and increasing, with Kenya's ratio being about a third of the average ratio for a country of similar size (figure 1.2). Thus, opportunities to expand export could be further explored for Kenya.

Figure 1.2: Kenya's export-to-GDP ratio



Source: World Development Indicators (https://datacatalog.worldbank.org/search/dataset/0037712/World-Development-Indicators).

Recent shocks have reversed Kenya's hard-earned gains in poverty reduction, as the country's current social policy response has failed to reach the most vulnerable. Nearly one-third of the population lives in poverty, with many concentrated in the north and northeast. The impact of the COVID-19 pandemic on Kenya's services-dependent economy increased poverty, including in urban areas, due to large job and

earnings losses.[6] And although the strong economic rebound in 2021 should have helped reduce poverty rates to pre-COVID-19 levels, the severe droughts (NDMA 2023a) pushed up poverty rates, especially in rural areas. But the sustained growth in real per capita incomes in 2022 has brought poverty levels close to pre-pandemic levels (World Bank 2023a).

1.2. Accelerated and inclusive growth is necessary if Kenya is to become an UMIC by 2030

Kenya's Vision 2030, launched in 2008, sets the goal for becoming "globally competitive and prosperous" with "a high quality of life by 2030".[7] Aiming to transform Kenya into an industrialized, middle-income country with enhanced food security, its priorities include: sustaining 10 percent average annual economic growth until 2030; creating a just, cohesive, and equitable path for social development in a clean and secure environment; and building a democratic political system that respects the rule of law and protects every individual's rights and freedoms. The BETA[8] is closely aligned with Vision 2030.

Aimed at increasing productivity and inclusivity, and reducing inequity, the BETA has a strong focus on supporting smallholder agriculture and the informal sector. It has five core thematic areas: agricultural transformation and inclusive growth; transforming the micro, small and medium enterprise (MSME) economy; housing and settlement; health care; and the digital superhighway and creative economy. The government has also committed to expanding infrastructure (including for water, roads, electricity, logistics, and e-mobility), strengthening manufacturing (by engaging with the pharmaceutical, leather, building products, and garment and textile industries) and the blue economy, expanding services (tourism, financial sector, and aviation), addressing climate change and environmental issues, providing social protection, bolstering education, and improving governance through stronger devolution and accountability.

Kenya's fiscal reality requires the BETA implementation to strategically prioritize interventions while mitigating the impacts of climate change and mobilizing more private financing. Committing to achieve these goals in a fiscally sustainable manner while actively promoting private investment in the economy, the government has embraced a more aggressive fiscal consolidation path by further reducing the fiscal deficit target for 2022/23 from 6.1 to 5.7 percent. In the medium term, the government aims to reduce the overall fiscal deficit to 3.9 percent, phase out consumption subsidies for, among others, fuel and maize flour, and establish domestic revenue management reforms.

Kenya's devolved government structure underscores the importance of central and county government coordination in implementing the BETA in a climate-informed manner. Following constitutional reforms, the country introduced devolution in 2010, mandating the involvement of 47 county governments in promoting social and economic development and providing proximate and easily accessible services. While not all services have been devolved, progress has been made in delegating all functions to county governments as stipulated in the fourth schedule of the constitution. Devolution is expected to boost growth and reduce inequalities, as counties address county-specific needs. County governments also need to mobilize and manage climate finance to achieve climate-compatible growth.

1.2.1. Kenya could leverage a demographic dividend by investing in its youth

Kenya is a young country at an advanced stage of demographic transition. With nearly 39 percent of the population under the age of 15, Kenya is undergoing a demographic shift. The largest age cohort—aged between 10 and 14—will enter the labor force over the next decade (World Bank 2023b), and the

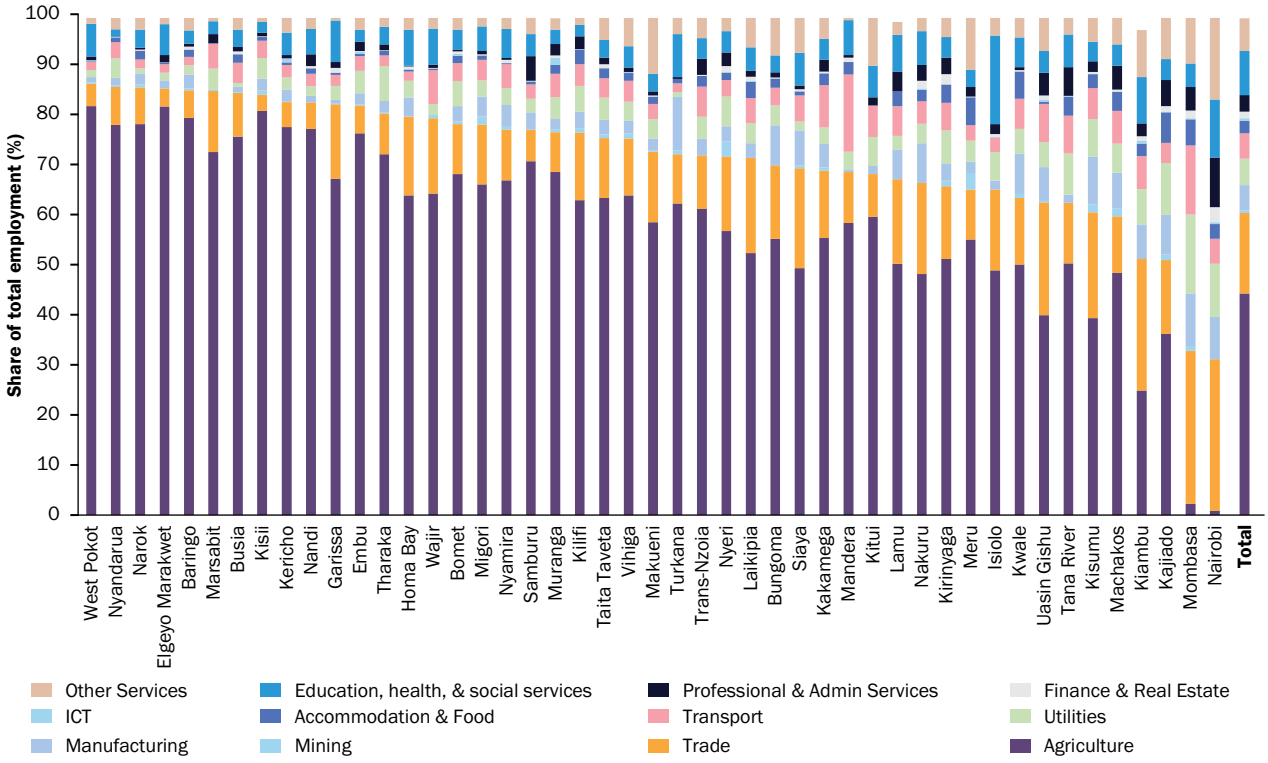
6 The number of unemployed more than doubled from 0.8 million in the second quarter of 2019 to 1.8 million by the second quarter of 2020. Employment decreased by almost 2 million (Kenya National Bureau of Statistics 2020).

7 https://vision2030.go.ke/.

8 https://africacheck.org/sites/default/files/media/documents/2022-08/Kenya%20Kwanza%20UDA%20Manifesto%202022.pdf

working population is projected to increase from 30 million in 2020 to 39 and 56 million in 2030 and 2050, respectively.[9] But many workers are engaged in poor-quality and low-productivity jobs, and although the proportion of Kenyans relying on low-productivity jobs decreased between 2015 and 2019,[10] job quality remains a challenge across the country. Agriculture and trade, both low-productivity sectors, absorb the most workers, with a combined share of about 61 percent (figure 1.3). Most jobs have neither employment contracts nor social protection, leaving workers vulnerable to shocks.

Figure 1.3: Employment by sector at county level, 2019



Source: KNBS, 2019a.

Kenya has yet to capitalize on its the incipient demographic dividend. In 2020, Kenya outperformed its mainland Sub-Saharan counterparts with a Human Capital Index (HCI) score of 0.55, well above the region's average of 0.40, and nearing the UMIC average of 0.56. This score is largely driven by Kenya's strong performance in education. But despite this encouraging HCI figure, significant inequalities remain stubbornly high. School attendance remains mixed, especially among the poorest children living in the most threatened regions: 70 percent of children aged three and above in the northern and northeastern counties have never attended school. There are also large intercounty disparities in learning-adjusted years of schooling, and in some regions, school accessibility is an area of concern. Tertiary enrolment is low and unequal, with participation in tertiary education especially low among rural females.

Kenya's HCI score is significantly influenced by environmental factors, particularly diseases resulting from insufficient access to safe WASH services, and the harmful effects of air pollution. One-third of Kenyan households have no access to a basic water supply and two-thirds have no access to basic sanitation. In rural areas, particularly in Kenya's arid and semi-arid lands (ASALs), people have to walk

9 Using United Nations medium variant projections. https://population.un.org/wpp/Download/Standard/Population/.

10 The percentage of the population engaged in agriculture fell by about 10 percentage points in 2015–19.

long distances to collect water, often from contaminated sources that are unsafe to drink. Economic water insecurity disproportionately impacts women and children, who spend a lot of time collecting water, and created additional hygiene and sanitation challenges for girls and women, especially in rural areas, where menstrual hygiene materials are scarce. For school-going children, it often means missed days of school (UNDP 2020). Over 5 million people living in urban areas have no piped water supply and rely on vendors or wells that are prone to contamination. With wastewater treatment low and inadequate, waterborne diseases are a major cause of death, especially among children under five. The potential impact of climate change on access to safe water is likely to exacerbate this already concerning situation.

Kenya's sanitation deficit costs around 1 percent of its GDP annually, in productivity losses, health expenses, and premature deaths.[11] Close to 4 million people, mostly in northeastern counties, still practice open defecation. The health system is also overwhelmed with the double burden of infectious and noninfectious diseases, with challenges amplified due to budget constraints and a shortage of specialized health care workers, particularly in grassroots primary care facilities.

1.2.2. The private sector plays and will continue to play an important role in shaping Kenya's growth and development

The private sector is a key driver of economic growth in Kenya, contributing more than 80 percent of GDP, 70 percent of employment, and the bulk of export earnings. The private sector is composed mostly of 7.4 million MSMEs, 91 percent of which are informal microfirms, and 65 percent of which are one-person establishments. There is spatial concentration of microfirms; counties with high rates of employment in subsistence agriculture, such as Wajir, Samburu, Marsabit, and Garissa, have a very small number and share of MSMEs. As much as 85 percent of MSMEs operate in the services sector (World Bank 2023b), with formal microfirms emerging in the ICT, finance, real estate, professional administrative services, education, health, and social security sectors. The productivity of these formal firms is higher than that of informal MSMEs. Scale appears to be less important for productivity in the service sector than it is in agriculture and manufacturing, pointing to the potential for Kenya to enable more of these productive firms outside of sectors that require high skill levels, contributing to inclusive growth.

The private sector is prominent in most parts of Kenya's economy, with opportunities to further expand its presence. Analyses by the International Finance Corporation (IFC) find notable private sector investments in the horticulture, livestock, dairy, poultry, and food and beverages subsectors. Natural asset-based sectors considered to have growth potential included timber, pulp and paper, and biofuels. An overarching challenge in the aggregate agriculture sector is productivity and efficiency of operations and processes, which affect international competitiveness. Improved access to power, land, and soil, better water management, and more effective responses to adverse weather events could reduce such challenges. Similar analysis revealed that other sectors with potential for private sector investment include: cement, concrete, iron, steel, e-mobility, textiles, pharmaceuticals, and chemicals. In the services sector, tourism, hospitality, real estate, and housing are the main subsectors with private sector involvement. There is a need to anticipate and address how growth in these sectors will increase the load on transport, energy, and water infrastructure, and how to meet this demand in a climate-informed manner.

1.3. Adaptation and greater resilience to climate change are paramount for Kenya's future development

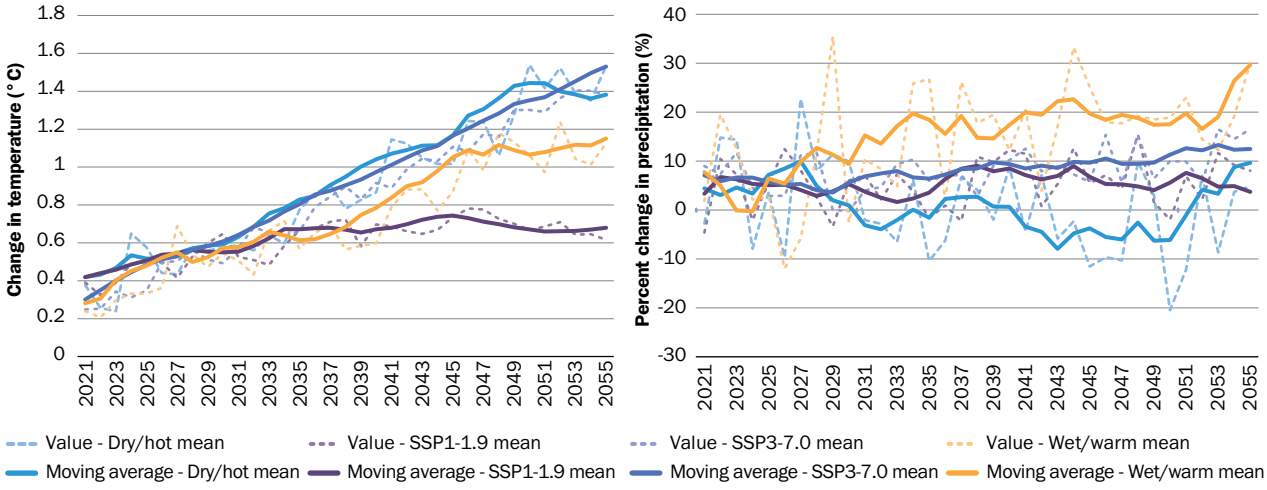
Climate variability is already a source of significant economic risk for Kenya. Estimates suggest that more than 70 percent of disasters from natural hazards are attributable to extreme climatic events. These include major droughts that occur every 10 years, and moderate droughts or floods every three to four

11 https://www.zaragoza.es/contenidos/medioambiente/onu/825-eng-v6.pdf

years. The repeating patterns of floods and droughts in the country have had devastating socioeconomic impacts and high economic costs. For example, the 2008–11 drought is estimated to have cost Kenya $12.1 billion, including $805.6 million for the destruction of physical and durable assets (Republic of Kenya 2012). Droughts have affected more people than floods and have had the greatest economic impact (averaging 8 percent of GDP every five years). They also appear to be increasing in frequency. And although droughts often affect the whole country, the most severe impacts are felt in the country's highly arid zones, which include many of the poorest counties (Republic of Kenya 2013). Floods and droughts have also resulted in episodes of acute food insecurity and loss of assets.

For Kenya, adaptation and greater resilience will continue to be the primary concern when it comes to climate change. Its diverse topography creates a wide range of microclimates: hot and humid along the coast, temperate inland, hot and arid in the north and northeast, and cooler in the central highlands, which are mix of tropical highlands. A range of climate models forecast that Kenya's climate future will entail the mean temperature increasing, with greater increases in temperature under a scenario with no global decarbonization effort. Precipitation will fluctuate significantly on an annual basis, with all but the most extreme GCMs indicating that Kenya will get wetter (figure 1.4). Climate change impacts are spatially varied, due to Kenya's topography, the Intertropical Convergence Zone, and the concentration of population and economic activity. The western, central, and coastal regions, which occupy less than 20 percent of the country's land area, are home to nearly 90 percent of its population.

Figure 1.4: Projected changes in mean temperature and precipitation (results from four models)



Source: IEc 2023.

1.3.1. Kenya's largely rainfed agriculture and pastoral systems are highly vulnerable to climate change

Kenya's agriculture is currently largely rainfed and of low productivity. Only 15–17 percent of its total land area is arable cropland (equivalent to 8.8–10 million hectares), and a further 31–33 percent is pasture and rangeland, mainly in drier areas of the country (KNBS 2019b).[12] Less than 5 percent of cultivated land is irrigated. Smallholder agriculture accounts for roughly three-quarters of total agricultural output, with average farm sizes declining due to population growth (D'Alessandro et al. 2015). Agricultural performance

12 Also, https://wateraccounting.app/media/045b6377-da48-4acc-bdb4-312ba60f3975/index.html. Agricultural land as a share of Kenya's total land area was 48.5% in 2020, up from 44.4% in 1971 and growing at an average annual rate of 0.19% (https://data.worldbank.org/indicator/AG.LND.AGRI.ZS?locations=KE).

is further constrained by government interventions distorting input and cereal markets, limited access to credit, low adoption of sustainable land management practices, decreased public spending on agricultural research,[13] and climate change.

Kenya's diverse livestock sector—which includes agropastoralism, nomadic pastoralism, and ranching—also suffers from low productivity. Based on traditional customs, *nomadic pastoralism* is practiced on communal lands in the low rainfall (arid) zone, which receive 200–350 millimeters of rainfall annually. *Agropastoralism* is practiced on privately owned lands in semi-arid counties, which receive 500–750 millimeters of rainfall annually. Ranching is mainly practiced in the medium-rainfall rangeland zones, where cattle and small stock are maintained through free natural grazing in open pastures and on private ranches owned by individuals or limited companies, group ranches, and cooperative ranches. A recently completed feed inventory showed a national negative potential in terms of feed balance, elevating concerns about meeting the livestock subsector's needs.

Climate impacts on agriculture and productivity of specific crops are expected to vary, based on the climate change scenario (figure 1.5). Depending on the crop and assumed climate projections, the production shock could result in increased output. For some key export crops, such as coffee and beans, the production shock is predominantly negative compared to the baseline. The same is true for some key food security products, such as maize and cassava, while for others, the spread of the production shock (including the means) is quite large compared to the baseline. But in aggregate, the impact of the mean of different clusters of climate projections results in a decline in the contribution of agriculture value add to overall GDP, if no action is taken.

Without intervention, the projected annual variability in precipitation could compromise food security and Kenya's agricultural export basket. Recent weather shocks (five consecutive seasons of drought) have already resulted in 14 counties being classified as having at least acute food insecurity.[14] Maize is the staple cereal, synonymous with food and nutrition security. Improving maize production and storage systems could boost levels of productivity and reduce postharvest losses, bolstering resilience to shocks. To buffer the impact of climate on Kenya's export basket, which largely comprises primary agricultural products, the agrifood sector could diversify exports and adding value to several commodities, including milk, chocolate, prepared or preserved meats, cheese, and wood and paper-based products.[15]

1.3.2. Kenya's road and digital infrastructure networks are vulnerable to climate change, leaving some regions and freight at risk

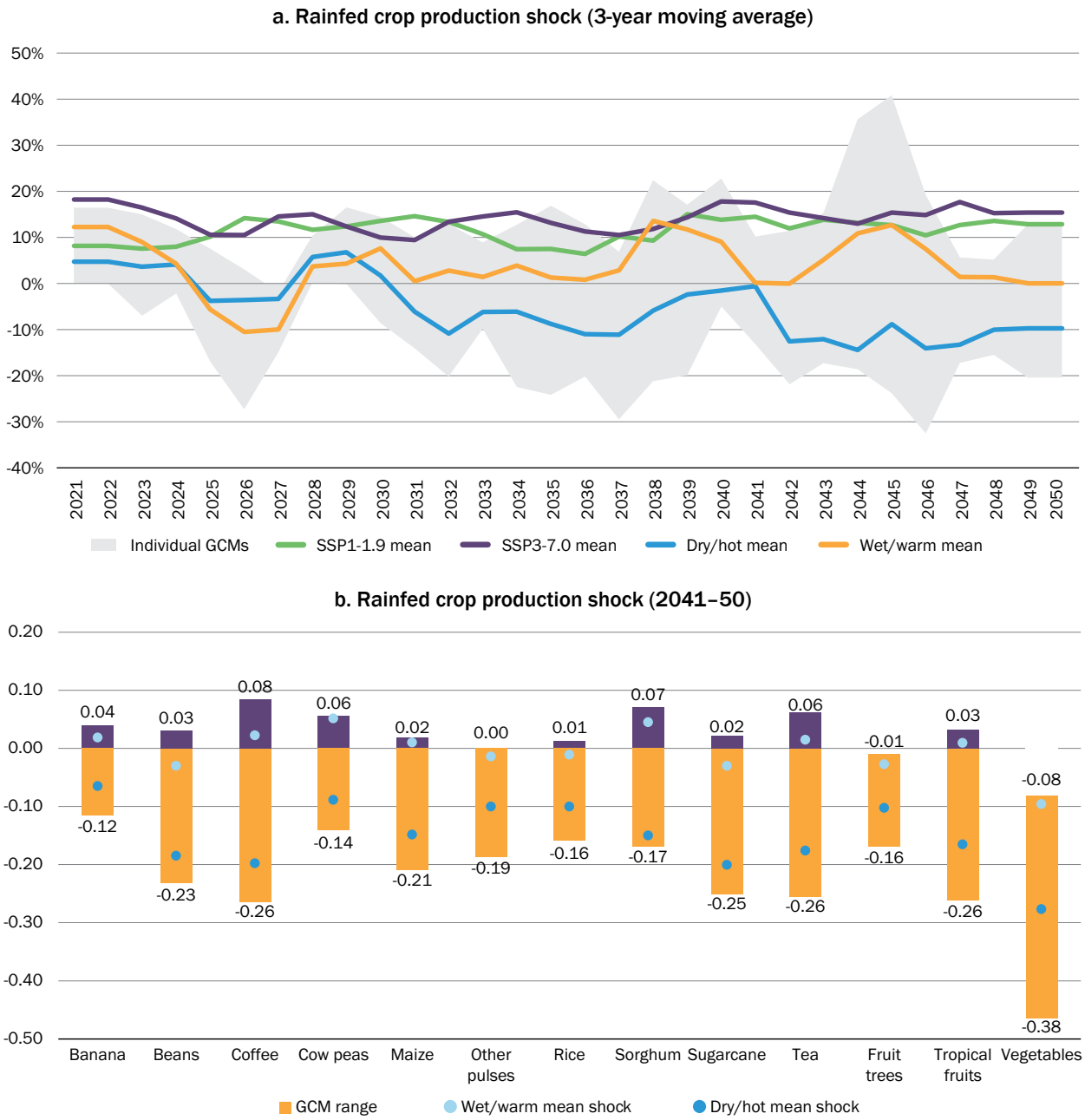
Road transport carries about 93 percent of all freight and passenger traffic in Kenya. Although costs are relatively high, the air transport industry—including airlines and their supply chains—are estimated to contribute $1.6 billion to Kenya's GDP. The Port of Mombasa, a major gateway to trade that serves a region with a population of over 250 million people, receives more imports than exports, but is expected to handle about 10 million containers annually within three decades (Kenya Port Authority 2018). The susceptibility of infrastructure to climate risks is typically influenced by transport assets' resilience to extreme events. Although inadequate network maintenance can result in a gradual deterioration of conditions over time due to precipitation, more immediate impacts are experienced in the form of compromised vehicle stability and disrupted traffic. An aggregate assessment of the impacts of climate on roads and bridges by 2030 finds that additional annual damages could range from $100–900 million, with damages decreasing through 2040, and increasing again in 2050, with a range from around $400 million to $900 million (IEc 2023).

