2024
REPORT

Climate change impacts in Kenya

WHAT CLIMATE CHANGE MEANS FOR A COUNTRY AND ITS PEOPLE.

A scientific synthesis led by the Kenya Meteorological Department

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This report is a scientiJc synthesis led by the Kenya Meteorological Department. It is intended to inform policymakers, media, the private sector, civil society, academics and anyone looking for country-level information on the impacts of climate change in Kenya. It has been reviewed internally before publication.

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Climate change impacts in Kenya

Executive summary

Kenya is a tropical, water-scarce country located on the equator in East Africa. Its diverse landscapes and abundant natural resources directly support the lives and livelihoods of millions of people through agriculture and nature tourism. The government recognizes the cultural richness that Indigenous tribes and communities bring to the country, yet the impact of climate change on already fragile natural ecosystems poses a growing challenge for their very survival.

Rich in biodiversity and natural resources, Kenya's landscape and climate are highly diverse.

Bordering the Indian Ocean in the east, flat plains characterize Kenya's coastal region, giving way to vast savannah in the south-east lowlands. The Great Rift Valley contains eight of Kenya's 64 lakes and supports a variety of human and aquatic life, including flamingos and crocodiles. Lush green forest dominates the central highlands to the east of the Great Rift Valley, while rolling hills cover the highlands to the west. This geographic diversity gives rise to very different climatic environments, from arid to temperate.

> *Kenya contains part of three of the world's 36 biodiversity hotspots – the Eastern Afromontane, the Coastal Forests of Eastern Africa and the Horn of Africa – which are home to species not found anywhere else on Earth.*

Kenya derives 42% of its gross domestic product (GDP) from its natural resources, including through agriculture, tourism, forestry, mining and fishing. About 50% of its land is used for agricultural crops, including tea, coffee, pyrethrum, maize, wheat, potatoes, pulses, fruits, vegetables and flowers. Kenya contains part of three of the world's 36 biodiversity hotspots[1] – the Eastern Afromontane, the Coastal Forests of Eastern Africa and the Horn of Africa – which are home to species not found anywhere else on Earth.

Kenya's rich landscapes support lives, livelihoods and cultural traditions while also contributing to the economy.

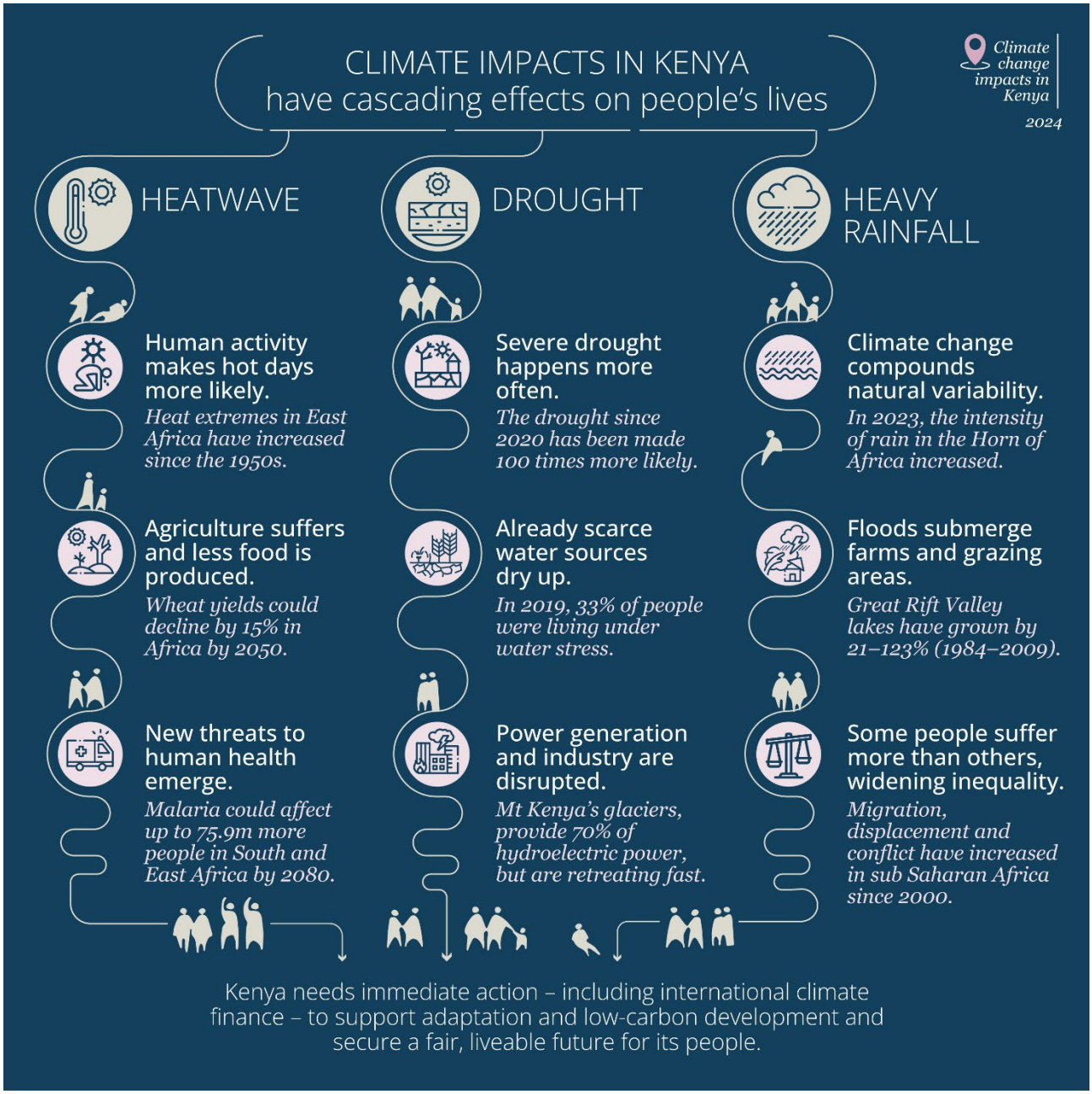
Kenya is home to about 47.6 million people, with about 68% of the population living in rural areas. The more than 42 tribes in Kenya, each with its own history, beliefs, culture and traditions, religions, and economic activities, bring a rich and vibrant cultural heritage.

With an average annual growth rate of 5.9% between 2010 and 2018, Kenya has one of the fastest growing economies in Africa.[2] Agriculture employs over 40% of the active workforce (more than 70% in rural areas) and directly contributes about 20% of Kenya's GDP.[3] Tourism is another key economic driver, generating 10.4% of GDP and employing 5.5% of Kenya's active workforce.[4] Visitors are attracted by the Maasai Mara and the Tsavo, Amboseli and Mount Kenya national parks,

among many others. Both agriculture and tourism are finely tuned to the environment. The agricultural sector depends largely on rainfall, and in 2022 a prolonged drought that had been gripping the Horn of Africa triggered a countrywide fall in maize production of 6.5% and a 3.3% drop in the volume of horticultural exports.[5]

Climate change – especially heatwaves, rainfall and drought – is creating unexpected challenges for Kenyan society and the economy.

Over East Africa, the average temperature increased by 0.7–1°C between 1973 and 2013 (depending on the season).[6] This increased temperature is having multiple, cascading impacts on Kenya's people, natural ecosystems and economy.



Signature figure. *Climate impacts in Kenya have cascading effects on people's lives. Credit: InfoDesignLab.*

Heatwaves have become more severe and longer lasting, with extreme heat associated with rises in emergency department visits and hospital admissions.[7,8] Under a very high, worst-case emissions scenario (RCP8.5; see box in Section 3.2), climate change is predicted to result in an additional 75.9 million people at risk from malaria in eastern and southern Africa by 2080[9] and to a decline in wheat yields in Africa of 15% by 2050.[10]

Climate change increased the intensity of heavy rainfall in the Horn of Africa in 2023, causing more than 300 deaths and displacing over a million people.[11] Increased flows on large rivers are flooding farmlands, degrading soils and reducing farm output, with consequences for food availability.[12] The Great Rift Valley lakes have expanded in area – by 21% for Lake Naivasha up to 123% for Lake Solai, for example.[13]

Global temperature rise to date has made events like the extreme drought that Kenya has been experiencing since 2020 much stronger and about 100 times more likely.[14] Between 1995 and 2019, the percentage of Kenyans living under water-stressed conditions increased from 15% to 33%.[15] Migration, internal displacements and conflict have been on the rise in Sub-Saharan Africa due to increased occurrence of floods, droughts and extreme heat and their associated impacts on food, pasture and water resources.

> *Climate change increased the intensity of heavy rainfall in the Horn of Africa in 2023, causing more than 300 deaths and displacing over a million people.*

Tourism plays an important role in Kenya's economy. But rainfall variability and prolonged drought are already altering wildlife migrations, affecting tourist visits on big nature reserves such as the Maasai Mara.[16,17] About 70% of Kenya's hydropower (about 28% of total power) is generated from Mount Kenya's glaciers,[18] which are projected to disappear by 2030 under all climate scenarios.[6]

A lack of historical weather and climate data in Kenya, and the continent of Africa more widely, combined with high natural climatic variability, makes for a complicated picture. But with a faster rate of warming in Kenya compared with the global average, climate change impacts are projected to increase steeply with every degree of warming.[6]

Kenya needs immediate action – including international climate finance – to support adaptation and low-carbon development and secure a fair, liveable future for its people.

With 70% of the Kenyan population employed in climate-sensitive sectors,[19] the government has outlined its sustainable development blueprint, Vision 2030.[20] The County Climate Change Fund, for example, is a mechanism that invests in locally led adaptation and promotes citizen engagement.[21] The government has also set up an emergency cash transfer programme for vulnerable households during extreme weather events, such as drought and flooding.[22]

> *In 2018, 79% of international public climate finance into Kenya was in the form of debt, with most (55%) channelled towards mitigation.*

In 2023, Kenya generated about 90% of its electricity from renewable sources. The majority came from geothermal and hydropower, with a fast-growing contingent from wind and solar power.[23] A

just transition would require systemic solutions that allow low-income countries and lower-middle-income countries, such as Kenya, to provide universal energy access to their citizens within the remaining global carbon budget. Yet the budget is being depleted by already affluent countries, rather than by lifting people out of poverty.[24]

Despite being a vulnerable continent, very little funding is directed to Africa for climate change adaptation research.[6] In 2018, 79% of international public climate finance into Kenya was in the form of debt, with most (55%) channelled towards mitigation. Changes in the climate financing landscape would be needed to spur resilience building and transformation in Kenya, as would ways to better involve Indigenous peoples and promote gender and social inclusivity.

