INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
IFPRI

IFPRI PROJECT PAPER JULY 2025

Digital Finance and Agri-Food Value Chains

Case Studies from Kenya

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CONTENTS

1. INTRODUCTION

Kenya’s agrifood systems are broad and diverse, including both staple food crops and high-value exports which are essential to the economic and social advancement of the nation. The agricultural sector employs more than 40 percent of Kenya's workforce, including more than 70 percent of rural residents, and accounts for about 33 percent of the country's GDP (FAO, 2023a; FAO, n.d.). The growth of Kenya’s agrifood system is largely driven by domestic market demand rather than exports, a trend driven by rapid urbanization and rising income opportunities in the rural nonfarm sector, which are leading to shifts in dietary preferences and are expected to further influence ongoing structural transformation (Diao et al., 2023).

Kenya’s agricultural sector is characterized by several value chains that significantly support economic output, job creation, and trade. Tea is Kenya's most significant agricultural export, contributing about 2 percent to the overall GDP and 4 percent to GDP in agriculture. Managed predominantly by the Kenya Tea Development Agency (KTDA), which oversees over 60 percent of national tea production, the sector supports approximately 6.5 million people (Tea Board of Kenya, 2024). Tea also contributes around 21 percent of Kenya's export earnings, which makes it the third-largest source of foreign exchange earnings in the nation after diaspora remittances and tourism (Kilimo News, 2024).

Coffee is another valuable export crop, accounting for about 6 percent of total agricultural exports, and is dominated by smallholder farmers organized through cooperatives, involving around 150,000 farmers. Kenyan coffee is globally renowned for its quality, and despite market volatility, it remains a key source of income and export revenue (FAO, n.d.). Horticulture, particularly floriculture, is another important export sector, with Kenya being a leading exporter of cut flowers, fruits, and vegetables. Horticultural exports are primarily destined for European markets and remain a major source of foreign exchange (Horticultural Crops Directorate, 2023).

Avocado production has expanded rapidly, positioning Kenya as a leading global exporter. Between 2019 and 2023, avocado production rose from 230,000 metric tons in 2019 to approximately 350,000 metric tons by 2023 (Nyakang’i et al., 2023; KALRO, 2023). Maize remains Kenya’s principal staple crop, accounting for approximately 3 percent of agricultural GDP and 21 percent of the value of major agricultural commodities (Kang’ethe et al., 2020). The country is also a global leader in French bean exports, though it faces challenges such as strict export standards and international competition.

Domestically, bananas are the top horticultural crop in terms of volume and value, contributing 17.8 percent to the total horticulture sector value. In 2020, banana production rose by 24 percent to 1.87 million tons, with its value increasing by 18 percent to Kenya Shillings (KSh) 9.02 billion, largely due to small-scale farmers in Meru, Taita Taveta, and Murang’a (KALRO, 2020).

The livestock sector, which includes dairy, beef, and poultry, employs over 50 percent of the agricultural labor force (FAO, 2019). The sector makes up around 12 percent of the national GDP and 40 percent of the agricultural GDP (Kevevapi, 2023). More than 700,000 people are employed by the dairy business alone, which supports 1.8 million rural households and accounts for 3 to 4 percent of the national GDP and roughly 12 percent of the agricultural GDP (KDB, 2025). Over 80 percent of milk produced in dairy farming ends up in informal marketplaces, with small-scale farmers controlling most of the industry (Kevevapi, 2023).

Kenya's agrifood system is characterized by diverse value chains that vary in their contributions to key development outcomes such as poverty reduction, economic growth, employment, and nutrition. Sectors like coffee, tea, cattle, and dairy play important roles in generating off-farm employment and GDP, yet their impacts on poverty alleviation and dietary improvement remain limited (Diao et al., 2023). With two-thirds of value-added stemming from primary agriculture and the majority of agrifood employment concentrated in this area, there is a clear need for policies that promote a balanced and inclusive agrifood transformation.

1.1. Value Chain Selection

Five key features served as a guide for choosing value chains for inclusion in this report: value chain structure, scale and market potential, socio-economic impact, food security contribution, and other considerations. Each criterion included specific sub-criteria. For value chain structure, the sub-criteria were vertical and horizontal integration, level of formality, infrastructure and market access, value addition, and innovation and technology adoption. Scale and market potential considered production value, market demand, export potential, growth potential, cost competitiveness, and market expansion potential. Socio-economic impact included employment generation, households benefiting, inclusivity and equity, and accessibility for the poor. Food security contribution focused on food availability and access, price stability and affordability, and nutritional impact. Other considerations covered policy and institutional support, environmental sustainability, and cultural importance.

Each value chain was scored from one to ten under each sub-criterion, where one indicated minimal presence and ten the highest level. Sub-totals were calculated for each main criterion, and the total score was derived by summing these sub-totals (see the appendix). A total of ten value chains were evaluated, including avocado, dairy, chicken, maize, French beans, Irish potatoes, banana, coffee, apiculture, and tomatoes. Based on the total scores, avocado ranked highest, followed by dairy, chicken, maize, French beans, Irish potatoes, banana, coffee, apiculture, and tomatoes. For further analysis in the study, the top seven value chains including avocado, dairy, chicken, maize, French beans, Irish potatoes, and banana were selected.

1.2. Data and Resources

The data and resources used in this study include existing IFPRI research along with a broad range of non-IFPRI studies. The initial data collection involved sourcing and reviewing documents based on the author's expertise and targeted online searches, including official websites of value chain stakeholders and the Kenya National Bureau of Statistics (KNBS). Sector-specific reports were also consulted: the Kenya Dairy Board for dairy, the Agriculture and Food Authority (AFA) for avocado and banana, and the Kenya Agricultural and Livestock Research Organization (KALRO) for chicken and banana. French beans were analyzed using fresh produce reports, while KNBS data from 2019 to 2024 was utilized across all value chains. Additional documents from the Ministry of Agriculture, Livestock, and Cooperatives were also reviewed. A comprehensive literature search covering the period 2019 through 2025 was conducted during February to April 2025 using platforms such as Google Scholar, Scopus, JSTOR, Web of Science, institutional repositories, and general web searches. The search applied a structured string of keywords tailored to each value chain, combining terms related to Kenya, specific crops or livestock, and thematic areas such as market access, value addition, employment, and sustainability. Journal articles obtained were further screened for credibility using the Scimago Journal Rank to avoid predatory sources.

1.3. Key Findings

The analysis of Kenya's agrifood value chains reveals distinct patterns and challenges across seven key value chains: avocado, dairy, chicken, maize, Irish potatoes, banana, and French beans. Despite their unique features, common trends include the dominance of smallholder farmers, the prevalence of informal markets, and increasing integration of digital technologies. However, common challenges such as limited processing, weak coordination, infrastructure gaps, limited access to quality inputs, reliance on informal markets and gender disparities continue to constrain performance and inclusivity.

Differences across value chains lie in their levels of commercialization and market integration. Avocado and French beans are export-oriented, with structured value chains and compliance with international standards. In contrast, chicken and Irish potatoes remain informal, with limited processing and market access. The dairy sector is fragmented, balancing informal raw milk trade with formal channels dominated by large processors. These dynamics highlight the need for targeted policies to strengthen cooperatives, improve infrastructure, formalize markets, and enhance access to finance and inputs tailored to each sector's needs.

Kenya's avocado sector is export-driven, with smallholder farmers contributing around 70 percent of national production (COLEAD, 2023). While exports and production volumes are rising, challenges persist in fruit quality, coordination, and limited processing. Regional disparities, especially Murang'a's dominance, highlight uneven development. Policy priorities include digital traceability systems, enhanced processing, and regulatory reforms, supported by initiatives like the National Agricultural Value Chain Development Program (NAVCDP).

The dairy sector supports 1.8 million smallholders and involves both formal and informal marketing of milk (KDB, 2025). Key issues include seasonal production, inadequate feed, and limited access to finance. Strengthening digital financial tools, cold chains, and regulatory oversight is essential. Programs like Kenya Commercial Bank (KCB), MobiGrow, and M-PESA are enhancing access to markets and finance.

Serving 5.5 million households, the chicken sector is marked by informal indigenous production and growing youth and women's participation (FAO, 2022). Broiler production is more commercialized and vertically integrated. Key barriers include market access, low formalization, and limited digital extension. Strengthening producer groups, input access, and youth/women-focused support can drive sector growth. Central to food security, maize production is dominated by smallholders using rain-fed systems, though larger producers play a key market role. The value chain faces input access issues, post-harvest losses, and gender inequities. Strengthening cooperatives, promoting digital tools like the Warehouse Receipt System, and land use efficiency are vital for resilience and productivity.