13 Spending on agricultural research fell steadily in the decade before 2016, reaching one-third of its 2006 value, resulting in a fall in qualified extension service personnel, with a 1:1.000 ratio of national extension staff to farmers, compared with the recommended 1:400 (Breisinger et al. 2022).

14 Kenya Food Security Act 2017 and Constitution.

15 https://atlas.cid.harvard.edu/countries/116/product-table (viewed April 2023).

Figure 1.5: Impact of different climate models on rainfed crops

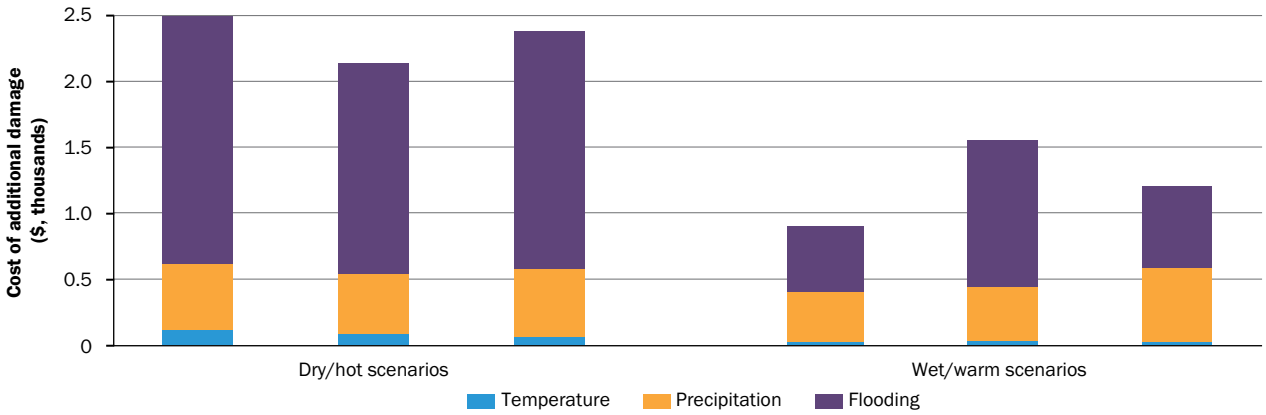


Source: IEc 2023.

Flooding is responsible for most of the additional costs, followed by precipitation and temperature change (figure 1.6).

Some regions of Kenya remain marginalized due to poor road conditions. For example, in the northeast, Isiolo, Wajir, Mandera, Garissa, and other counties, where the populations rely mainly on livestock and trading, are cut off from the rest of the country in the rainy season. The poor infrastructure network results in poor access to services and information, restricting the development of input and product markets, and as a result, 55–87 percent of the population in these counties live below the absolute poverty line, compared to 30.3 percent nationally.

Figure 1.6: Additional annual damage per kilometer, by climate event (baseline to 2031–50)



Source: IEc 2023.

1.3.3. Urban areas, Kenya's centers of economic activity, are at risk of floods and heat events

Poorly planned urbanization has led to multiple challenges that impact livability, resilience, and economic growth. As one of Africa's fastest-urbanizing countries, Kenya's urban areas are major contributors to the economy. But rapid urbanization has not been matched by adequate planning and investment in urban infrastructure and enhancement of access services, which are important for job creation and MSME productivity. Around 28 percent of Kenyans live in urban areas, and this is expected to increase to 46 percent by 2050.[16] Compared to other LMICs, a relatively larger percentage of Kenya's population lives in urban slums (Feng and Russ 2023). Its affordable housing deficit of more than 2 million units is expected to grow to 3 million by 2025 (World Bank 2017).

A considerable portion of public infrastructure is vulnerable to hazard risk. As part of a country climate risk analysis, this CCDR examined 10 cities: Eldoret, Garissa, Isiolo, Kisumu. Lodwar, Mombasa, Nairobi, Naruku, Nyeri, and Wote. Ranging in size, population density, and primary economic activity, these 10 cities are home to 68 percent of the country's urban population. They are projected to experience mean temperature increases of 0.6–1.4°C by 2040–59, from the national mean annual temperature of 24.3°C. Projected average temperatures vary from 16–31°C, with the maximum daily temperature reaching 40°C in some cities. Exposed built-up areas are projected to increase through 2100 due to urban expansion under all policy scenarios. Across the 10 urban areas, built-up area grew by 54.6 percent from 1985 to 2015, and built-up areas exposed to pluvial flood hazard grew by 57.9 percent, higher than the overall rate. Urban intensification and expansion could further increase built-up areas in flood zones over the course of this century.

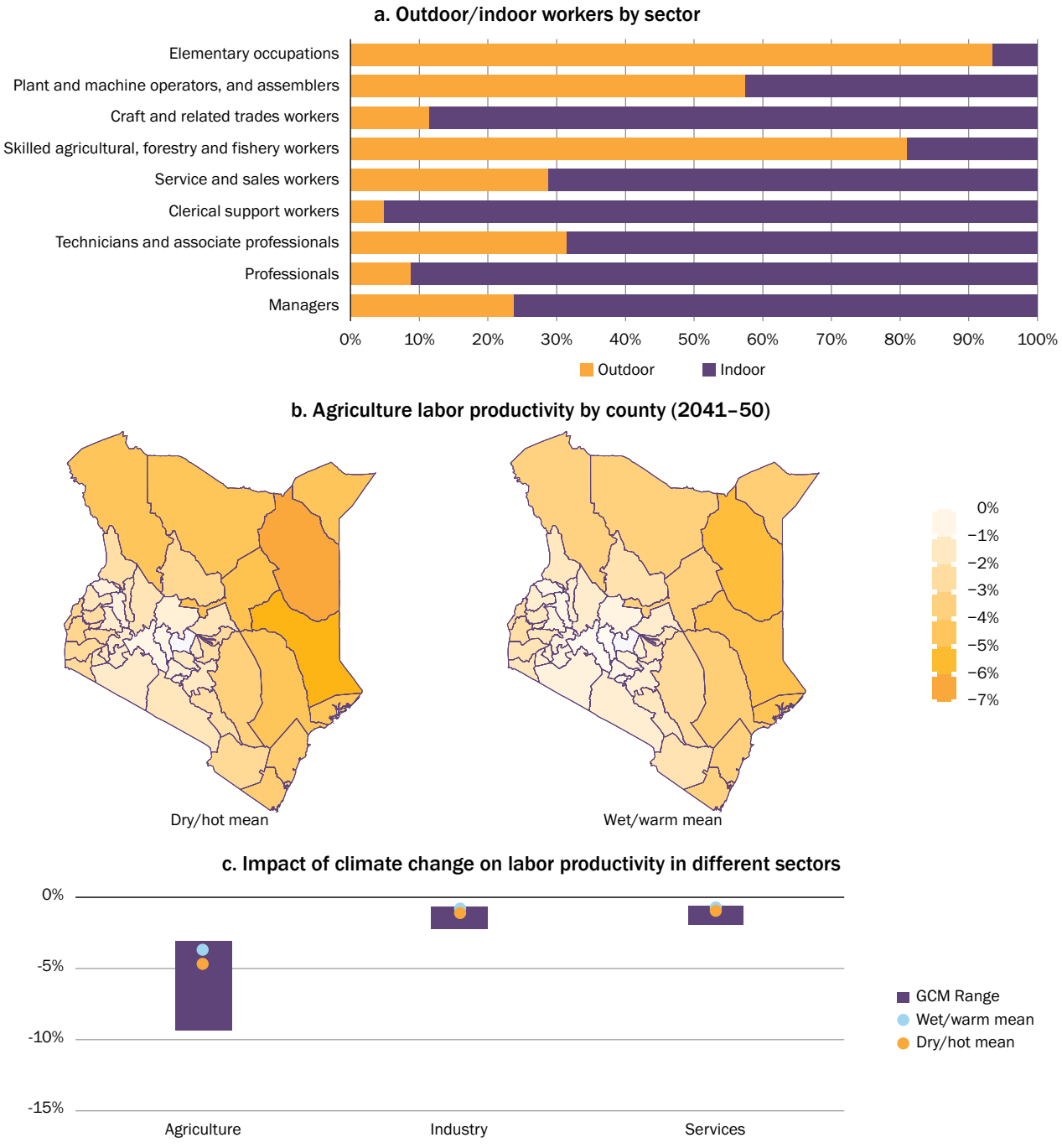
Although there are regional differences in fluvial (riverine) flood hazards, pluvial (surface water) flood hazards are a serious threat in all 10 urban areas. Seasonal inundation of low-lying areas (Lake Victoria and Tana River) are major sources of flood hazard, with their flood zones spreading from Garissa to Kisumu. Pluvial flood zones, on the other hand, tend to be disjointed and affect both older and newer settlements, creating challenges for flood control and prevention, in terms of updating infrastructure in historic neighborhoods and protecting newer residents in more recent settlements. Rainfall-triggered landslide hazards are a major threat in several of the urban areas studied.

16 https://databank.worldbank.org/source/population-estimates-and-projections#

1.3.4. Climate change is expected to impact labor productivity across all economic sectors

Increased heat is forecast to have a significant negative impact on labor productivity, compared to a baseline of no climate change impacts. Outdoor labor productivity is expected to decline the most, exacerbating the direct impact of climate change on low-skilled workers and sectors like agriculture, forestry, and fisheries, particularly in the arid and semi-arid lands (ASALs) (figure 1.7). While both indoor and outdoor workers can be impacted by heat stress, outdoor workers are generally exposed to higher wet bulb globe temperatures at full sun exposure.

Figure 1.7: Sectors most affected by climate change



Source: IEc 2023.

Labor productivity in industry and services is impacted by poor air quality and the urban heat island effect. The impacts of climate change on labor productivity in the agriculture, industry, and services sectors are significant independent of the climate scenarios (figure 1.7c). This is compounded by high levels of pollution, with average small particulate matter (PM2.5) in the 10 urban areas exceeding 5 μg/m^3, a threshold associated with a 6–13 percent increase in long-term mortality.[17] Air pollution is caused by transportation, industry, and domestic cooking fuel. There are spatial differentiations in the impact of heat and pollutants based in urban areas, with heat distribution correlating with patterns of older and newer settlements, and lower values associated with blue and green infrastructure such as open space, rivers, waterways, or coastal areas. For example, in Garissa, surface temperatures in the denser built-up areas in the central, northern and southern parts of the city are in the high 40s Celsius, while forested areas close to the river on the western side are significantly cooler, depicting a classic urban heat island.

1.3.5. Climate change is expected to increase the incidence of certain diseases

Climate change will increase households' exposure to health shocks, due to an increase in vector- and waterborne diseases, heat stress, and air pollution. The projected higher temperatures and rainfall intensities are predicted to increase suitability for malaria vector species, with spillovers into seasonal transmission areas, traditionally low-risk areas, and areas where the malaria burden had previously been controlled. The mortality and morbidity due to malaria and dengue are expected to increase by 56 and 35 percent respectively by 2050. Climate change–induced flash floods and prolonged droughts in Kenya have significantly affected the quality and quantity of drinking water, with direct implications for outbreaks of waterborne diseases. The prolonged dry seasons increase the length and intensity of allergy seasons and pollutants, leading to lower air quality and more respiratory illnesses. Other expected health impacts of climate change include heat-related illness, rising food insecurity, mental health, and well-being challenges, and direct injuries and deaths due to extreme weather events; children, women, and elderly people are disproportionally affected, especially in poor rural households (UNDP 2020). Kenya's health system, already inadequate, will struggle to cope with the growing demand for services.

1.3.6. Households' socioeconomic status influences how they cope with climate shocks

Households have different ways of coping with climate shocks. In the first half of 2022, Kenyan households were exposed to sharp increases in food, fuel, and input prices, and the worst drought in the Horn of Africa in over 40 years.[18] Households with agricultural activities are particularly vulnerable to these climatic shocks, with 40 percent reporting a negative impact from drought in 2022 or 2023. Exposure increases with aridity, with 56 percent of households with agricultural activities in arid counties reporting a negative impact, compared to 35 percent in non-arid counties. But due to the distribution of the population, around 40 percent of drought-affected agricultural households were in non-arid counties, while roughly 10 percent were in arid counties. Around 80 percent of agricultural households across the country reported, via phone surveys, that the drought damaged their crops, and 15 percent lost livestock. In arid counties, however, over two-thirds of reported a loss of livestock.

To cope with multiple shocks, households reduce consumption or look for additional income. Over 90 percent of households reported being affected by the increase in food prices in the last 12 months, 40 percent by energy price increases, and over one-third by an increase in input prices. Around 37 percent of affected households said they have reduced food consumption due to higher food prices, and just under one-third looked for additional income sources. Rural households are more liked to reduce consumption, and urban households more likely to seek additional income. Households in arid counties are more likely to rely on credit to cope with the increase in food prices (17 percent). In response to increasing energy

17 World Bank Urban and DRM Team. 2023. "Urban and DRM Sector" Background note for Kenya CCDR.

18 The World Food Programme warns of up to 26 million people sliding into crisis-level food insecurity in the region by the end of 2022. https://docs.wfp.org/api/documents/WFP-0000142656/download/?_ga=2.209904789.1429357199.1667548913-941467586.1667548913.

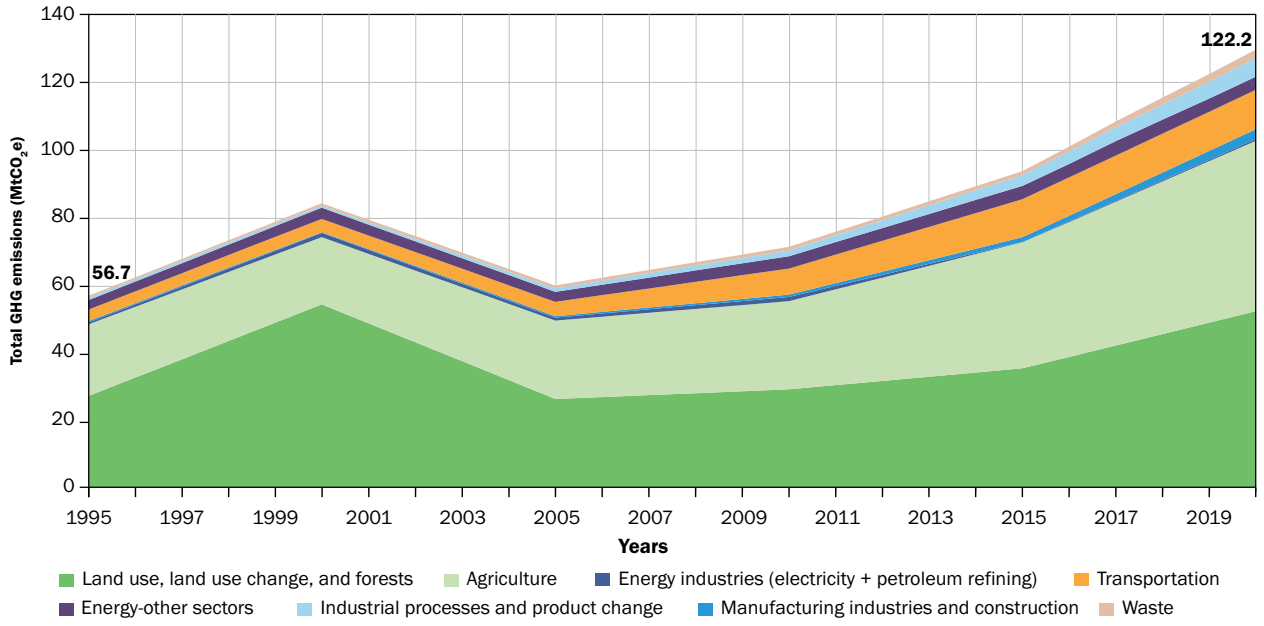
prices, households predominately looked for other income sources (31 percent) or did nothing (29 percent), while in arid counties, households more often reduced their nonfood consumption. These strategies remain similar to how households coped with climate shocks over a period of five years till 2015/2016. Repeatedly deploying such coping strategies can lead to child malnutrition and selling of assets, which have long-term impacts on households' future socioeconomic mobility.

Although climatic conditions in Kenya improved in 2023, food security continued to be an issue. By May 2023, over one-fifth of crop-growing households reported an increase in their harvest compared to 9 percent in June 2022. But despite the improving climate, food security continued to worsen. More than half of Kenyan households reported an adult skipping a meal in the last seven days, with almost one-fifth reporting an adult skipping five or more meals. The increase in food insecurity was driven by increases in non-arid and semi-arid counties, although the share of households with a member skipping five or more meals was largest in arid counties. According to the National Drought Management Authority's (NDMA), 2.8 million people needed assistance and over 650,000 children were acutely malnourished and in need of treatment in August 2023 (NDMA 2023b).

1.4. Kenya's GHG emissions are relatively minor on a global scale, but increasing

Kenya contributes less than 0.1 percent of global GHG emissions, but its emissions have more than doubled since 1995 (figure 1.8) (USAID 2022). In 1995, Kenya's GHG emissions were 56.7 $MtCO_2e$, increasing to 93.7 $MtCO_2e$ in 2015.[19] In 2015, agriculture was the leading source of emissions (40 percent) due largely to enteric fermentation and land use and land use change and forests (38 percent). These were followed by transport, energy (excluding transport), industrial processes, and waste, at 12, 6, 3, and 1 percent, respectively.

Figure 1.8: Total GHG emissions (1995–2020)



Source: World Bank staff calculations, based on data from Kenya's National Inventory Report.

19 The emissions data for the years ending in 5 and 0 between 1995 and 2015 are from Kenya's National Inventory Report, with interpolations for years in between; 2020 data are from Kenya's draft Long-Term Strategy document, received offline in April 2023, with interpolation for data for 2016–19.

Kenya's draft Long-Term Strategy estimates that, without interventions, annual GHG emissions will grow to more than double again from 2020 levels to 300 $MtCO_2e$ by 2050. This is based on projections for steep increases in emissions in the energy sector (projected to grow from 7.2 to 35.1 $MtCO_2e$), the transport sector (from 11.7 to 75.7 $MtCO_2e$), and agriculture (from 50.5 to 87.2 $MtCO_2e$).

1.4.1. Rapid and unplanned urbanization in Kenya is increasing GHG emissions

Rapid urbanization and the spatial development patterns adopted has made mobility in Kenya's large cities an overwhelming challenge. National data indicate that, between 2012 and 2021, about 2.6 million vehicles were added to the country's vehicle stock, at an annual growth rate of approximately 10 percent. Kenya has been motorizing at a higher pace than originally projected, with 93 vehicles per 1,000 inhabitants in 2021, compared with past projections of 56 vehicles per 1,000 inhabitants by 2030 (Ogot, Nyang'aya and Muriuki 2018). The high pace of motorization is expected to continue, even as the public transport system and traffic management struggle to keep up with the pace and scale of urbanization (table 1.1), with only a small percentage of person trips in urban areas taking place in private vehicles. About 90 percent of vehicles have a petrol engine, and 9 percent have a diesel engine. In 2019, 88 percent of Kenya's vehicles were imported used vehicles and 12 percent were new (Kenya Association of Manufacturers 2020). Despite Kenya's strict age limit for imported vehicles (less than eight years old from the year of first registration), the average age of passenger cars and *matatus* (privately owned minibuses), is 12.4 and 15.9 years, respectively, and these have low fuel efficiency (Ogot, Nyang'aya and Muriuki 2018). Between May 2021 and February 2023, approximately 0.1 percent of new vehicle registrations were for electric vehicles (EVs).

Table 1.1: Modal share of different forms of transport in urban areas

Modal share (%)	Nairobi (2013)	Mombasa (2015)	Nakuru (2018)	Kisumu (2020)
Walking	37.8	45.5	63.8	52.7
Matatu (minibus)	*41.5 (10.5)*	*36.9*	*15.4*	*13.0*
Boda-boda (motorcycle taxi)	*4.0*	*	*13.2*	*19.3*
Tuk-tuk	*	*	*	3.4
Private vehicle	12.6	2.5	6.2	5.6
Other	4.16	15.1	1.4	6.0

Sources: Nairobi: Integrated Urban Development Plan; Mombasa: Comprehensive Development Master Plan in the Mombasa Gate City; Nakuru: County Integrated Development Plan 2018–22; Kisumu: Kisumu Sustainable Mobility Plan 2020.

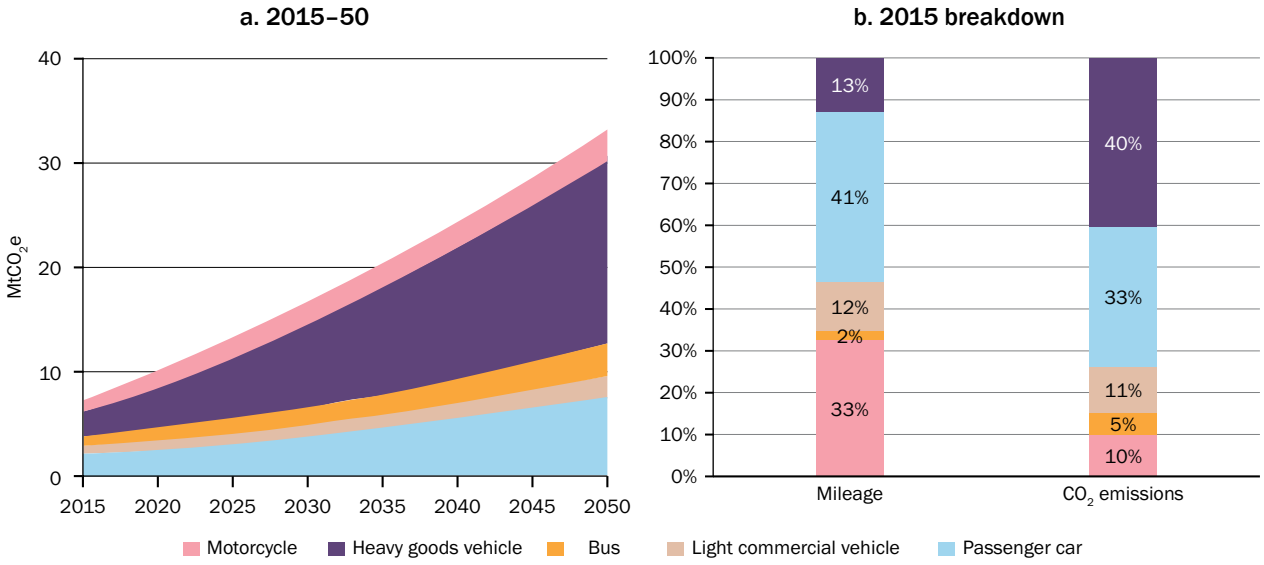
Notes: * = included under "Other"; Mombasa matatu figure includes ferry and rail; Kisumu boda-boda figure includes motorcycle and motor-boda.

