CHAPTER 7

Processing and Value Addition Technologies in African Agrifood Systems

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Introduction

Agrifood processing and value addition are essential to Africa's agricultural transformation and inclusive economic growth. Agriculture employs around 65 percent of the continent's economically active population (AUC and AUDA-NEPAD 2022), despite a significant number of youth migrating to cities in search of employment opportunities. The tendency is anticipated to increase the urban population from 43.5 percent in 2020 to 48.4 percent by 2030 (Odjo, Traoré, and Zaki 2024). The shift from rural to urban areas exacerbates unemployment (Odjo, Traoré, and Zaki 2024). Industrialization, especially through value addition and agrifood processing, offers opportunities to generate decent employment for semi-skilled and unskilled labor (Newfarmer et al. 2018).

Continental strategies like the African Union's Agenda 2063 and the Comprehensive Africa Agriculture Development Programme (CAADP) emphasize the need to transition from subsistence to commercial production by leveraging modern technology to bolster economic growth, food and nutrition security, and employment generation (AUC 2024). This transformation hinges on investment in technology and innovation, encompassing digital technologies for agriculture, climate-smart agricultural practices, biotechnology, and agrifood processing infrastructure to improve the productivity and competitiveness of agrifood systems.

This chapter offers an in-depth examination of agrifood processing and value addition in Africa's agrifood systems. It links continental frameworks such as CAADP and Agenda 2063 to practical realities through pertinent statistics, value chain classifications, technological and innovation levels, and illustrative case studies.

Concept of Agrifood Processing and Value Addition in Agrifood Systems

The agrifood system includes all operations from the production to the disposal of food products (Rolle et al. 2024; Ellis et al. 2022). Africa's agrifood systems are increasingly influenced by urbanization, population growth, changing consumer preferences, rising incomes, health and safety issues, and sustainability concerns (Aboushady, Kornher, and Zaki 2024; Matchaya, Odjo, and Collins 2024; Boye and Arcand 2012). Urbanization has intensified the need for convenient, ready-to-eat foods, which raw and perishable commodities are unable to satisfy (Wilkinson and Rocha 2008; Odjo et al. 2024). Given the limited shelf stability of most agricultural commodities, value-added processing is essential to prolong shelf life, boost safety and nutrition, improve marketability, and promote environmental sustainability. Agrifood processing further propels Africa's Agenda 2063 (AUDA-NEPAD 2022) and key Sustainable Development Goals (SDGs), including Zero Hunger (SDG 2), Clean Water and Sanitation (SDG 6), Reduced Food Loss (SDG 12.3), Climate Action (SDG 13), and Life on Land (SDG 15) (FAO 2019).

BOX 7.1—AGRIFOOD PROCESSING AND VALUE ADDITION

Agrifood processing and value addition are sometimes used interchangeably, but the former is considered as a subset of the later. Value addition refers to any process or technique that enhances the utilization, usefulness and value of an agricultural commodity, whereas Agrifood processing is specific activity of transforming raw agricultural food products into intermediate or final products with high market value (Disenyana et al. 2019). Such transformations range from simple as cleaning to complex (form/structural and chemical change) processes (Disenyana et al. 2019). Agrifood-processing aims at preserving and ensuring safety, increasing shelf life and availability, improving digestibility, palatability and organoleptic quality (texture, flavour, colour), and convenience (Sharma et al. 2024).

Importance of Agrifood Processing and Value Addition in Agrifood Systems

Agrifood processing is essential for enhancing the value and quality of agricultural food products and for facilitating connections between producers and consumers within agrifood systems and value chains. This document examines several contributions related to agrifood processing that hold policy significance.

Socio-economic role

Consumers' food selections are affected by income, safety, taste, shelf life, and health benefits. As income increases, the demand for high-quality, safe, and

nutritious foods becomes paramount. Likewise, urbanization and population growth further drive demand for convenient, ready-to-eat alternatives (Mado and Saio 2009). Agrifood processing addresses these requirements by guaranteeing food availability in the preferred form, quality, timing, and location, while generating employment and income by connecting production and consumption through the backward demand for raw materials and the forward supply of value-added products (Wilkinson and Rocha 2008; Newfarmer et al. 2018; Matchaya, Odjo, and Collins 2024). The diversion of food commodities to biofuels and other bio-based products diminishes the availability of food meant for human consumption (Boye and Arcand 2013).

Food and nutrition security

In addition to low production, post-harvest food losses are substantial in Africa. The loss rate for cereals and pulses is 10–20 percent; however, for fruits and vegetables, it is considerably higher, estimated at 50 percent (Santacoloma et al. 2021; FAO 2019). The transformation of agricultural commodities into shelf-stable forms prolongs their availability beyond the production season and geographic area. The production of functional foods via fortification and the processing of nutraceuticals caters to the dietary demands of individuals with specific nutritional requirements (Egbuna and Dable-Tupas 2020). Agrifood processing transforms raw, perishable resources into products that are less prone to spoiling, more convenient for consumption, and enhanced in quality and presentation (Ayofemi et al. 2016; Sharma 2017; Rolle et al. 2024). Moreover, methods such as washing, sorting, grading, cold storage, heat treatment (Mado and Saio 2009), and packing (Rolle et al. 2024) are employed to mitigate food losses, enhance public health, and increase marketability.

Environmental conservation and climate change adaptation

While agrifood processing presents numerous benefits, it also entails challenges, including the generation of wastewater, leading to eutrophication of aquatic ecosystems from nutrient overload, the accumulation of organic residues from byproduct disposal, escalating packaging waste in the environment, and increased greenhouse gas emissions resulting from the anaerobic decomposition of food waste (Boye and Arcand 2013; Thomas 2024). Increasing consumer knowledge of sustainable consumption underscores the need for a balance between environmental protection and economic benefits in agrifood processing. The adoption of a circular economy and climate-smart agrifood processing, focusing on the efficient utilization of water and energy, zero-waste strategies, and biodiversity preservation, is increasing. Strategies and concepts such as 3RVE waste management—namely, Reduce, Reuse, Recycle, Valorize, and Eliminate—are recommended to mitigate greenhouse gas emissions, particularly methane, from organic waste (Boye and Arcand 2013).

Key Food Value Chains in Africa Agrifood Systems

Potential crop value chains for processing and value addition

Africa exhibits significant agroecological diversity; however, the continent is susceptible to food insecurity, climatic disturbances, including droughts and floods, and pests and diseases (AfDB 2016; Thomas 2024). The African Union and the New Partnership for Africa's Development (AU-NEPAD), through the CAADP Strategy (2026–2035) and the Feed Africa Strategy for Agricultural Transformation (2016–2025), have identified and prioritized 18 agrifood value chains: rice, maize, cassava, millet, palm oil, cocoa, horticulture (fruits, vegetables, and spices), wheat, coffee, cashews, cotton, aquaculture, sorghum, cowpeas, soybeans, beef, chicken, and dairy. These agricultural commodities were chosen for their potential to enhance food security and dietary diversification, stimulate economic growth, promote regional integration, align with consumer preferences, compete with imports, offer export potential, and facilitate scalability for mass production and processing (AfDB 2016; AUC 2024).

