



Enhanced Cassava Production for Food Security and Economic Development in Nigeria: A review

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Abstract

In addition to contributing to food security, cassava is gaining popularity as a feedstuff and feedstock across the world. Efforts are being made to substitute cassava for grains in the animal feed, ethanol production, etc. It is being increasingly recognized that growing high yielding cassava can spur sustainable development. The objectives of this study were to identify gaps in the cassava sub-sector and proffer solutions for optimal production and utilization of cassava and its products for food security and economic development. The data and information for this study were collected from sources like Google Scholar, Science Direct, Research Gate and FAOSTAT. The challenge of how to produce beyond domestic demand and sustain supply to the international markets is one of the constraints we face in Nigeria cassava subsector. Despite being the world's largest cassava producer, more than 90 % of cassava produced in the country is consumed locally as food. Since little is processed for many and varied uses, the outlook for increasing cassava production is promising as it can encourage rural and economic development through increase in production, processing, marketing and export of starch, pellets and chips to earn foreign exchange. The study suggests that, like Thailand, Nigeria should focus on increasing productivity alongside creating market opportunities. This could be achieved by raising institutional structures and functioning infrastructures, enacting favourable agricultural policies such as the export-led industrialization policy, trade and investment liberation and common agricultural policy. Such policies will support large agribusinesses interventions, including cassava processors and commodity exporters, and help create a conducive environment that will sustain cassava production for food security and economic development.

Keywords: *Cassava industry, food security, trade opportunities, economic development, trade constraints, global market*

Introduction

Cassava (*Manihot esculenta Crantz*), is a woody shrub cultivated extensively as an annual crop although it is a perennial plant (Wikipedia, 2022) It is majorly grown for its storage roots and its importance is increasing in Africa because of its diverse uses, tolerance to environmental stress such as drought, low soil fertility and its relatively high productivity where many other crops fail (McCormick and Schmitz, 2001). The International Center for Tropical Agriculture (CIAT) has referred to the crop as the "Rambo of food crops" because of its ability to thrive in warmer climates. This particular feature of cassava will be found to be useful in the fight for food security and in combating the possible effect that the expected temperature rise by 2 degrees Celsius in Africa by 2030, will have on food availability (Cecilia Schubert, 2012). It is predominantly consumed as food, but also used as animal feed and raw materials for related industries. Cassava is classified as 'sweet'

when the cyanogenic glucoside (CG) content is less than 100 mg kg⁻¹ fresh weight, while cultivars with CG content of 100–500 mg kg⁻¹ fresh weight are referred as 'bitter' (Alves, 2002). The leaves serve as vegetable in at least 60 % of the countries in sub Saharan Africa (SSA), providing an important source of vitamins (B1, B2 and C), carotenoids, minerals and proteins, with crude protein content ranging between 17 – 40 %, depending on variety, stage of maturity, soil fertility, harvesting frequency and climate (Ravindran, 2021; Latif and Muller, 2015).

In 2020, the world cassava production stands at 302.66 million metric tones; Africa is the world's largest cassava growing region, with total production of 193.62 million metric tones and unarguably, Nigeria remains the highest producer of cassava in the world with about 60 million metric tones (FAO, 2022). Also, global cassava production in terms of total area harvested has increased substantially in recent years. Nigeria led the

world in this aspect with total harvested area of 7.7 million ha in 2020 (FAOSTAT, 2022). Despite being the world's largest cassava producer, more than 90 % of cassava produced in Nigeria is consumed locally (The Guardian, 2020). To maximize the prospects of the cassava industry in areas such as exportation, industrial uses, food security, economic development, etc., there is the need for increased and enhanced production, processing and packaging leveraging the current technologies and innovations. The objectives of this study were to identify gaps in the cassava sub-sector, highlight existing opportunities and proffer solutions for optimal production and utilization of cassava and its products for food security and economic development.