1.4.2. Kenya's supply chain logistics depend heavily on roads and fossil fuels

The movement of freight and products from factories to ports and vice versa is a significant source of emissions. In Kenya, total road transport emissions are expected to increase by 380 percent between 2015 and 2050, with the share of heavy goods vehicles growing from 41 to 55 percent (GIZ 2018). Although passenger cars dominate total mileage driven, trucks cause the largest amount of emissions (figure 1.9).

Petroleum fuel consumption in the transport sector increased significantly between 2014 and 2018 and, without intervention, is projected to continue growing at an accelerated rate between 2018 and 2025. Road transport is responsible for about 85 percent of Kenya's petroleum fuel consumption, and aviation accounts for about 15 percent. With the introduction of freight rail services along the standard gauge railway (SGR), the rail sector's consumption of fuel more than tripled from 1,147 tonnes in 2017 to 3,544 tonnes in 2018 and almost doubled between 2020 and 2021 (from 11,400 to 19,400 tonnes). It is

Figure 1.9: Mileage and CO_2 emissions from road transport in Kenya



Source: GIZ 2018.

worth mentioning that the shift in freight volume from road to rail has resulted in with nearly 6 million tonnes of traffic being transported by SGR in 2021, after its opening in May 2017. This reduced emissions in freight by reducing the fuel consumption of heavy trucks (see section 3.3.1).

1.4.3. Kenya's predominantly renewable energy mix will need to meet growing energy demands

Kenya has developed a well-diversified energy mix, and about 90 percent of its energy generation is renewable, with geothermal, hydro, and wind providing 48, 33, and 12 percent, respectively. Installed generation capacity is 3,121 megawatts (MW) compared to peak demand of 2,128 MW. Between 2015 and 2023, thermal (fossil fuel-based) capacity has declined from about one-third to about one-fifth of installed capacity, with generation halving to contribute only 10–12 percent of total energy generation in 2022. About 30 percent of installed capacity is owned and operated by independent power producers, which have mobilized at least $2.5 billion in private capital.

Kenya has leveraged regional integration and renewable energy imports in meeting its national power demand. The national utility, Kenya Power and Lighting Company (KPLC), has recently signed a power purchase agreement with Ethiopia Electric Utility to import 200 MW from Ethiopia, increasing to 400 MW after three years, once the network strengthening investments are completed in Kenya's system to allow it to absorb the increased import. Crossborder energy trade is also happening on a small scale with Uganda and Tanzania (338 GWh in 2022).

While Kenya is a low GHG emitter, it should remain vigilant to avoid becoming reliant on fossil fuel production. It will need to install more than 1,500 MW of additional capacity by 2030 to meet the electricity demand. Electricity also contributes only about 9 percent of the country's total energy supply. Biomass and fossil fuels account for 68 percent and 22 percent, respectively, with 74.7 percent of the population using biomass as their primary energy source, predominantly for cooking, with about 24 percent using liquefied petroleum gas (LPG). Growth in energy demand in energy-intensive industries—such as steel and cement manufacturing, which both use coal—may also contribute to higher GHG emissions.

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Policy and Institutional Structures for Addressing Climate Change

2. Policy and Institutional Structures for Addressing Climate Change

Kenya can be a regional leader in resilient and low-carbon growth if it makes effective progress from policy to implementation. The country has developed a strong climate policy framework, including the National Climate Change Response Strategy (2010), NCCAP (2013–18), NDMA Act (2016), National CCA (2016)—rare among its peers—Green Economy Strategy and Implementation Plan (2016–30), National Adaptation Plan (2017), and NCCAP (2018–22). Implementing this framework should now be the priority. Kenya's NDCs stipulate that 87 percent of NDC actions will be undertaken with international support. Mobilizing this level of international support, ensuring it aligns with the country's priorities, and deploying it effectively will require an unprecedented whole-of-government effort. This chapter explores three thematic priorities the government can use to organize the actions needed to institutionalize this effort: aligning the climate policy planning and implementation framework with NDC goals, operationalizing robust institutional coordination mechanisms, and strengthening institutional capacity to upscale public and concessional finance to support climate outcomes.

2.1. Align climate policy planning and implementation framework with NDC goals

Fully aligning its climate policy framework and NDCs could strengthen Kenya's access to climate finance. As the overarching legal instrument that promotes climate-resilient, low-carbon economic development, the CCA establishes the key institutions to manage the climate agenda. Yet it does not discuss how NDC targets should feature in core planning instruments—that is, medium-term plans (MTPs), sector strategies, and annual budgets. Required by the CCA, the 2018–22 NCCAP aims to address the country's vulnerability to climate change through measures such as reducing GHG emissions, promoting renewable energy, and enhancing resilience to climate change impacts. Emphasizing the importance of stakeholder involvement and collaboration between government agencies, civil society, and the private sector, it details priority actions for climate-related sectors. Although many of these, including forestry, agriculture, water, transport, and energy, overlap with NDC sectors, the lack of a requirement to integrate NDC elements into planning instruments constrains the government's ability to mobilize climate finance.

Integrating the NDC mitigation and adaptation targets in the new MTP could bolster effective budgeting to address climate change. Including NDC and the National Adaptation Plan indicators in the MTP monitoring systems—that is, the National and County Integrated Monitoring and Evaluation Systems and budget circulars—would encourage ministries, counties, departments, and agencies (MCDAs) to align their budget proposals with NDC targets. This would allow the government to track progress against NDC objectives and inform climate finance mobilization.

Featuring adaptation and resilience measures more prominently in development planning could increase resilience. County Integrated Development Plans could include investments in infrastructure and social safety nets to build resilience against drought and floods. National agencies and county governments would support such investments through budgeting, public investment, and public financial management systems and incentives that underpin the intergovernmental fiscal transfer scheme. Such actions would increase the contribution of public resources to local communities' resilience against climate events.

Engaging citizens and local communities in the policy planning and implementation discourse will be key for success. With Kenya's rich history of understanding its natural surroundings, local and traditional knowledge is valuable for devising locally applicable and scalable adaptation interventions for national and

county adaptation strategies.[20] To harness this knowledge, it is important to clarify mechanisms for engaging civil society and external stakeholders in formulating policy, such as for the upcoming NCCAP. The Kenyan judicial system enables citizens to bring complaints before the Environment and Land Court against any person acting in a way that may adversely affect mitigation and adaptation actions, and recent cases signal that violating public participation requirements can be a cause for a judge to halt the implementation of an investment project.[21] But the absence of technical and scientific guidance limits legislative scrutiny over expenditures related to addressing climate change. The absence of information regarding progress against of climate objectives is also a challenge for engaging the public.

Kenya could benefit from strengthening and streamlining monitoring and reporting on climate indicators. The Budget Policy Statement (BPS) is clear regarding climate risks in fiscal policy and has information on projects and programs to address the risks. For example, in 2022, the BPS proposed to upscale the development of County Emergency Operations Plans and County Multi-Hazard Risk Profiles, to develop a national policy framework on green fiscal incentives, issue a sovereign green bond, and approve a long-term strategy for climate change and the next NCCAP, some of which were achieved. The BPS would benefit from including the potential or real cost of recovering from climate-induced events, such as rehabilitating damaged infrastructure or providing support to affected populations. Program-based budgeting allows for a yearly review of MCDA performance outcomes and establishing a mechanism for aggregating these outcomes would allow the government to gauge overall progress toward achieving its NDCs. Introducing a data management platform that tracks the country's climate and disaster risk exposure and NDC indicators would be helpful. Timely and robust information on climate change risk at national and subnational levels is key for public and private sector decisions on investments and insurance.

2.2. Operationalize robust institutional coordination mechanisms for climate action

Operationalizing a robust whole-of-economy coordination mechanism is urgent. Most countries that meet their climate targets consider climate action as a whole-of-government matter and have political and technical coordinating bodies comprising actors with relevant knowledge, representatives of academic institutions, and involvement of the head of government (von Lüpke, Leopold and Tosun 2022). The CCA establishes the National Climate Change Council (NCCC) as the high-level coordination mechanism for the climate agenda. Chaired by the president and deputy president, the NCCC's nine members are appointed by the president and include sector-specific cabinet secretaries, the chair of the Council of Governors, and representatives from the private sector, civil society, marginalized communities, and academia. However, the council is yet to be convened and its wide scope of high-profile functions makes its absence problematic for the climate agenda. For example, the absence of an operational NCCC has delayed the operationalization of the National Climate Change Fund (NCCF), and therefore the mobilization of financing for climate actions.

An active and robust coordination mechanism would ensure a whole-of-government approach to planning, financing, implementing, and reporting on climate positive actions. Such a mechanism can also play a role in promoting the Green Economy Strategy and Implementation Plan 2016–30, providing a platform for engaging the private sector in implementing green growth. Robust and effective vertical and horizontal coordination is important for resolving institutional and capacity issues, ensuring NDC targets are mainstreamed into the next MTP and relevant sector policies and strategies, and solidifying the technical coherence of climate action.

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20 Despite evidence that adaptation responses influenced by Indigenous and local knowledge are more effective in reducing risks, only five African governments—Benin, Burkina Faso, Somalia, South Africa, and Zimbabwe—acknowledge and include Indigenous and local knowledge in their long-term adaptation planning.

21 See, for example, the 2019 case of Save Lamu vs. National Environmental Management Authority and Amu Power Co, Ltd. https://leap.unep.org/countries/ke/national-case-law/save-lamu-et-al-vs-national-environmental-management-authority-and.

The incomplete devolution of functions to county level for climate-related sectors warrants attention. Key climate sectors such as WASH, agriculture, and the environment were devolved under the 2010 constitution. But the transfer of functions from the national government is incomplete, complicating climate agenda coordination. For example, it is unclear how much the various state-owned enterprises (SOEs) in the water sector are coordinating with relevant agencies on environmental activities or initiatives to advance adaptation goals, creating a fragmented approach to sectoral issues. According to the CCA, each state department and public entity must have an adequately staffed and budgeted Climate Change Unit to coordinate the mainstreaming of climate change actions into sectoral strategies. And while some line ministries have established such a unit, many are understaffed.

The World Bank-financed Financing Locally Led Climate Action (FLLoCA) program is supporting all counties to establish a climate change unit and many have developed other coordination mechanisms. The CCA also states that county governments must designate a member of their County Executive Committee to coordinate local climate change initiatives. Some, such as Kisumu County, have established climate change working groups, multistakeholder platforms that bring together representatives from local government, NGOs, and municipalities to develop and monitor the climate change action plan in a participatory manner. Others have developed cross-sectoral steering committees. Cities and urban areas face very different climate change impacts, but in both, the wards act as the coordinating actor to consult with citizens and communities, elaborating action plans that outline climate adaptation and mitigation measures, and sharing these with county directorates.

Operationalizing the NCCF would help mobilize climate finance. The CCA establishes the NCCF within the National Treasury to fund national investments, and the County Climate Change Fund (CCCF) to operate at subnational level. But despite its designation as the primary financing mechanism for priority NCCC-approved climate change actions, the NCCF has yet to be operationalized and its governance and implementation arrangements remain undefined. There has been more progress on the CCCF, which was piloted in five counties—Isiolo, Kitui, Makueni, Garissa, and Wajir, which allocated 2 percent of their annual development budget to the fund—through the Adaptation Consortium under the NDMA. Across the country, 62 percent of all counties have established a CCCF to date. The NCCF requires an accompanying resource mobilization and investment strategy. When developing this strategy and determining priority investments, decision-makers should consider public investment management (PIM) regulations and the revised Public Private Partnership (PPP) Act, which allows counties to enter into PPPs. Once approved, these regulations can allow counties to use PPPs as vehicles for resource mobilization. The ongoing dialogue on a carbon market framework could also become part of the NCCF and CCCF resource mobilization strategies.

2.3. Strengthen institutional capacity to upscale public and concessional climate finance

Treating climate change as a crosscutting public finance matter would help Kenya align the budget with climate change strategies in the BPS and incorporate specific climate targets and indicators into the performance contracts of budget units and SOEs. Developing a framework to identify, tag and track climate-related expenditures and incorporating it into the Integrated Financial Management Information System would allow the country to systematically trace and link budgetary allocations to their corresponding expenses and outputs in climate-related actions and provide comprehensive budgeting and expenditure information related to climate change, enabling the government to make informed decisions on climate policies (Government of Kenya and UNDP 2019). Tracking private climate finance flows and providing regular reports on overall financing alignment with national climate goals would also be beneficial, while integrating the sustainable procurement framework that is under development into procurement regulations can help incentivize the emergence of a green goods and services industry.

When allocating public expenditure on climate action, decision-makers should prioritize the implementation of investments that advance adaptation and resilience. This will require a shift in the way MCDAs in key climate-related sectors use their annual budgets for climate change-specific programs and projects, from developing policies and strategies to investing in activities that will achieve climate change and NDCs goals. Climate finance for lowering GHG emissions is being disproportionally targeted at the renewable energy sector, while efforts in agriculture, forestry and land use, transport, water management, and urban areas are dramatically underfunded. For example, in 2018, only around one-third of the financing needed for climate action flowed to climate-related investments, and eighty percent of this was channeled to mitigation activities (Mazza, Balm and Caenegem 2021).

The government should develop a pipeline of critical projects that deliver climate objectives. Establishing a project preparation facility would allow MCDAs to identify, design, and appraise complex, bankable projects that are eligible for climate finance, including by green bonds. This can be embedded into the National Treasury and provided for in the PIM and PPP regulations as an advisory facility supporting MCDAs that lack the capacity or resources to design and implement transformational infrastructure investments in climate-related sectors. Clarifying the roles of MCDAs, SOEs, and municipal governments around public infrastructure in climate-relevant sectors can also help to leverage synergies in the use of institutional capacity and resources. Introducing a public infrastructure and asset maintenance strategy and regulations can help delay the deterioration of critical infrastructure and reduce the need for substantial capital investments over the long run. Incorporating climate disaster risk screening as part of PIM regulations and manuals throughout all phases of the project cycle can ensure infrastructure is more resilient and inform the application of maintenance protocols once the asset is completed.

Intergovernmental fiscal arrangements can incentivize local-level climate action. Considering the challenges county governments face in accessing green finance, the National Treasury can leverage mechanisms such as budget reallocations, green bonds, the NCCF, the CCCF, insurance and guarantee financing for local projects, and create national intermediary institutions such as subnational development banks to support local and regional green infrastructure outcomes. Conditional grants earmarked for adaptation or mitigation investments, such as those under the World Bank-financed FLLoCA program, are a step in the right direction. Kenya's rich endowment of protected areas is an opportunity for implementing innovative fiscal transfer mechanisms, such as ecological fiscal transfers, which can incentivize county governments to take climate action based on their achievement of ecological indicators for preserving natural capital. There is room in the ongoing discourse about mobilization of taxes, fees, and user charges for counties to consider subsidies or tax exemptions to incentivize sustainability outcomes at local level.

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3

Measures for Inclusive Growth that Increase Climate Resilience and Maintain a Low-Carbon Path

3. Measures for Inclusive Growth that Increase Climate Resilience and Maintain a Low-Carbon Path

To achieve its rapid and inclusive growth ambitions in climate-positive manner, three key multisectoral priority action areas, centered around natural, human, and physical capital, are crucial. Actions in these areas can improve food security, increase productivity, change the sector composition of the economy, and make Kenya's exports more dynamic while bolstering resilience to climate change and promoting growth that is not carbon intensive. This chapter presents investment and policy measures key for operationalizing actions to manage water, land, and forests for climate resilient agriculture and rural economies, deliver people-centered resilience with climate-informed basic services and urbanization, and strengthen productivity and competitiveness in international markets through shifts in energy, transport, and digital systems.

3.1. Manage water, land, and forests for climate-resilient agriculture and rural economies

Water is necessary for agriculture, energy, and domestic consumption. More than 98 percent of Kenya's agricultural and rangeland area is rainfed, making increasingly erratic rainfall the main climate risk to Kenya's food and water security, agricultural production, and human capital.[22] Kenya's varied topographical features—which include high mountains, plains, and coastal areas—directly affect water relations. Kenya's high altitude mountainous areas, often referred to as natural 'water towers', play a critical role in regulating water flows to lower altitude parts of the country. The ability of these natural water towers regulate water flows is threatened by deforestation land degradation.

Kenya faces economic, rather than absolute, water scarcity, as there are water resources it has yet to harness for productive uses. Existing water infrastructure only provides 3 cubic kilometers for irrigation and 2 cubic kilometers for domestic purposes, industry, and livestock. As such, much of the 21 cubic kilometers of internally renewable water resources is under-used, and there is considerable scope for sustainably developing these water resources to expand irrigation and for growing cities. The country's ability to manage natural climate variability is also constrained by its relatively low level of built water storage capacity. At around 103 cubic meters per capita, Kenya is well below the Sub-Saharan Africa average of 807 cubic meters per capita,[23] underscoring the important role of water towers in naturally regulating water flows.

Unsustainable land and forest management compounds the exposure of Kenya's economy to the impact of climate risks. The conversion of forests and dense vegetation implies a loss of natural regulatory services, such as natural water storage, water flow regulation, and soil erosion prevention. This can increase the impact of flooding on physical capital, increase siltation in physical water storage systems, and lead to the loss of organic matter in topsoil, which is vital for agricultural productivity. Buffering against the consequences of climate change requires a coordinated and multisectoral approach to managing water, land, and forests for economic purposes and complementing this with sector-specific measures.

3.1.1. Improve water resource management and expand irrigation

For water security, water, food, and energy systems must transform at a faster pace over the next 30 years than they have over the past 60 years. With water demand increasing from growing urban populations and irrigation, per capita water availability in the 2040s and 2050s will fall to just over 215 cubic meters, and Kenya may face absolute water scarcity. Addressing its economic water scarcity will require further investment in water storage, conveyance, irrigation, and water supply infrastructure, as set out in the proposed National Irrigation Sector Investment Plan and National Water Sector Investment Plan, respectively.

22 https://wateraccounting.app/media/045b6377-da48-4acc-bdb4-312ba60f3975/index.html.

23 For example, South Africa has seven times more storage capacity than Kenya.

Decisions on where and how to develop Kenya's remaining freshwater resources are urgent and need to factor in future development and climate. By 2050, under the ASP scenario, with 70 percent of people living in urban areas, around one-third of available renewable water resources will need to be channeled to cities, leaving two-thirds for irrigation and environmental flows. In the Athi, Tana, and Rift Valley River Basins, planned irrigation scheme expansions (>140,000 hectares) will require half of all available water; and, if irrigation is also expanded below High Grand Falls Dam, even more will be required. Such demand makes irrigation sensitive to climate shocks, forcing potential tradeoffs with water allocation to cities and the environment. But there is opportunity to expand irrigation in other river basins, such as Lake Victoria North and South, without it being climate sensitive. There is also scope to further develop decentralized water-harvesting structures, groundwater sources, and spate irrigation in the Ewaso Ng'iro Basin, where planned irrigation development is limited, and fodder is needed to climate-proof livestock production. To supply these growing demands from cities and irrigation, while also sustaining environmental base-flows, Kenya plans to expand its dam storage capacity fourfold, to around 16 cubic kilometers. This is enough to manage projected intra-annual variability in precipitation under all the climate futures examined, except CNRM-ESM2-1.

A framework for coherent action on water security that boosts climate resilience should include:

- Enhancing the water productivity of existing rainfed cropping systems through better soil and water management, agroforestry, and drought-tolerant crop use
- Rapidly expanding water use in agriculture through large, medium, and farmer-led irrigation services to cushion dry shocks and avert agricultural drought
- Sustaining water resources in landscapes by conserving native vegetation and supporting regulation services in watersheds, including storage, water quality protection, and groundwater recharge (section 3.1.2)
- Supporting sustainable grazing and biomass management models in rangelands, alongside water harvesting methods for livestock and fodder production, such as *hafir*, sand, and underground dams, and, where possible, spate irrigation
- Manage demand by improving financial, institutional, and water efficiencies
- Strategically use virtual water trade to import low-value, heavy water-using crops, such as wheat and maize, while using available water for high-value export crops, such as floriculture, horticulture, and tea
- Facilitating structural shifts in the economy—for example, from agriculture to services—to de-link the economy from heavy water use in the longer term.

3.1.2. Restore and manage forest assets for water storage while generating other economic benefits

Restoring and improving the management of Kenya's water towers can provide the natural water storage the country needs to smooth out climate change impacts on water availability in the medium and long terms. Kenya's five major forested water towers—Mount Kenya, Aberdares, Mau Forest Complex, Mount Elgon, and Cherangany Hills—supply 75 percent of the country's renewable surface water, and are vital for agriculture, industry, and domestic water consumption, and hydropower generation, which supplies 28 percent of Kenya's current power mix. The loss of around 50,000 hectares of forest cover in the water towers between 2000 and 2010 has reduced water availability by around 62 million cubic meters a year, and sediment deposits in reservoirs and dams have reduced water storage capacity by 1 million cubic meters (UNEP 2012).

The National Landscape and Ecosystem Restoration Programme (2022–32) commits the government to go beyond its NDC target of 10 percent of total land area under forest (an increase of 1.76 million hectares of forests) to placing 10.58 million hectares under tree cover. Based on preliminary drafts of government strategies for achieving this target, approximately half of this target would be delivered in dryland landscapes, less than 30 percent would involve agroforestry in farmlands, and the remainder would involve planting in degraded water towers, private plantations, public spaces, and public institutions. Prioritizing the landscape restoration sites based on the possibility of stacking climate and development benefits from different provisioning and regulatory ecosystem services could generate meaningful economic benefits, such as increased natural water storage.

Linking landscape and ecosystem restoration actions with efforts to address the drivers of forest landscape degradation and deforestation, and economic opportunities will enhance their effectiveness. Forest degradation and deforestation are the result of illegal encroachment for agricultural expansion, infrastructure extension, and mining (Indufor 2023), unsustainable fuelwood and charcoal production, uncontrolled livestock grazing, and forest fires. Constraints to land access, and tenure insecurity constrain investments in increasing agricultural productivity. The slow transition to clean cooking compounds the situation, with the BAU scenario projecting that 8.49 million households will rely on fuelwood and charcoal in 2030.

