CARISCA Centre for Applied Research and Innovation in Supply Chain – Africa

AN INDUSTRY REPORT

Agricultural Supply Chain Activities in Ghana - A Focus on Roots and Tubers and Cereals Sub-Sectors

Report by: Robert Aidoo and Priscilla Agyemang

Produced as part of Ghana Agricultural Industry Report Series (GAIRS) under the auspices of CARISCA, KNUST-Kumasi, in Collaboration with Arizona State University, USA.

EXECUTIVE SUMMARY

Agricultural supply chains are responsible for the production and distribution of crop and animal-based products across countries and markets around the globe. To provide better understanding of current trends, challenges and opportunities along agricultural supply chains in Ghana, CARISCA is engaging industry players through periodic publication of the Ghana Agricultural Industry Report Series (GAIRS). The aim of GAIRS is to communicate activities and trends in specific agricultural supply chains in the country to industry players to promote evidence-based business decision making. This industry report focuses on roots & tubers and cereals sub-sectors of the Ghanaian agricultural industry. It was produced through a combination of desk review, key informant interviews, secondary data analysis and synthesis.

The report demonstrates that agriculture is pivotal in the Ghanaian economy. The roots & tubers and cereal sub-sectors will continue to be very important in the country's food system. Activities along these supply chains have a great potential to generate employment and income, and ensure food security for chain actors and the country as a whole. In the face of numerous opportunities in these supply chains, growth and performance have been stifled by key production, marketing, processing, financial and logistical constraints. Private sector investment is required in the area of improved technology to mechanize supply chain activities to improve efficiency and competitiveness. Also, the role of government is critical in providing an enabling environment through investment in irrigation, road and storage infrastructure, and implementation of favorable policies. For enhanced supply chain performance, there is an urgent need to strengthen supplier networks and linkages/coordination among key supply chain actors through the creation of Innovation Platforms for periodic capacity building. Innovation Platforms bring together various actor groups, chain influencers and policy makers in specific agricultural supply chains periodically (monthly, quarterly or semi-annually) to identify, discuss and find solutions to common supply chain problems. For a start, these platforms should be established at the local community and district levels to test new ideas and generate action on the ground. However, the platforms should be scaled-up to the regional level over time, to allow for cross-fertilization of ideas and promotion of market linkages among multiple innovation platforms within a particular region of the country. These platforms should also serve as leverage points for training and capacity building to enable actors take advantage of opportunities along supply chains, while addressing critical bottlenecks.

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1. INTRODUCTION

Agricultural supply chains represent a significant proportion of global trade, both in value and volume. Estimates from the International Labour Organization (ILO)[1] suggest that, in 2019, the agricultural sector contributed 26% of global employment and over half of total employment in developing economies.

Agricultural supply chains are responsible for the production and distribution of all crop and animal-based food products across national, sub-regional, regional and global markets. The core actors in agricultural supply chains include input suppliers, primary producers (farmers), rural assemblers, transporters, warehouse operators, processors, traders (wholesalers and retailers) and consumers. Some non-governmental organizations (NGOs) and civil society organizations (CSOs), regulatory institutions of state and different private sector actors also provide support services that create an enabling environment for the efficient performance of agricultural supply chains. In Ghana, some of these institutions include the Food and Drugs Authority (FDA), Ghana Standards Authority (GSA), Environmental Protection Agency (EPA), financial services providers, extension services providers, and research institutes.

Agricultural supply chains with downstream processing[2] activities tend to generate larger growth multiplier effects (Arndt and Hartley, 2017). But performance and growth in supply chain activities can only be stimulated when policies and strategies are formulated based on quality data and information. Unfortunately, industry benchmarks are largely non-existent in the Ghanaian agricultural sector. Where such data/information exist, they are largely unorganized and scattered across different institutions/organizations, thereby limiting access to them by key supply chain actors and key industry players. Access to organized and well-packaged information on supply chain activities, trends and constraints in the agricultural sector will make it possible for key actors to make quality operational decisions. Also, a better understanding of current supply chain activities, trends, challenges and opportunities is required to fashion out strategies to improve the performance and competitiveness of agricultural supply chains in Ghana. The Ghana Agricultural Industry Report Series (GAIRS) was commissioned by CARISCA to analyze and communicate activities and trends in specific agricultural supply chains in the country to industry players to promote evidence-based business decision making. This industry report focuses on roots & tubers and cereals sub-sectors of the Ghanaian agricultural industry. Subsequent industry reports will target supply chains in other sub-sectors.

We combined desk review, secondary data analysis and key informant interviews, synthesis and report writing as our main approach to produce this industry report (Figure 1).

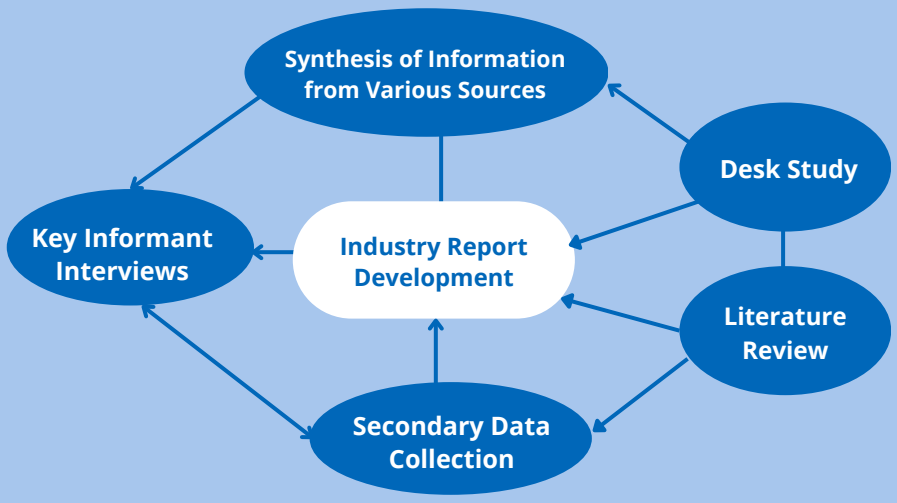

Figure 1: Approach adopted

2. THE GHANAIAN AGRICULTURAL SECTOR: AN OVERVIEW

Agriculture is one of the principal sectors driving the development and growth of Ghana's economy. The sector's contribution to Ghana's gross domestic product (GDP) has declined from 30% in the year 2010 to 20% in 2020 (Figure 2a). Despite this decline, the agricultural sector continues to contribute significantly (above 40%) to export earnings and employs about 50%[3] of the active workforce in Ghana.

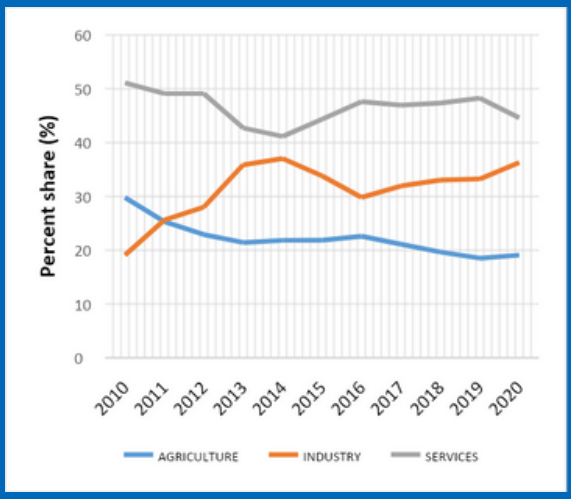

Figure 2a: Agriculture's Contribution to Ghana's GDP

Source: MoFA, 2021.

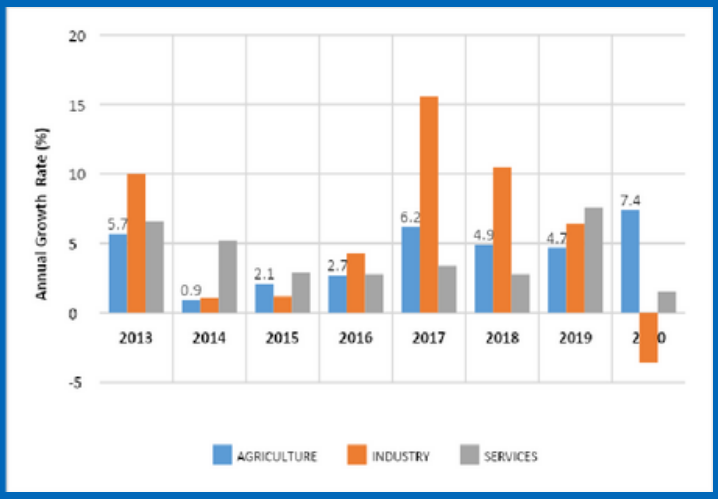

Figure 2b: Agricultural sector's growth rate over time

The growth rate of the agricultural sector has seen fluctuations over the past decade, declining from 5.7% in the year 2013 to 2.7% in 2016. Growth of the sector picked up in 2017, to 6.2%, and declined marginally in 2018 and 2019, to 4.9% and 4.7%, respectively, before rising to 7.4% in 2020.

The growth rate of the sector in 2020 was significant in two respects. This was the first time the agricultural sector had out-performed industry and services sectors of the Ghanaian economy since 2016. Secondly, this high growth rate occurred in the midst of the COVID-19 pandemic, which saw lots of restrictions in movement and business activities across the globe. This outstanding performance of the sector speaks to the resilience of agricultural supply chains in the face of global pandemics.