Despite increasing demand and economic potential, the Irish potato value chain remains largely informal and under-processed. Constraints include low access to quality seed, financing, and market infrastructure, with gender barriers limiting women's full participation. Priorities include enforcing sector regulations, upgrading infrastructure, and expanding tools like ViaziSoko for better market access and productivity.

Driven by high domestic demand, the banana value chain is dominated by smallholders and informal trade. Fragmented markets and low export volumes persist despite increasing digital integration. Cold storage, contract farming, and digital market platforms (e.g., M-PESA, Twiga Foods) are crucial for improving competitiveness and inclusivity. A leading export-oriented chain, French beans rely heavily on

contract farming and meet stringent quality standards. Women are key labor contributors but face restricted control over inputs and earnings. To maintain international competitiveness, policies should expand digital finance, improve training, and promote equitable access to markets and compliance support.

Across all value chains, improving infrastructure, formalizing market systems, enhancing gender inclusion, promoting digital solutions, and strengthening institutional support are critical for driving growth, equity, and resilience in Kenya's agrifood system.

2. AVOCADO VALUE CHAIN

2.1. Value Chain Characteristics

Avocado is a principal emergent export crop that Kenya intends to enhance, as specified in the Fourth Medium-Term Plan for 2023–2027, part of the Vision 2030 initiative. Kenya Vision 2030 is a strategic initiative aimed at transforming Kenya into a successful, competitive middle-income nation with an elevated quality of life by the year 2030 (GoK, 2007). The fourth medium-term plan specifically encompasses the creation of genetic markers for the classification of avocado types at the Kenya Agricultural and Livestock Research Organization (KALRO) in Thika (GoK, 2024). Avocado is a prioritized value chain within the National Agricultural Value Chain Development Project (NAVCDP), a World Bank-funded effort executed by the Ministry of Agriculture and Livestock Development. The project, spanning from September 2022 to June 2028 throughout 33 counties, seeks to shift smallholder farmers from subsistence to commercial farming by improving value addition and market engagement. (GoK, n.d).

Avocado was ranked second among the leading fruits by value in 2023, accounting for 23 percent, following bananas at 35 percent. Other fruits included mangoes (16 percent), oranges (6 percent), and watermelons (5 percent). Eight counties contributed over 5 percent to the total avocado value, with Murang'a leading at 24.7 percent, followed by Kisii (11.5 percent), Nakuru (10.6 percent), Nyeri (6.0 percent), Kiambu (5.8 percent), Trans Nzoia (5.7 percent), Kirinyaga (5.7 percent), and Nyamira (5.6 percent) (AFA, 2024).

The avocado value chain is a source of income to many families in Kenya as it creates employment across all the nodes. At production, smallholder farmers produce an estimated 70 percent of the country's avocados and make up the largest producer group (COLEAD, 2023). Most of these farmers own less than 2 acres of land and have between 5 and 20 avocado trees, with an average of 10 to 20 trees per homestead. These smallholders represent a significant portion of the 136,623 known commercial avocado farmers, with 130,424 being smallholders, 6,114 medium-scale farmers, and 85 large-scale farmers (COLEAD, 2023). The quantity of avocados produced and marketed, as well as their value, has been on the rise over the years. For instance, the quantity of avocado exported increased steadily in 2020, 2021, 2022, and 2023, reaching 72, 86, 103, and 114 million tonnes, respectively. Similarly, the value of avocado exports in Kenya, measured in million KSh, rose from 14,646 in 2021 to 15,597 in 2022 and further to 19,037 in 2023 (AFA, 2024).

Kenya exports approximately 10 to 15 percent of its overall avocado production, despite the crop being a significant source of foreign exchange (HCD, 2020; COLEAD, 2023). As of 2020, there were 156 registered avocado exporters in the country, though only 94 were actively involved in the trade (MoALFC, 2020). The country primarily exports three varieties: Hass, Fuerte, and the local jumbo variety (Yanyan, 2018). Leading exporters include Vegpro, Kakuzi, Kenya Horticultural Exporters (KHE), East African

Growers (EAG), Biofarms Limited, Frutplanet, Sunripe, and more recently, Keitt Exporters Limited (Shivachi et al., 2023). The growth of Kenya's avocado exports is constrained by several issues, such as low fruit quality, strict international regulations, smallholder farmers' insufficient institutional ability, and inadequate export chain coordination (Amare et al., 2019). Kenya exports avocados to a wide range of countries, including the Netherlands, the United Kingdom, France, the UAE, Russia, Saudi Arabia, Germany, Spain, Singapore, Kuwait, Egypt, Morocco, Malaysia, Hong Kong, South Africa, Oman,and Ghana. Emerging markets such as China and India are also showing growing interest in Kenyan avocados (ITC, 2025).

2.2. Types of Actors

The avocado value chain in Kenya is made up of a diverse set of actors, including input supply, production, aggregation, processing, and trading. Input suppliers include agro-input dealers, certified avocado nurseries, equipment suppliers, and packaging material providers. Small and large-scale farms are among the producers, while aggregators include marketing agents, cold chain logistics providers, and farmer producer organizations (FPOs). Processing is carried out by pack-house operators, small and medium-term enterprises (SMEs), and larger processing firms, and trading involves wholesalers, fresh produce markets, supermarkets, retailers, and exporters. Avocado and its products are sold to local consumers, and both regional and international markets.

Both national and county governments, in collaboration with institutions such as the Kenya Forestry Research Institute (KEFRI), the Agriculture and Food Authority (AFA), and the World Bank, have actively promoted smallholder participation in the avocado sector. Through the National Agricultural Value Chain Development Project (NAVCDP), these stakeholders have supported farmers by providing certified seedlings, access to capital, and technical training to enhance productivity and market readiness (World Bank, 2021). To ensure compliance with global standards, the Kenyan government has also implemented various regulatory initiatives. Agencies like the Kenya Plant Health Inspectorate Service (KEPHIS) and the Horticultural Crops Directorate (HCD) play a critical role in monitoring quality and offering guidance to farmers and exporters (Ministry of Agriculture, 2019).

Gender is not a strong determinant of participation in Kenya’s avocado value chain. A study by Muriithi and Kabubo-Mariara (2022) found growing engagement of women, particularly around Nairobi. While men-headed households had more education and more Hass trees, women-headed households had better access to finance. In retail, women dominate avocado selling in local markets in Murang’a county of Kenya (Oduol & Mithöfer, 2014).

2.3. Conditions for Digitalization

Kenya's avocado value chain is changing because of digital technology, which improves market accessibility, productivity, and traceability. One noteworthy project is the partnership between One Million Avocados (OMA) and the blockchain-focused agri-tech company Dimitra. The goal of this collaboration is to provide smallholder farmers with cutting-edge resources, including blockchain technology, Internet of Things (IoT) sensors, and artificial intelligence (AI). Each avocado tree is linked to its GPS location, farm score, and development history, by being digitized as non-fungible tokens (NFTs) on the Polygon blockchain. This method solves issues with quality control and export standard compliance while improving transparency and traceability in the avocado supply chain (Cointelegraph, 2024; Blockchain News Group, 2024).

The integration of digital platforms further supports farmers in managing their operations efficiently. The Connected Farmer platform, developed by Dimitra, offers a user-friendly interface accessible via Android, iOS, and web browsers. Through this platform, farmers gain access to AI-powered agronomic analysis, monitor pest and disease occurrences in real time, and receive customized recommendations for crop management. Moreover, the platform supports transactions using DMTR tokens, promoting seamless financial exchanges and fostering a digital economy within the agricultural sector (The Fintech Times, 2024; Cointelegraph, 2024).

Onyangore's (2024) case study in Kenya on Information Communication and Technology (ICT) use for an integrated chain-wide traceability system in the avocado value chain assessed the readiness of stakeholders within both local and export-oriented sectors to adopt ICT-based traceability solutions. The study also examined the governance structure of the avocado value chain and compiled a list of digital technologies that could support the development of a comprehensive traceability system. SokoFresh, Ujuzi-Kilimo, and GTNet by Tracesoft, as well as blockchain and IoT technologies, were identified as key components for this system. These innovations are designed to improve information sharing, strengthen governance, and enhance the quality, safety, and global competitiveness of Kenyan avocados.

3. DAIRY VALUE CHAIN

3.1. Value Chain Characteristics

The value of marketed milk has shown an upward trajectory over the past five years (2019 to 2023). The highest recorded value was KSh 41.0 billion in 2023. In comparison, the value of marketed milk in previous years was KSh 20.6 billion in 2019, KSh 22.7 billion in 2020, KSh 33.7 billion in 2021, and KSh 36.9 billion in 2022 (KNBS, 2021; KNBS, 2022, KNBS, 2023 and KNBS, 2024). Over the last five years, the highest amount of marketed milk production was 806.6 million liters in 2023, while the highest milk production occurred in 2021, with 4,640.90 million liters. Regarding butter and ghee, the highest amount of 1,013.40 tonnes was recorded in 2019. For cheese, the quantity has been decreasing, with the lowest amount of 72.5 tonnes reported in 2023.