Accelerating the registration of community lands is a no-regrets and low-cost investment that would provide tenure security and unlock opportunities for communities to engage in alternative economic development. Based on an average of preliminary cost estimation in Isiolo and Marsabit Counties, and 11–15 community land titles in each, we estimate that registering all community lands in a county would average $2.53 million. Secure tenure enables communities to engage with potential investors in activities such as carbon offsets. Registered land is also a prerequisite for receiving infrastructure development projects. Involving local stakeholders in the decisions to excise forest land, as outlined in the Forest Conservation and Management Act (2016), is an important complementary activity for reinforcing tenure security.

Implementing the government's clean cooking program will also be instrumental for effective landscape restoration. If the government meets its target of achieving universal access to improved cooking systems by 2028—assumed to involve 35 percent improved cooking systems and 65 percent modern energy cooking systems—approximately 5 million households would transition from traditional to improved cooking systems, 6.8 million from traditional to modern energy cooking systems, and 2.2 million from improved to modern energy cooking systems by 2028. This could reduce degraded forest areas by 346,000–520,000 hectares compared to BAU. Under an ASP scenario of 100 percent modern energy cooking systems by 2050, 16.1 million households will need to transition from traditional systems and 4.1 million from improved to modern energy cooking systems for no urban or rural households to rely on fuelwood or charcoal by 2050. At an estimated additional capital investment cost of $1.29 billion by 2030 compared to BAU, and $4.4 billion between 2031–50, this could reduce emissions by more than 10.8 $MtCO_2e$ by 2050 compared to BAU and generate other benefits for human health To provide the power for clean cooking, increased rural electricity access will also be necessary and could require the use of mini-grids and standalone solar systems in rural areas where electrification rates are low. Existing programs can help overcome constraints around awareness, acceptability, access, and affordability of alternative solutions, and results-based financing, including payments for reducing CO_2 emissions, could provide private sector incentives to support clean and efficient cooking.

Scaling up sustainable production of biomass-based energy is also vital. As well as traditional cookstoves, the cement, steel, textile, chemical processing, food, tea, and other industries are large users of biomass, much of which is not sustainably sourced. And while clean cooking will reduce biomass use, establishing a national certification system for sustainably sourced biomass could enable the emergence of a formal biomass

industry to supply key industries that could channel funding back into sustainable forest management on state, private and community-owned lands.

Coordinating landscape restoration efforts with economic opportunities can enhance their sustainability and development benefits. When selecting restoration sites, using criteria that combine climate and development benefits from different ecosystem services could increase benefits. For example, prioritizing landscape restoration in the south and central parts of Kenya, where agricultural is projected to expand, could generate multiple ecosystem services. This would improve habitat quality, reducing one of the main drivers of wildlife loss and boosting Kenya's wildlife tourism industry, an important source of foreign exchange and jobs in areas with few quality job opportunities.[24] Combining the improved habitat quality in selected basins that account for $1.03 billion of the total value of nature-based tourism in 2018 (representing approximately 96 percent of all national nature-based tourism) with the presence of wildlife populations in protected areas and reserves can increase the per-hectare increase in nature-based tourism value by 140 percent in conservancies, from $13.62 in 2018 to $32.7 in 2050, and by 144 percent in national parks and reserves, from $148.59 (2018) to $363.1 in 2050 (Turpie et al. 2023). Landscape restoration could also generate benefits from reduced flooding and increased carbon stocks. A preliminary estimation suggests that restoration could reverse a decrease in carbon stock of 26.38 $MtCO_2e$ between 2020 and 2050 under BAU to an increase of 322 $MtCO_2e$.[25]

Improved monitoring and mobilization of financing will be instrumental for operationalizing a coordinated, multisectoral landscape restoration effort that has positive climate and development outcomes. A comprehensive national forest monitoring and data system would provide granularity to restoration recommendations and help ensure restoration efforts are well coordinated and efficiently implemented across the energy, agriculture, and tourism sectors. Successful implementation of landscape restoration efforts could help Kenya meet its NDC commitments and net-zero targets, while making carbon credits available for international markets. The upfront investments needed to achieve tree planting and forest restoration at scale is well in excess of the public resources allocated to date for approximately 521,000 hectares. The government would benefit from exploring grant and concessional financing options, as the economic benefits exceed the costs. Chapter 5 presents some financing options.

3.1.3. Transform agricultural productivity

Climate change will impact Kenya's predominantly rainfed agriculture and livestock production systems, exposing them to the risks of annual variability in precipitation. The underdevelopment of water resources constrains agricultural output and exacerbates the exposure of rainfed agriculture to climate shocks. Under such circumstances, Kenya may benefit from importing some foods from parts of the world that have more water.

Achieving Kenya's stated target for self-sufficiency in food security with the anticipated impacts of climate change requires developing and disseminating technologies, innovations, and management practices. If maize is to remain the main dietary energy supply within the cereals category and to meet its 2050 food security goals, Kenya will need to expand agricultural land, increase its reliance on inorganic inputs, and allocated resources to improve agricultural yields, which are below those of its regional and international peers. This will help avoid a cumulative shortfall of 122.7–126.4 million tonnes of maize between 2023 and 2050. Dairy and beef herd sizes also need to increase, by some 21.43 million heads and 6.77 million heads, respectively (FAO 2019). Widespread deployment of technologies, innovations, and management practices—such as sustainable seed systems, expanded irrigation, and improved product

24 Between 1977 and 2013, Kenya lost 68% of its wildlife, with extreme declines among ungulates and predators.

25 This estimate compares carbon factors from the 2020 United Nations Food and Agriculture Organization (FAO) resource assessment with an alternative landcover of shrubland using data from Pfeifer et al. (2013). The FAO carbon factor is nearly three times higher than the carbon factor generated using a weighted average.

storage—could help increase maize production by an average of 75 percent.[26] Improving irrigation could increase outputs by 100–400 percent. Deploying technologies, innovations, and management practices in 5 percent of the area under maize production each year would allow Kenya to reach maize self-sufficiency 2028 under all climate scenarios, and reduce land under maize from 1.9 million to 577,284 hectares by 2050, boosting resilience and lowering emissions from land conversion/deforestation.

Box 3.1: Adopting improved animal feed and breeds could meet consumption needs while reducing heads of cattle—and methane emissions—by 2050

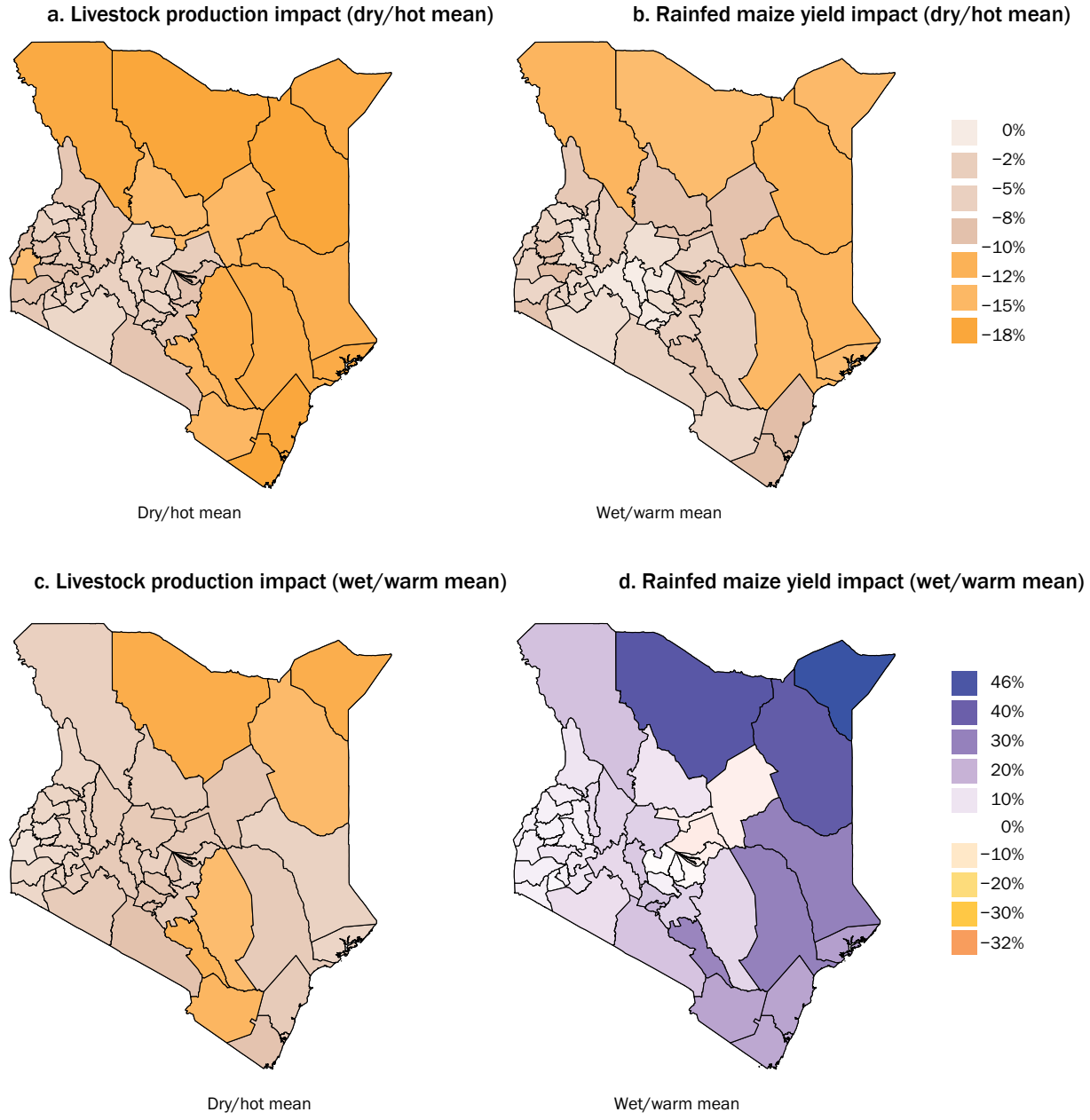
Assuming improvements of animal feed and breed that result in a slaughter weight of 450 kilograms per animal, and that 70 percent of lactating cows produce 20 liters of milk per day each, Kenya could shift from a future of 28.2 million to 13.1 million head of cattle, with around 25 percent dairy cows. This would allow the country to meet a yearly milk consumption of 180 liters per person and an annual per capita consumption of 30 kilograms of beef. Fewer cattle would imply improved rangeland quality, reduced water demand, and lower methane emissions, with estimates indicating a reduced emission intensity of 21–36 percent.

Tailored efforts to improve animal nutrition and herd health, through enhanced fodder production and improved vaccination programs, is also imperative for Kenya's food security and pastoral community incomes. Beef production in Kenya's ASAL counties is carried out mainly by pastoralists and large-scale ranches. Pastoralists produce about 80 percent of the beef consumed in Kenya, large-scale ranches about 2–5 percent, and highland farmers produce the rest as part of mixed farming. In the short term, it is important to prioritize the scaling up of improved fodder production by using suitable grass and legume varieties. The Kenya Agricultural & Livestock Research Organization and International Livestock Research Institute have developed climate-smart improved pasture technologies and varieties. It is important to complement the dissemination of these technologies and varieties with training for farmers on feed storage methods and conservation innovations, efficient use of industrial by-products to cover deficits, and the popularization of small- and large-scale enterprises involved in fodder production and trade (Ministry of Agriculture, Livestock, Fisheries, and Cooperatives 2010). Scaling up the Kenya Veterinary Vaccines Production Institute's efforts to improve livestock heath and micronutrient supplements and control endemic diseases, and in the medium to long term, investing in improved genetics and breeding, will also be important. Within-breed selection of desirable traits and crossbreeding has been the standard approach to genetic improvement in Kenya. But for faster progress, genetic improvement efforts should focus on disseminating the best germplasm expansion of artificial intelligence processing and distribution infrastructure for efficient delivery of genetics, including for proven bulls, as is being done at the Kenya Animal Genetic Resource Centre.

The impact of repeated weather shocks on production is spatially varied (figure 3.1) and compounded, in the dry/hot scenario, with the impact of heat stress on agricultural labor. These climate change impacts trigger the deployment of wide-ranging coping strategies, including on-farm adaptation, such as changes in production and technology, when farmers have access to extension and information services, and off-farm strategies, such as reducing consumption, selling assets, and borrowing capital (Tongruksawattana and Wainaina 2019). For pastoralists, coping strategies include using local grazing reserves, traveling greater distances to access fodder and water sources, purchasing additional animal feed and water, off-taking animals ahead of drought, receiving livestock loans from family or neighbors, adjusting household consumption, or seeking alternative forms of income (McPeak et al. 2011 and Silvestri et al. 2012, as cited in Mauerman et al. 2023). Pastoralists have varying abilities to implement these strategies, some of which can have long-term detrimental impacts on households.

26 This result is based on deploying 132 different technologies, innovations, and management practices.

Figure 3.1: Impact of climate scenarios on rainfed agriculture and livestock, by county (2041–50)



Source: IEc 2023.

Integrating climate considerations into the implementation of Kenya's Agricultural Sector Transformation and Growth Strategy (ASTGS) 2019–29 can increase resilience and productivity in the sector. The ASTGS is a well-articulated, multipronged approach anchored around three pillars: increasing incomes of small-scale farmers, pastoralists and fisherfolk; increasing agricultural output and value addition; and boosting household food resilience. The proposed interventions revolve around modernizing small to large-scale agriculture and elements of the agrifood system through better equipment and inputs and drawing on private and public sector to support this transformation; expanding irrigation and availability of inputs; and increasing the availability of, and security over, land to motivate long-term investment and planning. As part of the strategy, the government has plans to increase the land area under crops that

are important for food security and for value addition based on county agroecosystems.[27] Evidence on the impact of climate change on crops and Kenya's fiscal context underscores the importance of considering where and how to operationalize the strategy and prioritizing interventions that create synergies with other key sectors.

Expanding investment in agricultural research and technology dissemination will be central for increasing productivity while mitigating GHG emissions from the agriculture sector. Research toward precision agriculture could strengthen farmers' access to information on when and how much to irrigate, fertilize, and apply pesticides to their crops. Continued investment in biotechnology and genetics can lead to the development of new crop varieties[28] that are more resistant to drought, pests, and infestation, boosting agricultural productivity and increasing the resilience of farmers to temperature and precipitation shocks.

Sustainable mechanization, as part of efforts to scale out climate-smart agriculture (CSA), will be instrumental on two fronts: improving agricultural labor productivity and sustainably managing soils and water to maximize output. On average, 30 percent of land preparation in Kenya is mechanized, 20 percent relies on animal power, and the remaining 50 percent is based on person power. With the expected impact of higher temperatures on outdoor labor, increased mechanization—facilitated by scaling out county initiatives to make equipment, including tractors, accessible to clusters of farmers via subcounty services—could help prevent the already low productivity from declining further.

If it wants to expand agriculture in a sustainable manner, Kenya will need to tackle the land constraint. As an immediate step, it could competitively procure up to 50 new large-scale farm concessions of 1,000 hectares or more to unlock up to 200,000 hectares of new farm production, as mentioned in the ASTGS. Although much of this land will be state-owned, the new farm enterprises would need to be predominantly funded and owned by the private sector.

Box 3.2: Enabling partnerships between farmers and aggregators to enhance climate resilience

Under the recently approved $250 million National Agriculture Value Chain Development Project, the World Bank is supporting the government of Kenya to enable linkages between farmers and leading aggregators under some of the key focus value chains. Through the project, the government will invest on mobilizing the farmers into farmer producer organizations and facilitate investments across the value chain to enhance their climate resilience and incomes.

Partnerships between the farmer producer organizations and private sector aggregators will play a key role to play in enhancing climate resilience and profitability through a strong emphasis on the uptake of CSA practices across the value chain. Initial discussions around such partnerships have been initiated, with leading aggregators such as Twiga (potato, banana, and tomato) which is also an IFC investee, ETG (cashew), Suguna (poultry) and M-Shamba and TruTrade (potato and avocado).

Over the next five years, the Ministry of Agriculture & Livestock Development is keen to leverage investments through project and scale up more partnerships between the farmer producer organizations and aggregators across multiple value chains to build climate resilience and increase smallholder incomes.

27 The proposal could involve increasing the area under maize by 1.7-fold, potato by a similar amount, wheat by 10-fold, and avocado by 19%. The area under rice may need to be increased between 5- and 11-fold, depending on productivity. The proposal could also require increasing milk and beef production by 93% and 130%, respectively.

28 Crop varieties that have been validated and found to be drought-tolerant in Kenya include maize variety KCB (Katumani Composite B), sorghum nyadundo 1 variety, finger millet variety EUFM 401, and cassava siri variety. The inventory of technologies, innovations, and management practices shows increased productivity on adoption of these varieties.

To improve agricultural productivity and value added, Kenya will need to crowd in private sector funding and improve capital infrastructure. It could concentrate efforts on increasing the share of agricultural products that are processed, from a current low of 16 percent (Ministry of Agriculture, Livestock, Fisheries and Irrigation 2019). The private sector can help the country expand into a variety of agro-processing and value-addition activities, as already evidenced in the cut flower, horticulture, dairy, tea, and agricultural input markets. Private sector involvement in developing marketing infrastructure and regional and international quality and safety standards could enable Kenyan farmers to add value to their tea, coffee, pyrethrum, milk, beef, fruit, and vegetable products. Empowering farmer organizations to deliver market support services and PPPs should scale up investments in value-adding technologies. Enhancing farmers' and herders' access to e-vouchers for purchasing inputs and improving their access to quality agro-weather, climate, advisory, and market information services would improve decision-making and efficiency. Investing in roads, electrification, irrigation, and other rural infrastructure would also help lower the cost of agricultural production.

To deliver on the ASTGS in a climate-informed manner, Kenya will need to restructure institutional arrangements, increase public expenditure in the sector, and reduce government intervention in output markets. Recruiting young professionals with private sector experience in the Ministry of Agriculture could stimulate innovative thinking around increasing the penetration of digital technologies for smallholder farmers. ASTGS institutional arrangements will need to emphasize stronger coordination between the national ministry and county teams to improve delivery of knowledge and inputs, informed with data from robust monitoring of performance at both national and county levels. Increasing the share of public expenditure in agriculture will help Kenya reach the Malabo Declaration[29] target of 10 percent, while investing more in extension and advisory services can generate higher rates of return and increase the adoption of new technologies, innovations, and management practices to improve agricultural productivity in smallholder settings. Kenya can also reinvigorate the linkages between agriculture research and extension by reforming the Kenya Agricultural & Livestock Research Organization and strengthening partnerships with the strong network of Consultative Group on International Agricultural Research institutions present in the country and region.

3.2. Deliver people-centered resilience with climate-informed basic services and urbanization

Reducing regional inequities and the impact of climate on labor productivity is essential for adapting to climate change. Fulfilling development goals—including universal access to basic services, such as education, health, and WASH—in a climate-informed manner is central to such efforts. At the same time, targeted active labor market programs will help mitigate the impact of higher temperatures on outdoor and informal labor activities on workers and MSMEs. Efforts to enable socioeconomic mobility should therefore ensure that urban areas provide locations for formal and productive jobs, are climate-resilient, and include measures to reduce air pollution, congestion, and informal settlements to support quality of life.

3.2.1. Ensure climate-proof universal access to basic services

3.2.1.1. Universal coverage in a resilient health system

Efforts to provide universal health coverage to all Kenyans by 2030 would benefit from complementary actions to create a more climate-informed and resilient health system. A resilient health system will need to cope with increased demand for services, including different types of service due to climate change. In the short term, establishing a climate-responsive health service will require reducing distances to services

29 The 2014 Malabo Declaration is a re-commitment to the principles of the Third Comprehensive Africa Agriculture Development Programme (CAADP) adopted by African Union heads of state and government to provide effective leadership for the attainment of specific goals by the year 2025, including ending hunger, tripling intra-African trade in agricultural goods and services, enhancing resilience of livelihoods and production systems, and ensuring that agriculture contributes significantly to poverty reduction.

and improving responsiveness in the health system. Strengthening grassroots or community-level health workers, mobile clinics, and basic emergency response equipment in remote areas can help improve proximity of services. Collecting community-sourced health data and raising awareness in communities of vector-borne diseases and their link with climate, the importance of preventative dietary, WASH, and safe water measures, and ensuring communities have access to and can interpret data from early warning systems will be key.

3.2.1.2. Increased access to WASH services

Readily accessible WASH services can counter the impacts of climate change on the incidence of water-borne disease while lowering time spent accessing distant WASH facilities. Kenya loses about one percent of GDP every year due to inadequate sanitation (Water and Sanitation Program 2011) and waterborne diseases accounted for 7.4 percent of deaths between 2015 and 2019. Compared to the baseline, climate change-related mortality and morbidity due to waterborne diseases could increase by 51–104 percent between 2041 and 2050. According to the Kenya Population and Housing Census 2019 (KNBS 2019), 91 percent of the urban population and 63 percent of the rural population have access to improved water services, including shared services. Around 79 percent of open defecation is concentrated in 13 counties, mainly in the north and east. These same counties are also exposed to climate change. Accelerating access to improved water supply and sanitation, particularly in counties with poor levels of access such as those in the ASALs, would lower these climate change impacts. Scaling gender-sensitive measures in rural areas—through sanitation facilities and hygiene measures, and by subsidizing or offering free sanitary products—would also help communities cope.

Kenya has an ambitious goal of achieving universal access to safe and affordable water supply and sanitation services by 2030. The cost of achieving this is estimated at $9 billion. To bring down these costs down and provide universal access to safe and affordable WASH services by 2030, Kenya can adopt a mixed model of 60/40 percent non-sewer/sewer connections, as an alternative to full sewerage services (*non-sewer sanitation*—a combination of on-site sanitation, such as flush toilets with septic tanks, and safe fecal sludge disposal at treatment plants—is a lower-cost solution); implement operational and capital efficiency, and tariff reforms; and seek $675 million in additional public funding above BAU levels. This would give 100 percent of Kenyan households access to improved water and sanitation, and 100 and 40 percent of urban households access to piped water and sewer services, respectively. Additional resources would be required to expand WASH program coverage to health facilities, especially in rural areas.