In this report:

Climate change impacts in Kenya

Chapter 1 | National snapshot

Rich in biodiversity and natural resources, Kenya's landscape and climate are highly diverse.

Kenya is a tropical, water-scarce country located on the equator in East Africa. It shares many international borders – with Ethiopia in the north, South Sudan in the north-west, Uganda in the west, Tanzania in the south and Somalia in the east. Kenya has a range of climatic conditions, with pockets of tropical and temperate climate in a mostly arid and semi-arid landscape. Kenya's wildlife is renowned, from Lake Victoria's hippos to the iconic wildebeest of the Maasai Mara.

1.1 A diverse landscape

Kenya has a number of distinct climatic and ecological zones, linked in part to its widely varying topography (see Figure 1). The coastal region in the east, bordering the Indian Ocean, is characterized by predominantly flat plains with warm, humid weather. The plains give way to vast sprawling savannah in the south-east lowlands, dominated by grassy ecosystems with an arid and semi-arid climate. Wildlife roams these savannahs, migrating seasonally into and out of neighbouring Tanzania to find food and water.

The Kenyan section of the Great Rift Valley contains eight of the 64 lakes in the country. These lakes, both freshwater and saltwater, support humans and a variety of aquatic life, including flamingos and crocodiles. The central highlands to the east of the Great Rift Valley include Mount Kenya and the Aberdare mountain range. Characterized by lush, green, dense forests and by rivers, ravines and waterfalls, these highlands are generally cool all year round and provide habitats for a vast array of birds, insects, fish and wildlife, including zebras and antelopes, as well as hosting fertile tea and coffee farms.

> *Kenya's landscape can be categorized into three major climatological zones, distinguished primarily by the distribution of rainfall: arid and semi-arid, tropical, and temperate.*

The highlands west of the Great Rift Valley are characterized by rolling hills, green vegetation and cool weather, also making this area suitable for tea and coffee farming. Rising to 2,000 m above mean sea level, these highlands provide ideal training zones for high-altitude, long-distance athletics, which has helped Kenya achieve its status as a global champion in this discipline. The lake basin region forms the westernmost part of Kenya. Lake Victoria, Africa's largest lake and the world's second largest freshwater lake, is shared across Tanzania (49%), Uganda (45%) and Kenya (6%). The famous lake supports many fish species, various bird species and some large mammals, including hippopotamuses and elephants.

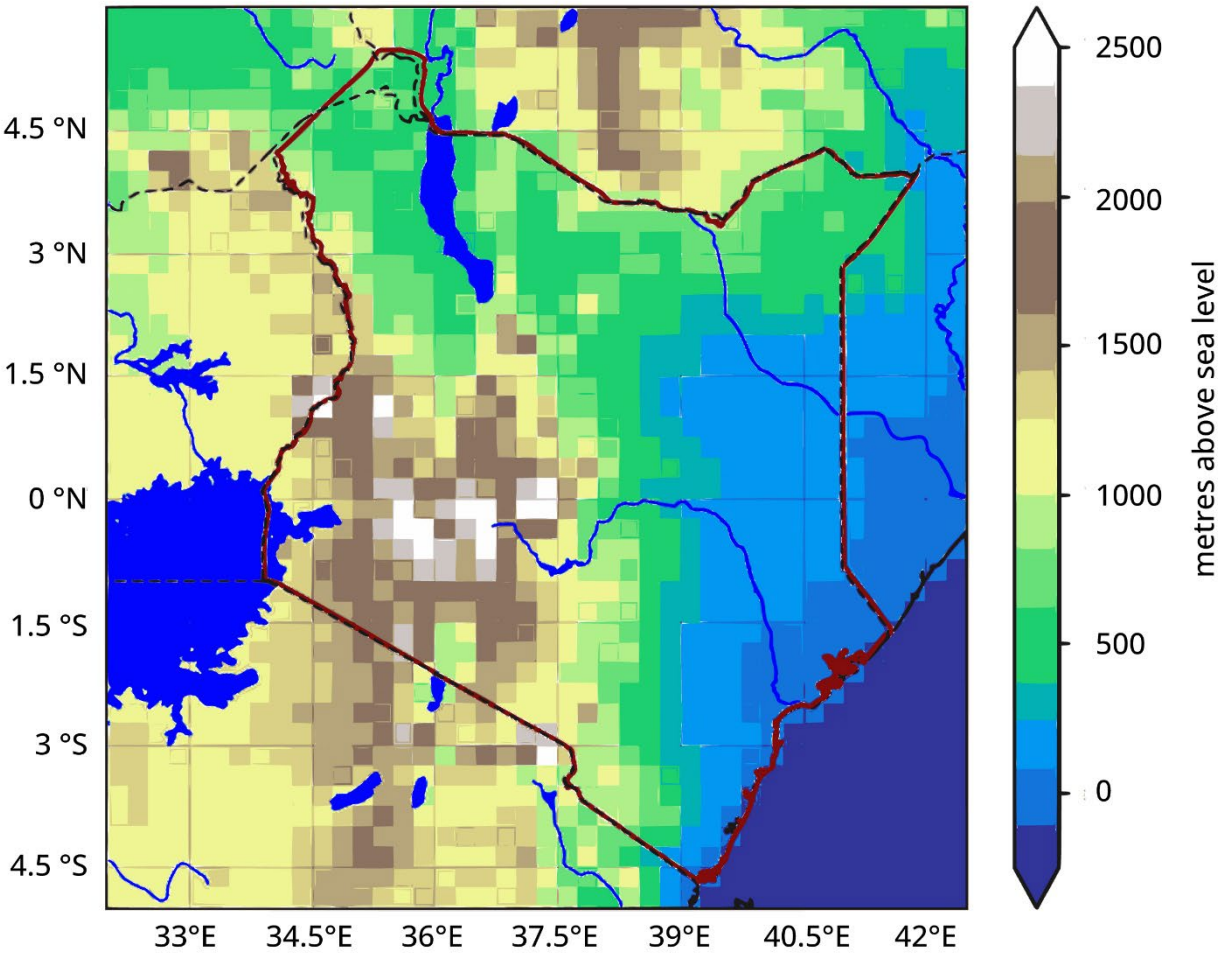


Figure 1. *Kenya's topography and climate are highly diverse. Situated between 5° N and 5° S latitude and 34° E and 42° E longitude, Kenya's geography spans low-lying coastal regions up to the towering peaks of Mount Kenya in the central highlands.*

Kenya has two main wet seasons: March to May is referred to as the "long rains", and October to December as the "short rains". Parts of the country experience a third wet season between June and August. There are three main sources of moisture for rainfall: Lake Victoria, the Indian Ocean and the humid layer of the Congo air mass. The moisture brought in interacts with Kenya's varying topography, resulting in different rainfall regimes within this overall seasonal pattern.[25,26]

Kenya's landscape can be categorized into three major climatological zones, distinguished primarily by the distribution of rainfall: arid and semi-arid, tropical, and temperate (see Figure 2). The arid and semi-arid lands are characterized by low and erratic rainfall, strong winds and intense sunlight for most of the year. They provide generally hostile environmental conditions and frequently experience drought.[27] Kenya's temperate zones are typically highland areas, such as the Lake Victoria basin and Mount Kenya regions. These zones are characterized by cool temperatures and relatively high rainfall. The tropical zones, predominantly the plateaus, receive moderate rain during the two main wet seasons and serve as transition zones between temperate and arid areas.

