An Overview of the Kenyan Food System:
Outcomes, Drivers and Activities

Foresight4Food

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Key messages

Kenya is home to more than 54 million inhabitants and possesses seven distinct agroecological zones, from highlands and coastal zones to semi-arid lowlands. Kenya's food system involves a wide range of food-related activities and provides multiple outcomes to Kenyan society. Over the past decades, poverty has gradually been declining; various governance initiatives have spurred economic growth and realized limited structural reforms (particularly since 2010); digitalisation has progressed; and green energy provision (largely from sustainable renewable sources) has expanded. However, many food systems outcomes are not equally distributed. For instance, a substantial part of the population, including a significant number of refugees, lack access to food and nutrition security. Meanwhile, urbanisation and rapid population growth, with a large youth cohort, pose major challenges for the Kenyan government's aim of achieving middle income country status. Additionally, factors including ongoing issues related to food and nutrition security, a high cost of living, limited market access for smallholder farmers, political issues related to land, social instability after elections, and ethnic divisions, all continue to pose significant challenges.

The Kenyan food system has multiple drivers, including climate change, urbanisation, population growth, economic modernisation, governance restructuring, digitalisation, and social inequality. For example, the long period of drought, between 2016 and 2022, deeply affected pastoralist communities in the north and influenced cropping patterns in the south. Revenues generated from exports such as tea and coffee, and increasingly horticulture, are seen as key to economic growth. And, although food imports have increased in recent decades, these offer a solution for providing urban populations with cheaper staple foods. However, since the COVID-19 pandemic and the start of Russia-Ukraine war, inflation and prices of inputs and staple foods have increased. In light of such challenges and to boost staple crop production and decrease reliance on (costly) imports, the Kenyan government recently embarked on a national maize fertiliser subsidy program and the digital registration of farmers. Yet, despite such efforts, the question remains: how to (nutritiously) feed a growing Kenyan population in the future?

Highlights of the Kenyan food system:

1. The population living below the poverty line has been steadily declining. However, there are large disparities of economic growth across regions and notable income inequalities. North and north-eastern counties suffer most from high levels of poverty and under-nutrition.

2. Agriculture contributes the highest share of Kenya's gross domestic product (GDP), accounting for 21.2% (KNBS, 2023). Employment in agriculture has been declining, from 40% in 2010 to 33% in 2022 (World Bank, 2022g).

3. In Kenya, a growing population of youth is coming of age. At the same time, the share of the population living in urban areas has been steadily increasing up to 29.5% in 2023 (KNOEMA, 2023).

4. Among certain socio-economic groups, diets are changing towards more (ultra)processed food and animal-sourced proteins. Moreover, concerns for food safety are driving the 'supermarketisation' of the food environment.

5. Food and nutrition insecurity has increased. Almost 70% on the population was severely or moderately food insecure in 2020. The prevalence of obesity among some population groups has also increased.

6. Kenya faces high levels of post-harvest food losses (12-20% of total national production) while being highly dependent on food imports. Kenya's cereal import dependency ratio rose from 23.9% over the period 2000-2002 to 43.1% in the 2019-2021 period.

7. Due to drought in recent years arising from climate change, freshwater use by Kenya's agriculture sector has increased – with the sector responsible for roughly 80% of all freshwater withdrawals in the country between 2017 and 2020. This is related to the fact that most of Kenya's agricultural output is grown in rain-fed farming systems, yet only 17% of the country's arable land is deemed suitable for such production.

8. Despite greenhouse gas (GHG) emissions being comparatively low compared to industrialised countries, emissions from the food system are rising. Agricultural production was responsible for the largest share of Kenya's food system's GHG emissions in 2018 (83%), followed by food waste and disposal (13%).

1 Introduction

Food system transformations are urgently needed

Food systems transformation is regarded as an urgent issue around the world. Together with hikes in the price of food, world events such as climate change, COVID-19 and Russia's war in Ukraine have awakened the international community to the necessity of reconsidering the ways in which food is produced, handled, consumed and managed. Doing so is critical to ensuring food security for both present and future generations. The challenge is to determine how to bring about the transformations that will enable better nutrition, sustainability, inclusiveness and resilience.

The urgency of this transformation calls for a systemic approach to policymaking that can be integrated with 'future thinking' to assess the longer-term requirements and consequences of alternative scenarios. Creating political will and societal understanding for change will demand an effective process involving scientifically informed stakeholder engagement. Such processes should integrate systems approaches with foresight and scenario analysis, supported by the effective use of data and its analysis, visualisation and computer modelling.

Prioritising food system change in Kenya

The United Nations (UN) Food Systems Summit 2021 underscored the need to transform food systems and chart broad directions for change. Such directions must be implemented at national and local levels, but doing so will not be possible without significantly enhancing the forward-looking processes of engagement between policymakers, researchers and society as a whole.

The Government of Kenya has made food security a key pillar of its national development strategy, Vision 2030, through the Medium-Term Plan III and the Big Four Agenda, with the (ambitious) aim of achieving 100% food and nutrition security by 2022. This follows on from the National Food and Nutrition Security Policy that the government established in 2011.

At the UN Food Systems Summit 2021, Kenya provided a plan for transformation of its food systems, emphasising:
- Tackling climate change through climate resilience
- Diverse and nutritious diets
- Digital innovation
- Inclusion of women and youth in food systems

Kenya is already considered a regional leader in digital agriculture innovation and has increasingly positioned itself as an African climate action leader, hosting the Africa Climate Summit in Nairobi in 2023. The country has also begun implementing various enabling policy frameworks and business environments in recent years (Breisinger et al., 2023).

A devolved governance system was implemented following the revision of the Kenyan constitution in 2010, which see responsibilities (including those related to agriculture) delegated to the 47 county governments. In addition to the normal budget transfers from central government, counties must independently allocate a proportion of their own budgets to agriculture – providing them with responsibilities and challenges in supporting food systems transformation processes. Participation of communities and regions is important, and in order to support this the Bottom-Up Economic Transformation Agenda 2022-2027 is another critical policy framework that guides the process of food systems transformation.

Moving from a food security to a 'food systems' approach and developing stronger policy coherence remains imperative. To aid in achieving this, the government established the Agricultural Transformation Office (ATO) to coordinate implementation of the Agricultural Sector Transformation and Growth Strategy; the Joint Agricultural Sector Steering Committee to coordinate between national and county government; the Council of Governors, representing the Counties; and the Agriculture and Rural Development Partner Group to coordinate among donors (Breisinger et al., 2023). However, following the downscaling of the ATO

at the end of 2023, the Inter-Agency National Food Security Technical Working Group, chaired by the Agriculture Cabinet Secretary and supported by various Rome-based agencies (such as the Food and Agriculture Organization (FAO) and the International Fund for Agricultural Development (IFAD)), has become active in supporting the overall coordination and reporting towards the UN Food Systems Summit Stocktaking Moments. As such, a well-established mechanism to allow for the effective coordination of all food system actors is not yet in place.

Initiating the Foresight4Food process

Foresight approaches are used as a structured method for examining important uncertainties that shape the ways in which decisions taken today might play out in the future. The forward-looking perspective helps ensure that decision-making is prepared for the future, and can be used to test some of the assumptions on which these decisions are based. Merging foresight approaches with an understanding of the complex structures and key outcomes of current food systems, the Foresight4Food initiative developed an approach to facilitate planning for processes of food system transition. A key element of this approach involved developing a comprehensive description of the food system that can be used to generate a collective understanding among various stakeholders and enable them to make well-considered, evidence-based compromises and informed strategic decisions that lead towards a sustainable and resilient future.

The Foresight4Food approach consists of the following stages: i) building common ground for the transformation process, including building consensus around definitions, methodologies and approaches; ii) identifying and surveying the prevailing food system at the national and sub-national levels; iii) analysing the prevailing food system in terms of nutritional value, financial cost, environmental impact, challenges and inefficiencies, and other factors (foresight and scenario analyses); iv) developing new/alternative food systems, including the identification of advantages and disadvantages (foresight and scenario analyses); v) identifying the conditions and requirements for the successful implementation of these systems (i.e. providing the enabling environment); and vi) developing the Road Map and Action Plan for transformation.

The objective of the present report is to describe the Kenyan food system to provide evidence-based input for a participatory scenario process and for the development of an Action Plan in Kenya, led by Kenyan stakeholders, to support the implementation of national pathways and subsequent food system transformation. Systems and foresight analyses are crucial to helping stakeholders understand the likely consequences of conducting 'business as usual' and encouraging them to engage in exploring the trade-offs, opportunities, synergies and risks of alternative scenarios and pathways. This effort is conducted under the support facility known as 'Foresight for Food System Transformation (FoSTr)', a three-year programme funded by the Kingdom of the Netherlands, overseen by IFAD and implemented by University of Oxford and Wageningen University & Research in five countries: Bangladesh, Jordan, Kenya, Niger and Uganda.

Building on what has already been done

Foresight4Food recognises the active landscape of initiatives working towards a common goal: to promote sustainable food system transformation in Kenya. Throughout FoSTr's implementation in Kenya, various multi-stakeholder workshops and dialogues were organised to gather insights and discuss key issues. These have partly contributed to the content of this report. The workshops included:

1. An initial introductory engagement bringing the FoSTr Programme to Kenya, in February 2023
2. A foresight and food systems orientation session in Nairobi, in June 2023
3. A roundtable in Nakuru, in November 2023
4. A foresight and scenario workshop in Marsabit, in March 2024
5. A scenario building workshop in Nakuru, in March 2024

The Foresight4Food team has also recognised and built upon a range of publications by notable institutions that offer deep insight into Kenya's food system. This report therefore acknowledges and recommends the following reports:

- Breisinger, C., Keenan, M., Mbuthia, J., and Njuki, J. (eds) 2023. Food Systems Transformation in Kenya: Lessons from the Past and Policy Options for the Future. Washington, DC: International Food Policy Research Institute (IFPRI).
- FAO, European Union & CIRAD. 2023. Food Systems Profile – Kenya. Catalysing the sustainable and inclusive transformation of food systems. Rome, Brussels and Montpellier, France.
- Rampa, F., and Dekeyser, K. 2020. AgrInvest-Food Systems Project – Political economy analysis of the Kenyan food systems. Key political economy factors and promising value chains to improve food system sustainability. Rome: FAO.

The FoSTr programme aims to complement such actions and accumulate recent works on Kenya's food system, ultimately compiling a comprehensive and up-to-date account of this system.

The report structure

This report is structured as follows:

- Section 2 outlines the approach and methodology used to describe and analyse the food system. It also indicates how this report builds on the concept of food system analysis and its application to specific contexts.
- Section 3 provides key insights into the regional context and geography of the Kenyan food system, describing a variety of farming systems in the four agricultural zones of Kenya.
- Section 4 describes the key outcomes of the Kenyan food system in terms of food and nutrition security, economic and social well-being, and environmental sustainability.
- Section 5 provides an overview of the key drivers of the Kenyan food system: demographics, development, consumption, technology, markets, climate and environment, and policy and geopolitics.
- Section 6 presents an overview of key actors in the Kenyan food system and their activities. It analyses the producers, processors, traders, retailers and consumers who shape the system on a daily basis.
- Section 7 describes the dynamics between various elements in the Kenyan food system, focusing on example trade-offs and synergies.
- Section 8 provides key conclusions emerging from this food system mapping analysis, along with initial policy recommendations and suggestions for subsequent research steps within the FoSTr programme.

The report is intended for use in discussions amongst food system stakeholders in Kenya, aimed at building on the ideas presented herein. This published version offers a snapshot of the current status as of 2024.

Disclaimer

This report uses data from both national and global sources. It is important to acknowledge that we have given priority to national statistics whenever they are accessible, contingent upon data availability. We understand that national and global datasets may not always coincide with each other, thus requiring continuous iterations in order to obtain accurate and up-to-date data.

2   Using a food systems approach

To map the key components of the Kenyan food system, we adopted the Foresight4Food food system framework (Figure 1). This framework builds on previous work and incorporates elements of the food system framework developed by Ingram (2011), High Level Panel of Experts on Food Security and Nutrition (FAO, 2017) and van Berkum et al. (2018). We use this framework as a basis for describing the food system, while customising specific elements to the Kenyan context. We also use it to scan for trends relating to the food system and to detect major drivers behind it. This framework describes the main components of a food system: activities, support systems, drivers and outcomes.

A set of activities forms the core of the food system. These activities are undertaken by various actors and include primary production, processing, retail and consumption, and storage and disposal. As food systems involve multiple interacting value chains, their proper functioning requires a broad set of support services, including physical and market infrastructure, transport, financial services, and information and technology.

The incentives and operating conditions for the actors are influenced by the institutional environment of policies, rules and regulations (e.g. concerning food safety, food quality, financial matters, taxation and environmental considerations), consumer preferences and social norms. These institutions create the formal and informal rules that are applied by key actors to govern the food system.

The food system operates within the wider context of society, which includes human and natural systems, with multiple interactions and feedback loops. These systems create a set of external drivers and trends that shape the behaviour and evolution of the food system as a whole. However, although each system actor influences, they are simultaneously influenced and react accordingly. Food system drivers include population dynamics, consumption preferences, technological developments, global markets, environmental factors and politics. Food system outcomes can be categorised into three main areas: economic and social well-being, food and nutrition security, and outcomes relating to nature and the environment.

