WEATHERING RISK

Climate Security Study: Kenya

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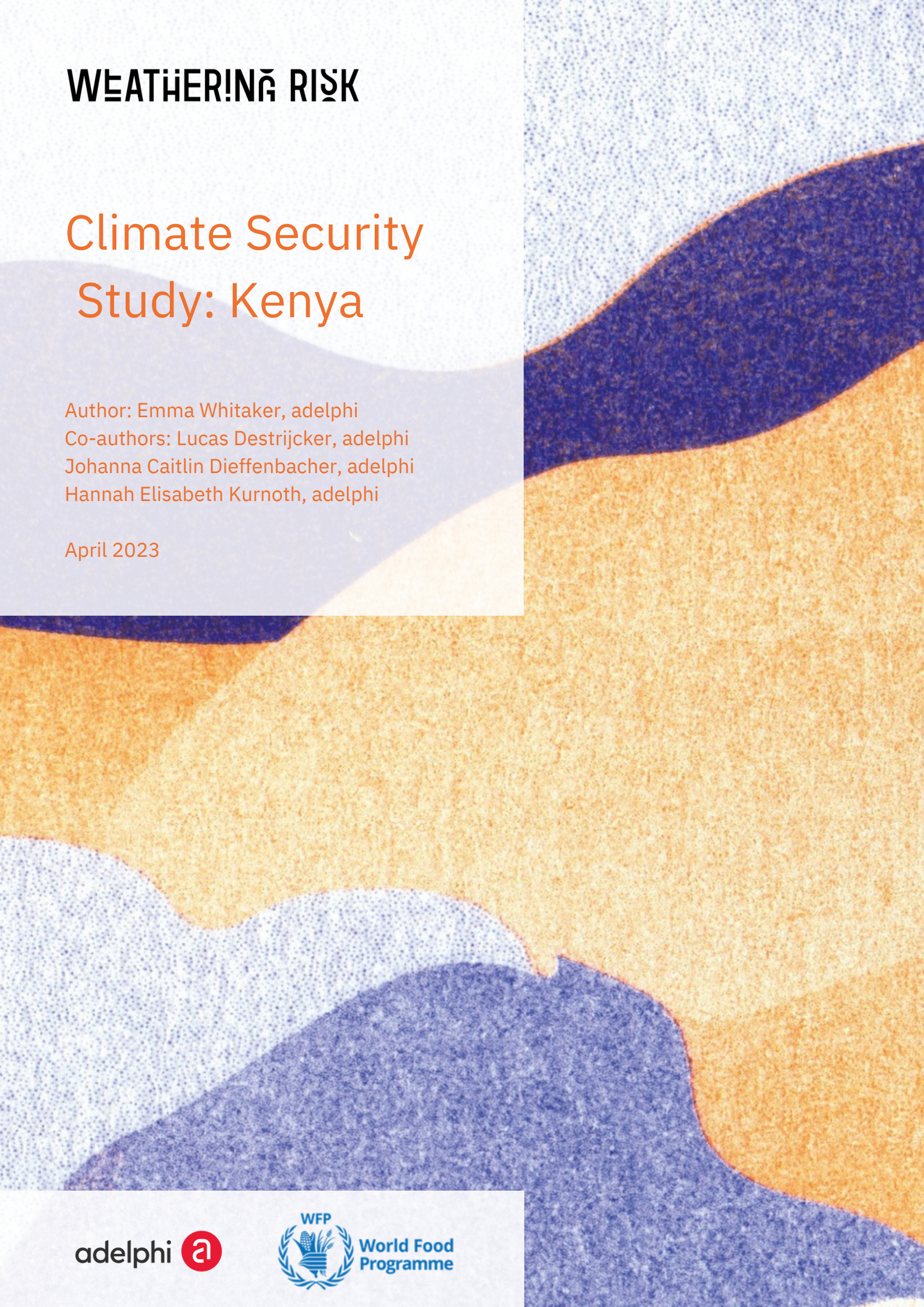

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WFP World Food Programme

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Executive Summary

Kenya´s topography and environment are diverse, with Arid and Semi-Arid lands (ASALs) occupying over 80 per cent of the land area, creating unique challenges for the approximately 38 per cent of the population that live there. Agriculture is the main economic driver but is very vulnerable to climate shocks, and access to adequate quantities of nutritious food remains a challenge for many. Rapid population growth, stagnating agricultural production and inefficient food systems are undermining livelihoods and food security.

More recently, as a result of the Russia-Ukraine conflict, a surge in commodity prices, including for fertilizers, has been projected to further reduce GDP growth in Kenya, which risks putting an additional 1.4 million people below the poverty line (IFPRI 2022). As with much of the rest of the world, inflation in Kenya rose to 7.1 per cent in May 2022, with an estimated shrinking of GDP in 2022 by 0.8 per cent, with more than half of losses from the agricultural sector. The agriculture sector contributes to around 33 per cent of GDP (USAID 2022) and employs over 75 per cent of the workforce (FAO 2022a), therefore any decrease in agricultural production has a major impact on the unemployment rate, which is already high at over 40 per cent.

In the last two decades, Kenya has faced a rising degree of vulnerability to climate-induced hazards and risks – specifically recurring and protracted droughts, and more frequent and intense flooding during rainy seasons. Recurring droughts have caused heavy losses to livestock, an economic mainstay in ASAL areas, and forced roughly 30 per cent of livestock owners out of pastoralism in the last 20 years. Climate change will continue to impact Kenya´s ecosystems through rising temperatures, droughts, floods and rising sea levels into the future. Further projections in Kenya include:

- 59 more very hot days per year until 2080
- Fivefold increase in heat-related mortality
- Temperature rise of between 1.2 and 3.2 °C by 2080
- An overall wetter climate for the country, based on higher emission scenarios
- Fivefold increase in crop land area exposed to drought

Declining agricultural productivity, loss of crops and damage to infrastructure are among the top increasingly adverse impacts of climate change projected for Africa. Recurrent drought, environmental degradation and resource depletion are further undermining the pastoral way of life. These climate and environment induced changes affect the physical safety of households and communities, seriously disrupting their lives and livelihoods beyond their capacity to cope or withstand using their own resources.

There is strong evidence that climate variability leading to the failure of food systems is an important driver of conflict. Across Kenya, climate change and environmental pressures have contributed to violent conflict in multiple settings and this is expected to continue or further increase in the future as the impacts of climate change worsen. This study has identified four interrelated climate security pathways that affect food systems, livelihood security and conflict in Kenya. These include:

Pathway 1: Climate and environmental pressures worsen livelihood conditions, aggravate scarcity and increase competition over natural resources, heightening the risk for livelihood deterioration, food insecurity and violent conflict.

Pathway 2: Deteriorating livelihood conditions change mobility patterns and livestock migration, contributing to rural and urban stress and food insecurity.

Pathway 3: Changing pastoral norms challenge dispute resolution mechanisms and social cohesion, aggravating existing grievances and increasing tensions.

Pathway 4: Changes in water availability and use cause displacement, disrupt food systems and increase insecurity.

The purpose of this report is to explore ways for the World Food Programme (WFP) to better mainstream climate adaptation and resilience-building in its strategies, programmes and projects in Kenya. Through this analysis, the report aims to facilitate risk-informed planning, enhance capacity for action and improve operational responses that promote climate resilience and peace.

Achieving food systems that are resilient and sustainable under a range of climate-related and environmental pressures requires them to be 'climate smart'. This means that different pillars of the food system in Kenya – comprising agriculture, pastoralism and fisheries – are able to adapt to climate change and environmental degradation in a sustainable manner. Our analysis finds that there are a myriad of opportunities across the range of food systems programming which can i) reduce the risks of exacerbating these climate-security dynamics, ii) build resilience to climate-security risks and iii) support food security and peace in the face of a range of possible climate outcomes.

The following recommendations, summarised in Table 1, will help WFP in undertaking a more systemic and long-term approach to strengthening resilience, climate adaptation and conflict prevention in Kenya. Additional conclusions and recommendations can be found in the final section of this report.

No.	Area	Recommendation for WFP
1	**Support efforts to strengthen climate resilience**, including through diversified livelihoods, improved land use and agricultural practices, and social safety nets.	• Prioritise investments in climate-resilient livelihoods, decreasing the need for humanitarian responses. • Invest in nutritious and climate-resilient value chains, including expanding support for Post-Harvest Management capacity strengthening. • Reduce the risk of climate-related shocks through nature-based solutions and improvements in agricultural practices. • Support the identification of locally-appropriate and sustainable livelihood diversification opportunities, notably for pastoral and pastoral-drop out communities. • Expand the uptake of social protection and insurance schemes.
2	**Promote inclusive climate and conflict sensitive adaptation** that supports marginalised groups, as well as moving populations.	• Develop locally-informed ASAL county-specific climate security risk profiles. • Explore approaches that support improved rangeland management and rehabilitation. • Explore opportunities to support improved access to water, promoting peace. • Explore local, appropriate promotion of drought resistant crops and solar powered systems for irrigation. • Invest in addressing gender inequalities along food systems components. • Increase integration of conflict sensitivity into all activities. • Integrate climate security monitoring and evaluation into all programs.
3	**Address pastoral mobility and migration** related to rapid and unplanned movements and urbanisation.	• Explore opportunities to work in urban and informal settlements to promote food security, in particular in ASALs. • Promote internal cooperation and coordination for sustained support to mobile pastoral groups across borders. • Explore opportunities to build resilience of at-risk departure point communities, in particular pastoral communities and pastoral-drop outs.
4	**Promote partnerships and coordination,** including with the private sector.	• Expand innovative partnerships, including with local and international private sector, for improved climate resilience, adaptation and food systems outcomes.
5	**Increase investments** in institutional capacity building.	• Support the capacity strengthening of government, at the national and county levels.

Table 1: Summary of Recommendations

Acronyms

ABN	African Biodiversity Network
ADB	African Development Bank
ASALs	Arid and Semi-Arid lands
AUC	African Union Commission
CSA	Climate Smart Agriculture
CSYAN	Kenya Chapter of the Climate Smart Agriculture Youth Network (CSAYN)
EAFF	Eastern Africa Farmers Federation
ECA	UN Economic Commission for Africa
FAO	Food and Agricultural Organisation of the United Nations
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HPAI	Highly Pathogenic Avian Influenza
IEA	International Energy Agency
IGAD	The Intergovernmental Authority on Development
INDC	Intended Nationally Determined Contribution
KENAFF	Kenya National Farmers' Federation
KOAN	Kenya Organic Agriculture Network
NAP	National Adaptation Plan
NCCAP	National Climate Change Action Plan
NCCRS	National Climate Change Response Strategy
NCCS	National Climate Change Secretariat
NDMA	National Drought Management Authority
NDVI	Normalized Difference Vegetation Index
NGO	Nongovernmental Organisation
PAINTY	Platform for the Promotion of Agribusiness, Investments, Networking and Trade for the Youth
PELUM	Participatory Land Use Management Association
RVF	Rift Valley Fever
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNHCR:	United Nations High Commissioner for Refugees
USD	US Dollar
WFP	World Food Programme

Definitions

Adaptation: The process of adjustment to actual or expected climate change and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities.

Adaptive capacity: The ability of a system to adjust to climate change categorised as: knowledge and awareness, institutional capacities, infrastructure, economic (including food imports) and technological resources and equity.

Clean cookstoves: Solar-powered or fuel-burning household stoves that reduce greenhouse gas emissions by increasing thermal efficiency, reducing specific emissions, or increasing ventilation. This solution replaces traditional cookstoves that burn wood and/or charcoal inefficiently and without ventilation.

Climate migration (migrant): A migration that can be attributed largely to the slow-onset
impacts of climate change on livelihoods, owing to shifts in water availability and crop productivity, or to factors such as sea level rise or storm surge.

Climate Security: Security threats that climate change poses at the international, national and individual level. Climate-related security concerns include impacts on food and water supply, increased competition for natural resources, natural disasters and loss of livelihoods, migration and displacement.

Climate resilience: The ability to adequately prepare for, recover from and adapt to the impacts of climate change.

Climate Smart Agriculture (CSA): An approach that helps guide actions to transform agri-food systems towards green and climate resilient practices, according to the Food and Agricultural Organization of the United Nations (FAO). CSA supports reaching internationally agreed goals such as the Sustainable Development Goals and the Paris Agreement. It aims to tackle three main objectives: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions, where possible.

Displacement: Forced removal of people or the process of people needing to leave their places of habitual residence.

Exposure: Changes in climate parameters that might affect socio-ecological systems either directly or through, for example, disrupting the flow of goods, finance, information
or people into an area.

Food Security: The state in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life, as defined by the United Nations' Committee on World Food Security.

Food Systems: The public policy decisions, the national and global systems and supply chains, and the individuals and groups – public and private – that influence what we eat.

Forced migration: Migratory movement in which an element of coercion exists, including threats
to life and livelihood, whether arising from natural or man-made causes. Forced migration generally implies a lack of volition concerning the decision to move, though in reality the
decision to move may include some degree of personal agency or volition.

Gender-responsive: Identifying, understanding, and implementing interventions to address gender gaps and overcome historical gender biases in policies and interventions. Gender-responsive approaches aim to transform gender dynamics towards creating more equality and should be pursued whenever possible in climate adaptation and mitigation policies.

Gender sensitivity: Understanding and taking into consideration socio-cultural factors underlying sex-based discrimination, with the intent of doing no harm as a bare minimum in climate adaptation policies.

Immobility: Inability to move from a place of risk or choosing not to move away from a place of
risk.

Internal migration (migrant): Migration that occurs within national borders.

International or cross-border migration (migrant): Migration that occurs across national
borders.

Intersectionality: The complex, cumulative way in which the multiple forms of discrimination (such as racism, sexism, ableism and classism) combine, overlap, or intersect and thereby create overlapping and intersecting systems of discrimination or disadvantage.

Loss and Damage: A term used to describe the aftermath of the impacts of climate change as mitigation efforts fail and emissions continue to rise, and the consequences of climate change go beyond what people can adapt to. Loss and damage materialize in the wake of extreme weather events such as heatwaves, floods, storms and droughts, as well as slow-onset events such as sea level rise, desertification and biodiversity loss. The scale of loss and damage can range from the disruption of essential services, displacement and food insecurity to the irreversible loss of life, culture, territory and ecosystem services.

Migration: Movement that requires a change in the place of usual residence and that is longer term. In demographic research and official statistics, it involves crossing a recognised political/administrative border.

Mobility: Movement of people, including temporary or long-term, short- or long-distance, voluntary or forced, and seasonal or permanent movement as well as planned relocation.

Potential impact: Determined by combining the exposure and sensitivity to climate change of a system.

Rapid-onset event: Events such as cyclones and floods which take place in days or weeks.

Resilience: Capacity of social, economic, and environmental systems to cope with a hazardous event, trend or disturbance by responding or reorganising in ways that maintain their essential function, identity, and structure while maintaining their capacity for adaptation, learning, and transformation.

Sensitivity: The state of the physical and natural environment that makes the affected systems particularly susceptible to climate change, including population density, migrant and refugee populations and urban extent.

Slow-onset event: Changes in climate parameters – such as temperature, precipitation - and associated impacts – such as water availability and crop production declines – that occur over long periods of time.

Vulnerability: Environmental pressures and climate-related changes have differing impacts depending on other demographic factors such as how gender intersects with ethnicity, race, caste, class, age and disability, as well as marital status; all of which are related to differing degrees of vulnerability.

Introduction and methodology

In Kenya, the effects of a fifth consecutive below-average rainy season are resulting in deteriorating food security outcomes driven by the impacts of poor crop and livestock production, resource-based conflict, and livestock disease and mortality, among others (FEWSNET 2022). Further, declining forage and water resources in some areas are driving migration in search of pasture and water, resulting in conflict among communities over rangeland resources. The growing frequency and intensity of climate change impacts are putting food systems and livelihoods at risk, with far reaching impacts for security and stability.

The Weathering Risk programme, led by an interdisciplinary team from adelphi and the Potsdam Institute for Climate Impact Research (PIK), unites state-of-the-art climate impact data and expert conflict analysis to promote peace and resilience in a changing climate. It uses an innovative methodology that unpacks the complex relationship between climate change and insecurity and identifies entry points for action. PIK contributes knowledge to the global scientific community by way of publications in high-ranking peer-reviewed international journals and engagement in numerous partnerships and networks. Its main methods are integrated and complex systems analysis and data integration. Through its methodological framework, Weathering Risk aims to facilitate risk-informed planning, enhance capacity for action and improve operational responses that promote climate resilience and peace.

As part of the Weathering Risk initiative, adelphi and the World Food Programme (WFP) Regional Bureau for Eastern Africa set up a regional learning facility on climate adaptation. The purpose of this collaboration is to explore ways for WFP to better mainstream climate adaptation and resilience-building in its strategies, programmes and projects in East Africa.

Figure 1: The Weathering Risk Methodology (Source: Weathering Risk)

This climate security profile, focusing on Kenya, is one of the outputs produced for the learning facility. Kenya was selected because access to adequate quantities of nutritious food remains a challenge for many, especially in Arid and Semi-Arid Lands (ASALs). Agriculture remains the main economic driver but is very vulnerable to climate shocks. Rapid population growth, stagnating agricultural production and inefficient food systems are undermining livelihoods and food security, and climate change is exacerbating these pressures, increasing risks for conflict.