The dairy value chain supports 1.8 million smallholder farmers, providing them with a source of livelihood. Additionally, the dairy value chain directly supports 750,000 individuals employed along the value chain, with another 500,000 individuals benefiting indirectly (KDB, 2023; KDB, 2025). Despite the importance of dairy value chain contribution to the livelihood of dairy value chain actors, the chain is affected by seasonality. According to the Kenya National Dairy Master Plan of 2010-2030, the dairy industry is seasonal, with milk production reliant on rainfall, which impacts forage availability (GoK, 2010). Peak milk production is during the rainy seasons (March to May and October to December) due to abundant pasture and quality feed. In contrast, production declines during the drought period (January and February and June to September) because of reduced pasture, lower feed quality, and water scarcity, leading to lower yields and higher costs for farmers. Seasonality also affects domestic consumption patterns, with higher consumption during the rainy seasons when milk is more available and affordable.

The seasonality of feed production is one of the major constraints to milk production, with an annual feed deficit estimated at 40 percent in Eastern African countries, of which Kenya is a member. Kenya has a dry matter deficit of 60 percent. This fluctuation in milk production is attributed to the limited availability and affordability of forage seeds (Burkart and Mwendia, 2024).

According to the Kenya National Bureau of Statistics (KNBS), milk and milk products are the most consumed food in Kenya when it comes to the consumption of various agricultural products. In 2023, the average yearly consumption per person was 86.1 liters. This consumption was followed by maize, bananas, sugarcane, wheat, and potatoes and products, with per capita consumption of 63.3 kilograms, 48 kilograms, 40.6 kilograms, 39.3 kilograms, and 32.3 kilograms, respectively (KNBS, 2024). On the consumption of dairy products, unpackaged milk is the most consumed dairy item, representing 72 percent of total consumption nationwide, 84 percent of rural consumption, and 55 percent of urban consumption (Revoredo-Giha and Zavala-Nacul, 2024).

Milk marketing occurs through formal and informal channels. The formal sector, regulated by the Kenya Dairy Board (KDB) and involving licensed actors, handles about 30 percent of the total milk traded, while the remaining 70 percent is distributed informally (Nyokabi et al., 2021). Formal channels sell packaged and branded dairy products, including pasteurized or ultra-heat treated (UHT) milk, yogurt, and ice cream (Brown et al., 2018). In contrast, raw milk and milk products that have not undergone industrial processing are primarily sold within the informal sector (Alonso et al., 2018; Blackmore et al., 2022).

Four businesses dominate the processed milk sector in the official market: Sameer Agriculture and Livestock Limited, Githunguri Dairy Cooperative Society, New Kenya Cooperative Creameries, and Brookside Dairy Limited. These businesses collectively control 21 percent of Kenya's overall milk market and 70 percent of the processed milk market. Other processors split the remaining 30 percent of the processed milk market (Kyule and Nguli, 2020). In rural and peri-urban areas, raw, unprocessed milk is supplied by the informal market, which is made up of milk bars, mobile traders, and small-scale retailers.

The Kenya National Bureau of Statistics 2024 report shows that the market share of formally marketed milk reached 17.7 in 2023, the highest in five years, while processed milk market share rose by 1.9 percent, from 10.3 percent in 2022 to 12.2 percent in 2023. According to the Kenya National Bureau of Statistics 2024 report, the market share of formally marketed milk was the highest in five years (2019 to 2023), at 17.7 percent in 2023, while the market share of processed milk rose by 1.9 percent, from 10.3 percent in 2022 to 12.2 percent in 2023.

Kenya's milk production is insufficient to meet domestic demand, with the deficit covered by imports. The export markets for milk and milk products remain limited, although efforts to expand exports and improve value addition are ongoing.

3.2. Types of Actors

The Kenya dairy value chain includes input suppliers, producers, aggregators (cooperative societies, self-help groups, and traders), transporters, processors, retailers, and consumers. The dairy value chain is extensive, involving thousands of actors across its various segments due to a mix of formal and informal markets. Service providers and input suppliers, primarily agro-vet dealers, offer essential services and inputs such as animal health products, feed supplements, breeding services, advisory services to farmers, and financial support. Milk production is predominantly carried out by approximately 1.8 million small-scale farmers, who own 3 to 5 dairy cows and use various systems, including zero grazing, semi-zero grazing, or open grazing (GoK, 2023; KDB, 2023). The aggregation segment involves hundreds of farmer producer organizations (FPOs), which include dairy cooperatives, self-help groups, community-based organizations (CBOs), and private companies that assist in transporting milk from farmers to processors or informal markets. They also play a crucial role in milk marketing by collecting, cooling, and distributing

milk. For instance, Kenya has 770 dairy cooperatives that connect both smallholder and large-scale producers to the commercial market (USDA, 2024).

In the Kenyan dairy value chain, dairy cooperative organizations play a vital role in managing the gathering, storing, and selling of milk on behalf of farmers (Nyokabi et al., 2018). Since they provide their members with more services, more sophisticated dairy cooperatives are known as dairy hubs. A communal, farmer-owned/managed milk bulking and/or chilling company is known as a dairy hub, and it provides farmers with access to a range of services necessary for their everyday operations (Mutinda et al., 2015). These services include animal feeds, health services, artificial insemination, sexed semen, veterinary services, and credit, with repayments deducted from milk sale proceeds. Dairy hubs also serve as intermediaries between farmers, financial service providers, and processors. However, dairy cooperatives face challenges such as low capacity utilization of cooling facilities due to factors like low milk production, competition from the informal market, and disorganization in some areas (GoK, 2023).

The processing segment is led by fewer than 100 large processors, including New Kenya Cooperative Creameries (New KCC), Brookside, and Githunguri Dairy, along with several small- and medium-scale processors (MoALFC, 2022). Kenya has 35 registered processing companies (GoK, 2023), with a total installed capacity of 3.7 million liters per day, of which 47.5 percent is utilized. The informal market also plays a significant role, with milk bars, kiosks, and mobile traders selling unprocessed milk directly to consumers, though some are unlicensed and seasonal. The retail and consumer segment spans thousands of actors, from supermarkets and retail shops to informal markets, which serve most domestic consumers.

Gender plays a key role in Kenya's dairy value chain. At the production stage, women primarily handle milking, livestock care (watering, cleaning the pens, feeding the animals), and milk marketing, while men focus on animal health tasks such as artificial insemination, veterinary care, and live animal marketing (Gallina, 2016).

At the intermediary level, women are primarily involved in informal trading and vending but remain underrepresented in formal roles such as cooperative leadership, aggregation, and processing. A study by Katothya (2017) on gender in Kenya's dairy value chains found that while women participate most at the production node, they face significant challenges at the milk traders' node, including limited access to capital, technology, and mobility. Milk transportation services are largely dominated by male youth, and employment at Milk Collection Centres (MCCs) is male dominated, especially in management. Additionally, a few women own dairy support businesses like agrovet stores, which mostly employ young women as attendants. The study also highlighted higher male employment in dairy processing (Katothya, 2017).

The Kenyan dairy value chain involves both formal and informal relationships linking smallholder farmers with cooperatives, processors, and traders. While large processors and cooperatives maintain formal quality standards, smallholder farmers mostly rely on local traders through informal, power-imbalanced arrangements. Cooperatives establish contracts and aggregate milk, but farmer-trader relations remain loosely regulated. The Kenya Dairy Board (KDB) oversees the sector, though enforcement is weak in rural areas. A study by Nyokabi et al. (2018) found that formal contracts were rare in the value chain, with the informal sector relying on verbal agreements and goodwill.

Credit is vital in the Kenyan dairy sector, supporting investment in infrastructure, inputs, and technology. Smallholder farmers use it to boost production, while cooperatives and processors invest in the cold chain and processing equipment. However, limited access to affordable credit hampers productivity. Digital tools like mobile financial services are used for mobile payment, mobile savings, and accessing credit by

farmers. The use of mobile financial services to access loans for agricultural investment is however limited in Kenya. While over 80 percent of farmers use mobile financial services, only 15 percent use them for agricultural purposes, and less than 1 percent access mobile loans for agricultural investment (Martin et al., 2022).