A food systems model provides the basis for understanding and exploring the critical relations, trends and trade-offs that support any desired system transformation aimed at generating higher levels of desired outcomes. For example, indicators of the three outcomes enable the assessment of whether food systems are functioning in desirable or undesirable ways, in light of wider societal and environmental objectives. Analysing the drivers that fuel the current state of the food system promotes an understanding of the pressures exerted on food systems (with these drivers subsequently being influenced by the outcomes).
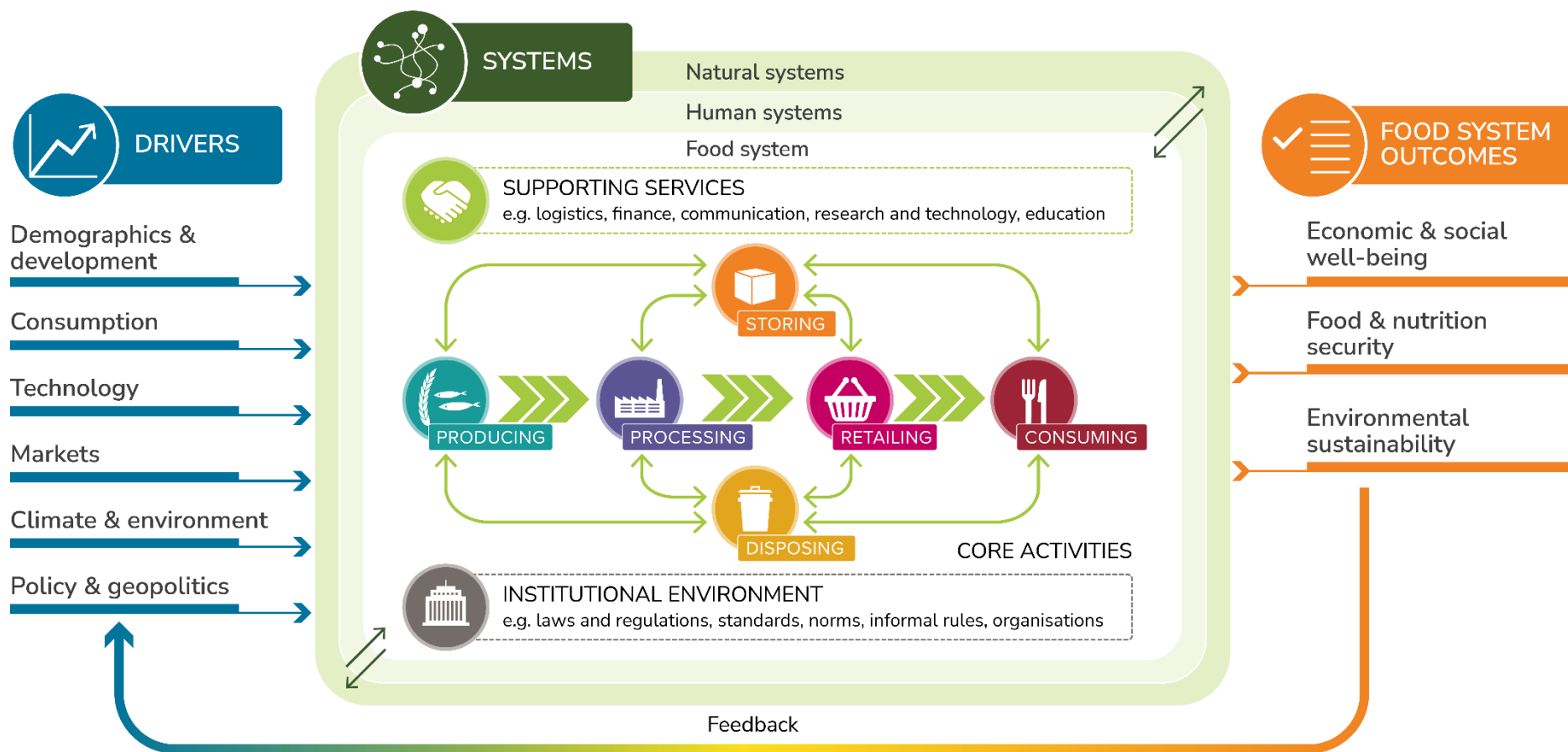
Figure 1 *The Foresight4Food food systems framework*

3 Context and geography

3.1 Brief context and history of the Republic of Kenya

Kenya's history has contributed to shaping the food system we see today. Early settlers included people from all over the African continent, such as Bantu farmers and Nilotic pastoralists. From the first century A.D., the East African coast was also visited by Arabs and Portuguese, among others, who established trade hubs (Black History Month, 2020). In 1888, the British East African Company was granted a charter, which led to the colonisation of present-day Kenya. When the company went bankrupt, the British government took over in 1895, creating the East Africa Protectorate, later known as the Kenya Colony. The government passed a bill that reserved the central highlands for white settlers, and this remained in place until 1961. Between 1920-1963, the Kenya Land and Freedom Army (KLFA) fought the British and European authorities (BBC, 2011). Kenya became independent in 1963 following the Mau Mau revolution (Kenya Embassy Washington D.C., 2023), with Mzee Jomo Kenyatta as the first president. However, the country remained part of the Commonwealth of Nations. The constitution was replaced in 2010, which significantly changed the organisation of the country (Hassan, 2015): the government is now more decentralised, and the former eight provinces have been replaced by 47 counties. Today, the Republic of Kenya has a population of more than 54 million people (World Bank, 2022).

Tensions between ethnic groups have influenced Kenyan politics since its independence. The Kenyan population consists of many different ethnic groups, of which the Kikuyu is the largest, accounting for about 20% of the population. Other large ethnic groups include: Luhya, Kalenjin, Luo and Kamba (KNBS, 2022, 2019). Ethnicity influences the formation of political parties, competition and how public goods and national resources are allocated (Ahere, 2020; Kenya Human Rights Commission, 2018). The Kikuyu and Kalenjin ethnic groups have been particularly favoured economically, first by colonial powers and later by Kenyan presidents

(De Luca, Hodler, Raschky, & Valsecchi, 2018). Conflicts between ethnic groups increased with the introduction of multiparty politics, as political parties are generally formed along ethnic lines (Kenya Human Rights Commission, 2018). Most notably was the violent 2007-2008 Kenyan crisis, which followed election of President Kibaki (CSIS, 2009). The constitution was changed in part to respond to the sense of exclusion, with revisions providing a clearer delineation of powers. Additionally, the office of prime minister was established, and a coalition government was formed. The Taskforce on Building Bridges to Unity is the most recent attempt to investigate critical governance challenges (World Bank, 2020).

Even in postcolonial times, land access and the Kenyan food system have been politicised. Land has been a contested resource in the postcolonial period, and a series of land reform acts have aimed to restore inequalities in land access that evolved during colonial times (FAO, 2023a). Political leaders and government officials own substantial proportions of the country's land (Kariuki & Ng'Etich, 2016). Often significant parts of larger landholdings remain uncultivated, yet there is land scarcity for smallholder farmers – and this affects the food system, particularly food security (Jayne, Chamberlin & Headey, 2014). Thus, land access and agriculture are highly politicised (World Bank, 2020). Conflicts related to distribution also come to the fore when pastoralists, who are nomadic and semi-nomadic peoples, require resources to sustain their herds, especially during droughts. Furthermore, informal rules and patriarchy limit women's ownership of land and consequently access to finance, since land is often taken as collateral (Rampa & Dekeyser, 2020).

3.2 Physiographic zones

Kenya is positioned astride the equator and has a diverse range of physio climatic zones. The country's total land area is 582,000 km sq, and it has a coastline of more than 500 km, bordering the Indian Ocean in the east (Kirui et al., 2013).

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Kenya shares borders with Ethiopia to the north, South Sudan and Uganda to the northwest and west, and Tanzania to the south. Aside from the coastal plain, the land consists of plateaus and highlands, with Mount Kenya the highest mountain at an elevation of 5,199 m and the highland area divided by the Rift Valley. In the west, Kenya borders Lake Victoria. As a result, there are many different agroecological zones, with differences in temperatures, rainfall and agricultural potential. Moreover, Kenya's climate is strongly influenced by the Inter Tropical Convergence Zone, a belt of low pressure and heavy precipitation near the equator (Ministry of Foreign Affairs of the Netherlands, 2018).
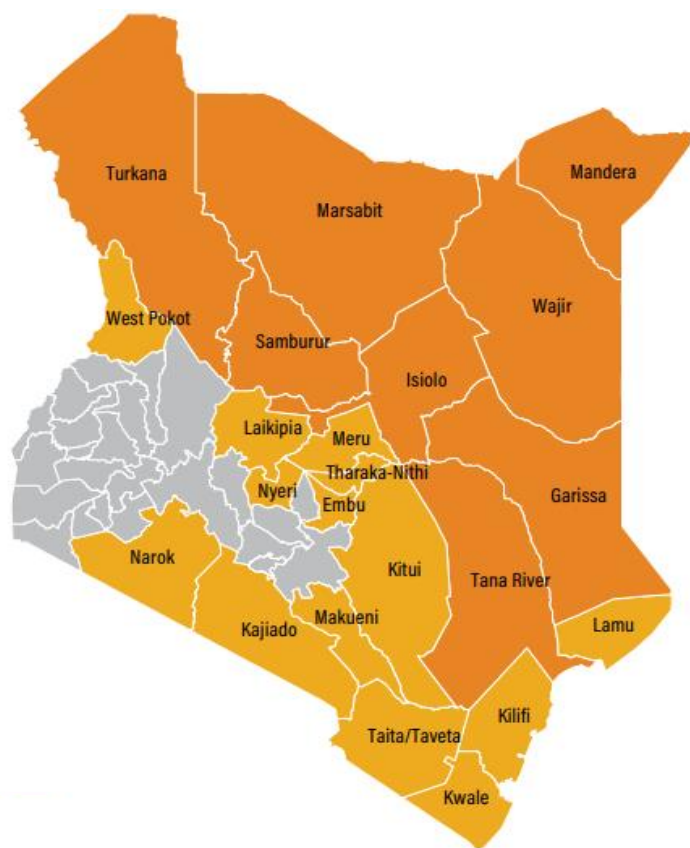
Figure 2   *Arid (dark orange) and sem i-arid (orange) counties in Kenya Source: Chaudhuri, Summerlin & Ginoya (2020).*

3.2.1   Arid or semi-arid lands

More than 80% of Kenya's land area is formally classified as arid or semi-arid land (ASAL), which are mainly located in the north and north-eastern regions of the country (see Figure **2**) (World Bank, 2021). ASALs consist of series of plains and are home to about 20% of Kenya's human population and 60% of livestock, particularly held by pastoralist communities. There are extreme climatic conditions in ASALs, with average rainfall between 200 and 700 mm/year (Chaudhuri, Summerlin & Ginoya, 2020), and high temperatures throughout the year. While extreme rainfall events are occurring with greater frequency and intensity, prolonged droughts have become more common, and aridity is increasing (World Bank, 2021).

3.2.2   Rift Valley

The Rift Valley is a trench 48-64 km wide and 600-900 m deep, with steep slopes that run north to south. It divides the highlands into an eastern and western region. Multiple lakes and volcanoes are located in the Rift Valley, including two freshwater lakes: Baringo and Naivasha (Omondi et al., 2018). The reliable precipitation and fertile soils mean the Rift Valley is considered a high-potential area for agricultural production (particularly the Mau Escarpment). Contrary to other regions, some prognoses show that parts of the Rift Valley may benefit from changes in climatic conditions, as increases in rainfall and slightly warmer temperatures may actually raise crop yields (World Bank, 2021).

3.2.3   Highlands

The highland areas are characterised by high altitudes, cooler temperatures and more rainfall than other regions. They receive approximately 1,000 mm of rainfall each year (World Bank, 2021). Mount Kenya is in the eastern section and includes multiple glaciers, which are rapidly retreating (WMO, 2021). Only seven of the original 18 glaciers still exist. The central highlands are densely populated, and where the majority of agricultural production takes place (Ministry of Foreign Affairs of the Netherlands, 2018). In the west, the highlands slope towards the Lake Victoria Basin. Areas near Lake Victoria and the central highlands east of the Rift Valley can receive up to 1,200-2,000 mm rain per year (Parry et al., 2012).

3.2.4   Coastal area and hinterlands

The coastal regions have a tropical climate and are generally hot and humid, with average daily temperatures between 27°C and 31°C (Parry et al., 2012). Rising sea levels present a risk to all five coastal counties (Kwale, Mombasa, Kilifi, Tana River and Lamu) (World Bank, 2021). Coastal areas are particularly prone to floods, coastal erosion and the intrusion of salt water in aquifers (Ministry of Foreign Affairs of the Netherlands, 2018).

3.3   Water resources

Kenya is categorised as a water-scarce country that is largely dependent on rainfall. Water resources are under pressure and unevenly distributed throughout Kenya. Lake Victoria and the Tana River are the two main surface water bodies, and about 75% of all surface water comes from the central highlands. Agricultural activities and deforestation in the central highlands cause increased siltation, sedimentation, turbidity and runoff into downstream watercourses, and reduce recharge needed to sustain base flow rates of rivers (Parry et al., 2012). While groundwater is underutilised compared to surface water, it is also an important source of domestic water supply. However, concentrated pumping and over-abstraction have depleted the Merti and Nairobi aquifers, and there have been water management and coordination challenges. While some responsibilities have been devolved to county-level authorities, overlapping mandates between authorities, as well as institutional capacity constraints and funding constraints (Parry et al., 2012) afford challenges.

Limited capacity to store water increases rainfall dependence (World Bank, 2021), and changes in rainfall patterns, coupled with temperature rises, pose a significant risk to water availability. The water scarcity index in Kenya has deteriorated over the last decades. In 2010, available water per capita was approximately 586 m^3, but this is projected to be 293 m^3 per capita by 2050 (World Bank, 2021). Simultaneously, the frequency and severity of flooding is expected to increase due to higher rainfall intensity (Parry et al., 2012). As such, changes in water conditions are threatening livelihoods, infrastructure and food security.

4   Food system outcomes

To obtain an overview of the current state of the food system, it is important to understand what the food system currently delivers in terms of outcomes. Food system outcomes can be classified into three main areas: ensuring food security and optimal nutrition for all; meeting socio-economic goals, particularly with regard to reducing poverty and inequalities; and making it possible to meet food needs within the boundaries of the planetary environment and climate. To deliver on these outcomes, food systems need to be resilient to shocks, sustainable over the long-term, and equitable in terms of the costs and benefits to different societal groups. Trade-offs and synergies occur across the outcomes and properties of food systems, accompanied by the potential for both conflict and collaboration between interest groups. This section provides an overview of the status of the outcomes of the Kenyan food system.

4.1   Economic and social well-being

Agriculture accounts for the highest share of Kenya's GDP, at 21.2% (KNBS, 2023). In recent years, employment in agriculture has been steadily declining, from nearly 40% in 2010 to 33% in 2022 (World Bank, 2022g); yet, the sector remains responsible for the largest share of employment in the country. In Kenya, about 75-80% of the population is below 35 years old (NCPD, 2017). Among this group, unemployment is especially high, at around 35% (Fairtrade Africa, 2021). Participation in the labour force by women is about 73%, compared to 76% by men. While this gap is smaller than the sub-Saharan Africa average (World Bank, 2022b), Kenyan women spend, on average, five times more hours on unpaid and domestic labour than men (UN Women, 2023).