WFP has been a major humanitarian and development partner in Kenya, providing food assistance to Kenyans affected by drought emergencies and to refugees in Northern Kenya. This report lays out potential risk pathways posed by climate change and insecurity to food systems in Kenya, as well as ascertains entry points for proactive risk reduction and integrated responses for WFP programming. The aim is to unveil new opportunities to take a more systemic and long-term approach to strengthening climate resilience, climate adaptation and conflict prevention.

Country Context and Trends

Geography and Topography

Kenya´s topography and environment are diverse with Arid and Semi-Arid lands (ASALs) occupying over 80 per cent of the land area, supporting approximately 38 per cent of Kenya's population, 70 per cent of national livestock and 90 per cent of wildlife (Government of Kenya 2019a). The ASALs are spread across 29 counties with varying degrees of aridity. The extreme conditions of ASALs create unique challenges for communities, and the effects of climate change have had devastating impacts on the environment and livelihoods there.

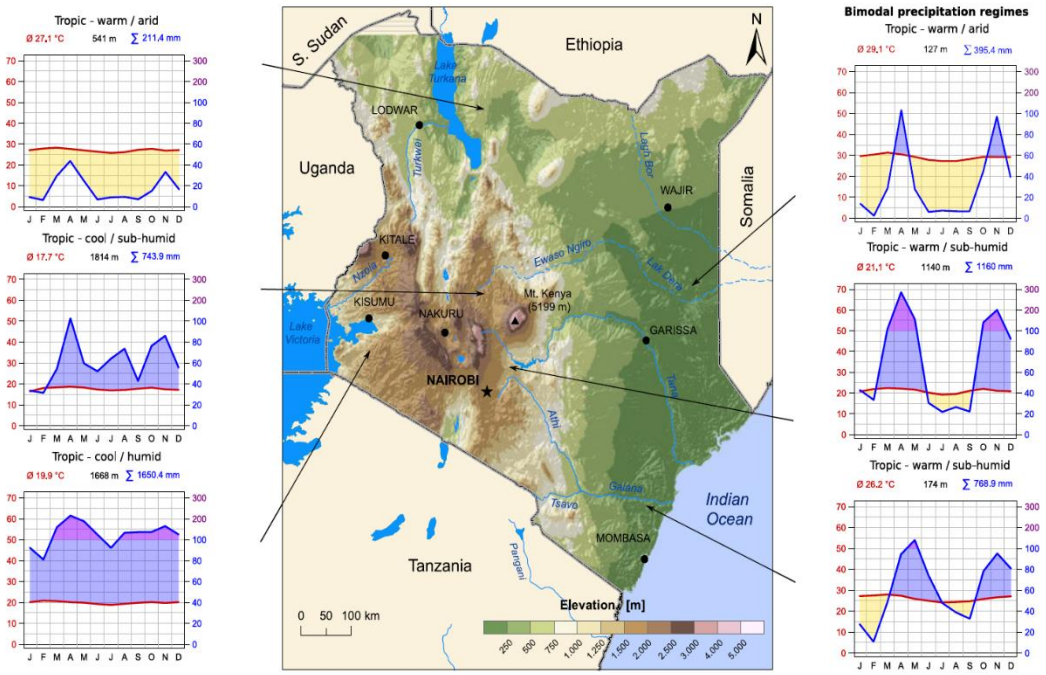


Figure 2: Topographical map of Kenya with existing precipitation regimes (Source: PIK 2021)

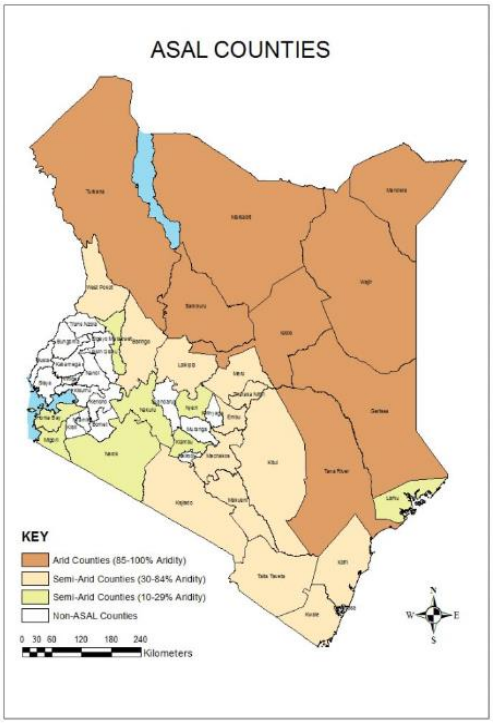


Figure 3: ASAL Counties (Source: Kenya Agricultural & Livestock Research Organization

Kenya's temperatures vary dramatically, with highlands experiencing cooler temperatures than coastal or lowland regions. Kenya typically has two rainy seasons between March-May and September-November, though seasonal patterns have become increasingly erratic. In northern and eastern Kenya, which is characterized by steppe, an ecoregion characterized by grassland plains without trees, annual precipitation sums are low in comparison to western Kenya, where annual precipitation sums reach 1600mm (PIK 2021). ASAL counties receive rainfalls in the range of 150-550 mm per year in the arid areas and 550-850 in the semi-arid areas (NDMA 2021a).

Excessive flooding in Kenya occurs relatively frequently – on average every three to four years – and is linked to El Niño or La Niña episodes that contribute to a long-term fiscal liability equivalent to between 2 - 2.8 per cent of the country's Gross Domestic Product every year (Government of Kenya 2018). Riverine floods are the most dominant floods in Kenya, although the ASALs are particularly vulnerable to flash flooding. The impacts of these climate-related disasters are felt at the household level through food insecurity, damage to property, and increased prices of food and fuel.

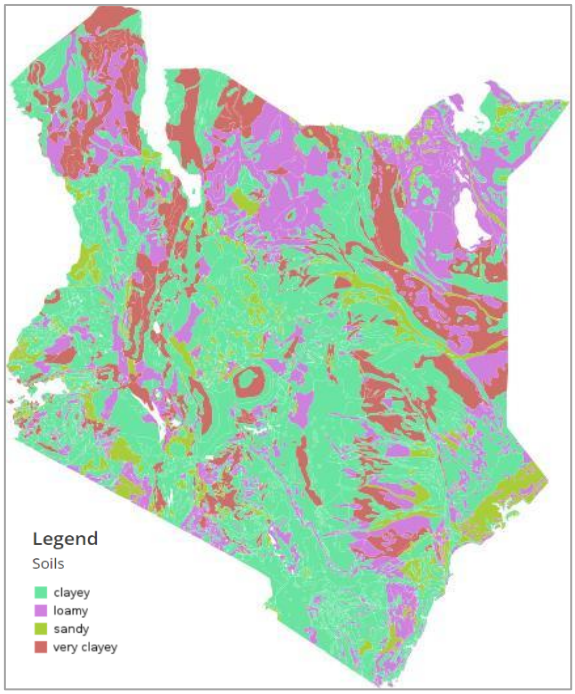


Figure 4: Soil Types in Kenya (Source: ICPAC Geoportal)

Soils in Kenya provide a wide range of ecosystem services that support the population, including the provision of 98.8 per cent of food (Kopittke et al. 2019). Soil health is critical to a range of services, including carbon storage, greenhouse gas regulation or flood mitigation. Soils and their associated services are under unprecedented pressure from a combination of rapid population growth and intensification of agricultural production.

Increased agricultural production accelerates the loss of organic matter, which is critical to maintaining soil fertility. A persistent challenge is therefore how to increase agricultural productivity to support food security, despite the loss of soil fertility ibid).

Variation in climates, soils and agro-ecological zonation impacts human distribution and population density (ICPAC and WFP 2018). The main cropping areas for agricultural production are located in central, Rift Valley, western and partly coastal areas of Kenya (see Figure 5), with very few exceptions in the east of the country. Pastoral production is most common in the north-eastern and northern areas of the country (ICPAC and WFP 2018).

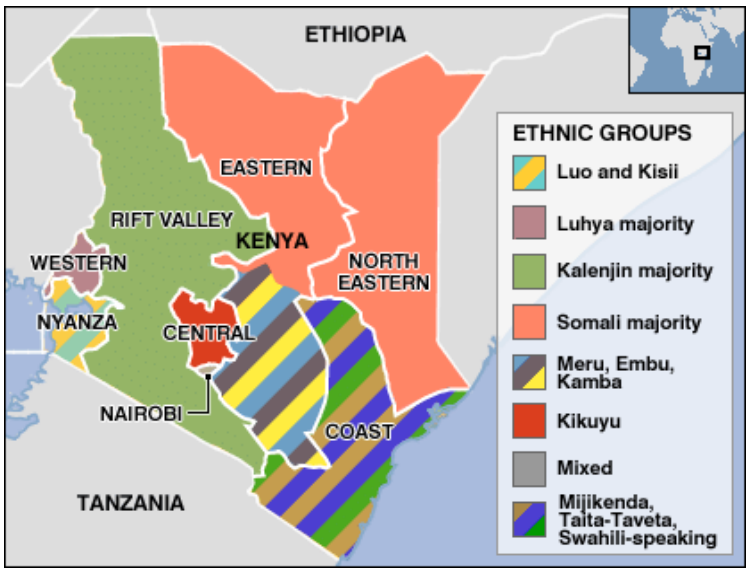


Figure 5: Map of Kenya regional division and ethnic distribution (Source: Okilwa 2015)

Demographics

With a population of approximately 54 million people, Kenya has roughly 42 ethnic groups (World Bank 2021). These diverse groups speak different languages, inhabit different landscapes and practise varying cultures, including related food production and consumption (Subbo, 1994; World Bank 2020).

Population growth in Kenya is at 2.3 per cent (World Bank 2021) and the country is transforming rapidly, with a strong urbanisation trend. Urban dwellers account for 31 per cent of the total population, projected to rise to 50 per cent by 2050 (FAO 2022b). Urban populations are concentrated in three cities – Nairobi, Kisumu and Mombasa – but populations are also increasing in secondary towns. Despite increasing economic development, one third of the country is living below the international poverty line of 2.15USD/day, and social, gender and economic inequalities continue to exist (World Bank 2022).

ASALs face a particular set of challenges affecting their socio-economic development, food security and environmental sustainability. These challenges include: climate change, desertification, radicalization, resource-based and cross-community conflict, low education participation, low human capital development, highly dispersed population and land degradation. Further, harmful gender-based practices continue to prevail, hindering access to education and opportunities for young women and men, and limiting participation in development activities (Government of Kenya 2018).

Those aged between 18 and 35 make up approximately 75 per cent of Kenya's population; a large percentage of this population is unemployed and feels marginalised in terms of access to opportunities and representation (World Bank 2020). It is estimated that 64 per cent of the unemployed in Kenya are youth who are largely moving away from the agricultural sector towards fast growing non-agricultural sectors in urban areas or large towns (Government of Kenya 2018). Rising unemployment, poverty and intra-urban inequality are contributing factors to rising food and nutrition insecurity in urban areas, including small intermediary cities (FAO 2022b).

Kenya is also one of the world's largest refugee-hosting countries with 539,766 refugee and asylum seekers, 76 per cent of which are women and children (UNHCR 2022a). Almost half of the refugees in Kenya reside in Dadaab (44 per cent), 40 per cent in Kakuma and 16 per cent in urban zones (mainly Nairobi) alongside 18,500 stateless persons (UNHCR 2022b). Refugee populations are highly dependent on international assistance, unable to work or move freely, lack access financial services and face many obstacles to economic inclusion. The Government of Kenya is currently operationalising the Refugees Act 2021 to provide for the recognition, protection and management of refugees. Economic activities are limited to informal employment within displacement camps (FAO 2019b), and refugees face higher poverty and unemployment rates than Kenyan citizens. This translates into higher levels of vulnerability, be it regarding food security, climate change, or violence (Graham and Miller 2021). Moreover, the concentration of large number of refugees and asylum seeker populations results in severe overexploitation of natural resources around displacement camps (FAO 2021b).

Governance

In 2013, Kenyans voted to decentralise the government, establishing 47 new county governments to promote democratic and accountable exercise of power; recognise the right of communities to manage their own affairs; and ensure equitable sharing of national and local resources (Government of Kenya 2013a). While local county officials initially struggled with the capacity, knowledge and resources to effectively deliver the devolution dividends, improvements have since been seen. Strengthening local autonomy supports the empowerment of local authorities and communities necessary to face their unique environmental, economic and livelihood challenges. For example, decentralisation provides an opportunity for greater political voice and economic engagement for pastoralists.

The Government of Kenya's Agricultural Sector Development Strategy endeavours to combine public and private sector efforts to overcome the outstanding challenges in Kenya. The approach focuses on ensuring food and nutritional security for all, including making nutritional security for all Kenyans a national priority, and designing the Agricultural Sector Transformation and Growth Strategy to increase productivity and livelihoods (United Nations in Kenya 2021). In Kenya's Pathway to Sustainable Food Systems National Position Paper, Vision 2030 for 100 per cent food and nutrition security is reinforced by four aspirations, including increasing the number of young people receiving school based agricultural education, and the uptake of digital agricultural solutions (United Nations Food Systems Summit 2021). The focus also includes generating higher incomes and employment in rural areas. Government ambitions aim to transform Kenya's agricultural sector into a profitable, commercially

oriented and internationally competitive industry, including through facilitating the entrance of multinational corporations into the system to establish profit-driven agricultural strategies.

The country also has a vibrant farmer association life, including Kenya Organic Agriculture Network (KOAN), the African Biodiversity Network (ABN), Kenya National Farmers' Federation (KENAFF), Eastern Africa Farmers Federation (EAFF), and Participatory Land Use Management Association (PELUM), which work on blending agroecology and Indigenous knowledge in the quest for nutritional food which meets the needs of communities and conserves biodiversity and natural resources (Route to Food 2019).

Kenya has been one of the most active countries in the region advocating for climate adaptation. The Kenyan government launched a National Climate Change Response Strategy (NCCRS) in 2010 and a National Climate Change Action Plan (NCCAP 2013-2017) in 2013. Based on these, the government developed its National Adaptation Plan (NAP 2015-2030), which forms the basis for the adaptation component of Kenya's Intended Nationally Determined Contribution (INDC). The NAP is aligned with Kenya's Climate Change Act, which was enacted into law in May 2016. The coordination of climate change activities is currently the responsibility of the National Climate Change Secretariat (NCCS) in the Ministry of Environment and Natural Resources. The NCCS is the National Focal Point for the United Nations Framework Convention on Climate Change (UNFCCC). The Kenyan government prioritises adaptation activities under four key sectors, which include the economic, social and political pillars, as well as foundations for national transformation. The latter includes, amongst others, sectors such as infrastructure, science, technology, information, communication and human resources (NAP 2015-2030).

One of the key priorities for the Kenyan government in tackling climate change is drought management. The National Drought Management Authority (NDMA) exercises overall coordination over all matters relating to drought risk management and the establishment of mechanisms to respond to drought emergencies in Kenya. In addition to coordination and knowledge management, the NDMA's activities include building drought resilience, disseminating early warning information, and strengthening drought contingency planning and response (NDMA, 2016).

Despite these positive efforts to address wide-spread food insecurity and climate change, governance challenges continue to hinder the realisation of adaptation ambitions. Kenya is performing relatively low on multiple governance indicators, especially regarding political stability, absence of violence and terrorism, and control of corruption. Over the past 15 years, the quality of governance did not improve overall and declined between 2015 and 2020 for some indicators, such as voice and accountability, government effectiveness, regulatory quality, and rule of law. From 2012 to 2021, Kenya scored 25-31 out of 100 in the Corruption Perception Index (CPI). The CPI measures the perceived level of public sector corruption, in which 0 means highly corrupt and 100 means no corruption at all. This shows that the perception of levels of corruption stayed relatively stable over the roughly 10-year period (Transparency International 2022).