The key sub-sectors making up the agricultural industry in Ghana include crops, livestock, forestry & logging and fishing/aquaculture. Contribution of the crops sub-sector to agricultural GDP has grown consistently, from 72% in the year 2015 to about 81% in 2020 (Figure 3a). In 2020, cocoa contributed 9% and all other crops contributed 72% to agric. GDP (Figure 3b)

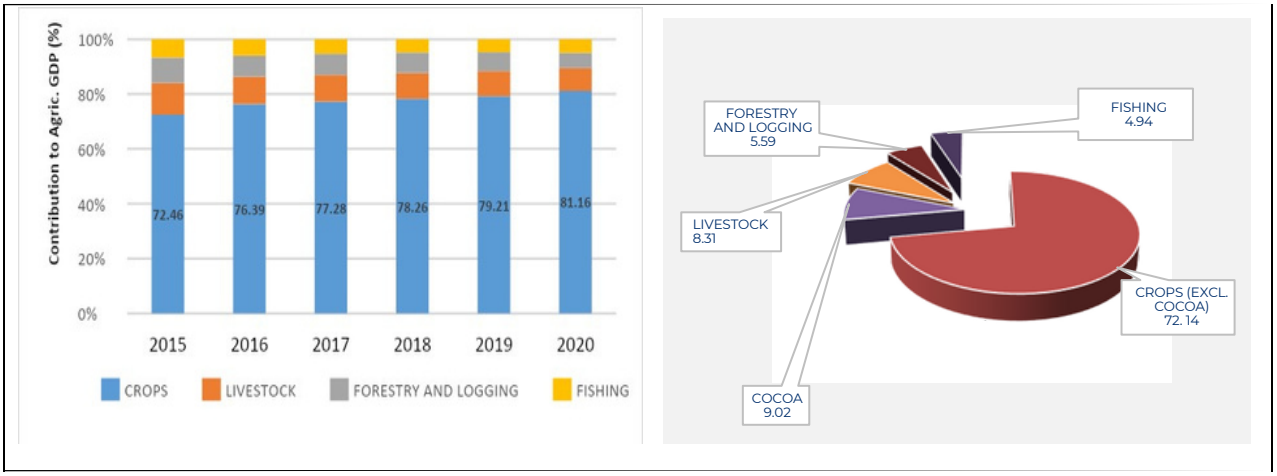

Figure 3a: Contribution of sub-sectors to Agric. GDP over time

Figure 3b: 2020 Agricultural GDP by sub-sectors (%)

Source: MoFA, 2021.

The key commodities produced and handled along agricultural supply chains include roots & tubers, cereals & legumes as well as fruits & vegetables (Table 1). Also important in the supply chains are industrial crops such as soybean, cocoa, oil palm and natural rubber. Important farm animals include small ruminants (sheep and goats), poultry, swine/pigs and microlivestock.

Statistics from the 2018 agricultural census by the Ghana Statistical Service (GSS) show that 53% of the 4.9 million households in the country are engaged in agricultural activities as sources of livelihood (Figure 4a). Among the agricultural households in Ghana, about 91% produce arable (food) crops and 46% are into the production of tree crops (Figure 4b). Livestock and poultry production is common among only 41% of agricultural households in the country and less than 1% of households have adopted aquaculture and bee-keeping (honey production) as part of the portfolio of activities for their livelihoods.

Table 1: Key Agricultural Commodities Produced in Ghana

Commodity Category	Symbol	Key Examples
Roots and Tubers		Cassava, Yam, Cocoyam, Sweet Potato, Plantain.
Cereals and Legumes		Maize, Rice, Millet, Sorghum, Cowpea and Groundnut.
Fruits and Vegetables		Pineapple, Citrus, Banana, Pawpaw, Mango, Tomato, Pepper, Okra, Egg Plant, Onion, etc.
Industrial Crops		Cocoa, Oil Palm, Coconut, Coffee, Cotton, Kola, Rubber, Cashew, Shea, Soya Bean.
Farm Animals		Cattle, Sheep, Goats, Pigs, Poultry, and Microlivestock (E.G. Grasscutters, Snails, Rabbits, Etc.)

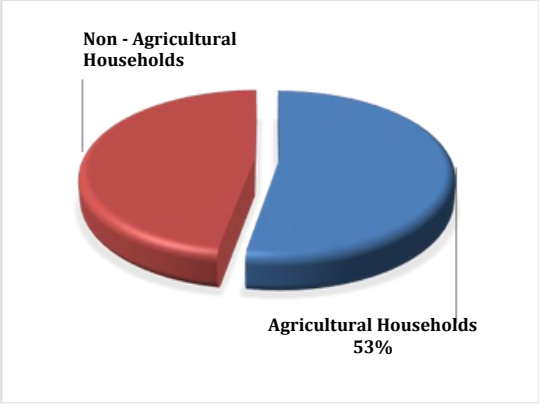

Figure 4a: Ghanaian Households engaged in Agriculture

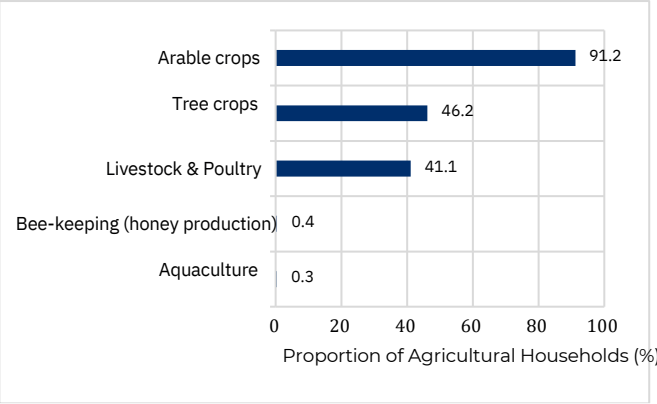

Figure 4*b*: Type of Agric. Activities undertaken by Households

Source: Ghana Agricultural Census by GSS, 2018.

3. ROOTS & TUBERS SUPPLY CHAIN ACTIVITIES

3.1 Importance and Production Trends

Root and tuber crops are very important in the food system of Ghana in particular and the West African sub-region in general. The common root and tuber crops produced and handled in Ghana include cassava, yam, cocoyam and sweet potato. In the broader classification of crops in Ghana, plantain is added to roots & tubers even though it does not technically belong to that category. The supply chains of these root and tuber crops are described as pro-poor, suggesting their impactful role in reducing poverty due to the large number of households in the country that depend on them for their livelihoods. Produced by about 55%[4] of farmers in Ghana, all roots & tubers contribute about 50% to agricultural GDP in the country. These groups of crops are able to withstand drought and can adapt quite well on marginal soils, making them important for household food security.

Plate 1: Yam tubers

Plate 2: Cassava roots

Plate 3: Sweet potatoes

Plate 4: Cocoyam comels

Plate 5: Cocoyam plant

The total production of the three main root and tuber crops in Ghana (cassava, yam and cocoyam) increased by about 28%, from 26.58 million Mt in 2016 to about 33.93 million Mt in 2020 (Figure 5a). The total quantity of cassava produced and moved through the supply chain increased by 29%, from 17.80 million Mt in 2016 to 22.96 million Mt in 2020. The growth in production was highest for cocoyam, whose total volume rose by 61% between 2016 and 2020. In the case of yam, total output increased by 18% only during the same period, from 7.4 million Mt to 8.8 million Mt in 2020. In the case of sweet potato, estimates from the FAO database indicate that Ghana's total production increased from 92,059 Mt in 2000 to about 135,000Mt in 2012 (Figure 5b). However, the first official survey conducted by MoFA (2012) in collaboration with the West Africa Agricultural Productivity Program (WAAPP) provided regional sweet potato production statistics for the country, and the official national output was reported to be 131,990 Mt.

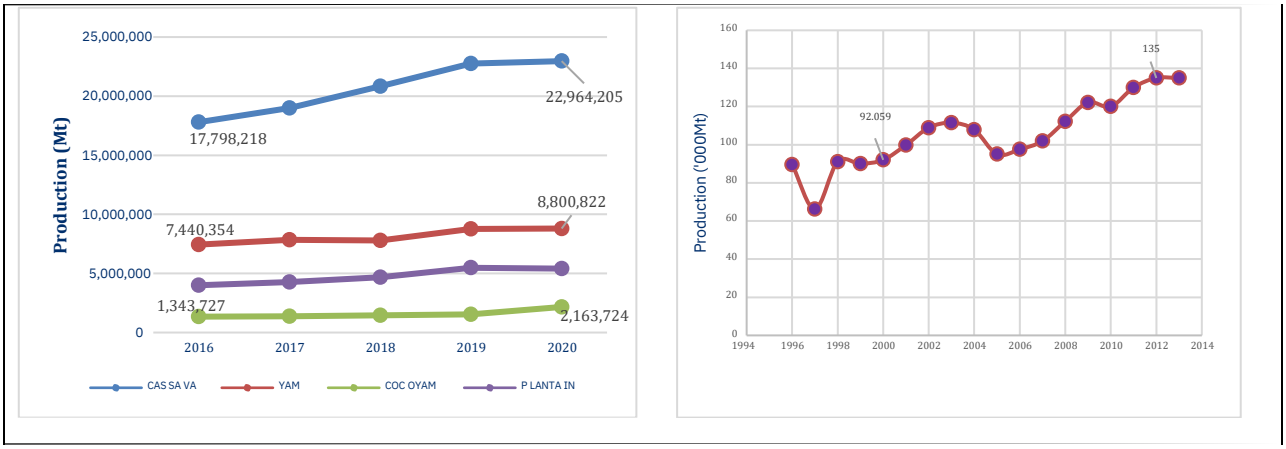

Figure 5*a*: Production trend for Cassava, Yam & Cocoyam in Ghana

Figure 5*b*: Production trend for Sweet potato in Ghana

Source: FAOSTATS, 2015 & MoFA, 2021.

Ghana is an important country in terms of root and tuber crop production. Globally, the country contributes about 6% and 11% to total cassava and yam production, respectively (Figure 6). Ghana also supplies 10% and 11% of the total cassava and yam production in Africa. In the West African sub-region, the country controls 21% of total cassava production and 12% of total yam production, placing Ghana behind Nigeria and Ivory Coast with respect to yam.