In previous years, the population living below the poverty line had been steadily declining, from 46.7% in 2005/06 to 33.6% in 2019 (World Bank, 2023a). However, the pandemic reversed this trend, with poverty rates increasing to

above 40% in 2020. Since then, recovery has been slow and poverty levels remain above pre-pandemic ones (World Bank, 2023a).
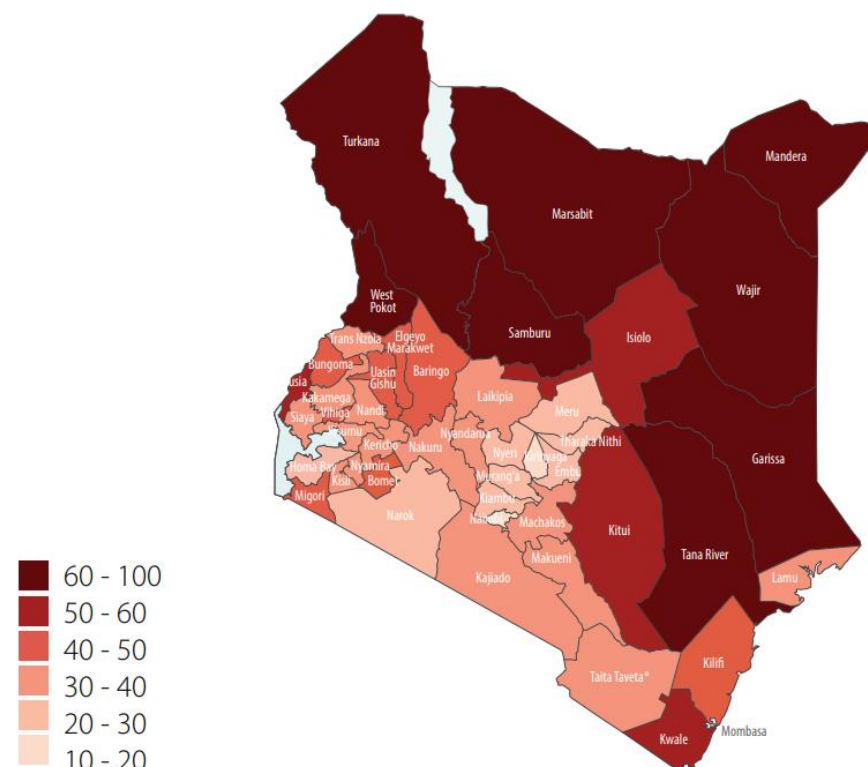
Figure 3   *2021 poverty rates (%) per county. World Bank (2023a). Kenya Poverty Assessment 2023*

The Gini-index, commonly used as a key indicator to measure income inequality in a country (ranging from 0 to 1), improved only slightly between 2005 and 2015, from 0.46 to 0.41 respectively, which is comparable to neighbouring countries (World Bank Poverty and Inequality data, 2023). Inequality is most pronounced in urban and non-ASAL areas (Figure 3). North and north-eastern counties suffer most from persistently high levels of poverty with rates of 64% in 2015-2016 compared to the national average of 36% (AfDB, 2023). Approximately 60% of Kenya's total national expenditure is controlled by the top 20% of the population, while the bottom fifth only control 3.6% (KIPPRA, 2020).

in the region range from about 11% to 28%, with Kenya at around 18% (UN Women, UNDP, & UNEP 2018; World Bank 2012; cited in Breisinger et al., 2023).

4.2   Food and nutrition security

Persistent and widespread hunger and malnutrition remain a huge challenge in some parts of Kenya. Data from Food and Agricultural Organization Statistics (FAOSTAT) show that a significant percentage of Kenyans are moderately or severely food insecure. Food insecurity has increased over the past years (WFP, 2023), and more than 70% of the population was severely or moderately food insecure in 2023 according to figures from the FAO, African Union Commission (AUC), United Nations Economic Commission for Africa (ECA) and United Nations World Food Programme (WFP, 2023).

Poverty rate at the national poverty line, 2005/06–2021

Figure 4   *Percent of the national, rural and urban Kenyan population living below the poverty line, between 2005/06 and 2021*

Gender inequalities contribute to underperformance in the Kenyan economy, particularly in agriculture. This is due to a diverse range of issues, including lack of access to and control of resources for women, which has been a pervasive issue affecting productivity and resilience building. Additionally, inequalities largely rise from socio-cultural norms and traditional role divisions. Gender productivity gaps

Figure 5   *Prevalence of moderate or severe food insecurity in the population (%)*

4.2.1 Food availability

In Kenya, it is often said that 'ugali is food, and food is ugali'. High emphasis on ensuring enough domestic maize production has often driven agricultural policy, despite this not always being followed by high government financial investments. Maize is by far the most grown staple crop in Kenya, particularly by smallholders who grow it for both home consumption and cash. It is the most important staple food source, with an annual consumption of 62 kg per person. Maize is grown in two growing seasons, mostly in Western and Central Kenya. In recent decades, the area (and thus quantity) production of maize has grown, despite yields remaining at same level since the 1990s. This is seen as problematic, since the population is growing rapidly and shortages of domestic maize are being countered by increasing maize, rice and wheat imports (de Groote, 2023, in Breisinger et al., 2023).

4.2.2 Food access

Food access is a key constraint for Kenyan households, as poverty influences the type of food people buy. A healthy diet is too expensive for most Kenyan households' income to afford (Ecker, Comstock & Pauw, 2023, in Breisinger et al., 2023). Based on 2015/2026 data and looking at price per calorie, meat, fish and eggs are the most expensive food groups, at 14-16 times the price of oils and fats, 12-15 times the price of starchy staples, and 10-11 times the price of sugars and pulses and nuts. Vegetables are the second most expensive product per calorie and are less often purchased because households prefer high calorie/low price food products. The greatest price differences across rural, peri-urban and urban areas relate to vegetables and dairy, with both being cheaper in rural areas. Interestingly, pulses and beans are cheaper sources of protein, yet under consumed. This indicates a slightly different dynamic which is not dominated by price considerations: these nutritious foods are less desired than others – particularly in urban areas, but also in other rural and peri-urban areas – which may be due to la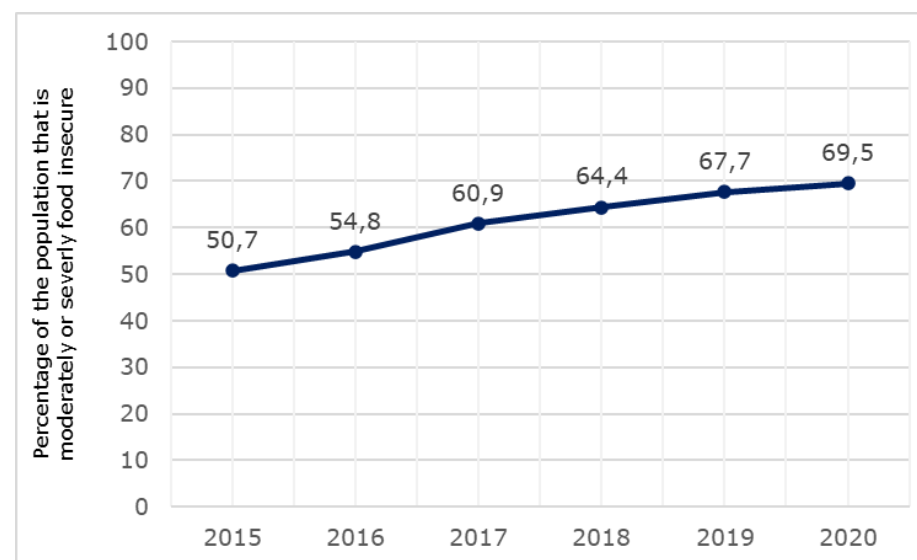ck of consumer knowledge on the nutrition of these food groups (Ecker, Comstock & Pauw, 2023, in Breisinger et al., 2023).

Food prices have been rising gradually in Kenya since 2022. Drought exacerbated domestic food shortages and global prices increased following from the war in Ukraine; and costs have stayed high ever since (Africa News, 2023). Food insecurity is most severe in the ASAL counties: Marsabit, Turkana, Baringo, Isiolo, Samburu, Garissa, Wajir, Tana River and Mandera. The number of people in Kenya who could not afford a healthy diet in 2021 was 39.2 million, or 74% of the total population (compared to 42% at a global level). In 2021, the cost of a healthy diet in Kenya was US$3.19 (current PPP$) (World Bank, 2021).

The country's reliance on agriculture and growing dependence on imports (especially wheat, maize and rice, among others) underscores the need for sustainable, resilient increases in agricultural productivity for food security and economic growth (Ministry of Agriculture, Livestock and Fisheries, 2017).

4.2.3 Food utilisation

In Kenya, the average dietary patterns seen in rural, peri-urban and urban areas differ quite significantly from the recommended flexitarian or healthy dietary guidelines. The average Kenyan eats more starchy staples than they require and not enough nutritious foods, such as vegetables, fruits, and animal-source and plant-based protein ingredients. Over 90% of staples are derived from cereals, mostly as maize meal, but can also be wheat flour or rice. According to CGIAR estimates, 28% of all households receive more than two-thirds of their calories from starchy staple foods. This is particularly the case in rural areas (34%) and peri-urban areas (29%), while the figure is lower in urban areas (18%). In total, 80% of rural households, 75% of peri-urban households and 70% of urban households have insufficient calorie consumption amounts from vegetables, fruits, or animal-source or plant-based protein ingredients compared to healthy diet reference points. Dairy consumption is below reference targets for flexitarian diets in 50% of all households. Added sugar consumption is also high across groups (Ecker, Comstock & Pauw, 2023, in Breisinger et al., 2023).
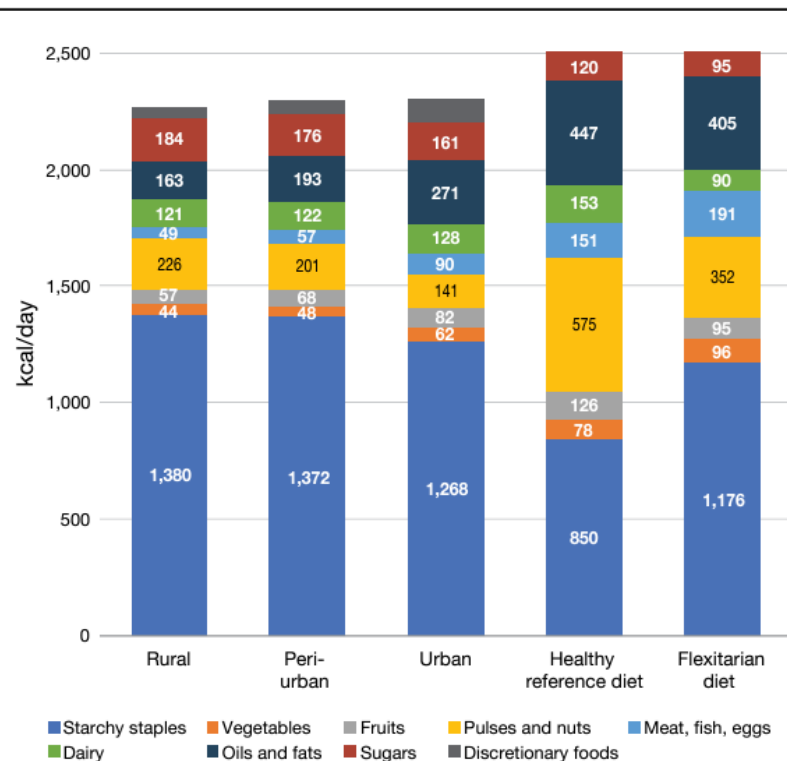
Figure 6   *Mean calorie consumption amounts per adult equivalent and reference intakes of the EAT Lancet diets by major food group*
Source: (Ecker, Comstock and & Pauw, 2023; in Breisinger et al., 2023).

Particularly in Kenya's urban areas, where households (on average) have higher incomes, increased consumption of animal-based proteins and (sweet) processed foods (particularly cereals and beverages) is occurring. This is aligned with the globally observed spread of modern food retailers (most notably supermarkets) and increasing prevalence of overweight, obesity and related non-communicable diseases in the country's urban areas (Ecker, Comstock & Pauw, 2023, in Breisinger et al., 2023). Future dietary trends in sub-Saharan Africa are likely to follow similar trends to those that have occurred in more affluent regions. The prevalence of obesity among the population has also been increasing, with 13.4%

of adult women and 3.6% of adult men living with obesity. However, Kenya's obesity prevalence is lower than the regional average of 20.8% for women and 9.2% for men (Global Nutrition Report, 2023). Additionally, transitions towards diets that include more calories and larger quantities of animal-source foods lead to greater environmental impacts. The largest proportional and absolute increases in per capita impacts are projected in currently low-income and lower middle-income countries (Clark et al., 2020).

4.2.4   Food loss and waste

Significant post-harvest food losses in Kenya have been recorded for crops, livestock and fisheries. In 2017, more than 1.9 million tonnes of food were lost at the post-harvest phase, worsening the impacts of drought that the country faced in 2016/17 (FAO, European Union & CIRAD, 2023). Kenya recorded 37 million bags of maize, of which 12% was estimated to have been lost to poor post-harvest handling and storage. It is estimated that 20% of cereals are lost prior to reaching the market, and this is a contributing factor to increasing dependency on food imports. Over the past two decades, the cereal import dependency ratio of Kenya has increased from 23.9% (over the period 2000-2002) to 43.1% (over the period 2019-2021) (World Bank, n.d.). These losses translate into approximately 4.5 million bags, and post-harvest losses are estimated at 12-20% of total national production (Snel et al., 2021). In Kenya, the fruit sector has grown (by 12% between 2005 and 2015) due to larger demand for fresh fruits and heathier drinks. Yet, only 8% of mango fruits grown are processed and about 40% of the fruit goes to waste. As such, there are opportunities for increased processing of fruits into juices as well as pulp and concentrate (FAO, European Union & CIRAD, 2023).

4.3   Environmental sustainability

4.3.1   Land degradation

In 2010, about 6% of Kenya's total land area was covered by natural forests. However, between 2001 and 2022, 11% of this tree cover was lost. More than half of tree cover loss occurred in Narok, Nakuru, Kilifi, Lamu and Kwale counties (Global Forest Watch, n.d.). Agriculture, particularly livestock farming, is the main driver of deforestation (Dummett & Fenton, 2023). To counter this trend, the

Kenyan government has set a target to increase the tree cover to more than 10% by 2030, by planting new trees and encouraging citizen tree planting during national holidays (UNDP, 2022a).

Another land-related challenge is that of soil degradation, including soil erosion, depletion of soil nutrients and decline in fertility. This is largely due to deforestation and land use cover change, and affects the majority of all land area (FAO & ITPS, 2015; Nkonya et al., 2018). ASAL areas are particularly vulnerable to degradation, due to a lack of vegetation and soil structure. It is estimated that 30-40% of ASALs' soils are rapidly degrading, and 2% have completely been degraded (Mganga, 2022). Declining soil fertility affects crop and fodder production rates and thereby food security.

