

Full Length Research Paper

Analysis of cassava production and processing by various groups in support of cassava value chain in the south west of Nigeria

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Received 26 February, 2020; Accepted 12 June, 2020

The study aimed to analyse cassava production and processing in the 5 highest cassava producing states in the south west of Nigeria. A multistage sampling procedure was used to select 136 smallholder farmers producing cassava in the study area. Primary data were collected using a structured questionnaire and an interview schedule while the data were analysed using descriptive and inferential statistics. Findings revealed that, within the study area, male headed households dominate (67%), average size of the household is six while the primary occupation of the household head is farming. The average yield per hectare for improved varieties is about 18 tons and that for local varieties is about 10 tons. The average price of a ton of fresh cassava roots (FCR) is US\$55.5. There is no significant relationship between the socioeconomic characteristics of the smallholder farmers and the varieties planted but there is a significant relationship between the varieties grown and the processed products. It is therefore recommended that while farmers continue to grow cassava for local food use, they should plant the improved varieties for increased yield while also targeting markets for industrial uses to improve income from the sale of fresh cassava roots.

Key words: Smallholder farmers, cassava production, processing, value addition.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a perennial vegetatively propagated shrub grown throughout the lowland tropics for its starchy, thickened roots. Global production of cassava amounted to about 278 million metric tons in 2018 out of which Africa's share was put at about 61% (FAOSTAT, 2020).

The world's cassava production has been on the increase from about 240 million metric tons from the year

2010 (Figure 1). In the same period, Nigeria alone produced about 42.5 million metric tons which is estimated to be about 18% of total global production. Nigeria's share of world production had risen to 21.5% of world production by 2018. FAO projects that by the year 2025, about 62% of global cassava production will be from sub-Saharan Africa (FAOSTAT, 2020).

Cassava is an important staple crop in sub-Saharan

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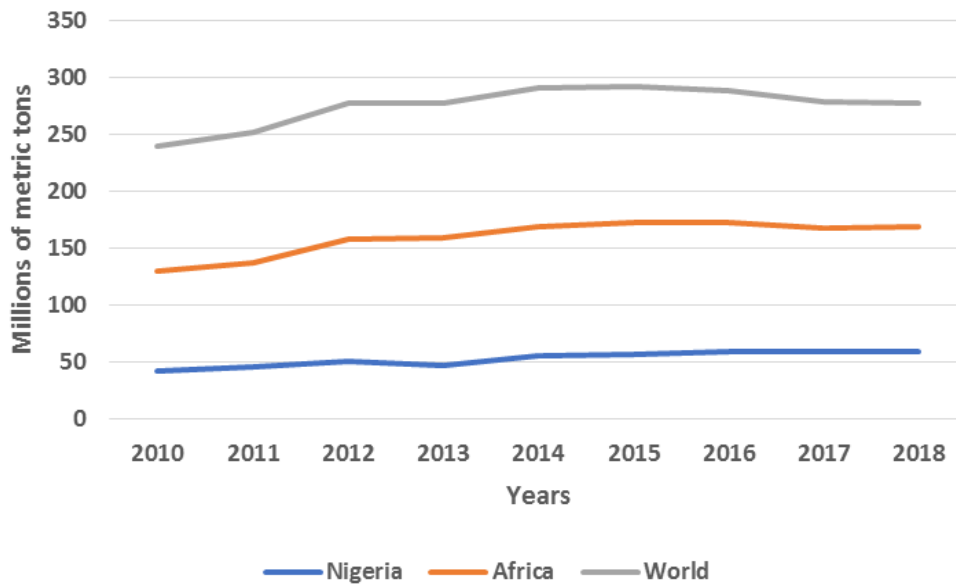


Figure 1. Production of cassava between 2010 and 2018.
Source: FAO (2020).

Africa (SSA). It is Africa's second most important food staple in terms of calories consumed per capita and a major source of calories for roughly two out of every five Africans (IFAD/FAO, 2005; Rosenthal and Ort, 2012).