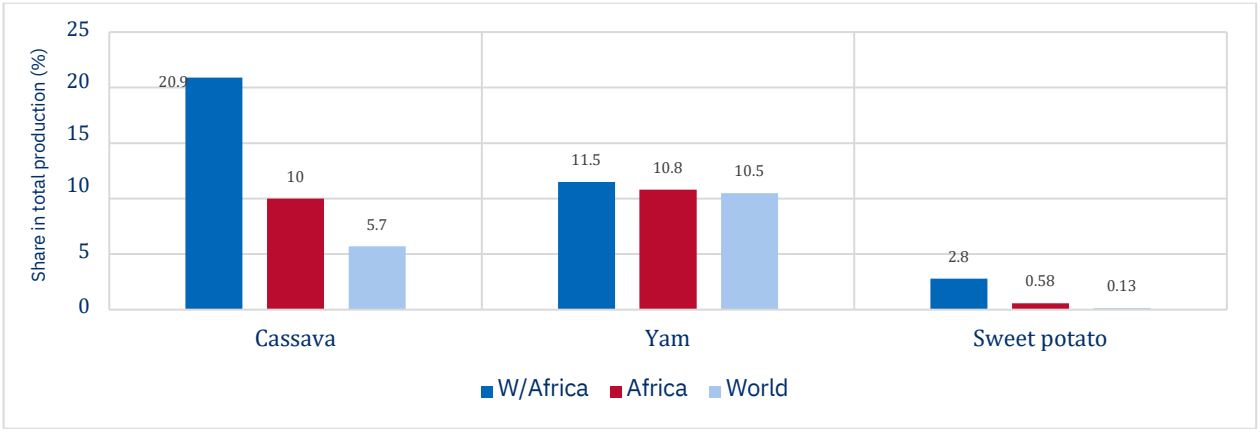

Figure 6: Ghana's Share of Root & Tuber Crop Production in Various Regions of the World

Source: FAO STATS, 2018.

3.2 Main Supply Centers/Sources

Different root and tuber crops are produced in different parts of the country and transported to major urban markets for sale and distribution. The bulk of cassava is supplied from the middle belt of Ghana with Eastern, Brong Ahafo, Ashanti and Central regions supplying a cumulative proportion of about 76% (Figure 7a). Cassava harvested in farming communities in these regions are moved by traders to regional and district markets across the country for retailing, processing and direct consumption. The major supply centers for yam are Brong Ahafo and Northern regions, which jointly contribute as high as 63% of total national output (Figure 7b). Cocoyams are produced in the forest belt of Ashanti, Eastern and Western Regions as well as the transitional belt of Brong Ahafo region (Figure 7c). In the case of sweet potato, Upper East, Eastern, Upper West and Volta regions are the main sources of supply (Figure 7d).

Since roots & tubers are not produced in all parts of Ghana where these important carbohydrate sources are consumed, efficient supply chain activities are required to ensure that the commodities get to their final destination across the country and beyond.

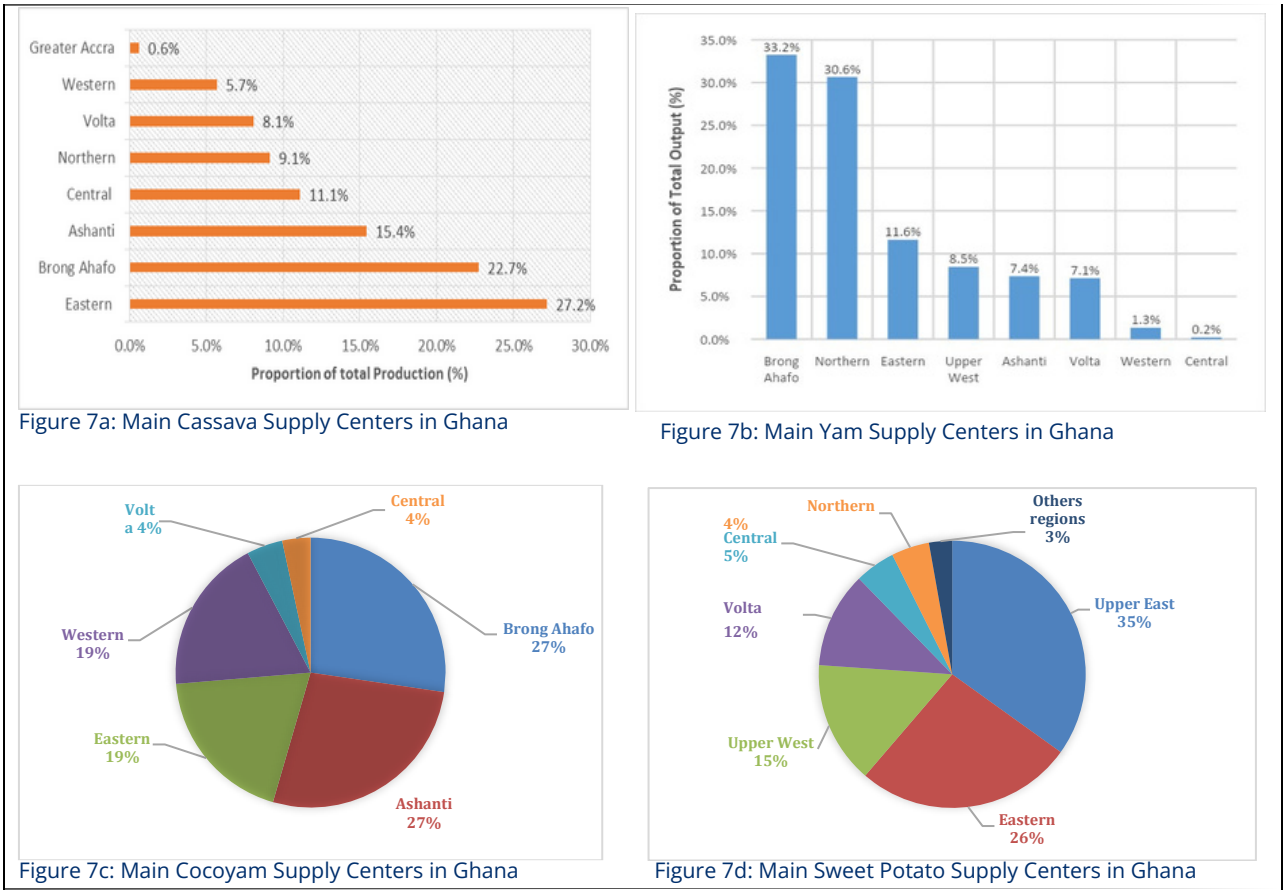

Figure 7a: Main Cassava Supply Centers in Ghana

Figure 7b: Main Yam Supply Centers in Ghana

Figure 7c: Main Cocoyam Supply Centers in Ghana

Figure 7d: Main Sweet Potato Supply Centers in Ghana

Source: MoFA, 2021.

3.3 Yield Gap Analysis and Input Sources

Yield levels recorded by roots & tubers farmers in Ghana are very low, mainly due to low adoption of improved crop varieties, poor soil fertility, and high incidence of pests and diseases. The average yield levels for all root and tuber crops are low and well below attainable levels (Figure 8a). Current yields are estimated at 27%, 33%, 40% and 42% of the potential achievable yields of sweet potato, yam, cocoyam and cassava, respectively. These suggest a yield gap of between 58 and 73%, highlighting the need for primary producers to become more productive and efficient for the country to derive the full benefit from the roots & tubers sub-sector. Policy makers should streamline input support schemes (e.g., Planting for Food and Jobs) to improve access to yield-enhancing inputs to bridge the yield gap.

Roots & tubers are vegetatively propagated crops, and farmers in Ghana usually use farmer-saved seeds/planting materials from the previous season for cultivation. In addition, family members and friends are an important source of planting material (Figure 8b). For commercial producers of yam, some planting materials (seed yam) are usually purchased from the open market to augment farmers' own saved seeds. The continuous recycling of planting materials and the use of traditional varieties partly account for the low crop productivity seen in Ghana. Agrochemicals such as herbicides and fertilizers are usually sourced from agrochemical shops located in the main district markets as well as satellite markets across producing districts. It is important to indicate that there is very minimal usage of fertilizer in root and tuber production in Ghana; only a few yam and sweet potato farmers use chemical fertilizers to improve the fertility status of their soils. Cutlasses and hoes used for land preparation and farming, as well as knapsack sprayers used for herbicide application, are normally sourced from open market and agro-input shops in urban markets.

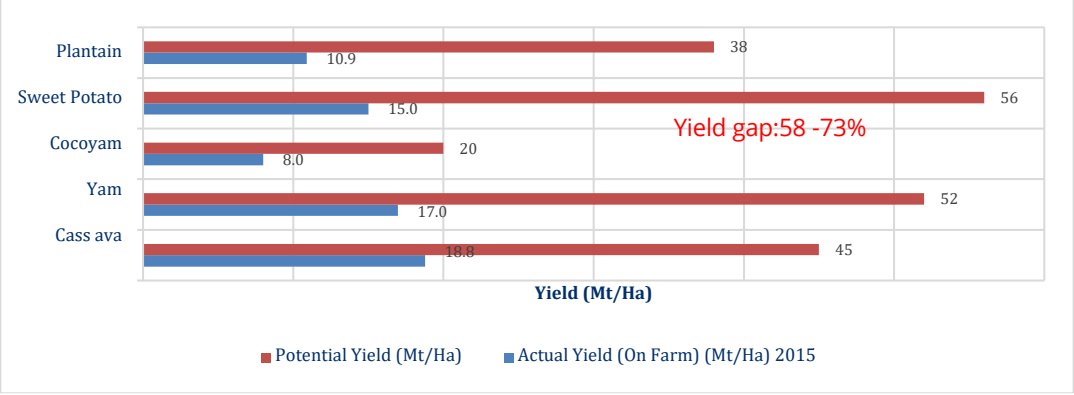

Figure 8*a*: Yield Gaps Analysis for root and tuber crops
Source: MoFA, 2021.