Food wastage, coupled with poor production practices and limited processing, renders Africa a net importer of numerous agricultural goods (Maertens and Swinnen 2015). Simultaneously, numerous agrifood items exported are transacted as raw materials or semi-processed goods (Odjo et al. 2024). In response, initiatives such as the Abuja Food Security Summit and the International Year of Millets (2023) have been launched to promote value addition. Several prominent agrifood processing enterprises located in Africa, including Tiger Brands and Illovo in South Africa, BIDICO Africa in Kenya, Bakhresa Group and Mount Meru Group in Tanzania, Babban Gona in West Africa, and Olam Group and Cevital in North Africa, have invested in advanced facilities for the production of ready-to-eat and convenient food products.

TABLE 7.1—TOTAL PRODUCTION FOR SELECTED CROPS IN AFRICA, 2015 TO 2023, MILLION MT

Crops	2015	2023	Difference	Percentage increase
Cassava	167.1	213.1	46.0	27.5
Maize	73.7	95.0	21.3	28.8
Sorghum	26.1	26.0	-0.2	-0.6
Millet	12.7	13.1	0.5	3.7
Bean	7.2	8.3	1.1	15.7
Cowpea	5.8	9.5	3.7	64.1
Cocoa bean	3.4	3.8	0.4	12.7
Cotton seed	2.4	2.6	0.2	6.4
Soya bean	2.6	7.3	4.7	177.7
Cashew nut, in shell	1.7	2.3	0.5	30.8
Coffee, green	1.2	1.9	0.8	65.7
Avocado	0.8	1.4	0.7	87.7

Source: FAOSTAT (2025).

TABLE 7.2—VALUE OF EXPORTED FRUITS AND VEGETABLES FROM AFRICA, US$ MILLION, 2003 AND 2022

Year	Unprocessed		Semi-processed		Processed	
	Fruits	Vegetables	Fruits	Vegetables	Fruits	Vegetables
2003	2,752	759	91	250	359	513
2022	9,433	3,419	627	1,527	581	2,088

Source: Aboushady, Kornher, and Zaki (2024).

TABLE 7.3—VALUE OF IMPORTED FRUITS AND VEGETABLES TO AFRICA, US$ MILLION, 2003 AND 2022

Year	Unprocessed		Semi-processed		Processed	
	Fruits	Vegetables	Fruits	Vegetables	Fruits	Vegetables
2003	250	250	10.5	400	150	759
2022	1,904	1,077	28.6	1,881	385	3,871

Source: Aboushady, Kornher, and Zaki (2024).

Notwithstanding the limited processing capacity, production of the priority commodities continues to rise (Table 7.1). For example, total cereal production rose by 15.5 percent, from 188 million tons in 2013 to 217 million tons in 2023 (FAOSTAT 2025). The increase in agricultural production offers prospects for expanding agrifood processing.

Fruit and vegetable processing trends

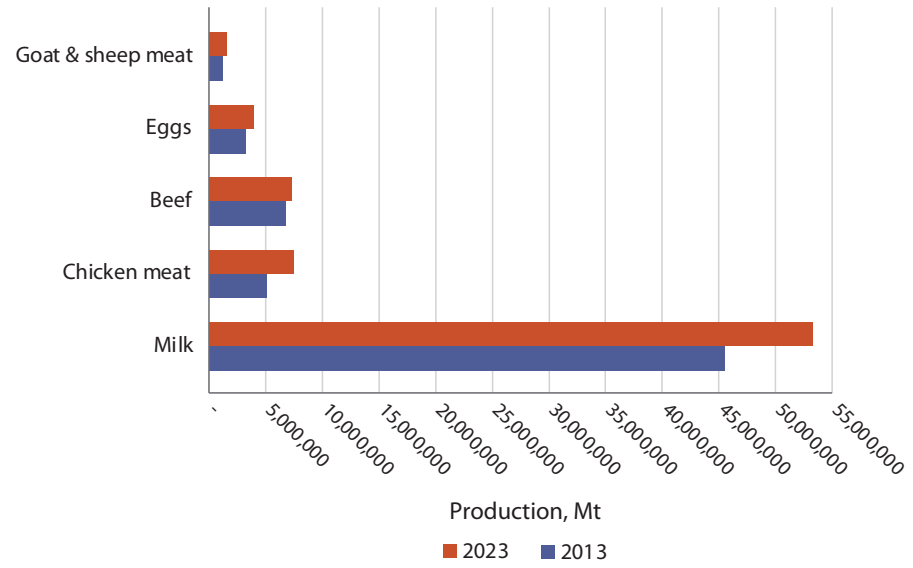
For certain agrifood sub-sectors, exports from Africa are increasing. This includes exports of fruits and vegetables (Table 7.2). However, most of the exports are unprocessed (Aboushady, Kornher, and Zaki 2024). Similarly, imports of fruits and vegetables to Africa are also increasing, with most share of fruits being unprocessed (Table 7.3).

In contrast to vegetables, the unit prices of unprocessed fruit are typically greater than those of processed fruit (Altendorf 2017; Aboushady, Kornher, and Zaki 2024; Schreinemachers et al. 2022). The low value of semi-processed and processed fruit and vegetable exports may indicate difficulties within the African processing industry, such as inadequate processing capabilities and logistics, substandard quality and safety control, insufficient adherence to international standards for processed goods, and elevated tariffs in export markets (Fukase and Martin 2020; Olivetti et al. 2023). The diminished value of processed fruit and vegetable exports may be attributed to Africa's insufficient supply of commodities and processed goods in high global demand, including those for which the continent has a significant competitive advantage. Evidence indicates a rising global demand for processed vegetables, attributed to urbanization and a preference for easy-to-prepare meals. The demand for processed foods is increasing across Africa. Africa possesses a competitive advantage in the production of various processed fruits and vegetables, including preserved vegetables, fruits, and nuts; mixed frozen vegetables; fruit jams, purees, and pastes; orange juice; and some sauces (Aboushady, Kornher, and Zaki 2024).

Livestock commodities production trends

Similar to crops, Africa's production of livestock commodities, particularly chicken, meat, eggs, goat and sheep meat, milk, and beef has improved significantly from 2013 to 2023 (Figure 7.1). Many of these animal commodities can be processed into shelf-stable value-added products, such as cheese, yogurt, sausages, and smoked and canned meat.

FIGURE 7.1—ANNUAL PRODUCTION OF LIVESTOCK COMMODITIES IN AFRICA, 2013 AND 2023



Source: FAOSTAT (2025) .

Global, Africa, and Regional Perspectives on Agrifood Processing, Value Addition, and Related Technologies

Developments in agrifood processing

Agrifood processing is seeing global expansion; yet, in numerous low- and middle-income countries (LMIC), the food and beverage industry prevails, constituting over 60 percent of the agrifood processing sector (Wilkinson and Rocha 2008). The principal agrifood industries in Africa encompassed the processing of cocoa, sugar, tomatoes, meat, canned fruits, dairy products, tanneries, maize, wheat, tea, cotton, and coffee (Owoo and Lambon-Quayefio 2018). Following independence in countries such as Tanzania, Ghana, and Zambia, factories were predominantly managed by state-owned firms (Ackah et al. 2014). The plants were closed or privatized due to inadequate management stemming from restricted technological and innovative capabilities, and an increase in processed food imports (IFPRI 2016; Wilkinson and Rocha 2008; Newfarmer et al. 2017). Privatization facilitated foreign investment and fostered the emergence of substantial domestic private enterprises.