3.3. Conditions for Digitalization

Kenya's M-PESA (M for mobile, Pesa for cash in Swahili), launched by Safaricom in 2007, is a leading mobile money service in Kenya with near-universal coverage (Suri, 2017). According to the GSMA 2024 State of the Industry Report on Mobile Money, 94 percent of male adults and 92 percent of female adults in Kenya own mobile money accounts. Regarding the dairy value chain, Mukurweini Wakulima Dairy Limited, a farmer owned processor, offers M-Pesa and mobile banking services, allowing farmers to open accounts, make deposits, withdraw money, buy shares, and access account queries (Mukurweinini Wakulima Dairy Limited website).

Programs also exist to improve smallholder dairy farmers' access to in-kind loans. One example is KCB MobiGrow, which enables smallholder dairy farmers to access loans through direct disbursements from Kenya Commercial Bank (KCB) to suppliers, with loan repayments automatically deducted from buyers' payments (FAO & AFRACA, 2020). This five-year initiative, funded by the Mastercard Foundation and KCB Bank, operates in Kenya and Rwanda, targeting smallholders in sectors like dairy, maize, potatoes, rice, sorghum, soybeans, and livestock. MobiGrow aims to enhance financial inclusion, improve livelihoods, and boost productivity through training, technology, and support for farmer producer organizations (FPOs) to improve access to markets, savings, credit, and insurance.

Digital payments are growing in Kenya's dairy value chain, improving efficiency, reducing cash reliance, and boosting transparency. Farmers receive milk sale payments via mobile money like M-Pesa. The adoption of digital financial services in Kenya's dairy value chain is driven by mobile technology, the demand for faster transactions, and the need for payment transparency. Platforms like M-Pesa help farmers manage cash flow. The Government's Agricultural Marketing Strategy (AMS) 2023-2032 aims to improve market access for smallholder farmers through digital technologies like mobile apps, precision farming, and e-commerce (MoALD, 2023). Partnerships between mobile operators, financial institutions, and agricultural stakeholders support this adoption. An example is the case of the KCB MobiGrow, a bank-led buyer linkage and mobile model that resulted from a partnership between a development partner and commercial bank to reach unconnected small farmers with markets and financing (FAO & AFRACA, 2020).

4. CHICKEN VALUE CHAIN

4.1. Value Chain Characteristics

In Kenya, poultry farming is a vital livestock subsector that contributes 7.8 percent to the agricultural Gross Domestic Products (GDP) and 0.34 percent to the national GDP, while contributing to income and food security in rural areas (Garsow et al., 2022; Macharia et al., 2020). Over 80 percent of households keep indigenous chickens, which are typically owned and managed by women and children, who also control the benefits derived from them (KALRO, 2023). In 2022, the value of poultry meat and egg production stood at USD 237 million and USD 167 million, respectively (FAO, 2022). Chicken dominates the

country's poultry industry with a total population of 44.6 million birds, comprising 36.6 million indigenous chickens, 4.2 million exotic layers, and 3.1 million broilers (KALRO, 2023).

In 2023, chicken meat production reached 26,630 tonnes, valued at Ksh 12.8 billion (County Express, 2025). Slaughter figures showed variability, with 63.4 million chickens processed in 2019, reducing to 49.4 million in 2020, then increasing to 66.9 million by 2023. Over the same period, the value of marketed chicken and eggs ranged from Ksh 9.2 billion in 2019 to a peak of Ksh 10.9 billion in 2022, before declining to Ksh 8.7 billion in 2023, reflecting dynamic supply and demand conditions in the sector (KNBS, 2024). The poultry value chain in Kenya is highly inclusive, with approximately 90 percent of rural households engaged in chicken farming, primarily raising indigenous breeds, and small-scale farmers contributing over 80 percent of the national poultry production, often depending on it as a vital source of income (KALRO, 2025).

4.2. Types of Actors

Kenya's poultry value chain is primarily oriented toward the domestic market and consists of various stakeholders, including input providers, farmers, processors, transporters, traders, retailers, service providers, and consumers (Omondi, 2022).

Input providers in the Kenyan chicken value chain include research institutions such as the Kenya Agricultural and Livestock Research Organization (KALRO). Various universities are key innovators in poultry breeding, disease control, and nutrition. Hatcheries and breeding companies, including Kenchic Ltd., supply improved day-old chicks to farmers across the country. Agro-veterinary dealers distribute essential inputs such as vaccines, veterinary drugs, and formulated feeds, with some of these inputs being locally manufactured by institutions like the Kenya Veterinary Vaccines Production Institute (KEVEVAPI). In addition, public and private extension service providers offer technical support to farmers, while local artisans and importers supply essential production equipment such as feeders, drinkers, and brooders, supporting the mechanization of poultry farming.

Smallholder farmers predominantly rear indigenous chickens under extensive or semi-intensive systems, characterized by low input, low output, and limited commercialization (Ochieng et al., 2013). Kenya's commercial poultry production system is fragmented, comprising a few large, vertically integrated farms (over 5,000 birds), a significant mid-tier production sector (501–5,000 birds), and a broad base of small-scale producers (50–500 birds) (Muloi et al., 2025). Large-scale commercial producers like Kenchic limited function as apex actors. Kenchic plays a pivotal role in coordinating various stages of the value chain by supplying contracted farmers who are primarily broiler producers with essential inputs such as day-old chicks, feed, and vaccines, as well as offering veterinary and extension services. These farmers, mainly located in Thika and surrounding counties, are responsible for poultry management and housing. Kenchic further extends its influence through training programs for aspiring farmers, consolidating its position as a central actor in the poultry sector (FAO, 2022).

Producer organizations within the poultry value chain play a limited role due to low membership and engagement levels. In areas such as Thika and Kisumu, most poultry farmers operate independently, regardless of scale. Small producer groups, usually comprising 10 to 15 members and largely consisting of women and youth, are present but only 4 percent of farmers report belonging to such cooperatives (Omondi, 2022). These organizations can help address common challenges such as access to markets and inputs, yet their impact remains constrained by their limited scale and informality. Strengthening and

formalizing these cooperatives could enhance bargaining power, improve input access, and enable more consistent engagement with formal market structures.

Chicken processing is primarily for broilers and spent layers which are handled by slaughterhouses in major towns like Nairobi, Kisumu, and Mombasa. Traders include aggregators, wholesalers, retailers, and food service providers such as hotels. Middlemen play a vital role in consolidating products from farmers and connecting them to markets, while transporters ensure timely delivery. However, trading is male dominated due to the physically demanding nature of the job and limited access to capital among women. Consumers, found across both rural and urban areas, purchase chicken and eggs through formal and informal channels. However, current per capita consumption remains well below the WHO's recommended levels, signaling opportunities for growth in both production and awareness.

Regarding the relationships among actors in the chicken value chain, only a few farmers operate under contractual arrangements in their poultry businesses. A study examining the poultry value chain in two medium-sized cities in Kenya found that only 22 farmers, representing 7 percent of those surveyed, were engaged in poultry production through contracts with entities such as traders, hotels, restaurants, input suppliers, or schools. Notably, most of these arrangements were informal and lacked written documentation. Among those with contractual agreements, the main roles of the contracting parties included purchasing poultry products (77 percent), supplying inputs (27 percent), and providing veterinary services (9 percent) (Omondi, 2022).

Gender plays a significant role throughout the poultry value chain in Kenya, with women and youth being the primary actors in smallholder poultry production as revealed by various studies. For instance, Garsow et al. (2022) on the roles of men, women, and youth in ensuring food safety within Kenya's smallholder poultry value chain revealed that women and youth are more actively involved in the earlier stages of the value chain, particularly in poultry production and processing at the farm level. Similarly, a study that aimed to identify insect-based feed interventions that could reduce feed costs and benefit both women and men equitably in the counties of Kisii, Nakuru, and Kirinyaga revealed notable gender disparities in the poultry value chain, particularly in labor and decision-making roles. Women were significantly more involved in daily poultry-related activities, spending 70.2 percent of their working hours on such tasks compared to 39.9 percent for men. They also played a leading role in decision-making regarding the type of poultry raised and the feed used, while men were typically responsible for managing poultry sales. Despite their dominant role in the day-to-day care of poultry women often lacked control over the income generated from poultry sales (Waithanji et al., 2020).

4.3. Conditions for Digitalization

Kenya is called the "Silicon Savannah," given its large amounts of ICT start-ups ecosystem (Stroisch, 2018). The country has embraced digital innovation in agriculture, including the poultry sector. A notable example is the Indigenous KALRO chicken mobile application developed by the Kenya Agricultural and Livestock Research Organization (KALRO). This digital tool serves as an e-encyclopedia, offering generic extension advice and practical information on poultry husbandry. It aims to support smallholder farmers by improving access to knowledge and best practices, thereby enhancing productivity and sustainability in indigenous chicken farming (Daum et al., 2022). The application is designed for Android devices, provides summarized information on key aspects of chicken production, including feeding, vaccination, housing, breeding and selection, and economics. It serves as a convenient tool to enhance access to reliable information and services related to poultry farming, aiming to support farmers in improving productivity and management of indigenous chickens (KALRO TIMPs, n.d).