4.3.2 Water depletion

The agriculture sector is the main source of water withdrawals in Kenya, including water used for livestock, irrigation and aquaculture. Due to climate change-driven drought in recent years, freshwater use by Kenya's agriculture sector has significantly increased, and was responsible for roughly 80% of all freshwater withdrawals in the country between 2016 and 2020 (World Bank in Data via FAO, AQUASTAT data). While most of Kenya's agricultural output is grown in rain-fed farming systems, only 17% of the country's arable land is deemed suitable for rain-fed agriculture. And, although irrigation is required in the remaining 83% of the country to ensure optimal crop growth, irrigated fields only occupy around 2% of Kenya's total area under crops (Hornum & Bolwig, 2020). Comparatively, in sub-Saharan Africa, 6% of arable land is irrigated, on average (FAO, European Union & CIRAD, 2023). A lack of investment in irrigation infrastructure increases climate vulnerability and food insecurity, so irrigation has become part of recent visions and strategies – such as Kenya's Vision 2030. Nevertheless, enhanced irrigation may also increase the amounts of freshwater withdrawn for agriculture, meaning that agricultural water management remains a serious challenge in Kenya.
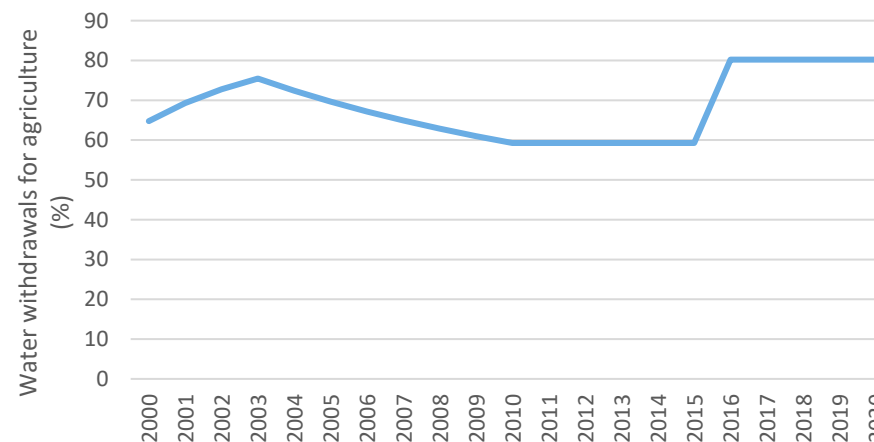
Figure 7 *Annual freshwater withdrawals, agriculture (% of total freshwater withdrawal), in Kenya*
Source: World Bank, 2020.

4.3.3 GHG emissions

Food systems are responsible for roughly one third of total GHG emissions in the world (Crippa et al., 2022). In Kenya, the food system is responsible for roughly 73% of the country's national net GHG emissions (FAO, 2023). Though emissions at a per capita level are low compared to the global average (1.2 tCO2 eq. per capita in Kenya vs. 2.1 tCO2 eq. per capita globally) (Marinus et. al., 2023), GHG emissions from the food system have been rising rapidly in recent years, from nearly 30,000 kton in 2000 to nearly 65,000 kton in 2018 Agricultural production was responsible for the largest share of Kenya's food system GHG emissions in 2018 at 83%, followed by 'end of life' (food waste and disposal) emissions (13%) (Figure 9). Within this, livestock – particularly the dairy and beef sectors – contributes to about 92% of agricultural emissions (FAO, n.d.).
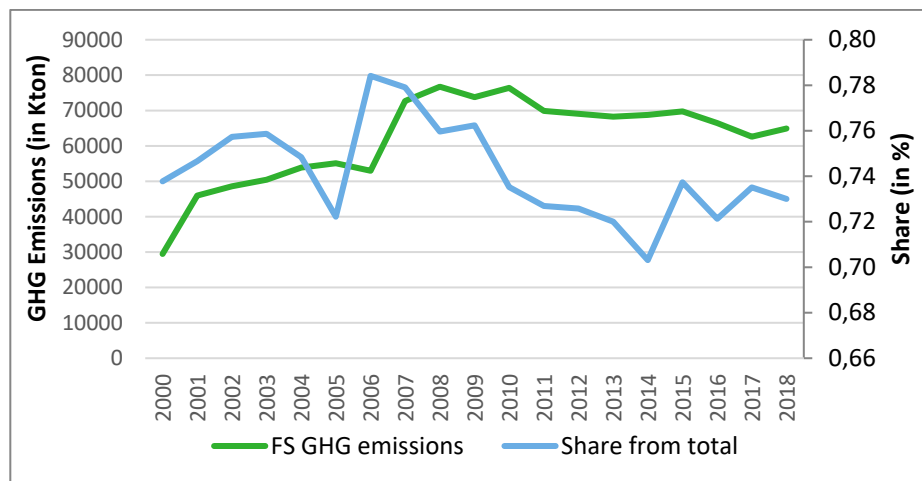
Figure 8 *Absolute (in Kton) and share of GHG emissions from the food system in Kenya*
Source: Crippa, 2022; Reference dataset: EDGAR-FOODv6.0.
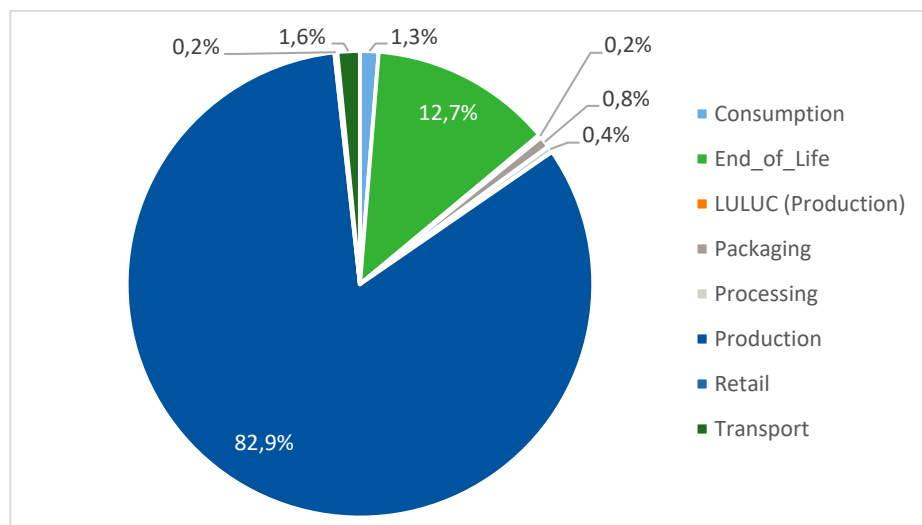
Figure 9 *CO2 eq. emissions in Kenya by food system stage in 2018*
Based on (Crippa et al., 2022).

5   Food system drivers

Following the snapshot of what the Kenyan food system delivers to society, we can begin to explore the factors that shape the food system and its associated outcomes. Food system drivers are detailed below in the following categories: demographics and development, consumption, technology, markets, policy and geopolitics, and climate and environment.

5.1   Demographics and development

5.1.1   Demographics

Kenya has experienced a strong increase in population growth, from 7.8 million in 1960 to over 54 million in 2022 (World Bank, 2022a). As of 2020, the population growth rate was 2.3%, with 28% of the population living in urban areas (FAO, European Union & CIRAD, 2023). Kenya's population is expected to nearly double by 2050, and a much larger share (46%) will live in urban areas (UN Population and Urbanization prospects, 2022) (Figure 10). The population increase has consequences on many aspects of the food system, particularly resource availability (FAO, European Union & CIRAD, 2023).

Kenya has a young population, with almost 38% of individuals under 15 years of age (World Bank, 2022a). The youth population is at the centre of dynamics related to future economic and demographic challenges and solutions. Given that most work takes place informally, most jobs for youth in the food system are in casual (agri)labour or as low value service provision. These jobs are generally not what youth aspire to, and some roles face additional negative perceptions. For instance, selling fresh vegetables is considered a (young) women's job (mama mboga) (Mugo & Kinyua, 2023, in Breisinger et al., 2023). Catering to the needs of the youth and harnessing their potential is a high priority for Kenya's leadership, despite indications that there is limited youth participation in decision-

making and there are limited frameworks accommodating the heterogeneity of the Kenyan youth (Mugo & Kinyua, 2023, in Breisinger et al., 2023).
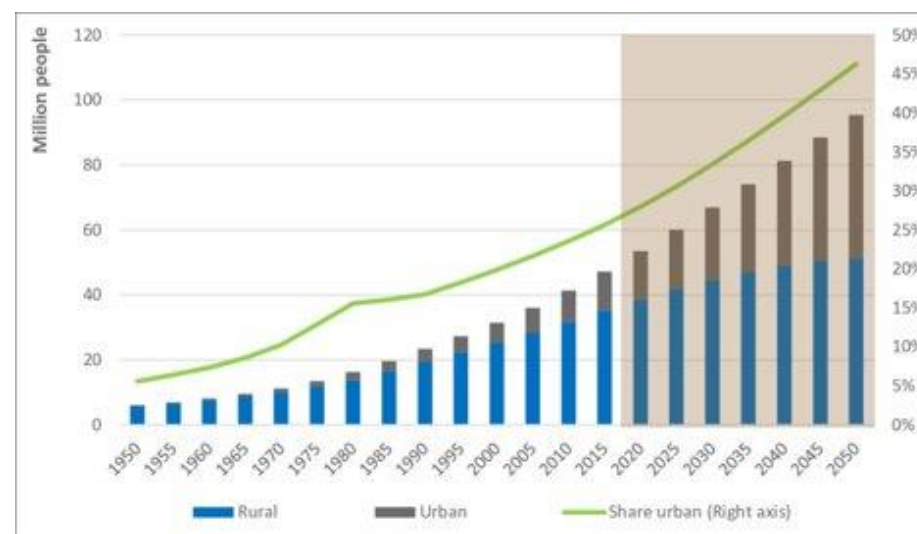
Figure 10 *Population growth forecast for Kenya and the divide between the urban & rural population*
Source: Binfield et al. (2019).

5.1.2   Macro-economic development

The GDP per capita has been sharply increasing, from approximately US$400 per capita in 2002 to US$2,100 in 2022. There was a slight decrease in GDP during the pandemic in 2020, but this recovered in 2021 (World Bank, 2022c).
Kenya's GDP growth has remained relatively stable at 5%, compared to 6.3% and 9.8% in neighbouring countries Tanzania and Ethiopia, respectively (World Bank,

2023). While agriculture, forestry and fishery contributions to GDP decreased from 25.9% to 21.2% in the period 2002-2022 (World Bank, 2022), there has been an increasing trend since 2010.

5.2   Consumption

Urbanisation, with its associated lifestyle changes and economic growth, shift diets towards more ultra-processed food and animal-sourced proteins, which contributes to more overweight and GHG emissions (FAO, European Union & CIRAD, 2023). In 2020, the average Kenya meat consumption was around 11 kg per capita, per year. In the US, this number was close to 127 kg per capita, per year (FAOSTAT, n.d.). While the current overweight and GHG-intensity of Kenyan diets are small, they are projected to increase in line with those of affluent countries.

These consumption habit changes have been explored by CGIAR in relation to the potential of Kenya's livestock sector (Bahti et al., 2023, in Breisinger et al., 2023) Their quantitative modelling analysis suggests that – through a combination of drivers – production of milk, beef, small ruminant meat, pig meat, poultry meat and eggs could increase by between 8% (eggs) and 69% (poultry meat) over 15 years. If one considers a scenario whereby bottlenecks, such as animal diseases, have been tackled through health and cattle vaccine interventions, a 166% increase in domestic supply of beef by 2034 might be possible (Bahti et al., 2023, in Breisinger et al., 2023).

In Kenya, wealthier consumers purchase food at supermarkets and retailers more often, which is partly driven by a concern for food safety (Yen et al., 2018). This drives the 'supermarketisation' of the distribution system, with modern shops, such as supermarkets, replacing traditional shops. As supermarkets ultimately compete with traditional markets and distribution systems, smallholder farmers may lose market access as they are unable to deliver the consistent quantity and quality necessary for supermarket procurements (Gómez & Ricketts, 2013). Yet, 'traditional' value chains are still well represented, even in cities. For example, traditional retail outlets sell 66% of Nairobi's staples, such as dairy, fruits and vegetables.

5.3   Technology

5.3.1   Innovation and entrepreneurship

Kenya is at the forefront of innovation and entrepreneurship in Africa, with Nairobi often referred to as the 'Silicon Savannah' of Africa. Together with South Africa, Nigeria and Egypt, Kenya is among the 'big four' technology ecosystems. In addition to public sector efforts (the Kenyan Startup Act; Micro & Small Enterprises policy), Nairobi hosts global tech giants including Google, Microsoft, Samsung and Intel, which also makes the city more attractive to tech start-ups.

5.3.2   Phone-based financial services

Kenya has been leading the way with mobile phone-based financial services platforms. For instance, alongside other operational services, M-PESA, launched by Safaricom in 2007, is considered a highly successful money transfer system used for retail payments, savings and credit supply. These innovations have made payments more efficient, transparent and safe, facilitating financial inclusion regardless of income level. Moreover, this type of money transfer system has enabled the establishment of online marketplaces for buyers and sellers (Gupta et al., 2017).

5.3.3   Technology in agriculture

Enhancing agricultural productivity rates is key to feed the rapidly increasing African population (De Groote et al., 2020). Although the use of improved varieties has increased substantially over the last 20 years, the use of land- and labour-saving technologies, such as mechanisation, has lagged (De Groote et al., 2020). The main types of mechanisation within Kenya's agriculture sector include animal-drawn and motorised machinery and equipment to increase power inputs (Ministry of Agriculture, Livestock, Fisheries and Cooperatives, 2021).

Artificial intelligence (AI) applications have also been developed for use in Kenya's agriculture sector. This includes technologies to monitor soil needs and identify pests and diseases in crops via photo images (e.g. Eska), and AI chatbots that give advice to farmers (e.g. Arifu). AI can also be used to determine a farmer's credit worthiness, based on farm information (e.g. Farm Drive). These platforms

are mostly privately owned and include collaborations between local institutions and international organisations (Akello, 2022). It should be noted that while private sector digital innovations move quickly in Kenya, the government only put in place a Data Protection Act in 2019.

5.4   Markets

5.4.1   International export markets

Enabled by growing global demand and value chains, state support and trade policies, Kenyan farmers have increased their capacity to engage in international markets – with tea, coffee, horticulture and floriculture being major export commodities (FAO, European Union & CIRAD, 2023). The global standards required for export are difficult to attain for the smallest producers, but those that can participate reap the benefits, causing a divergence of income growth and investments (Swinnen, 2007). Many Kenyan farmers are strongly connected with global food trade. Increasingly, the professionalised horticultural export farmers are also finding a middle-class consumer segment within Kenya that demands higher food quality and safety standards (FAO, 2023).

5.4.2   Import markets

Kenya relies heavily on imports of grains (ITC, n.d.). A key explanatory factor for sub-Saharan Africa's low agricultural productivity in comparison to other regions of the world, is the region's low rates of fertiliser use. As the New Partnership for African Development (NEPAD, 2013) notes, cereal yields in Africa are less than half of those obtained in Asia. Substantial agricultural intensification has not occurred in the region (Hemming et al., 2018).