Owing to inadequate technological capabilities and innovations in agrifood processing, most African nations engage predominantly in low-skill and low-value segments of the global value chain (GVC), where prospects for advancement into more sophisticated, technology-driven, and skill-intensive areas that yield higher returns are constrained. This resulted in the establishment of regional value chains (RVCs) as an auxiliary mechanism for the development of export-oriented agrifood systems among several food processing enterprises in Africa. Regional value chains promote integration and diminish entry barriers for agrifood processing enterprises in Africa. Such engagements must be strategic; it is essential to identify the agricultural commodities having the greatest potential to enhance regional cross-border trade. Some African governments are currently prioritizing their agrifood and processing sectors, emphasizing the significance of agrifood processing in their national development policies for economic and social transformation (Chitonge 2021). Since then, the use of advanced technology and equipment in agriculture across Africa, particularly in the agrifood processing subsector, has been on the rise due to foreign direct investment (FDI) (Wilkison and Rocha, 2008; Fukase and Martin 2020). The increased adoption will facilitate the processes of contemporary agrifood industrialization (Dube et al. 2020).

The agrifood processing sector in Africa is primarily characterized by informal, fragmented micro-small-medium enterprises (MSMEs) (AGRA 2024), predominantly employing traditional food processing and preservation methods, including curing, pickling, drying, smoking, and salting (Olaoye and Ade-Omowaye 2011; Adeyeye 2017). These technologies and procedures are constrained by size, resulting in low productivity, uneven product quality, and a short shelf life for the processed goods. The adoption of contemporary intermediate processing techniques, including small mechanized milling lines, pasteurization, fermentation, freezing, canning, bottling, irradiation, and packaging, as well as quality control protocols such as Hazard Analysis Critical Control Point (HACCP), is increasing in Africa to address deficiencies in the agrifood processing sector. Within value chains, large-scale processing of cereals,

cane sugar, and cooking oil has experienced notable growth, involving global food corporations that manufacture diverse consumer products through various arrangements, including licensing.

The world is currently adopting the Fourth Industrial Revolution (4IR), which incorporates modern technologies such as automation, digital systems, artificial intelligence (AI), the Internet of Things (IoT), blockchain, traceability tools, and e-commerce into agrifood processing. These technologies enhance efficiency, safety, quality, and sustainability in food processing via real-time monitoring, traceability, and waste reduction. Nonetheless, their implementation in Africa is restricted to selected Northern and Southern countries, with widespread acceptance hindered by elevated expenses, insufficient expertise, and inadequate infrastructure (Mbadlisa and Jokonya 2024; Magdy-Elhusseiny and Crispm 2025).

Challenges in agrifood processing transformations

The advancement of Africa's agrifood processing sector is hindered by various factors, including restricted access to financing and technical support, insufficient technology and infrastructure, inadequate enforcement of food standards, weak market connections, limited export promotion, and a lack of political commitment (Ellis et al. 2022; UNIDO 2024; Malabo Montpellier Panel 2024). The sector faces unreliable electrical supply, poor transportation networks, and insufficient dry and cold-chain storage facilities. Deficiencies in handling perishable goods, including fresh horticulture crops, fish, meat, and milk, exacerbate postharvest losses, increase operational expenses, and diminish profitability and competitiveness in both regional and worldwide markets.

Although they represent the bulk of enterprises in Africa's agrifood processing industry, MSMEs face challenges accessing funding due to their fragmentation and informal status. Consequently, they predominantly depend on informal financial service providers to acquire the capital necessary for starting their businesses, which is more expensive than formal systems. This limits their capacity to invest in contemporary processing facilities and technologies required to satisfy evolving consumer expectations and preferences. Likewise, MSMEs have limited access to laboratories and testing facilities necessary for adhering to food quality and safety requirements (Disenyana et al. 2019; Malabo Montpellier Panel 2024). This non-compliance diminishes their capacity to promote the products in high-end markets.

To recuperate expenditures in value addition and processing machines and technologies through enhanced revenues, such firms require access to dependable markets and marketing intelligence. Access to markets and marketing intelligence empowers agrifood processors to make informed, demand-driven decisions. Regrettably, market intelligence and the use of digital platforms in Africa remain limited, though steadily improving (Malabo Montpellier Panel 2024; UNIDO 2024; Frischtak 2018). The majority of MSMEs face restricted access to cost-effective and dependable Information and Communication Technology (ICT) tools, such as the Internet of Things (IoT) and artificial intelligence (AI), which are essential for obtaining market intelligence, forming connections, marketing products, and developing robust brands. Government agencies are unlikely to independently enhance and sustain the agrifood processing sector, or to provide comprehensive support across all necessary dimensions for agrifood processors to operate profitably. Public-private partnerships have demonstrated considerable success as a framework for supporting enterprises in the sector (Ellis et al. 2022).

Investment in agrifood processing and value addition

Investment in agrifood processing equipment and solutions across Africa is propelled by evolving consumer dietary preferences. Africa is a net importer of agrifood processing equipment, with a compounded annual growth rate of three percent (Disenyana et al. 2019). As of 2018, the predominant investment in agrifood processing was allocated to the acquisition of machinery for packaging and labeling, followed by equipment for grain milling, bakery machinery, and machines for the industrial production of macaroni, spaghetti, or similar products (Table 7.4). The most significant increase in import values was noted for machinery used in the preparation of animal feed, processing of fruits, nuts, and vegetables, dryers, and machine components for agrifood processing. Conversely, a decline in investment was noted in milking and meat and poultry machinery (Disenyana et al. 2019). The increased investment in packaging, sealing, labeling, cereal and pulse milling, bakery and confectionery equipment, and food and beverage manufacturing machinery indicates a rise in secondary and tertiary processed agrifood products. Conversely, the elevated import share and growth in import value of cleaning, sorting, and grading machines for grain and pulse seeds suggest an expansion in primary processing operations within the agrifood systems.

TABLE 7.4—AFRICA AGRIFOOD PROCESSING MACHINERY IMPORT VALUES, SHARE IN AFRICA'S IMPORT, AND GROWTH IN IMPORT VALUE BY PRODUCT FROM 2008 TO 2017

Agro-processing Machinery (for)	Mean import value (US$ million)	Share in Africa's import (%)	Growth in import value (US$ million)
Filling, closing, sealing/labelling bottles, cans, boxes, bags	516	24	3
Cereal and pulse milling	228	11	2
Bakery and confectionery (including macaroni/ spaghetti)	204	10	2
Parts for prep or manuf of food/drinks	164	8	2
Industrial processing of food or drinks	155	7	5
Brewery	135	6	3
Sugar processing	112	5	6
Cleaning, sorting, grading seeds/grains/pulses	97	5	6
Parts/machines for milling/working of cereals/pulses	71	3	3
Animal feeding stuffs	58	3	10
Meat or poultry processing	52	2	-5
Confectionery, cocoa/chocolate	52	2	0
Dairy processing	48	2	0
Processing of fruits, nuts, vegetables	40	2	8
Presses, crushers, and wine, cider, juices	21	1	3
Cleaning, sorting, or grading eggs, fruits, e.t.c	18	1	3
Dryers for agricultural products	15	1	7
Milking	13	1	-9
Parts of milking and dairy processing machines	12	1	0
Parts of presses/crushers and machines for wine, juices	4	0	7

Source: Disenyana et al. (2019).