5. MAIZE VALUE CHAIN

5.1. Value Chain Characteristics

Maize plays a vital role in Kenya's economy and food security, being consumed by 85 percent of the population and contributing 12 percent to the agricultural GDP, 3 percent to the national GDP, and approximately 25 percent to overall employment (Ngeno, 2024). It is the most important food crop in the country, contributing 20 percent to the country's agricultural production (MOALD, 2015; FAO, 2021). Between 2019 and 2023, maize production in Kenya experienced notable fluctuations in value, output, and cultivation area. The total value of maize rose slightly from Ksh 121.3 billion in 2019 to Ksh 126.3 billion in 2020, dropped to KSh 105.0 billion in 2021, then surged significantly to KSh 179.7 billion in 2022 and further to a five-year high of Ksh 180.8 billion in 2023. In terms of production, output steadily declined from 3,960,385 tonnes in 2019 to 3,087,220 tonnes in 2022, before rebounding sharply in 2023 to 4,285,206 tonnes being the highest within the period. The area under maize cultivation followed a similar pattern, gradually decreasing from 2,207,325 hectares in 2019 to 2,113,520 hectares in 2022, but then rising markedly to 2,430,013 hectares in 2023, indicating a renewed focus or improved conditions for maize farming during that year (KNBS 2024a).

Kenya experiences a significant maize production deficit, with annual consumption reaching 5 million metric tonnes while domestic production lags at just 3.5 million metric tonnes, necessitating regular imports to bridge the gap (De Groote, 2023). Furthermore, only 2.1 million acres of the country's 4.1 million acres of arable land suitable for maize cultivation are currently being utilized, indicating substantial underutilization of agricultural potential and inefficient allocation of farming resources (FAO, 2022).

Regarding the maize value addition, between 2019 and 2023, maize flour processing in Kenya exhibited a steady downward trend, with the volume processed declining from 707.4 thousand tonnes in 2019 to 625.3 thousand tonnes in 2023 which was the lowest over the five-year period. While there was a minor recovery in 2022 to 639.6 thousand tonnes, this was not sustained. Corresponding to this, the value of unmilled maize (excluding sweet corn) fluctuated sharply during the same period. It rose from Ksh 508.7 million in 2019 to a peak of Ksh 1,147.7 million in 2020, followed by a decline to KSh 320.8 million in 2022, before rebounding to Ksh 677.3 million in 2023 (KNBS, 2024b). These fluctuations reflect volatility in market dynamics, possibly linked to climatic conditions, input costs, and policy interventions.

Kenya's maize market is characterized by fluctuating import volumes and values, influenced by factors such as domestic production, global prices, and policy decisions. From 2019 to 2022, maize imports rose sharply from 228,783.5 tonnes to a peak of 793,751.5 tonnes, before declining to 507,932.5 tonnes in 2023, suggesting improved local production or a shift in trade dynamics (KNBS, 2024b). In terms of value, imports increased from Ksh 508.7 million in 2019 to a peak of Ksh 1,147.7 million in 2020, followed by a steady decline to Ksh 320.8 million in 2022, then a recovery to Ksh 677.3 million in 2023 (KNBS, 2024b). Despite rising production levels, Kenya continues to face a supply gap, with imports helping to bridge the shortfall. In 2023, total maize and related product consumption rose to 63.3 kg per capita, up from 58.7 kg in 2022, highlighting growing domestic demand.

Maize remains the most widely consumed staple, with 85 percent of the population depending on it for consumption (Abodi et al., 2021). Consumption per person of maize has been on the rise. In 2023, maize and maize products consumption in Kenya rose to 63.3 kgs per person per year, up from 58.7 kgs in 2022, indicating an increase in per capita demand (KNBS, 2024b).

Employment in maize cultivation is widespread, with the 2019 census recording over 5.1 million households involved. The top maize-producing counties include Kakamega, Bungoma, Nakuru, and Meru (KNBS, 2019). Maize cultivation aligns with two growing seasons: the long rains (March–May) and short rains (October–November), influencing planting, harvesting, and market supply cycles (Kenduiywo and Miller, 2024). These seasonal patterns influence value chain operations and consumption trends, especially within the domestic market, emphasizing maize's vital role in supporting Kenyan livelihoods and the national food system.

5.2. Types of Actors

The maize value chain in Kenya involves many actors including input suppliers, farmers, marketers, processors, and consumers. Farmers are the actors that are involved in maize production from sowing to harvesting and selling to different actors at the marketer level.

Most maize in Kenya is produced by smallholder farmers, the majority of whom grow maize primarily for their own household's consumption. Only about 45 percent of household-produced maize is marketed, and many farmers are not self-sufficient, often needing to purchase maize even within the same season. Approximately 18 percent of farmers both sell and buy maize in the same year, while only 20 percent, mostly large-scale producers cultivating over 30 acres, sell maize consistently (Kang'ethe et al., 2020). Medium-scale producers, farming between 5 and 20 acres, also contribute to market supply. Marketed maize production has declined from 316.7 thousand tonnes in 2019 to 185.4 thousand tonnes in 2023 (KNBS, 2024b). Assemblers are the first commercial buyers of maize from the field, and they sell it to retailers, wholesalers, or consumers. They account for 55 percent of sales by farmers (Kang'ethe et al., 2020).

Wholesalers are key intermediaries in Kenya's maize value chain, purchasing maize in bulk from farmers and assemblers, fumigating it, and storing it in warehouses before reselling it to processors and retailers at higher prices. These actors typically source maize from surplus-producing areas and distribute it to deficit regions, commanding approximately 23 percent of the market (Kang'ethe et al., 2020). A notable player among wholesalers is the National Cereals and Produce Board (NCPB), a state corporation tasked with the procurement, marketing, processing, importation, and exportation of maize and other scheduled crops. The NCPB also advises the government on production levels and trade policies concerning these crops (NCPB, 2023).

Large-scale processors, such as Unga Group Limited, Mombasa Maize Millers, and Nairobi Flour Mills Limited, TSS Grain Millers, Pembe Flour Mills, and others play a major role in the formal segment of the value chain. They serve as lead firms in the formal chain, demanding that suppliers adhere to East African Community (EAC) or Kenyan quality standards (Daly et al., 2017). Retailers, including supermarkets and kiosks, supply maize and maize-based products directly to consumers in both rural and urban areas.

Cooperatives play a crucial role in Kenya's maize value chain by supporting members across various stages, including the supply of inputs, maize production, storage, and distribution of maize and maize-based products. These cooperatives help address inefficiencies created by intermediaries and ensure that profits are redirected back to the member farmers. Beyond logistical support, cooperatives also provide essential services such as financial assistance, access to transportation, reliable market information, supply of farming inputs, and capacity-building initiatives aimed at strengthening member resilience and productivity.

The structure of relationships within the maize value chain, particularly between intermediaries, is marked by a relatively high level of formality. This is largely due to the regulatory presence of the National Cereals and Produce Board (NCPB), which oversees maize and input pricing, helping to stabilize market dynamics. However, trust in transactions is also influenced by informal mechanisms such as social networks, buyer reputations, and the recurrence of business relationships, highlighting the coexistence of formal regulation and informal trust-based systems within the maize trade.

5.3. Conditions for Digitalization

A notable innovation in Kenya's maize value chain is the warehouse receipt system (WRS), where farmers store maize in certified warehouses that ensure high-quality standards, including the prevention of aflatoxin contamination. Through this system, farmers secure storage and market leverage, as the receipts can be used to trade maize on commodity exchanges or serve as collateral for loans, enabling them to sell when prices are more favorable. By lowering post-harvest losses and middlemen's price exploitation, the WRS, which was introduced in July 2020 by Kenya's Ministry of Agriculture Livestock, Fisheries and Cooperatives (MoALFC), promises to boost smallholder farmers' incomes. Following a successful trial in 2017, the Alliance for a Green Revolution in Africa (AGRA) partnered with the East African Grain Council to activate the WRS. The WRS Act 2019, which established the Warehouse Receipt Council and provided a legislative and regulatory framework for its development, was passed by the Kenyan Parliament, and the system went into action (FSD Kenya, 2024).

6. IRISH POTATO VALUE CHAIN

6.1. Value Chain Characteristics

Irish potatoes are vital to rural lives and national food security, ranking as the second most significant food crop after maize (MOALD, 2015; MOALD&C, 2021). The Irish potato has been recognized by the government as one of the native crops that can help diversify the staple diet and increase the nation's overall food production volume (Laibuni et al., 2018).