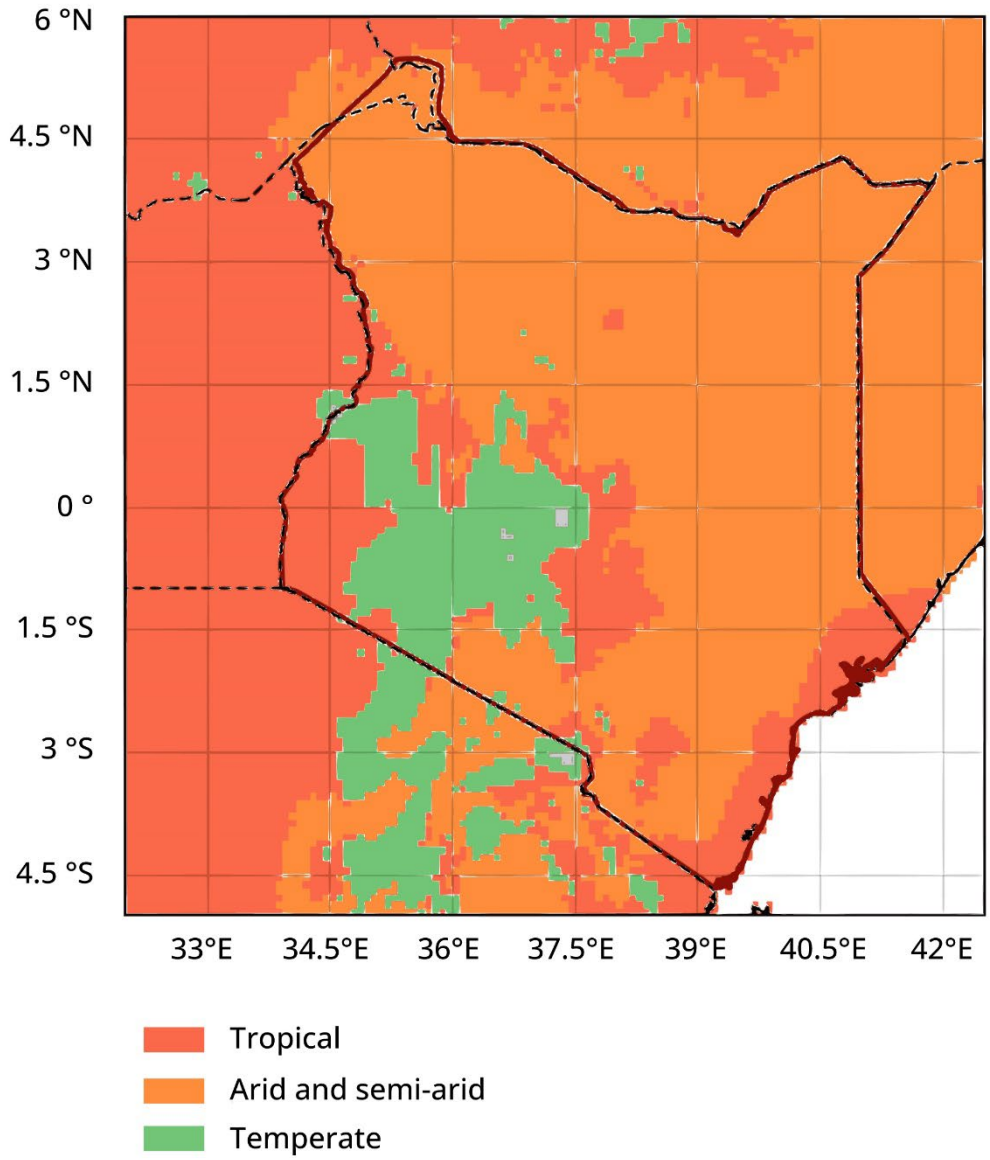


Figure 2. *Kenya has three main climatic zones, according to the Köppen–Geiger classification. Arid and semi-arid regions (orange) cover most of the land area, with the tropical (red) and temperate (green) climates less dominant.*

1.2 Natural assets

Covering a total area of over 582,500 km^2, Kenya is globally renowned for its abundant natural resources and rich biodiversity. An estimated 42% of Kenya's gross domestic product (GDP) is derived from its natural resources, including through agriculture, tourism, forestry, mining and fishing. Preserving and protecting Kenya's natural capital is therefore fundamental to the country's social, economic and environmental wellbeing.[29] Kenya's key natural resources include:

Land: About 50% of land in Kenya is used for agricultural crops, including tea, coffee and pyrethrum, as well as food and horticultural crops such as maize, wheat, potatoes, pulses, fruits, vegetables

and flowers. Dairy farms are found in high rainfall areas, while livestock farming and mixed cropping dominate in arid and semi-arid regions.

> *An estimated 42% of Kenya's GDP is derived from its natural resources, including through agriculture, tourism, forestry, mining and fishing.*

Water: Kenya is among the most water-scarce countries in the world, and although natural renewable water resources exist, they are unevenly distributed.[30] The arid and semi-arid regions, which cover most of Kenya, are notably water insecure. Traversing the country's western border, Lake Victoria is the largest lake in the African Great Lakes region and hosts the largest freshwater fishery in the world, producing 1 million tons of fish per year.

Natural ecosystems: Kenya's varied natural ecosystems provide the services necessary to support human life, including provisioning (e.g. food and drinking water), regulation (e.g. water purification and carbon storage), cultural services (e.g. recreational and spiritual benefits), and supporting services (e.g. nutrient cycling and biodiversity).

Arid and semi-arid ecosystems (drylands): Making up over 80% of the total land area in Kenya, arid and semi-arid ecosystems are home to about 36% of the population, 70% of its livestock and 90% of its wildlife, including Grévy's zebras, Somali ostriches and gerenuks.

Savannah ecosystems: Grasslands, savannah woodlands, and shrublands – including the Maasai Mara National Reserve, Amboseli National Park and Tsavo National Park – are renowned for their abundant wildlife. The iconic annual wildebeest migration sees more than 1.5 million animals journey between Kenya and Tanzania.

Forest ecosystems: Tropical rainforests, montane forests (including the Aberdare range and Mount Kenya) and coastal forests (such as the Sacred Mijikenda Kaya Forests) support communities, including Indigenous peoples, and a range of plant and animal species. About 8.8% of Kenya's land is forested, short of the constitutionally accepted target of 10%.

Wetland ecosystems: Freshwater and saline lakes, and swamps and rivers support people and aquatic life, including birds, flamingos and crocodiles. The Kenyan section of the Great Rift Valley contains eight lakes, ranging from the saline Lake Bogoria to the freshwater Lake Naivasha. The Great Rift Valley lakes were added to the UNESCO World Heritage List in 2011.

Marine and coastal ecosystems: Coral reefs, seagrasses, mangroves and sandy beaches support local communities and provide habitats for marine biodiversity. Colourful residents of these regions include bottlenose dolphins, humpback whales and five of the world's seven species of sea turtle: green, hawksbill, loggerhead, olive ridley and leatherback.

Mountain ecosystems: High-altitude areas, including Mount Kenya and the Aberdare range, support unique alpine vegetation such as giant lobelias and Afro-alpine grasslands. They provide habitat for birds and endemic wildlife and are the source of many rivers. Agriculture is practised at the foot of mountainous forest areas, supporting lives and livelihoods.

Home to a recorded 25,000 animal species and 7,000 plant species, Kenya contains part of three of the world's 36 biodiversity hotspots. These are Earth's most biologically rich – yet threatened – terrestrial regions, as designated by Conservation International.[1] The three biodiversity hotspots in Kenya – the Eastern Afromontane, the Coastal Forests of Eastern Africa and the Horn of Africa – are home to numerous species not found anywhere else on Earth (see Figure 3).

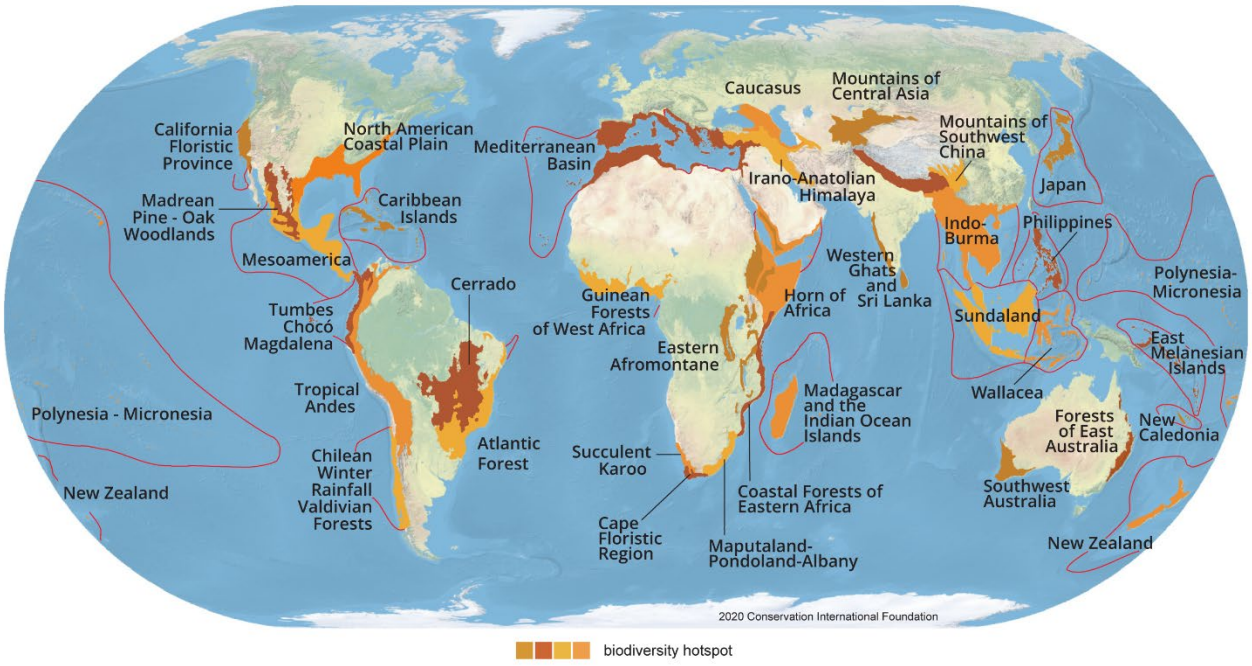


***Figure 3**. Kenya contains part of three of the world's 36 biodiversity hotspots: the Eastern Afromontane, the Coastal Forests of Eastern Africa and the Horn of Africa. These special areas have a rich variety of plant and animal species that are not found anywhere else. Source: Conservation International.[1]*

> *CHAPTER 2 looks at how Kenya's landscapes and natural resources directly support the lives and livelihoods of millions of people, and how they have led to the development of unique knowledge systems.*

Climate change impacts in Kenya

Chapter 2 | People and practices

Kenya's rich landscapes support lives, livelihoods and cultural traditions while also contributing to the economy.

Over time, Kenya's peoples have developed practices to help navigate the country's diverse landscapes and natural climate variability. The constitution celebrates – and is bound to protect – the cultural richness that the many Indigenous tribes and communities bring to the country. Yet these communities' high reliance on natural ecosystems presents challenges. In addition, agriculture and nature tourism are among Kenya's key economic activities but also are finely tuned to the environment, making them vulnerable to change.

2.1 Lives and livelihoods

Kenya is home to about 47.6 million people, with over 50% of the population younger than 34 years old.[31] Being a "young" country provides momentum to spur sustainable development and makes the protection of Kenya's natural resources for the benefit of the country's youth an even more pressing concern.

Rural areas are home to approximately 68% of Kenya's population; the remaining 32% reside in towns and cities. As of 2014, more than half of Kenya's urban population – 56% (about 8.6 million people) – lived in informal settlements.[32] Kibera, in Nairobi, is the largest informal settlement in Africa[33] and one of the biggest in the world. Often located close to major urban centres, informal settlements provide a relatively insecure way of life with inadequate housing and limited infrastructure. Despite this, there exists a certain community vitality, where residents develop collective solutions to their challenges.[34]

There are over 42 tribes in Kenya, each with its own history, beliefs, culture and traditions, religions, and economic activities, resulting in a rich and vibrant cultural heritage. Kenya's constitution recognizes culture as the foundation of the nation, committing the government to promoting all forms of national cultural expression and protecting the intellectual property rights of Kenyan people (see Section 2.2).