3.2.1.3. Resilience in education services, and skills training

Increasing awareness of climate change causes, impacts, and responses through education can motivate mitigation and adaptation actions and avoid perverse effects, such as intercommunity conflict, in some contexts (Amenya and Fitzpatrick 2023)**.** At tertiary level, both university and technical and vocational education and training students need to be equipped with the necessary skills to negotiate climate change. About 23 percent of the country's technical and vocational institutions offer climate-forward courses, and some include climate and green initiatives in their curriculum, administration, leadership, governance, and culture. But climate change-related coursework remains relatively scarce at tertiary level. Given the urgent need for technical skills and the potential job opportunities, enhancing the focus on climate and technology-related skills is crucial. Tertiary education that emphasizes in-demand skills—for example, in the decentralized renewable energy sector, which is projected to create 17,000 direct, formal, full-time equivalent jobs, marking a significant 70 percent increase from 2017—is not only vital for climate change mitigation, but also offers considerable potential for economic growth and job creation. Public financing can serve as a channel for such alignment by encouraging public-private collaborations. For example, a results-based financing model can incentivize partnerships between businesses and educational institutions, aligning the supply and demand of specific skills programs.

Given the risks associated with extreme weather conditions, the education sector should also adapt its infrastructure and service delivery to withstand potential disruptions. Leveraging lessons learned from the COVID-19 crisis could help ensure the continuity of educational services during extreme weather events. Remote learning tools proved invaluable during this period, including e-cloud-based content, live-streamed classes, and lessons delivered via radio and television. These tools should be readily available and deployable during climate disruptions. Educational facilities can also be adapted to be climate-resilient—for example, through bioclimatic architecture, which can naturally cool buildings even in extremely hot environments. Distance learning and climate-resilient infrastructure are particularly crucial in rural areas, where low learning already maps with expected losses due to climate change.

3.2.2. Implement adaptive social protection and active labor market programs to achieve socioeconomic mobility and resilience to climate change

Increasing the coverage of social protection programs and improving their accompanying delivery systems are vital to effectively contain the impact of climate change. Kenya is well placed to build up and expand the coverage of its flagship safety net programs Inua Jamii and the Hunger Safety Net Program, which both have accompanying measures for investing in poorer households' capacities to sustainably enhance their livelihoods. Increasing the coverage and adequacy of social insurance programs, such as the Haba Haba scheme, and other employment services can also help cushion the impact of income loss on urban informal sector workers during periods of crisis and transition. Kenya has already made significant strides by harmonizing targeting methodology for social programs and investing in operationalizing a digitally enabled enhanced single registry (ESR) that will function as a national social registry, with welfare information on more than 50 percent of Kenyan households. Establishing adequate policy and legislative basis for using ESR for targeting would enable quick, objective, and transparent identification of poor and vulnerable populations affected by climate shocks and effective deployment of social protection services to these populations. Overlaying these data with the geographic locations that are most vulnerable to climate shocks should help Kenyan early warning systems protect the poor and guide the scaling up of social protection programs to cover impacted households by leveraging Kenya's digital payment system. Complementary measures for vertical and horizontal government coordination, contingency planning, and predictable financing for timely delivery and scaling up social protection are also necessary. More specifically, operationalizing the approved National Drought Emergency Fund and adopting a risk layering strategy that complements the national budget with other contingency funds will be central for managing recurrent climatic shocks, especially in the northern parts of Kenya.

The expected impact of heat stress on labor productivity and transitions toward more climate-friendly activities underscores the need for measures that ensure the productivity of Kenya's growing workforce. Outdoor workers in agriculture, forestry, fisheries, and low-skill work would benefit from measures that promote the increased use of mechanization and cooling technologies, climate-informed labor policies, and support for the transition to indoor activities or alternative livelihoods to reduce the impact of heat stress. The transition to more climate-informed employment opportunities may result in short-term livelihood losses. To mitigate this, the government needs to put in place measures to protect the poorest and most vulnerable households and cushion the effects of this transition, such as leveraging government social assistance systems to provide temporary income support or mobilizing social protection to increase livelihood resilience, implementing active labor market policies and skills development programs, and helping MSMEs turn to more sustainable activities and build digital skills and entrepreneurship for youth and women. It should also make a deliberate effort to target active labor market policies to assist the transition to climate-compatible jobs from the demand and supply side—that is, matching skills with market demands—and focus on the most vulnerable segments of the population. For example, one group that would need such support are the more than 700,000 persons (including informal workers) employed in the charcoal production industry, which generates more than $400 million a year (Government of Kenya Ministry of Environment, Water and Natural Resources 2013).

Modifying Kenya's job programs will be important. Although there is a high degree of informality in Kenya's labor force and MSMEs, the country's job programs largely address challenges in the formal sector, are predominantly used by wealthier individuals in urban areas, and have limited reach among the poor, youth, and women (especially in rural areas). To effectively implement these programs, the government will need to increase public spending from the current low levels (KNBS 2022). Efforts to strengthen active labor market policies and scale up successful examples of comprehensive job programming for the most vulnerable segments of the population, such as the Kenya Youth Employment and Opportunities Project, could facilitate a smooth transition to a low-carbon future.

3.2.3. Transform urban areas into climate-resilient hubs that foster economic growth

Developing a vision for an efficient system of cities could help boost climate resilience and promote low-carbon development across the country. Kenya has 47 urban areas with a population above 50,000, and almost 70 percent of the urban population is concentrated in 22 cities. As urbanization is in its early stages, Kenya could use an approach involving a system of cities within which different types of city play different roles in the country's development, based on population size, location, and density. Planning Kenya's urbanization process through the system-of-cities lens would inform intercity connectivity, infrastructure planning, and the efficient provision of services such as WASH, employment support, education, health, security, and other amenities. It also makes an affordable housing supply-side solution viable.

3.2.3.1. Robust plans, interinstitutional coordination, data, and capacity for climate-compatible urbanization

Mainstreaming national climate change goals in the urban development agenda could reinforce a deliberate focus on climate-compatible growth in urban areas. Doing so would require updating the National Urban Development Policy, integrating climate actions into urban plans (including spatial plans) and existing and emerging city programs, including Mombasa, Kisumu-Kakamega, Naivasha-Nakuru-Eldoret, Wajir-Garissa-Mandera, and Kitui-Mwingi-Meru, and systematic monitoring and evaluation of climate change actions. An institutional framework for the sustainable management of the Nairobi Metropolitan Region, complemented with harmonized and updated urban planning legislation (in the Urban Areas and Cities Act, Physical and Land Use Planning Act, and County Governments Act) that promotes climate-smart plans will be pivotal. Strengthening climate, green and resilience considerations in the National Building Code and improving inter- and intragovernmental coordination will help address climate change in the built environment across administrative levels. Parliamentary approval of the updated code would be a first step in enhancing implementation and enforcement of development and building control.

Urban institutions must improve their capacity for data management, data use, and climate risk-informed planning and infrastructure design. A centralized and spatially explicit data management platform on the country's climate change risks and hazards is key, alongside a data dissemination plan. As joint undertakings of the Kenya Meteorology Department and National Disaster Operation Centre, this platform can serve as a repository for climate risks, disaster events, hazard zone maps, and urban plans to inform policy decisions and build public support improving resilience to climate risk. Such data should inform decisions for development and to protect critical wetlands that are key for biodiversity and flood reduction, particularly in risk-prone areas. The data should help streamline and resolve potentially deficient land use planning and administration, building code approvals, and development control, including the expansion of informal settlements and encroachment into flood zones.

Urban institutions require adequate staffing and resources to enable them to address key priorities. Areas for strengthening capacity include: developing urban plans that promote urban regeneration and compact mixed-use development to counter expected urban sprawl and reduce carbon emissions and vulnerability to natural hazards; limiting construction in areas that are at risk of flooding and storm surges by enforcing land

use plans and building design standards; climate-proofing/retrofitting critical urban infrastructure, assets, and services, and integrating nature-based solutions; and enhancing municipal solid waste management services.

3.2.3.2. Affordable urban housing that uses low-carbon materials and promotes green buildings

Closing the affordable housing gap and improving urban infrastructure does not mean increased emissions. Building 3 million affordable housing units by 2025 will require significant expansion of construction activities. Kenya imports about 70 percent of building and construction materials, which has implications for affordable housing. If the market is big enough, Kenya could start manufacturing low-cost materials. If it also starts using alternative construction materials, this could reduce the carbon footprint of affordable housing units, as much of the embodied carbon in building materials is from energy use in manufacturing and transportation. Adopting a whole-life carbon mitigation effort, which lowers emissions over the course building life cycles, would also help.[30] For example, the cement sector, a significant consumer of thermal energy, could substitute at least 30 percent of its thermal energy demand with economically viable alternative fuels such as municipal waste, agricultural waste, and sewage sludge, all of which would reduce CO_2 emissions by reducing coal use. A 2017 study estimates this could save up to 10 percent, or $7–8 million a year in fuel costs (IFC 2017). If by 2050, Kenya builds 6.23 million new affordable housing units using current practices, the cumulative value of embodied carbon is equivalent to 17 tonnes of CO_2 equivalent (tCO_2e) per unit. Changing construction materials, design, appliance and lighting use, and waste management could lower the per unit value of embodied carbon to 7 tCO_2e.[31]

3.2.3.3. Boosting productivity with green urban transportation

Adopting an avoid-shift-improve and resilience approach to urban transport would help Kenya moderate congestion and air pollution in emerging and expanding cities. Traffic congestion in the Nairobi Metropolitan Area costs the economy about $1 billion a year,[32] while Kenya's annual cost of road traffic accidents, in which most victims are pedestrians in urban areas, is about $3 million (National Transport and Safety Authority 2015). The avoid-shift-improve and resilience approach needs a comprehensive enabling national urban transport policy framework that defines the government's role in public transport management, provides a clear direction to manage urban mobility nationwide, ensures coordination between urban and transport planning, and guides the financing framework for urban mobility. A low-carbon development path should also be well articulated in the updated National Integrated Transport Policy, and a strong linkage made between this and a national urban transport policy to ensure a strong impact on reducing GHG emissions. A safe and secure walking environment in urban areas requires avoiding unnecessary expansion of *boda-bodas* (motorcycle taxis) in urban areas, creating a fleet renewal program, and ensuring emission monitoring and control of all types of vehicles. This will require a funding mechanism for mass rapid transit and improved bus services.

A green and reliable public transport system in urban areas should prioritize developing an integrated and improved multimodal public transport system, nonmotorized transport options, and shifting from a car- to a people-centric approach. An improved public transit system by 2030, with a 43.4 percent modal share of public transport, and greener public transit—including a 9 and 14 percent shift from privately-owned *matatus* to mass rapid transit (bus and commuter rail) by 2030 and 2040, respectively—could reduce emissions by 78,100 and roughly 224,100 tCO_2e by 2023 and 2040, respectively. All systems and options should consider climate resilience and energy efficiency in their design.

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30 https://unfccc.int/sites/default/files/resource/Action_table_HS.pdf (accessed April 18, 2023).

31 This includes zero-emissions cement production, greater use of existing fiber sources, adopting and using tested alternatives to steel, plastic replacement technologies, solar water heating, photovoltaics for electricity generation, and energy-efficient lighting and appliances, and reducing on-site and pre-site waste from 30% to 50%.

32 https://www.bloomberg.com/news/articles/2019-09-24/traffic-jams-in-kenya-s-capital-bleed-1-billion-from-economy#xj4y7vzkg.

Adopting battery EVs while also developing mass rapid transit will be a game-changer for Kenya. While the Ministry of Roads and Transport is working on charging facility standards, they will also need to establish the demand profile, charging tariff design, and battery end-of-life management regulations applicable for battery electric buses and other EV types. Battery EVs receive tax benefits of reduced import duty, which adopting e-mobility will have a negative impact on road maintenance funds. As such, exploring adjustments and solutions in road asset management will be required.

The electrification of the transport sector—and the introduction of EVs in particular—is a relatively new concept for Kenya, and the economic cases for different modes of transport vary. For example, there is a clear economic case for electric motorcycles, while high capital costs for electric cars, buses, and charging facilities make the economic case for these vehicles less evident. Kenya has the largest e-mobility startup ecosystem in Africa, with over 50 startups, mostly focused on motorcycles. There are various opportunities for EV providers and private sector-led investors, including opportunities to scale up e-motorcyles, which currently make up less than 1,000 of the country's 1.5 million motorcycles. Kenya has already developed several policies and support mechanisms conducive to EV, including reduced taxes and registration fees, competitively priced renewable energy, point-of-sale subsidies, and increased investment in supporting charging infrastructure. Pro-EV and pro-local product legislation, such as production mandates, are expected to support localized EV assembly, strengthening the subsector. By 2030, an EV transition could reduce emissions by 5.13 $MtCO_2e$, local pollutants (nitrous oxides, sulfur oxides, and particulate matter with a diameter of 10 microns or less, or PM10) by 27,000 tonnes, and gasoline and diesel consumption by 161 and 37 million liters of diesel, respectively. While buses are expected to constitute only 1 percent share in EV stock by 2030, they could contribute to 23 percent of emissions reductions, and e-motorcycles could contribute up to 50 percent.

Developing and implementing e-mobility policies and a strategy, and enhancing capacity in the public and private sectors, are urgent tasks to advance this endeavor. Strengthening institutional capacity for effectively managing the ever-growing vehicle fleet in the country is vital. Developing and implementing an e-mobility strategy, as well as policies and programs to ensure sustainable urban mobility through efficient motorization management is also a priority.

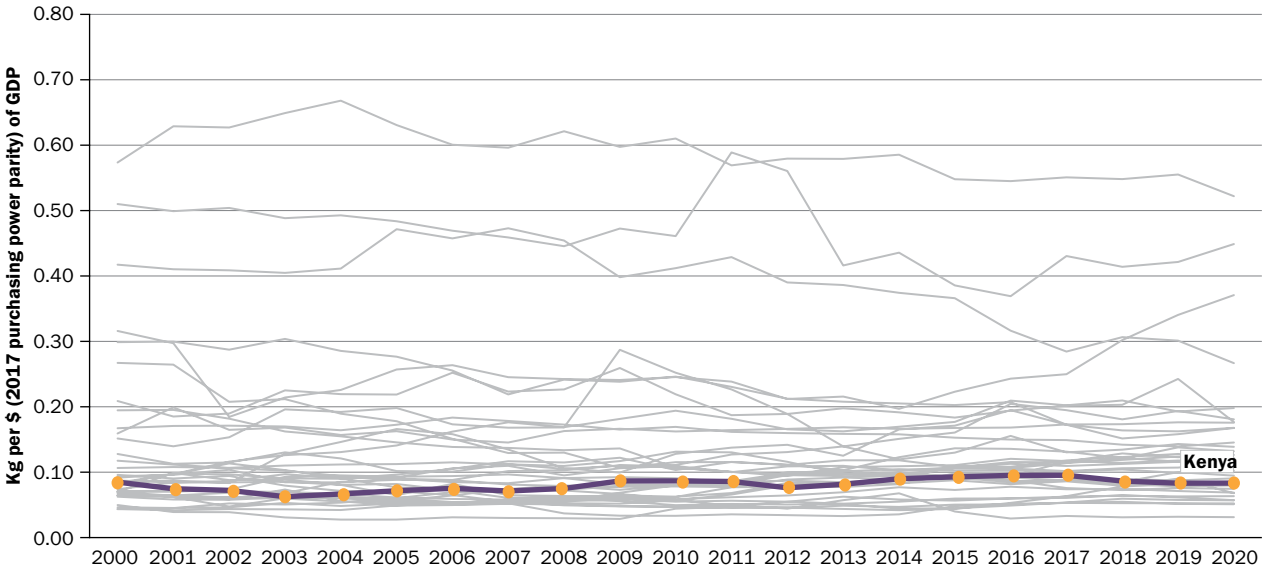
3.2.3.4. A sustainable urban infrastructure financing mechanism

More resilient and affordable cities will require high levels of human, technical, and financial resources. Establishing and capitalizing a sustainable urban infrastructure financing mechanism could promote the implementation of climate-resilient infrastructure across the country's main urban centers. The lack of reliable funding stream means that counties and municipalities are unsure about when resources will be available to implement complementary investments in an integrated way and have adopted an ad hoc approach to urban infrastructure planning and development. As a result, climate-resilient principles are rarely considered in new urban infrastructure. Improving the framework for financing cities and urban areas will help ensure adequate funding, which will promote integrated urban planning and ensure infrastructure programs are sustainable and climate-informed.

3.3. Strengthen productivity and competitiveness in international markets through shifts in energy, transport, and digital systems

Kenya has been on a low carbon intensity growth path (figure 3.2) and would benefit from remaining on such a path. The country's low-carbon intensity growth is the result of both the underdeveloped nature of its industrial sector and the government's efforts to increase the share of renewables in the country's power mix. But despite this, as discussed in Chapter 1, Kenya's GHG emissions have been growing.

Figure 3.2: Kenya's CO_2 emissions, compared to other countries in the region



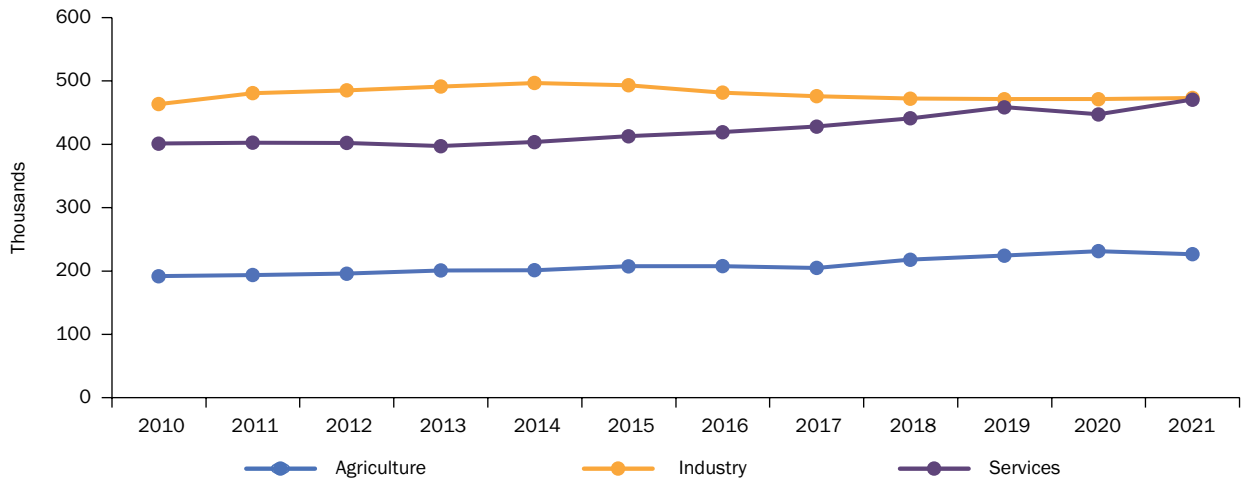
Source: World Bank staff calculations, based on data from World Development Indicators database.

While Kenya's emissions are not a concern on the global scale, it is important to monitor changes in key export markets' requirements regarding carbon emissions. For example, the European Union (EU) and United States are strengthening existing and developing new measures to lower carbon emissions. And although few of Kenya's exports are subject to the EU's Carbon Border Adjustment Mechanism, there could be consequences for exports to countries that add value to Kenya's products. The European Commission has also proposed ambitious new regulation to stop deforestation and forest degradation in EU supply chains, improve sustainable sourcing practices, and increase transparency in global commodity value chains.[33] The regulations cover commodities such as cattle, cocoa, coffee, palm oil, soya, timber, rubber, and their derived products, such as beef, leather, chocolate, furniture, printed paper. Once approved, importers will have approximately 18 months to implement the new rules, and both they and exporters will need to undertake a due diligence process that confirms their products are not contributing to deforestation. The importance of the EU as an importer and policy leader means these regulations will have broad consequences across international markets.

If aligned with boosting productivity and supporting inclusive socioeconomic mobility, maintaining a low-carbon development path could contribute to Kenya's efforts to accelerate growth. While increasing value addition in industry and services sectors is the fastest way to boost labor productivity (figure 3.3), most of Kenya's exports are agricultural products and minerals, which are low in complexity. Export dynamism in Kenya has been driven by the services sector, including tourism and ICT. The country has only added 15 new products since 2005, and their volume has been too small to contribute to substantial income growth. To ensure its low carbon intensity growth pathway contributes to overall growth, Kenya can focus its short- and medium-term efforts on: using a green matrix to ensure the power sector meets growing electricity demands, reducing fossil fuel consumption in the logistics and transport sectors, and maximizing opportunities created by digital. Such efforts could leverage carbon markets, generating necessary financing for additional climate action.

33 https://environment.ec.europa.eu/document/download/5f1b726e-d7c4-4c51-a75c-3f1ac41eb1f8_en?filename=COM_2021_706_1_EN_ACT_part1_v6.pdf.

Figure 3.3: Value added per worker, by sector and year



Source: World Bank 2022a.

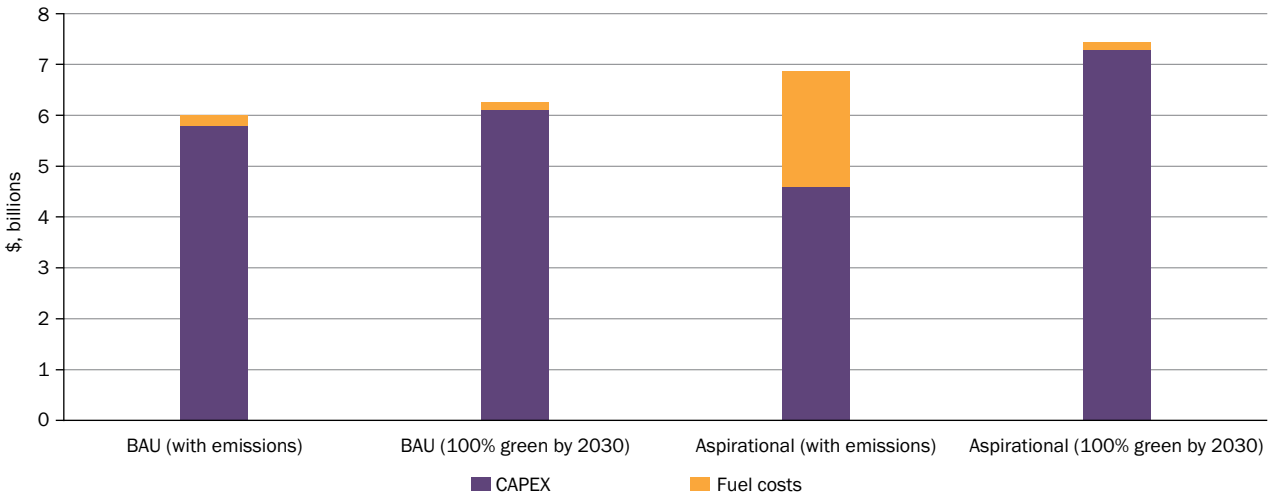
3.3.1. A green energy matrix

Kenya's energy sector already meets 90 percent of its power demand from renewable energy. Developing geothermal, wind, and solar power generation has enhanced the country's energy security and significantly reduced weather-induced supply shortages that are typical in systems with a large share of hydro. Kenya has more than quadrupled its geothermal capacity from 198 MW in 2010 to 950 MW today, and its development alongside wind, and solar has displaced generation from thermal (fossil fuel-based) sources, which have decreased from 45 percent in 2010 to 10–12 percent today.