Northern Africa accounted for 36 percent of processing machinery imports, followed by Western Africa at 25 percent, Eastern Africa at 21 percent, Southern Africa at 14 percent, and Central Africa at 4 percent. Algeria, Egypt, Nigeria, Ivory Coast, Ethiopia, Kenya, Zambia, Angola, Cameroon, and the Democratic Republic of Congo were prominent importers of agrifood processing machinery in their respective regions (Disenyana et al. 2019).

TABLE 7.5—INVESTMENTS IN AFRICA'S AGRIFOOD PROCESSING

Country/ Region	Investment Type and Source	Key Figures and Trends
Nigeria	Special Agro-industrial Processing Zone (SAPZ) infrastructure (public-private facilitated; Government, AfDB, IFAD, Islamic Development Bank (IsDB)	Phase I: US$ 538 million across 8 states
East and Southern Africa	Agri-SME loans (commercial banks)	About US$ 497 million across 4 countries in 2022, up from US$ 154 m in 2019
Pan-Africa SME Gap	Agri-SME unmet demand (all sources)	US$ 55–80 billion per year

Source: Author's generation from ACELIAFRICA (2024); NPCO-SAPZ (2024), GCA (n.d.); IFAD (2021); AGRA (2024).

Data on agrifood processing investment levels in Africa is scarce, and much of the available information includes non-food sectors. Table 7.5 shows investment trends in Nigeria and East and Southern Africa (Tanzania, Uganda, Rwanda, Kenya, Zambia) along with the continent's projected investment gap. Generally, most of the investments come from private loans, followed by public–private partnerships and public funding, particularly in special processing zones and industrial parks. Agrifood SMEs rely mainly on private loans and blended financing, but continue to face a much larger investment gap than large enterprises.

Classification of Agrifood Processing, Value Addition, and Related Technologies

Agrifood processing can be classified by the scale of enterprise, the level of processing or value addition, the type of agrifood commodities processed, and the actors running the business.

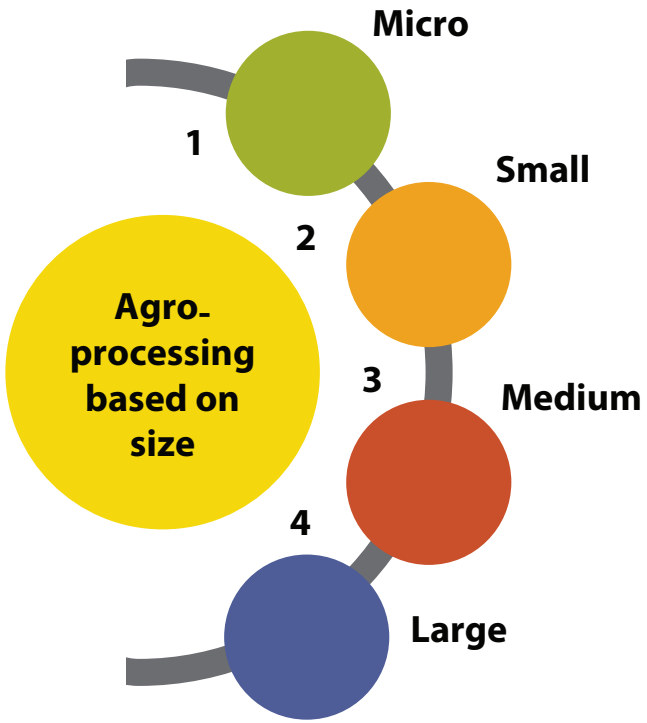
Classification by scale of enterprise

This refers to the size and level of production of the agrifood processing firm. Based on scale, enterprises can be classified into micro (cottage), small, medium, and large-scale enterprises (Figure 7.2).

Micro, Small, and Medium Agrifood processing Enterprises (MSMEs)

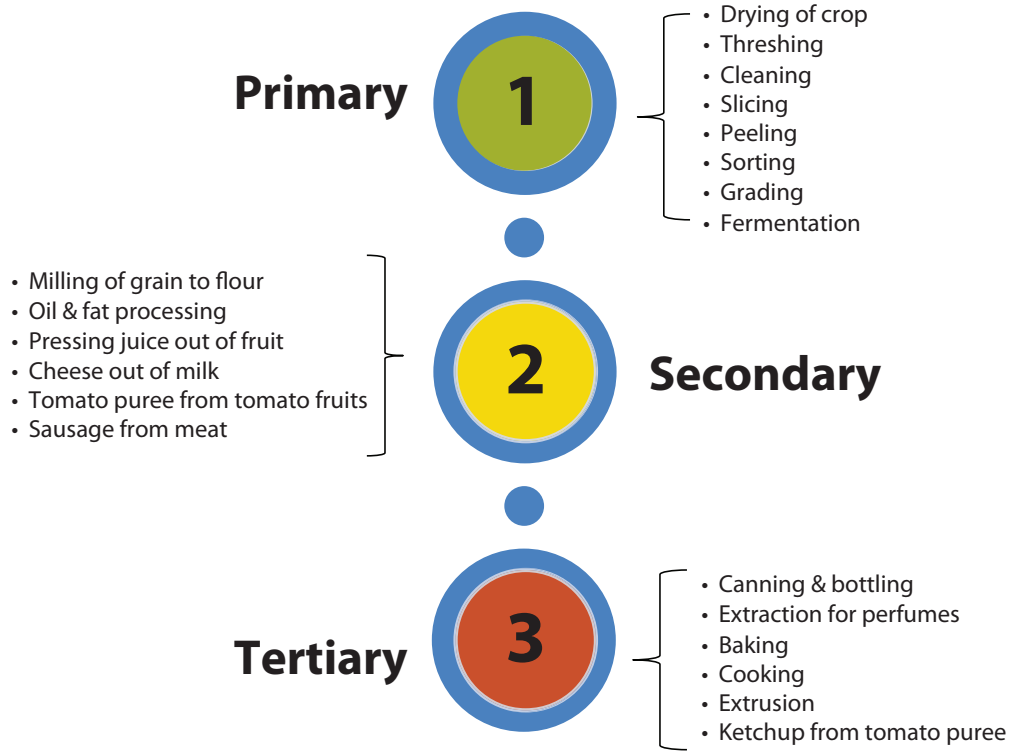
Micro, small, and medium enterprises (MSMEs) are essential to global economic growth, representing approximately two-thirds of global employment and over 80 percent of jobs in developing nations (Sulistyono et al. 2022).

FIGURE 7.2—AGRIFOOD PROCESSING FIRMS CLASSIFIED BY SIZE OF THE ENTERPRISE



Source: Authors.

FIGURE 7.3—AGRIFOOD PROCESSING FIRMS CLASSIFIED BASED ON LEVEL OF PROCESSING



Source: Authors.