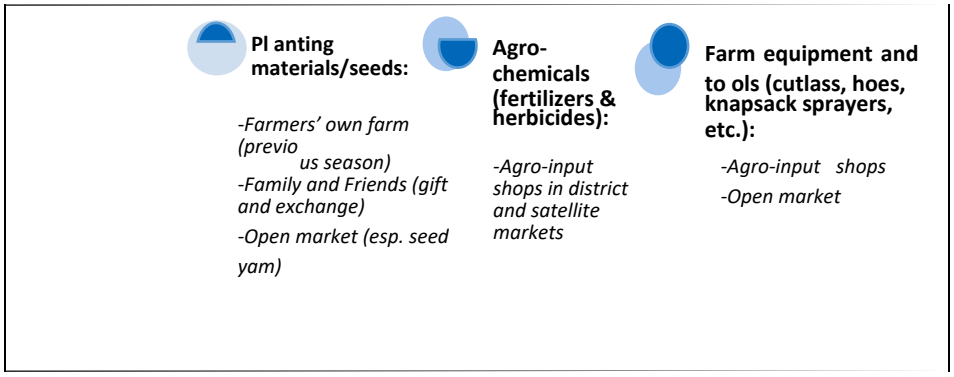

Figure 8*b*: Sources of Inputs used by primary producers

3.4 Production versus Utilization

Ghana is self-sufficient in the production of root and tuber crops. In 2020, we used only 77% of our total cassava production as food, leaving some 23% as surplus for industrial and other uses (Figure 9a). In the case of yam, we produced more than enough and exported about 28,284 Mt to earn foreign exchange for the country in 2020.

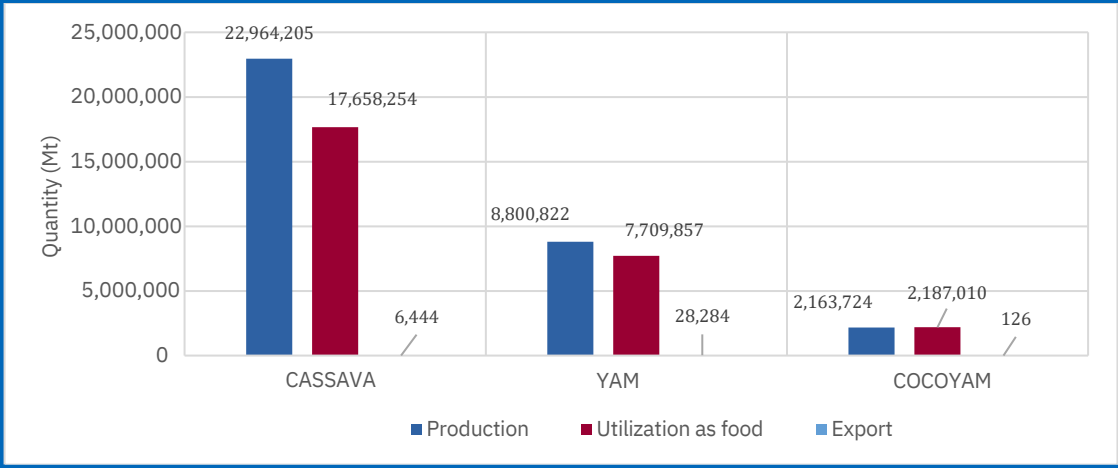

Figure 9a: Food Balance sheet for main roots & tubers for the year 2020
Source: Generated from MoFA Data, 2021

In terms of utilization, cassava contributes significantly to dietary calorie intake in Ghana. The per capita consumption of cassava ranged between 400 and 580 Kg per annum between 2016 and 2020, emphasizing its position as a major staple crop in the country (Figure 9b). Per capita consumption of yam is about 50% of the cassava figure, possibly because of its high price: the price of yam is more than double that of cassava, making cassava a cheaper source of food, especially for low-income households. Because cocoyam is relatively scarce on the market, its consumption level is quite low (<160kg/yr/capita) compared to the other root and tuber crops.

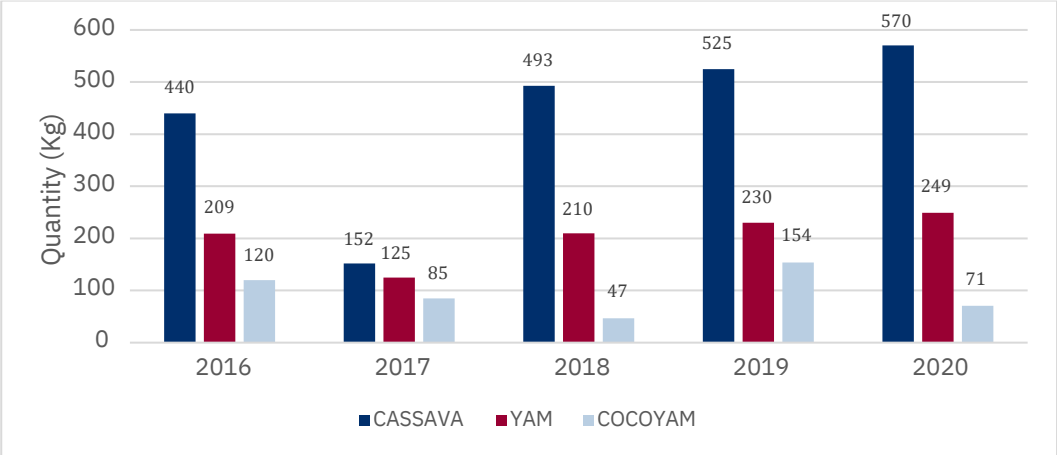

Figure 9*b*: Per capita consumption of main roots & tubers

Source: Generated from MoFA Data, 2021

3.5 Structure of the Root and Tuber Supply Chain

The supply chain of a typical root and tuber crop is made up of input suppliers, primary producers, aggregators or rural assemblers, traders, processors and final consumers. Farmers (who are mainly smallholders) source inputs to cultivate root and tuber crops, which are handed over to bulkers or aggregators (assemblers) after harvesting. From these aggregators, cassava roots are transported to cottage processing centers, industrial processing centers and traders of fresh cassava roots in urban markets (Figure 10a). Some of the fresh products in the open markets are sold directly to local chop bar operators (traditional eateries) and the rest are sold to households for final consumption. At the cottage level, cassava roots are mainly processed into gari (a fine to coarse granular flour made from cassava roots), cassava chips and flour as well as cassava dough (agbelima). At the industrial level, cassava roots are processed into starch for beer production (by Guinness Ghana Brewery Limited) and industrial starch for the plywood industry. Gari is by far the most important and commercial product obtained from cassava. Large volumes of gari produced are sold to schools (under the school feeding program) and households through wholesale and retail nodes of the supply chain. There is an export node of the cassava supply chain through which gari is exported to Ghanaians and other Africans in the diaspora.

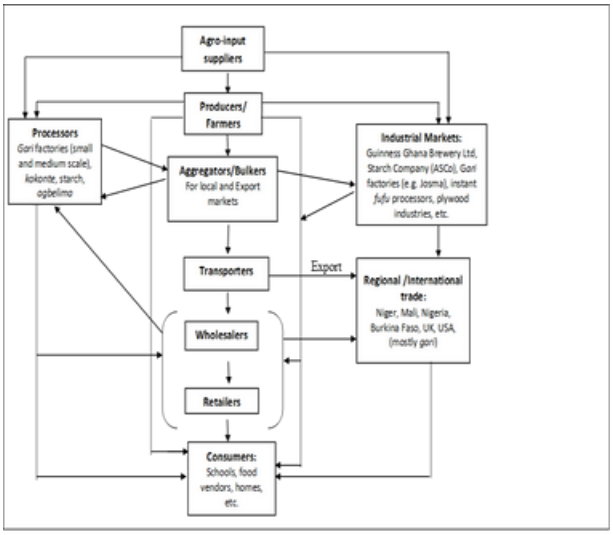

Figure 10a: Cassava Supply Chain Map

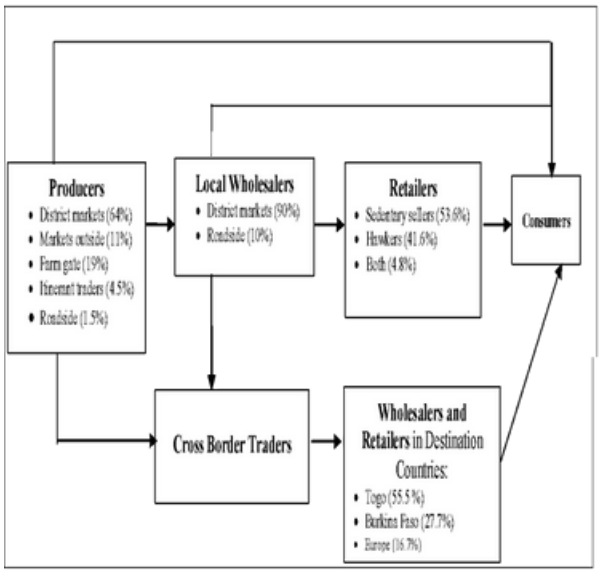

Figure 10b: Yam Supply Chain Map

Source: Aidoo *et al.* (2012) [5]

Unlike the cassava supply chain, the yam chain does not have a significant processing node. Fresh tubers produced at the farm gate are usually moved through a number of intermediaries (aggregators, wholesalers and retailers) before reaching final consumers in urban areas of Ghana (Figure 10b). There is a vibrant export node of the yam supply chain through which cross-border traders move yam tubers out of Ghana to external markets in neighboring West-African countries (Burkina Faso, Togo and Mali), Europe and the United States of America. In fact, Ghana is the leading exporter of yams in the world, generating significant foreign exchange for the country. The Yam Exporters Association of Ghana is very active at this node of the supply chain.

3.5.1 Aggregation, Transportation & Trading Activities

Because of their high moisture content, roots & tubers are bulky and highly perishable after harvest. They therefore require special care during bulking and transportation through the supply chain. Smallholder farmers produce roots & tubers in many scattered communities that are usually far away from the main district and other urban markets. Rural assemblers (aggregators) therefore play a crucial role in the chain by sourcing fresh produce across a number of communities and aggregating them for transportation to the main district market. Third-party commercial trucks (tractors, mini trucks and tricycles) are hired by aggregators to cart the produce from farming communities to the district and satellite markets, where sedentary and long-distance (itinerant) traders serve as the main off-takers. Some of the aggregators also sell cassava roots to gari-processing centers within their local districts.