Kenya has one of the fastest growing economies in Africa. An average annual growth rate of 5.9% between 2010 and 2018, boosted by political and economic reforms, has helped Kenya recently achieve lower-middle-income country status.[2] The largest contributor to Kenya's GDP is services (55%), followed by the agricultural sector (21%), which includes fisheries, and then by industry (17%), which includes tourism.[35] Although the poverty rate has significantly reduced – from 47% in

2005/2006 to 36% in 2015/2016 – it remains a key development challenge, along with inequality, youth unemployment and, increasingly, climate change (see Chapter 3).[36]

Food and nutrition

Kenyan food is mainly traditional and domestically grown. It is supplemented by imports for items that cannot be produced internally in sufficiently large quantities, such as wheat and rice. Across the country, a wide variety of food is consumed, but diets are determined locally by geographical location, tribal customs, and history. Ugali, made from maize, is the staple food, which is eaten with a variety of accompaniments, ranging from meat to vegetables and eggs. Additionally, Kenya's food reflects the influences of colonization and of foreign settlers, combining customs from the United Kingdom, India, the Arabian peninsula, Portugal and elsewhere. Kenya is famous for nyama choma – specially grilled goat meat, eaten with ugali, sukuma wiki, potatoes and other accompaniments.

Despite an overall improvement in nutritional health over the past two decades, child hunger remains a challenge in Kenya. More than a quarter of children under the age of five – 1.8 million children – experience stunted growth.[37] There are disparities across the country, with this figure rising to 46% in some arid and semi-arid counties, including Kitui, West Pokot, Samburu, Mandera, Uasin Gishu and Bomet.

Agriculture and fisheries

Agriculture is practised at both subsistence and commercial scale in Kenya, mainly in rural areas but increasingly in urban areas. As well as providing food for the country, agriculture employs over 40% of the active workforce (more than 70% in rural areas) and directly contributes about 20% of Kenya's GDP.[3]

Kenya produces 6 million tons of food crops annually, primarily maize, wheat, rice, potatoes, green grams and beans. Additionally, 4.2 million tons of horticultural crops are produced each year, including vegetables, flowers, fruits and nuts. These horticultural crops are primarily for the domestic market, but the 5% that is exported represents the second biggest foreign exchange earner after tourism.[38] Kenya produces a further 500,000 tons of industrial crops, including cotton, sunflower, pyrethrum, barley, tobacco, sisal, coconut, cashew and bixa, each year. Livestock farming is a significant subsector of Kenyan agriculture, primarily cattle (dairy and beef), goats, camels, pigs, poultry and, to a lesser extent, rabbits and quail. As well as supplying meat, milk and other dairy products locally, livestock contributes at least 50% of the agricultural GDP – about 10% of Kenya's total GDP.[39] Over 70% of Kenya's livestock is farmed in arid and semi-arid lands. In these grassland ecosystems, livestock farming employs about 90% of the predominantly pastoralist communities and generates 95% of their income.[40]

The agricultural sector depends largely on rainfall during the two main wet seasons, making it vulnerable to altered weather patterns as a result of climate change (see Chapter 3). In the arid and semi-arid lands, pastoral and agropastoral households are especially vulnerable, given how much their livelihood depends on agriculture. In 2022, a prolonged drought that had been gripping the Horn of Africa region triggered a countrywide fall in maize production of 6.5% and a 3.3% drop in

the volume of horticultural exports. The quantity of marketed milk also decreased by 5.9%, largely due to scarcity of fodder for livestock.[5] Alongside changing weather patterns, agriculture faces challenges from crop diseases, pests and weeds, and the rising cost of farm inputs.

> *As well as providing food for the country, agriculture employs over 40% of the active workforce (more than 70% in rural areas) and directly contributes about 20% of Kenya's GDP.*

Fishing is a crucial source of livelihoods for millions of Kenyans. Between 2018 and 2022, the fisheries sector recorded a steady increase in the total quantity of fish landed. Fish production from freshwater sources, in particular, increased by 4.5% from 2021 to 2022, with Lake Victoria – home to the largest freshwater fishery in the world – recording a 3.4% increase. This increase is significantly positive since the fishing industry in Lake Victoria directly employs about 200,000 people and supports the livelihoods of about 4 million people.[41]

Three fishermen on the shore of Lake Turkana, Kenya, holding up a small fishing catch. Credit: Maurizio Di Pietro/ Climate Visuals.

Nature tourism

Tourism is one of Kenya's key economic drivers. Travel to the country rebounded well after COVID-19 restrictions were lifted, and the tourism sector currently generates 10.4% of GDP and employs 5.5% of the active workforce.[4] Kenya's iconic wildlife is the greatest attraction for visitors. Huge numbers of tourists, domestic and international, visit the country's numerous wildlife parks,

including the Maasai Mara National Reserve – home to the world-famous wildebeest migration – and the Tsavo, Amboseli and Mount Kenya national parks, and many others. The coastline on the Indian Ocean, with beautiful pristine beaches, is one of the most visited in the region. However, these habitats and their iconic species are vulnerable to climate change. Species distribution and migration and mating patterns are already being impacted by changing weather patterns (see Chapter 3).

2.2 Knowledge systems

The diversity of Kenya's landscape, climate and cultural traditions has given rise to a wealth of different types of knowledge linked to an understanding of and appreciation for nature. These knowledge systems are both affected by climate change (see Chapter 3) and can help build resilience against it (see Chapter 4).

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services defines a knowledge system as, in part, "a body of propositions that are adhered to, whether formally or informally, and are routinely used to claim truth".[42] The IPCC defines Indigenous knowledge as the understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings, and local knowledge as the understandings and skills developed by individuals and populations, specific to the place where they live.[43] These types of knowledge are highly context specific and provide some of the most effective ways to cope with challenges, including those posed by climate change.[44] Additionally, the government of Kenya recognizes pastoralism as both an economic activity and a cultural identity in arid and semi-arid lands.

Indigenous and local knowledge

Most tribes in Kenya have settled after migrating, and their livelihoods have evolved in harmony with their surroundings. In the pre-colonial period, communities in Kenya relied on diverse Indigenous knowledge systems for their lives and livelihoods, particularly in agriculture. This knowledge enabled the population to subsist sustainably within Kenya's various ecosystems.

Among Kenya's Indigenous communities are the Maasai people, who live across the country (mainly in arid and semi-arid regions); the Turkana along Lake Turkana; the Elmolo, Endorois and Samburu, who are mostly pastoralists living in arid and semi-arid lands; and the Ogiek, Sengwer, Yaaku, Waata and Sanya, who are predominantly hunters and gatherers living in forests. The Luo people in Kenya and Tanzania, inhabiting the regions adjacent to Lake Victoria, are known for fishing and are referred to as River-Lake Nilotes. Inhabitants of the highlands east and west of the Great Rift Valley are predominantly farmers, due to the abundance of arable land for both subsistence and commercial farming. Within Kenya's tribes, there are many more ethnic groupings. The Luhya and Mijikenda tribes, for example, have several subtribes with mutually understood dialects and slight variations in cultural practices.

During the colonial period, Indigenous knowledge became fragmented since Western education tended to emphasize the separation of theory from practice, at odds with the Indigenous focus on sustainability and mutual enrichment.[45] In the post-colonial period, reliance on Indigenous

knowledge reduced further because of an increased interest in the principles of modernity among the population and the associated commodification of nature and food systems.[46]

Local knowledge, which is developed by individuals and populations specific to where they live, is also widely relied on in Kenya. Communities have developed knowledge about their ecosystems, and this knowledge is passed on from generation to generation (see Chapter 4).

Pastoralism

The unique knowledge and place-based experiences of Kenya's pastoralist communities have equipped their members with skills to understand and live in dryland environments. These experiences, in addition to other strategies, may be drawn on to enable pastoralist communities to effectively cope with climate extremes, such as droughts and floods. For example, communities carry out Indigenous weather forecasting using environmental indicators such as wildlife behaviour, wind direction, star–moon alignment and the timings of flowering plants. To minimize losses during drought, pastoralists practice herd splitting (creating smaller groups from the main herd) and/or migration, among other measures.

As a cultural identity, pastoralism plays a critical role in sociocultural functions, with livestock acting as a source of prestige, wealth and dowry and used in the settlement of family disputes. However, grazing lands in dryland environments are being degraded by factors including deforestation, reduced rainfall, overgrazing and conversion to crop production. This degradation is limiting the opportunities for nomadic pastoralism and increasing conflicts with sedentary crop producers and other pastoralists, including in neighbouring countries.

> *CHAPTER 3 looks at how climate change poses a growing threat to Kenya's people and economy through its negative impact on biodiversity, health, water and food security, and infrastructure.*

Climate change impacts in Kenya

Chapter 3 | Climate impacts

Climate change – especially heatwaves, rainfall and drought – is creating unexpected challenges for Kenyan society and the economy.

Kenya is already experiencing the impacts of climate change, with extreme weather linked to poor health, altered wildlife migrations, damage to infrastructure, and food and water insecurity. Large gaps in observational data over Africa, along with complex natural variability, make it difficult to determine how some aspects of the climate are changing. However, as global temperature rises, the overall picture for Kenya is one of increasingly extreme weather, with cascading effects on people's lives and the economy.