5.5   Policy and geopolitics

5.5.1   Policy development

The Government of Kenya seeks innovative policy solutions for food systems. As such, it has prioritised a bottom-up approach, while also working closely with national and international research organisations. Furthermore, a vibrant national and international food policy research community, as well as digitalisation, provide support to policy- and decision-makers. The Government of Kenya plans to put a stronger focus on: coherent policy design and strengthening the science–policy interface; improving access to data; enhancing data-sharing between counties, and between counties and the national government; and empowering counties to get involved in data collection (CGIAR, 2023).
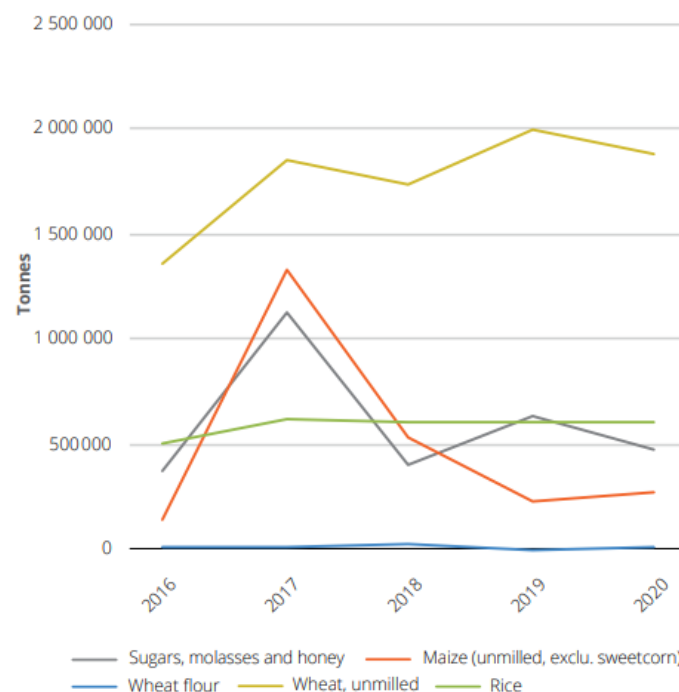

Figure 11   *Key imports of cereals (in tonnes) by Kenya between 2016-2020*

5.5.2   The war in Ukraine

Ukraine and Russia are significant global producers of cereals and sunflower oil, with Russia also being a major exporter of fertilisers. Since the outbreak of the war in Ukraine in February 2022, global food prices have increased, particularly for cereals and vegetable oils, which were already at high levels in 2021. This has led to record-high prices since March 2022. The disruption of Ukrainian agriculture caused by Russia's invasion has created a shortage of commodities in African countries, like Kenya, that heavily rely on imported grain and products such as fertiliser and irrigation equipment.

In 2021, Kenya imported 85.7% of its wheat from the rest of the world, including Russia and Ukraine, who provided 28.5% of the wheat consumed in the country. In 2021, total wheat imports stood at 2.1 million tonnes compared to 350 tonnes produced within the country (UNDP, 2022b). Fertiliser imports from the rest of the world into Kenya were estimated at 10,526 mt in 2019. Of this amount, 1,008 mt (9.6%) were imported from the Russian Federation, making the latter the third-largest source of fertiliser after Jordan and Germany. These three countries accounted for 73.4% of total fertiliser imports in Kenya. Over 70% of fertilisers is used in maize, tea and flower production, which are critical produce in the export market (UNDP, 2022b).

5.6   Climate and environment

5.6.1   Land use change

When Kenya gained independence in 1963, about 11% of the country was covered in forest (Stiebert et al., 2012). By 2010, this number had dropped to 6% (Global Forest Watch, n.d.) as a result of charcoal and timber production, agriculture expansion, unregulated logging and urbanisation. Not only has this deforestation contributed to climate change, but it has also played a role in a number of other devastating impacts, including land degradation, increased flooding risks, reduced availability of freshwater during droughts (Mutuku, 2019) and habitat loss. In turn, these outcomes increase pressure on agricultural production.

Land use dynamics are also influenced by sociocultural norms that shape customary land tenure systems. Land is generally only transferred to sons, once they have their own family or when their father passes away – and these practices are excluding Kenya's youth population from accessing land. Traditional norms and systems also impact land management and the economic potential of holdings, as land is consequently subdivided in smaller plots over generations and women have even greater difficulty accessing land (Mugo & Kinyua, 2023, in Breisinger et al., 2023).

5.6.2   Climate variability and change

Kenya's economy is highly dependent on its natural resource base and is thus highly vulnerable to climate variability and change. Rising temperatures and changing rainfall patterns result in increased frequency and intensity of extreme weather events. Both annual precipitation (Figure 12) and incidence of droughts have increased (FAO, European Union & CIRAD, 2023), which threatens the sustainability of the country's development. To safeguard sustainable development, the Government of Kenya has developed a National Climate Change Framework Policy (NCCFP) to provide a clear and concise articulation of overall response priorities to climate variability and change. The NCCFP is further complemented by a National Climate Change Action Plan, which contains sectoral mitigation priorities.

As a result of global warming, the average temperature in Kenya is rising, while the long-term annual precipitation trend is decreasing – particularly in the ASALs (World Bank, 2021). Kenya's average annual temperature has increased by about 1.5 °C since 1990, fuelled by climate change in combination with the strong influence of El Niño and La Niña periods (FAO et al., 2020). The annual mean temperature trend (between 1991 and 2020) shows a steeper slope than in the past. Moreover, drought is a significant pressing environmental risk for farmers and pastoralists. Twenty-eight droughts have occurred in the past 100 years, equalling once every three to four years on average, and drought frequency has been increasing since 2000 (World Bank, 2021). In 2022, there was a prolonged drought during four rainy seasons, with below-average rainfall in ASALs and some areas not experiencing rain for three years (FAO, European Union & CIRAD, 2023). These periods of drought contribute to rising food insecurity and poverty.
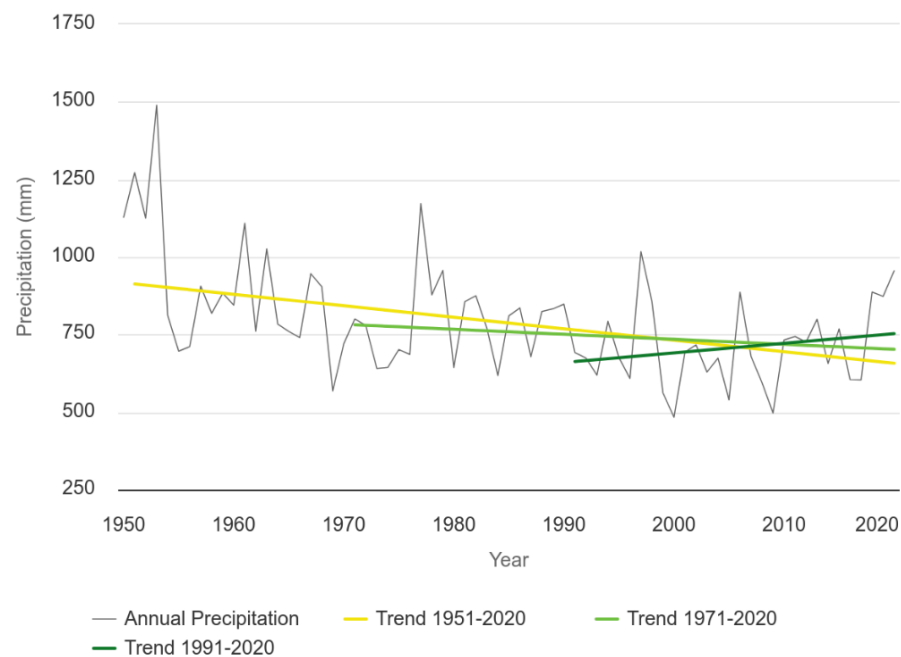
Figure 12   *Annual precipitation (mm) and trends per decade between 1951-2020 in Kenya*
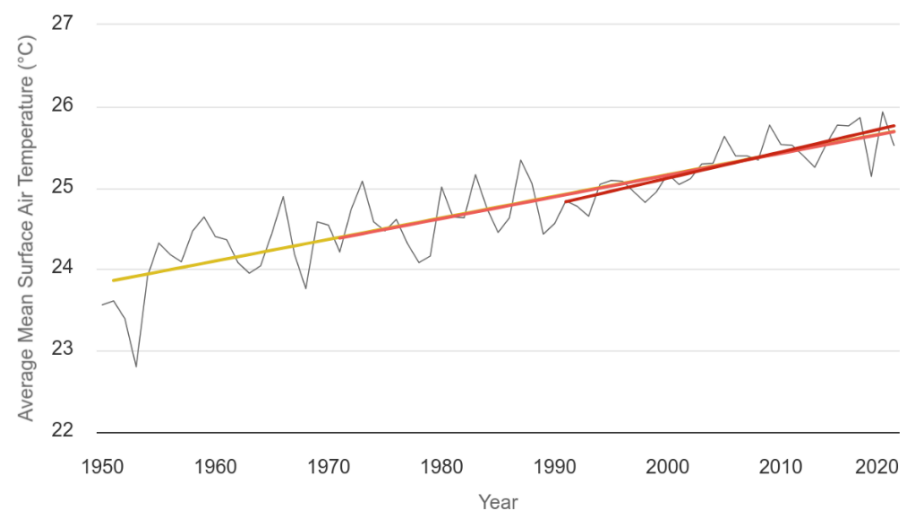

Figure 13   *Average mean surface air temperature and trends per decade, between 1951 and -2020 in Kenya*
Source: World Bank, n.d.

6   Actors and activities

This section presents the key actors in the Kenyan food system, along with their activities throughout value chains and the environments within which they operate. The Kenyan population living in urban areas has been steadily growing, and is currently around 30%. Kenya is an important exporter of tea, flowers and green coffee, whereas cereals, fats and oils rank among the products that are imported in the largest volumes. Most value addition to the economy by agricultural value chains occurs at farm level, with cereals most representative of this. The root crops value chain is the least oriented toward off-farm value addition, with almost all value added generated at the farm level: for every US$1 generated on-farm, US$0.49 is generated off-farm. As Kenyan agriculture increasingly becomes market-oriented, it is expected that off-farm activities will grow (Breisinger et al., 2023). Although the majority of consumers buy their products at traditional outlets, there is a growth in the market share of supermarkets. A summary of key actors and their activities is provided in Table 1. The food system activities are then placed into context by describing the enabling environment and food environment in which they take place.

Table 1   *Overview of key food system activities in the value chain and related stakeholders*

	Production	Processing	Trade	Retail	Consumption	Storage and disposal
Actors and activities	• Dominated by smallholder production (66%) • Stagnating yields • Increasing pressure on available arable land • Largely dependent on rainfed agriculture (98%) • Recently deregulated fertiliser market • Increasing trend in usage of fertiliser and pesticides	• Processing agricultural products into higher-value intermediate or consumer products • The food and beverage processing industry is the largest manufacturing industry in Kenya (55.1%) • Relatively low percentage (16%) of exports products are processed	• In 2022, total imports accounted for US$21,128 million • Cereals and animal and vegetable fats rank among the five most imported product groups • Total exports had a value of US$7,390 million in 2022 • Tea, flowers, fruits and vegetables, and unroasted coffee are some of the main export products • Kenya is considered a regional trade hub in East Africa	• Traditional markets (informal markets and via micro-, small- and medium-sized enterprises) still dominate, representing 66% of total outlets • Supermarketisation: modern retailing is growing in number and volume of sales • Online retail platforms are also becoming increasingly popular and more widely available	• Because of urbanisation, there is increasing dependency on food markets • Westernisation of diets, including more fast food • Promotion of indigenous crops: potential to diversify diets and provide affordable source of nutrients	• Food losses ranging from 12-25% • In 2017, over 1.9 million tonnes of food was wasted to post-harvest losses • General lack of storage facilities • Mismatch in supply and demand; overproduction during the rainy seasons leads to higher losses

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6.1 Food system activities

6.1.1 Production

Agriculture is an important source of livelihoods, but agricultural land is increasingly under pressure. The agricultural sector employs more than 33% of Kenya's total population (World Bank, 2022g), and more than 70% of people living in rural areas, with a high percentage of women working on farms (FAO, 2023b). Agricultural crop land is concentrated in central and western Kenya and covers about 27,710 thousand hectares, 48.5% of the Kenya's total land area. Although this number has been stable since 2011 (FAOSTAT, 2021), pressures on land are increasing due to a growing human population and growing herd sizes. As a result, the size of agricultural land parcels is decreasing (see Figure 14), affecting productivity and yields (FAO, 2023b).

Smallholder farmers are responsible for the majority of agricultural production and provide a range of different products. The agricultural sector consists of about 4.5 million smallholder farmers (approximately 66% of all farmers), including 3.5 million crop farmers, 600,000 pastoralists and 130,000 fishermen (IFAD, 2019). Farmers have an average land size of 0.2-0.3 hectares (Rampa & Dekeyser, 2020) and generally less than 2 hectares (FAO, 2015). Smallholders are responsible for 65% of the marketed agricultural produce (Rampa & Dekeyser, 2020). Among the most produced commodities are sugar cane, raw milk, maize, potatoes and tea (FAOSTAT, 2023). Livestock is mainly held in ASALs by pastoralists on communal lands. The key livestock subsectors are beef, dairy, sheep, goats, camels, poultry and pigs. The livestock sector is estimated to account for about 12% of the country's GDP and 40% of agricultural GDP, and employs about half of the agricultural labour force (Breisinger et al., 2023).