The Irish potato value chain is a main source of employment and livelihood. It supports over 3.5 million actors directly and indirectly, ranging from smallholder farmers to transporters, traders, and processors (MOALD&C, 2021). An estimated 1.17 million farmers are actively involved in potato production, with small-scale farmers contributing approximately 83 percent of the national output (GAA, 2024). The sector provides income for more than 70 percent of rural dwellers and plays a critical role in food security (GIZ, 2024). With an estimated worth exceeding Ksh 50 billion annually and the potential to contribute more than Ksh 200 billion to the national economy.

Irish potato cultivation in Kenya aligns closely with the country's bimodal rainfall pattern, which facilitates two growing seasons per year. The short rains allow planting in October or November, with harvesting in January and February, while the long rainy season begins in March or April, with harvests around July and August (Sinelle, 2018). Most production is rain-fed, making the sector vulnerable to seasonal fluctuations, which can lead to gluts and depressed market prices due to poor storage infrastructure (KALRO, 2021). Despite these challenges, the crop remains a staple food with high productivity per unit area, contributing to national food security and urban demand growth (AFA, 2023). The domestic market dom-

inates, but Kenya also engages in international trade, exporting over 78,000 metric tonnes in 2023, although most producers still rely heavily on informal market channels and intermediaries (GIZ, 2016; AFA, 2024).

6.2. Types of Actors

Irish potato value chain involves various actors including input suppliers, farmers, traders, processors, and consumers. The input supply segment of the Irish potato value chain comprises a mix of public and private entities involved in the production and distribution of certified seed and agricultural inputs. As of 2021, there were around 30 registered seed potato merchants, with five operating at a large scale (NPCK, 2021). Public institutions such as the Agricultural Development Corporation (ADC) and Kenya Agricultural and Livestock Research Organization (KALRO) Tigoni focus on producing basic seed, while private firms like Kisima Farm limited Potato Services Africa and Egerton University handle seed multiplication and distribution. These actors also support technology transfer and capacity building to improve farmer access to quality seeds (MOALD&C, 2021). Input suppliers such as Amiran, Bayer East Africa, and Yara provide essential agrochemicals and fertilizers, along with extension services and demonstration projects to promote proper usage and maximize yields.

At the production stage, over 1.17 million households in Kenya engage in Irish potato farming, with both small- and large-scale farmers contributing to ware potato production (KNBS, 2020). However, most producers face limited control over market prices due to the perishability of the crop, poor storage infrastructure, and a lack of organized marketing systems. To mitigate these challenges, farmer groups and cooperatives help in aggregating produce, pooling resources for input purchases, and advocating for farmers' interests (MOALD&C, 2021). Brokers, traders, and transporters form the backbone of the informal market system. These actors often overlap in roles such as aggregating, sorting, and packaging potatoes for processors and consumers without clear role distinctions or entry barriers, which complicates market organization (SNV, 2015).

Processors handle only about 15 percent of market share and influence production standards by demanding potatoes with specific qualities like shape, size, and low discoloration (GIZ, 2016). Large-scale processors, such as Sereni Fries Limited and GAEA Foods Limited often offer premium prices for potatoes that meet strict requirements, while small processors typically purchase available stock with fewer specifications (SNV, 2015).

Consumers of Irish potatoes range from individual buyers to institutions like hotels and supermarkets, basing their preferences on factors such as taste, texture, and shelf life. Supporting actors including mechanization service providers, storage solution companies (e.g., Omnivent, Tolsma), and various regulatory and development agencies ensure that the value chain operates efficiently. Institutions such as KALRO, Kenya Bureau of Standards (KEBS), and donor organizations like United States Agency for International Development (USAID) and AGRA contribute to research, infrastructure, and policy, while financial institutions help reduce risk and enhance investment in the sector. Intermediary relationships within the potato value chain remain largely informal, with weak institutional structures governing interactions between actors such as brokers, transporters, and retailers. Most transactions lack formal contracts or regulatory oversight, allowing middlemen to set prices arbitrarily, often to the disadvantage of farmers.

While regulatory frameworks like the Crops (Irish Potato) Regulations, 2019, have been introduced to formalize aspects such as packaging and pricing, their enforcement is hindered by infrastructure and

compliance issues (NPCK, 2020). Credit access is another key factor influencing value chain efficiency. Although credit can enhance production, processing, and marketing by enabling actors to invest in inputs and technology, many farmers struggle to obtain formal financing due to collateral demands. As a result, they turn to informal lending groups such as Village Savings and Loan Associations (VSLAs), which offer limited but accessible funding, often at higher interest rates. Initiatives like the Potato Value Chain Capacity Building Project aim to bridge this gap by linking actors with financial institutions and promoting inclusive financing models.

Gender disparities are deeply embedded within Kenya's Irish potato value chain, particularly at the production and intermediary levels. Women often lack access to critical productive resources such as land, capital, and agricultural inputs, making commercial seed potato production largely a male-dominated activity. While men engage in commercial and mechanized farming tasks such as land preparation, spraying, and marketing, women are relegated to labor-intensive roles such as weeding, roguing, harvesting, and packaging, often performed as unpaid family labor.

Cooperative organizations play a significant role in counteracting some of these disparities by promoting collective action. These cooperatives enhance farmers' access to inputs and markets through collective aggregation and purchasing, while also providing platforms for capacity building and advocacy (MOALD&C, 2021).

Despite the potential for organized systems to improve value chain efficiency, most relationships among intermediary actors such as brokers, transporters, wholesalers, and retailers remain informal. These interactions typically lack formal contracts or regulatory oversight, leading to exploitative practices and price disparities that disadvantage producers. While policy interventions like the Crops (Irish Potato) Regulations, 2019, aim to formalize packaging and pricing, their impact is limited due to weak enforcement and infrastructural challenges (NPCK, 2020). Credit accessibility also shapes the efficiency of the value chain. While financing helps actors invest in inputs and adopt value-adding technologies, many smallholder farmers face barriers in accessing formal credit due to high collateral requirements. As a result, they rely on informal sources like village savings groups, which offer smaller, more costly loans. These financial constraints limit growth and perpetuate inequality across the value chain.

6.3. Conditions for Digitalization

In the Irish potato value chain, the development of Automated Marketing Information Systems (AMIS) such as the ViaziSoko platform has significantly improved market access and information flow for farmers (MOALD&C, 2021). Developed by the National Potato Council of Kenya (NPCK), in collaboration with the International Potato Center (CIP) and the German Corporation for International Cooperation (GIZ), ViaziSoko is a comprehensive digital platform accessible via web portal, mobile app, and USSD service. ViaziSoko serves as an e-advisory, extension, and marketing tool tailored specifically for potato farmers and value chain actors. It supports online marketing of potato-related products and services while facilitating the dissemination of critical agricultural information. The platform enhances market intelligence, connects farmers with certified seed producers and traders, and promotes the use of quality inputs (Regional Seed Potato Strategy and Action Plan, 2022–2032).

Additionally, it addresses key challenges in the potato sector by offering access to certified seeds, specialized fertilizers, agrochemicals, spray and soil testing services, and mechanization. Through the USSD service, farmers can quickly check input availability, while the web and mobile apps allow for placing orders, booking services, accessing weather forecasts, receiving guidance on good agricultural practices

(GAPs), and obtaining pest and disease management advisories, ultimately boosting productivity and profitability (NPCK ViaziSoko, n.d.). Although Kenya has several digital platforms that address various value chains, the ViaziSoko (VS) Digital platform is the only tool specifically developed for potato farmers and stakeholders in the potato industry, including input and output market linkages. Other digital platforms that feature a potato component include DigiFarm and M-Shamba (Borus, 2023).

To increase access to and utilization of high-quality inputs, the Potato Council has been collaborating with several partners. In recent years, NPCK has worked with the government and other partners to create input subsidy programs, including the GoK-IFAD Project (Revitalization of Potato Production Project) and the E-voucher program. An important source of information for stakeholders about current opportunities, developments, and ongoing projects in the sector is the yearly potato magazine. (NCPK, 2022).

Digital payments are playing a transformative role in Kenya's Irish potato value chain by enhancing efficiency, transparency, and financial inclusion. Mobile money platforms like M-Pesa have enabled farmers to receive secure, instant payments, reducing reliance on cash and mitigating risks like theft and fraud (Farmers Magazine, 2025). Solutions such as M-Shamba also facilitate direct transactions between farmers and buyers, often resulting in better prices by bypassing intermediaries (Maina et al., 2023). The introduction of platforms like the Kenya Rural Transformation Centres Digital Platform (KRTCDP) aims to integrate farmers, cooperatives, input suppliers, and financial institutions into a unified ecosystem that supports access to quality inputs, extension services, and financial products (Kenya News, 2024). Several factors are driving the adoption of digital financial services (DFS) in the Irish potato value chain. Key among them is the widespread penetration of mobile phones and mobile money platforms, which have become essential tools for rural transactions.