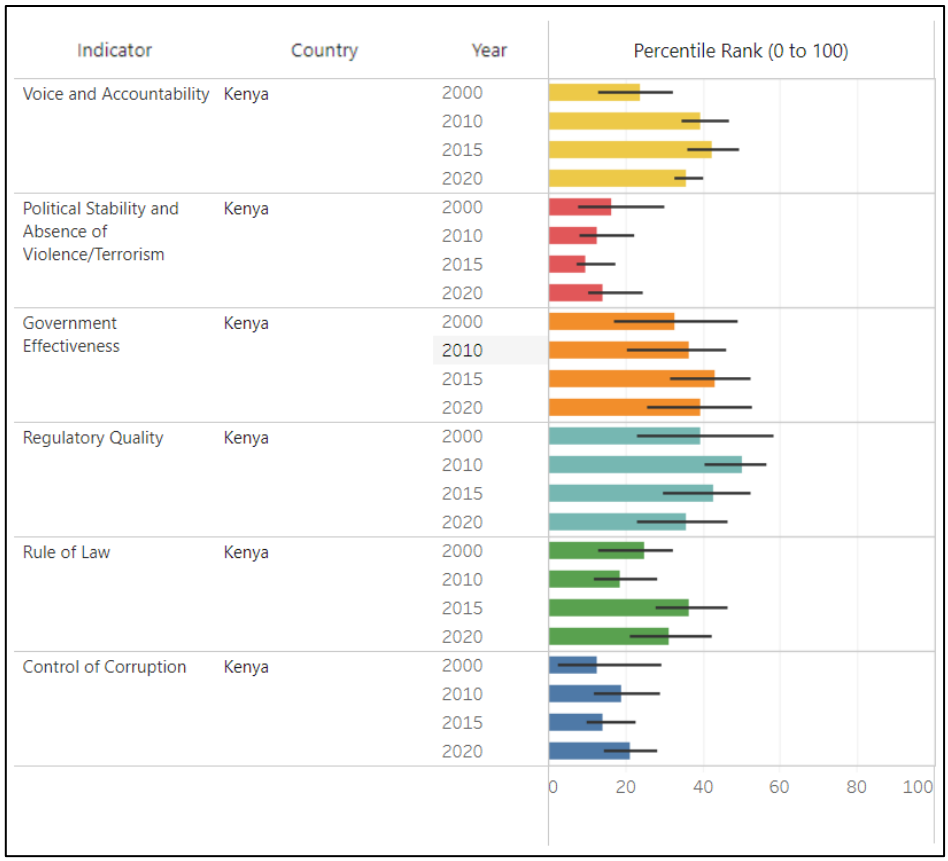


Figure 6: Worldwide Governance Indicators (WGI) for Kenya (Source: World Bank)

Further, government policies – including Kenya's Vision 2030, which aims to transform Kenya into a newly industrialising, middle-income country – are seen to have an urban bias, which can have adverse implications on broader food systems. Urbanization is increasing pressure on food systems through the conversion of rural land to urban and industrial sites, as well as the shrinking of labour pools in rural areas (FAO 2022b).

The drawback of prioritising boosting economic growth through investing in technology and infrastructure under Vision 2030 is that rural dimensions of food production, livelihood security and wellbeing can be overlooked.

Socioeconomic Profile

Kenya's economy has developed significantly during the past decade and is considered a middle-income country since 2014 (WFP 2018), with the largest economy in East Africa (World Bank 2021). Coffee, cut flowers, petroleum and tea are the main exports (OEC 2020), together with other agricultural products, rendering the economy is highly sensitive to climate change. Before the pandemic, tourism was Kenya's most profitable economic sector. Kenya´s annual GDP growth rate experienced a rapid decline with the start of the COVID 19 pandemic, falling from 4.981 per cent in 2019 to -0.316 per cent in 2020. More recently, as a result of the Russia-Ukraine conflict, a surge in commodity prices, including for fertilizers, has been projected to further reduce GDP growth in Kenya, putting an additional 1.4 million people below the poverty line (IFPRI 2022). As with much of the rest of the world, inflation in Kenya rose to 7.1 per cent in May 2022, with an estimated shrinking of GDP in 2022 by 0.8 per cent, with more than 50 per cent of losses from the agricultural sector.

Even though 80 per cent of the land is arid or semi-arid, agriculture represents the main economic driver of Kenya's economy (WFP 2021a). The agriculture sector contributes to around 33 per cent of GDP (USAID 2022) and employs over 75 per cent of the workforce (FAO 2022a). As such, any decrease in agricultural production has a major impact on the unemployment rate, which is already high at over 40 per cent.

Pastoral economies in ASALs account for 90 per cent of all employment opportunities and 95 per cent of family income and livelihood security. Kenya´s GDP is boosted by the livestock sector through the production of saleable products, such as meat, dairy, eggs, hides, skins and wool. Similarly, the livestock sector is an important element of Kenya's food system, providing consumable products and generating income for food access. Livestock production comprises, among others, the keeping of cattle, sheep, goats, camels, donkeys, horses and poultry. The pastoral system revolves around subsistence livestock production or nomadic pastoralism, which includes extensive grazing on natural pastures and forages, involving migration of households and livestock (constant or seasonal) in order to find pasture and water resources.

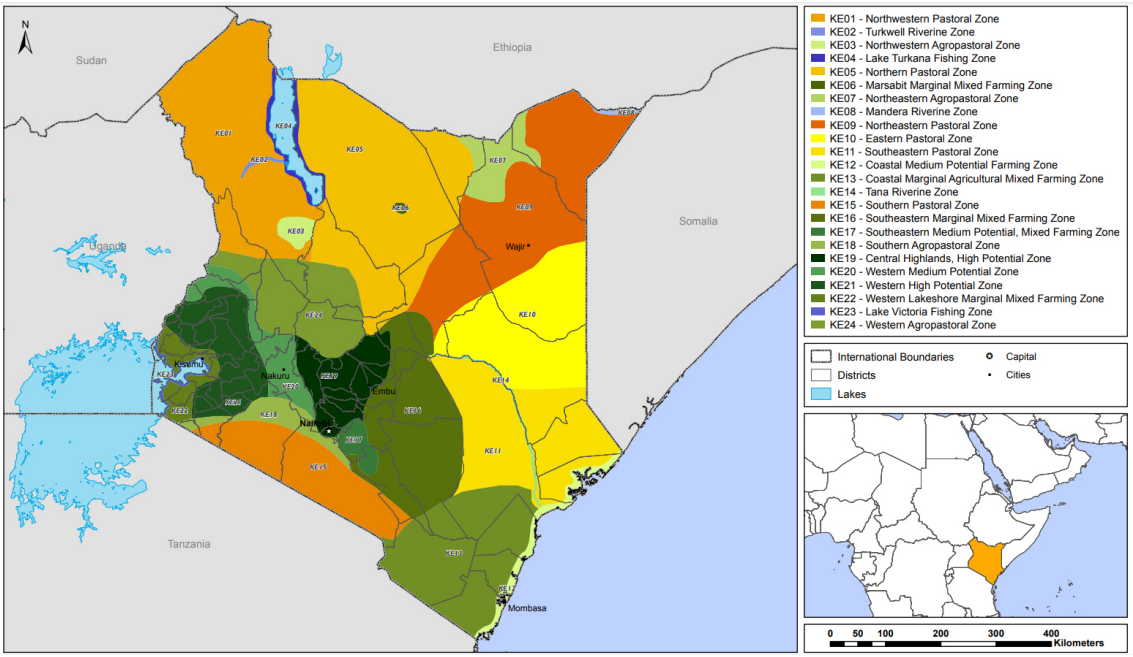


Figure 7: Kenya livelihood zones (Source: FEWS)

Global wheat prices have been rising since 2020 in reaction to poor harvests in key exporting countries and rising global demand for cereal products. In reaction to the war in Ukraine, global wheat prices jumped to a record high in Q1 2022, reaching the levels of the 2007/2008 global financial crisis. The compounding effects of the drought in the Horn of Africa and the conflict in Ukraine are expected to trigger short-term food inflation. When taking the size of the wheat demand and overreliance on imports from Russia and Ukraine into account, Kenya is considered to be the second most severely affected country in the region, headed by Sudan and followed by Ethiopia (WFP 2022). In an already fragile context, or at particularly politically sensitive moments such as elections or political transitions, these food systems-related stresses have been shown to interact with existing grievances to increase risks to peace (Rüttinger et al. 2015).

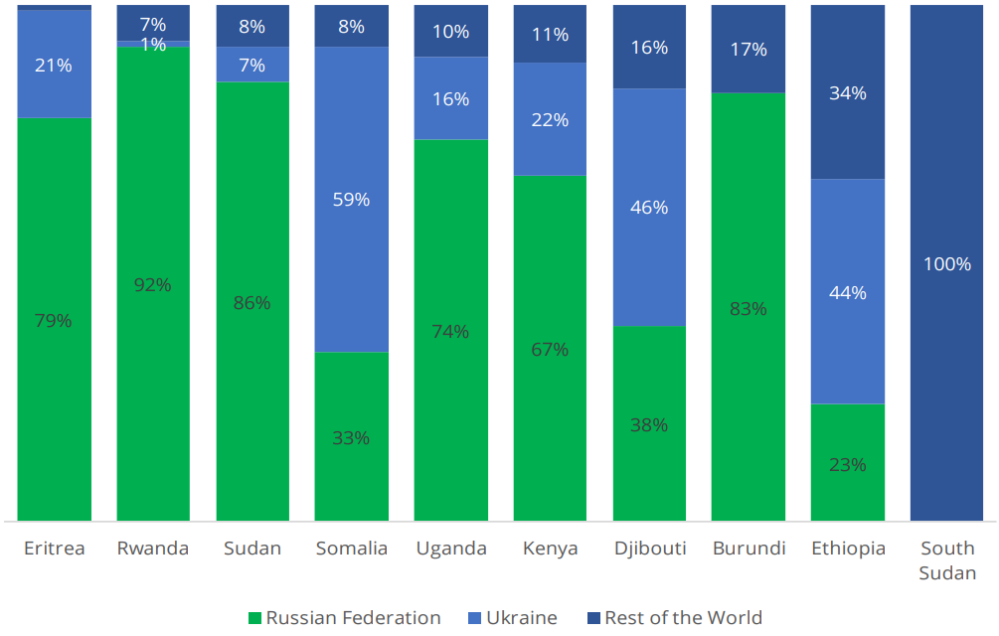


Figure 8: Share of wheat imports to Eastern Africa (Source: WFP 2022)

Impacts of the COVID 19 pandemic

The pandemic has severely affected food systems and related food security and livelihoods. In Kenya, the food system was disturbed as farmers, as well as service providers along the value chain, had to restrict operations due to fear of infection, decreased demand, or difficulties maintaining distancing attending work or providing Personal Protective Equipment to workers. Further, smallholder farmers exporting their crops internationally – notably flowers, vegetables, nuts, coffee and cocoa – lost access to global markets due to border closures and restricted transport options (FAO 2021b). Moreover, the closure of retail outlets and reduced purchasing power of consumers decreased Small and Medium Enterprise sales and cash flow, while the price of raw materials and production operations increased, leading to poor profits (Global Alliance for Improved Nutrition 2021).

During the pandemic, food insecurity increased in most ASAL counties of Kenya. Nationwide, it was reported by the World Bank that 28 per cent of adults skipped a meal in March 2021, rising to 39 per cent in April 2021. Urban poor and rural consumers engaged in local income-generating activities to compensate for their declining purchasing power.

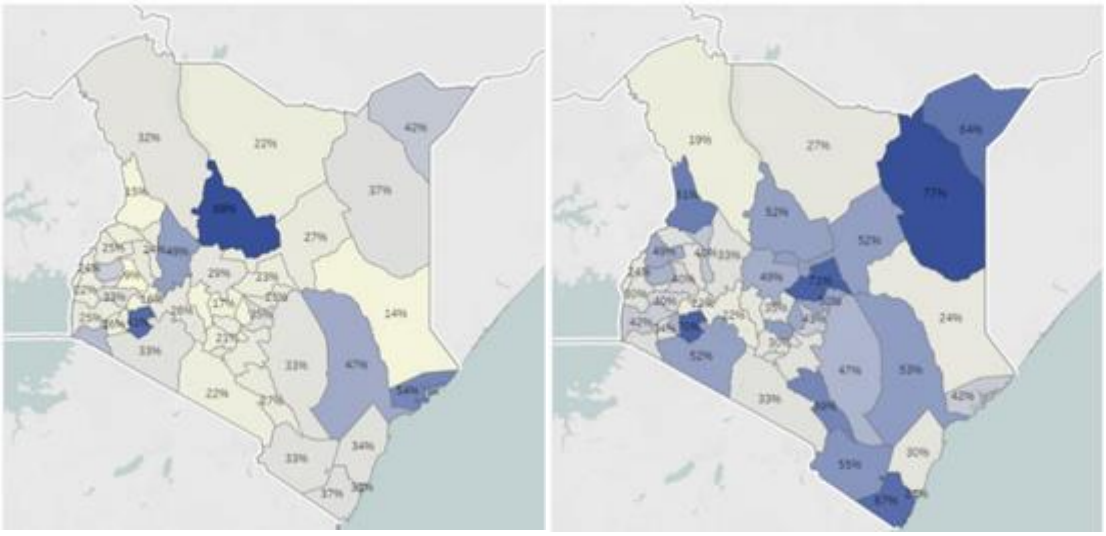


Figure 9: Proportion of households experiencing a food shortage from January to March 2021 (left) and from April to June 2021 (right); showing the impact of the pandemic on food systems throughout the country (Source: Global Alliance for Improved Nutrition 2021)

Gender

The Kenyan Constitution provides the foundational legal framework for gender equality, positing that 'Women and men have the right to equal treatment, including the right to equal opportunities in political, economic, cultural and social spheres', and that every person should have adequate food and be free from hunger, gender notwithstanding (Kenya Law Reform Commission 2010). In accordance with these parameters, the government has established several national and regional policies, legal and institutional frameworks[1] that are intended to support gender equality and empowerment, women's rights, and access to resources as well as care services.

[1] Such as the 2011 National Gender and Equality Commission Act, and the 2019 National Policy on Gender and Development.

Nonetheless, the implementation of gender mainstreaming in climate change policies is challenged by operational constraints, and has led to inadequate implementation of gender-responsive climate change action for communities (UNDP 2020). Similarly, gender mainstreaming runs the risk of homogenising men and women as general categories without giving adequate attention to how other hierarchies and categories of power intersect with gender to influence people's experience of and response to climate change and related security risks.

The three core food system components – value chains, the food environment and consumer behavior – interact with gender (in)equality. In semi-arid areas of Kenya, consecutive droughts have made incomes amongst male pastoralists insecure, frequently leading to male out migration. For example, male members of the Samburu tribe – semi-nomadic herders located in north-central Kenya – leave their homes for months to search for pasture with their herds. Women are therefore left with an increased workload, with the double burden of ensuring food security and financial stability while earning money to ensure their survival alongside their household duties (Evans 2020). Nonetheless, such a phenomenon has led to women's growing engagement with jobs once reserved for men, such as trading livestock, farming and other industries (Rao 2019), which has led to a shift in gender roles.

Rural women in particular have a limited capacity for climate change adaptation (Ingutia and Sumelius 2022) and food insecurity disproportionately affects women. In general, research shows that women and female-headed households are less food secure compared to men and male-headed households in Kenya (Kassie et al. 2012). For example, pastoral women in semi-arid rangelands not only shoulder a notable portion of the household burden for responding to climate change, but simultaneously face several gendered barriers – such as lack of access to land rights, credit and gendered violence – that adversely impact their ability to adapt (Walker et al. 2022).

Agricultural production in Kenya is predominantly rainfed, and climate change is leading to shorter growing seasons, crop failures and periods of drought-induced hunger and malnutrition, especially among mothers and children (Ingutia and Sumelius 2022; Musebe et al. 2018). In 2021, 103,286 pregnant and lactating women required acute malnutrition assistance, while the proportion of pregnant women receiving supplements was higher than the previous year (Government of Kenya 2022). According to the ASAL Humanitarian Network, approximately 885,500 children and 986,000 pregnant and lactating mothers are acutely malnourished in ASAL regions of Kenya (ASAL Humanitarian Network 2022).

The World Food Programme (WFP) in Kenya

The World Food Programme (WFP) has been a witness to and active partner of communities seeking to confront food and livelihood related challenges. For more than 60 years, the WFP has been embedded in the communities most in need, to bring life saving assistance and support to sustainable and resilient livelihoods with the ultimate goal of 'a world with zero hunger'. Now active in more than 123 countries around the world, WFP is no stranger to the increasing challenges exacerbated by climate change.

As the world's largest humanitarian organization, WFP witnesses firsthand how climate-induced losses and damages lead to the global food crisis. WFP works on the ground after climate disasters by providing urgent relief and food assistance, while helping communities in strengthening their resilience against climate impacts to avert and minimize loss and damage in food systems. In Eastern Africa, WFP works to tackle underlying vulnerabilities that heighten the exposure of communities to risks and fragility, such as conflict and natural hazards, threatening to reverse development gains. To confront them, WFP embeds resilience into its work, which can lessen the effects of shocks and stressors on communities, thereby more durably relieving human suffering. Building on more than half a century of global experience, WFP partners with national governments and other stakeholders to collectively support strategies for resilient food, livelihoods and ecosystems, no matter the threat.

In Kenya, WFP has four strategic objectives. The first is focused on crisis response, ensuring that refugees, asylum seekers and populations affected by natural and human-caused disasters have access to adequate food to meet their food and nutrition needs throughout the year. To achieve this outcome, WFP Kenya provides food assistance to refugees and vulnerable Kenyan populations to meet acute food needs, while supporting self-reliance in camps and settlement areas (WFP 2021). Climate-related objectives are most reflected in WFP's second strategic priority, namely to ensure that Kenyan food systems are sustainable and inclusive. This pillar of work targets smallholder producers and food-insecure, vulnerable populations to build resilience to climate shocks, enabling them to meet their food and nutrition needs. Activities include creating assets and transfering knowledge, skills, and climate risk management tools, as well as facilitating access to markets and providing technical expertise in value chain management (WFP 2022). Further country-specific objectives include strengthening the capacity of national and county institutions in disaster risk management, food assistance programmes and nutrition services, and providing government, humanitarian and development partners in Kenya with access to effective and cost-efficient services (Ibid). WFP has a strong footprint in ASAL counties and has extensive experience in connecting smallholder producers to markets, as well as in building climate resilient livelihoods and food systems in arid and semi-arid counties.