The growth in cassava production in Nigeria has been primarily due to a number of factors: rapid population growth, large internal market demand complemented by the availability of high yielding improved varieties of cassava. Other factors include a relatively well-developed market access infrastructure, the existence of improved processing technology and a well-organized internal market structure (Nigerian Federal Department of Agriculture, 2007). Another important factor is the location of the International Institute for Tropical Agriculture (IITA) which has its main research station in Ibadan, within the south west of the country, the study area. The Institute conducts research on and releases new varieties of root crops amongst others in sub-Saharan Africa.

The majority (88%) of cassava produced in Africa is used for human food, with over 50% used in the form of processed products (Westby, 1991; Oyewole and Eforuoku, 2019). Other uses in animal feed and for industrial purposes (starch, ethanol) are as yet very minor. Although the crop is considered as a staple in many countries, this situation is changing in some countries where cassava is now an industrial and cash crop (Reincke et al., 2018).

Cassava is produced largely by small-scale farmers using rudimentary implements. The average landholding is less than two hectares and for most farmers, land and family labour remain the essential inputs. Land is held on a communal basis, inherited or rented; cases of outright

purchase of land are rare. Capital is a major limitation in cassava production in the southwest Nigeria; only few farmers have access to rural credit (Oguntuase et al., 2015).

As a food crop, cassava has some inherent characteristics which make it attractive, especially to the smallholder farmers in the south-west of Nigeria. First, it is rich in carbohydrates especially starch and consequently has a multiplicity of end uses. Secondly, it is available all year round, making it preferable to other, more seasonal crops such as grains, peas and beans and other crops for food security. Compared to grains, cassava is more tolerant of low soil fertility and more resistant to drought, pests and diseases. Furthermore, its roots are storable in the ground for months after they mature.

Cassava is usually consumed in processed forms. Cassava processing by traditional methods is labour-intensive but the increasing application of improved processing technology has reduced processing time and labour and encouraged increased production. Industrial utilization of cassava products is increasing but still accounts for less than 5% of the total production (Shittu et al., 2016).

To implement the second phase of the Cassava: Adding Value for Africa (CAVA2) Project, it became necessary to map the production and processing situation of cassava within the study area. This included the scoping of who the smallholder farmers were, which varieties are grown and the yield per hectare and average price of cassava roots. It is on this basis that the study was conducted to analyze the state of cassava production and processing by various groups in south-west Nigeria, the study area.



Figure 2. Map of Nigeria showing the study area.

The specific objectives of the study were to:

- (1) ascertain some selected socio-economic characteristics of the smallholder farmers (SHF) in the study area,
- (2) identify the average yields and varieties grown,
- (3) identify best products from each variety grown by the respondents,
- (4) ascertain the average prices of fresh cassava roots,
- (5) describe the processing methods and products in the study area.

With support from the Bill and Melinda Gates Foundation, the aim of the Cassava Adding Value for Africa Project (CAVA2) was to facilitate increased production (yield) of fresh cassava roots (FCR) and promote alternative uses for the roots through processing. The first phase focussed on increased production and processing into high quality cassava flour (HQCF) for use as a wheat substitute in the bakery industry.

The first phase met its original target of benefitting over 35,000 smallholder farmers (SHFs) across the five countries of Ghana, Malawi, Nigeria, Tanzania and Uganda. The projected income to SHFs was estimated at over US\$33.3 million during the life of the project (Westby and Adebayo, 2014).

The premise of the second phase of the CAVA2 project was that if new markets for fresh cassava roots could be developed and SHFs linked to them at scale, then farmers would adopt new productivity enhancing technologies, increase productivity and increase their incomes. Cassava processing by traditional methods is labour-intensive but the application of improved processing technology has reduced processing time and labour and encouraged further production. The productivity enhancing technologies promoted by the

project included improved agronomic practices and adoption of improved and higher yielding varieties in production and efficient drying technologies for processing.

Hypotheses

- (1) There is no significant relationship between selected socio-economic characteristics of the smallholder farmers and the varieties grown.
- (2) There is no significant relationship between the varieties grown and the processed products.