A number of sedentary traders stationed permanently in the district markets buy yams in bulk from rural assemblers and re-sell to itinerant (long-distance) traders who usually come from urban markets such as Accra, Tema, Kumasi, Takoradi, Sunyani, Cape Coast, etc. A number of these long-distance wholesalers normally pool resources together to hire big trucks (third-party commercial trucks) to transport yams from the source market to the urban markets. Cross-border traders (exporters) also use long trucks (third party) to transport produce (especially yams) to the Sahelian countries.

Plate 6: Tricycle transporting yam tubers

Plate 7: Small truck transporting cassava roots

Plate 8: Long truck transporting yam tubers

Root and tuber produce in transit requires special care due to its highly perishable nature. When produce arrives in destination markets, long-distance traders hand it over to local wholesalers in these markets, who then retail to food service companies and street food vendors, institutional buyers and final consumers from individual households.

There are short-term credit sales arrangements among actors in the roots & tubers supply chain. For instance, at the wholesale node of the supply chain, traders could have a weekly or bi-weekly credit period within which to pay the supplier of the commodity. However, at the retail node of the chain, credit sales are not common. It is important to report that contract production arrangements also occur between primary producers and wholesalers, especially in the case of yam, due to the high production costs. Some traders pre-finance the production of the crop to guarantee access to a specified volume of a particular crop variety during harvest period.

3.5.2 Storage/Warehousing Issues

Roots & tubers are stored using traditional methods. Cassava is the most perishable root crop. Due to its short shelf life (three to five days) after harvest, farmers usually leave the plants in the field (on-farm storage) until there is a buyer before they are harvested. Once harvested, cassava roots must be used or processed immediately. If for some reason harvested cassava roots cannot be used immediately, they are buried underground for a few weeks before usage. Sweet potatoes and cocoyam are also subjected to the same treatment as the main method of storage. In the case of yam, different traditional and 'improved' storage structures are used to hold harvested produce for periods between three and six months. When adequate ventilation is provided in the storage structure, yams can stay in the structure for longer periods. However, when ventilation is poor, huge quantities of yam tubers could be lost through decay and sprouting. In recent times, improved storage structures with proper ventilation have been designed and constructed using locally available materials (Plates 9 and 10). However, adoption of such structures by individual farmers is quite low due to their high cost. Communal ownership of such storage facilities is the new direction being pursued by stakeholders in the industry.

Plate 9: Yam storage facility using thatch wall

Plate 10: Yam storage facility with wooden wall

3.5.3 Processing Activities and Value Addition

Apart from cassava, there is minimal processing of roots & tubers in Ghana. Cassava is processed at both cottage and industrial levels. Yam, sweet potato and cocoyam are minimally processed for consumption in the boiled, roasted or fried forms.

In Ghana, cassava is processed into various derivatives including:

- Cassava grits (Gari)
- Cassava chips
- Cassava dough (Agbelima)
- High-quality cassava flour (HQCF)
- Starch used for beer production.

The most popular product from cassava is cassava grits, locally known as gari. It is widely consumed in the country, especially by students at all levels of the educational ladder, due to its cheap price and convenience. The national buffer stock company now procures it in large volumes for distribution to senior high schools under the national school feeding program. In addition to local demand, there is high export demand from Africans in the diaspora. The high demand notwithstanding, gari processing in Ghana is largely done at the cottage level with labor-intensive and rudimentary technology (plates 11 & 12). Only few processing centers like Josma Agroindustries at Woraso, near Asante Mampong, use modern processing equipment. In 2012, Guinness Ghana Breweries Ltd. (GGBL) produced Ghana's first cassava beer, called Ruut Extra Premium, which was followed by Accra Brewery Limited's (ABL) Eagle brand a year later. These industrial processors intended to source cassava in large volumes from local farmers to produce quality but affordable beer for the low-income segment of the market. GGBL has taken over the Ayensu Starch (ASCo) factory that was established under the Presidential Special Initiative in 2003.

Plate 11: Peeling of cassava

Plate 12: Pressing

Plate 13: Roasting

Plate 14: Gari

Plate 15: Cassava Beer

Following the use of cassava in the production of beer, concerns are being raised about the possible negative implications for food security if the industrial demand for cassava roots grows faster than current production levels. Currently, the industrial processors are targeting the market surplus of nearly 40%. However, when the market for cassava beer expands, and they expand their production capacity, there is likely to be a shortage of cassava roots for food consumption with attendant price escalation if local production does not keep pace with industrial demand. Even at present, some key informants reported that, during certain periods (drought) of the year when cassava is difficult to harvest, gari processors source cassava roots from Ivory Coast to augment local supply. Some past research work at KNUST suggests that industrial production of composite flour from the main root and tuber crops (especially, cassava and yam) for the bakery industry is possible.

This will promote and diversify the utilization base of cassava and water yam (D. alata) cultivar whose market value is usually low compared to white yam cultivars. In a Danida-sponsored research project (2013 to 2017), KNUST developed some bakery products using flour from root and tuber crops (plates 16 -19). Sensory evaluation of the products suggests that composite flour from roots & tubers could be used as a substitute for wheat flour, which is used extensively in Ghana in the bakery industry. This is especially interesting, following the price escalation of wheat flour in Ghana as a result of the recent Russia-Ukraine war.

Plate 16: Bread from water yam flour

Plate 17: Bread rolls from cassava flour

Plate 18: Yam flour for instant fufu

Plate 19: baby food from sweet potato flour

Source: Products developed from Root and Tuber flour under Danida Root and Tuber Value Chain Project @ KNUST.

3.6 Price Trends

The prices of roots & tubers at the wholesale node of the supply chain in rural markets have been fluctuating in response to forces of demand and supply. Among the main root and tuber crops, cocoyam is usually more expensive than yam and cassava, which is the cheapest. In nominal terms, the average rural wholesale price of cassava rose from about GHC500.00 per Mt in 2013 to about GHC1,583.00 per metric ton in 2020 (Figure 11a). Yam price in rural markets increased by over 200% in nominal terms, from GHC900.00 in 2013 to GHC2,902.00 per Mt in 2020. This represents about a 140% increase in price in real terms (using 2012 as the base year) at the rural wholesale point. The nominal and real prices of cocoyam rose by 200% and 180%, respectively, between 2013 and 2020 (Figure 11b). The high price of cocoyam can be attributed to the scarcity of the commodity on the market. Cocoyam is grown on fertile lands in the forest belt of Ghana. With few supply centers in the country, the total supply is usually lower than demand, leading to high prices of the commodity on the market. It is important to indicate that the prices of roots & tubers are significantly influenced by seasonality. Prices are usually lower during the peak harvest season (August to October) and very high during the lean season (February to May).

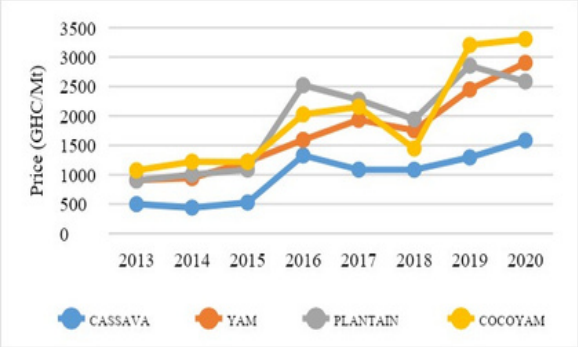

Figure 11a: Nominal Average Rural Wholesale Price

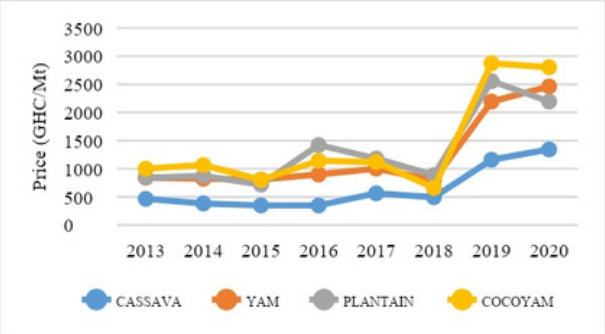

Figure 11b: Real Average Rural Wholesale Price (2012=100)

Source: Generated from MoFA Data, 2021.

3.7 Constraints and Opportunities along the Supply Chain

There are key constraints faced by actors at various nodes of the roots & tubers supply chain in Ghana. Limited access to credit and inappropriate storage facilities are common constraints faced by both primary producers and traders of roots & tubers (Table 2). High labor requirement is common at both production and processing nodes of the supply chain. Limited mechanization of several supply chain activities does not only create inefficiencies; it also results in longer activity lead-time.

At the trader node of the chain, actors experience fluctuations in both supply and demand of root and tuber commodities due to the significant effect of seasonality on production and availability of substitute products (cereals) during certain periods of the year. There are opportunities that actors in the supply chain can take advantage of. Apart from expansion in the export market, rising population (especially students) and rapid urbanization have created high consumption demand for root and tuber products like gari on the domestic market. At the same time, the high industrial demand for cassava roots presents a great opportunity for primary producers and aggregators to expand their scales of operation. The challenge of high post-harvest losses also presents a unique opportunity for value addition to produce root and tuber flour on a commercial scale for the bakery industry in Ghana.