Achieving a fully decarbonized power system by 2030 is feasible. The country's Least Cost Power Development Plan (LCPDP) for 2022–40 expands geothermal, wind, solar, battery storage, and hydropower, including through regional imports, but continues to use diesel generation and gas oil turbines until 2035. Extending the LCPDP modelling to 2050 and comparing BAU against achieving a 100 percent green grid by 2030, for low-demand (4.5 percent per year, associated with a 5 percent GDP growth) and ASP—which is equivalent to the LCPDP power sector demand reference scenario level—demand projections (5.2 percent per year, associated with a 6.1 percent GDP growth) points to the viability of a fully decarbonized power system. Results across decarbonization scenarios consistently show that: new capacity consists mainly of geothermal in the near and medium term and, from the mid-2030s, mainly of solar, wind, battery storage, and hydro; there is also a progressive increase in the use of import capacity; fossil plants are progressively retired until 2029; and renewables contribute more than 95 percent to the generation mix in 2050.

Investment requirements increase moderately as renewable energy is the cheapest source of new power generation in Kenya and can be offset by substantially reduced fuel import bills. Additional cumulative upfront investment costs for a green grid by 2030 range from $0.3 to $2.7 billion compared to scenarios with no emissions constraint. But the total cost remains the same since there is a shift from capital expenditure (CAPEX) to operational expenditure (OPEX) (figure 3.4). The additional CAPEX costs are almost fully offset by lower fossil fuel costs, as variable renewable energy sources and batteries dominate the capacity and generation mix.

Figure 3.4: Cumulative upfront investment and fuel costs (discounted) 2022–50



Source: World Bank staff calculations, based on data from the extended LCPDP.

Regional integration, renewable-based imports from neighboring countries, and geothermal contribute to Kenya's generation mix and can mitigate exposure to risks from climate risks. With support from the World Bank-financed Eastern Electricity Highway Project, Kenya has connected to regional hydropower resources via the Kenya-Ethiopia Interconnector, giving impetus to regional energy trading through the Eastern Africa Power Pool. This gives Kenya access to cheap diversified hydropower supply from different basins and climate patterns across the region. This interconnection will become the flagship of power trade in the Eastern Africa Power Pool region and provide the infrastructure to connect it to the South African Power Pool. Alongside renewable-based imports, increasing the share of geothermal can help mitigate negative impacts of projected changes in precipitation by 2050 on hydro generation.

Developing the climate-resilient power network infrastructure and increasing the use of digital technologies will enable network security and reliability in the face of climate change. Mainstreaming climate assessments into network designs and master plans will allow vulnerable electricity transmission and distribution networks to adapt to climate change impacts. Digital technologies play an important role in reducing system losses while also improving the reliability of electricity supply. Installing smart metering equipment and other demand-side management measures enhances financial and operational efficiency in power supply, use, system operation, and maintenance. For operators such as KPLC, digital tools could also support the company's efforts to bring power losses below 20 percent, if it can meet the necessary conditions, such as robust internet and network coverage and stability.

Ensuring financial viability and operational efficiency of energy sector utilities is key to securing investment for the 100% green grid, a robust transmission and distribution network, and ensuring affordability for electricity consumers. Further investments to address the challenges of grid capacity, poor voltage control, and supply instability are necessary to enable the transfer of renewable energy from generation sources—including regional imports—to load centers and regional interconnections. This will help support the transition from standalone diesel backup generators, currently used by over 73 percent of large consumers, and contribute to regional interconnections. To encourage private sector participation and investment, the government can ensure it can offer: a financially solvent and operationally efficient off-taker (such as KPLC); adequate public funding for last-mile electrification and network strengthening and expansion; and potentially partial risk guarantee instruments to de-risk private investments.

3.3.2. Greener freight transport, transport technologies, and resilient infrastructure

Kenya could lower its carbon footprint in freight transportation. Petroleum fuel consumption in the transport sector is projected to continue growing at an accelerated rate between 2018 and 2025. Scaling up the use of alternative green fuels and increasing the energy efficiency of vehicles and operations (including with digital platforms) can help lower the carbon footprint of freight. Sustainably produced and sourced biofuel could serve as a transition fuel that is produced locally from oil crop feedstocks and wastes. Biofuels have the advantage of already being in use and can be distributed existing fossil fuel infrastructure for transport refueling, and so on. Kenya can also assess the potential of alternative fuels, such as natural gas and hydrogen, and other technologies, such as batteries and fuel cells.

As more companies set standards for sustainable supply chain management and logistics, Kenya will need to increase transparency about the carbon footprint of its logistics systems. In response to emerging changes, Kenya would benefit from developing a comprehensive program promoting green logistics regulations and standards, implementing digital solutions to enhance efficiency and enable modal shift, and providing incentives and financing. Transitioning to more environmentally efficient modes of freight transportation necessitates adopting new practices for inventory management and tracking to account for slower speeds and ensure reliability. Calculating and reporting emissions is another crucial step. Global Logistics Emissions Council's framework methodology offers an approach to increase transparency regarding the impact of climate change on logistics operations.[34]

Trucking will likely remain the dominant mode of freight transportation, and the sole mode for first- and last-mile delivery. With this in mind, the following steps can help lower the footprint of freight transportation in Kenya: improving vehicle and facility efficiency; establishing fuel economy standards for all commercial vehicles; implementing a voluntary scrapping and replacement program for the least fuel-efficient vehicles; and combining eco-driver training programs with driver rewards. Complementary digital logistics platforms to match transporters and distributors with cargo owners and shippers can help overcome chronic inefficiencies resulting from low load factors, empty runs, and low market power of MSMEs (Lafkiki, Pan and Ballot 2019). Many of these efforts are under way in Kenya, with positive results and could be scaled up. One private company, Leta,[35] claims to have optimized over 500,000 deliveries, with over 20,000 tons of goods and 2,000 vehicles. Enhancing the fuel efficiency of logistics would benefit from maintenance of Kenya's transport infrastructure and resilience to climate events.

Shifting supply chains to lower-carbon transport modes such as railways is estimated to reduce emissions by more than 20,200 tCO_2 for each million tonne of freight (figure 3.5; table 3.1).[36] With nearly 6 million tonnes of traffic in 2021, the SGR is approaching economic and financial viability for investing in its electrification and further development. A benefit of reducing the transport sector's carbon footprint is the potential contribution that reduced demand for fossil fuels could make to addressing the significant trade deficit. Complementing the transition to greener logistics and transportation and sustainable supply chain management practices with suitable fiscal instruments and repurposed subsidies and reforms could help support the modernization of trucking fleets and green logistics and facility investments (Chapter 4).

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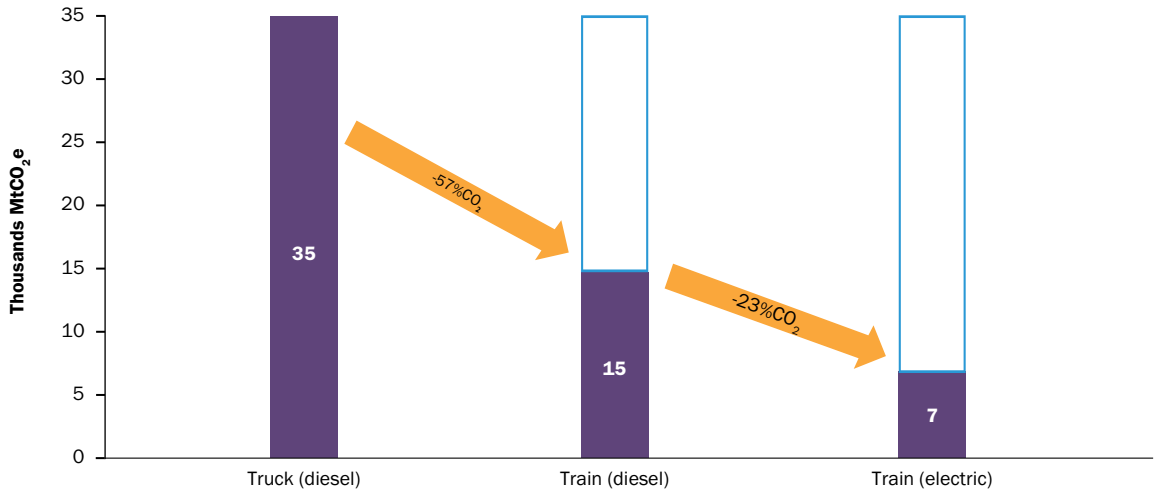
34 Accredited by the Greenhouse Gas Protocol Framework and led by the Smart Freight Centre, the Global Logistics Emissions Council is a group of companies, associations, and programs backed by leading experts and other stakeholders, with members including DHL, French rail company SNCF, Maersk, TNT, Hapag-Lloyd, and Kuehne + Nagel. The council has developed universal methods for calculating logistics emissions across road, rail, air, sea, inland waterways and trans-shipment centers, and its Framework for Logistics Emissions Methodologies combines methods into a single framework, filling an existing gap.

35 https://techcrunch.com/2022/11/22/leta-a-kenyan-supply-chain-and-logistics-saas-provider-raises-3m-to-scale-in-africa/.

36 Note that these numbers are only estimates and do not account for all relevant factors, such as variations in distance traveled by truck due to changes in freight routings and connections.

Figure 3.5: CO_2 emissions saved from shifting freight to rail, per million freight tonne (2021)



Source: Kishiue et al., 2023

Note: Where necessary, estimations were made.

Table 3.1: Emissions and emissions savings per million freight tonne (2021)

	Truck (diesel)	Train (diesel)	Train (electric)
Emissions per million tonne of freight (tCO_2e)	35,200	15,000	7,100
Savings per million tonne of freight from shifting freight from road to rail (tCO_2e)	-	20,200	28,100

Source: Kishiue et al., 2023.

Note: Where necessary, estimations were made.

To improve resilience of Kenya's road infrastructure, prioritization should be given to the links around Lake Victoria, selected corridors connecting Mombasa, Nairobi, and the coastal region. The Northern Economic Corridor is the principal multimodal transportation link for domestic, regional, and international supply chains. It is composed of road and railway networks and inland waterways along which Kenya exports goods worth about $2.2 billion (around 37 percent of total exports) to its neighbors. The transport link between Mombasa and Nairobi is expected to remain the most important driver for freight flows in the region, carrying about 66.1 million tons in 2040. The three counties along the northern shores of Lake Victoria—Siaya, Kakamega, and Kisumu—are expected to receive the most direct damage due to high network density and high exposure to floods. The damages are concentrated along three highways in the region, and annual damages are expected to reach around $4.9 and $5.8 million by 2030 and 2050, respectively, in a climate future scenario in which temperatures exceed the 1.5 degrees Celsius target, or around $7.4 and $9.3 million in the pessimistic climate future.

3.3.3. Resilient digital infrastructure for efficient, low-carbon growth

Given the critical role that digital connectivity and data infrastructure play in Kenya, ensuring digital infrastructure is resilient is in the public interest. People, businesses, and public institutions are increasingly reliant on digital services and solutions. In a pessimistic climate future, damage to mobile cellular infrastructure is estimated to reach $10.4 million by 2080 for a large (1-in-100-year) flood event. Climate change risks are not confined to single sites, but extend to regional infrastructure, partners, and

utilities. Climate change can impose costly effects on operating costs, supply chain disruptions, and data center migration or re-siting. Useful mitigation measures include planning for redundancy, using multiple technologies at key locations to improve resilience to climate events, and ensuring core network nodes have enough back-up power to sustain service during a loss of commercial power. Conducting a climate hazard risk analysis that considers current and future climate change risks as well as extreme events is essential for identifying at-risk locations for nodal infrastructures and implementing the relevant mitigation measures.[37]

37 World Bank digital team's background paper for this CCDR.

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4

Climate Change Impacts on Growth

4. Climate Change Impacts on Growth

Climate change has had palpable effects on Kenya's economy. More importantly, it has major implications for future development. Climate change affects economic growth mostly through the agriculture sector, which contributes about one-fifth of the value added to GDP. The ability to adapt to climate change is therefore urgent if growth is to be inclusive and sustainable. This chapter presents modeling results that combine the consequences of the various channels through which climate change impacts the economy (see Chapter 1.3) under multiple climate futures and BAU and ASP scenarios, as described in the Introduction chapter.

4.1. Kenya's economy could face setbacks without climate action

Climate change could hamper Kenya's aspiration of being a UMIC by 2030 and set back expected gains in addressing poverty. Under a BAU scenario, by 2050, inaction could imply a 3.61–7.25 percent reduction in real GDP compared to the baseline, which assumes no new climate variability, under wet/warm and dry/hot climate futures, respectively. Under the ASP scenario, by 2050, inaction could result in a 2.78–5.3 percent fall in real GDP compared to the baseline under the same climate futures. While the magnitude of GDP impact varies across the specific GCMs considered in the CCDR, at the mean, the results under the BAU and ASP scenarios show that GDP loss is most severe in a hot/dry climate scenario. It is also noteworthy that the impact on GDP increases every decade if climate action is postponed and, while a higher average annual GDP growth rate can buffer the impact of climate change on GDP in the ASP scenario, it cannot eliminate the risks.

4.1.1. Climate impact channels on Kenya's economy

Output losses are expected to occur from climate change and vary depending on the projected changes in precipitation and temperature. As the impacts are shown for the mean of multiple GCMs and reported every decade, the consequences of annual variability are masked. In the dry/hot climate scenario, the impact of climate change on rainfed crops and erosion (which also impacts crops) results in the greatest percentage of GDP loss compared to the baseline for both BAU and ASP. In contrast, in the wet/warm climate scenario, the impact of climate change on heat on labor productivity results in the greatest percentage of GDP loss compared to the baseline for both BAU and ASP.

Crops (rainfed and erosion): Agriculture in Kenya, which is mostly rainfed, is prone to damage from floods and droughts. But the most severe effects are from droughts. Figure 4.1 shows that both under the BAU and ASP scenarios, the dry/hot climate scenario presents the most significant damage to rainfed crop yields (including through erosion), with GDP losses compared to the baseline reaching 2.96 percent under BAU and 1.69 percent under ASP in 2050. In contrast, the negative GDP deviations from the baseline due to impact of climate change on crop yields under a wet/warm scenario are lower (0.81 percent) than the climate change impact on heat on labor (-1.08 percent) in BAU. The wet/warm climate future the ASP scenario also generates similar results, with the impact of climate change on crops resulting in a GDP loss of -0.41 percent compared to the baseline, and the impact of climate change on heat on labor resulting in a GDP loss of -0.92 percent compared to the baseline.

Livestock: The most significant loss from livestock yield occurs under the dry/hot scenario, reducing GDP by 0.65 percent under the BAU scenario compared to the baseline. But deviations are narrower in the ASP scenario, at 0.38 percent under a dry/hot future. The losses in a wet/warm future reduce GDP by 0.39 and 0.23 percent under BAU and ASP, respectively.

Heat stress on labor productivity: Productivity losses occur across all scenarios but are slightly higher under a dry/hot future under both BAU and ASP, because labor productivity is temperature dependent. Under ASP, productivity losses reduce GDP by 1.14 percent in the dry/hot mean, compared to 1.33 under BAU.

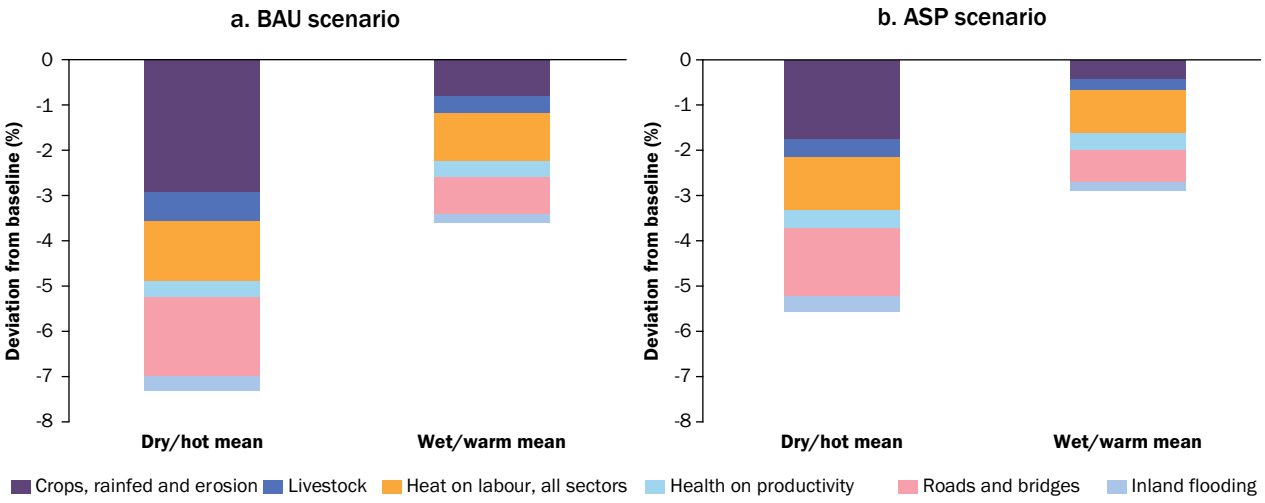
Under wet/warm climate futures, the productivity losses reduce GDP by -1.08 and -0.92 for BAU and ASP respectively.

Heat-related health shocks: Although not very significant under both BAU and ASP, the loss to GDP from the impacts of climate change on health does not deviate much, regardless of the climate future. It ranges between GDP loss of 0.36 and 0.34 percent for dry/hot and wet/warm futures, respectively, under BAU, compared to 0.37 and 0.35 for dry/hot and wet/warm futures, respectively, under ASP.

Roads and bridges: Damage to roads and bridges due to climate change can increase people's commute times to work, ultimately reducing labor hours and increasing capital and maintenance costs. Under both BAU and ASP, losses to GDP from damage to roads and bridges are 1.76 and 1.47 percent, respectively, under a dry/hot future and 0.84 and 0.7 percent, respectively, under a wet/warm future.

Inland flooding: Flooding generally affects infrastructure and physical capital. Under both BAU and ASP, losses to GDP (as deviation from the baseline) from inland flooding are similar, at 0.33 and 0.32 percent, respectively, under a dry/hot scenario and 0.2 and 0.19, respectively, in a wet/warm scenario.

Figure 4.1: Deviation in real GDP from baseline due to climate change impacts by damage channel, 2050



Source: World Bank staff calculations using CC-MFMod.

4.2. Modeling adaptation to climate change: selected interventions

Adaptation actions can reduce economic losses due to climate change. The government of Kenya's National Adaptation Plan (2015–30) and detailed five-year NCCAPs present a range of climate actions the government is committed to implement (with some conditional on international support). Included in these are two sets of adaptation actions that are modeled in this CCDR to provide an illustration of how implementation of such climate action could impact the economy. These focus on: mitigating the impact of heat on labor, and restoring landscapes to improve water storage and mitigate the impact of climate change on crop production. For the former, the cost of measures for lowering labor exposure to heat (such as mechanization and labor policies to reduce exposure to heat) are proxied using the cost of air conditioning, attributing no costs to supporting informal labor to improve productivity, and are subject to climate informed labor policies, as these are nominal. For landscape restoration, we assume that the government meets it target of 10.58 million hectares under tree cover by 2040, and puts measures in place to reduce deforestation, including by reducing reliance on fuelwood and charcoal through clean cooking programs. We estimate the costs using

data from draft government strategies, restoration plans, and other sources. Ensuring these development actions result in resilience to climate change will also require nominal additional costs associated with improved planning and building institutional capacity.

The two adaptation actions modeled for this CCDR lower the impact of climate change on the economy under BAU, independent of the climate scenario. But the adaptation measures lower the relative impact of climate change on GDP more under the dry/hot extreme than the wet/warm extreme in 2050. Adaptation actions focused on landscape restoration make a relatively greater contribution toward mitigating the negative impact of climate change on GDP than adaptation measures focused on reducing labor exposure to heat stress. Landscape restoration adaptation measures are also relatively more effective at mitigating the increase in poverty due to climate change than the actions to adapt to labor heat stress. While these effects are partly explained by the structure of Kenya's economy under BAU, the results are similar under ASP. It is noteworthy, however, that the impact of adaptation actions to mitigate labor heat stress are relatively greater at mitigating the impact of climate change on value addition from agriculture and industry than from services. In contrast, the landscape restoration adaptation actions mitigate the impacts of climate change on value addition from agriculture (primarily through crops) and have a slight negative impact on value addition from industry and services compared to no adaptation action. The results reinforce the importance of modernizing agricultural practices and accelerating structural transformation as part of Kenya's development agenda while investing in adaptation actions.