3.1 Evidence of climate change

Over East Africa, the average temperature has increased by 0.7–1°C, depending on the season (1973 to 2013).[6] The region has experienced an increase in extreme heat since the 1950s, attributable to human influence on the climate (see Figure 4, top). In Kenya specifically, heatwaves have become more severe and longer lasting in recent years, with the Tana River, Garissa and Turkana counties the most affected.[8]

There is limited scientific information available on how heavy rainfall has changed overall in East Africa since the 1950s and whether human influence is detectable (see Figure 4, middle). Looking at specific events can reveal a clearer signal, however. Climate change increased the intensity of rainfall in the short rainy season in the Horn of Africa in 2023, for example, acting in addition to natural variability. These intense rains led to severe flash flooding in eastern Kenya, causing more than 300 deaths and displacing over a million people.[11] The long rainy season, conversely, has seen a long-term drying trend.[47]

Kenya is highly vulnerable to drought, with recent occurrences in 2006, 2010/2011, 2016/2017 and 2020–2023. Studies differ as to whether droughts have been increasing or decreasing overall in East Africa since the 1950s (see Figure 4, bottom). Over a more recent period, since 2005, research suggests droughts have doubled in frequency from once every six years to once every three years in East Africa.[6] In Kenya specifically, climate change has made events like the extreme drought that the country has been experiencing since 2020 stronger and about 100 times more likely.[14]

Climate change impacts are already affecting every inhabited region across the globe, with increases in hot extremes in Kenya

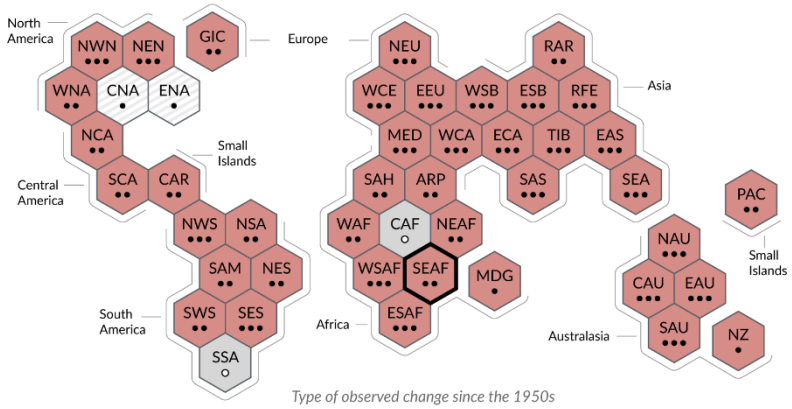
a) Synthesis of assessment of observed change in **hot extremes** and confidence in human contribution to the observed changes in the world's regions

Type of observed change
in hot extremes

- Increase (41)
- Decrease (0)
- Low agreement in the type of change (2)
- Limited data and/or literature (2)

Confidence in human contribution
to the observed change

- ●●● High
- ●● Medium
- ● Low due to limited agreement
- ○ Low due to limited evidence



Type of observed change since the 1950s

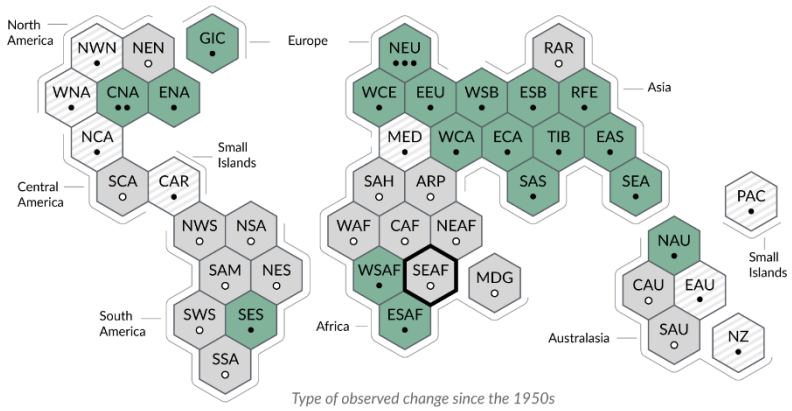
b) Synthesis of assessment of observed change in **heavy precipitation** and confidence in human contribution to the observed changes in the world's regions

Type of observed change
in heavy precipitation

- Increase (19)
- Decrease (0)
- Low agreement in the type of change (8)
- Limited data and/or literature (18)

Confidence in human contribution
to the observed change

- ●●● High
- ●● Medium
- ● Low due to limited agreement
- ○ Low due to limited evidence



Type of observed change since the 1950s

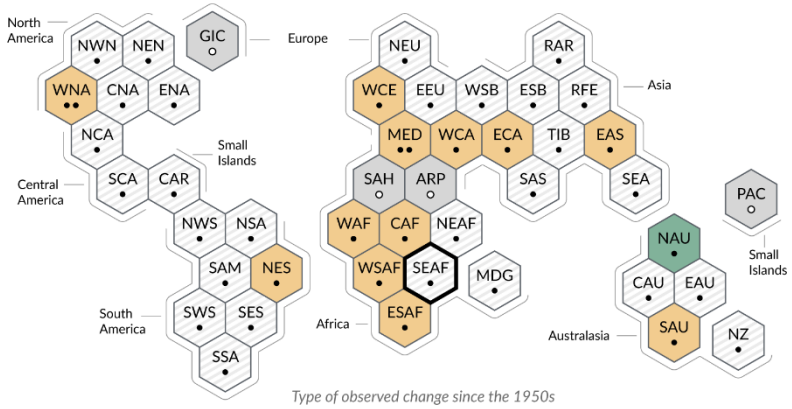
c) Synthesis of assessment of observed change in **agricultural and ecological drought** and confidence in human contribution to the observed changes in the world's regions

Type of observed change
in agricultural and ecological drought

- Increase (12)
- Decrease (1)
- Low agreement in the type of change (28)
- Limited data and/or literature (4)

Confidence in human contribution
to the observed change

- ●●● High
- ●● Medium
- ● Low due to limited agreement
- ○ Low due to limited evidence



Type of observed change since the 1950s

Each hexagon corresponds to one of the IPCC AR6 WGI reference regions

NWN *North-Western North America*

IPCC AR6 WGI reference regions: **North America:** ***NWN*** *(North-Western North America),* ***NEN*** *(North-Eastern North America),* ***WNA*** *(Western North America),* ***CNA*** *(Central North America),* ***ENA*** *(Eastern North America),* **Central America:** ***NCA*** *(Northern Central America),* ***SCA*** *(Southern Central America),* ***CAR*** *(Caribbean),* **South America:** ***NWS*** *(North-Western South America),* ***NSA*** *(Northern South America),* ***NES*** *(North-Eastern South America),* ***SAM*** *(South American Monsoon),* ***SWS*** *(South-Western South America),* ***SES*** *(South-Eastern South America),* ***SSA*** *(Southern South America),* **Europe:** ***GIC*** *(Greenland/Iceland),* ***NEU*** *(Northern Europe),* ***WCE*** *(Western and Central Europe),* ***EEU*** *(Eastern Europe),* ***MED*** *(Mediterranean),* **Africa:** ***MED*** *(Mediterranean),* ***SAH*** *(Sahara),* ***WAF*** *(Western Africa),* ***CAF*** *(Central Africa),* ***NEAF*** *(North Eastern Africa),* ***SEAF*** *(South Eastern Africa),* ***WSAF*** *(West Southern Africa),* ***ESAF*** *(East Southern Africa),* ***MDG*** *(Madagascar),* **Asia:** ***RAR*** *(Russian Arctic),* ***WSB*** *(West Siberia),* ***ESB*** *(East Siberia),* ***RFE*** *(Russian Far East),* ***WCA*** *(West Central Asia),* ***ECA*** *(East Central Asia),* ***TIB*** *(Tibetan Plateau),* ***EAS*** *(East Asia),* ***ARP*** *(Arabian Peninsula),* ***SAS*** *(South Asia),* ***SEA*** *(South East Asia),* **Australasia:** ***NAU*** *(Northern Australia),* ***CAU*** *(Central Australia),* ***EAU*** *(Eastern Australia),* ***SAU*** *(Southern Australia),* ***NZ*** *(New Zealand),* **Small Islands:** ***CAR*** *(Caribbean),* ***PAC*** *(Pacific Small Islands)*

Figure 4. *In south-eastern Africa (SEAF), human influence has contributed to an increase in hot extremes (top). There is limited scientific data and/or agreement on the change in heavy rainfall (middle) and drought (bottom). Source: IPCC,[48] adapted to emphasize Kenya.*

The persistent lack of long-term historical data in Kenya, East Africa and the continent of Africa more widely, combined with high natural climatic variability, makes for a complicated picture of past changes in extreme weather. Looking ahead, projections suggest the temperature will continue to rise in East Africa. With a global temperature rise of 1.5°C above pre-industrial levels, the average annual temperature in the region is projected to rise 0.6°C above the 1994–2005 average. For a global temperature rise of 2°C or 3°C, the figure increases to 1.1°C and 2.1°C, respectively.

Intense rainfall is expected to increase in most regions in Africa,[48] and children born in 2020 could be exposed to three to five times more heatwaves in their lifetimes than people born in 1960, even if global temperature rise is limited to 1.5°C. With a global temperature rise of 2.4°C, the same children would be exposed to four to nine times more heatwaves.[6]

> *In Kenya, climate change has made events like the extreme drought that the country has been experiencing since 2020 stronger and about 100 times more likely.*

There are limited studies on the impacts of climate change on sea level rise around Africa. Given global projections of 21–48 cm of sea level rise by the end of the 21st century compared with the 1980–1999 average, this is likely to be devastating for Kenya. A 30 cm increase in sea level rise could submerge 17% of the city of Mombasa, Kenya's second largest city and the largest seaport in East Africa.[49]

3.2 Cascading impacts of climate change

Kenya – and Africa more widely – is already experiencing the consequences of rising temperatures and more extreme weather (see Section 3.1), ranging from impacts on human health to loss of cultural heritage. With a faster rate of warming in Kenya compared with the global average, climate impacts are projected to increase steeply with every degree of warming.[6]

At a local level, the character and severity of climate change impacts in Kenya are influenced by factors such as land use; population density and distribution; infrastructure and technology; behaviours, cultural norms and practices; and the fragility of ecosystems. In addition, individual- or household-specific characteristics, such as age, socioeconomic status and pre-existing health conditions, play a role.

Figure 5 shows the impact of climate change on selected key risk factors in Africa: biodiversity loss and ecosystem disruption; ill health and deaths from heat and infectious diseases; and lower food production from crops, fisheries and livestock. All three risk levels are "moderate" with the amount of global temperature rise to date (1.09°C above pre-industrial levels, averaged between 2010 and 2020), transitioning to "high" with 1.5°C of warming.