Methodology

The data and information for this study were collected from sources like Google Scholar, Science Direct, Research Gate, FAOSTAT, Tridge, Wikipedia, journals, national reports, etc. Extensive research was carried out on the Nigerian cassava industry and literatures reviewed accordingly. The information on Thailand cassava industry was gotten from the Observatory of Economic Complexity (OEC) and Tridge web pages, including other published journals while the diagram showing Thailand's cassava market structure was the authors creation inspired by available information from OEC and other journals.

Cassava as a food security crop in Nigeria

Cassava is grown in almost all states in Nigeria, although it thrives in the southern and north central states. Its production is dominated by smallholder farmers who produce cassava primarily for the traditional food market. An estimated 30 million farmers are involved in cultivation of cassava and about 95 % of these farmers each cultivate less than 2 ha while those with more than 5 ha are about 5 % (Ezedinma *et al.*, 2007). Considering that food is a fundamental human right, food security has remained an issue in this present time and the cassava crop can be a ready solution especially because it can be identified with the four features of food security: availability, accessibility, utilization and stability, if certain measures are put in place. Shehu *et al.* (2019) opined that cassava is widely known as a food security crop and about 80 % of Nigerians consume cassava products, at least once a day. After the evaluation of consumption frequency of cassava products and the assessment of the effect of cassava products on food security among farming households, it was concluded that the provision of incentives such as soft loans by the government to farmers and putting in place favourable policies and strategies should be enhanced to reduce food insecurity. This is in tandem with the study by Bona and Richard (2017), on the role of cassava production in improving food security in Delta state of Nigeria. These studies also assert that cassava provides food security as it can be grown on less fertile soils; it is a source of income for farmers and provides food for many households. Bona and Richard (2017) showed that the rate of food insecurity in Nigeria has been increasing due to the lack

of economic access (which is one of the features of food security crops) to food either directly or indirectly. Evidences show that inappropriate agricultural policies and programs by government in Nigeria have been the contributing factors to the rate of food insecurity. Results from related studies proffer that understanding the relationship between cassava production, farm income and food security is important for designing appropriate intervention strategies.

Increase in cassava production in Nigeria has primarily been due to the growing domestic demand to meet the food needs as a result of rapid population growth, large internal market demand, complemented by the availability of high yielding improved varieties of cassava, a relatively well-developed market access infrastructure, the existence of improved processing technology and a well organized internal market structure (FAO and IFAD, 2005). Cassava products are dietary staple food in Nigeria, they include: cassava flakes (gari), cassava flour (pupuru and lafun), cassava paste (akpu, fufu), sliced cassava roots (abacha), all derived from the cassava storage roots. Cassava has been found to contain calcium, Vitamin B and C, and other essential minerals (Montagnac *et al.*, 2009). However, the quantity of these nutrients depend on the varieties, age at time of harvest, soil conditions, climate and other environmental factors (Cock, 1982). Most recent breakthrough in research has led to the release of cassava varieties bio-fortified with Vitamin A (Headmaster, Security, No-hunger). These pro vitamin A cassava varieties are proven for high dry matter content, high yielding, broad adaptation and very suitable for high quality cassava flour (HQCF). Though they are all very suitable for gari, the Headmaster variety is best for gari, while Security is best for fufu. Also, a project led by the Cornell University involving research scientists from NRCRI and IITA saw to the first ever cassava varieties released using genomics-assisted breeding. The varieties named by farmers as Poundable, Hope, Baba-70, Game-changer and Obasanjo-2 are all high yielding and resistant to viral diseases. Their unique features are as follows: Poundable – first sweet cassava variety released in Nigeria, it can be eaten without much processing, Hope and Baba-70 – excellent for making gari and fufu, Game-changer and Obasanjo-2 – high and stable starch content (IITA, 2021). The use of innovative technologies in breeding for improved and more desirable varieties has increased the satisfactory attributes of cassava, now making it more acceptable to consumers across income groups, unlike before, when it was seen as food for the poor.