7. BANANA VALUE CHAIN

7.1. Value Chain Characteristics

Bananas are the most important fruit crop in Kenya, both in terms of volume and value. As of 2023, bananas accounted for 35 percent of the total fruit value, followed by avocados (23 percent), mangoes (16 percent), oranges (6 percent), and watermelons (5 percent (AFA, 2024). Bananas contribute approximately 17.8 percent of Kenya’s total domestic horticultural value and 34.5 percent of all fruit production (KALRO, 2025).

Kenya grows a diverse range of banana varieties suited for dessert, cooking, and plantain uses. Popular dessert varieties include Grand Nain, Dwarf Cavendish, Williams Hybrid, and Gross Michel. Common cooking varieties are Ng’ombe, Mutahato, and Nusu Ng’ombe, while plantain types include Bokoboko and Mkono wa Tembo (KALRO, 2023). Beyond fresh consumption, bananas are processed into value-added products such as flour, wine, and bakery goods, enhancing economic and nutritional outcomes.

Banana cultivation has steadily expanded in recent years. The area under production grew from 67,032 hectares in 2021 to 75,184 hectares in 2023, representing a 12 percent increase. Despite this growth, production volumes fluctuated, rising from 1.98 million metric tonnes in 2021 to 2.05 million metric tonnes in 2022, then falling to 1.88 million metric tonnes in 2023 (AFA, 2024). However, the crop's value increased significantly, from KSh 27.5 billion in 2022 to KSh 35.9 billion in 2023, representing a 31 percent

rise driven by higher market prices and sustained demand. The unit price per 100 kg increased slightly from KSh 1,337.51 to KSh 1,366.60 over the same period (KNBS, 2024).

The consumption of bananas per person per year has steadily risen, reaching 48.0 kg in 2023, up from 34.9 kg in 2022. Over the past five years, consumption has ranged from 29.9 kgs in 2019 to the current peak of 48.0 kg (KNBS, 2020–2024). Despite increased production, domestic supply continues to fall short of demand. In 2016, the banana supply deficit was estimated at 600 metric tonnes, and local consumption still accounts for over 80 percent of total production.

Despite the sector's potential, banana farming faces constraints such as high production costs, limited access to quality inputs, and inefficient marketing systems (IFAD, 2019). Contract farming has emerged as a viable solution, providing farmers with better market access, stable prices, and extension services. Projects by Twiga Foods, Stawi Foods, and government-supported initiatives like NARIGP and SHEP have contributed to improved income and productivity. For instance, one project led to a 103.7 percent increase in farmers' income and the creation of 61 green jobs, with significant youth and women participation (Danida Business Partnerships, n.d.).

Studies in Meru and Embu counties have identified access to credit, quality inputs, extension services, and market access as key drivers of productivity and income among banana farmers (Murigi et al., 2024). Contract farming was shown to boost yields and earnings due to technical support and price guarantees.

7.2. Types of Actors

The banana value chain in Kenya is primarily informal and, as a direct consequence, relatively unstructured. Many intermediaries stand in many layers between the farmer and the final consumer. The value chain in is dominated by smallholder farmers, with about 2.1 million households involved in production (KNBS, 2019). The farmers use suckers for planting, which are sourced from neighbors and are usually infested with pests and diseases. This, coupled with poor management practices, leads to low yields, estimated at 11.8 metric tonnes against the potential output of 35 metric tonnes per acre. This practice is gradually changing with the introduction of tissue culture plantlets of high-yielding varieties. Furthermore, the use of appropriate inputs like fertilizers, compost, animal manure, and pesticides for pests and diseases is being promoted through extension support in a bid to address production and productivity challenges.

A formal arrangement known as aggregation allows smallholder farmers who are underserved by economies of scale to band together to jointly access input and output markets. These agreements may be top-down efforts by the government or a promotional group, or they may be bottom-up initiatives that arise within the small-holder farming community. Because of the retail industry's fragmentation, high transportation costs, inadequate facilities, and exploitation by influential dealers and middlemen, banana growers have long had trouble finding outlets for their produce. This scenario is slowly changing with the emergence of the aggregation of individual farmers and farmer groups into Farmer Producer Organizations (FPOs). A few of these FPOs are undertaking aggregation and marketing activities. About 90 percent of the aggregated bananas are sold to retailers, processors, and exporters, with the remainder being sold directly to local consumers.

There are two levels of processing involved: processing of banana fruits into edible products such as wine, crisps, and banana flour, among others like bread, cakes and biscuits, and processing of banana

stalks (pseudo stem) into fiber products such as handbags and other home décor products. This stage often comprises cottage processors for farmer groups, cooperatives, or private companies.

Most small-scale processors operate close to major banana-producing areas; examples include the Khwisero Agro-processing & Munami Agro-processing Cooperatives in Kakamega, Nyangorora Group based in Kisii, Amaroka enterprises in Vihiga, among others. Other private companies like Stawi Foods Limited and Amigos have designated processing outside production areas. Predictive data on the volume processed per month by each processor indicates that the average capacity of bananas processed per month in Kenya is 1,000 metric tons, translating to about 12,000 metric tons in a month against the available volumes of about 2 million metric tonnes of banana fruits. On the other hand, postharvest losses are estimated at 35 percent (700,000 metric tonnes) per year (KALRO, 2022).

At the banana marketing stage, various activities occur to promote and sell bananas to consumers locally and for export. Currently, for both markets, 80 percent of traders sell bananas at fluctuating prices (KSh 8 to KSh 20 per kilo) and undefined qualities to informal fruit markets, village markets, and groceries that settle along street sides depending on volumes. Approximately 20 percent of traders have formal trading structures targeting formal retail outlets locally and internationally. The formal traders include Twiga Foods and Pick and Pack, among others, who supply defined quality banana fruits to formal outlets like Naivas, Carrefour, Zucchini, and grocery shops such as Field Fresh. These traders also have an organized chain of supplying local groceries with fresh bananas from farms through marketing agents.

7.3. Conditions for Digitalization

Digital payments, particularly through platforms like M-Pesa, are transforming Kenya's banana value chain by improving market access by farmers. A notable example is Twiga Foods, a Kenyan agritech company founded in 2014, addresses market inefficiencies by using a cashless, mobile-based B2B platform to connect farmers with urban vendors, improving the distribution of fresh produce including bananas and reducing value chain fragmentation. The study by Kikulwe et al. (2014) on mobile money, smallholder farmers, and household welfare in Kenya found that the use of mobile money was associated with a 10.4 percent increase in banana sales. This suggests that mobile money can significantly enhance market access for small-holder farmers.

8. FRENCH BEANS VALUE CHAIN

8.1. Value Chain Characteristics

Kenya plays a pivotal role in the global French beans industry. French beans are the most exported vegetable (Fresh Produce Logistic, 2021), with average yields ranging from 2.4 to 3.2 tonnes per acre (Mwangi et al., 2019). Most French beans are cultivated for export, especially to the European Union, with the United Kingdom serving as the primary market (Kariuki et al., 2012). In 2020, French beans accounted for around 60 percent of Kenya's vegetable exports, generating KSh 4 billion, which represents 29 percent of total vegetable export earnings (FCI, 2021). Production is largely driven by smallholder farmers who contribute over 80 percent of the total output and cultivate approximately 4,500 hectares, while large-scale producers manage the remaining 3,000 hectares (COLEAD, 2023). These farmers are essential to the sector, with French beans contributing 19 percent to Kenya's horticultural value and 25 percent to the overall vegetable export volume (DGICD, 2018; RSA, 2018).

The French bean sector in Kenya is substantial, covering approximately 29,000 hectares of land and yielding between 6 to 9 tonnes per acre, with annual production averaging around 50,000 tonnes (Safi Organics, 2025). Most French bean farmers operate on small plots, typically averaging 0.75 hectares. Interestingly, nearly 60 percent of these farmers are under the age of 35, reflecting a significant level of youth engagement in the sector. This demographic shift presents an opportunity for industry to tap into a more innovative and dynamic labor force, potentially increasing productivity and adopting new agricultural technologies.

The French bean industry also plays a vital role in employment, particularly for smallholder farmers and women. According to COLEAD (2023), the sector engaged around 1,300,288 casual laborers and 1,031,314 full-time employees in activities such as land preparation, planting, weeding, and value addition in the 2014-2015 period. Women are especially important in the value chain, contributing significantly to household farming and post-harvest activities such as sorting, grading, and quality control in pack houses. While men tend to handle more labor-intensive tasks like loading and offloading, women are central to maintaining quality standards and ensuring the efficiency of the supply chain. In addition, commercial farms, processing facilities, and logistics operations employ between 45,000 and 60,000 people, 60 percent of whom are women (SNV, 2012).