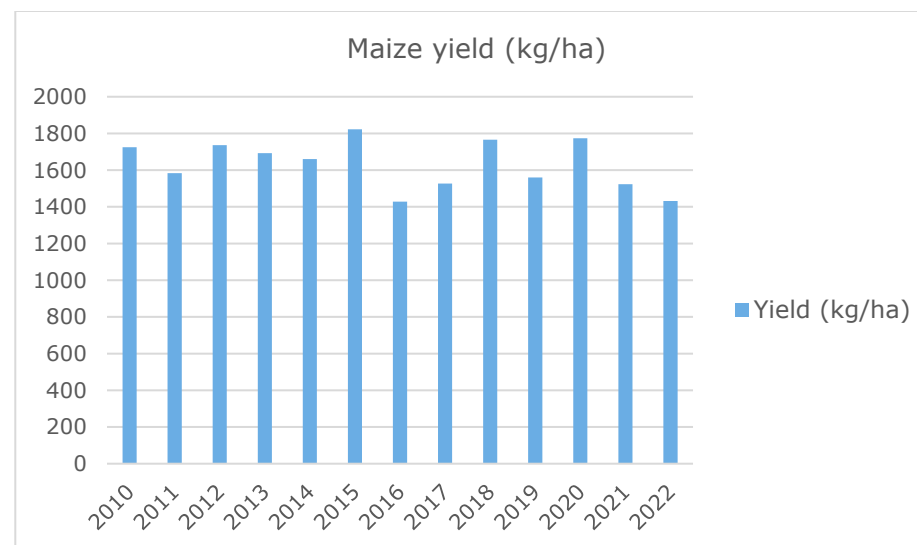**Figure 14**   *Available arable land per person in Kenya between 1970 and -2020 Source: World Bank, 2022.*

Figure 15   *Maize yields in kg per hectare in Kenya, between 2010 and 2022 Source: FAOSTAT, 2023.*

Medium-scale farms (5-100 ha) account for around 20% of all farmland (Jayne et al., 2016). Moreover, there is medium- and large-scale production of coffee, tea and horticultural products, especially for export. Large farms can mainly be found in Nakuru, Uasin Gishu, Trans-Nzoia, Kericho, Nandi and Laikipia (GOK, 2023). Many international investors are involved in this type of production type (FAO, European Union & CIRAD, 2023).
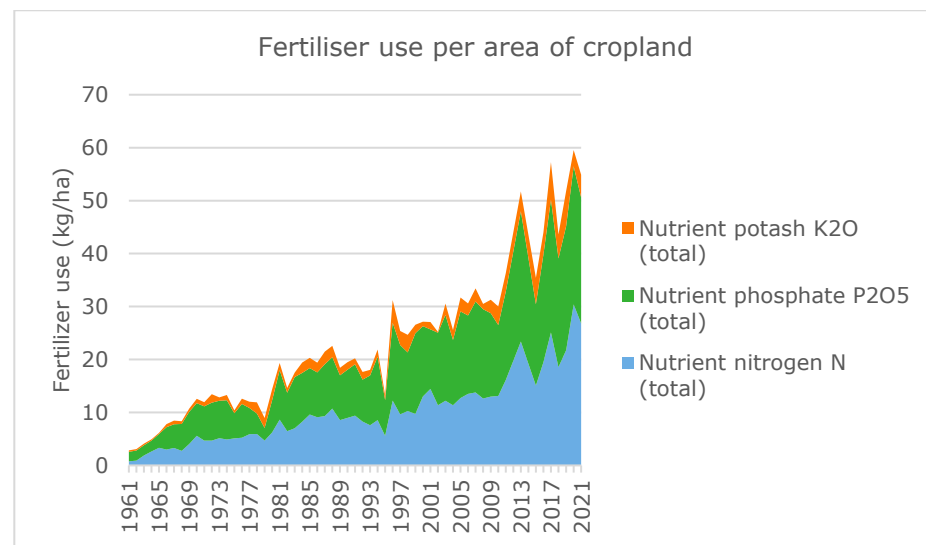

Figure 16 *Quantities of fertilizer use per hectare of cropland, specified for nitrogen, phosphate and potash fertilizer*

Although the use of agricultural inputs has increased over time, productivity levels for many crops are below potential levels. Crop and livestock yields have stagnated in recent years (USAID, 2023); see Figure 15 for developments in average maize yield over time as an illustrative example. This stagnation is partly due to low levels of mechanisation, lagging technology development and adoption, and a lack of economies of scale (De Groote et al., 2020). Agriculture in Kenya is still 98% dependent on rainfed production (USAID, 2018). Meanwhile, the use of fertilisers has been growing (Figure 16). The fertiliser market has recently been deregulated, and fertiliser has been subsidized (World Bank, 2020a), making it

more accessible to smallholder farmers, which benefits the national food supply (IFPRI, 2023). However, greater fertiliser use comes with increased energy costs and emissions from production (Lord, 2023) – although fertiliser application is about 60 kg per hectare in Kenya, which is much lower than the global average of 146 kg per hectare (Malpass, 2022). Moreover, Kenya ranks among the top 10 African countries in terms of pesticide imports.

6.1.2 Processing

Compared to other African countries, Kenya is relatively industrialised, and ranks among the top 10 countries in Africa's industrialisation index (AfDB, AU & UNIDO, 2022; Ogunjuyigbe, 2022). The value addition from manufacturing increased from US$5 billion to nearly US$9 billion over the period 2010-2022 (World Bank, 2022f). Only South Africa, Egypt, Nigeria and Morocco account for a larger manufacturing value in Africa. The most important manufacturing sectors in 2021 included food and beverages (55.1%), chemicals and chemical products (8.4%), fabricated metal products (6.4%), non-metallic metal products (5%) and textiles (4.1%) (UNIDO, n.d.). Meanwhile, the fruit, vegetable and cut flower sectors employ around 200,000 people and generate over US$1 billion in export revenue per year (Ogunjuyigbe, 2022).

The food and beverage sector in particular makes up a substantial share of the processing industry. Agrifood processing primarily concerns coffee and tea processing; the milling of rice, maize and wheat; and the processing of oils and fats. Additionally, there are 23 milk processors and 74 licensed mini dairies (FAO, European Union & CIRAD, 2023). Processing activities are centred in urban areas with industrial facilities, especially Nairobi, Thika and Kiambu, with 46% of the food processing workforce located in such areas (FAO, European Union & CIRAD, 2023). However, capital investments in processing capacity have been restrained by inadequate quantity and quality in the supply of raw materials (World Bank, 2019b).

There is potential to increase the level of product processing in Kenya. Only 16% of Kenya's agricultural exports are processed, particularly pineapples and beans, compared to 57% of imports. Some major cash crops don't need processing, such as flowers, or only require primary processing, such as coffee and tea (FAO, European Union & CIRAD, 2023). Trade barriers of importing countries can also

restrict the export of processed goods from developing countries. For example, the EU imposes lower tariffs on raw and intermediate products than on consumer products (European Commission, 2023). Many primary cash crops either do not require processing, or processing is performed elsewhere. Yet, there is significant potential to increase processing activities in Kenya. For example, about 40% of all fruit is lost or wasted, whereas only 8% is currently processed (FAO, European Union & CIRAD, 2023). There is potential to expand exports of processed foods such as fruit purees, processed vegetables and macadamia nuts. For the Kenyan market, there are opportunities to grow markets for purees, potatoes, fish and meat (e.g. canned or smoked) (World Bank, 2019b). Processing and local value addition are considered key to improving economic development and food security, as emphasised in Kenya's strategic Transformation and Growth Strategy and the Big Four Agenda (FAO, European Union & CIRAD, 2023).

6.1.3 Trade

Kenya has a negative total trade balance, and is thus a net importer. In 2022, total product imports accounted for US$21 billion, compared to exports with a value of US$7,390 million. Cereals and animal and vegetable fats rank among the top five most imported product groups (ITC, n.d.). Products are mainly imported from China, United Arab Emirates, India, Saudi Arabia and Malaysia. Tea, on the other hand, is the major export product, and (cut) flowers, fruits and vegetables, and unroasted coffee also rank among the main export products. The majority of products are shipped to Uganda, USA, the Netherlands, Pakistan and Tanzania (ITC, n.d.). Agriculture produce accounts for 65% of total exports from Kenya (FAO, 2023b), and Figure 17 shows the export values of the five main agricultural products traded.

Kenya is considered to be a regional trade hub in East Africa. The country is strategically located, with the port of Mombasa being the largest in East and Central Africa (Ho, 2019). Besides, Kenya is relatively developed in terms of logistic infrastructure and membership of regional economic blocs, making it a regional trade hub (USDA, 2023; Africa Business Pages, n.d.). By ratifying the African Continental Free Trade Area in 2022, Kenya also aims to expand and boost exports within Africa (UNECA, 2021). Tariff liberalisation and/or subsidising food crops is expected to have beneficial effects on food consumption and welfare (Nechifor et al., 2022).

6.1.4 Retail

In Kenya, most food distribution is informal and for the domestic market. The types of food retailers vary widely, ranging from food kiosks and grocers, which includes open air markets and mini-markets (FAO, European Union & CIRAD, 2023). Traditional retail outlets still sell 66% of Nairobi's staple foods. Apart from food distribution, small-scale food retailers and markets also provide employment and livelihoods to many Kenyans. Yet, inadequate legislation and weak food regulatory agencies have contributed to poorly regulated food outlets and low hygiene levels.
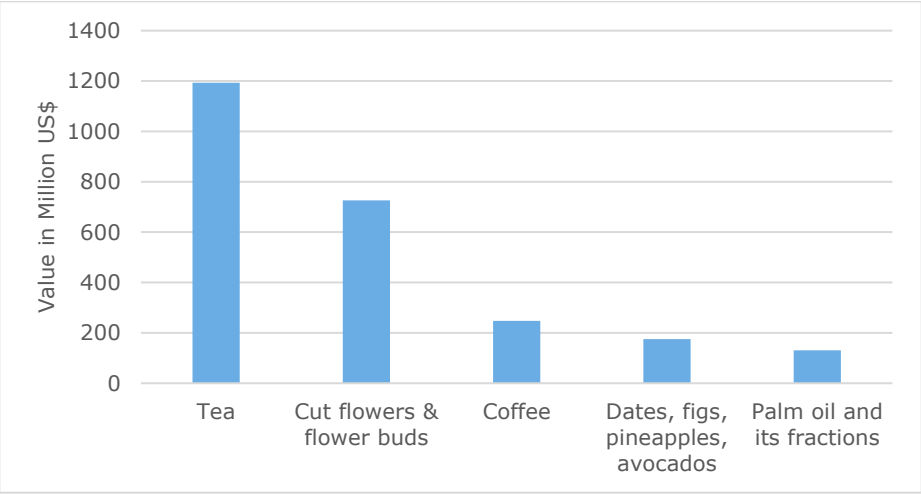
Figure 17 *Value of the five main agricultural products exported from Kenya in 2021*

Growing food safety concerns, particularly among the urban population, have also spurred a 'supermaketisation' of the distribution system (FAO, European Union & CIRAD, 2023). There is rapid growth in the number of supermarkets (IFPRI, 2018; Rampa & Dekeyser, 2020) offering processed foods, staple foods, fruits and vegetables. Modern grocery retailers stock most categories of imported consumer-oriented high value products. Supermarkets can influence price premiums and set food safety and quality control criteria. They also often have their own system of registered traders (Rampa & Knaepen, 2019) that can

guarantee consistent quantities and produce quality. Yet, the number of supermarkets per 100,000 people remains low Hin Kenya and Africa overall (Food Systems Dashboard, n.d.).

Moreover, most of Kenya's major food retail chains have developed an online presence. Many retailers have formed partnerships with online firms such as Jumia, Glovo, Copia and Uber Eats. During the COVID-19 lockdown, e-commerce grew substantially, especially the food and beverages segment (ITA, 2022). E-commerce is now moving into the rural areas, as well (USDA, 2023).

6.1.5   Consumption

Lifestyle changes and economic growth encourage shifts in diets towards greater consumption of (ultra-)processed food and animal-sourced proteins. In Kenya, the share of the population living in urban areas is increasing. Currently, nearly 12% of the population lives in Nairobi, which is 80% dependent on food supply from outside the city. As a result, there is a strong link between agricultural production and Nairobi's food markets (Rampa & Knaepen, 2019). A growing middle class, with rising disposable income, is becoming more aware of food safety considerations and increasingly willing to pay a premium for safer foods (IFPRI, 2018). Imports of consumer food products have increased, with an average annual rate of 9.6% between 2016 and 2020 (USDA, 2023). There has also been a surge in the number of multinational fast-food companies with branches in Kenya, such as KFC, Papa John's and Chicken Cottage. This highlights a trend towards the westernisation of consumer food preferences in Kenya and more broadly in East Africa (FAO, European Union & CIRAD, 2023).

Healthy and diverse diets remain elusive for most Kenyans. In 2021, 74% of the population could not afford a healthy diet (World Bank, 2023c). In rural areas, households spend more than 60% of their income on food, and in urban areas, this figure is 48.8% (Amadala, 2023). Since 2022, Kenya has faced high inflation rates and increasing costs of living due to a combination of factors, ranging from prolonged droughts to depreciation of the Kenyan shilling (Shibia, 2023). On average, the caloric intake has been insufficient in Kenya, with 2,193 kcal per capita per day in 2020 (Figure 18), compared to a target intake of 2,500 kcal/capita/day (FAOSTAT, n.d.). Moreover, the share of dietary energy derived from cereals, roots and tubers has been around 58% over the last two

decades (Food Systems Dashboard, n.d.), compared to a world average of 50%, indicating an unbalanced diet. FAO indicates that increasing awareness of indigenous vegetables can be one way to support consumption diversification. Research about the nutritional value of indigenous vegetables, and related awareness campaigns on national media, have contributed to the growing focus on these vegetables (Rampa & Dekeyser, 2020).