The role of cassava in Nigeria's economic development

In addition to contributing to food security, cassava is gaining popularity among commercial feedstuff producers in Nigeria. Efforts are being made to substitute cassava for grains in the animal feed producing industries, through the promotion of cassava products such as pellets and chips, in order to reduce cost of importation of feedstuffs. Undoubtedly, a rise in productivity at the farm level is needed for cassava to

become a competitive feedstuff on both domestic and international markets. The world now recognizes that growing high yielding cassava spurs development especially in Agrarian countries (Hershey *et al.*, 2001). The problem of how to produce beyond domestic demand and sustain supply to the international markets is one of the challenges facing the cassava production sector in Nigeria. Data show that countries that have institutional structures to sustain cassava production have continually increased their participation as economic agents at the world cassava market (Edamisan and Kemisola, 2020).

To fully tap the potentials of cassava to develop the Nigerian economy, there is the need for value addition and the fundamental step towards adding value to cassava is processing. Cassava, especially the bitter type which is predominant in Nigeria is processed before consumption. This is important to remove or reduce the potentially toxic cyanogenic glucosides present in the cassava storage roots. Processing also serves as a means of preservation. If left unprocessed, cassava roots exhibit visible symptoms of postharvest physiological deterioration (PPD) within only 24 to 72 hours of harvest (Morante *et al.*, 2010, Salcedo and Siritunga, 2011, Vanderschuren *et al.*, 2014). In addition to removing or reducing the toxins in cassava and preserving the storage roots, processing generates diverse products with increasing value. Transformation of fresh cassava into stable products reduces its weight to ease transportation and handling. Such products may be cassava pellets, chips, and flour. Processing the storage roots into flour is one of the traditional ways of value addition to cassava in Africa. However, the traditional way of preparing cassava flour results in poor quality flour. This has greatly reduced its marketability especially as it is unappealing as a substitute for wheat flour in bakery products (Joko and Kazuhiko, 2013).

Over the years, the supply of cassava derivatives or by-products in Nigeria has fallen short of demand. For instance, the demand for high quality cassava flour (HQCF) for bread, biscuits and snacks is put at 500,000 metric tones per annum, but supply is less than 15,000 metric tones per annum (PWC, 2020). On the other hand, the demand for cassava starch is 300,000 metric tones, but supply remains below 10,000 metric tones. Despite the high demand for these products, supply is still very low. More startling is the near zero supply for ethanol in the country despite a huge potential demand of over one billion litres needed for industrial and domestic purposes (PWC, 2020). This implies that if supply of cassava does not grow at the same rate as demand, the cassava market equilibrium will be altered and in response, prices of cassava products will always fluctuate accordingly (Edamisan and Kemisola, 2020). Since little is processed as done in Thailand for many and varied uses, the outlook for increasing cassava production is promising as it can encourage rural and economic development through increase in production, processing, marketing and export of HQCF, starch, pellets and chips to earn foreign exchange. A study carried out by Udemezue *et al.* (2019) reviewed the cassava production trends, cassava value chain issues,

value chain and the challenges for cassava production and processing in Nigeria. The study agrees that agricultural sector is a strong driver of the economy and therefore recommends that for the nation to leverage on the cassava crop to boost her economy; the extension linkage with research should be strengthened so as to facilitate the spread of improved cultivars and management practices to farmers, integration of information and supply of necessary inputs, promotion of group approach to extension delivery, linking agricultural cooperative societies with other important stakeholders like agricultural research institutions, equipment fabricators, amongst others.

Harnessing opportunities in cassava production

Cassava is the highest produced crop in Nigeria at 60 million metric tonnes (FAOSTAT, 2022) but, it is surprisingly not among the top 10 exports (Khadijat Kareem, 2021). There exists huge opportunities yet to be exploited to extend the Nigerian cassava industry to global markets and harness the trade opportunities to achieve economic growth and development. Strategies towards achieving this may be through a critical understudy of the industry to identify areas of strengths and weaknesses, forestall potential threats and utilize opportunities both locally and globally. These will ensure expansion in trade, improved cassava supply chain, identification of economical vendors and fast-growing markets. Studying the Thailand cassava industry and its effect on the economy would certainly contribute to providing insights for the improvement of cassava industry in Nigeria. This is because Thailand has a much larger export base, a clear cut market structure and more economically developed systems in place for the cassava industry.