MATERIALS AND METHODS

Study area

The study area comprised the five main cassava producing areas of Nigeria and covered by the project. They are Ekiti, Ogun, Ondo, Oyo and Osun states. Figure 2 shows the map of Nigeria highlighting these states. The sixth state in the south-west of the country; Lagos, being an industrial state, does not produce any significant amount of cassava.

Sampling methodology

A multi-stage sampling technique was used for the study. The first stage was the purposive selection of five out of the six states in south-west Nigeria.

The second stage was the random selection of a total of 34 villages in the five states as shown in Table 1. The number of villages selected in each state was proportional to the production figures and were amongst those to be aggregated around the cassava Small and Medium Enterprises (SMEs) and large processing factories that were expected to add value to the roots through processing. These SMEs and large factories are sited in close proximity to the source of their main raw material, cassava to

Table 1. Number of villages by states.

State	Number of villages
Ekiti	4
Ogun	6
Ondo	8
Oyo	13
Osun	3

reduce transportation costs and minimise damage to the roots.

Stage 3 was the random selection of four farmers from each village. Therefore, a total of 136 cassava farmers were sampled for the study ($n=136$).

An interview schedule was developed and used to collect information from the respondents. The information comprised socio-economic characteristics, cassava varieties planted and yield obtained, average price per ton of roots sold and uses of cassava roots amongst others. Enumerators were trained while the interview schedule used was pretested to ensure both content and face validity. Based on responses received during the pretesting, some questions were reframed or merged while others were dropped as responses were already captured in the reframed questions.

Data analysis

Data analysis was done using SPSS. Descriptive statistics such as frequency count and percentages while inferential statistics such as Chi-square and z-test were used to determine associations and relationships between variables at $P<0.05$ level of significance.

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

The analysis of the socio-economic characteristics of the respondents shows some interesting results as shown in Table 2. The average size of the household (HH) is 6 (HH is defined as a group of people who usually live and eat together in a dwelling and acknowledge the authority of a single head of household, regardless of whether the latter is living with the HH members or not) while Male Headed (MH) constituted 67% of the sample. Mean age of HH head is 52 years while the mean number of years spent in formal education is 12.

Primary occupation of HH Head is farming followed by civil service. Primary income source is overwhelmingly from cassava root sales followed by maize and yam sales. Other income sources include sale of livestock (chicken and goats). Access to land for cassava cultivation is mostly by renting/borrowing (57%) and inheritance 32%.

The size of HHs helps in farming operations while also reducing the cost of farming and harvesting when the crop matures. SHFs who have higher levels of formal education tend to request more access to extension services and information to improve on their farming

activities (Davis et al., 2019).

Cassava varieties grown and their yields

The most widely grown cassava varieties across the study area are: TMS 30572 and TME 419. These are followed by NR 8082 and NR 8083. While the survey found that all varieties are grown for processing into local foods such as gari, lafun, tapioca, fufu and pupuru, some varieties grown are best for commercial uses because of their higher starch content and quality (IITA, 1990). Table 3 shows the average yield of both the local and the improved varieties grown in the study area. As shown in Table 3, even the average yield per hectare for improved varieties grown across the study area is still low compared to the potential yield (40-45 tons) of released varieties by the IITA (Wossen et al., 2017).

Cassava varieties and their best use products

Starch is the major food reserve of cassava. Fresh cassava root consists of about 21.5% starch (IITA, 1990). As indicated earlier, it is widely used in the food industry and consumed as tapioca and non-food industries such as paper and plywood, textiles and pharmaceuticals.

There are many varieties grown in the study area. Table 4 shows the four main varieties grown by the respondents in each state and their best uses based on the starch content. These varieties (unlike the local ones) contain a minimum of 25% starch content. The higher starch content makes these varieties very good for industrial scale starch production (one of the main products being promoted by the Project). They therefore attract higher prices by processors; the SMEs and large factories. These varieties are also easily converted into high quality cassava flour and ethanol.