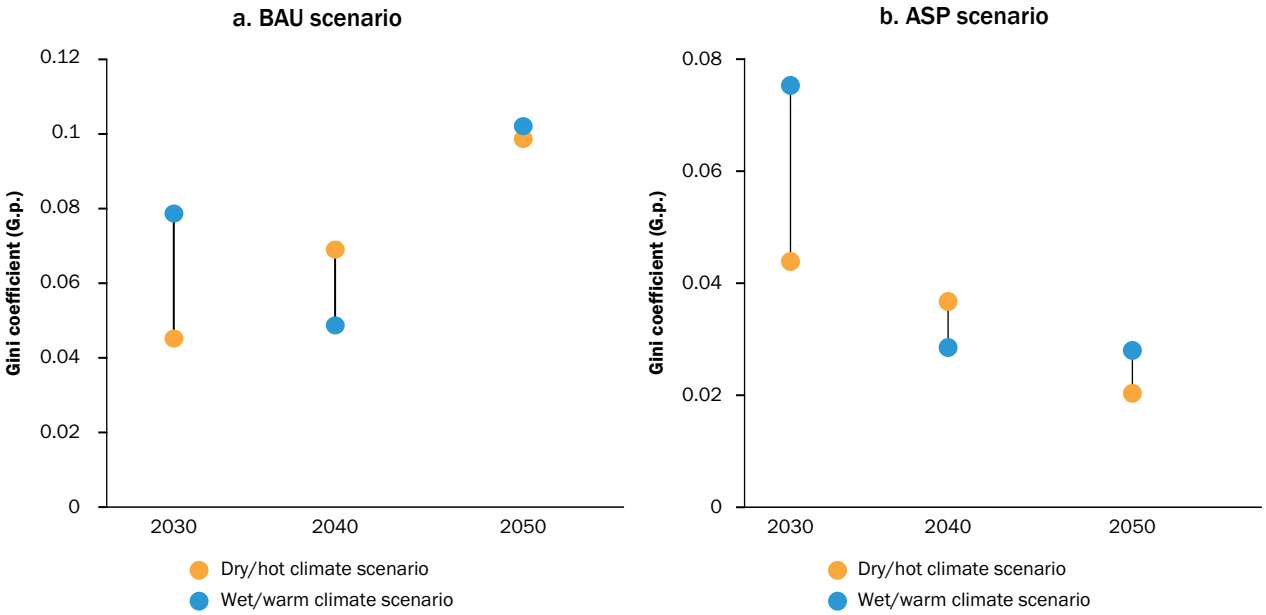
4.3. Poverty impacts of climate change shocks[38]

Not acting to address climate change will set back Kenya's poverty reduction gains and increase inequality. Without the impacts of climate change, projected economic growth appears enough to significantly reduce poverty by 2050. Under the BAU scenario with no climate change, the poverty rate (using the international poverty rate of $2.15 per person, per day) is expected to decline from 36.1 percent in 2021 to 4.2 percent by 2050, diminishing the poverty gap to 1.2 percent, despite continued population growth. This is driven by an assumption of 5 percent real GDP growth starting around 2030 and the population growing by slightly more than 2 percent until 2030, then declining to 1.3 percent in 2050, meaning real per capita GDP would accelerate to 3.5 percent per year by 2040 and stay that way into 2050. Under ASP, the decrease in poverty is even larger, with the population growth rate dropping to 1.2 percent in 2050, and the poverty gap to 0.3 percent. When we consider climate change impacts, the gains in reducing poverty are set back, and in a dry/hot climate future scenario under BAU, there are 1.1 million additional poor in 2050. Under ASP, the poverty headcount increases by 25,000 in a dry/hot climate future scenario compared to the baseline. These results are largely explained by the impact of climate on agricultural production and labor. Without climate change, the Gini coefficient is predicted to increase from 40.7 in 2021 to 43.5 in 2050. Under BAU, both climate scenarios result in an increase in the Gini coefficient relative to the baseline. The trend is similar under ASP growth, but the deviation is much smaller (figure 4.2).

Climate change has a heterogenous impact on poverty levels, which are higher in rural areas (particularly the ASALs) under all scenarios. The reliance on agriculture that is not climate-smart or modernized and the predicted growth in industry and services exceeding growth in agriculture is the main cause of this result. In both rural and urban areas, the percentage point increase in poverty relative to the baseline in 2050 is higher in the dry/hot than the wet/warm climate future. This is notably higher in the more arid ASAL counties in the northeast (figure 4.3). In a dry/hot climate future, the difference in poverty headcount

38 To assess the poverty and distributional implications of different macroeconomic scenarios, we used simulations that leverage household survey data with the macro projections to produce overall poverty and inequality trends under BAU assumptions and estimates of the distribution of aggregate changes in income among population groups with different characteristics, such as location (urban and rural), age, and education level. The results from the CC-MFMod macro model are linked to a microsimulation model over the projection period, using the macro projections as inputs to simulate changes in demographics, employment, labor productivity, and prices, based on 2015–16 national survey data (the latest available). The Poverty Impacts background note prepared for the Kenya CCDR provides more details of the poverty analysis methodology and data.

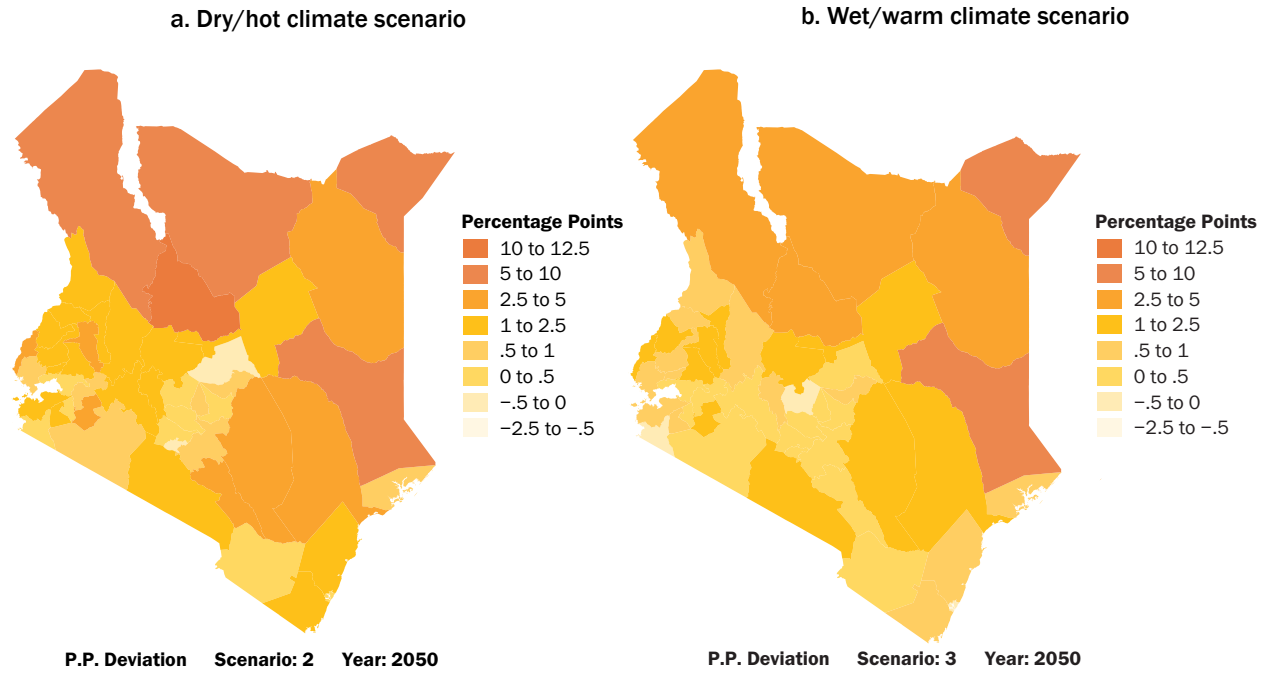
Figure 4.2: Inequality increase from no-climate-change scenario



Source: Poverty impacts background note for CCDR.

from the baseline for arid counties widens over time, reaching 6.6 percent in 2050. There are also regional variations in the way climate change impacts households. While outdoor workers in all regions suffer the consequences of heat stress, in arid areas, where livestock productivity losses are also high, and proximate to labor heat stress losses.

Figure 4.3: County poverty impact from baseline scenario, 2050



Source: IEc 2023.

Adaptation measures such as landscape restoration and mitigation of labor heat stress can slow the increase in poverty due to climate change. Under both BAU and ASP, landscape restoration has a greater effect on minimizing poverty reduction setbacks caused by climate change by 2050 than measures to reduce labor heat stress, particularly in an optimistic climate future.

4.4. Integrating climate finance into macrofiscal policies, subsidies, and decentralization initiatives

While Kenya is taking steps to enable a transition to a greener development path, there is room to further maximize the benefits of such a transition while promoting climate resilience and environmental sustainability. The government has acknowledged the need for additional green fiscal policies, such as taxes and subsidies, that can influence costs, prices, and profits across various markets, and facilitate a shift toward low-carbon, climate-resilient, and environmentally sustainable practices. The National Policy on Climate Finance (2018) provides a clear framework for mobilizing climate finance from all sources, emphasizing the need for green fiscal incentives to catalyze private sector investment in the transition to a low-carbon, climate-resilient, and green development path. The government can leverage fiscal instruments—including concessional loans, guarantees, and interest rate subsidies—to overcome investment barriers and leverage private sector green investments. It can also target spending toward delivering environmental outcomes that the private sector may overlook.

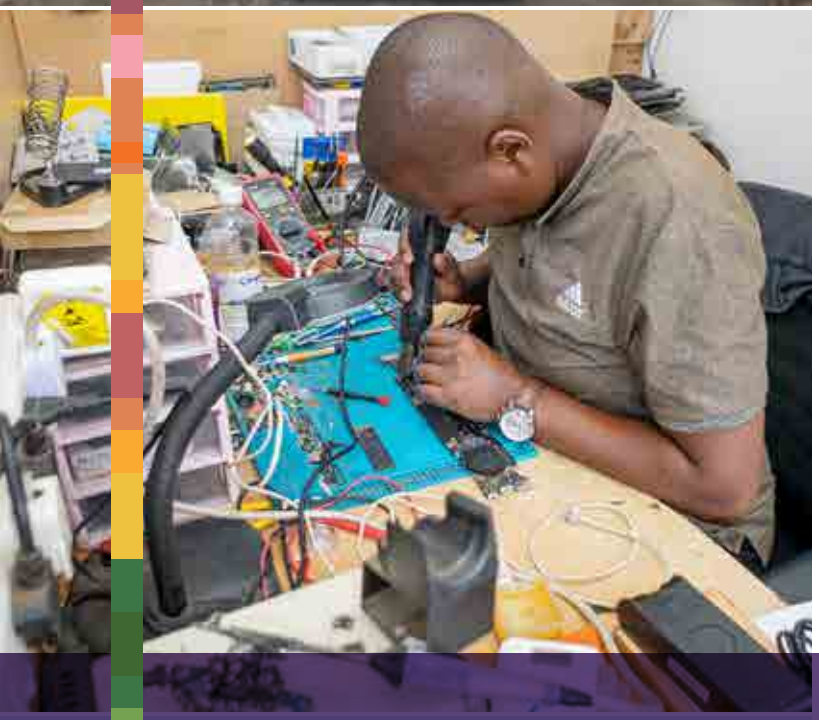
Several sectoral measures already support climate-positive action. For example, Kenya has created several disaster management funds, including the National Disaster Management Contingency Fund, which addresses perennial floods and associated risks. These are complemented with private sector initiatives, including weather index-based insurance schemes for increasing farmers' resilience to climate change (World Bank 2022b), and social protection programs, such as the Hunger Safety Net Program, to help build the resilience of and cushion vulnerable households. To promote modern and clean cooking, the government's Behavior Change and Communication Strategy aims to raise awareness and promoting clean cooking. But such efforts need more financing.

There are also proposals for climate action in some sectors, such as the transport sector. The draft National Green Fiscal Incentives Policy Framework (Republic of Kenya National Treasury and Economic Planning 2022) proposes a change in the transport fuel tax rate, particularly in combination with the carbon tax, which is expected to enable a comparison of fuel use changes compared to growth in vehicle miles traveled**.** Other proposals to incentivize shifts toward electric mass transit include incentives for the import, manufacture, and assembly of electric and hybrid motor vehicles, motorcycles, and their spare parts, and for installing EV and e-mobility infrastructure. It is also exploring the possibility of implementing a congestion charge scheme in cities and incentivizing the production of alternative transport fuels such as biofuels and green hydrogen.

Kenya can develop green fiscal incentive policies that incorporate measures for raising and spending financial resources, thereby steering the economy toward a green development path. Successful implementation of green fiscal policies has been observed worldwide, from economywide solutions such as carbon taxes in South Africa and ecological fiscal transfers in India and Brazil, to more direct measures, such as government investment in afforestation and land protection in Ethiopia and the African Union's Great Green Wall.[39] Kenya could deploy similar efforts. For example, it could reform its county fiscal transfer allocation formula to include climate-related indicators to funnel more fiscal resources to county governments, incentivizing them to design and implement county-level climate policies that are aligned with national climate policies, promote local ownership and participation, and ensure social equity and inclusivity. It could also issue green bonds to signal its commitment to achieving specific climate outcomes.

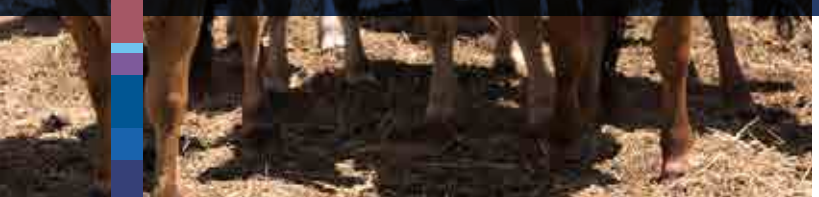
39 https://www.unccd.int/our-work/ggwi.

Preliminary analyses suggest Kenya could consider different carbon pricing instruments with revenue recycling schemes without negatively impacting growth. Options include standardizing the current value-added tax (VAT) rate from 8 to 16 percent for gasoline, diesel, and kerosene (that is, no fossil fuel subsidy reform); a low-ambition, gradual carbon tax with annual increases to reach $\$25/tCO_2$ by 2050 (this includes a fossil fuel subsidy reform that phase out subsidies and price controls over five years); and a combination of VAT standardization and introducing a low-ambition carbon tax. These measures could reduce emissions compared to the baseline by 1.1–4.5 percent. With a revenue recycling scheme, the first and third options should not have any negative effects on GDP. Correcting the fossil fuel prices to their efficient levels would impact households, but the revenues raised through carbon pricing instruments and the recycling channels used can help make the effect more progressive.



5

Prioritizing Actions and Mobilizing Climate Finance



5. Prioritizing actions and mobilizing climate finance

Increasing its resilience to climate risks will enable Kenya to meet its growth objectives while positioning itself as an important player in the global decarbonization efforts. This CCDR identifies five key action areas for a whole-of-economy approach to climate-positive growth and to support sustained engagement at scale. Each action area includes a mix of short-, medium-, and long-term policy and investment measures that would support the country's resilient development while maintaining a low-carbon growth path. Measures associated with the first action area – improving integration and coordination of climate action in policy, planning, and investment decision-making across the economy – is necessary and no-regrets for climate positive development irrespective of the climate future. The three multisectoral action areas include no-regrets measures that generate positive outcomes in all climate futures and priority actions where implementation delay could result in higher costs. This chapter uses an expert ranking to illustrate how Kenya could prioritize measures associated with the three multisectoral action areas. It also presents the fifth action area - policy measures for mobilizing climate finance from private and public sources.

5.1. Ranking climate-positive actions

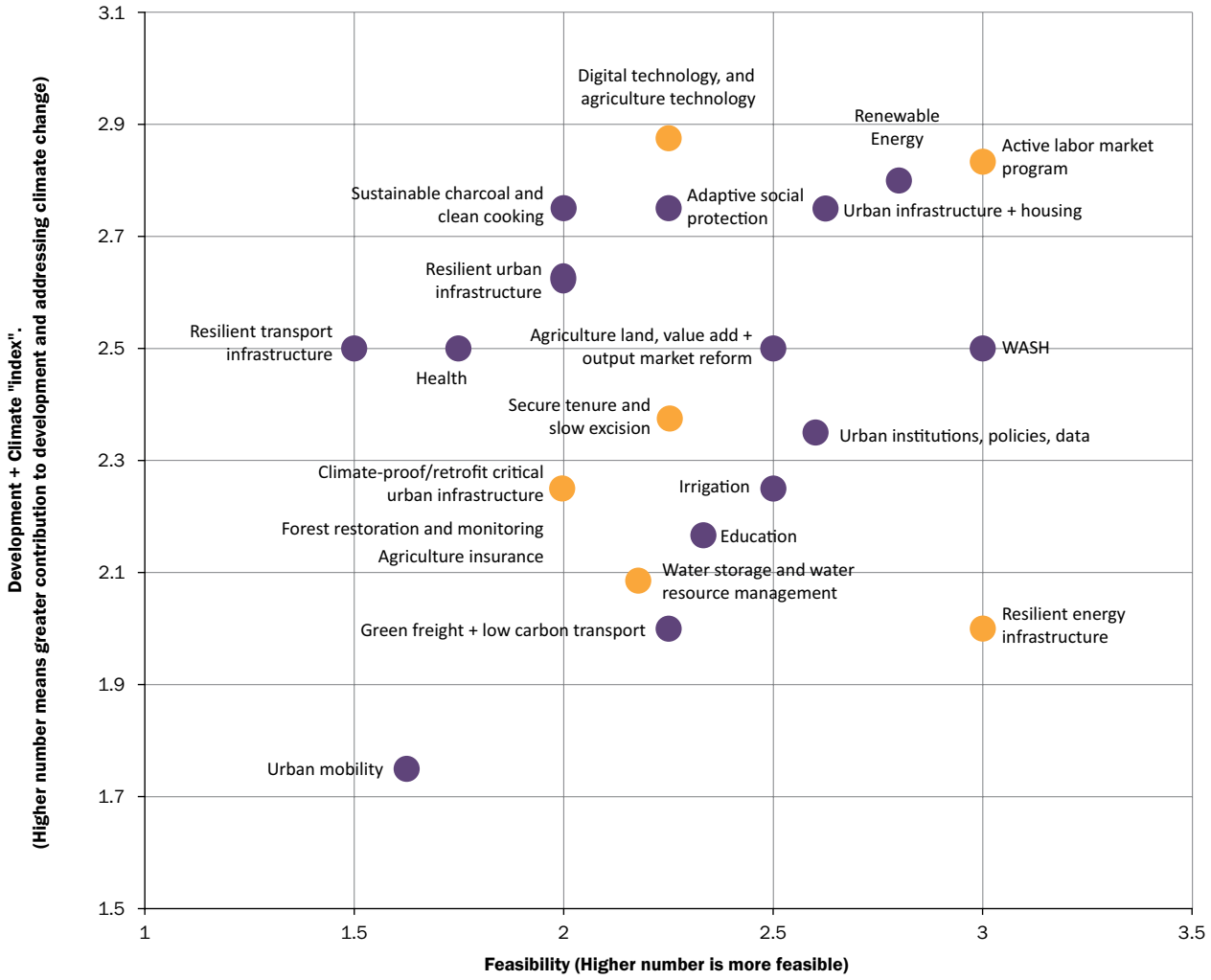
A multicriteria expert ranking of measures under the three multisectoral action areas generates an indicative prioritization of the actions based on the expert view of the context for implementation. For the three multisectoral action areas, the ranking was based on expert opinion on the following criteria:

- Contribution to development based on how actions improve productivity and reduce inequality
- Are no-regret interventions or urgent because the actions are costlier if delayed
- Institutional readiness and public financing required, with higher institutional readiness and lower public financing required being more feasible
- Whether they are aligned with, or additional to, Kenya's NDC.

A graphical representation of an aggregation of the expert ranking (figure 5.1) reveals which actions are more feasible and have positive climate and development impacts. In the figure, development and climate index gives equal weight to development (proxied by taking the averages of the ranking given for productivity gain and reducing inequality) and climate action (which scores a climate action that contributes to mitigation and adaptation higher than an action that contributes to adaptation alone, and gives mitigation the lowest score since Kenya is a relatively small emitter), and feasibility is assessed based on institutional readiness and public financing required. The dark circles indicate no-regrets actions or those that could result in greater costs if postponed; the yellow circles indicate actions for which costs will increase if delayed, but relatively less so than other actions.

The expert ranking shows that actions related to urban resilience, and development actions that contribute to the resilience of human capital (social protection, active labor market policies, health, WASH, and education), the productivity of agricultural systems (agricultural technology, secure tenure, forest restoration and monitoring, agricultural insurance, and value addition and output market reform), and renewable energy can result in climate-positive development. But if financial resources are constrained, not all of the ranked actions need to be tackled in the short-term, a few could be deferred to implementation in the medium-term but should not be deferred indefinitely.

Figure 5.1: Expert scoring of action areas on a development/climate and feasibility scale



Note: The dark circles indicate no-regrets actions or those that could result in greater costs if postponed; the yellow circles indicate that actions where costs will increase if delayed, but relatively less so than other actions.

Table 5.1 provides more information on the expert ranking. The actions that have all green cells are those that could be readily implemented. Actions with a green indicative priority cell require institutional readiness and financing challenges to be address before they can be implemented in the short-term.