Thailand is ranked third in the world leading cassava producers, with high productivity in tons per hectare and ranked first in the world leading exporters of cassava products with an export share of 42.1% in 2020 (Tridge, 2022a). Thailand exported 9.5 million tons of cassava flour and starch, 12.2 million tons of chips and pellets in 2017 (Olutosin and Otekunrin, 2019) and recorded about 1.19 billion USD from sales of cassava products (OEC, 2019). In recent times, Thailand's cassava export has experienced a massive surge as importers sought grain alternatives amid food crisis brought on by the Russia-Ukraine war (Reuters, 2022).

In Thailand, cassava is grown as an industrial rather than a staple crop. Hence, the Thailand cassava industry is export-oriented with about two-third of total production exported at 697 million USD, in 2020 (OEC, 2022). The main destinations of cassava export in Thailand are China, South Korea, Japan, Netherlands and United States. The cassava industry has clear-cut products, value chain and markets (Fig. 1). The two value chains are dried cassava and starch (Tijaja, 2010). The dried cassava value chain has two main products namely; chips and pellets. Chips are sold to three market channels which are; the animal feed industry in the domestic market, ethanol producers in China and as intermediary input in pellet production (TTSA, 2009). Pellets are used as animal feed in more developed

markets. Also, the starch value chain has two main products; native and modified starches which are used in food and non-food industries to produce sweeteners, paper, textile, glue, Monosodium glutamate (Carlsson, 2006).

Thailand cassava industry has benefited from the emergence of strong and active commodity specific trade associations and research institutions, specifically tailored to the cassava industry. They are the Thai Tapioca Trade Association (TTTA), Thai Tapioca Starch Association (TTSA), Thai Tapioca Products Factory Association (TTPFA) and North Eastern Tapioca Trade Association (NETTA). The TTTA is dominated by exporters and larger dried cassava producers, while TTSA represents the starch value chain. These trade associations assist in promoting and disseminating new cassava varieties, including conducting training programs for farmers. TTTA and TTSA are actively involved in policy dialogues, organizing investors' visits and trade missions. The cassava dedicated research institutes and work programmes are the Thai Tapioca Development Institute (TTDI), Centro Internacional de Agricultura Tropical (CIAT) and Suranaree University of Technology (SUT). The promotion of cassava utilization as animal feed in the domestic market is undertaken by Suwanvajokkasikit Animal Research and Development Institute (SARDI). Thailand does not only focus on improving yield and farm productivity but creates market opportunities through cassava products promotion and attracts appropriate investments. Further, the country's cassava industry has benefited from favourable agricultural policies such as the export-led industrialization policy, trade and investment liberalization and common agricultural policy. The market-friendly policy has given rise to large agribusinesses, including cassava processors and commodity exporters. In addition, an understanding of the Chinese business culture and knowledge of a common language generated a sense of kinship that facilitated bilateral trade, between Thailand and China. Thailand-Chinese entrepreneurs are culturally comfortable in working with the Thailand farmers and they provide important market linkages for the farmers through the provision of inputs, business services and market access.

Globally, only 15 % of total production of cassava is exported. The direction of cassava export is mainly Europe and North America, with Europe accounting for about 90 % of the total buyers (Uba, 2019). In Europe cassava is used in compound feed formulation for animal production. Animal production in Europe, accounts for about 70 % of total agricultural output. Europe's main suppliers are Thailand (about 85 %) and Indonesia (about 6 %) (Uba, 2019). Cassava is a choice animal feedstuff because of its high carbohydrate content. Africa is yet to contribute significantly to world trade in cassava with only 3 % recorded in the early part of the millennium. About 30 % of cassava produced globally is used for starch and other industrial products and less than 1 % is processed into ethanol, particularly in Brazil (Uba, 2019). Though Nigeria has been a major producer of cassava, there was ban on the exportation of cassava and its allied products until 1996, when the ban