Table 2: Key Constraints and Opportunities

Constraints/Challenges	Opportunities
Producers:	
Limited access to improved planting materials	High demand for improved varieties from new industrial processors
High labor requirement during harvesting (no mechanized harvesting)	Favorable government policy (PFJ)
Short shelf life of freshly harvested produce	On-farm processing technologies.
Inappropriate storage structures	High industrial demand
Limited access to market information	
Limited access to credit	
Processors:	
Inconsistent supply (esp. during lean season)	Rising population/urbanization (high demand)
Inability to handle effluent/waste management	High demand from industrial buyers
Inefficient processing equipment at cottage level	High demand from diaspora
High cost of labor	Semi- or fully mechanized processing technologies
Traders:	
Demand fluctuations leading to post-harvest losses (fresh tubers)	Rising population and urbanization leading to high demand
Supply fluctuations leading to low market margins	Rising incomes have potential for high demand for yam
Limited use of grades and standards (only supermarkets and exporters adopt grades and standards)	
Bad roads to producing communities leading to high transportation costs	
Rotten tubers in cases where whole farms are bought by traders	
Inappropriate storage structures/facilities in the market	
Limited access to credit	

4. CEREALS SUPPLY CHAIN ACTIVITIES

This section presents supply chain activities in the cereals sub-sector of the agri-food industry in Ghana. Cereals are a group of food crops whose seeds are used as human food. They also contribute significantly to animal feed production as inputs. Maize, rice, sorghum and millet are the major cereal crops grown in Ghana. However, consumption of cereals in the country goes beyond these crops to include wheat and oats.

4.1 Importance and Production Trends

Cereals contribute significantly[6] to agricultural GDP, employment generation and food security in Ghana. Maize and rice supply chains have been identified as pro-poor, leading to significant poverty reduction. According to Arndt and Hartley (2017),[7] growth in these supply chains is most effective at reducing poverty at the national level. This is because a high number of actors are involved in their production, processing, marketing and distribution. Whereas males dominate the production node of the supply chain, processing and trading activities in the chain are largely controlled by women.

In 2020, total production of cereals in Ghana was a little above 4 million Metric tons. Maize is the most widely grown crop in Ghana, integrating very well in all types of farming systems across all agro-ecologies in the country. The crop constitutes a little above 70%[8] of total cereal production in Ghana.

Plate 20a: Maize farm

Plate 20b: Maize on cobs

Plate 20c: Drying of Paddy Rice

Plate 20d: Rice farm

Plate 20e: Sorghum farm

Total annual maize production in the country increased by 82% from about 1.7 million Mt in 2011 to 3.1 million Mt in 2020 (Figure 12a). It is important to point out that maize output stagnated at levels below 2 million Metric tons from 2011 to 2016. However, the quantity produced by the country increased consistently from 2 million Mt in 2017 to 3.1 million Mt in 2020. This quantum jump in national output (53% increase) could be attributed to the government's flagship Planting for Food and Jobs (PFJ) program, which had maize as the anchor crop. Under this program, smallholder farmers were supplied with improved seeds and fertilizers at a 50% subsidy rate; which was to be paid after crop harvest. In addition, there was improved access to extension services as a result of a boost in the number of extension agents under the program to reduce the extension-farmer ratio.

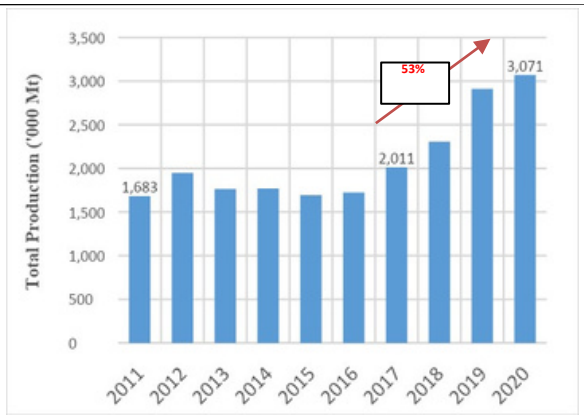

Figure 12a: Maize production trend

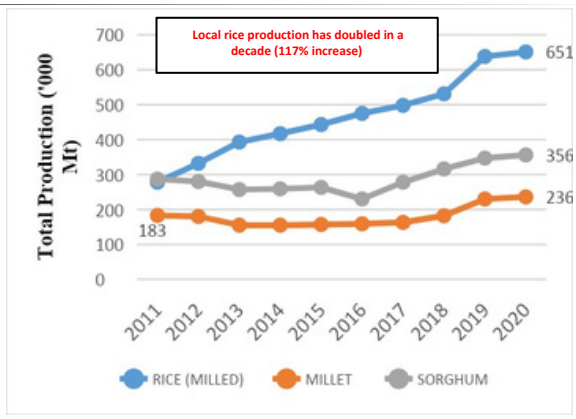

Figure 12b: Production trend for rice, millet and sorghum

Source: Generated from MoFA data, 2021.

Rice production in Ghana also saw consistent increase in production, from about 300,000 Mt in 2011 to 651,000 Mt in 2020 (Figure 12b). This 117% increase in local rice production had a positive effect on the Ghanaian economy since the country saved a significant amount of foreign exchange that would have otherwise been used to import extra rice over the years. The role of the government subsidy program in stimulating growth over the period 2018 to 2020 cannot be discounted. Under the PFJ program, a number of private sector actors were engaged to produce and supply improved planting materials (seeds) for farmers. This expanded the production scale of such seed producers, thereby intensifying activity levels at the input stage of the maize and rice supply chains

The country's total production of sorghum witnessed about a 19% increase from a little below 300,000 Mt in 2011 to 356,000 Mt in 2020 (Figure 12b). In the case of millet, the increase in production was about 29% over the same 10-year period. Considering all the four major cereals produced in the country, total production witnessed an average growth rate of about 62% over the period 2010 to 2020. This marks a significant progress, which has to be sustained if the country is to become self-sufficient in the production of its basic food staples.

4.2 Main Supply Sources and Yield Gap Analysis

Like root and tuber crops, cereals are also produced and supplied from different agro-ecologies and regions in Ghana. The middle belt of Ghana is the main supply hub for maize. Largest volumes are moved from the Ashanti, Eastern, Bono and Bono-East regions to various regional and district markets in the country for further distribution and processing (Figure 13a). In contrast, rice is produced and supplied mainly from southern (Volta and Oti regions) and northern regions (Upper East and Northern) and parts of the Ashanti region (Figure 13b). The production of sorghum and millet is confined to only the northern belt of Ghana, where these crops are major staples (Figure 13c). Sorghum as an industrial crop is usually transported from these production centers to the brewery companies which are located in Ashanti and Greater Accra regions for further processing.

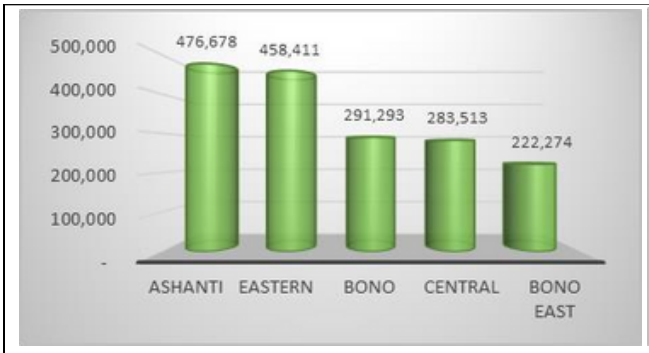

Figure 13a: Major Maize supply centers in Ghana

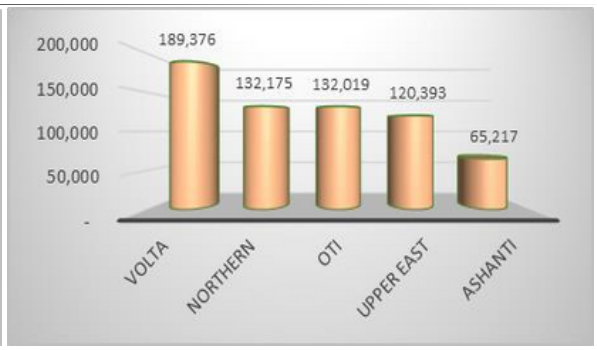

Figure 13b: Major Local Rice supply centers in Ghana

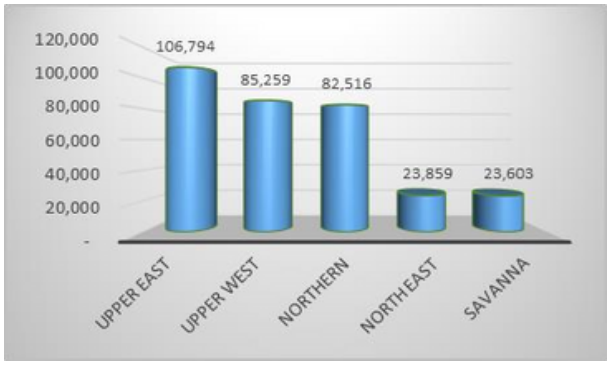

Figure 13c: Major Sorghum supply centers in Ghana

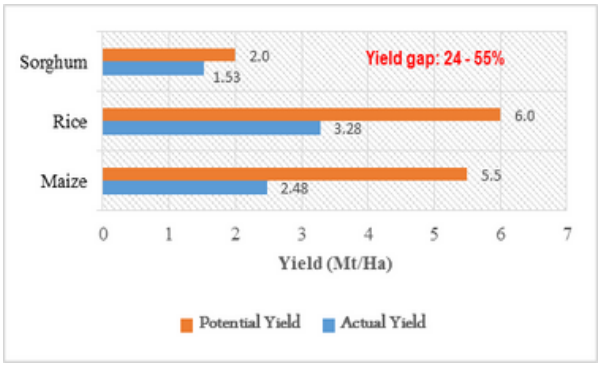

Figure 13d: Yield gap analysis for main cereals

Source: MoFA, 2021.

Like all other crops in Ghana, current yield levels for cereals are all below the attainable level. A gap ranging from 24 to 55% between actual and potential yield was recorded for the major cereals produced in the country in 2020 (Figure 13d). Maize has the highest yield gap (55%) and sorghum has the lowest yield gap (24%), with rice recording a yield gap of 45%. When the use of improved seeds and fertilizers is intensified together with expansion in irrigation infrastructure, the country could reduce these gaps in productivity over the next five to 10 years.

4.3 Production versus Utilization

In terms of cereals, Ghana is self-sufficient in the production of millet and near self-sufficiency level as far as maize is concerned. Based on the 2020 food balance sheet, Ghana is able to fulfill 93% of its demand for maize from domestic production (Figure 14a). Similarly, 92% of sorghum demand is satisfied through local production (Figure 14c).