Table 5.1: Expert ranking of the three multisectoral action areas

Action area	Brief description of activities	Development impact	Indicative priority	Institutional readiness	Public financing required	Aligned with or additional to NDC
Manage water, land, and forests for climate-resilient agriculture and rural economies						
Improve water resource management and expand irrigation	Develop and manage gray and green water storage to manage variability	P: ●●● I: ●●				Y
	Virtual water trading	P: ●● I: ●				+
	Manage demand through allocation, regulation enforcement within agreed basin plans	P: ●● I: ●●●				+
	Small-scale and farmer-led irrigation	P: ●●● I: ●●●				Y
	Performance-based improvement of large-scale irrigation (private engagement)	P: ●●● I: ●●				Y
	Expand public irrigation	P: ●●● I: ●				Y
Restore and manage forest assets for water storage while generating other economic benefits	Targeted restoration efforts	P: ●● I: ●●				Y
	Secure forest and tree tenure ownership	P: ●●● I: ●●				+
	Forest resource monitoring	P: ● I: ●				Y
	Adequate forest management for charcoal production	P: ●● I: ●●●				Y
	Accelerate transition to modern energy cooking services in rural areas	P: ●● I: ●●●				Y
	Slow the excision of forest land	P: ● I: ●				+
Transform agricultural productivity	Rainfed, smallholder agriculture: CSA measures; rainwater harvesting; technologies, innovations, and management practices	P: ●●● I: ●●●				Y
	Livestock CSA pasture management, groundwater recharge, spate irrigation animal health management, fodder production, and shifting to feedlot-based beef production	P: ●●● I: ●●				Y
	Increase value addition and reduce food loss	P: ●● I: ●				Y
	Undertake reforms to reduce government intervention in output markets, encourage the use of warehouse receipts, and establish a commodity exchange	P: ●● I: ●●●				Y
	Unlock new large-scale private farms	P: ●●● I: ●				Y
	Extend provision to crop and livestock insurance	P: ●● I: ●●●				Y

Action area	Brief description of activities	Development impact	Indicative priority	Institutional readiness	Public financing required	Aligned with or additional to NDC
Deliver people-centered resilience with climate-informed basic services and urbanization						
Ensure climate-proof universal access to basic services						
Universal coverage in a resilient health system	Reduce distance to health facility	P: ●●● I: ●●●				Y
	Increase community knowledge and awareness	P: ●●● I: ●●●				Y
Accelerate WASH rollout and to make services more resilient to climate change	Implement reforms: capital efficiency, operational efficiency, and tariff reforms	P: ●●● I: ●●●				Y
Resilience in education services and skills training	Increase awareness of climate causes, impacts and responses	P: ● I: ●●●				Y
	Reduce disruption, adapt infrastructure	P: ●● I: ●●●				Y
	Tertiary education system, including technical and vocational education and training, universities	P: ●●● I: ●●				+
Implement adaptive social protection and active labor market programs to achieve socioeconomic mobility and resilience to climate change						
Adaptive social protection	Increase coverage by operationalizing enhanced single registry	P: ●●● I: ●●●				+
	Increase and improve coverage and scalability of social protection programs	P: ● I: ●●●				+
Active labor market	Strengthen coverage and targeting of active labor market policies	P: ●●● I: ●●●				+
	Match skills with market demand	P: ●●● I: ●				+
	Build digital skills and entrepreneurship for youth and women	P: ●●● I: ●●●				+
Transform urban areas into climate-resilient hubs that foster economic growth						
Integrate climate in urban plans, policy improving data access and use, and build institutional capacity	Harmonize urban planning legislation and mainstream climate considerations and vertical and horizontal government coordination	P: ● I: ●●				Y
	Ensure urban plans are climate-smart	P: ● I: ●●●				Y
	Improve data access and capacity to use data	P: ● I: ●●				+
	Update the National Urban Development Policy	P: ● I: ●●				Y
	Enhance capacity of urban institutions	P: ● I: ●●●				Y
Climate-resilient urban hubs for growth	Implement nature-based solutions to reduce vulnerability to climate change	P: ● I: ●				Y

Action area	Brief description of activities	Development impact	Indicative priority	Institutional readiness	Public financing required	Aligned with or additional to NDC
Urban infrastructure and housing	Update national building code	P: ● I: ●●●				Y
	Climate-proof/retrofit critical urban infrastructure	P: ●●● I: ●●●				Y
	Upgrade and build new solid waste management infrastructure, waste management programs	P: ●● I: ●●●				Y
	Adopt measures to ensure climate-smart and energy efficient buildings: less water-intensive materials, renewable energy	P: ●●● I: ●●				Y
	Support innovative building initiatives, develop local manufacturing capacities	P: ●●● I: ●●●				Y
Urban mobility	Develop and adopt enabling urban transport policy framework, adopt an avoid-shift-improve and resilience approach	P: ●●● I: ●●●				+
	Implement integrated multimodal public transport system with smart solutions	P: ●●● I: ●●●				Y
	Adopt electric vehicles while also developing mass rapid transit	P: ●● I: ●●				Y
	Enhance institutional capacity of institutions related to urban mobility	P: ●● I: ●●				Y
Strengthen Kenya's competitiveness in international markets through shifts in energy, transport, and digital systems						
A green energy matrix	Expand renewable energy capacity through competitive auction framework	P: ●●● I: ●●			DD	Y
	Adopt geothermal strategy and sector development	P: ●●● I: ●●			DO	Y
	Expand access to clean energy (universal electrification)	P: ●●● I: ●●●				Y
	Regional interconnection	P: ●●● I: ●●			TBD	+
	Climate resilient power network infrastructure	P: ●●● I: ●			TBD	Y
	Battery energy storage	P: ●●● I: ●●			TBD	+
Greener freight transport, transport technologies, and resilient infrastructure	Develop an action program for greener freight solutions (shift to lower emissions modes, increasing reliability and efficiency of freight, and multi-modal transfer notes	P: ●●● I: ●●●				Y
	Adopt and enhance low-carbon transport technologies (transition to green gateways, decarbonize road transport)	P: ●●● I: ●●●				Y
	Accelerate climate proofing strategic road transport infrastructure and critical links	P: ●●● I: ●●●				Y
Resilient digital infrastructure for efficient, low-carbon growth	Close digital divide	P: ●●● I: ●●●				+
	Resilient digital infrastructure – power back up	P: ●● I: ●●●				+

Notes: P = productivity; I = inequality; Y = aligned with NDC; + = additional to NDC; DD = depends on demand; DO = depends on options chosen; TBD = to be determined. Based on expert ranking, under *Indicative priority*, green = high priority, yellow = medium priority, and orange = low priority; under *Institutional readiness*, green = readiness, yellow = needs some assistance, and orange = needs assistance; under *Public financing required*, green = financing is unlikely to be a constraint, yellow = financing could be a constraint, and orange = financing will be a constraint.

5.2. Policy measures for mobilizing climate financing from public and private sector

The government of Kenya estimates that delivering its updated NDC will cost $62 billion and has committed to mobilize resources to meet 13 percent of the cost. It will need around $5.39 billion of additional financing per annum. In 2018, Kenya invested a total of $1.53 billion in public climate finance and received an additional $0.97 billion in private climate finance, and around 80 percent of all climate finance tracked flowed to mitigation sectors, such as energy (Balm et al. 2022). While filling the financing gap is imperative for climate positive development, our estimation of investment needs for a few of key actions covered in this CCDR (table 5.2) show that the additional costs for ensuring the investments are low-carbon and contribute to climate resilience in the BAU scenario are manageable, and in some cases notably offset by the economic benefits. For example, the additional capital investment needed to decarbonize power generation is 9 percent of the investments needed without decarbonization consideration. Where investment needs for more resilient actions are high (e.g., restoring forest landscapes), the economic benefits justify the investment. There are also significant opportunities for mobilizing private sector financing in the investment areas mentioned in table 5.2.

Table 5.2: Estimated costs, benefits, and investment needs for a few key actions ($, millions)

Investment needs, economic costs and benefits for key climate actions	BAU		Low-carbon and resilient climate actions (with BAU growth scenario)	
	2022–30	2031–50	2022–30	2031–50
Manage water, land, and forest for climate-resilient agriculture and rural economies				
Restoring forest landscapes	122.67	(213.78)	2,838.46	(4,057.23)
Investment need: afforestation/reforestation, agroforestry, plantation forestry, restoration of degraded lands	138.37	124.42	3,154.95	2,836.34
Economic cost: operations and maintenance for investments in previous row	18.65	120.60	399.12	2,486.49
Economic benefit: timber revenue	NA	104.07	NA	1,988.27
Economic benefit: reduced externalities (soil erosion, carbon sequestration)	34.34	354.73	715.62	7,391.78
Boosting agricultural productivity and resilience	NA	NA	1,363.40	(11,301.22)
Investment need: increasing productivity with CSA and irrigation expansion	NA	NA	3,017.25	2,514.65
Economic cost: CSA and irrigation operations and maintenance	NA	NA	802.58	971.95
Economic benefits: increased production efficiency and reduced output loss and waste	NA	NA	2,456.43	14,787.82
Economic benefit: CO_2	NA	NA	Not estimated	Not estimated
Promoting clean cooking	20,638.26	29,032.08	(22,374.39)	(109,429.27)
Investment need: stove costs (CAPEX)	583.38	435.01	1,871.58	4,792.89
Economic cost: fuel costs (OPEX)	7,949.55	21,794.37	7,225.90	19,461.44
Economic cost: damages to the global society of additional $MtCO_2e$	12,105.33	6,802.70	11,741.20	5,628.78
Economic benefits: avoided morbidity and mortality caused by household air pollution	NA	NA	43,213.07	139,312.38

Investment needs, economic costs and benefits for key climate actions	BAU		Low-carbon and resilient climate actions (with BAU growth scenario)	
	2022–30	2031–50	2022–30	2031–50
Deliver people-centered resilience with climate-informed basic services and urbanization				
Facilitating e-mobility	113,646.33	268,368.93	110,963.96	238,432.32
Investment need: e-mobility CAPEX (infrastructure + vehicle capital cost)	34,485.12	95,687.73	37,030.15	116,274.70
Economic cost: e-mobility (OPEX)	79,161.21	172,681.20	73,933.81	122,157.62
Strengthen Kenya's competitiveness in international markets through shifts in energy, transport, and digital systems				
Decarbonizing the power system	4,079.14	7,830.00	4,465.85	8,238.27
Investment need: generation (CAPEX)	2,059.88	3,835.83	2,059.80	4,183.40
Economic cost: transmission and distribution (OPEX)	2,007.71	3,918.96	2,008.00	3,795.00
Investment need: resilience to reduced hydrology (CAPEX)	NA	NA	253.89	129.25
Economic cost: resilience and adaptation to lower hydrology (OPEX)	NA	NA	132.22	130.62
Economic cost: fuel costs (OPEX)	11.55	75.21	11.94	NA

Notes: Estimates are based on data availability; NA = not applicable; figures in parentheses are net benefits.

Given its reliance on public sector financing, either directly or as a conduit for international financing from development banks and donors, the government will need to explore a range of options to crowd in new sources of money. Financing to increase Kenya's resilience to climate change will require both domestic resources and expanding climate-compatible private investment in existing areas, such as livestock feed and tourism. But Kenya is well positioned to accelerate private sector-led growth, and expand and explore the use of climate financing options such as carbon markets and risk transfer instruments in the short-term and debt instruments in the medium-term.

5.2.1. Leveraging private sector funding

Kenya will need to mobilize a significant portion of its climate action investment needs from the private sector, where financing is more readily available. For example, growing awareness of green building benefits could drive private sector innovations and investment in sustainable solutions to develop green buildings and cities. But for this market to grow, the government needs to address existing barriers, including limited access to suitable capital given traditional lending patterns, titling issues, high land costs in urban and semi-urban areas, and the slow adoption of alternative building materials. Weak inclusion of the construction and housing sector in the national climate policy and legal framework—including tracking mitigation goals of the sector in the NDCs—is to a missed opportunity to build this market.

E-transportation is another area with potential for greater private sector engagement. There are opportunities to scale investment in e-motorcycles, e-buses, and EV manufacturing and assembly. A partnership between the government and private sector could help promote the use of public charging stations, a key barrier for EV adoption. But to fully seize the opportunities for private investment, the government must develop a more effective tax environment for importing EV batteries and EV assemblers and prevent the dumping of internal combustion engine vehicles.

Private financing opportunities are available in the domestic, regional, and international markets. There are relatively large pools of domestic finance available—including pension funds worth $14 billion, which represent nearly 13 percent of GDP—and it is important to evaluate these to determine how they could

potentially be leveraged directly and indirectly for climate finance. Corporate and investment project-based financing can also offer opportunities for green/blue resource mobilization to move away from a reliance on government-issued bonds. East African Community investors consider Kenya a domestic investment, which presents opportunities to channel resources from regional investors. Greater access to and transparency of information, projects, and retail platforms related to sustainable investments could also mobilize $19 billion of retail capital to support Kenya's climate finance goal and has a 11.5 percent growth potential (Standard Chartered 2022). The Vuka platform for Acorn Real Estate Investment Trust's green student housing program[40] is one example of this approach.

To maximize the benefits of concessional financing, the government can deploy it to de-risk the investment and use blended structures that crowd in private sector funds for resilience. PPPs will be key for large-scale infrastructure investments and in land-based sectors, such as agriculture, forestry, and tourism. Accelerating efforts to integrate climate considerations when prioritizing and selecting investments will be instrumental for mobilizing private sector interests and leveraging dedicated climate grants. This should include adopting and operationalizing a green investment taxonomy and standards framework for certification of sustainable agriculture and forestry.

5.2.2. Carbon markets

The economic rationale for some of the investments in resilience—for example, investing in landscapes—are the positive ecosystem benefits they generate, including in terms of reducing CO_2 emissions. Financing such investments hinges on internalizing and monetizing the resultant ecosystem services—for example, through carbon markets. As well as offering Kenya new opportunities for product diversification and investment, carbon markets can be extended to cover mitigation financing in multiple sectors. Sectors that offer the most potential for near-term carbon market opportunities include energy (leveraging the well-established cookstove model), housing, forestry, the blue economy, and agriculture, including livestock.

Kenya is expected to benefit from the new Africa Carbon Markets Initiative, which works with major carbon credit buyers and financiers. To tap into carbon markets, the government will need a robust, operational carbon markets legal framework that is aligned with its NDC targets and clearly presents the potential for carbon markets, the processes it will follow, the necessary interministerial coordination, and linkages between compliance and voluntary markets. The framework should also be aligned with Kenya's carbon pricing and measurement, registry, and reporting strategies, how Kenya will meet its NDC commitment to reduce GHG emissions, and whether it will sell internationally traded mitigation outcomes to help other countries meet their NDC commitments. The latter will be set out in Kenya's forthcoming Article 6 strategy and will, ideally, be underpinned by a clear understanding of the cost to Kenya of meeting its NDC target to avoid overselling. But to benefit from carbon markets, Kenya will need to show that an activity has avoided or removed harmful GHG emissions. This will require developing the necessary measurement, reporting, and verification (MRV) systems and registry infrastructure. A robust MRV system would help ensure high environmental integrity and help Kenya meet international standards.

Several entities in Kenya have experience with carbon markets under the Clean Development Mechanism of the Kyoto Protocol. For example, in 2018–19, the World Bank provided technical assistance to pilot the generation of emission reduction credits from Kenya Electricity Generating Company PLC's (KenGen) geothermal projects. KenGen is the SOE responsible for electricity generation, and the private sector has also shown interest in voluntary carbon markets.

40 https://acornholdingsafrica.com/vuka/.

5.2.3. Risk transfer instruments

To insure against climate-induced disasters, the government can explore risk transfer instruments that cover high-impact, low-probability events. This includes issuing parametric catastrophe bonds (cat bonds) or insurance to transfer catastrophe risk from a sponsor to bond investors.[41] The risk coverage period is typically two to five years and cat bonds can provide quick payouts when designed with parametric or modeled loss triggers. Cat bonds are tradable securities and require more complex legal documentation than reinsurance, and therefore often result in larger transaction costs than reinsurance. However, these costs can be spread over a longer period. Placing a cat bond will require a market-accepted risk model for a specific hazard, and this may take time to develop for Kenya.

Reviewing the implementation of the National Disaster Risk Finance Strategy (2018–22) could inform efforts to ensure climate insurance programs, such as shock-responsive social protection and agricultural insurance, have the budget to protect against shocks. This strategy sets out the National Treasury's strategic priorities and implementation plan for financing disaster response at sovereign, firm, and household levels. Many of the financing instruments put in place between 2018 and 2022 have now expired or been fully depleted. Based on the findings of the review, the government can adopt a second phase of the disaster risk finance strategy to inform adaptation-orientated budget allocations. The updated strategy could support the government's efforts to mobilize global sources of concessional finance for risk finance, for example through the World Bank's Global Shield Financing Facility and/or the African Development Bank's Africa Disaster Risk Financing Program, and to prioritize the mobilization of private capital for climate adaptation.

5.2.4. Debt instruments

Over the medium to longer term, Kenya could also use debt instruments to finance climate investments. Priority instruments to consider include green bonds, key performance indicator linked bonds, and concessional financing.

5.3. Scaling up climate and nature finance

The government has a strong institutional and policy framework in place to finance its climate and nature ambitions. In addition to the actions mentioned above, to expedite and sustain resource mobilization efforts, especially from new financial mechanisms, capital markets, and the private sector, it could:

- Enhance national financial and institutional capacity to mobilize climate finance to support priority NDC investments, by standardizing the use of MRV systems and related capabilities to leverage innovative policy, debt, and non-debt instruments
- Prioritize a portfolio of investments, considering climate and biodiversity targets, the macrofiscal situation, debt management strategy, and access to capital markets
- Scale up efforts under government FLLoCA activities to develop locally-led climate resilience actions to tackle local and regional impacts of climate change, and channel climate funds to local government and help strengthen coordinated climate action
- Optimize the use of grant and concessional finance to catalyze private sector investments
- Expand PPPs for priority investment sectors where feasible and increase civil society collaboration, including to promote blended financing opportunities
- Initiate a program to pilot test and scale innovative instruments, especially those that do not add to sovereign debt, and performance-based financing, including carbon markets, structured bonds, wildlife conservation bonds, and sustainability-linked bonds or loans.

41 Cat bonds are similar to insurance, where sponsors receive a payout when a disaster event meets certain predefined criteria. They are fully funded transactions and investors stand to lose some or all of the principal.

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6

Conclusion and Looking Ahead

6. Conclusion and Looking Ahead

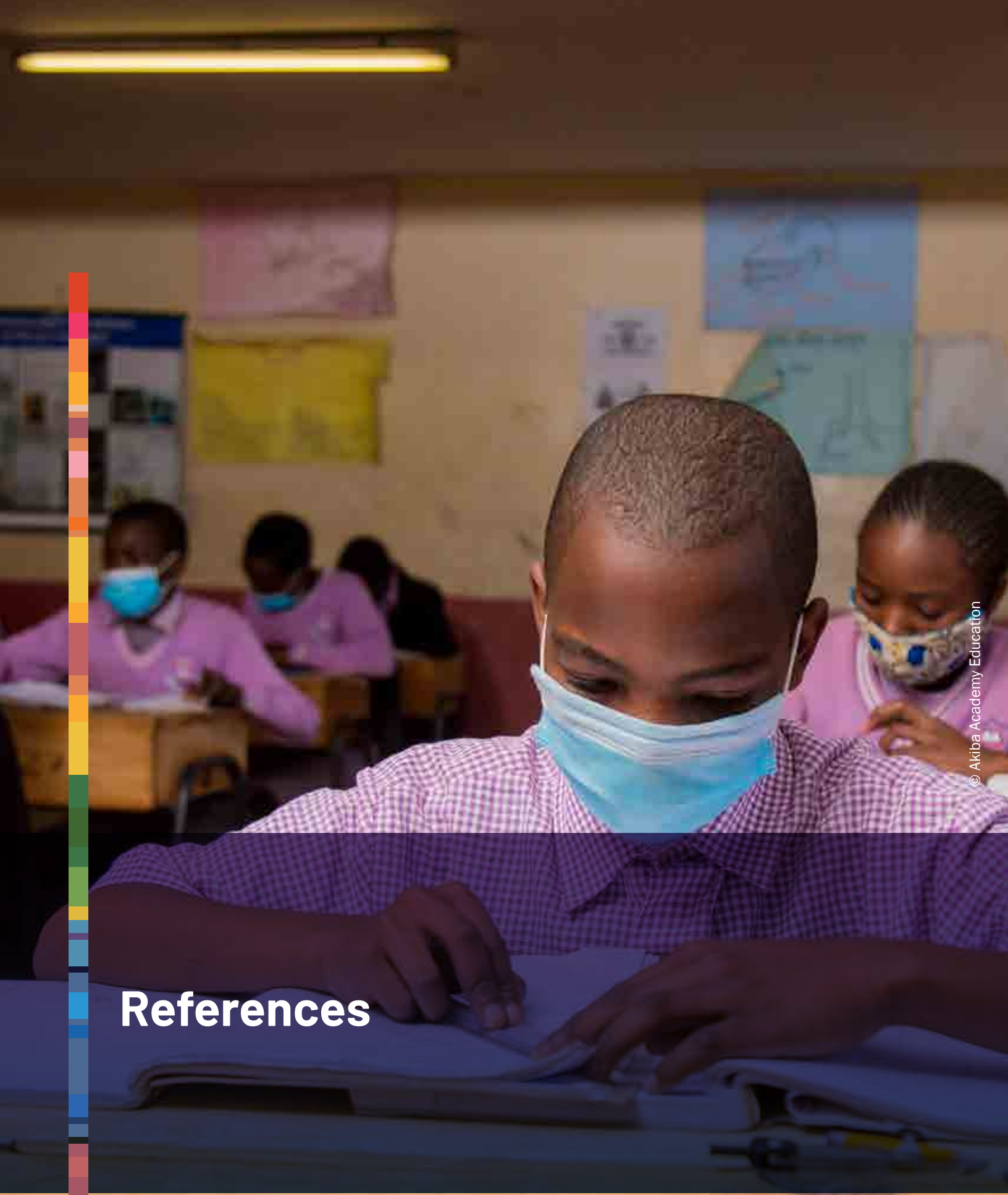
This CCDR highlights how Kenya could, through climate positive actions, achieve inclusive and resilient growth while positioning itself to be competitive in a decarbonizing world. The significant share of renewables in its power sector, the opportunity to benefit from the youth bulge by making additional investments in human capital, digital penetration, and government commitment to landscape restoration and agricultural transformation position Kenya well for tackling climate change while maintaining a low-carbon growth path. But the country's current economic structure, level of informality, and slow structural transformation expose it to exogenous climate risks, creating some real challenges for the government to tackle.

Addressing the potential impacts of, and seizing the opportunities created by, climate change will require structural shifts that promote productivity gains, and these should be complemented with sectoral policies and whole-of-economy measures. While structural transformation will provide some protection against climate risks, it is not enough on its own. The government will need to complement this with sectoral and economywide measures. While most of these are technically feasible and economically viable, they require robust institutional coordination, and targeted policy reforms, as well as technical support for planning, data, and capacity building. Operationalizing the policy reforms could require addressing political economy constraints, latent conflicts, and other challenges that hamper effective implementation, around secure land tenure, the public sector's role in the construction industry, carbon trading, the introduction of green fiscal measures or carbon pricing, and other issues.

This CCDR, with its focus on a subset of issues and multisectoral deep dives, presents opportunities and challenges created by climate change, and operationalizing it will require further work. The multisectoral dives cover a range of issues connecting climate change with the country's agriculture, natural capital, human capital, urbanization agenda, and physical capital. But the analysis does not cover all the challenges that climate change could pose to the citizens of Kenya and is not an exhaustive quantification of all risks and opportunities.

Our findings offer valuable insights into the necessary direction of action rather than definitive answers because future climate scenarios have a range of uncertainty, and the different models have a host of assumptions, many of which are validated. What is definitive, however, is the need for climate-informed development and for climate action to be effectively coordinated, geographically and demographically targeted, and, where necessary, phased to optimize development and climate outcomes. Equally definitive is the importance of involving the private sector and deploying innovative approaches to mobilize climate finance to accelerate achieving the desired development and climate outcomes. While this CCDR brings robust evidence for adopting an integrated approach to tackling climate and development, follow-up studies on specific issues and actions are needed, and several have already been launched.

Operationalizing the actions identified in this CCDR would benefit from a programmatic approach that facilitates coordinated climate action that is sustained and at scale. This can provide the much-needed integrated framework for addressing the issues highlighted in the five action areas. Such an approach will require strong coordination by a government entity that can effectively champion the multisectoral agenda and convene the diverse stakeholders. This would help ensure that the enabling policies and institutional measures supported by the programmatic approach would lay the required foundation for enhancing the efficiency of climate investments. To complement the policy and institutional aspects, a set of investment programs would help coordinate climate investments in specific areas of intervention to achieve change at scale. Investment programs can also serve as platforms for bringing together public, private, and concessional sources of financing, as well as dedicated climate grants. An integral part of the programmatic approach would be a monitoring framework with clear performance indicators and accountabilities for outcomes. By taking such an approach, Kenya could catalyze its transition towards a climate resilient and inclusive growth path.



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