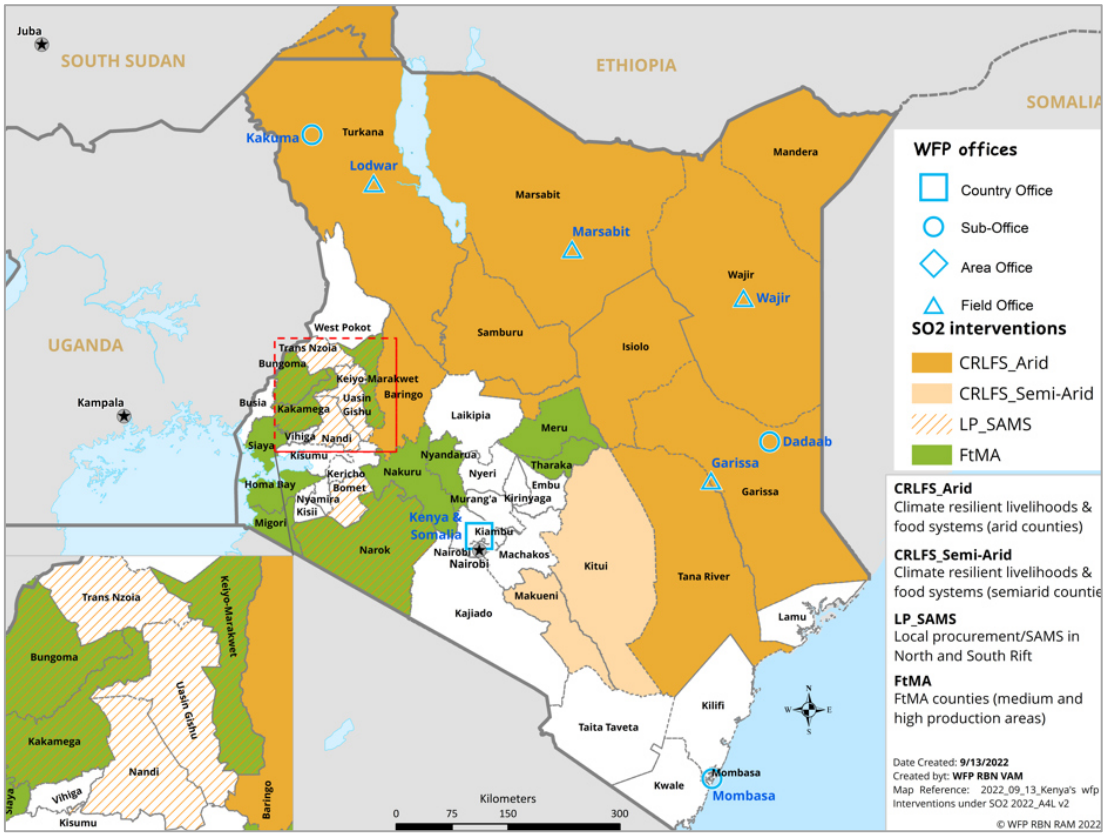


Figure 10: WFP offices in Kenya (Source: WFP 2022)

Climate and Environment

This chapter provides an overview of historic trends and projected changes in climate parameters, and related impacts on different key sectors for 2030, 2050 and until 2080, taking different climate change emission scenarios into account. It is important to note that, due to challenges in zooming in at the very local level, most climate data and projections in this section focus at the national level, rather than on the ASAL sub-regions.

In the last two decades, Kenya has continued to face a rising degree of vulnerability to climate-induced hazards and risks, specifically recurring and protracted droughts, and more frequent and intense flooding during rainy seasons. Kenya is currently experiencing the worst drought in 40 years. Climate change will continue to impact Kenya´s ecosystems through rising temperatures, droughts, floods and rising sea levels into the future. The growing population of the country will use more resources and expand agriculture, most likely resulting in additional environmental challenges, including land degradation, deforestation and pollution of water. These environmental changes affect the physical safety of households and communities, seriously disrupting their lives and livelihoods beyond their capacity to cope or withstand it using their own resources. There is an urgent need for increased adaptation measures, specifically in regard to food systems, to protect biodiversity and maintain fragile ecosystems and their services, while securing people´s livelihoods in the long-term (PIK 2021).

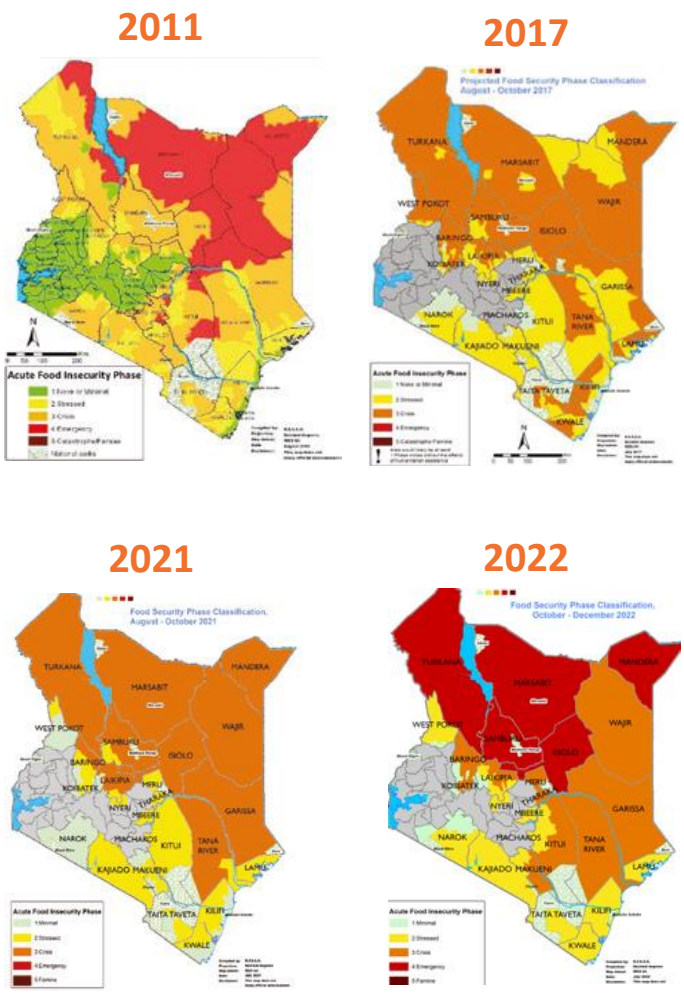


Figure 11: Drought in Kenya (Source: WFP 2022)

Climate Projections

Historic and current trends (source: World Bank, Climate Change Knowledge Platform)
Temperature ● Average temperature in Kenya has increased by 1°C since the 1960s, average +0.21°C per decade Precipitation ● Highly variable, significant geographical diversity in observed rainfall trends ● Northern areas became wetter, southern areas drier since the 1960s ● Greater frequency and intensity of extreme rainfall events ● Increased aridity and droughts, occurrence of moderate drought events on average every three to four years ● Major droughts every ten years ● Since 2000, prolonged droughts have become more common

Climate projections (source: Potsdam Institute for Climate Impact Research)
Temperature • Depending on the scenario, temperature projected to rise by between 1.2 and 3.2 °C by 2080 • 59 more very hot days per year until 2080, heat-related mortality expected to multiply by a factor of five • Higher temperatures and more temperature extremes projected for the north and east of the country • Heatwaves will affect 6.0% of population in 2080 (from 0.6% in 2000) Precipitation • Precipitation trends highly uncertain, depending on model indicating almost no change or annual average precipitation increase of up to 53 mm by 2080 • Wet and dry periods likely to become more extreme • High emissions scenario projects 40 cm sea-level rise by 2080, threatening coastal communities • Due to population growth, per capita water availability will decline by 2080 • Crop land will be increasingly exposed to droughts, yields of millet and sorghum expected to decline, yields of cassava and cow peas projected to benefit from CO_2 fertilisation • Ecosystems, biodiversity and crop production might be impacted by shifting agro-ecological zones

Table 2: Climate projections and historic and current trends

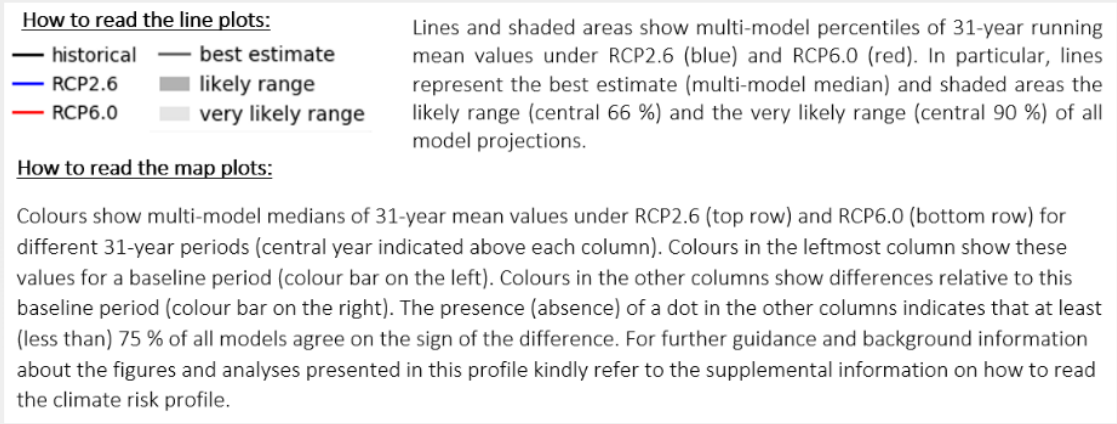
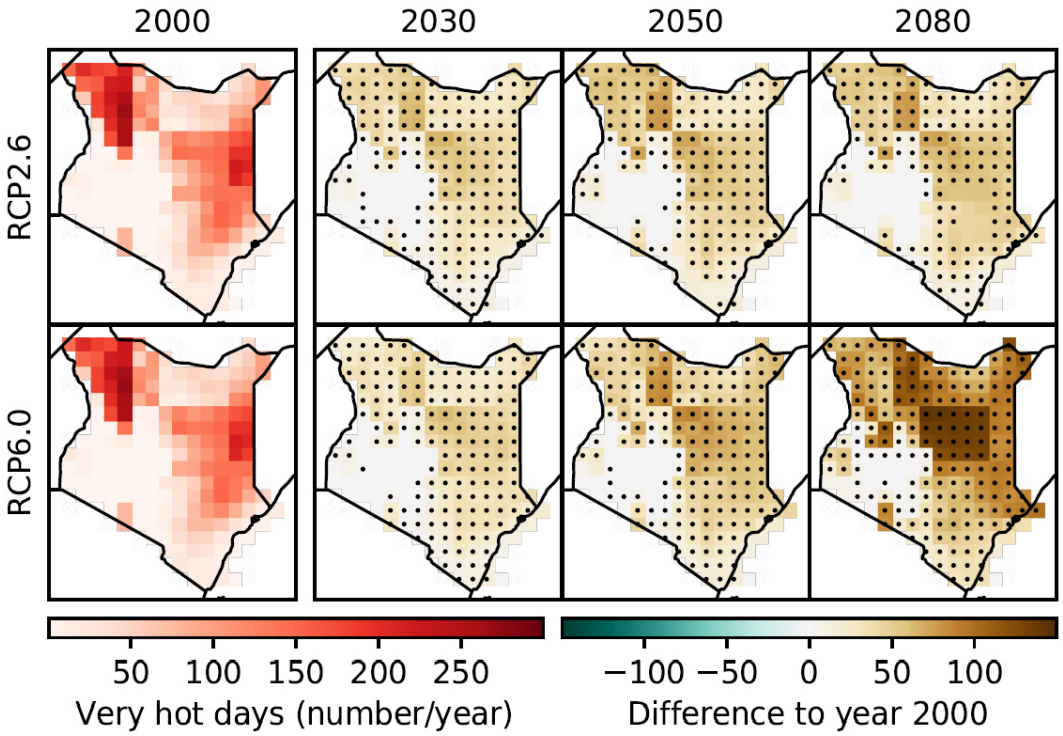


Figure 12: How to read the graphs in this section (Source: PIK 2021)

Temperature

Kenya´s air temperature is projected to increase by 1.2 °C to 3.2 °C by 2080, relative to the year 1876. When looking at pre-industrial levels, low emissions scenarios show a temperature increase of approximately 1.4 °C in 2030 and 1.7 °C in 2080. High emission scenarios show 1.3 °C in 2030 and 2.2 °C in 2080 (PIK 2021).

The annual number of very hot days[2] is projected to rise substantially, notably throughout high aridity ASAL counties in the northwest, including Turkana, Samburu and Marsabit, as well as eastern and central regions, including Wajir, Garissa and Isiolo (Figure 13). High emission scenarios project 25 more very hot days on average per year in 2030 than Kenya experienced in the year 2000. This number increases to 36 more in 2050 and 59 more in 2080. In some parts of the country, notably high (85-100 per cent) and semi-aridity (30-84 per cent) ASAL areas, the average number of very hot days per year increases to approximately 300 days by 2080 (PIK 2021). By mid-century, hot nights are expected on 45 per cent to 75 per cent of nights, increasing more quickly



than very hot days. By end of century, this is expected to increase to 64 per cent to 93 per cent of nights. The country will most likely experience fewer cold days and nights (World Bank 2021).

Figure 13: Projections of the annual number of very hot days for Kenya for different GHG emissions scenarios (Source: PIK 2021). Darker colors suggest higher number of very hot days and different compared to the year 2000.

Precipitation

Future projections of precipitation are less certain than projections of temperature change due to high natural year-to-year variability (PIK 2021). Median model projections indicate a slight increase in levels of precipitation towards the year 2030, but an overall decrease towards the end of the century. Higher emission scenarios predict an overall wetter climate for the country (PIK 2021).

[2] Days with a daily maximum temperature above 35 °C

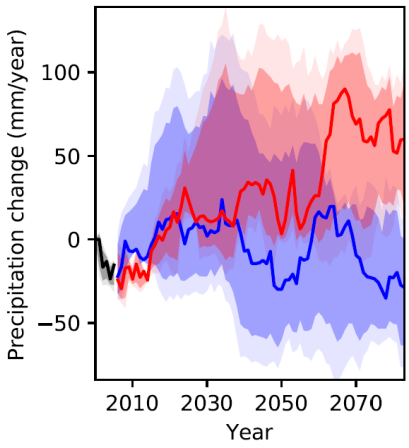


Figure 14: Annual mean precipitation projections for Kenya for different GHG emissions scenarios, relative to the year 2000 (Source: PIK 2021).

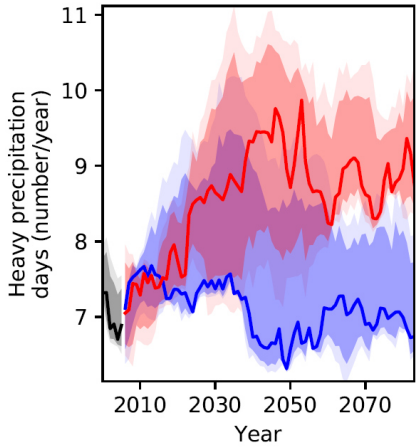


Figure 15: Projections of the number of days with heavy precipitation over Kenya for different GHG emissions scenarios, relative to the year 2000 (Source: PIK 2021).

Due to the increased water vapour holding capacity of a warmer atmosphere, **heavy precipitation events** are projected to become more **intense** in some parts of Kenya. In turn, heavy rain events can overwhelm the local watershed's capacity to absorb excessive water, leading to increased flooding. Simultaneously, models show an **increase in the number of days** with heavy precipitation events (PIK 2021). The likelihood of mudslides and landslides, particularly in mountainous areas, will increase due to intense rainfall and flooding (World Bank 2021).

Sea level rise

Globally, increasing temperatures are contributing to the melting of mountain glaciers and polar ice sheets, as well as to warming water in the oceans, leading to an expansion of water surface area, increasing volume. In turn, sea levels are rising. In areas with high sea-level rise, salt water intrusion likely expands inland and increases salinity levels in agricultural land, rendering it less fertile. Regional variations exist due to natural variability in regional winds and ocean currents with an approximate annual rise around 3mm per year (World Bank 2022). Off the coast of Kenya, sea levels are also projected to rise. Under both stringent and high emissions scenarios, sea levels are expected to rise by 10 cm in 2030, 21 cm in 2050, and 40 cm in 2080 (PIK 2021).

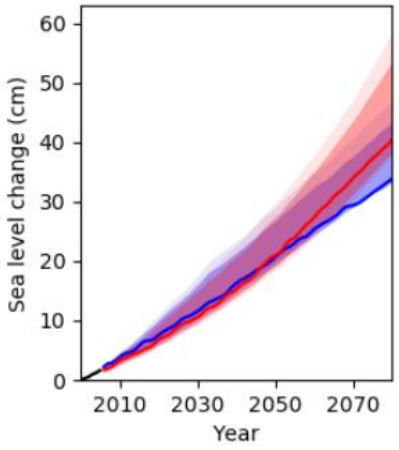


Figure 16: Projections for sea level rise off the coat of Kenya for different HG emissions scenarios, relative to the year 2000 (Source: PIK 2021).