In the case of rice, the quantity produced domestically in 2020 was about 45% of domestic demand, which was almost equal to the quantity imported (Figure 14b). Importing rice to satisfy the unfulfilled demand costs the country about US$500,000 per year. This amount could be reduced significantly if domestic production of rice is improved through improved technology adoption.

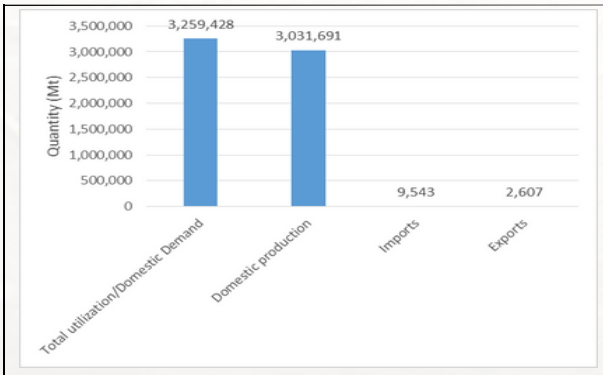

Figure 14a: Maize Balance sheet - 2020

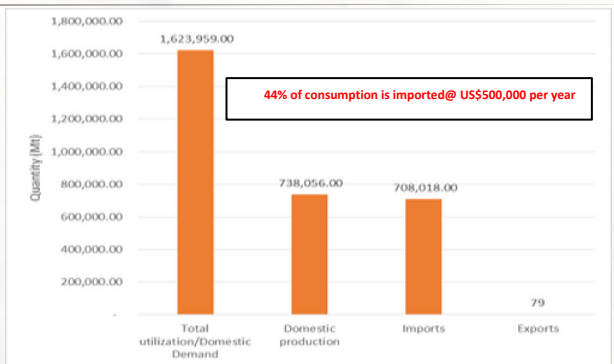

Figure 14b: Rice Balance sheet - 2020

Source: Generated from MoFA Data, 2021.

Figure 14c: Sorghum Balance sheet -2020

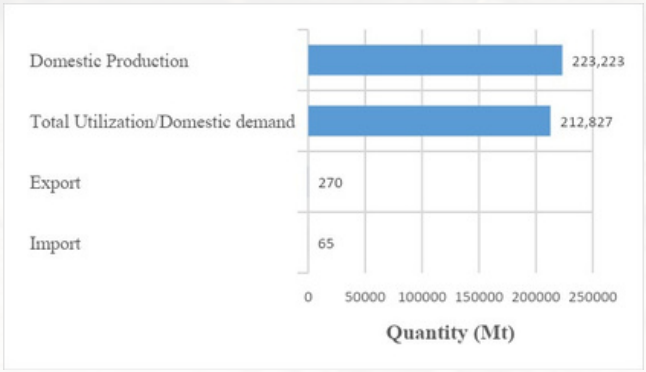

Figure 14d: Millet Balance sheet - 2020

Source: Generated from MoFA Data, 2021.

In terms of utilization as food, the per capita consumption of maize has increased consistently, from 45 Kg in 2016 to nearly 76 Kg in 2020 (Figure 15). For the same period, per capita consumption of rice moved from 40 Kg in 2016 to 52 Kg in 2020. The quantity of maize and rice consumed explains the critical role the crops play in the food security status of a typical household in Ghana. The other two cereals do not contribute significantly towards calorie intake of a typical consumer in the country.

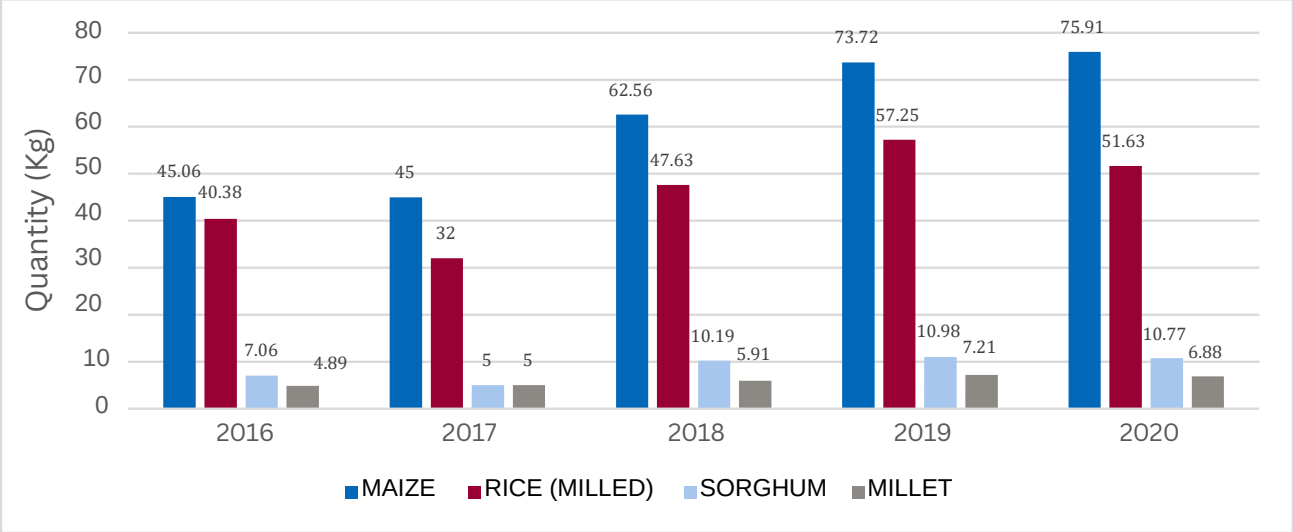

Figure 15: Annual Per capita Consumption of Cereals in Ghana

Source: Generated from MoFA Data, 2021.

4.4 Key Supply Chain Activities

A typical cereal supply chain consists of an input supply stage, primary production node, aggregation, storage and processing stages as well as trading and distribution stage (Figure 16). The final consumption stage comes before disposal of waste products. Basic inputs employed in cereal production are usually sourced from agro-input shops, open market, family members and friends. About 70% of the primary producers of cereals in Ghana are smallholders cultivating two (2) hectares or less. The operations of these smallholder farmers are barely mechanized.

Recently, some combined harvesters have been introduced by private sector operators who rent their services to rice farmers during harvest period. Due to their limited number vis-a-vis the number of rice farmers, operators of these harvesters move them from one district to another depending on service demand.

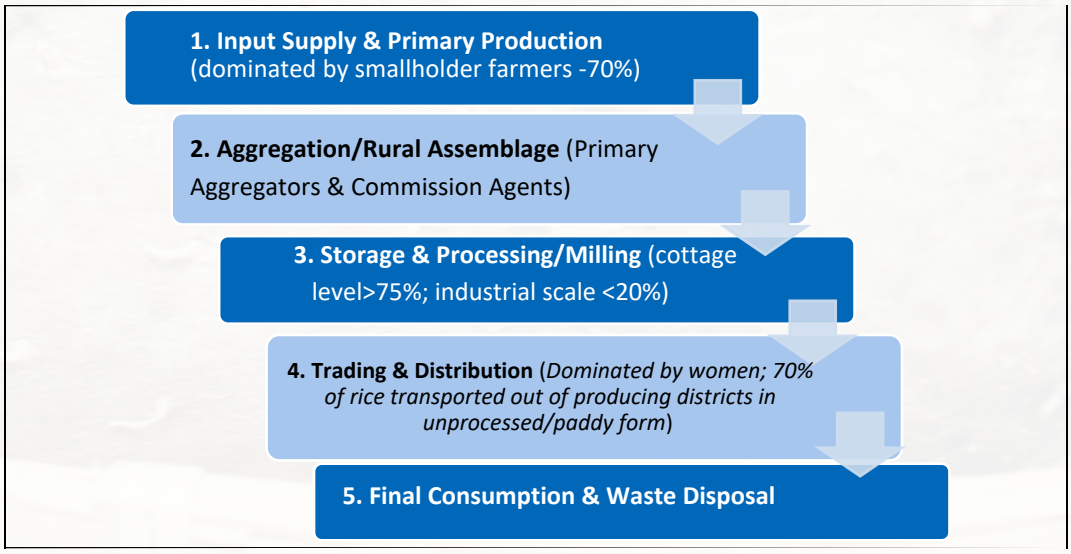

Figure 16: Stages in the Cereal Supply Chain

Plate 21*a*: Combined harvester at work

Plate 21*b*: Ultra-modern rice milling center

Literature review and key informant interviews revealed that there are many intermediary activities between the on-farm harvest stage and the final consumption stage. The fresh maize/corn is sold to retailers who prepare it and sell it in rural and urban markets in boiled or roasted forms. For grains, they are harvested dry and the farmer may store them for some time if a storage facility is available. Otherwise, the dry maize is dehusked, shelled and sold to aggregators or wholesalers. In the case of rice, the majority of farmers store it for some time before they sell it to wholesalers through rural assemblers. Some of these wholesalers are long-distance traders who move from places like Kumasi, Sogakope, Akuse and Asutuare to the producing districts to buy paddy rice in bulk for milling and onward distribution and sale.

Storage and processing are two critical activities in the cereal supply chain. Maize is commonly stored in narrow cribs at the farm gate. However, there are warehouses owned and operated by Ghana Grains Council (GGC) and Ghana Commodity Exchange, which are used for long-term storage of cereals (Plate 22). The government of Ghana is in the process of constructing warehouses across all the 260 districts under its 1-District-1-Warehouse (1D1W) policy to help address the storage and post-harvest challenges associated with cereals. About 38 of such warehouses have been completed with 1000 Mt capacity each (Plate 23). These have been handed over to the Ghana National Food Buffer Stock Company (NAFCO) to support its operations. The rest are at different stages of construction. Notwithstanding these recent developments, there is a need for increased national storage capacity to be able to support supply chain actors to hold stocks when prices are not favorable.