Average prices of fresh cassava roots obtained by respondents

The selling price of a ton of FCR varies depending on its starch content, distance from processing site/location, season and how urgently the farmer needs money for personal HH use. Table 5 shows the average prices obtained by the respondents for a ton of FCR in each of the five states of the study area. The average price varies from USD 48.4 in Ekiti State to USD 64.9 in Ogun State. The average price across the study area is USD 55.5. This result confirms the prices obtained by Westby and Adebayo (2014) in which they found that the cost price for a ton of FCR is higher when the farms are located near a processing factory.

The result shows clearly that higher prices were obtained in Ogun State which is primarily a result of the

Table 2. Demographic characteristics of the study respondents.

Selected demographic characteristics	Frequency	Percentage	Mean
Average size of household head	-	-	6
Mean age of household head	-	-	52
Mean number of years spent in formal education by household head	-	-	12
Headship of household			
Male headed household	91	67	-
Female headed household	45	33	-
Occupation			
Primary occupation of household head			
Farming	103	76	-
Secondary occupation of household head			
Civil service	44	32	-
Income source			
Primary income source of household head			
Cassava root sales	68	74	-
Secondary income source of household head			
Livestock sale	32	53	-
Access to land for farming			
Renting/Borrowing	78	57	-
Inheritance	44	32	-

Source: Field Survey Data (2015).

Table 3. Average yield (in tons per hectare) of cassava varieties.

State	Average yield (tons per hectare)	
	Local varieties	Improved varieties
Ekiti	10.5	16.5
Ondo	9	18.9
Oyo	11.5	20
Ogun	8.3	18.0
Osun	9.8	15.2

Source: Field Survey Data (2015).

presence of some big factories utilizing fresh cassava roots in the state. This was closely followed by Oyo and Osun states, respectively. The variation in root prices is a result of a number of factors; in Oyo and Ogun states where the prices are the highest, there are large industrial factories that utilise these roots as their industrial raw material examples include Thai Farms with processing capacity of 4,000 tons of fresh cassava roots/day into high quality cassava flour, Allied Atlantic Distilleries (AADL) with processing capacity of 2,000 tons/day into ethanol. The roots thus have a ready

market and higher prices in these locations. These large factories need large volumes of raw materials and are therefore ready to pay high prices compared to other locations with no large industries ready to buy the fresh roots.

Processing methods and products in the study area

It is interesting to note that in all the five states, the processing methods and the products are similar. This is

Table 4. Varieties grown and best uses within the study area.

State	Varieties most widely planted	Best use
Ekiti	NR 8082	Starch
	NR 8083	Starch
	TME 419	Starch
	TMS 30572	Starch
Ogun	TMS 30572	Starch
	NR 8082	Starch
	TMS 14(2)1425	Starch/Ethanol
	TME 419	Starch
Ondo	TMS 30572	Starch
	TME 419	Starch
	TMS 0581	Starch
	TME 419	Starch
Oyo	TMS 30572	Starch
	TME 419	Starch
	TMS 1632	Starch
	TMS 98/0581	Starch
Osun	TMS 30572	Starch
	TME 419	Starch
	NR 8082	Starch
	TMS 30555	Starch

Source: Field Survey Data (2015).

Table 5. Average price of fresh cassava roots by state

State	Average price/ton (USD)
Ekiti	48.4
Ondo	51.5
Oyo	58.7
Ogun	64.9
Osun	53.8

Source: Field Survey Data (2015).

not unconnected with the fact the five states have almost the same culture and thereby prepare food in the same way. Another interesting result about the method of processing is that the old method as reported by Westby (1991), Oluwole and Adio (2013) and Doportto et al. (2012) are still very much in use by many households as described in Figure 3.

Cassava roots are highly perishable due to the high moisture content at harvest. Processing adds value to the roots through conversion into other products of varying economic value apart from the advantage of preservation.

Primary processing of cassava roots involves physical modification to achieve either root preservation, enhanced handling or storage stability. Such products are either consumed by humans or animals or used as raw materials in some other processing applications. These include mainly chips (dried and boiled), flours and starch (Shittu et al., 2016). As shown in Figure 3, the eight basic steps involved in processing of cassava roots are as follow:

Step 1: Root washing: mainly to remove the adhering dirt and sand particles from the root surface.