was lifted. Locally, there is a huge potential demand of about 250,000 tons per year for high quality cassava flour (HQCF) through the initiative of 10 % HQCF addition to wheat flour for bread production, as also required for bouillon, noodles and the adhesives industries. On the other hand, there is a gradually growing market opportunity for dried cassava leaves. It is not a popular delicacy in Nigeria but is highly appreciated in most African countries. A farmer in Rwanda came up with a way to dehydrate cassava leaves and reduce its cyanogenic contents safe for human consumption, while maintaining its taste and nutritional content (Kageni, 2021). Table 1 shows fresh cassava storage roots required to meet estimated demand for cassava products alongside the acreage of land required. The trade opportunities for cassava are on the increase as more significant use of its products and by-products are being discovered. In Nigeria, there is a need for over 400 million litres of ethanol for industrial uses. The country has always resorted to the importation of ethanol to bridge this gap. As a way forward, the Nigerian National Petroleum Corporation (NNPC) projects cultivating about 32,000 hectares of cassava and 15,000 hectares of sugar cane in Kebbi State and another 20,000 hectares of sugarcane and 15,000 hectares of cassava in Kogi state, of which the output will serve as a feedstock for the NNPC proposed 84 million litres per day ethanol plant in the quest for renewable energy sources. As at June 2020, about 2,675 hectares of cassava plantations have been cultivated in Kebbi state (Naturenews, 2022). Given that a tone of cassava produces 166 litres of ethanol, the country would need to produce 2.41 million metric tones to achieve the proposed project. A huge gap exists between demand and supply as the supply of cassava products remains low. Cassava starch, also known as tapioca starch is a major component of the cassava root. It has several uses such as a binding agent, sweetener in food manufacturing industries, in the production off monosodium glutamate (MSG). The Data Bridge (2022), reports that the Nigerian cassava starch market, was valued at USD 118.81 million in 2021 and is expected to reach the value of USD 198.11 million by 2029 at a CAGR of 6.6 % during the forecast period of 2022 to 2029. The report impressed that rising technological advancement and modernization in Nigeria has resulted in advanced product innovations and diversification in various applications which directly impacts the market growth. Other growth factors include rising demand for confectioneries and ready to eat items, growing demand from pharmaceutical as well as paper industry, rising cases of diabetes in the country which has shifted the consumer preference for artificial sweetener. Table 2 shows the different starch products in the market and other attributes.

Additional qualities of cassava produced in Nigeria - such as high beta-carotene content which is a precursor to Vitamin A, excellent garri and fufu quality, regular shapes etc., are unique selling propositions that should come in handy in the marketability of cassava. If the right systems are put in place, from the total output of 60

million metric tonnes of cassava produced in the country based on 2020 estimates, Nigeria has the economic potential to generate revenues of over 427.3 million USD from domestic value-addition and derive income of 2.98 billion USD in exports of cassava yearly (PWC, 2020). Presently, the federal government targets 18 billion USD annual returns from export of cassava products (Thisday, 2021). Whereas this is very feasible, the country is yet to take full advantage of the much-sought-after commodity. Production, processing and exportation of cassava and its by-products will do the Nigeria economy so much good as it will help to diversify the seemingly mono product economy, increase the country's revenue and create mass employment for the citizens. It will further foster entrepreneurship in the bid to meet with demands in areas such as, but not limited to machine manufacturing, logistics, transportation, packaging, waste management and consultation services.

In 2020, Nigeria had an export value of 355.68K USD and 86.16K USD in 2021 (Tridge, 2022b). Cassava exportation in Nigeria has experienced its own share of fluctuations without a definite movement in the upward direction. Though the 2020 export value is high compared to past years, but when compared with the potential export value, there is much gap and opportunity for improvement. Table 3 shows the top export destinations of cassava from Nigeria between 2016 and 2020.