In Africa, the majority of MSMEs operate in rural or peri-urban areas, producing processed goods and generating employment for women and youth (Malabo Montpellier Panel 2024). In Uganda, MSMEs constitute 90 percent of the private sector, provide over 80 percent of manufactured output, and account for around 75 percent of GDP (Kigozi et al. 2021). Micro-firms generally engage one to four people, often family members, while small and medium enterprises employ five to 49 and 50 to 99 individuals, respectively (JICA 2014).

Agrifood processing MSMEs depend on manual, semi-mechanized, or mobile technologies, including small mills, dairies, and fruit or vegetable processors. Their expansion is hindered by inadequate financing, insufficient technical expertise, substandard quality and certification processes, and logistical obstacles, which stifle innovation and lead many to fail within one to two years, while those that endure frequently experience stagnation (Mwang'ombola 2005).

Large-scale agrifood processing firms

In contrast to MSMEs, large-scale agrifood processing enterprises are generally substantial and active entities with established markets at the national, regional, or international levels. Such enterprises include but are not limited to industrial food and beverage makers, grain, sugar, edible oils, and poultry/dairy processors (World Bank 2018; UNIDO 2024). They employ sophisticated industrial processing technologies, encompassing contemporary machinery, sensors, and automation (including robotics), dry and cold chain infrastructure, climate-smart processing, fortification, product diversification, and quality control systems

(HACCP and digital traceability) to manufacture packaged, branded, easy-to-prepare or ready-to-eat foods. Several organizations are currently incorporating Fourth Industrial Revolution technologies and developments, including digital systems, Internet of Things, artificial intelligence, and blockchain. They generally employ 100 or more people and substantially impact the national economy through export trade and job creation (JICA 2014).

Classification by Level of Processing or Value Addition

Based on the level of processing or value addition, agrifood processing enterprises are classified into: (i) primary processing, (ii) secondary processing, and (iii) tertiary processing (Figure 7.3).

Primary agrifood processing

This focuses on the preliminary preparation or conversion of raw materials from agriculture, livestock, and fisheries into forms appropriate for direct human consumption, animal feed, or subsequent processing as components in secondary food processing. It aims to establish quality and uniformity in the product and encompasses procedures such as cleaning, threshing, slicing, peeling, sorting, grading, drying, and the removal of inedible components, often via physical or microbial techniques (ERIA 2019). Depending on the commodity, some of the primary processing procedures may be classified as pre-processing or integrated into the former (Table 7.6). Current advancements involve integrating artificial intelligence, sensor-based automation, and mobile processing units/lines.

Secondary agrifood processing

Secondary agrifood processing involves converting products that have undergone primary processing or slightly processed ingredients into more refined food products that are ready for consumption. Typical

TABLE 7.6—CLASSIFICATION OF AGRIFOOD PROCESSING TECHNOLOGIES

Agrifood processing stage	Technologies	Machines and equipment	Example
Pre-processing Technologies	Cleaning, grading, and sorting	• Sorting machines, color sorter, gravity separators, de-stoners, de-hullers	Remove impurities in grain Cleaning, sorting, and grading of fruits/vegetables
	Moisture content analyzers	• Rapid moisture meters, Portable moisture meter	Cereals like maize, wheat
	Sensors and AI in quality assessment of raw materials	• Temperature sensors, optical sensors, robotic arms	Fruit picking, fruit sorting, storage of fruits and vegetables
Primary Processing Technologies	Milling, pulping, juicing, drying	• Hammer and disc hammers, fruit pulpers, Juice extractors, Solar dryers, Tunnel dryers	Juice processing, Fruit and vegetable drying
	Pasteurization and blanching units	• Pasteurizers	Juice and milk pasteurization
	Fermentation equipment	• Bioreactors	Alcoholic beverages
Secondary Processing Technologies	Extruders (for snacks, feeds)	• Extruders	Ready-to-eat snacks, animal feeds
	Spray dryers, freeze dryers	• Spray dryers, freeze dryers	Powdered milk
	Mixing and blending systems	Batch mixers,	Juice processing
	Retort and Ultra-High Temperature (UHT) processing	• Autoclave, UHT sterilizer	Milk processing
Packaging Technologies (secondary and tertiary stages)	Vacuum packaging, Modified Atmosphere Packaging (MAP)	• MAP machines, Vacuum packaging machines	Fruit and vegetables
	Biodegradable and active packaging materials	• Form, fill, and seal machines	Ready-to-eat snacks
Storage and Preservation Technologies (secondary and tertiary stages)	Cold storage and refrigeration systems	• Zero energy cooling chambers (ZECCs), Pot-in-pot, Charcoal Cooler, Cool-bolt, Blast freezers, chillers	Fruits and vegetables
	Controlled Atmosphere storage and Hermetic storage	• CO2 absorbers, Ethylene combustors, Gas sensors, Hermetic storage containers (metal silos, hermetic bags)	Fruits and vegetables, cereals, pulses, nuts
	Preservatives, antimicrobials, and edible coatings	• Pulse light technology, Coating machines, Dipping tanks	Fruit coating (apples)
Transportation and Distribution Technologies (secondary and tertiary stages)	Cold chain logistics systems	• Refrigerated trucks, Barcode scanners, Radio-Frequency IDentification (RFID) technology	Fruits and vegetables, milk, meat
	Global Positioning System (GPS) and Internet of Things (IoT)-enabled tracking systems	• GPS trackers, IoT sensors, Blockchain traceability	Fruits and vegetables

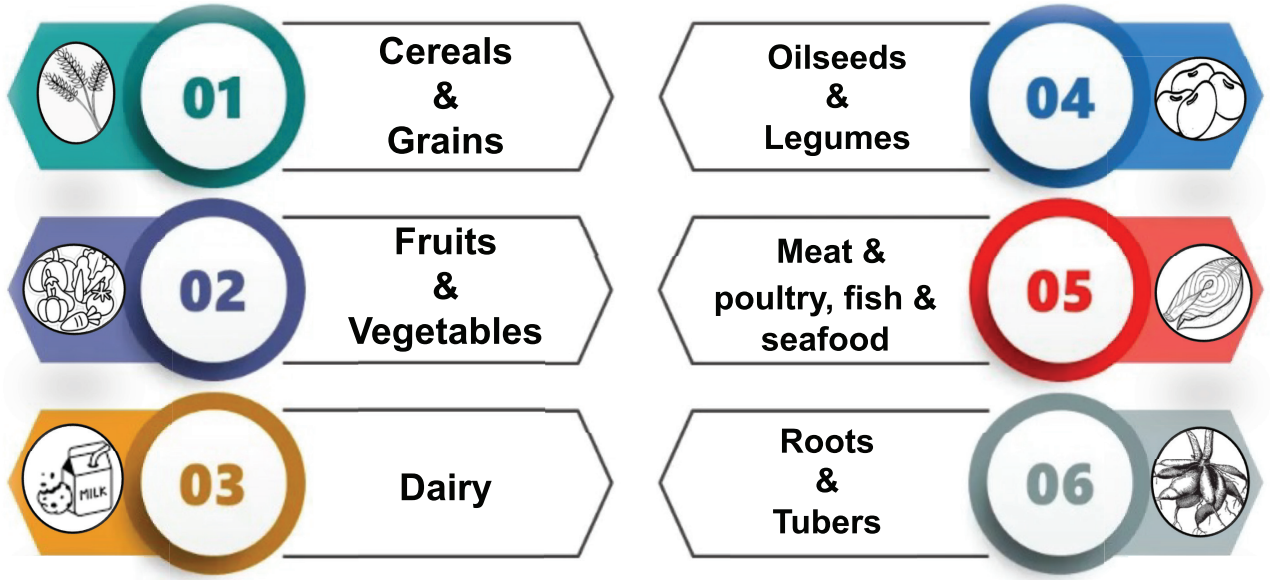
Source: Authors.

examples include juice production from sorted and sanitized fruits, milling of cleaned maize into flour, and crude oil extraction from cleaned nuts or oil seeds (Vigneshwaran and Mohankumar 2020), as well as cheese production from filtered and pasteurized milk (Chen 2022). In many instances, secondary agrifood processing firms are incorporating primary processing activities to guarantee quality consistency. The common technologies used are indicated in Table 7.6.