Extreme weather events and natural hazards

Kenya has experienced an increase in the frequency and severity of extreme weather events, particularly droughts, floods, and landslides. Hotspots affected by flooding include Budalangi, Nyando, Homa Bay areas, and Tana River county (Kenya Meteorological Department 2020). Here and elsewhere, floods have been associated with loss of lives, damaged property and infrastructure over vast areas.

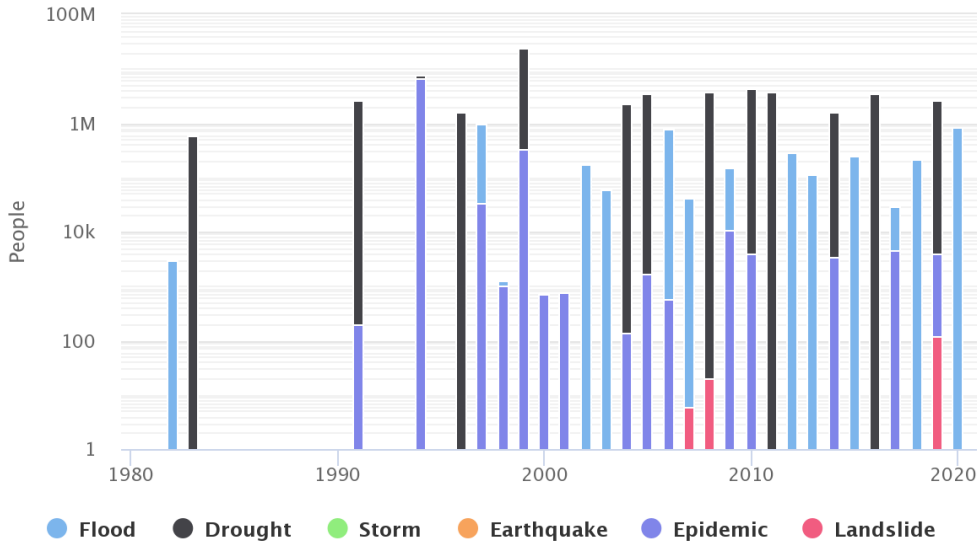


Figure 17: Key natural hazard statistics affecting number of populations for 1980 - 2020 in Kenya (Source: World Bank Climate Change Knowledge Portal)

Conversely, drought is characterized by a lack of precipitation for a protracted period of time, resulting in a water shortage (Kenya Meteorological Department 2020). The high uncertainty of water availability depending on various emissions scenarios leads to uncertainty in drought projections. Some models project a fivefold increase in crop land area exposed to drought, while others project no change (PIK 2021). Hotspots for droughts include counties in eastern, northeastern, coastal areas, **ASAL counties and parts of the Rift Valley (Kenya Meteorological Department 2020)**. A central indicator for drought conditions is **soil moisture**, which depends on precipitation and evapotranspiration, as well as soil parameters and management. Under both emissions scenarios, projections for the country do not show any changes (PIK 2021).

Climate change impacts to key sectors

Climate change is already undermining several key sectors in Kenya, with impacts projected to intensify in the future. The impacts also reflect and exacerbate gender disparities and pre-existing inequalities in the country. Vulnerability due to environmental pressures and climate-related changes has differing impacts depending on other demographic factors such as how gender intersects with ethnicity, race, caste, class, age and disability, as well as marital status. Some of the most vulnerable sectors include agriculture, health, water resources, forests, energy and infrastructure, which are all closely interlinked with livelihood security and food systems.

Sector	Projected impact	Mechanism
Water	Water scarcity	Higher temperatures with more variability in rainfall may lead to drought stress, steady degradation of water resources, higher demands for water, and conflict. Power shortages from decreased hydropower may also impact agricultural production. Biodiversity may also be impacted, given its relieance on water flows and cycling.
	Change in crop yields	More intense rainfall, soil erosion, high temperatures, and droughts could cause loss in yields; changes in average rainfall may increase or decrease yields.
	Increased Competition	Population growth reduces per capita water availability. Increased competition for water between human consumption, agriculture and livestock.
Livelihoods & Agriculture	Flooding	Increased intense rainfall events and possibly higher rainfall levels will increase risk of flooding, causing widespread damage or total loss of crops, loss of property and infrastructure, waterlogged soils, and harvesting delays. Additional risks to food security include displacement as a result of flooding.

	Pastoralism/ Livestock changes	Increased droughts could cause losses in livestock through declining forage and water resources. Increased starvation, disease, and long trekking distances can contribute to declining livestock health resulting in death. Livestock disease outbreaks may also increase.
	Fishers/ Fisheries	High temperatures and changes in water levels can cause reduced spawning or migration of fish populations.
Health	Injury and Mortality	Increased injury and mortality due to an increase in extreme weather events and natural disasters.
	Water borne diseases	Diseases such as diarrhoea and cholera are likely to increase with increased rainfall intensity and flooding, largely affecting areas with poor sanitation. Reduced water per capita can undermine health.
	Malnutrition	Reduced food options from high rainfall variability, high temperatures, and extreme weather and their associated reduced crop yields/ agricultural production might contribute to malnutrition and famine.
	Vector borne diseases	Higher temperatures may result in an extension of vector borne diseases such as malaria.
Energy	Biomass loss	Higher temperatures will increase the risk of forest fires; reduced livelihood options will exert more pressure on forest products.
	Hydro capacity	Lack of water availability can lead to more power shortages due to decreased hydropower.

Infrastructure	Transport	Higher temperatures can cause infrastructure to degrade more quickly, increasing maintenance and replacement costs.
	Human settlements	Extreme weather events will affect human settlements, with especially devastating consequences for informal settlements and production sites, posing a challenge to the country´s economy.
Ecosystems		
	Converting wetlands and riverine systems	Due to extreme weather events, wetlands and riverine systems are at risk of converting to other ecosystems. This poses challenges to plant populations and animals.

Table 3: Overview of impacts of climate change on various sectors in Kenya (Source: PIK 2021; World Bank 2021)

Water

Projections of water resources show high uncertainty under the different emissions scenarios. When looking at models accounting for the expected population growth, per capita water availability is projected to decline by 73 per cent under low emission and by 63 per cent under high emission scenarios by 2080 in comparison to the year 2000 (PIK 2021). Models which do not account for the growth in population show increased availability or no changes, which leads to the conclusion that the decline in water availability per capita is first and foremost driven by population growth rather than climate change.

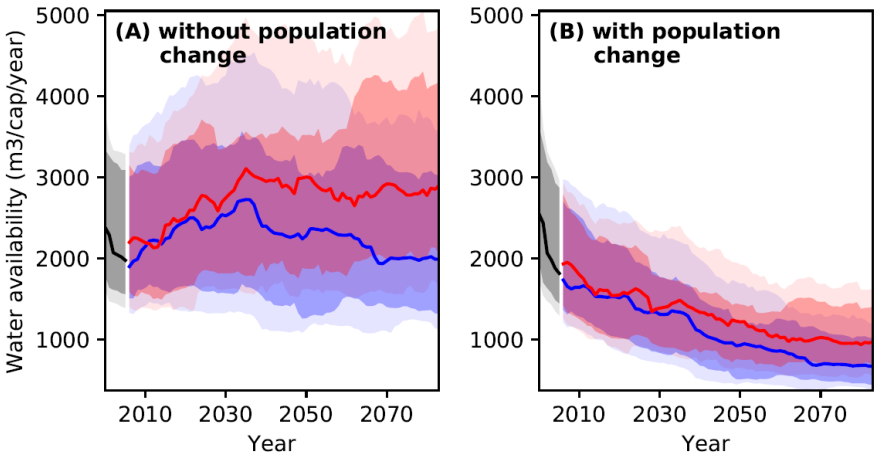


Figure 18: Projections of water availability from precipitation per capita and year with (A) national population held constant at year 2000 level and (B) changing population in line with SSP2 projections for different GHG emissions scenarios, relative to the year (Source: PIK 2021).

Looking at future water availability from precipitation shows varying projections for different regions and emissions scenarios. In western Kenya, water availability is projected to decrease until 2080 by up to 25 per cent under low emission scenarios. This marginal decrease in precipitation will have adverse implications on the productive capacity of rainfed agriculture. Water shortage and droughts are largely pronounced in rural areas and in the ASALs, where ongoing droughts are the result of five consecutive below-average rainy seasons, and have consequently put an estimated 4.2 million people in urgent need of humanitarian assistance (IPS 2022). Pastoral and agro-pastoral communities are most impacted by this, as water scarcity leads to a loss of arable land and deterioration in livestock body conditions (IPC 2022). Further, water scarcity puts a particular strain on women and children who face the task of searching for water, particularly for domestic use (Mulwa et al. 2021). In the ASALs for example, drought has heightened the risk of sexual exploitation and gender-based violence, while more than 54,000 children in 17 drought-affected counties in Kenya risk dropping out of school, unless measures are put in place to provide them with sufficient food and water (ASAL Humanitarian Network 2022).

Conversely, in southern Kenya, water availability from precipitation is projected to increase by up to 25 per cent, and by up to 80 per cent in eastern Kenya (PIK 2021). In areas of southern Kenya, such as Kitui or Tana River, or eastern areas, such as Bungoma, Kakamega or Nandi (see Figure 17), increased rainfall may expand agricultural production and improve yields, or may conversely increase flooding and inundation, where the landscape is unable to absorb the increase in moisture.

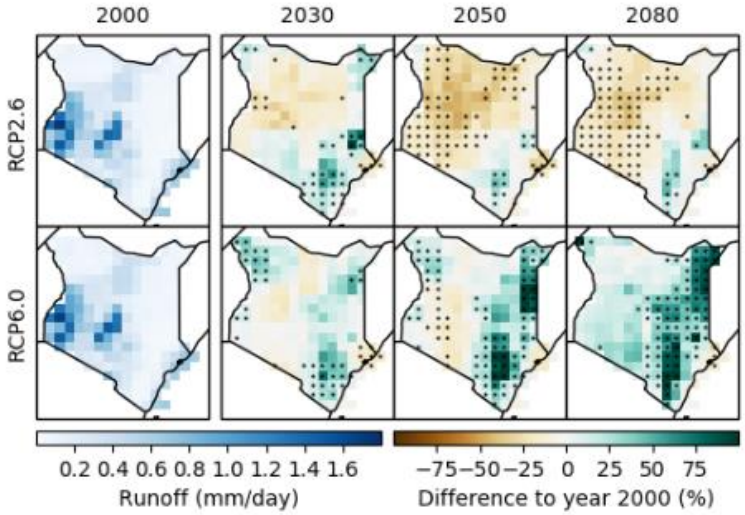


Figure 19: Water availability from precipitation (runoff) projections for Kenya for different GHG emissions scenarios. (Source: PIK 2021).

While models predict a wetter future due to climate change, recent experience shows frequent droughts that are attributed to failed rains. Major drought events are experienced every ten years. In practice, the observed decline in Eastern African Long Rains is characterised by a shortening of the rainy season with later onset and earlier cessation, rather than by a decrease in the peak daily rainfall (Wainwright et al. 2019). Further climate variability and the continuous degradation of water resources will continue to limit water availability and increase unpredictability.

Already, investments in the water sector, specifically in the poorest ASAL counties, are not sufficient with regard to the fundamental right to water, enshrined in the

Constitution of Kenya 2010 (NDMA 2021b). This can lead to increased competition between users and between uses for water, including between agriculture, hygiene, hydropower, etc. As hydropower provides over 65 per cent of Kenya's electricity, this may result in production and income losses in various sectors, inducing other negative socio-economic impacts (PIK 2021).

Livelihoods

Agriculture

The agricultural sector provides a basis for the development of an economy around logistics, construction, non-profit, education and digital services, as well as value added food transformation to modify or enhance foods for higher market values. Despite the centrality of agriculture for the Kenyan economy, smallholder farmers lack access to inputs, technology, finances and markets. To date, the use of irrigation facilities remains low, with only .037 per cent of total agricultural land irrigated as of 2009. Poor extension services and management, as well as lack of finance, credit or technical equipment constrains expansion of agricultural land under irrigation (PIK 2021). Further, given the importance of agriculture in rural areas of Kenya where poverty is prevalent, the sector's importance in poverty alleviation cannot be overstated (FAO 2022a).

This lack of access, combined with pests and extreme weather events, has made smallholder farmers particularly vulnerable, and exacerbated overall food insecurity in the country (Greenpeace Africa 2022).

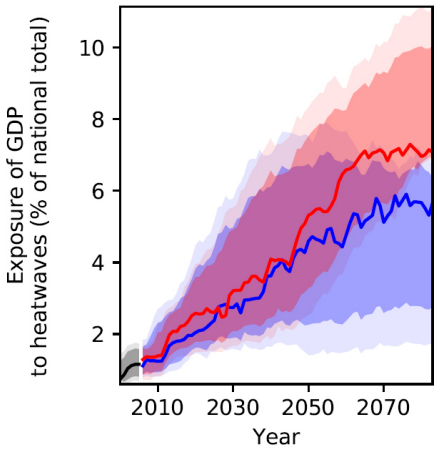


Figure 20: Exposure of GDP in Kenya to heatwaves for different GHG emissions scenarios (Source: PIK 2021)

Crop Production

Climate-induced changes in weather patterns are likely to result in short-term crop failures and long-term production declines for rain-fed agriculture (Government of Kenya 2013b). Rain-fed agriculture is the foundation of livelihoods for the largest share of the rural poor and a central source of food production in Kenya. Declining agricultural productivity, loss of crops and damage to infrastructure are among the top increasingly adverse impacts of climate change projected for Africa (IPCC 2022). Risk to food security, risk of malnutrition and micronutrient deficiency, and loss of livelihood due to reduced food production from crops, livestock and fisheries is also projected with medium certainty (IPCC 2022). Further, changing temperature and precipitation

patterns may lead to changes in livelihood zones, threatening long-held patterns of use and social cohesion (Government of Kenya 2017a).

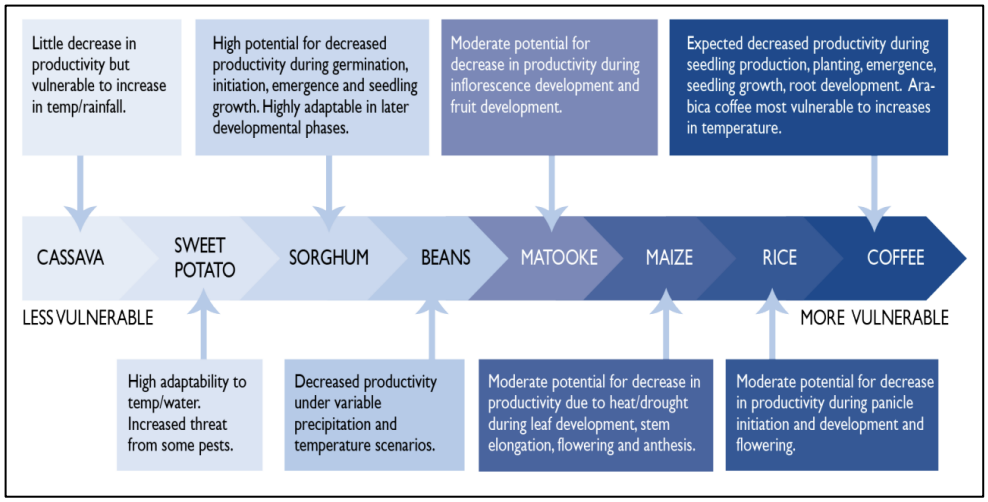


Figure 21: Phenological climate Change Vulnerability Continuum of Selected Crops (Source: Caffrey et al., 2013)

Figure 21 provides an overview of crop sensitivity to climate change for some of the main crops grown in East Africa. It is important to highlight that regional climate variability within Kenya will likely benefit crop yields in some areas, while negatively impacting them in others.

Crops such as maize, rice and coffee are all highly vulnerable to decreased productivity as a result of heat and weather extremes. It is worth noting that while maize is the most important staple food in Kenya and a key material in animal feed, the country is already underproducing maize and therefore heavily relies on trade to meet demand. Millet and sorghum, cereals for human consumption grown in western, northern Rift Valley, eastern and central parts of Central Kenya, will both be negatively impacted by climate change. In comparison to the year 2000, a decline of 5 per cent under low emission and 1 per cent under high emission scenarios is projected by 2050.

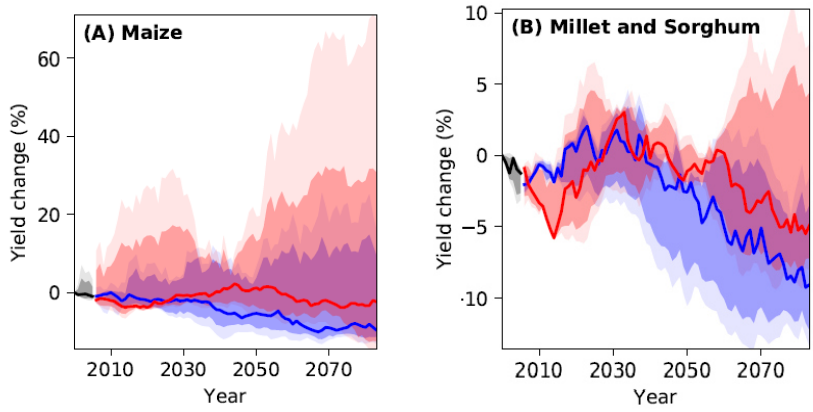


Figure 22: Projections of crop yield changes for Maize, Millet an Sorghum in Kenya for different GHG emissions scenarios assuming constant land use and agricultural management, relative to the year 2000 (Source: PIK 2021)

Conversely, crops like sweet potatoes, cassava, and pulses such as beans, are less vulnerable, and under certain conditions could increase in yields. Yields of cassava in particular are projected to gain from climate change, with a 25 per cent increase under high emissions scenarios (PIK 2021).