Constraints militating against the cassava industry in Nigeria

The setback in the cassava industry could be attributed to many constraints including, shortage of adequate research funding, public-private partnership and investment-readiness in the cassava subsector. These affect the capacity to identify, create and expand cassava market opportunities locally and globally. This is followed by inconsistencies in policy execution, for instance, policies favourable to the Nigeria cassava subsector such as 10 % inclusion of cassava flour as substitute for wheat flour in bread making and the blending of 10 % ethanol in petrol (E-10) are not being implemented. Also, there is ineffective coordination between the various stakeholders in cassava production as business and for exports. These stakeholders include; Nigeria Export Promotion Council (NEPC), National Agency for Food and Drugs Administration and Control (NAFDAC), Standards Organization of Nigeria (SON), Nigeria Export and Import Bank (NEXIM), Bank Of Industry (BOI), Nigeria Agricultural Cooperative and Rural Development Bank (NACRDB) and the Organized Private Sector (OPS). Good working understanding among the stakeholders could improve the economics of cassava subsector in Nigeria.

The existing high cost of production increases price of the commodity which reduces the competitiveness of cassava products in the international market. This is so because the international buyers may likely not be willing to pay higher for cassava products that they can readily get at cheaper prices from other countries. This is worsened by substandard cassava product derivatives,

as most cassava farmers and processors engage in traditional processing, resulting in low quality products that do not meet the export quality standard. Undoubtedly, the low adoption of improved technologies and varieties that are high yielding and diseases resistant leads to low yields, inefficiency in inputs use, post-harvest losses and environmental degradation. Poor yields continue to widen the yield gap, thereby increasing cost of production. Poor condition of the roads limits access to markets and commercial processing plants. Hence, large scale cassava farmers struggle to get their products on time to processing plants. Furthermore, the cyclical gluts which occur when the supply of cassava products largely exceed local demand result in huge wastage and fall in price. Effects of climate change in the form of recurring flooding in some parts of the country have also posed a major challenge in the industry, as cassava is prone to flooding. In as much as it is drought tolerant and nutrient use efficient with high yield potential, more than a day of flooding kills the plant, accompanied by root rots in older plants, and subsequently, poor production.

Conclusion

The cassava subsector has the potential to significantly boost the economy of Nigeria if optimally harnessed. With the increasing flood incidence across the region, flood tolerant cassava varieties are required. This has been achieved in rice with varieties that can tolerate complete submergence for two weeks, thereby reducing risks. Also, there is need to specifically advocate for yield increase per unit land area, through consistent transfer of improved technologies and good agronomic practices. These efforts when put in place can boost cassava yield from 7 – 12 to 30 – 50 t ha⁻¹ or more, depending on the farmers' investment capacities. Hence, we can maximize the current bilateral trade agreement with China to encourage the export of cassava to China in large quantities. Small and medium enterprises and exporters should be encouraged to meet the requirements of the international market with a detailed plan for market access. Actions should include identifying and promoting key unique selling propositions (USPs) of the Nigerian cassava that would provide a competitive advantage in the market. This could be the taste, colour, quality, price, product packaging, product convenience, etc. that would contribute to building a positive brand perception. Also, improve and maintain products quality, adhering to the identified standards required by the importers. Furthermore, there should be proactive measures to ensure functioning infrastructures and accessible inputs that will minimize cost and enhance productivity. This way, cassava can be processed into more desirable forms, with lesser wastages, better packaging solutions that offer greater flexibility to the buyer. New products should also be developed to offer more options to the buyer, for example, packaged dried leaves and frozen fresh leaves, all-in-one-gari-pack (gari+sugar+milk), fruited gari, etc. Scientists should be encouraged to look into modern biotechnological tools that can be used to modify certain characteristics of cassava cultivars in

order to enhance processing and meet specific product requirements. Priority should be given to funding further research on cassava as there exists the capacity to do much more, and when positive results arise from the research, they should be extended quickly to the farmers and other stakeholders. Moreover, government should enforce the existing policies such as the 10 % cassava flour inclusion as a substitute for wheat flour in bread making and the 10 % ethanol inclusion in petrol. Implement removal of import duties on agricultural machineries and agro-processing equipment and restrict importation of cassava-based products and close substitutes.