French beans in Kenya are primarily grown for export, with irrigation systems enabling year-round production. However, the main export season runs from October to May, coinciding with the European winter when domestic supply is limited and demand is high (CROPNUTS, n.d.; Greenlife Crop Protection Africa, 2024). The sector is driven by Kenya's bimodal rainfall patterns, with farmers typically staggering planting every 2 to 3 weeks to ensure continuous harvesting. The European Union remains the largest destination for Kenyan French beans, accounting for about 56 percent of vegetable exports, followed by markets such as the United States (19 percent) and other European countries (MARKUP Kenya, 2024). Export channels include both fresh and processed (canned) beans, while domestically, beans that do not meet export standards are sold in local markets, including supermarkets and restaurants. Despite this, local consumption remains limited due to higher prices and consumer preferences for other vegetables (FAO, 2012; Business Radar Kenya, 2025). The French bean value chain involves numerous actors, from smallholder farmers to large exporters and processors, all working together to meet international market standards. Key players include Vegpro Kenya, Kenya Horticultural Exports Limited, and French Produce Exports Association, among others.

French beans are grown in the counties of Embu, Kakamega, Kirinyaga, Laikipia, Machakos, Makueni, Meru, Migori, Murang’a, Nakuru, Nandi, Narok, Nyandarua, Nyeri, Taita Taveta, Tharaka Nithi, Trans Nzoia, and Uasin-Gishu. Major French bean production areas are: Kirinyaga with over 60 percent; Meru and Laikipia each with 10 percent; Muranga 5 percent; others include Makueni and Machakos (COLEAD, 2022).

8.2. Types of Actors

The French beans value chain in Kenya is supported by a diverse set of actors that contribute to its production, processing, and export. Smallholder farmers and farmer groups are the primary producers, often working under contract with exporters such as VegPro, Homefresh Horticulture Export Limited, and InterVeg Exports Limited. These exporters manage marketing and logistics to international markets, including Europe, the Middle East, and the United States (Business Radar, 2025).

Input suppliers and extension services provide essential resources such as seeds, fertilizers, pesticides, and training to maintain quality production, while transporters ensure the safe movement of beans from farms to markets (Business Radar, 2025). Additionally, certification bodies like GlobalGAP and regulatory agencies such as KEPHIS and the Ministry of Agriculture ensure compliance with both domestic and international standards.

Intermediary actors, including brokers, middlemen, and cooperatives, are essential in connecting smallholder farmers to domestic and international markets. These actors facilitate the aggregation, grading, and transportation of beans from rural farms to processing centers and export hubs. Apex actors in the value chain, such as large-scale exporters like VegPro, East African Growers (EAG), and Meru Greens Horticulture (MGH), dominate the market. These firms operate vertically integrated models, managing their own farms and contracting thousands of smallholder farmers. They provide training and inputs and ensure compliance with international standards, thereby handling the logistics of exporting produce to high-demand markets in Europe and the Middle East. The dominance of these apex actors shapes the overall structure of the value chain, influencing pricing, quality standards, and market access, thus playing a key role in driving efficiency and competitiveness within the sector.

Cooperatives like Abosi Top Hill Farmers' Cooperative and Golden Greengrowers Cooperative enhance farmers' bargaining power, especially by providing training, resources, and access to markets, while fostering greater gender inclusivity within the value chain.

8.3. Conditions for Digitalization

Digital payment saves French bean farmers the time and expense of traveling to collect their payment, increases the users' transparency through documenting their income streams and building a credit history, lowers the risk of theft, and enables easier and more flexible use of the money. Lenders can use it to underwrite credit for new inputs, such as seeds, fertilizer, or equipment (World Bank Group, 2021).

9. CONCLUSIONS

The value chains under consideration, including avocado, dairy, maize, Irish potatoes, bananas, chicken, and French beans, share several common characteristics. All are predominantly driven by smallholder farmers who face challenges such as limited access to quality inputs, extension services, post-harvest infrastructure, and formal markets. Widespread informality often leads to inefficiencies, post-harvest losses, and farmer exploitation. Seasonality and climate variability further impact the consistency of production across all chains. While digital tools and mobile platforms are increasingly used to improve market access, traceability, financial inclusion, and farm management, their adoption and effectiveness vary across the different value chains.

Distinct aspects emerge in the level of formalization, market orientation, and policy support across value chains. Avocado and French beans stand out for their export orientation and relatively higher formalization, driven by international standards and the presence of certified nurseries, cold chain providers, and registered exporters. The dairy sector, although domestically focused, is more structured due to strong cooperative networks and service hubs offering bundled inputs, credit, and veterinary care. In contrast, value chains such as chicken, maize, and Irish potatoes remain largely informal and domestically oriented, with low levels of processing and limited infrastructure. Maize is unique in its strategic food security

role and use of the Warehouse Receipt System (WRS), while chicken farming is heavily indigenous and faces volatile demand with minimal policy or institutional support.

To strengthen these agricultural value chains, targeted policy interventions are needed. These include investment in cold chain and rural infrastructure, enforcement of quality standards, promotion of certified inputs, and support for cooperative formalization. Export-oriented chains require compliance facilitation and expanded market access, while domestic-focused sectors need improved storage, processing, and climate-smart practices. Gender inclusivity, youth engagement, and digital transformation should be cross-cutting themes, alongside institutional strengthening through projects like the National Agricultural Value Chain Development Project (NAVCDP). Tailoring interventions to the specific structural and market realities of each chain will enhance their resilience, equity, and commercial viability.

A. APPENDIX

Value Chain Selection Matrix											
Criteria	**Sub-Criteria**	**Maize**	**Dairy**	**Chicken**	**Irish potatoes**	**Avocado**	**Banana**	**Coffee**	**Tomatoes**	**French Beans**	**Apiculture**
Value Chain Structure	**Vertical Integration:**	5	7	4	3	4	3	4	3	5	4
	Horizontal Integration:	4	6	3	3	5	5	6	5	6	5
	Level of Formality:	4	4	3	3	4	3	4	2	6	3
	Infrastructure & Market	5	6	7	5	6	5	6	5	7	6
	Value Addition:	5	6	5	5	7	4	5	4	4	4
	Innovation:	5	6	6	4	5	4	4	3	5	3
Subtotal		***19***	***22***	***21***	***17***	***22***	***16***	***19***	***14***	***22***	***16***
Scale and Market Potential	**Production Value**:	**7**	**7**	**7**	**7**	**8**	**7**	**8**	**7**	**7**	**6**
	Market Demand:	8	8	8	8	9	8	7	8	8	**7**
	Export Potential:	5	5	5	4	9	4	9	4	9	**7**
	Growth Potential:	6	7	7	7	8	7	6	6	7	**8**
	Cost Competitiveness:	5	6	5	6	7	6	5	6	6	**6**
	Market Potential:	6	7	6	6	8	5	7	5	6	**7**
Subtotal		***30***	***33***	***31***	***31***	***41***	***30***	***34***	***29***	***36***	***35***
Socio-economic Impact	**Employment Generation**:	7	8	7	7	8	7	6	6	8	6
	Households Benefitting:	9	9	8	8	9	8	8	7	7	7
	Inclusivity & Equity:	6	6	6	6	7	6	6	5	6	6
	Accessibility for the Poor:	7	7	7	7	6	6	5	6	5	7
Subtotal		***29***	***30***	***28***	***28***	***30***	***27***	***25***	***24***	***26***	26
Food Security	**Food Availability & Access**:	9	9	8	9	8	8	6	8	6	5
	Price Stability:	6	7	6	7	6	7	4	6	4	3
	Nutrition & Health Impact:	5	8	8	7	9	7	5	9	7	7
Subtotal		***20***	***24***	***22***	***23***	***23***	***22***	***15***	***23***	***17***	15
Other Considerations	**Institutional Support:**	7	7	6	6	8	5	7	5	6	6
	Sustainability:	5	5	4	5	6	7	6	6	7	8
	Cultural Importance:	9	9	8	7	6	9	9	8	4	7
Subtotal		***21***	***21***	***18***	***18***	***20***	***21***	***22***	***19***	***17***	21
TOTAL SCORE		**119**	**130**	**120**	**117**	**136**	**116**	**115**	**109**	**118**	113
RANK		**4**	**2**	**3**	**6**	**1**	**7**	**8**	**10**	**5**	9

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This publication has not been independently peer reviewed. Any opinions expressed here belong to the author(s) and are not necessarily representative of or endorsed by IFPRI. Funding for this work was provided by the Gates Foundation.

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