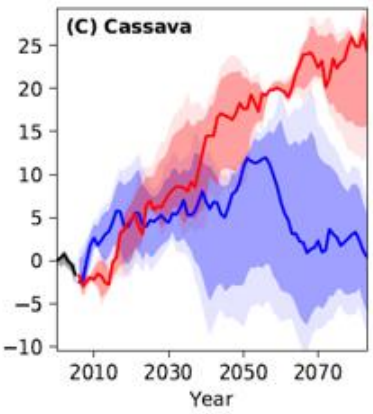


Figure 23: Projections of crop yield changes for Cassava in Kenya for different GHG emissions scenarios assuming constant land use and agricultural management, relative to the year 2000 (Source: PIK 2021)

When looking at different crop varieties, the difference between the emissions scenarios can be explained by non-temperature related parameters, like precipitation changes, and the CO_2 fertilisation effect under higher emissions pathways, which benefits plant growth. Adaptation strategies such as switching to high-yielding improved varieties is critical and must be weighed against negative knock-on effects such as agro-biodiversity loss (PIK 2021). Although varietal factors, including institutional, socioeconomic and environmental dimensions, influence smallholder farmers' perceptions of climate change and related adaptation strategies (Mairura et al. 2021), smallholder farmers in Kenya are increasingly seen to adopt single or multiple agricultural practices, such as climate-smart agricultural practices (CSAPs), to cope with the impacts of climate change (Musafiri et al. 2022). For example, studies show that in the central highlands and western parts of Kenya, some smallholder farmers have begun to adopt CSAPs such as crop diversification, crop-livestock integration, soil water conservation, and agroforestry in order to improve food security and community wellbeing in the context of climatic shocks (Ibid.; Bryan et al. 2013; Kanyenji et al. 2020; Reppin et al. 2020).

Disease and pests

Desert locust outbreaks in East Africa, and Kenya in particular, threaten livelihoods, food security, environment and economic development. 2020 and 2021 saw desert locust invasions of a magnitude not seen in over 70 years. Locust swarms are especially dangerous as they can move long distances rapidly, destroying crops and plants in their path, causing severe impacts including food shortages. Inter-communal conflicts in Kenya among the Marehan and the Murulle as well as the Garre and the Murule were also linked to desert locust invasion that exacerbated scarcity of resources by destroying pastures (IGAD 2021). Evidence suggests that a hotter climate will lead to more damaging locust swarms, leaving Africa disproportionately affected (UNEP 2020).

Pastoralism/ Livestock

Increasing inter-seasonal climate variability, decreasing precipitation windows and volume, and more frequent extreme weather events have resulted in frequent floods and droughts. Droughts have already led to severe livestock losses, while excessive rainfall has resulted in increased incidence of livestock diseases including Rift Valley Fever (RVF) (Government of Kenya 2017a). This impacts predominantly pastoralists,

who risk losing their livestock when forage availability is reduced due to drought. Kenyan food systems are also highly impacted by animal disease, notably RVF, and highly pathogenic avian influenza (HPAI). Indeed, RVF outbreaks have severely disrupted the Kenyan meat trade, both by causing high mortality of livestock and threatening human health as well as from export bans to other countries. Climate change is likely to increase the frequency of RVF epidemics.

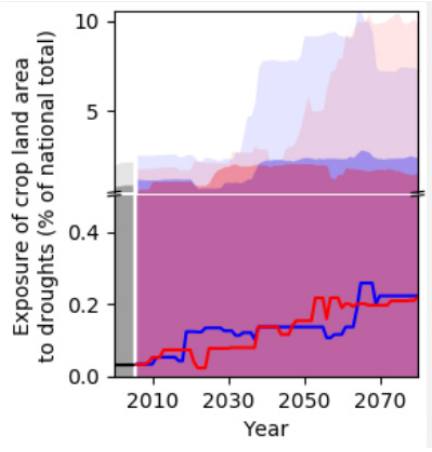


Figure 24: Projections of crop land area exposed to drought at least once a year for Kenya for different GHG emissions scenarios (Source: PIK 2021)

In agro-pastoral zones, declining water and forage availability is likely to reduce livestock productivity, which in turn will likely lead to a decline in access to food and income (IPC 2022). Vulnerabilities for girls from pastoral or farmer communities impacted by drought and climate change are particularly acute, as men tend to marry off their daughters when losing livestock in order to relieve economic pressure (Plan International 2022).

Fishers/ Fisheries

The fisheries sub-sector provides food, employment and income to a large number of Kenyans and earns the country Ksh 5 billion (USD $42 million) annually from foreign exchange (Government of Kenya 2017b). Both sea level rise and increasing temperature will negatively affect coastal ecosystems and fish stocks. Risks to marine ecosystem health and to livelihoods in coastal communities is projected with medium certainty (IPCC 2022). High emission scenarios project a sea level rise of 10 cm in 2030 and 40 cm in 2080. Sea level rise can expand salt water inland and salt water intrusions can contaminate freshwater aquifers, many of which sustain municipal and agricultural water supplies and natural ecosystems (World Bank 2021). Further, coastal areas including Mombasa, Malindi, Kwale and Lamu are highly dependent on fishing and tourism and could see inundation limiting the viability of the future tourism industry.

Human Health

The health and sanitation sectors are under increasing pressure from direct and indirect climate change impacts, including due to more frequent incidences of floods, heatwaves, droughts and storms. Increased human mortality and morbidity due to infectious diseases, including vector-borne and diarrhoeal diseases, is projected with medium certainty (IPCC 2022). Inadequate access to water, sanitation and hygiene can undermine health outcomes, and already diarrhoea alone is responsible for 10 per cent of under-5 mortality in Kenya (USAID 2017). Furthermore, heat-related mortality and associated diseases are expected to increase. Under high emissions scenarios, the population affected by heatwaves will increase from 0.6 per cent in 2000 to 6.0 per cent in 2080. Heat-related mortality will increase fivefold in this time period, from 1.4 deaths

per 100,000 in 2000 to 6.8 deaths per 100,000 people per year in 2080 (PIK 2021). The World Health Organisation estimates 70 per cent of the Kenyan population to be at risk of contracting malaria, as climate change is likely to stretch the transmission period and expand the geographic range of vector borne diseases.

In general, the relationship between health and climate is impacted by several other types of vulnerability, for example the physiology and behaviour of individuals, social and gender norms, environmental and socio-economic conditions of populations, and coverage and effectiveness of health programmes (WHO 2012). For example, declining access to food and water in the context of increased climate-related disasters can undermine women's ability to become economically independent and maintain health and wellbeing for themselves and their families (Eastin 2018).

Studies have also identified a strong link between child stunting and levels of precipitation. Higher temperatures and changing rainfall patterns are projected to reduce crop yield, decreasing the amount of available food as well as potentially altering some food's nutritional content (Schmidt 2019). Model results under various emissions scenarios estimate that while stunting rates would rise in aggregate as climate change progresses, the increases would impact the rural poor hardest. Stunting among children under five years decreased over the last years, but is still more acute in rural areas and among boys (WFP 2018). In the Global Hunger Index of 2021, Kenya ranks 87th out of 116 countries with a score of 23.0, signalling a serious level of hunger. Over the past twenty years, the overall score has been decreasing but stayed rather steady between 2012 and 2021 (Concern Worldwide and Welthungerhilfe 2021).

Migration

Internal migration, including specifically rural-to-urban migration, is expected to increase. As climate change alters the conditions of land, coastal areas or availability of natural resources, households migrate in search of secure livelihoods or food sources. By 2050, 29-86 million in Sub-Saharan Africa are expected to be displaced within the continent as a result of the climate crisis (Clement et al. 2021). The majority of climate related migration is internal, though this displacement still carries a high level of risk, including food insecurity and risk of Sexual and Gender Based Violence (SGVB). Rapid urbanisation is placing tremendous pressure on longer food supply chains and insfrastructure to deliver safe and nutritious food sustainably to congested metropolis areas. Additionally, high levels of poverty and inequality in urban areas prevent the most vulnerable from accessing safe and nutritious foods in adequate quantities. Rapid rates of urbanisation have also resulted in more work-away and eat-away from home habits, with direct impact on the demand for easy-to-prepare, processed or convenient foods, whcih are often high in fat, sugar and or salt (FAO et al. 2021).

Displaced women are particularly vulnerable given socio-cultural norms which can prohibit their inclusion in decisions around household resource use, or access to education. At progressive levels of warming, involuntary migration from regions with high exposure and low adaptive capacity is expected to occur with medium confidence (IPCC 2022).

Infrastructure

The built environment, public facilities and infrastructure critical to social and economic systems are under increasing pressure to meet needs in a changing climate. Extreme weather events, such as floods and droughts, will negatively impact Kenya´s infrastructure. Critical infrastructure that supports the national economy, such as roads, bridges, water pipelines and power lines are prone to flood damage (Government of Kenya 2015). This is especially true for coastal areas with low altitudes where damage to ship docking ports and coastal industries can affect activity inland. Kenya's existing infrastructure is poor, often with impassable roads, poor telecommunication lines, and inaccessible regions that hamper the transportation of food either for commercial purposes or relief aid, conditions which are expected to deteriorate. Higher temperatures can cause infrastructure to degrade more quickly, increasing maintenance and replacement costs. Extreme weather events will also affect human settlements, with especially devastating consequences for informal settlements.

The effects of urbanisation and climate change are also converging to undermine safe and secure housing. Many homes and critical infrastructure in Kenya, in urban and marginal lands especially, are not resilient to the impacts of climate change. Further, poor urban planning has resulted in residential and commercial development in floodplains that restricts water flow and increases the likelihood of flooding, which when combined with increasing precipitation and extreme weather events, heightens vulnerability (UN HABITAT 2011). In urban areas, particularly informal settlements, 29 per cent of the population is considered food poor (FAO 2022b); the urban poor largely purchase food from street vendors in informal markets, where 40 per cent of the food is wasted because of poor infrastructure (HealthyFoodAfrica 2020).

Ecosystems

The ecology and distribution of ecosystems will be significantly influenced by climate change. Due to increased frequency and intensity of extreme weather events, wetlands and riverine systems are at risk of converting to other ecosystems. This poses challenges to plant populations' diversity, which are slowly being overrun by more dominant species, and animals losing their natural habitat. Temperature increase and more droughts might also negatively affect forest systems, while in parallel increasing the risk of invasive species. All these elements are connected and affect the ecosystems of Kenya, with implications for food security (PIK 2021). The Normalized Difference Vegetation Index (NDVI), which analyses results from one year to previous years to determine the amount of vegetation cover on a given area, was lower than normal for the period of October 2021 to February 2022 (Figure 25), suggesting that crops are suffering from drought, insect infestation, or other problem, leading to lower than normal agricultural production.

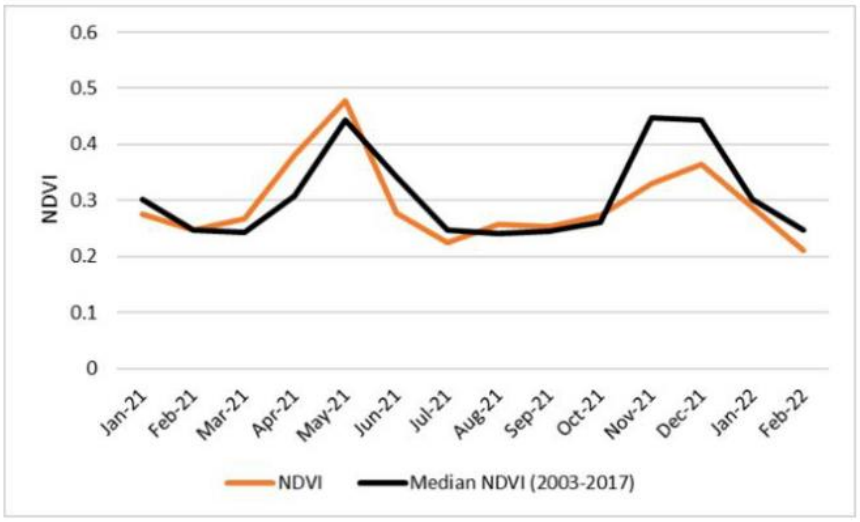


Figure 25: Normalized Difference Vegetation Index (NDVI) January 1 2021 – February 11, 2022 (Source: FEWS NET/USGS)

Biodiversity loss also impacts ecosystem degradation, along with deforestation, land degradation and forest fires. Low agricultural production and high population growth might lead to continuous agricultural expansion, impacting animal and plant biodiversity. Moreover, human activities, such as land use, have already had a significant impact on losses of biodiversity around the globe in the past, and are expected to remain a major driver in future (PIK 2021).

Climate security pathways

Conflict history and security situation

Conflict is a major driver of instability in the Kenyan food system. Kenya is increasingly affected by farmer-herder conflict, as climate change disrupts forage and water resources, depleting pastures and leading herders to move their livestock over vast distances, occasioning conflict with local communities. Other instances of conflict affecting the food system range from banditry and cattle rustling to inter-group conflict, terrorism and political aggravation. These increase food insecurity by causing displacement and impoverishment, as well as restricting livelihoods.

The examples are widespread throughout the country. In the past 10 years (2013-2022), Kenya has seen numerous security incidents, with the highest concentration of violence also taking place in the most populous areas of the county, i.e. the central region, the former Rift Valley, the capital region and the coastal areas. However, some of the most densely populated regions such as the Nyanza and Western Provinces have seen relatively few occurrences of battles, i.e. violent clashes between at least two adversary groups, including both state- and non-state actors. When overlaying security incidents with livelihood zones, battles and cases of violence against civilians appear to concentrate in agropastoral, agriculture and pastoral zones (see Figure 24).

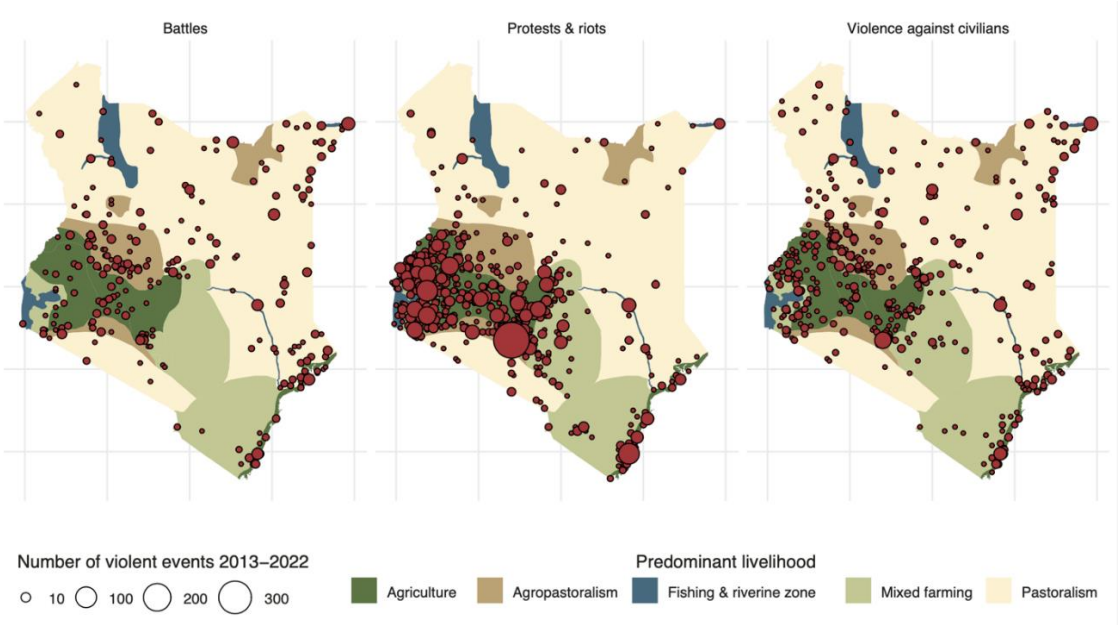


Figure 26: Number of violent events (2013-2022) per livelihood zone (Source: ACLED, FEWSNET)

While conflicts relating to livestock raiding are not a new phenomenon in many pastoral societies, in recent years, raiding has become more frequent, more violent and more destructive (Schiling et al. 2012).

The regions most affected by climate change are also the most susceptible to violent conflict because of an over-dependence on rain reliant economic activities, the high demand for already scarce arable land, and limited ability to adapt to climate impacts (Saddam 2022). For instance, communal groups in northwestern Kenya's Karamoja

Cluster, such as the Turkana, Pokot and Samburu, traditionally compete for access to water and land, which are essential in a livestock rearing economy. As pastoralist violence is closely linked to erratic local weather conditions, prolonged droughts in the Karamoja Cluster frequently force herders to relocate into areas inhabited by other farming or herding communities, thus provoking conflicts as different groups simultaneously access the same resources (adelphi 2022).