Tertiary agrifood processing

This represents the most sophisticated phase of food processing, in which primary and secondary food products undergo further processing to produce highly convenient, easy-to-prepare, or ready-to-use foods. This processing level aims to meet the growing consumer demand for speed, convenience in preparation, and consistency in taste and quality. Examples encompass television dinners, reheated airplane meals, breakfast cereals, infant formula, fruit-flavored yogurts, and assorted packaged breads. They are produced en masse utilizing standardized formulations and may include functional food additives to improve flavor, texture, appearance, or nutritional quality (Chen 2022). Tertiary processing has faced criticism about its impact on nutritional quality. Numerous highly processed foods frequently have elevated levels of sugar, salt, and fat, while being deficient in fiber and critical micronutrients. Table 7.6 delineates and categorizes agrifood processing technologies employed at various stages of food processing.

FIGURE 7.4—AGRIFOOD PROCESSING FIRMS CLASSIFIED BASED ON THE AGRICULTURAL PRODUCT BEING PROCESSED



Source: Authors.

Classification by agricultural commodity being processed

Agrifood processing enterprises and technologies can be categorized according to commodity as cereals and grains, fruits and vegetables, dairy products, oil seeds and legumes, meat and poultry, fish and sea foods, and roots and tubers processing (Figure 7.4). Some of the technologies or machinery used for processing foods in this category are presented in Table 7.6 and Table 7.7.

Cereal and grain processing

Cereals are consumable grains belonging to the Poaceae family, abundant in complex carbohydrates, dietary fiber, and plant-based proteins. The principal cereals of significance comprise wheat, rice, maize, barley, rye, oats, millet, sorghum, and triticale. The primary operation in cereal processing is milling, which is divided into dry and wet milling (Papageorgiou and Skendi 2018). Dry processing encompasses threshing, cleaning, sorting, grading, milling, and making of easy-to-prepare or ready-to-eat foods. Wet processing entails the separation of grain components (e.g., starch) from whole grain through soaking and other physical, chemical, or mechanical methods.

Fruits and vegetable processing

Fruit and vegetable processing represents a substantial component of global agricultural output. They function as essential food items and as critical components in numerous processed foods. These crops are rich in vitamins, minerals, phytochemicals, and dietary fiber, all essential for daily nutrition. The

crops exhibit numerous commonalities regarding their composition, cultivation and harvesting methods, storage attributes, and processing techniques.

The World Population Review (2025) indicates that Nigeria was the foremost producer of fruits in Africa in 2024, with an output of almost 18 million tonnes. Subsequently, Egypt, Uganda, and South Africa produce key crops such as mangoes, pineapples, and citrus fruits (Nigeria); oranges and grapes (Egypt); bananas, mangoes, and pineapples (Uganda); and primarily apples, grapes, and citrus fruits (South Africa) (Index Box 2025). The crops are mostly processed into products such as juice, jams, wine, cider, dried fruit crisps, canned goods, and pickles. In the fresh market, processing fruits and vegetables may involve only pre-processing, primary processing, and cold storage.

Oilseeds and Legumes

Legumes, also referred to as food legumes, are a vital source of both protein (20–25 percent) and energy. Food legumes are categorized into pulses and oilseeds. Pulses include the dried seeds of cultivated legumes such as beans, cowpeas, and chickpeas, whereas oilseeds are legumes valued for their oil content, which can be extracted through mechanical pressing or chemical solvent methods (Subuola et al. 2012).

Dairy, fish and seafood, and meat and poultry processing

Dairy, fish, meat, and poultry are products that undergo relatively similar value-addition or processing processes and technologies to generate an array of products. Among others, Table 7.7 presents agrifood categories and crops or products, including dairy, fish, meat, and poultry; the processing technologies used; and the products derived from them.

TABLE 7.7—COMMON PROCESSING TECHNOLOGIES FOR VARIOUS AGRICULTURAL COMMODITIES AND DERIVED PROCESSED PRODUCTS

Commodity type	Main Crops/Products	Example of Processed Products	Common Technologies Used
Cereals and Grains	Maize, rice, millet, sorghum, wheat	Maize flour (ugali flour), rice, porridge, chapati, breakfast cereals	Milling (hammer/roller mills), fermentation, baking
Roots and Tubers	Cassava, sweet potato, yam, Irish potato	Gari, cassava flour, starch, sweet potato chips, fries	Peeling, grating, fermentation, drying, frying
Fruits and Vegetables	Mango, tomato, pineapple, banana, avocado	Juice, jam, dried fruit, tomato paste, banana chips	Solar/tunnel drying, juice extraction, canning, pasteurization
Oil Seeds and Legumes	Groundnuts, sunflower, soybeans, beans	Edible oil, peanut butter, roasted nuts, soy flour, cooked beans	Oil pressing, roasting, grinding, boiling, fermentation
Fish and Seafood	Tilapia, sardines (dagaa), catfish	Smoked fish, dried fish, salted fish, fish powder	Traditional/modern smoking kilns, solar drying, salting
Meat and Poultry	Beef, goat, chicken	Smoked meat, sausages, dried meat, frozen meat	Smoking, drying, slaughtering, freezing, packaging
Dairy Products	Cow/goat milk	Pasteurized milk, yogurt, mtindi (fermented milk), cheese, butter	Pasteurization, fermentation, cooling, packaging

Source: Authors.

Classification by type of operator of an agrifood processing enterprise

This classification provides an important framework for understanding the structure, capabilities, and challenges of different types of firms within the agrifood processing sub-sector. Each actor category brings unique strengths and faces specific constraints that reflect the scale of their production, their access to finance, technology, market, and policy environment. Four categories of operators of agrifood processing businesses—private companies, government agencies and parastatals; processor cooperatives; and women and youth groups—are discussed in this section.

Private Companies

These are agrifood processing business enterprises owned by individuals or a small group of shareholders, encompassing large-scale, multifunctional agribusinesses involved in converting agricultural raw materials into finished or semi-finished products (AGRA 2024). Large private processing enterprises typically participate in capital-intensive production that utilizes advanced technology, close supply chain management, and structured management frameworks (UNIDO 2017). They are the principal entities in agrifood processing, handling substantial volumes of raw materials and fostering economic growth via job creation and exports (Seck 2014). The primary problems encountered include excessive taxation and elevated levies on imported raw materials and spare parts, substantial expenditures associated with compliance with government regulations, and the need to manage inadequate infrastructure quality.