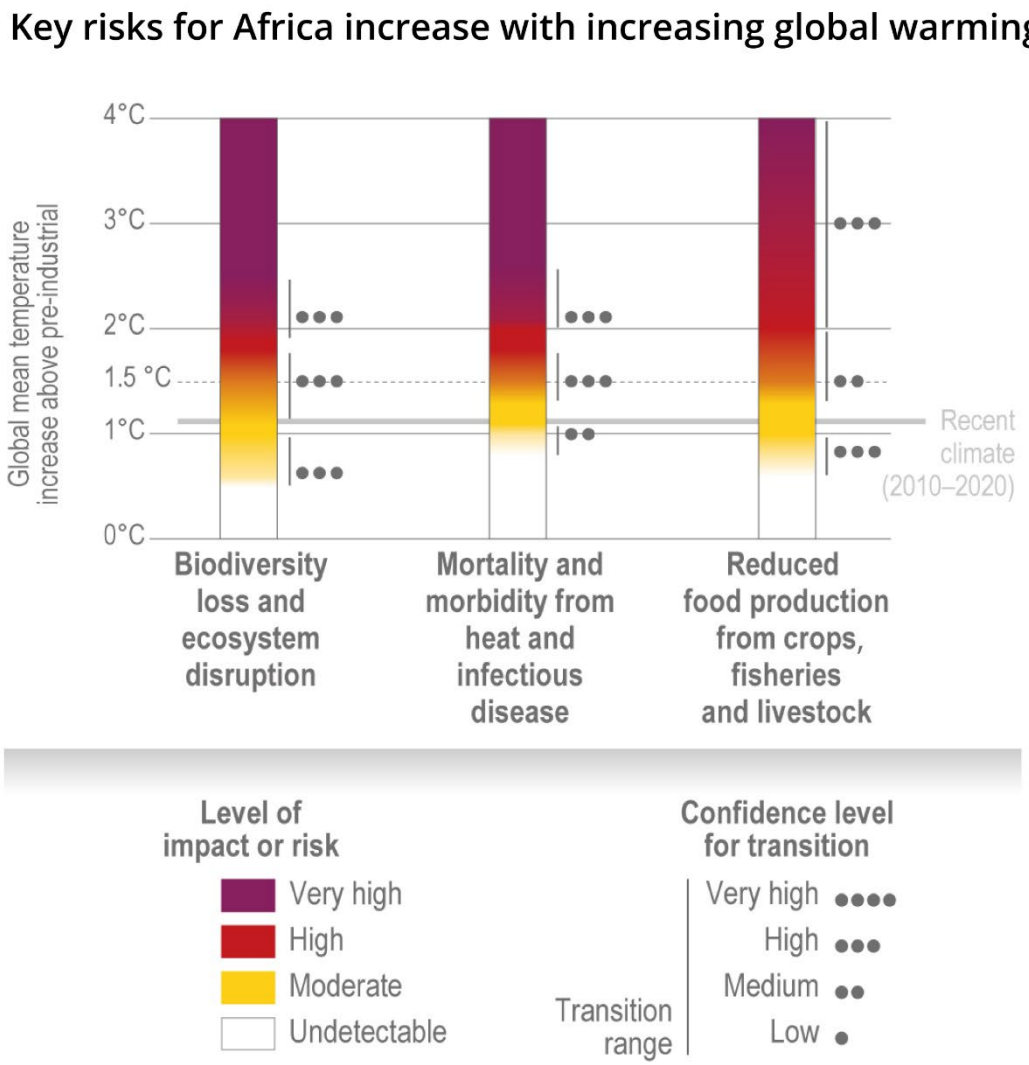


Figure 5. *Kenya is already experiencing the consequences of rising temperatures. This diagram shows the impact of climate change on selected key risk factors in Africa. All three risk levels are "moderate" with warming to date (1.09°C, 2010–2020) and transition to "high" with warming of 1.5°C. Source: Trisos et al., 2022.*[6]

Biodiversity and ecosystem services

As the impacts of climate change increase in Kenya, critical ecosystem services (see Chapter 1) are deteriorating in quality and quantity.[50] This deterioration affects the provision of water, food and timber; air purification; carbon sequestration; flood control; soil and habitats; and cultural, spiritual and recreational services.

Species richness along the Tana River basin – an economically important and ecologically diverse region – is projected to reduce significantly with just 2°C of global temperature rise with plants and birds most affected. And the impacts worsen with further warming. While 82% of the basin can offer protection for the majority of plant species with 1.5°C of warming, this figure reduces to 23% with 2°C of warming and to just 3% with 4.5°C of warming.[51]

Climate models and future scenarios

Climate models are mathematical representations of the physical and biogeochemical processes that occur in the atmosphere, land and oceans. They are one of the main tools that scientists have to examine how certain changes will affect Earth's future climate.

The Sixth Assessment Report from the IPCC featured a set of climate models from the Sixth Coupled Model Intercomparison Project (CMIP6). To allow comparison across the different models, the project developed a standard set of scenarios that each modelling group from around the world uses.

This set of scenarios, called Shared Socio-economic Pathways (SSPs), differ in their assumptions about future socioeconomic factors, such as population, economic growth and urbanization. They describe five very different "baseline" worlds. The IPCC's Sixth Assessment Report combined the SSPs with a separate set of scenarios that describe how concentrations of greenhouse gases and other factors that affect the climate could evolve. There are four of these Representative Concentration Pathways (RCPs) – RCP2.6, RCP4.5, RCP6.0 and RCP8.5 – with the names representing the total heating effect (or radiative forcing) by 2100.

Below is a summary of the combined SSP-RCP pathways referenced in the literature cited by this report (temperatures are relative to pre-industrial levels):

SSP1-2.6 An optimistic, sustainability-focused scenario in which global temperature rise is limited to 2°C by the end of the century.
SSP3-7.0 Regional rivalry means that efforts to reduce emissions are fragmented and temperature rise reaches 3.6°C by the end of the century.
SSP5-8.5 A worst case, no-mitigation scenario in which fossil fuels dominate economic growth and global temperature rises by 4.4°C by the end of the century.

Before the SSPs were available, model studies used the RCPs to describe possible future worlds in terms of greenhouse gases and warming. This report refers to RCP2.6 as an ambitious, very low emissions scenario, RCP4.5 as a middle-of-the-road scenario and RCP8.5 as a very high emissions scenario (higher than the world is currently tracking).

Sea level rise and heavy rainfall are projected to cause flooding of coastlines and coastal environments – including beaches, wetlands and estuaries – in Kenya.[52] At the same time, climate change is expected to cause a substantial shift in vegetation, towards more shrubland (normally associated with arid lands) at the expense of savannahs, grasslands and forests. Protected areas in Kenya could lose between 16% and 50% of their forests, depending on future emissions.[53]

> *Glaciers on Mount Kenya are currently estimated to cover just 4.2% of their total area in 1900 and are projected to disappear by 2030 under all climate scenarios.*

East Africa's glaciers are declining as temperatures rise. Glaciers on Mount Kenya are currently estimated to cover just 4.2% of their total area in 1900[54] and are projected to disappear by 2030

under all climate scenarios.[6] This has the potential for cascading impacts, including the loss of plants, animals and endemic species that rely on the Mount Kenya ecosystem to thrive.[55] Coral bleaching at the Kenyan coast has also been observed, with 30% of coral reefs showing signs of high or severe bleaching after the 2016 global bleaching event and 10% exhibiting high or severe mortality.[56]

Tourism plays an important role in Kenya's economy (see Chapters 1 and 2). Alongside destruction of ecosystems, coastal flooding is projected to cause damage to national park infrastructure and hamper tourist visits, reducing revenue for both national and county governments.[49] Rainfall variability and prolonged drought are already altering wildlife migrations, affecting tourist visits on big nature reserves such as the Maasai Mara.[16,17]

Human health

Over the past ten years, the trend towards increasingly severe heatwaves in Kenya has been associated with rises in emergency department visits and hospital admissions.[7] Weather-related deaths are a particular public health concern in informal settlements, with research finding an increase in child mortality and in deaths from non-communicable illnesses, such as cardiovascular and respiratory diseases, with increasing temperature.[57]

> *Climate change is predicted to result in an additional 75.9 million people at risk from malaria in eastern and southern Africa by 2080, with the greatest risk in eastern Africa.*

Since 2000, the incidence rate of malaria in Kenya has declined and stabilized.[58] Yet the risk of transmission is shifting geographically in response to increasing average temperatures, rainfall and flooding. Under a very high emissions scenario (RCP8.5; see box in Section 3.2), climate change is predicted to result in an additional 75.9 million people at risk from malaria in eastern and southern Africa by 2080, with the greatest risk in eastern Africa.[9] New hotspots could emerge for other diseases too, such as dengue and chikungunya.[59]

Agriculture and food security

The agriculture sector in Kenya faces significant impacts from climate change.[60] The biggest impacts are expected on maize and wheat production owing to their high vulnerability to heat stress. Under a very high emissions scenario (RCP8.5), wheat yields in Africa are projected to decline by 15% by 2050, a much greater loss than the 1.9% reduction projected globally by mid-century.[10] Even with ambitious action to reduce greenhouse gas emissions (RCP2.6), the area of farmland optimal for tea production in Kenya is projected to decrease by 26% by 2050.[61] High temperatures induce heat stress among farm workers, further reducing agricultural productivity.[62]

> *Under a very high emissions scenario (RCP8.5), wheat yields in Africa are projected to decline by 15% by 2050.*

Heavy rainfall has led to increased flows on large rivers, such as the Tana, resulting in flooded farmlands, degraded soils and reduced farm output.[12] Similarly, changes in rainfall have increased

the area of lakes in the Great Rift Valley, ranging from a 21% increase for Lake Naivasha to a 123% increase for Lake Solai,[13] leading to changes in flora and fauna and affecting local communities that rely on these natural aquatic resources.[63] Additionally, climate-induced locust outbreaks devouring agricultural crops has become a particular problem in East Africa.[64] Along Kenya's coast, sea level rise, coral bleaching and mangrove degradation associated with a very high emissions scenario (RCP8.5) could decrease Kenya's fisheries catch by an estimated 63–76% by 2100.[65]

As a result of these complex changes, food availability is projected to reduce over many parts of the country.[66] In 2022, 4.3 million Kenyans required humanitarian assistance due to drought-related food emergencies, including the loss of livestock.[67] Approximately 4% of livestock are currently being raised in areas where dangerous heat stress events are likely to become more common from 2071 to 2100 under a middle-of-the-road emissions scenario (RCP4.5). Under a very high emissions scenario (RCP8.5), the proportion of livestock at risk rises to 19%.[68]

Two women harvesting a farmed seaweed food crop in shallow waters of the Indian Ocean off the coast of Wasini Island, Kenya. Credit: Anthony Onyango / Climate Visuals.