The threat of terrorism also impacts food security. The presence of a large number of Somali migrants poses a pressing political and social challenge. However, unless response measures such as detentions and deportations are handled with increased sensitively, there is likely to be further backlash. For example, mass detentions of Somalis threaten to create a greater constituency for al-Shabaab, uniting grievances that are specific to the Somali community with those of the wider Muslim population. This includes the largely Muslim coastal counties, whose social indicators are among the worst in Kenya (ICG 2014). Counterterrorism operations can also have an adverse effect on food security by restricting economic activities, for example in Lamu County where operations restricted farmers' access to the market, causing lower trade volumes.

The increasing scarcity of resources has also led to human-wildlife conflict, such as in the Kanjoo and Kinanduba counties, where herds of elephants destroyed 100 hectares of maize. Incidents are also increasing around wildlife protected areas such as the Amboseli National Park, where elephants invade farms and destroy crops, and compete with livestock for pasture. Other instances of human-wildlife conflict of sorts have been characterized by the proliferation of invasive plant species such as *prosopis juliflora* and *acacia reficiens*, which restrict the access to quality pasture, as well as the infestation of tsetse fly, notably in Garissa and Isiolo Counties (Government of Kenya 2022).

In Kenya's already fragile context, politically sensitive moments such as elections or political transitions can also negatively impact food security. For example, food insecurity was compounded by the post-election violence of 2007-2008, which starkly affected purchasing power, leading households to employ negative coping strategies such as eating less, or salvaging for discarded and expired foods. In Nairobi, and in other major cities of the country, the food market is fraught with conflict, notably for informal street vendors. As official markets do not have the capacity to host them, the traders operate in the streets, notably close to the central business district, which leads to significant conflict with the authorities, as they are often fined, arrested, assaulted or killed by police (Hungry Cities 2017).

Climate-related security risks to food systems and livelihoods

Food systems in Kenya do not benefit everyone equally, evidenced by existing over- and underconsumption. Kenya faces a double nutrition burden, with a high prevalence of undernutrition, particularly stunting early in life, as well as high levels of obesity in adulthood, notably among women (Kimani et al. 2015). Several overlaying challenges come together to affect food systems, peace and stability, namely: accelerating population growth, manifold impacts of climate change, stagnating agricultural

production, gender inequalities, ethnic marginalisation and underperforming food systems.

In Kenya, both men and women participate in food systems, but the nature and extent of their involvement is contingent on economic structures and gender norms (Quisumbing et al. 2021). While women play a vital role in traditional food markets and other off-farm jobs such as marketing, processing and other services (Snel et al. 2021), they are a minority in other activities such as farming and brokering. Their contributions tend to be undervalued or limited due to societal norms or gender-specific barriers (Quisumbing et al. 2021). Despite providing 42-65 per cent of the agricultural workforce (Diiro et al. 2018), female farmers traditionally have less access and control of assets, capital, training and opportunities than men, seldom own land, and thus earn notably less (Food Systems Summit Dialogues 2021). Women also tend to be concentrated in the low value capture nodes of agricultural value chains as compared to men. Socio-economic impacts of the COVID 19 pandemic further exacerbated the situation, impacting urban areas and poor households hardest (WFP 2021a).

This section identifies four interrelated climate security pathways that affect food systems, livelihood security and conflict in Kenya (see Figure 27). It is important to note that the impact of climate on peace and security is highly complex, with multiple moving parts influencing each other. Linkages between climate and insecurity rarely are direct, but most of the time represent indirect, intermediate factors and context-specific linkages (Liebig et al. 2022).

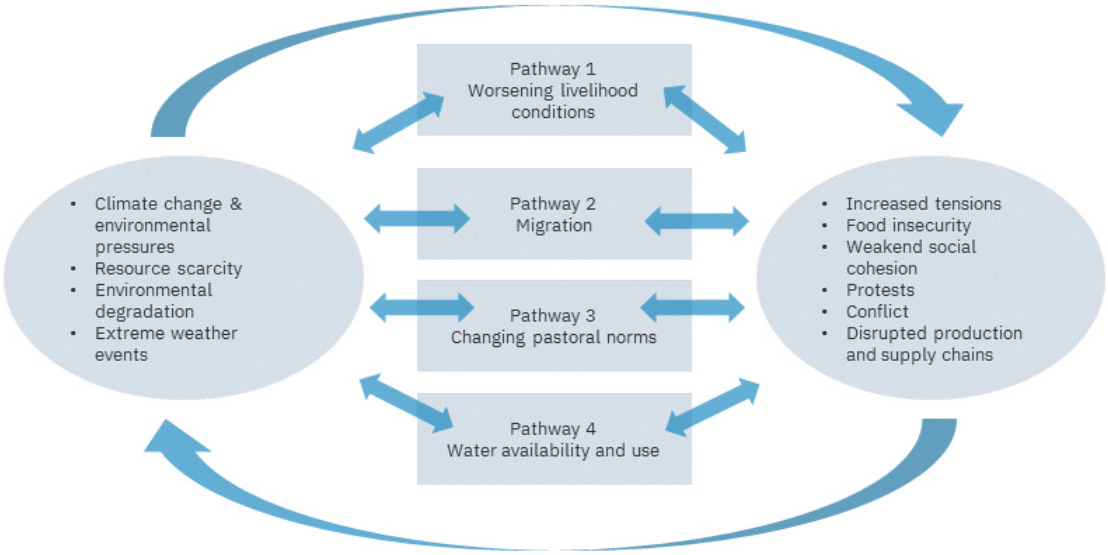


Figure 27: Climate insecurity pathways (Source: adelphi, Weathering Risk)

Pathway 1: Climate and environmental pressures worsen livelihood conditions, aggravate scarcity and increase competition over natural resources, heightening the risk for livelihood deterioration, food insecurity and violent conflict.

Farming and herding communities depend on regular rain patterns for pasture rejuvenation and crop culture. While less significant to the national formal economy, pastoralism is another important source of income in Kenya, with livestock often the

main asset of the country's pastoral tribes such as the Turkana, Maasai, Pokot and Samburu peoples. Fishing and aquaculture are another major livelihood source for Kenya's riverine, lake and coastal communities.

Different livelihood groups are impacted in distinct ways by climate-related security risks to food systems:

- **Farmers:** Declines in agricultural productivity and loss of crops due to climate change predominantly affect food security among Kenyan smallholder and small-scale subsistence farmers who are highly dependent on climate-sensitive resources.
- **Agro-pastoralists**: Reduced water availability and increased temperatures are likely to deteriorate soil quality, while heat stress and drought will negatively affect livestock productivity, negatively impacting agro-pastoral livelihoods.
- **Pastoralists:** In ASALs, pastoralists face the double burden of livestock death due to a lack of water and feed, as well as increases in insecurity and conflict (Government of Kenya 2018). Droughts lead to severe livestock losses, while excessive rainfall can result in increased incidence of livestock diseases including Rift Valley Fever.
- **Fishers**: Both sea level rise and increasing temperature will negatively affect coastal ecosystems and fish stocks as well as inland fish stocks. Risks to marine ecosystem health and to livelihoods in coastal communities is projected with medium certainty.

In the ASAL region, climate-induced decreases in rainfall have already had a negative impact on crop production and led to a decline in arable pasture land for livestock. Across pastoral counties, 80-90 per cent of all livestock species were seen to migrate to dry season grazing areas. The high concentration of livestock in these regions is likely to further heighten conflict and insecurity among pastoralists, while simultaneously exerting additional pressure on already stretched rangeland resources (IPC 2022).

In Turkana Country for example, herding and fishing are two critical livelihoods. Less water and grazing land degrade livestock health and therefore milk production, a central component of the Turkana diet. Degrading health also increases susceptibility to diseases. In the region, conflict over scarce grazing land and water resources among pastoralists has increased, leading to additional loss of livestock due to raids (Human Rights Watch 2015). The reduction in pasture, water and livestock has made raiding the only survival alternative other than relying on food aid (Schilling, Opiyo and Juergen 2012). Climate-induced conflict in Turkana has impacted both men and women. However, due to the loss of cattle and other livestock, male pastoralists and heads of households frequently move in search for alternative livelihoods, leaving women in positions of vulnerability. Not only do they face poor customary rights in accessing resources, but women are frequently left with the double burden of ensuring family survival through diversified income generation, as well as domestic work (Omolo 2010).

Climate change is therefore reducing the viability and diversity of livelihoods and decreasing resilience, leading to adverse livelihood strategies.[3] When missing income or food, many, particularly women and girls, have been forced to adopt coping strategies such as turning to survival sex or early marriage (Oxfam 2017).[4] These dynamics can erode social cohesion and increase tensions and conflicts at all levels of society, from within families to between different ethno-linguistic groups. Within families, diminished incomes reflect negatively on men and younger generations, and can lead to intergenerational conflict and ruptured social roles. Conflict and distress from work has been carried into families, where domestic violence can also increase. Reduced social cohesion can also facilitate new grievances and conflicts, while the economic impacts of climate change increase relative losses for individuals and families, and reduce their opportunities to prepare for and respond to conflict.

Pathway 2: Deteriorating livelihood conditions change mobility patterns and livestock migration, contributing to rural and urban stress and food insecurity.

In pastoral areas, declining forage and water resources have kept livestock in dry season grazing areas and continuing to migrate further afield in search of pasture and water. The resulting shift in transhumance pathways, an essential livelihood strategy underpinning pastoral economies, is resulting in conflict among communities over rangeland and other resources. Ill-conceived local grazing policies have also contributed to an escalation of conflict. For example, Isiolo County's Range Management policy protects dry season grazing zones from being accessed during wet season. This has led to border conflicts as herders from Garissa and Wajir attempt to settle longer on the protected areas driven by prolonged drought, reflective of a broader trend of pastoralists moving to dry-zones earlier and settling there longer. Long trekking distance, starvation and disease are also contributing to declining livestock health and resulting in large scale livestock death.

The loss of livestock, below-average milk production, and declining goat-to-maize terms-of-trade across the northern and eastern pastoral areas are resulting in households facing Crisis (IPC Phase 3) and Emergency (IPC Phase 4) food insecurity outcomes. Fifteen of Kenya's 23 ASAL counties are facing Crisis (IPC 3) levels of acute food insecurity as of September 2022. Analysis projects that food insecurity will increase across all 23 ASAL counties between October and December 2022 and warn that four counties—Isiolo, Mandera, Marsabit, and Turkana—may shift from Crisis to Emergency (IPC 4) classifications as households gradually deplete their food stocks (USAID 2022). This highlights the urgent need for timely, coordinated assistance to address food insecurity and malnutrition, as well as the importance of building resilience to future climatic shocks in the ASAL counties (IPC 2022).

[3] Adverse livelihood strategies are activities that, while ensuring income or sustenance, are potentially harmful to individuals and/or communities, leaving them exposed to risk of violence, persecution and other threats. This included illicit activities, for example the farming of illegal crops.

[4] Survival sex refers to sex (work) to receive necessary food, income or other basic provisions.

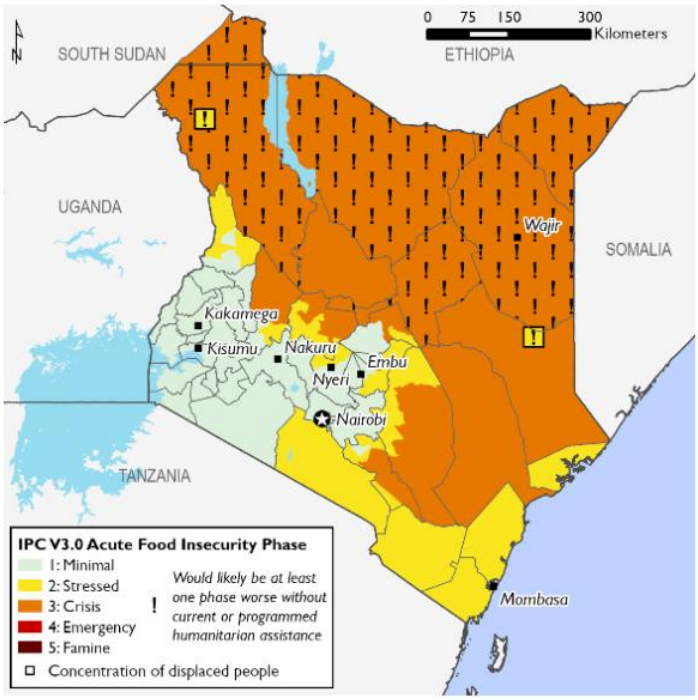


Figure 28: Projected food security outcomes, June-September 2022 (Source: FEWS NET)

Changing migration patterns include a strong gender dimension. Traditionally, men are responsible for livestock and therefore especially challenged by decreasing livestock rates, moving to new rural settlements or urban centres in search of resources or wage employment. This means that women and children are left behind and need to cope with the additional burden of sustaining household food, water and human security. In response, school attendance rates decrease, child labour increase and conflicts over scarce natural resources intensifies (Kibugi and Lanyasunya 2017).

Whilst there is a strong urban bias in government priorities, especially under Vision 2030, the urban poor and those in informal settlements such as Kibera or around Naivasha are still often underserved by these provisions, for example with regards to access to livelihoods, markets and safe and nutritious food. Where the social contract is already strained and in the absence of adequate social safety nets, any additional stress caused by climate change and climate-related mobility compounds these challenges and could heighten pre-existing grievances around governance deficits (Kibugi and Lanyasunya 2017).

Pathway 3: Changing pastoral norms challenge dispute resolution mechanisms and social cohesion, aggravating existing grievances and increasing tensions.

Pastoralism in ASAL counties in Kenya is primarily nomadic transhumance, characterised by risk-spreading and flexible mechanisms, such as mobility, communal land ownership, large and diverse herd sizes, and herd separation and splitting (Opiyo et al. 2011). Traditionally, pastoralists rustled cattle as a method to increase herds or pay dowry. Evidence shows this practise is increasingly becoming militarised and commercialised under the influence of local elites. In Laikipia county in the former Rift Valley province, for example, violent clashes occur mostly among rival herder communities or between herders and farmers, as well as herders and ranchers. While

the roots of cattle-related conflict are multifaceted, climate impacts such as extended periods of drought put immense pressures on livelihoods and consequently exacerbate existing tensions (Crisis Group 2022).

Necessary shifts in grazing routes and land use, in part due to climate change, have produced new disputes between pastoralist communities and between pastoralists and sedentary farmers. Competition and scarcity of resources in the form of water, pasture, land resources and livestock assets play a key role in the conflicts. These disputes are often left unresolved by traditional conflict resolution mechanisms as different occupational and ethnic groups within communities are also at odds. These tensions are often compounded by conflict with people who are displaced within ASAL counties, who are blamed for the erosion of resources by host communities (Kibugi and Lanyasunya 2017).

Further, the perception that pastoralists are marginalised by government policies diminishes cohesion and negatively influences conflict dynamics. Political marginalisation of Turkana and Pokot regions has led to lack of basic services such as education, infrastructure and health care.
For example, the operationalisation of country peace structures including local community peace and resource sharing committees, designed for resolving conflicts in hotspot ASAL counties remains a challenge, undermining community resilience to these escalating tensions (Njoka 2021).

Compounding this, the trade-offs between national and local development priorities pertaining to pastoralism, such as the perceived prioritisation of water use for export-focused agriculture or horticulture at the expense of pastoralism has significantly undermined pastoral livelihoods (Schilling, Opiyo and Juergen 2012; Schilling et al. 2015). Due to the increasingly prevalent political view that pastoralism is unsustainable, and that due to climate change, there is insufficient land and water available for grazing vast herds, national policies propose adapting pastoral norms towards smaller, more sedentary herd sizes which are seen to favour farming.

Changing pastoral norms also imply that previously highly mobile communities now settle with homesteads and are less mobile. This provides benefits like access to services, but also challenges, such as natural resource degradation and reduced economic potential. One example of this are the Turkana people living in northern Kenya. Previously leading a largely nomadic life, part of the population along the riverine now grow crops and only some members of the family or hired herdsmen migrate with livestock to search for water and pasture (Kibugi and Lanyasunya 2017). This can increase conflict and decrease access to the dry season grazing areas for pastoralists (Opiyo et el. 2014)

Without adequate alternative livelihood and food security options for pastoralists, these shifts bring an increased risk of grievance by pastoralists towards national and local government. Alternative crop farming is not suitable for pastoralists in semi-arid lands where extreme climatic conditions makes farming untenable.

Pathway 4: Changes in water availability and use cause displacement, disrupt food systems and increase insecurity

Climate change impacts in Kenya, including extreme weather events, recurrent droughts, higher variability and more uncertain rainfall lead to increasingly unpredictable water availability. Current climate variability and increasingly erratic rain patterns are influencing water availability in Kenya, which in turn is causing displacement, a disruption in food systems and increased insecurity. More frequent droughts in other parts of Kenya are leading to water and energy shortages. This, in turn, heightens conflicts over pasture and water resources, as occurred among the Samburu, Turkana, Borana and Somali groups during the 2009 droughts, during which thousands were displaced and experienced extensive livestock loss (USAID 2019).