The value chains in which they operate may pose challenges, including unreliable raw material supplies from the informal sector, insufficient market facilities, competition from informal processors, inadequate quality control infrastructure, and limited access to market information (Hartwich et al. 2025).

Government Agencies and Parastatals (GAP)

GAPs are state-owned or supported entities created to oversee and manage agrifood processing businesses to achieve development objectives such as food security, rural industrialization, or stabilization of food prices. They primarily focus on public service delivery rather than commercial profitability, operate within bureaucratic frameworks, support key areas such as grain reserves, and operate under public service mandates. Nevertheless, these attributes frequently lead state-owned organizations to experience inadequate management, unproductive financial outcomes, political meddling, and a deficiency in innovation, particularly compared to private corporations (AU et al. 2010). Box 7.2 presents an example of a parastatal involved in agrifood processing.

BOX 7.2—CEREALS AND OTHER PRODUCE REGULATORY AUTHORITY (COPRA) AND CEREAL AND OTHER PRODUCE BOARD (CPB) OF TANZANIA—PARASTATALS ENGAGED IN AGRIFOOD PROCESSING AND REGULATION

COPRA and CPB are semi-autonomous bodies of the Government of Tanzania under the Ministry of Agriculture established under the Food Security Act of 1991 (CAP 249) and the Cereals and Other Produce Act of 2009 (CAP 274), respectively. COPRA is responsible for regulating the production, processing and marketing of cereals and other crops for enhancing economic growth and food availability in the country (Kilimo Kwanza 2023; URT 2009). COPRA works in close association with the Cereals and other Produce Board of Tanzania (CPB), a government body involved in commercial and promotional functions particularly processing and value addition, purchasing and selling, storing and transporting, marketing and promotion of cereals and other produce. Among others, the CPB processes and pack maize, sorghum, legumes, cashews, rice and soybeans intended for sale to local, regional and international markets.

Cooperatives and Processor Organizations (CPOs)

Agrifood processing CPOs are organizations owned by farmers or processors that bring members together to collectively add value to agricultural products, improve access to markets for processed goods, and bolster their economic position. Their aggregation facilitates small-scale processors and communities in accessing processing infrastructure, augmenting value addition, and increasing their incomes through shared services and collaborative endeavors. Such organizations enable processors or farmer groups to gain enhanced market connections, centralized support services, increased productivity, and a more robust collective voice to influence policy and advocate for their interests. Additionally, it functions as a venue for providing training and enhancing the capabilities of rural producers (Sifa 2014). Often supported by government, development agencies, or NGOs, providing shared facilities for processing, packaging, and marketing to achieve mutual benefits. The CPOs face challenges due to restricted capital access, interpersonal conflicts among members, inadequate leadership, management issues, and mismanagement of cooperative resources (ICA 2012). Box 7.3 gives a case study of CPOs known as the Morogoro Food Processors Cluster in Tanzania.

Women and Youth-operated small and medium enterprise groups

The involvement of women and youth in agrifood processing and value addition can serve as an important and equitable means for transforming local agrifood systems in underdeveloped countries. Women's participation in agrifood processing in Zimbabwe, Ethiopia, Kenya, and Tanzania is 67 percent, 65 percent, 48 percent, and 43 percent, respectively (Mkuna et al. 2021). Women and youth organizations can easily access finance (credit), training, networking opportunities, and market information or processing facilities (Njenga et al. 2013). In Tanzania, local government authorities (LGAs) encourage youths and women to form groups for access to business loans, including the establishment of agrifood processing initiatives. In 2023, the LGAs allocated 44 billion Tanzanian shillings (US$ 18 million) in loans to women and youth, benefiting over 23,000 recipients. These groups facilitate the advancement of gender equity and youth employment, leading to enhanced household income and food security. Table 7.8 presents a summary of the actors engaged in agrifood processing.

BOX 7.3—CASE STUDY: MOROGORO FOOD PROCESSORS CLUSTER (KONGANO), TANZANIA

Cluster members displaying their products

Fruit drying at cluster walk-in solar drier facility

Cluster members processing breadfruit

The Morogoro Food Processors Cluster (Kongano) brings together food processors within Morogoro Municipality to enhance their competitiveness and the quality of their products. Founded in 2006, Kongano operates under a collaborative framework involving producers, technology and knowledge sources, and government. The main objectives of the cluster are:

- Production of safe and high-quality processed food for local and international markets.
- Adding value to agricultural products.
- Supporting members' business development and entrepreneurship.
- Facilitating market access through branding, packaging, and exhibitions.
- Improving food safety and quality standards, including aflatoxin management.
- Encouraging collaboration with national and international stakeholders.

The cluster engages in several strategic activities that include:

- Production of fortified and safe food products, such as composite flour from local ingredients, like soyabean, millet, cassava, and breadfruit.
- Training in food processing, hygiene, regulations, and standards compliance.
- Acquiring Tanzania Bureau of Standards quality marks and barcodes.
- Participating in local and international exhibitions to market products.
- Establishing individual and shared processing facilities.

Among the significant achievements of the Morogoro cluster are:

- Product innovation: Developed aflatoxin-safe composite flour rich in nutrients and antioxidants, which can be consumed without cooking.
- Market recognition:1st place in the 2009 East Africa Jua Kali exhibitions.
- Capacity building: Provided training to Sokoine University of Agricultural students and entrepreneurs from other regions.
- Income generation: Over 80 percent of members increased their incomes over five-fold.
- Infrastructure: Constructed a food processing center through TPSF support.
- Market expansion: Products are now sold in supermarkets in Morogoro, Dar es Salaam, and other regions. Some members export their products.

Despite considerable progress, the cluster continues to face several challenges. These include limited access to affordable financing and startup capital, difficulties in obtaining quality raw materials and specialized packaging materials, and a lack of advanced processing equipment. Within local markets, there also is low consumer awareness about product value and pricing.

The Morogoro Food Processors Cluster exemplifies how coordinated collaboration among industry, academia, and government can accelerate economic growth, improve food safety, and enhance livelihoods. The cluster's achievements over the years demonstrate the potential of such initiatives for promoting industrial development and food security in Tanzania.

TABLE 7.8—CLASSIFICATION BY ACTORS RUNNING AGRIFOOD PROCESSING ENTERPRISES

Operator Type	Ownership	Scale	Examples	Key roles
Private Companies (medium -large)	Individual or corporate	Medium–Large	Nestlé, Bakhresa, Tiger Brands	Innovation, investment, commercialization.
Government Agencies	Public or government-owned	Medium–Large	National Food Reserve Agency-Tanzania (NFRA), Trade and Development Bank group (TDB), National Milling Corp.	Regulation, stabilization, infrastructure.
Cooperatives	Member-owned (farmers)	Small–Medium	Dairy or coffee cooperatives	Collective marketing, inclusive value chains.
Women or Youth Groups	Community-based	Micro–Small	Cassava processors, youth honey projects	Inclusion, empowerment, social development.

Source: Authors.