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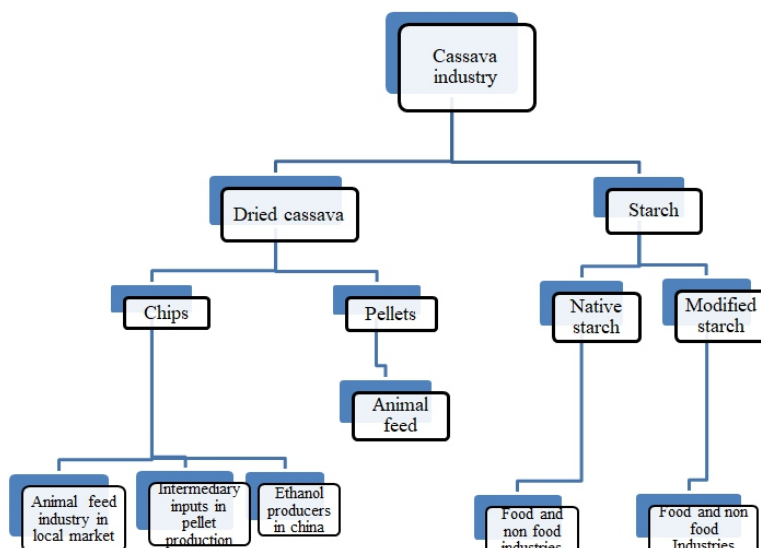


Diagram source: Authors' creation

Fig. 1. Diagrammatic representation of Thailand cassava industry, showing the two major value chains - dried cassava and starch

Table 1: The total number of fresh cassava storage roots (metric tonnes) to meet estimated demand in Nigeria, alongside the land area required, based on 25 t ha⁻¹ fresh storage root yield per unit land area

Cassava derivatives	Cassava storage roots	Land area
Cassava-based adhesives (Starch)	2,000,000	80,000
High Quality Cassava Flour (HQCF)	2,020,000	80,800
Cassava-based constituents in sugar syrup	1,750,000	70,000
Dried chips for export and animal feed	5,600,000	224,000
Fuel-grade Bioethanol	3,571,428	142,857
Ethanol (for industrial uses)	2,857,142	114,286
High quality garri for exports and supplements	12,525,000	501,000
Total	28,323,570	1,212,943

Source: PWC estimates

Table 2: Available starch products and attributes

Type	Starch hydrolysate, native starch, modified starch
Application	Food and beverages, industrial, others
Form	Powder, liquid
Function	Texturizing, binding/adhesion, gelling, stabilizing, thickening, moisture-retention, film forming agents, sizing, coating

Table 3: Top 10 export destinations of cassava from Nigeria with their share in export and export value in USD over a period of 5 years

Country	Export %	Export value				
		2016	2017	2018	2019	2020
China	48.6	-	-	-	-	205.7 ³
United States	22	84.3 ³	27.6 ³	76 ³	7.6 ³	93 ³
Canada	18.6	6.7 ³	9 ³	22.3 ³	20.8 ³	78.5 ³
Netherlands	6.7	15.4 ³	33.6 ³	42.6 ³	47.1 ³	28.3 ³
France	1.3	-	978 ²	4.8 ³	9 ³	5.4 ³
South Africa	0.6	10.1 ³	5 ³	1.3 ³	579 ²	2.4 ³
Sweden	0.4	4.3 ³	-	2 ³	211 ²	1.9 ³
Belgium	0.4	15 ¹	-	833 ²	-	1.7 ³
Germany	0.3	595 ²	23 ¹	297 ²	2.3 ³	1.5 ³
Iceland	0.3	1 ³	1.1 ³	1.8 ³	1.1 ³	1.4 ³

Source: Tridge, 2022

¹in tens, ²in hundreds, ³in thousands