Labour in-migration (as explored in pathway 2) from communities facing these increasing stresses is leading to increasingly unsustainable population growth in both rural areas perceived to have more resources, and urban areas. Accompanying increases in informal water abstraction for informal settlements affects groundwater availability and quality, and can cause tensions between new settlers and historic water user groups. In 2022, in Baringo, Nyeri, Meru, Lamu, Mandera and Marsabit counties, conflicts arose as a result of competition for scarce pasture and water resources, as well as long-standing rivalries between agro-pastoral communities (IPC 2022).

Water catchments are also decreasing due to deforestation by informal settlers for land clearance for small-scale cultivation around towns or settlements, as well as wood as a fuel source. Reduced groundwater also further limits subsistence and larger-scale farming.

Women's health is at particular risk due to changing water availability in Kenya. For example, in the northeastern county Garissa, social norms assign women the responsibility of water collection (Duus and Montag 2022). Due to increased droughts and water deprivation, women need to walk notably longer distances to collect water, which not only exposes them to exhaustion, but also makes them more vulnerable to unsafe routes (Ibid). While limited freshwater availability in the country and increasingly high rainfall variability will negatively affect per capita availability and lead to increasing droughts, extreme precipitation events will also threaten security.

Whilst much research is conducted regarding the risk of water scarcity, the risks created by too much water also increase fragility and threaten peace and stability (Baraka 2022). In the next 20 years, climate change may lead to heavier rains over the Omo, Kerio and Turkwel rivers, which feed Lake Turkana. Increased river inflows would raise water levels in the lake and increase the likelihood of severe flooding. Therefore, flooding, which in the past was considered a rare event, is likely to become more frequent in future. This poses severe challenges to the approximately 15 million people living on the shores of Lake Turkana, their livelihoods, health, economic situation and food systems (UNEP DHI 2021). The cost of flooding is estimated at 5.5 per cent of GDP every seven years and likely to increase (Government of Kenya 2016). Flooding disrupts ecosystems functioning, damages crops and increases the risk of food and water-borne diseases. Rising waters in 17 lakes across Kenya – including Lake Baringo, Lake Turkana and Lake Bogoria – are causing large-scale displacements and upending food production and distribution systems around the lake basins.

Existing responses, lessons learned and possible entry points

Livelihoods and resilience building: Evidence from Kenya demonstrates that investments in averting humanitarian crises in the country would yield savings of up to 30 per cent for the international donor community while also protecting billions of dollars of income and assets for the people who would have been most affected by the averted crises. Similarly, a resilience building intervention that results in an increase in income of USD 450 per household saves an estimated USD 273 million over the same timeframe. Livelihood diversification is an integral part of resilience building. WFP's work in ASAL counties in northeast Kenya has supported more than 400,000 people in livelihood activities such as fish-farming, and livestock and crop production, including beekeeping as a diversified source of income.

Farmer Service Centres: The World Food Programme's activities linking farmers to markets through sustainable business models support minimizing food loss, improving waste management and increasing value addition in supply chains. Estimates for Nairobi for example, put household per capita food waste between 99-100 kilogrammes per person per year, with negative impacts across environment, social and economic spheres. To address these challenges, WFP's partnership with the Farm to Market Alliance helps smallholder farmers transition to commercial agriculture through the provision of adequate information, investment and support across all stages in the production chain.

Partnerships with the private sector: National and international public-private partnerships offer opportunities to support growing industries and identify work opportunities for young Kenyans, in alignment with the Kenyan government's Vision 2030 agenda. Local small and medium-sized enterprises also support maintaining community-based food systems and maintaining local supply of safe and nutritious foods and promoting adaptation. For example, the Kenyan based Farm.ink is connecting geographically isolated farmers to share insights about livestock health management and productivity through the creation of a digital community (Steiner et al 2020).

Internationally, private sector partnerships also offer an opportunity to focus on the digital economy. WFP's partnership with the Mastercard Foundation focuses on empowering youth, in particular women, to fully engage in all segments of the value chain, increasing food security, income and employment opportunities. The approach focuses on linking youth aged 18-35 to digital and online work opportunities, with emphasis on making digital skills programs more accessible to young women, with the goal of supporting five million young Kenyans to secure dignified and fulfilling work by 2030.

Institutional capacity building: Supporting the capacity strengthening of government, national and county systems to transition to full ownership in gender- and shock-responsive social protection, and disaster and climate risk reduction and mitigation that empowers anticipatory action is a critical enabling condition to support long-term resilience in Kenya. WFP's close partnerships with county level governments have led to positive improvements in local capacities related to social protection, Environmental

Protection Management, humanitarian supply chains, climate resilience and food systems, among others. Scaling up this skill sharing at the national level will improve long-term sustainability.

Social protection and insurance schemes against disaster risk in agriculture and pastoralism: Index insurance provides a promising avenue to enhance social protection and reduce food insecurity. The Index-based Livestock Insurance programme, as a component of a broader social protection programme in Kenya, has led to increased smallholder resilience and reduced rural poverty while strengthening the planning capacities of public agencies (FAO et al. 2021). WFP's work through the Rural Resilience Initiative (R4) is addressing climate risk management by enabling vulnerable households to access index insurance products by participating in risk reduction activities. The R4 program enables vulnerable rural families to increase their food and income security by managing climate-related risks through four risk management strategies: risk reduction, risk transfer, prudent risk taking and risk retention. R4 contributes to the creation of rural financial markets by building the capacity of households, local insurance companies and micro-finance institutions and gradually supporting farmers to start paying for insurance in cash.

Initiatives such as cattle and crop insurance are examples of ways to support the resilience of individual farmers. Use of climate forecasts in longer-term planning and comprehensive risk assessments would also be a step in the right direction.

Urbanisation poses great risks but also offers great opportunities in Kenya. Kenya is less urbanised than many other African countries, but it is urbanising quickly. Today, a quarter of Kenyans live in an urban area, though this will increase to half the population by 2030, based on current trends. In other words, Kenya will be predominantly urban in less than a generation.

Rapid and unplanned urbanisation is affecting urban food systems as cities struggle to ensure their inhabitants' food security. The food security of big cities such as Nairobi also increasingly relies on international imports from East Africa and beyond, increasing costs (Hungry Cities 2017). The poverty penalty sees poorer households therefore paying more for products and services and receiving them at a lower quality (Route to Food 2018). On the other hand, informal food trade provides income to the urban poor (Hungry Cities 2017; United Nations in Kenya 2021). To face this challenge, 2021 saw a growth in balcony and backyard gardens, as urban residents try to increase their food security (Global Alliance for Improved Nutrition 2021).

A pathway to peace can be found by planning around this demographic shift. Some of the risks that need to be addressed are the pressures on infrastructure and the impacts of social and cultural dislocation of communities resulting from such fast-paced changes. One opportunity afforded by this risk is the possibility of developing new and better services, which will be able to support more people more quickly because they will not be so dispersed. WFP can support urban food security, particularly in rapidly growing provincial towns and refugee centers through the assessment and targeting of urban contexts and the application of supply chain expertise to address losses, waste and inefficiencies. A key element of this is to ensure urban planning to enable sustainable housing and food production opportunities as well as employment.

Given the lower levels of social capital among the dislocated and marginalised groups coming into informal settlements, any attempts to safeguard their wellbeing through the provision of basic services could yield significant peace dividends. Evidence demonstrates that the urban poor are constrained by both income and food affordability and therefore social protection support such as cash or food transfer programmes may be successful and promote resilience in the long-term.

Climate-conflict sensitive adaptation: Given the high sensitivity of Kenya's economy and its food systems to environmental change, efforts to ensure that the horticulture, agriculture, fisheries and infrastructure sectors are climate resilient will also ensure that sudden environmental shocks will not be destabilising. To achieve transformation in food systems in the face of climate change, the inclusion of people in poverty, youth and the marginalised is crucial. Local and context specific climate and conflict sensitivities must be integrated into any action. Opportunities exist in increased investments in context and environmentally appropriate drought resistant crops, solar powered systems for irrigation, and improved climate smart infrastructure.

The United Nations Environment Programme has found that increasing agricultural output by 1 percentage point per capita is five times more effective in reducing poverty than increasing output by the same amount in any other sector (IAASTD 2009), and that the best way to achieve this is through smallholder farming rather than the industrial-scale farms large investors prefer. Further, adopting a Gendered Food Systems Framework (Njuki et al. 2021) – an adaptation of the Food Systems Framework (De Brauw et al. 2019) – can serve to transform food systems in ways that empower women and enhance gender equality (Quisumbing et al. 2021). This includes recognizing the gender disparities along value chains, addressing gender inequalities along all food systems components, and ensuring that interventions both strengthen and enhance women's roles in agricultural systems, while reducing structural barriers.

Infrastructure: Transportation and building/housing are the two sectors driving Kenya's construction industry. One structural way in which equity across different parts of the country could be promoted is through greater freedom of movement of people and goods, including foodstuffs. Increased investment in resilient transport infrastructure will connect remote regions of Kenya to cities and ports, which will yield a peace dividend in the form of livelihood opportunities, access to markets and resources, and easier movement of people and goods. Given Kenya's current funding deficits for this critical work, increasing focus is turning towards the private sector to implement infrastructure projects. To ensure the investment in transport infrastructure does no harm, and has some chance of promoting peace, transport planning and infrastructure work needs to be conflict-sensitive manner.

Adequate investment must also be directed towards supporting climate smart infrastructure related to agricultural production. Investments such as solar powered irrigation including water pumps offer promising impacts, in addition to cold storage, which also increase available land for small scale irrigation or production.

Education: Food systems are under pressure from many different sources in Kenya, but a major one is lack of alternative livelihood opportunities in the face of climate change.

A key element to a functioning food system and thus food security is education as a means of enabling increased and more climate resilient livelihood options. This needs to be both affordable and safe.

A 'youth bulge' poses both challenges to and opportunities for food systems. On the one hand, negative attitudes towards the agricultural sector prevail among youth due to drudgery, low returns and the vulnerability that emerges from its seasonal nature. Further, many youths have limited access to sufficient agriculture training, information, financial services, markets and land. Climate change compounds these challenges, posing further constraints to food systems engagement (Government of Kenya 2018). On the other hand, the increasing demand for food market jobs and modern technologies offer interesting entrepreneurial opportunities for youth (FAO 2019b). Platforms are emerging that offer youth the chance to connect with young professionals and agripeneurs, such as the Platform for the Promotion of Agribusiness, Investments, Networking and Trade for the Youth (PAINT-Y), or the more recent Kenya Chapter of the Climate Smart Agriculture Youth Network (Ibid.).

In nomadic pastoral communities, schools need boarding facilities, as adults often travel for months on end during the dry season. Having a formal education will mean that children, particularly from agrarian and pastoralist communities, will have alternative options to the highly climate-sensitive ones of their farmer and herder parents. These investments require both supply and demand side interventions to ensure that there are employment opportunities open in the future, and that students have qualifications and skills to find work. While these investments will hold multi-generational impacts, they can also take time. Therefore, opportunities for short-term, demand driven skills and technical training should also be made available to those already engaged in the workforce. It is well established that, while unemployment is a major driver of conflict, young employed people have a strong vested interest in peace.

Climate-smart food systems: Conclusion and recommendations

Achieving food systems that are resilient and sustainable under a range of climate-related and environmental pressures requires them to be 'climate smart'. This means that different pillars of the food system – comprising agriculture, pastoralism and fisheries – are able to adapt to climate change and environmental degradation in a sustainable manner. This allows an increase in productivity that enables more stable nutrition intake and livelihood security in the face of different climate shocks. Climate smart food systems require holistic and integrated approaches.

Climate change pressures are already interacting with conflict dynamics in Kenya, threatening food systems and the food security for people in the region. However, our analysis finds that there are a myriad of opportunities across the raft of food systems programming which can i) reduce the risks of exacerbating these climate-security dynamics, ii) build resilience to climate-security risks and iii) support food security and peace in the face of a range of possible climate outcomes. Below are some priority entry points which emerge from our analysis:

1. **Support efforts to strengthen climate resilience:** Efforts to help to reduce people's vulnerability to food and livelihood shocks can also help lower the risk of violent conflict by lessening their chances of partaking in illicit coping mechanisms, including illegal livelihoods such as crime or raiding, sex work and joining armed groups. Food systems interventions that strengthen resilience could entail initiatives facilitating improved land use and expanded access to social safety nets, especially for the most vulnerable. Some focus areas to consider include:
    - **Increased investment in anticipatory action**, prioritizing investments in resilient livelihoods, averting the need for continued humanitarian responses. Investments in addressing the underlying fragilities that turn shocks and stresses into humanitarian crises are more sustainable and cost-effective.
    - **Supporting the identification of locally-appropriate and sustainable livelihood diversification opportunities** which are climate-smart and mitigate further environmental damage, notably for pastoral and pastoral-drop out communities. Successful examples in Kenya include beekeeping, as well as access to education, to support alternative and complementary livelihoods to supplement pastoral livelihoods.
    - Reduce the risk of climate-related shocks through nature-based solutions and improvements in agricultural practices. This can be achieved through the scaling-up and further investment in WFP's R4 Rural Resilience Initiative.
    - **Expand the uptake of social protection and insurance schemes**, including accessible or innovative finance, or Village Savings and Loans groups. Expand services to include cattle and crop insurance for individual farmers, including through the use of technology.
    - **Investing in locally appropriate**, **nutritious and climate-resilient value chains,** including non and off-farm components and expanding support for Post-Harvest Management capacity strengthening. This could be supported

through the provision of equipment such as solar dryers, cold storage or hermetic bags, as well as Food Safety and Quality trainings.
    - **Scale-up and expand Farmers Service Centers model**, notably to extend services to agro-pastoral communities.

2. **Support inclusive, climate and conflict sensitive adaptation,** to ensure that the horticulture, agriculture, fisheries and infrastructure sectors are climate resilient, reducing exposure to climate and environmental shocks. All efforts to strengthen adaptive capacity in Kenya and the Horn of Africa region can help to reduce conflict risk if they are designed and implemented in a conflict-sensitive manner. Some focus areas to consider include:
    - **Develop locally informed ASAL county-specific climate security risk profiles** for high-risk counties to inform geographic and population targeting. Improved contextual understanding can support opportunities to promote appropriate drought-resistant crops, and invest in addressing gender inequalities.
    - **Increase the use of conflict sensitivity in all programming**, including through the integration of marginalised groups, as well as moving populations in community adaptation and food system strengthening initiatives.
    - **Explore opportunities to support improved and sustainable access to water** which can promote peace. Water access should be strategically located to reduce movement across territories or counties, to support a reduction in intercommunal resource conflict.
    - **Integrate climate security monitoring and evaluation** into all programmes.
    - **Extend adaptation efforts to urban and peri-urban contexts,** not solely rural communities. For example, efforts to support newcomers in informal settlements could entail supporting unemployed youth in urban agriculture by connecting them to markets.
    - **Explore approaches, including training and input provision, that support improved rangeland management and rehabilitation,** including rangeland reseeding, that can also support positive food security and social outcomes.
    - **Explore opportunities to support partners in improved water governance** for improved food systems outcomes.
    - **Invest in addressing gender inequalities** along all food systems components, and ensuring that interventions both strengthen and enhance women's roles in agricultural systems while reducing structural barriers.

3. **Address pastoral mobility and migration** related to rapid and unplanned movements and increasing urbanisation, which is affecting food systems as cities and secondary cities and expanding rural areas struggle to ensure their inhabitants' food security. Some focus areas to consider include:
    - **Explore opportunities to work in urban and informal settlement** to promote food security, in particular in ASALs.
    - **Support the development of resilient and economically prosperous food systems,** integrated across landscapes and based on multi-stakeholder, multi-scalar and multi-sector collaboration.

- **Explore opportunities to build resilience of at-risk departure point communities**, in particular pastoral communities and pastoral-drop outs. Possibilities could include the establishment of Pastoral Service centres, mirroring the Farmers Service Centres models.
- **Promote internal cooperation and coordination** for sustained support of pastoral groups across borders and boundaries.
- **Deliver climate and conflict sensitive social protection support** such as cash or food transformation programs which support resilience in the long-term, including opportunities offered by mobile telephone banking in urban and informal settlements.

4. **Establish partnerships and drive coordination, including with the private sector.** National and international public-private partnerships offer opportunities to support growing industries and identify work opportunities for young Kenyans, in alignment with the Kenyan government's Vision 2030 agenda. Some focus areas to consider include:
   - **Prioritize innovative public-private partnerships**, including to increase access to credit and financial services for vulnerable community members.
   - **Consolidate partnerships with local and international actors** to harmonise activities and leverage synergies for improved sustainable outcomes.
   - **Collaborate with partners and stakeholders to develop programs that can build capacity** in climate security and resilience, climate adaptation and climate-smart food programs.
   - **Increase strategic partnerships with peace building and conflict actors** to better inform programming across pastoral, agropastoral, and farmer livelihoods.

5. **Increase investments in institutional capacity building.** Supporting the capacity strengthening of government, national and county systems to transition to full ownership in gender - and shock-responsive social protection systems. Disaster and climate risk reduction and mitigation investments that empower anticipatory action is critical in enabling conditions to support long-term resilience in Kenya. Some focus areas to consider include:
   - **Scale-up capacity building and skills-transfers** from county to national level
   - **Support local authorities to uphold appropriate urban food policies and efficient rural-urban linkages** essential to supporting the transformation of food systems to meet the needs of Kenya's growing urban and peri-urban populations.

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