Experience from Other Continents

Brazil's agrifood industry is largely driven by large-scale processors supported by cooperative-based MSMEs, financing from the Brazilian Development Bank (BNDES), and research from EMBRAPA (Neves et al. 2021; TRANSFER. 2021; BNDES 2023). In contrast, India's agrifood processing sector features a dual structure: a vast base of MSMEs alongside a small large enterprises. Both segments are supported through targeted policy interventions. The Indian government has implemented specific initiatives, such as the Prime Minister-Formalization of Micro Food Processing Enterprises (PMFME), One District One Product (ODOP), and the Mega Food Parks Scheme, recognizing the pivotal importance of MSMEs. These initiatives seek to formalize and enhance micro and small processors via credit-linked subsidies of up to 35 percent of project expenditures, cluster-based infrastructure, and branding and marketing support (India, Ministry of Food Processing Industries 2024; FAO 2023).

The Mega Food Parks, initiated in 2008, function on a cluster and hub model, providing MSMEs with shared access to modern facilities, testing laboratories, cold storage, and logistics services. Large processors leverage these hubs for scalability and exports, whereas MSMEs gain from reduced barriers to market entry. The ODOP initiative enables small processors to specialize in regionally competitive products, fostering economies of scale, efficient procurement, and enhanced branding (Kumar et al. 2024; Singh et al. 2025). This integrated approach has connected small-scale rural firms to global markets, enhancing employment prospects and supply chain resilience.

India's example illustrates how strategic clustering, targeted subsidies, and shared infrastructure can transform fragmented MSMEs into catalysts for rural employment, innovation, and export growth, positioning the country as a model for inclusive agrifood industrial transformation.

Status of Agrifood Processing Technologies and Innovation in Africa

Advances in agrifood processing technologies and innovations are somewhat influenced by shifts in consumer preferences toward foods. The increase in income among individuals and African economies has stimulated the demand for safe food, good taste, long shelf life, non-GMO products, and additional health benefits (Boye and Archand 2013). This shift subjects value chain actors, notably food processors, to continuous pressure to satisfy the demands of domestic and foreign markets (Boye and Archand 2013; Tabiri et al. 2022). The shift dictates the degree of sophistication required in the agrifood processing industry.

Agrifood processing technologies

In the early days, a substantial part of food produced was lost or wasted at different stages of the commodities value chain. A substantial portion of crop and livestock products considered as unsuitable for human consumption was either allowed to decompose, buried, or burnt, resulting in the emission of considerable amounts of greenhouse gases (GHGs), especially methane, along with hazardous compounds (Rolle et al. 2024; Boye and Arcand 2013). Practices such as behavioral change to responsive consumption and food management, minimizing over-purchasing, meal planning, and proper use of

BOX 7.4—AGRIFOOD PROCESSING TECHNOLOGIES

Agrifood processing technologies are methods, tools, equipment and or practices used in tranforming food agricultural raw products into value-added goods with enhanced quality, shelflife and safety. Agrifood processing technologies are evolving from traditional/analogue to digital systems, automation, AI based, advanced and precision methods of processing (Tadesse et al. 2022).

leftovers have been promoted at both consumer and hospitality levels (Boye and Archand 2013; Tabiri and Sakiji 2022; Rolle et al. 2024). When food waste is unavoidable, recycling and waste treatment are seen as optimal solutions. The demand for effective food-handling and processing technologies that reduce food losses and waste is increasing.

Emerging Technologies and Innovations in Agrifood processing and Value addition

The agrifood processing sector in Africa is predominantly composed of MSMEs, characterized by low capital investment, fragmented structures, and limited technological innovation. Consequently, the continent has seen an increase in the number of enterprises; however, minimal progress in innovation. In contrast, a few large food processors, including Illovo, BIDICO Africa, and Bakhresa Group, are more advanced in product and process innovation. Although the Global North and a few African countries are rapidly transforming agrifood processing through Fourth Industrial Revolution technologies such as automation, artificial intelligence, robotics, the Internet of Things, blockchain, and e-commerce, the majority of African countries continue to struggle with adoption.

AI and digital systems already facilitate product development and sensory evaluation, while modern methods such as multiplexed analysis allow for swift, low-cost detection of toxins, allergens, pathogens, and antibiotics (Boye and Arcand 2013). In Africa, certain technologies have been introduced by foreign direct investment (FDI), although their adoption among firms, especially MSMEs, remains limited due to insufficient capital investment.

Waste treatment, Valorization, and Circular economy

Irrespective of the quality of agricultural products, consumers and agrifood processors do not fully utilize all raw materials. Consequently, waste treatment has become an indispensable component of sustainable agrifood processing. Landfilling and incineration have been the most conventional and economical methods for solid waste management; nonetheless, they require extensive land use and may generate greenhouse gases. Aerobic and anaerobic treatment processes are the predominant methods for managing suspended and soluble water wastes. Despite their high cost, adsorption and absorption technologies are employed to remove nuisance gases from liquid waste. Activated carbon and sphagnum peat have been utilized, with the latter serving as a more economical alternative. After the absorption process, sphagnum peat may be used as bio-fertilizer. Nonetheless, these technologies are rarely used in low-income countries (LICs) owing to their prohibitive costs (Boye and Arcand 2013).

The circular economy is gaining prominence, aiming for zero waste by transforming waste into wealth through the reuse, recovery, and redistribution of surplus, unsold, or unmarketable food that is suitable for consumption, thereby reducing greenhouse gas emissions. It prevents food loss and reduces waste through proper processing, packaging, storage, and distribution (Rolle et al. 2024). It also involves recycling unavoidably spoiled food into other usable items, such as compost (fertilizer), food waste charcoal (fuel), and animal feed. Alternative innovative strategies for waste management include; micro- and nanoscale chemistry, which involves the utilization of minimal quantities of chemicals to mitigate environmental impact (Siegrist et al. 2007), as well as the implementation of waste management principles aimed at minimizing resource consumption and waste generation. Commodity value chain actors promote the 3RVE strategies—Reduce, Re-use, Recycle, Valorize, and Eliminate—as integral components of efficient food usage and waste management (Boye and Archand 2013).

Conclusion

Agrifood processing in the majority of African countries remains in its infant stage. It is dominated by MSMEs, which face several systemic barriers limiting their ability to meet rising consumer demand and compete in global value chains. Experiences from countries like India illustrate that with strategic clustering, catalytic financing, targeted subsidies, and shared infrastructure, MSMEs can serve as engines of innovation, job creation, and export growth.

Conversely, adopting circular economy concepts is essential for enhancing food security, minimizing waste, and fostering climate resilience. Likewise, persistent challenges such as inadequate cold-chain infrastructure and logistics, high compliance costs, and restricted funding and technology adoption require resolution.

Despite opportunities to enhance agrifood processing operations through foreign direct investment, many African nations frequently encounter obstacles due to unfavorable policies and regulations, inadequate workforce quality, substandard raw materials, and unreliable electricity and utility supplies. Africa must take urgent action to realize this potential: invest in modern infrastructure, enhance market access, promote innovation and financial ecosystems, and accelerate the adoption of advanced technologies such as automation, Internet of Things, AI, and blockchain. African countries should embrace circular economy principles to improve food security, minimize waste, and strengthen climate resilience. Integrating MSMEs into global markets while enhancing supply chain resilience can transform the agrifood processing sector into a powerful driver of inclusive growth and competitiveness. In the absence of bold and coordinated action, Africa risks falling behind in the Fourth Industrial Revolution.