Water security

In an already water-scarce environment, climate change – along with water pollution, environmental degradation, population growth, urbanization and inadequate management of water resources – further limits water security for many Kenyan communities.[69] Between 1995 and 2019, the percentage of people across the country living under water-stressed conditions increased from 14.8% to 33.2%.[15]

As well as having adverse effects on water security for downstream communities, the rapid decline of Mount Kenya's glaciers is affecting hydropower generation and industrial processes. Hydropower generation is currently extremely reliant on the Mount Kenya region, with the Tana River contributing around 70% of Kenya's total hydropower generation.[18]

> *Between 1995 and 2019, the percentage of people across the country living under water-stressed conditions increased from 14.8% to 33.2%.*

Climate security

Climate change is considered a "threat multiplier", impacting human security both directly and indirectly and exacerbating the existing vulnerabilities of marginalized communities.[70]

Migration, internal displacements and resource-based conflicts have been on the rise in Sub-Saharan Africa due to increased occurrence of floods, droughts and extreme heat and their associated impacts on food, pasture and water resources. For instance, during the 2021–2023 drought period, nearly 180,000 people crossed borders from Somalia and South Sudan into drought-affected areas of Kenya and Ethiopia.[14]

Communities in Kenya's low-lying coastal and Great Rift Valley areas are also facing displacement due to sea level and lake level rise, respectively, along with damage to infrastructure, biodiversity and cultural heritage sites.[71] Researchers have linked changing weather patterns, particularly wetter years, to social unrest,[72] suggesting that climate insecurity could worsen with projected increases in extreme rainfall.

Cities, settlements and infrastructure

As with most developing countries, Kenya is rapidly urbanizing. The growth of informal settlements (see Chapter 2) continues to expose large numbers of people to climate change, particularly floods and heatwaves, because of the high density of housing, insufficient drainage and, in some cases, their location on riparian lands and waterways.

Climate change, along with land use change – for example, the change from agricultural to residential settlements – poses a high risk to interdependent infrastructure systems, including electric power, transportation, telecommunication, drainage and water supply systems. The performance of Kenya's water–energy–food infrastructure is expected to be impacted negatively by recurrent multi-year droughts and flash floods.

> *CHAPTER 4 looks at how building resilience to the impacts of climate change, and limiting the emissions that cause it, can reduce the risks to the lives and livelihoods of Kenya's people.*

Climate change impacts in Kenya

Chapter 4 | Resilience and transformation

Kenya needs immediate action – including international climate finance – to support adaptation and low-carbon development and secure a fair, liveable future for its people.

As a country highly vulnerable to the impacts of climate change, Kenya requires urgent action to maintain its rich heritage, precious biodiversity and the lives and livelihoods of its people. Various strategies exist at a national level to build resilience, but tackling climate change is a collective global goal – bearing in mind historical responsibility for greenhouse gas emissions, differentiated capacities, equity, the remaining carbon budget and national circumstances.

4.1 National actions

With 70% of the Kenyan population employed in climate-sensitive sectors,[19] Kenya's government has demonstrated its resolve to adapt to the impacts of climate change and enhance the resilience of vulnerable communities.

IPCC Working Group II defines resilience as a state of bouncing back after previous disturbance and being able to maintain not only essential function, identity and structure but also the capacity for transformation. Resilience and transformation are highly context driven. Examples of different initiatives in Kenya include investing in locally led adaptation, providing direct financial payouts to households and championing initiatives to diversify livelihoods.

Investment in locally led adaptation

Through its development blueprint, Vision 2030, Kenya has outlined a pathway to sustainable development aligned with the Sustainable Development Goals.[20] The government has established national implementation frameworks for achieving Vision 2030 and provides technical guidelines for investing in low-carbon and climate-resilient adaptation and development. These mechanisms enable the government to define and engage local adaptation solutions at a community level.

One such example is the County Climate Change Fund, a mechanism that funds and coordinates climate change resilience-building projects that have been deemed the highest priority by vulnerable communities.[21] Piloted by the Adaptation Consortium and financed by the World Bank, the fund has been operationalized by the National Treasury, with devolved units of administration (counties) setting up implementation mechanisms at a local level.

Case study: Resilience building through locally led adaptation

In Embu County, a recent assessment of vulnerability in Getua village highlighted water scarcity as the most critical issue facing the community. The local administrative unit – the Ward Climate Change Planning Committee – launched a community engagement effort that prioritized an earth dam as an urgent solution to the issue of water scarcity. Costing K Sh 10 million, the dam was implemented by the National Drought Management Authority through a subcomponent of the Kenya Cereal Enhancement Programme – Climate Resilient Agricultural Livelihoods Window project, in partnership with the county government of Embu and the local community. This project exemplifies effective action to build climate resilience, since the dam not only provides water for household use but also enables farmers to irrigate their crops to boost production. It also fosters socioeconomic transformation, for example enabling school children to miss fewer classes by reducing their time spent fetching water.

One of the most effective ways the government of Kenya is implementing climate change adaptation through "nationally coordinated and locally implemented" projects is in the management of water security. This approach is being implemented through the National Drought Management Authority, with projects financed through the County Climate Change Fund and the Financing Locally Led Climate Action Program. With financial backing from the World Bank and the Danish and Swedish governments, the Financing Locally Led Climate Action Program aims to strengthen national governments' capacity to manage climate risks through locally led actions, maximizing effectiveness through citizen engagement in decision making.

Shaban Mwinji, a community scout ranger, standing in a restored mangrove forest. Mikoko Pamoja is a community-led restoration project based in southern Kenya. Credit: Anthony Ochieng / Climate Visuals Countdown.

Indigenous and local knowledge

The government of Kenya actively promotes research and development in science, technology and innovation to spur economic growth and deal with emerging challenges, including climate change. It also actively promotes the integration of science with Indigenous knowledge to create solutions. These knowledge systems and their integration remain crucial to Kenya's goals of developing sustainably and leaving no human behind.[73]

Intersectional risks are, however, a crucial consideration when drawing on different knowledge systems. Research in several African contexts shows that societal power structures – such as patriarchy, gender and generational preferences – are key determinants of climate action.[74] Therefore, a key consideration for successfully drawing on local knowledge is an understanding of these dynamics. With respect to scientific knowledge in local contexts, career impediments – such as balancing scientific work and familial responsibilities – tend to result in fewer women in science.[75] This, in turn, leads to a lack of female perspectives in addressing societal issues at the local level.

> *If Kenya is to effectively face the challenges brought by climate change, local and traditional knowledge systems will need to be mobilized and enhanced.*

Holders of Indigenous and local knowledge are facing uncertainty under climate change. For example, the long rains in Kenya have typically been known to start in mid-March. But in recent years this has changed, complicating long-held knowledge. Indicators such as flowering timings are being affected by climate change, confounding traditional forecasters (see Section 2.2). To support local knowledge, scientists from the Kenya Meteorological Department – particularly those working at the county level – carry out awareness and sensitization activities regarding climate change and its impacts while disseminating the seasonal forecast. This creates an opportunity for local experts to interact with scientific information and agree on strategies to cope with current and projected changes.

If Kenya is to effectively face the challenges brought by climate change – enabling its population and institutions to constantly adjust to unprecedented variability, extreme weather events and slow onset events such as sea level rise – local and traditional knowledge systems will need to be mobilized and enhanced. This is particularly true for the protection of natural resources and territories held by Indigenous communities. Research shows that Indigenous groups are key to the protection and conservation of the ecosystems they live in. For example, the Mijikenda are credited for the protection of part of the remaining coastal tropical rainforests in Kenya, which form the Sacred Mijikenda Kaya Forest ecosystem.

Financial safety nets

The Kenyan government has mapped the communities that are most vulnerable to the impacts of droughts and set up an emergency cash transfer programme for activation during climate disasters, such as drought and flooding. The emergency payments are delivered to households through the Hunger Safety Net Programme, which operates in Kenya's eight poorest and most vulnerable counties.[22] Financed by the government of Kenya and the World Bank through the Kenya

Social and Economic Empowerment Project, the Hunger Safety Net Programme has assisted nearly 5 million people during times of crisis, strengthening food security, preventing households from sliding into poverty and dramatically reducing the loss of life.

Livelihood diversification

Livelihood diversification is a risk management strategy intended to broaden how households can earn income or otherwise provide for themselves. Various studies have shown that households can benefit economically by diversifying their livelihoods to adapt to changes in climate. For example, in some parts of Kenya, pastoralist communities have ventured into apiculture (bee-keeping) to supplement incomes and boost climate resilience.

As a result of devolution, as embodied in the Kenyan constitution, livelihood diversification in Kenya is coordinated at the national level under relevant ministries but is spearheaded and implemented at the county level. Resource allocation and monitoring is also led at the county level, where it can be done more efficiently than via nationally coordinated systems. This has given prominence to local policy making. Through various participatory mechanisms, including stakeholder consultations, livelihood and environmental challenges are identified and prioritized by locals, and underrepresented groups are given a voice.

Early warning, action and response

As more than 70% of Kenya's workforce is employed in climate-sensitive sectors, providing timely and user-centric climate information to a wide range of actors and stakeholders is critical. Early warning, early action, and response to climate hazards are crucial components in safeguarding lives, property and livelihoods and in building long-term resilience. The Kenya Meteorological Department is responsible for issuing early warnings for weather and climate. Transitioning from traditional weather forecasting to impact-based forecasting, the department integrates data on hazards, risks and vulnerability to predict not only what will occur but also the potential impacts.

Kenya's efforts are geared towards aligning with the United Nations Early Warnings for All initiative to ensure everyone on Earth is protected from hazardous weather, water and climate events through life-saving early warning systems. Action and response in Kenya involve inter-agency collaboration among different stakeholders at varied decision and/or governance levels (e.g. the National Steering Committee on Drought Response). In instances when national capacity is overwhelmed, humanitarian response mechanisms step in to fill the gaps.