Typically, cereal grains are stored for a period of three to six months. Milling/processing of paddy rice is done with both traditional and modern milling equipment. Traditional equipment is the most common in the country. It are operated at small- to medium-scale rice milling centers which also serve as storage points for farmers' paddy rice and sales point milled rice. In addition to this equipment, there are modern processing centers with de-stoners and sorters/graders to separate the milled rice according to the broken rice percentage.

Under its One-District-One-Factory (1D1F) policy, the government has also facilitated the construction of a few large-scale rice milling centers in the country with ultramodern facilities (Plate 21b).

Plate 22: Government warehouse near completion

Plate 23: Ghana Grain Council Warehouse – cross section

Plate 24: Traditional storage facility for maize grains

Maize processing is largely undertaken on a small scale for food consumption across all major communities with the use of traditional corn milling plants. There are a few industrial processors of maize, such as the Yedent Group of companies and Premium Foods Limited, who process maize grains into breakfast cereals. These large-scale processors work with aggregators to mobilize significant volumes across a number of communities for haulage by their long trucks. Sorghum is also processed at the industrial level by companies like Guinness Ghana Brewery Limited (GGBL) to produce non-alcoholic beverages (e.g. Malta Guinness). The same aggregator model is employed by GGBL to source large volumes of sorghum from the northern belt of Ghana where the commodity is largely produced.

The sale of cereal grains is done in major district and regional markets and the business is dominated by women. Large wholesalers source large volumes from various source markets to urban markets to supply to retailers, restaurants/hotels and local processors who produce kenkey (a Ghanaian dish made from fermented corn). There are institutional buyers such as the school feeding program, hospitals, Ghana Prison Service and poultry farmers/animal feed producers. The animal feed industry is a major outlet for maize (especially yellow maize) produced in the country. In addition to local trade, there are cross-border traders who export maize to the Sahelian countries. During periods of scarcity, some of these traders also bring maize from neighboring countries (e.g. Ivory Coast) for sale to industrial processors. Products from industrial processors are usually sold to institutions like hospitals, World Food Program and supermarkets.

4.5 Price Trends

Quite consistent with expectations, the nominal average wholesale price of all the major cereals witnessed an upward trend from the years 2013 to 2020 (Figure 16a). However, the real wholesale price in rural markets saw some stability from 2016 to 2018 (Figure 16b). In fact, the real price of rice declined sharply during that period. Overall, rice is the most expensive cereal grain in Ghana, followed by millet and sorghum. The low price of maize could be attributed to its high production volume and the inadequate storage infrastructure, which forces many producers to sell immediately after harvest. The price of rice increased by more than 100% (nominal price increased by 159% and real price increased by 136%) from 2013 to 2020. Similarly, the nominal price of maize also more than doubled during the period under consideration; the real price doubled.

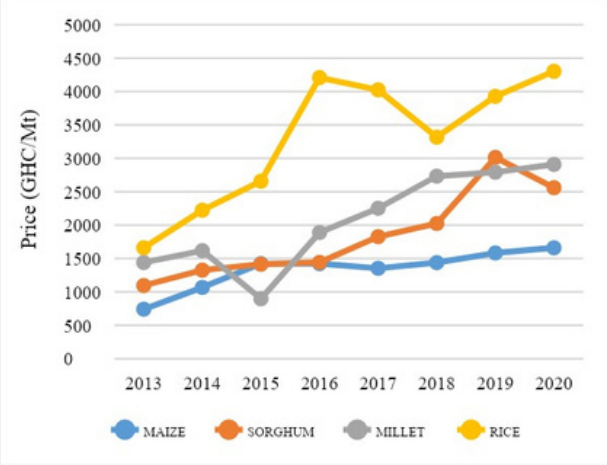

Figure 16a: Nominal Weighted Average Rural Wholesale Price

Source: Generated from MoFA Data, 2021.

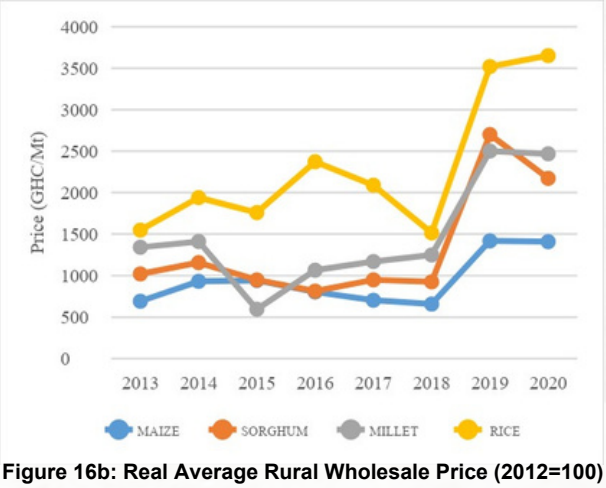

Figure 16b: Real Average Rural Wholesale Price (2012=100)

4.6 Constraints and Opportunities along the Supply Chain

Actors in the cereal supply chain face key challenges in their operations. At the primary production node of the chain, limited access to farm inputs, high incidence of diseases and inadequate storage facilities are important constraints (Table 3). Existence of weak farmer associations has tended to weaken the bargaining position of primary producers when dealing with other chain actors. At the processor node of the chain, inefficiency of traditional technologies adopted, limited capacity of milling centers, inadequacy of warehousing facilities, and unavailability of ancillary facilities like dryers and cleaners constitute the key bottlenecks. For traders in the chain, bad road network, high transaction cost, and post-harvest losses through spillage and storage pests are key challenges.

In spite of the constraints above, there are a number of opportunities actors in the cereal supply chain can take advantage of (Figure 17). For example, on the supply side, improved crop varieties that are both high-yielding and disease-resistant have been bred by agricultural research institutes in Ghana (e.g. Crops Research Institute and Savanna Agricultural Research Institute) for use by farmers. Also, the government flagship Planting for Food and Jobs (PFJ) policy is a great opportunity for cereal producers to have access to improved farm inputs (planting materials and fertilizers) at reduced prices.

Table 3: Constraints faced by Key supply chain actors

Producers	Processors	Traders
a) Limited access to farm inputs such as fertilizer and seeds	a) Inefficient and low-capacity processing/ milling facilities	a) Bad road network leading to producing communities
b) High incidence of diseases & pests (FAW)	b) Many milling facilities do not have de-stoners and grading equipment (resulting in poor quality products)	b) High transaction costs due to long distances
c) Inadequate irrigation facilities	c) Inadequate warehousing/ storage system	c) High post-harvest losses (spillage, storage pests)
d) High cost of production	d) Absence of mechanical/solar dryers & cleaners	d) Poor coordination among supply chain actors
e) High labor intensity (limited mechanization of operations) Weak farmer associations	e) High post-harvest losses (storage pests, processing losses, etc.)	e) Limited access to credit
f) *(weakening their bargaining position)*		
g) Limited access to credit		
h) High postharvest losses (storage pests, processing losses, etc.)		

The establishment of the Ghana Commodity Exchange (GCX) and the presence of some certified warehouses owned and operated by the Ghana Grains Council present an opportunity for producers and other intermediaries in the cereal supply chain to have access to storage facilities with dryers, weighing scales and cleaning services.

On the demand side, the booming food and beverage industry in Ghana as a result of high human population and the growth in the animal feed industry have created a huge demand for cereals for both human and animal consumption.

Actors in the cereal supply chain could take advantage of these opportunities to increase their scale of operation, while cutting down on costs to remain competitive.

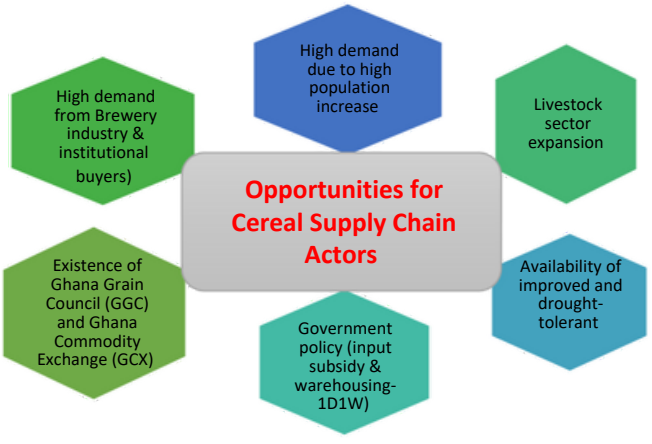

Figure 17: Opportunities along the Cereal Supply Chain

5. CONCLUSION AND THE WAY FORWARD

The agricultural sector is a pivot in the Ghanaian economy. The roots & tubers and cereal sub-sectors will continue to be of utmost importance in our food systems as a country. Activities along the supply chains of these commodities have a great potential to generate employment and income and ensure food security for chain actors and the country as a whole. In spite of the numerous opportunities in these supply chains, their growth and performance have been stifled by numerous production, marketing, processing, financial and logistical constraints. Private sector investment in the area of improved technology is required to mechanize supply chain activities to improve efficiency and competitiveness. The role of the government in providing the enabling environment through investment in irrigation, road and storage infrastructure, and implementation of favorable policies cannot be overemphasized if the full potential of these supply chains is to be unleashed.

In specific terms, the following recommendations are made to improve the performance of the agricultural supply chains in Ghana:

1. The central government should partner with private sector actors to promote local seed & organic fertilizer production and improve distribution systems to enhance access to these inputs by primary producers.
2. Private sector actors should invest in innovative technologies to promote mechanization of laborious supply chain activities to engender efficiency and reduce drudgery among women and youth.
3. There should be improved access to markets by strengthening supplier networks and linkages among key supply chain actors through the creation of Innovation Platforms and periodic capacity building.
4. Stakeholders should increase local processing capacity through investment in modern facilities with dryers, cleaners and sorters/graders, among others.
5. To reduce post-harvest losses along the supply chain, there is an urgent need for improved coordination among supply chain actors and increased investment in improved storage systems across the country by the government in strong partnership with the private sector.

ENDNOTES

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2 Arndt, C. and F. Hartley (2017). "Identifying priority value chains in Ghana." In The State of the Ghanaian Economy in 2016. Legon, Accra, Ghana: ISSER. pp. 213-232.

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