6.1.6   Storage and disposal

A lack of storage facilities and low levels of food processing, coupled with other market failures, leads to substantial losses. Losses reported by the processing industry and supermarkets range from 12-25% (FAO, European Union & CIRAD, 2023). In 2017, over 1.9 million tonnes of food was wasted in post-harvest losses, all the while Kenya was facing a severe drought (FAO, European Union & CIRAD, 2023). On the other hand, during the rainy season, there are often cases of overproduction, which leads to falling prices and/or food waste (Rampa & Dekeyser, 2020).
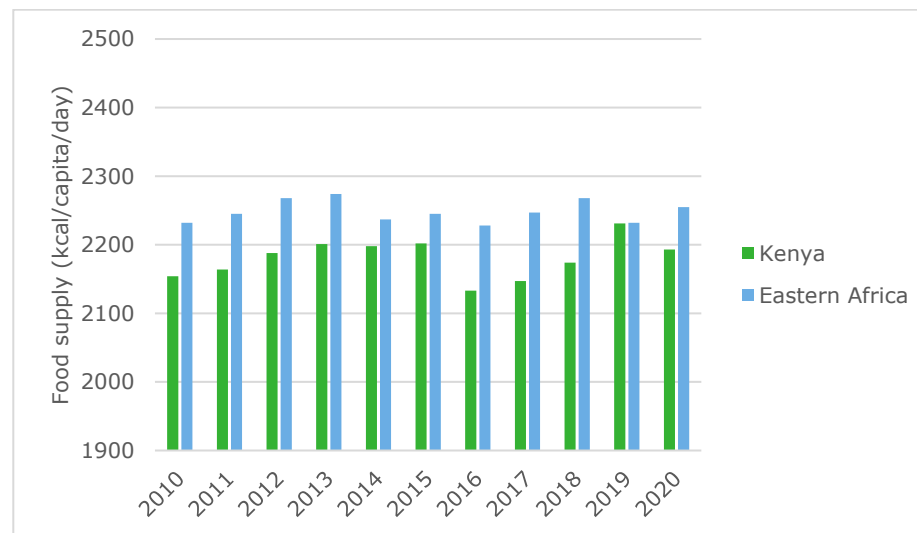

Figure 18   *Food supply in kcal per capita, per day, in Kenya and East Africa*

6.2   Enabling environment

6.2.1   Support services

Kenya is at the forefront of innovation and entrepreneurship in Africa; Nairobi is often referred to as the 'Silicon Savannah' of Africa. Together with South Africa, Nigeria and Egypt, Kenya is among the 'big four' technology ecosystems and home to numerous tech start-ups. Most start-ups can be found in the fintech, agri-tech and e-health sub-sectors (Disrupt Africa, 2022). Besides public sector efforts (the Kenyan Startup Act, Micro & Small Enterprises policy), Nairobi hosts global tech giants like Google, Microsoft, Samsung and Intel, making it more attractive to tech start-ups.
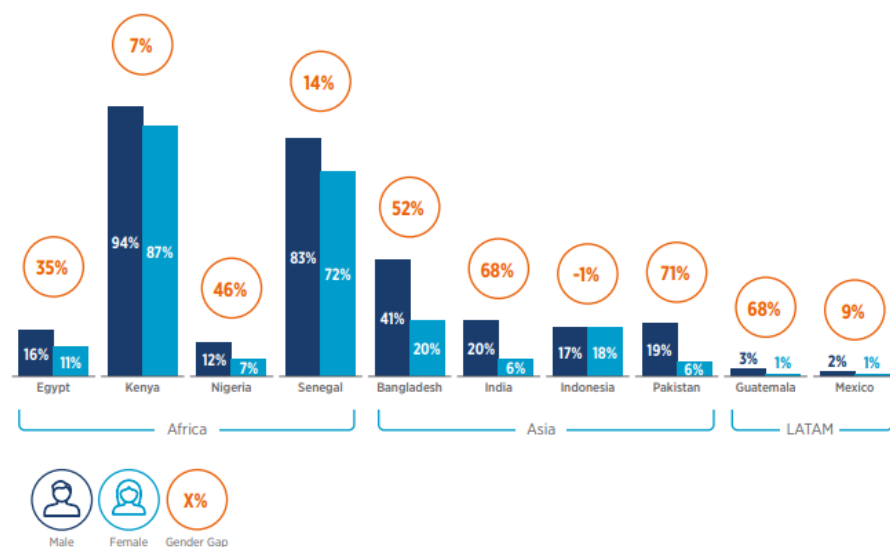
Figure 19   *Percentage of the total adult population that has mobile money account ownership, by country and gender*
Source: GSMA, 2022.

Kenya is rapidly expanding its digital infrastructures, which contributes to economic growth and development. Investments in undersea cables have improved internet speed (FAO & ITU, 2022), and mobile internet uptake has reached 56.5% (World Bank, 2022e) – with the uptake of mobile money in Kenya among the highest in the world (GSMA, 2022). The country is relatively well connected to electricity networks, and access to electricity has more than doubled in recent years: from 32% of households in 2013 to 75% in 2022. This access rate was more than 97% for urban areas and 68% in rural areas (IEA, 2023). The Last Mile Connectivity Project of the Kenyan government also contributed to enhanced access levels (IDEV, 2022).

Kenya has hosted many digital innovation pilots and start-ups tailored to the food system – ranging from agricultural extension services (iCow, iShamba); weather information services (KALRO's Kenya Agricultural Observation Platform (KAOP), SunCulture); market information systems (M-Kilimo); digital financial services (M-Pesa, M-Shwari); supply chain coordination (Viazi Soko, Smart Cow); and data and crowdsourcing (KAZNET, Nuru). However, many of these services are still operating as pilots and start-ups with difficulty to grow to scale. Services that do operate at scale, such as M-Pesa, do not demonstrate great uptake among farmers. Challenges to scale and transform the food system relate to a lack of increased and sustained public and private investment, along with a lack of a comprehensive digital policy environment. Specifically in the food systems space, other factors include a lack of agricultural changes keeping pace with digital innovations, and limited digital literacy of users and lack of inclusive client focus by digital service providers (Tabe-Ojong et al., 2023; in Breisinger et al., 2023).

Kenyan tech startups by sub-sector

Fintech	Agri-tech	e-health	e-commerce	Recruitment & HR	Ed-tech	Logistics	Mobility	Energy	Marketing	Other
93	31	31	29	19	18	14	8	7	7	51
30.2%	10.1%	10.1%	9.4%	6.2%	5.8%	4.5%	2.6%	2.3%	2.3%	16.6%

Figure 20   Technology start-ups per sector, in Kenya

6.2.2   Energy

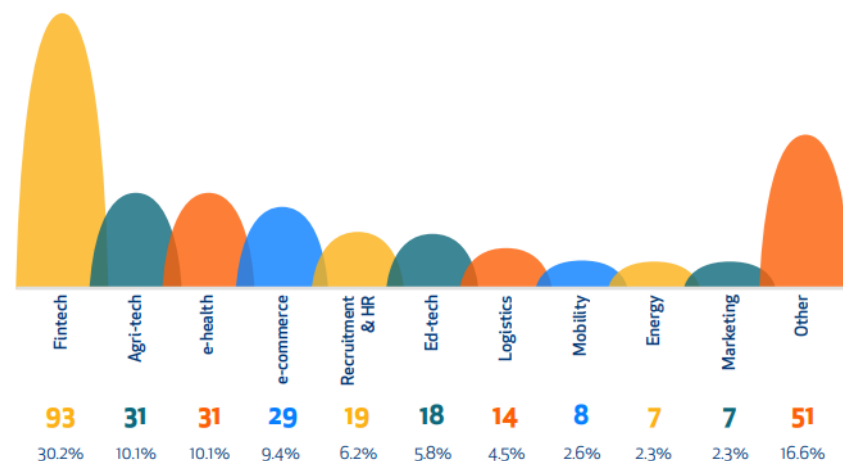Over the last decade, the national electricity generation capacity has grown substantially, from 1,800 MW in 2014 to 2,990 MW in 2021. 'Renewable energies, such as geothermal, hydro, wind and solar energy, account for 80% of Kenya's electricity (ITA, 2022).
In light of climate change, the country has stated further ambitions to transition to clean energy and improve energy efficiency and access (IEA, 2023). Despite the availability of electricity, firewood remains the main source of energy for the rural population. For the urban population, the main fuel type is petroleum gas (FAO, European Union & CIRAD, 2023). The use of biomass as an energy source is also high, often sourced from nature (IEA, n.d.).

6.2.3   Infrastructure

Kenya's logistical network is among the most developed in East Africa. The Northern Corridor – including roads, railways and waterways – is the most important transport route in East and Central Africa; starting at the Port of Mombasa, travelling through Nairobi, and continuing to Uganda, Rwanda and

Burundi. Via the Mombasa-Nairobi-Addis Ababa Corridor, the country is also well connected to Ethiopia (AfDB, 2019). The main mode of transport in Kenya is via road, carrying approximately 93% of all cargo and passengers (Logistics Cluster, 2022). Furthermore, with investments from China, the standard gauge railway line has been developed, with the aim of connecting Kenyan cities with neighbouring countries (The East African, 2023).

6.3   Institutional environment

Kenya is characterised by differences in regional development that can be traced back to colonial times (Friedrich Ebert Stiftung, 2012). Development funding policies prioritised investments in high rainfall areas, due to the perceived higher returns, as well as in urban areas, due to the political power of urban populations. As a result, 14 of the country's 47 counties have been identified as marginalised (World Bank, 2019). This is evidenced in infrastructure deficiencies, including lack of access to roads, electricity, health care, education, water and sanitation in north and north-eastern counties. In 2010, a devolved governance system was implemented, in which increased responsibilities were delegated to the 47 county governments, including key agriculture responsibilities. Counties can independently allocate their budget to agriculture in addition to the normal budget transfers from central government.

Kenya's public procurement spending between 2015 and 2019 (12.2%) was higher than average in Africa (8.7%), and can create a strong demand pull for local producers. However, the African Union recently called upon member states to allocate at least 30% of public procurement contracts to the African private sector (AUC/OECD, 2022). Further, public expenditure on the agriculture sector remained at around 2% in the 2021/22 fiscal year, well below the Malabo commitments of 10% and below the spending of its peers in Africa south of the Sahara (AUC, 2014; Kenya Parliamentary Service Commission, 2021; Pernechele et al., 2021, in Breisinger et al., 2023)

In particular, the Kenyan government invested heavily in digitalisation and information and communication technology infrastructure, as it intends to make Kenya are leader in mobile payment usage (GOK, 2023). Other governmental initiatives include an ambitious national school meal programme which started in

Nairobi (Oniango, 2023); the Kenya Youth Employment and Opportunities Program; and the Haba Haba and Mbao pension plans, which enable informal sector workers to save for retirement (World Bank, 2022e). Overall transparency about public procurement is, however, limited (World Bank, 2020a)

The Kenyan government focuses on supporting a 'Big Five' of agricultural crops and their marketing arrangements: maize, rice, potatoes, tea and coffee (Rampa & Dekeyser, 2020). The selection is based on the crop's relevance for food security or trade. Government investments in these 'political crops' can affect market prices and policies related to the specific sectors. For example, the maize sector is heavily impacted by government subsidies for inputs (such as fertilisers), direct buying by the state and subsidised imports (Rampa & Knaepen, 2019). In addition, there is a government focus on livestock and dairy. The formal milk processing chain is dominated by just three companies, of which one is owned by the former president's family (FAO, European Union, & CIRAD, 2023).

Other government policies that affect the Kenyan food system include the 2017 Kenya Climate-Smart Agriculture Strategy. This aims to guide the transformation of Kenya's agricultural system through to an integrated approach comprising agriculture, climate change, development, environment and food security. Moreover, the Agriculture Sector Transformation and Growth Strategy seeks to modernise agriculture by 2029, and is centred around increasing farmers' income, output and value adding, and household food security, particularly in the ASAL regions.

7 Food system dynamics

7.1 Mapping food system dynamics

To enhance understanding of Kenya's food system dynamics, it is necessary to draw links between its various elements: the drivers, actors and activities, and outcomes. The links and influences (+/-) between some key food system elements are mapped in Figure 21. This causal loop diagram (CLD) tries to capture the main elements, including drivers (green), outcomes (pink) and activities (blue) in the food system, which relate to, influence and change each other. In the CLD, '+' indicates a reinforcing connection (one element leads to more of another element) and '−' indicates a balancing or opposite connection (more of one element leads to less of another). This kind of analysis helps to connect issues across sectors and domains, while also showing the causal relationships between these. Based on this analysis, we can infer a number of patterns occurring in the system (Stroh, 2015).

A note as caveat: It should be noted that this CLD is still simplified and does not capture the full complexity of the food system. Finally, due to the national level of analysis, a number of generalisations may occur that could be different at regional level. This simplified CLD indicates a few observed patterns in the system, augmented by discussions during workshops conducted by FoSTr in Nairobi, Nakuru and Marsabit.

Agribusiness ascending: One of the first major patterns we identified is related to the topics of market competition in the agri-food space. Dynamics around market competition, particularly when it comes to access and reach to international markets and more upscale urban retail areas in Kenya, increasingly favour either high quality, safe foods or extremely cheap bulk foods. Agribusiness companies that can substantially raise quality and access high paying retail markets, or can consolidate for economies of scale, have a growing edge over smallholder farmers and other small- and medium-sized enterprises (SMEs). Compounding the dynamics, smallholder land subdivision, reallocation of capital

and increasing benefits from technologies and smart data management, widens an already large divide between smallholder farmers and larger agri-firms. Agri-firms, in turn, become more successful, raising their ability to invest more in accelerating digital and financial innovations, and becoming more attractive to the public sector as a source of tax and foreign currency. This contributes to a reinforcement of the paradigm that large scale farming is more efficient. Such differences among food producers are further widening the gaps in segmented food markets, reinforcing a systems pattern which can be called 'success to the successful'. All the positive dynamics surrounding the model of larger scale agriculture leads to the detriment of the viability of small-scale farming. Older farmers with small plots may retire or step out, leading to increased land fragmentation, fallow land or sales, and loss of knowledge. This negatively affects the viability of smallholder farming in the long run, and also brings environmental challenges, as described below.

The food security trade 'hydra': A second major systems dynamic is regarding food security-related imports and exports at national level. As urbanisation increases and local food production remains stable (does not increase substantially), gaps in the food balance sheet occur, and it becomes imperative that Kenya secures enough food for its people, at the most affordable price. Cereals in particular are sought at cheap world market prices. People's diets are also changing: for some, due to socio-economic growth, there is an eagerness to consume (imported) processed foods and proteins. For others, there is behavioural dependency on cheap staples. In order to finance imports, Kenya needs to increase its exports. The country mostly exports low-processed export commodity crops, such as tea, coffee and horticulture, which deliver revenue and economic growth but are being traded-off against food crops and value chains that emphasise food and nutrition security outcomes. At the moment, tea and coffee offer limited poverty alleviation effects and limited food and nutrition outcome value. In its current form, horticulture is similar, as the majority of Kenyan consumers cannot access or purchase many of the types of vegetables

produced in this sector, and purchase/grow limited vegetables and fruit from the informal economy. Furthermore, a new problem is in the making: a trend toward unhealthy diets. Overall, these issues may combine to form a pattern that could be called 'Shifting the Burden'. Metaphorically, it becomes like trying to cut off the head of a mythological 'hydra' (a mythological water-snake that has the property of generating an extra head if its head is cut off). The quick fix solution to the food security problem does not fundamentally solve the problem at large. It also gives rise to new and perhaps even greater long-term challenges, notably an emerging diet, economic and health divide, particularly between urban consumers and rural communities. This divide brings with it significant implications for food imports, (maize) production, long-term health care and general workforce productivity. Urbanised communities grow relatively richer and change their diet patterns (in many cases towards an unhealthy 'Western diet'), with consumption patterns shifting to rice and other imported cereals as well as animal-based proteins and processed foods. Meanwhile, rural and peri-urban communities remain poorer and subsist on cheap staples and produce from local, informal food markets. They continue to grow maize for their own consumption, but have a hard time purchasing a healthy and diverse diet. Both sides of the divide will generate new challenges for society, particularly in healthcare, as both malnutrition and obesity cases remain.