Coordination and reporting

Government efforts in resilience building have significantly improved Kenya's ability to cope with the challenges presented by climate change (although chronic underlying issues such as poverty and child hunger remain a challenge). However, there is a need for improved coordination among the many actors present in the climate space – including various ministries, agencies, county-level government entities, international financial partners and private sector stakeholders – to improve efficiency in the use of climate funds and the uptake or use of climate information. For example,

Kenya's nationally determined contribution is adaptation heavy, reflecting the situation on the ground. Financing, meanwhile, has gone mainly to mitigation (see Section 4.2). Tracking how much climate finance is spent on resilience and adaptation, and reporting its impact, could improve understanding of which needs are being prioritized and where gaps remain.

4.2 International collaboration

Successful action to adapt to the impacts of climate change, while at the same time protecting the Kenyan people and preserving the country's rich biodiversity, requires international collaboration. Such collaboration, in turn, requires drawing on strong support from a wide range of actors, including governments, regions, cities, business, investors and all parts of civil society.

Climate justice and the low-carbon energy transition

Renewable sources currently make up about 90% of Kenya's power mix. The majority comes from geothermal and hydropower, with a fast-growing contingent from wind and solar power.[23] According to the latest IPCC Working Group II report, Africa contributes less than 4% to global carbon emissions. Yet the impacts of climate change are hitting Africa far harder than the more industrialized regions of the world, which are responsible for the vast majority of the emissions.

A boy at the Lake Turkana wind power installations. Credit: Maurizio Di Pietro / Climate Visuals Countdown.

Kenya's domestic commitment to a clean energy transition can be seen in its Vision 2030 for sustainable development (see Section 4.1). Kenya aims to satisfy household energy requirements by ensuring access to clean and modern energy for cooking. For example, 70% of the population relies on biomass for their primary energy needs.

> *Renewable sources currently make up about 90% of Kenya's power mix. The majority comes from geothermal and hydropower, with a fast-growing contingent from wind and solar power.*

The global carbon budget represents the total remaining volume of greenhouse gases, measured in carbon dioxide equivalent, that can be emitted if global temperature rise is to be kept within specified limits (typically 1.5°C and 2°C). Carbon inequality refers to the fact that not all humans contribute to climate change equally. The richest 10% of the world's population accounted for 52% of cumulative emissions between 1990 and 2015, depleting the global carbon budget for a 1.5°C rise by a third (31%; grey and black in Figure 6). In contrast, the poorest 50% were responsible for just 7% of those global emissions and have used just 4% of the global carbon budget for a 1.5°C rise (dark green in Figure 6).[76]

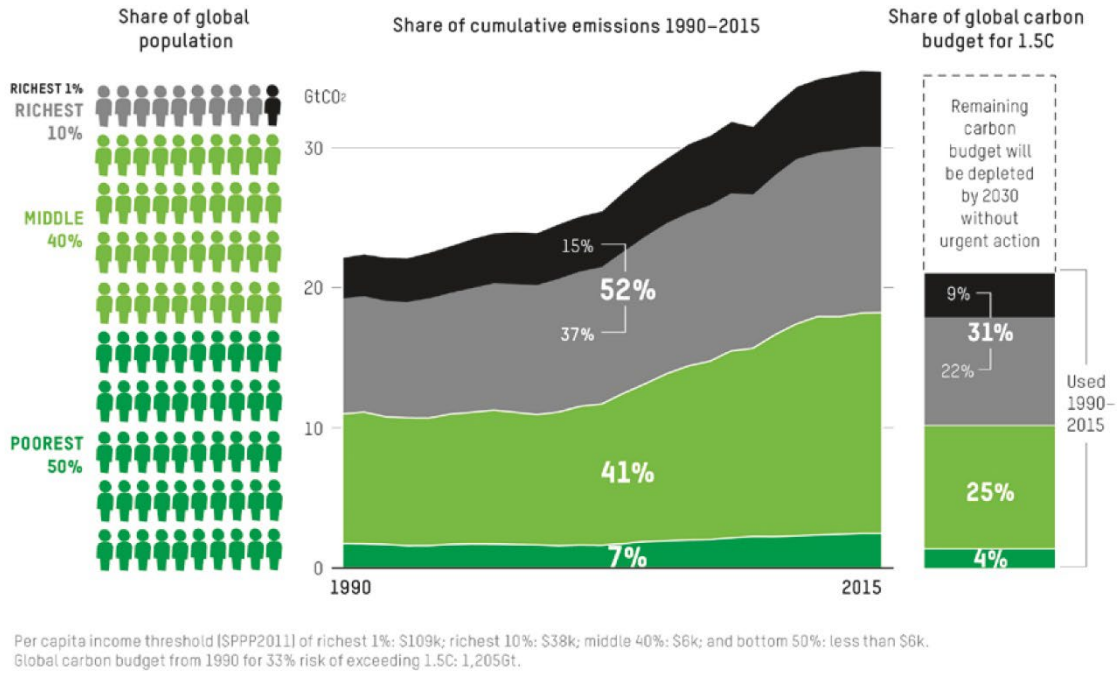


Figure 6. Different global income groups' share of cumulative emissions from 1990 to 2015 and use of the global carbon budget for a 1.5oC limit on global temperature rise. Black and grey combined are the richest 10%; dark green is the poorest 50%. Source: Oxfam (2020).[24]

The principles of just transition would require systemic solutions to be developed and implemented that allow low-income countries and lower-middle-income countries, such as Kenya, to provide universal energy access to their citizens within the remaining global carbon budget. Currently, that carbon budget is being rapidly depleted by consumption among already affluent countries, rather than by efforts to lift people out of poverty.[24]

Defining climate justice and a just transition

The latest report from IPCC Working Group II – the body responsible for reviewing impacts, adaptation and vulnerability due to climate change – presents just transition and the principles of climate justice as essential to ensuring effective adaptation, such that adaptive measures are not counterproductive and do not cause unintentional harm.

Working Group II defines three forms of climate justice: distributive, which refers to the allocation of burdens and benefits among individuals, nations and generations; procedural, which refers to who decides and participates in decision making; and recognition, which entails basic respect and robust engagement with, and fair consideration of, diverse cultures and perspectives. The IPCC defines just transition as "a set of principles, processes and practices that aim to ensure that no people, workers, places, sectors, countries or regions are left behind in the transition from a high-carbon to a low-carbon economy". Key principles of just transitions include:

- Respect and dignity for vulnerable groups, putting the groups at the centre of decision making
- Fairness in energy access and use
- Social dialogue and democratic consultation with relevant stakeholders
- The creation of decent jobs
- Social protection
- Rights at work

Climate finance

For many low-income countries and lower-middle-income countries, including Kenya, adaptation is a policy priority to safeguard lives and livelihoods. Climate finance is required to address adaptation needs – along with mitigation needs – where these are critical to resilience building and transformation. According to the UNEP *Adaptation Gap Report 2023*, a global temperature rise of 2°C could result in a total cost for adaptation in developing countries of approximately US$70 billion to US$100 billion per year for 2010–2050.[76] The estimated cost of implementing Kenya's adaptation plan is K Sh 6,775 billion for the period 2020–2030. Available data shows that by 2018 only K Sh 243.3 billion had been mobilized, a third of the total annual finance required. This translates to an annual resource gap of K Sh 486.6 billion.

In 2018, 79% of international public climate finance into Kenya was in the form of loans, and most (55%) was channelled towards mitigation. Debt vulnerabilities in low-income countries and lower-middle-income countries, such as Kenya, present a major barrier to their economic recovery and to their ability to make critical long-term investments. To spur resilience building and transformation, change in the global climate financing landscape would be needed, along with more innovative financing models to reduce debt strain. Emerging instruments include crowdfunding and investment platforms. These platforms are increasing in popularity as solutions to scaling up climate adaptation finance.[77]

A rethinking of financing models could better involve Indigenous peoples and the holders of local and traditional knowledge, as well as promote gender and social inclusivity. The gender responsiveness of financing instruments and funding allocations has improved in recent years, in response to prior research showing that in many regions women were disproportionately affected by climate change impacts because of persisting gender norms and inequalities.

Loss and damage

Loss and damage occurs when adaptation and mitigation limits are exceeded. Kenya is among the countries already suffering from economic losses due to negative impacts on infrastructure, agriculture, water resources and tourism. Kenya is also expected to experience non-economic losses in health, wellbeing, climate security and ecosystems (see Section 3.2).

In December 2023, COP28 agreed on a loss and damage deal, with pledges totalling approximately US$655 million. The fund and its subsequent operationalization will need to tackle gaps that existing funds (e.g. for adaptation) do not fill by providing new, additional, predictable and adequate finance. This would, in addition to safeguarding the lives and livelihoods of the most vulnerable, take away the burden that countries, such as Kenya, carry from climate-driven loss and damage and allow it to focus on building long-term resilience and other development priorities.

Carbon markets and Indigenous communities

The establishment of a carbon credits market has, at times, led the Kenyan government to view indigenous forests as financial assets. In recent years, the government has evicted forest-dwelling communities to gain full territorial and financial control over several of these forest areas. Principles of recognition and procedural justice would include due consideration of the rights and values of Indigenous communities. Similarly, the principles of distributive justice necessitate equitable distribution of carbon credits generated on indigenous forest land to benefit both the Indigenous communities that live on those lands and the Kenyan government. Following these principles, a model of climate change mitigation that interacts with adaptation and resilience building could be developed. For example, communities could grant free, prior and informed consent for carbon market projects on indigenous forest land, and socioeconomic growth could be supported through the carbon credits shared, alongside ensuring the sustainability of the ecological resources.

Funding climate research

The latest IPCC report highlighted how little funding is directed to Africa for research on climate change adaptation.[6] Despite being a vulnerable continent, Africa's complexities are therefore not being adequately captured in global assessments. For Kenya specifically, there is a need to increase research into the sector-specific costs of climate impacts and to enhance human resource capacity, funding and computational capacity. The latter could enable regional and local circulation model analyses, including downscaling global model outputs to determine more accurately, in the Kenyan context, the direction and magnitude of future changes under different climate scenarios. In addition, improved communication of findings at national and subnational levels, including by highlighting local issues and using local language, is crucial to spur evidence-based climate action.

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