The decreasing carrying capacity of the environment: The third pattern we identified relates to the status of the environment in Kenya. With climate change increasingly visible, particularly notable in the form of the recent six-year drought in the north of the country, new micro-climates and shifting seasons will affect Kenyan agriculture. At the same time, there is pressure to increase production due to high demand for more food, but also production of more resource-intensive food (cattle, livestock, etc.) is expected. This creates a dilemma regarding, for instance, livestock and challenges in the ASALs: growing demand from Kenyan consumers for animal-based proteins might offer a significant potential market growth of the livestock sector, yet the long droughts that affect key livestock-producing regions pose a significant climate risk for expansion of that sector and a relative risk to climate mitigation efforts. More to the south, in the Rift Valley, increased potential for horticulture and floriculture due to export opportunities, as well as an increased appreciation for large-scale consolidated agri-firm production, puts increasing pressure on natural resources, water tables, soil health and biodiversity. This is visible in deforestation, land degradation and

pollution incidences over the past decades. Smaller farmers seeking to keep up with the competition (but also governments seeking to increase yields) search for solutions in the form of increased fertiliser and pesticide use, supported by subsidies. While this might help in the short term, poor or indiscriminate use of chemicals may not be prevented fully, and eventually will accumulate in the environment – further degrading soils, limiting fresh and clean water, and harming biodiversity. Lack of environmental protections and regulations do not help to balance this trend, and while the Kenyan government's initiative to enhance tree planting is good, it may not be enough to reverse the damage. It is perhaps too much to say that this is a 'tragedy of the commons' in the making. However, without greater political and societal awareness and broad discussion, current systems dynamics may make a potential tragedy a reality. It is therefore important to discuss 1) the true, long-term price of the Kenyan agri-food system's economic activities and current food and nutrition outcomes; 2) the destabilising impact of climate change; and 3) the trade-offs of efficiency and resilience.
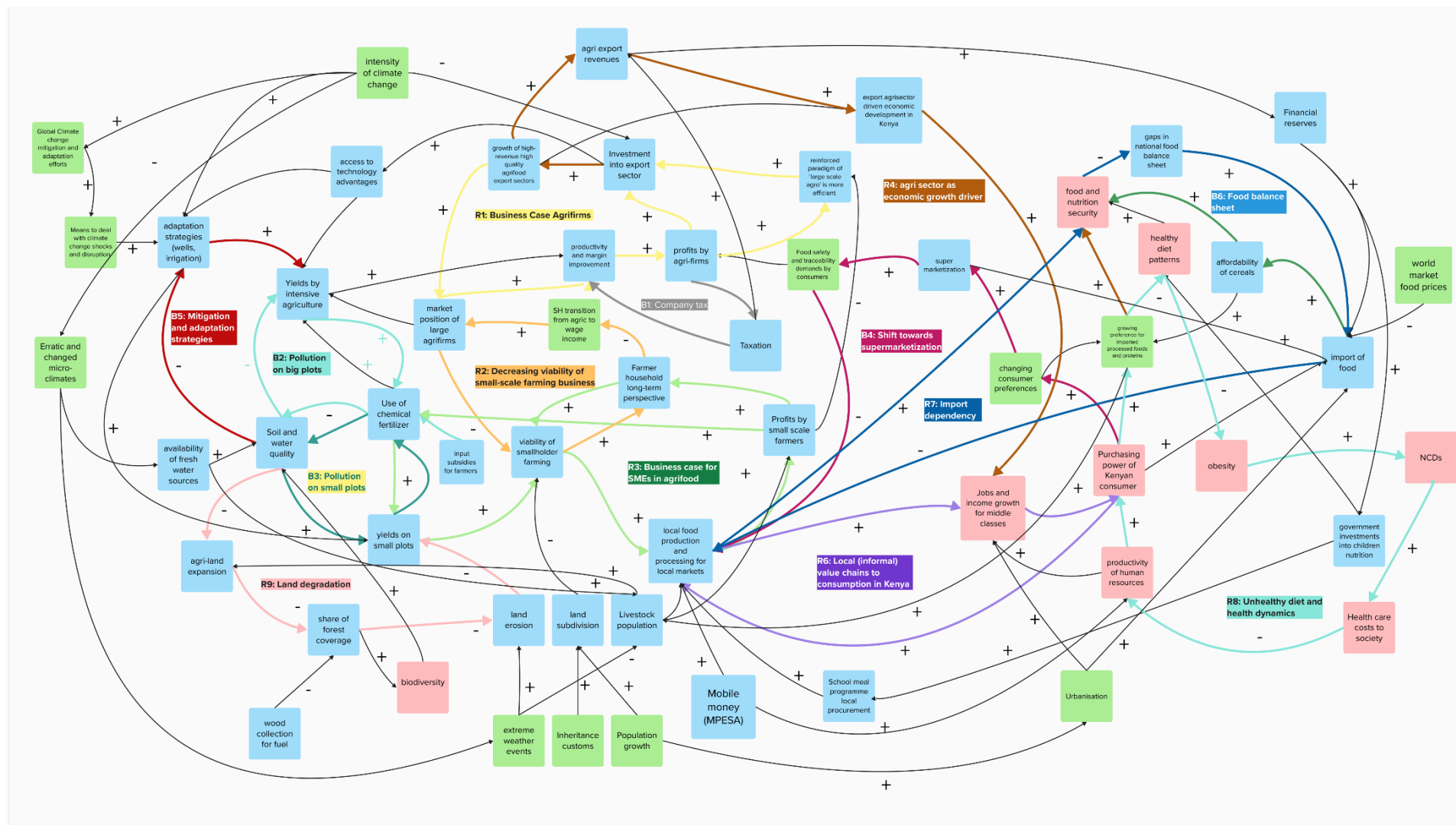
Figure 21   *A Draft Causal Loop Diagram of Kenya's Food System. Note: Food system drivers [green]; food system activities [blue]; food system outcomes [pink]. This simplified causal loop diagram represents a preliminary analysis of the dynamics in Kenya's food system. Please note that this diagram is subject to change based on ongoing multi-stakeholder engagements and input.*

8 Conclusions

This report is an attempt to create a solid understanding of Kenya's food system so that such matters can be discussed with multiple stakeholders in the food system. This overview complements and draws on similar work produced by various initiatives. This report was intended to be validated and used as a foundation to co-envision plausible futures for Kenya's food system and discuss what can be done to support Kenya's national food system transformation pathways, strengthen resilience and enhance food system performance.

Food system outcomes
Persistent and widespread hunger and malnutrition remain a huge challenge in some parts of Kenya. A significant percentage of Kenyans are moderately or severely food insecure, and food insecurity has increased in recent years. More than 70% on the population was severely or moderately food insecure in 2023. High emphasis on ensuring enough domestic maize production has often driven agricultural policy, despite this not always being followed through by high government financial investments. Maize is by far the most grown staple crop in Kenya, particularly by smallholders who grow it for home consumption and for cash – but the production yield has not grown substantially. A healthy diet in Kenya is too expensive for most households to afford. The greatest price differences across rural, peri-urban and urban areas relate to vegetables and dairy, with both being cheaper in rural areas. Food prices have been rising gradually in Kenya since 2022, with drought adding to food shortages and increased prices arising from the impact of war in Ukraine. Food insecurity is most severe in ASAL counties. Kenya has a reliance on agriculture and growing dependence on imports.

The agriculture sector generates the highest share of GDP in the country, responsible for 21.2% of Kenya's GDP (KNBS, 2023). Over recent years, employment in agriculture has been steadily declining, from nearly 40% in 2010 to 33% in 2022 (World Bank, 2022), but the sector accounts for the largest share of employment in the country. In Kenya, about 75-80% of the population is below 35 years old, and unemployment is especially high among this group. There are major differences between men and women. Notably, Kenyan women spend, on average, five times more hours on unpaid and domestic labour than men. The population living below the poverty line had been steadily declining in recent years, but the pandemic reversed this trend: with poverty rates increasing in 2020 to above 40%. Since then, recovery has been slow and poverty levels remain above pre-pandemic ones.

Kenya is facing growing environmental challenges, particularly in relation to deforestation, climate change, land degradation and water. Between 2001 and 2022, 11% of the country's tree cover was lost. Agriculture, particularly livestock farming, is the main driver of deforestation and soil erosion. ASAL areas are particularly vulnerable to degradation: it is estimated that 30-40% of ASAL soils are rapidly degrading and 2% have completely degraded. The agriculture sector is the main source of water withdrawals in Kenya, including water used for livestock, irrigation and aquaculture. Due to the drought in recent years, freshwater use by Kenya's agriculture sector has significantly increased, and was responsible for roughly 80% of all freshwater withdrawals in the country between 2016 and 2020. GHG emissions from Kenya's food system are relatively lower compared to the global average, but have been rising rapidly. In 2018, agricultural production was responsible for an 83% share of GHG emissions from the Kenyan food system. Within this figure, livestock – particularly the dairy and beef sectors – contributes to about 92% of agricultural emissions.

Food system drivers
Major Kenyan food system drivers are climate change, urbanisation, population growth, economic modernisation, governance restructuring, digitalisation and social inequality. Kenya has experienced a strong increase in population growth, from 7.8 million in 1960 to over 54 million in 2022. The country has a young population, with almost 38% under 15 years of age.

Kenya's economy is highly dependent on its natural resource base and is thus highly vulnerable to climate variability and change. Rising temperatures and changing rainfall patterns result in increased frequency and intensity of extreme weather events. Both annual precipitation and incidence of droughts have increased, threatening the sustainability of the country's development. The long drought period from 2016 until 2022 deeply affected pastoralist communities in the north and influenced cropping patterns in the south.

The GDP per capita has sharply increased, from approximately US$400 per capita in 2002 to US$2,100 in 2022. Revenues generated from exports, such as tea and coffee, and increasingly horticulture, are seen as key economic growth sectors. At the same time, the Kenyan economy is also investing in new sectors, with the country at the forefront of innovation and entrepreneurship in Africa. Nairobi is often referred to as the 'Silicon Savannah' of Africa.

Urbanisation, with its associated lifestyle changes and economic growth, transitions diets towards more ultra-processed food and animal-sourced proteins, which contributes to more unhealthy diets and GHG emissions. In Kenya, wealthier consumers purchase food at supermarkets and retailers more often, partly driven by a concern for food safety.

Food system activities
The Kenyan population living in urban areas has been steadily growing to the current rate of about 30%. At the same time, the agricultural sector employs about 33% of the Kenyan workforce, and is responsible for 21% of the national GDP. Kenya is an important exporter of tea, flowers and green coffee, whereas cereals and fats and oils rank among the products that are imported in the largest volumes. Most value addition to the economy by agricultural value chains occurs at farm level, with cereals being most representative of this: for every US$1 generated on-farm, US$0.49 is generated off-farm.

Agricultural crop land is concentrated in central and western Kenya and covers about 27,710 hectares, 48.5% of the Kenya's total land area. Land pressures are increasing due to a growing human population and growing herd sizes. As a result, the size of agricultural land parcels decreases, affecting productivity and yields. Smallholders are responsible for 65% of marketed agricultural produce, while the livestock sector is estimated to account for about 12% of country GDP and 40% of agricultural GDP, and employs about half of the agricultural labour force.

Kenya has a relatively industrialised processing sector, particularly the food and beverage sector, which makes up a substantial share of the processing industry. At the same time, food loss and waste is a serious issue. A lack of storage facilities and low levels of food processing, coupled with other market failures, lead to substantial losses. Losses reported by the processing industry and supermarkets range from 12-25%. About 40% of all fruits are lost or wasted, and only 8% is currently processed.

Kenya is considered to be a regional trade hub in East Africa. Tea is the major export product, and (cut) flowers, fruits and vegetables, and unroasted coffee also rank among the main export products. Kenya is strategically located, with the port of Mombasa being the largest in East and Central Africa. The country's relatively developed logistic infrastructure and membership of regional economic blocs make it a regional trade hub.

In Kenya, most food distribution is informal and for the domestic market. The types of food retailers vary widely, ranging from food kiosks to grocers. Growing food safety concerns, particularly among the urban population, have also spurred a 'supermaketisation' of the distribution system. Modern grocery retailers stock most categories of imported consumer-oriented high value products. Supermarkets can influence price premiums and set food safety and quality control criteria, and often have their own system of registered traders.

Kenya has hosted many digital innovation pilots and start-ups tailored to the food system, including agricultural extension services, weather information services, market information systems, digital financial services, supply chain coordination, and data and crowdsourcing.

Over the last decade, the national electricity generation capacity has grown substantially. Renewable sources, such as geothermal, hydro, wind and solar energy, account for more than 80% of Kenya's electricity. In light of climate change, the country has stated further ambitions to transition to clean energy and improve energy efficiency and access. Despite the availability of electricity, firewood remains the main source of energy for the rural population.

Food system dynamics
Food systems are dynamic and complex in nature, and change over time as a function of the interplay between drivers, trends, internal forces and feedback loops that steer the system in certain directions. Upon drafting a simplified causal loop diagram of the dynamics of Kenya's food system, several key patterns that shape the food system become clear.

The first pattern, 'agribusiness ascending', relates to the growing competitive edge of large-scale agribusiness and lack of level playing field in the agri-business market, which increasingly favours medium- to larger-scale agribusiness firms and further decreases the viability of small-scale farming and the business case for SMEs. This gap widens even further due to land fragmentation within rural communities, while larger scale companies reap the benefits of rapidly developing digital and financial innovations. This 'success to the successful' only reinforces the position of one over the other as time goes on, and is not easily reversed.

The second pattern, the food security trade 'hydra', involves the import/export balance and dynamic around food security. To tackle food security in light of a growing population and urbanisation, and as domestic food production yields have stalled, increased dependency on imports of cheap staple foods offers a 'quick fix'. However, this approach creates new and more serious long-term problems: an emerging diet and health divide, particularly between urban consumers and rural communities. This divide brings with it significant implications for food imports, the focus on staple production, long-term health care and general workforce productivity.

The third pattern is about the 'decreasing carrying capacity of the environment'. With climate change increasingly visible, new micro-climates and shifting seasons will affect Kenyan agriculture. At the same time, pressure to increase production due to high demand for more food, but also to produce more resource-intensive food, is testing the limits of Kenya's natural resources. This dilemma becomes apparent in different ways across Kenya. In the northern ASALs, soil is already degraded and livestock was decimated due to drought. While livestock is currently being restocked, recurring drought remains a risk. At the same time, growing demand from Kenyan consumers for animal-based proteins might offer significant potential market growth if livestock is further commercialised. A similar agriculture dilemma is occurring in the south: productive agriculture, high-end horticulture and floriculture may offer economic opportunities, but at the expense

of land, soils, water and biodiversity, potentially causing long-term ecosystem harm. Without greater political and societal awareness and broad discussion regarding: 1) the true, long-term price of the Kenya agri-food system's economic activities and current food and nutrition outcomes; 2) the destabilising impact of climate change; and 3) the principles of efficiency over resilience, current systems dynamics may result in further environmental tragedy.

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