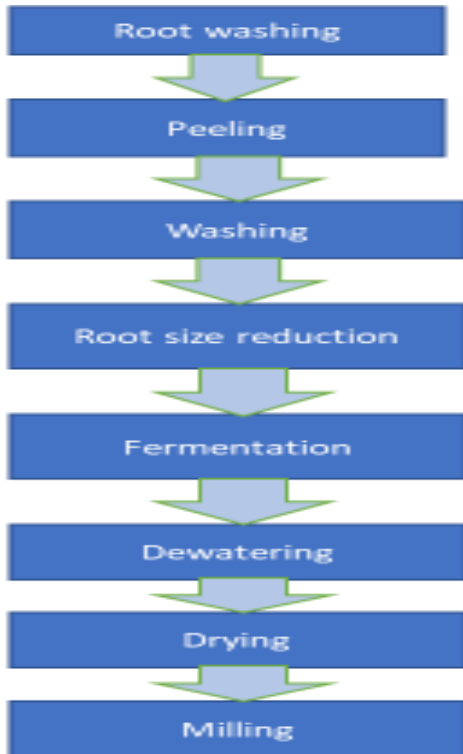


Figure 3. Cassava processing steps.
Source: Field Survey (2015).

Step 2: Peeling: to separate the skin from the flesh.

Step 3: Washing: to further clean the peeled roots.

Step 4: Root size reduction: chipping, chunking or grating to increase surface area and quicken drying of the resultant wet mash.

Step 5: Fermentation for 3-5 days to reduce the cyanogenic potential which is a critical quality factor for both trade and utilization purposes.

Step 6: Dewatering or pressing to remove the excess water from the wet mash.

Step 7: Sun or mechanical drying to reduce the water content to below 12%.

Step 8: Milling to fine particles (cassava flour) or if process is completed withing 24 hours, high quality cassava flour.

These steps are in line with the findings of Westby (1991), Oluwole and Adio (2013) and Doporto et al. (2012) who all found that higher quality products are obtained when all of these steps are followed in processing roots. Products from these steps also attract higher market prices.

The products from cassava roots fall into two broad categories: traditional and industrial as shown in Table 6. Table 6 also shows the percentage number of HHs either selling into or producing these products. Traditional products are widely produced in every part of the study area. These form the bulk of daily basic carbohydrate

intake of the majority of the population in this area. Traditional products therefore constitute a huge market for the cassava producing SHFs.

The objective of CAVA2 was to encourage the farmers to add value to their cassava crops through processing into industrial uses or selling into large factories which process the roots into these products. As can be seen from the Table 6, the percentages of HHs selling into industrial products are generally lower than those selling into traditional uses. Adebayo (2016) reported that out of a total of 181,256 tons of fresh cassava roots produced in the Project coverage area, 54,377 tons (30%) went into traditional food production with the rest being sold into the industrial uses.

Test of hypotheses

Hypothesis 1

There is no significant relationship between the socio-economic characteristics of the smallholder farmers and the varieties grown.

It was found that there was no significant relationship between all the selected socio-economic characteristics (headship of household, occupation of household head, income source of household head and respondents' access to land) of the smallholders and the varieties grown ($\chi^2=0.196$, $\chi^2=2.24$, $\chi^2=4.90$, $\chi^2=2.19$, $p=0.05$), respectively.

The socio-economic characteristics of the small holder farmers have no influence on the varieties of cassava that they grow. This is because smallholder farmers usually grow whatever cassava varieties that are readily available especially when they grow for home consumption unless they are targeting a particular end product market.

When interviewed, smallholder farmers indicated that they obtain their planting materials from left over stalks from previous season (45%), family/friends (22%), purchase from extension agents (18%), community member (10%) and others (7%) (Table 7).

Hypothesis 2

There is no significant relationship between the varieties grown and the processed products.

Table 8 shows that there was a significant relationship between the varieties grown and the processed products ($z=772.01$, $p<0.05$). The implication is that the processed products are influenced by the varieties of cassava grown. This is not unexpected. Value addition to cassava roots increases the income from sale of root products (Oyewole and Oforuoku, 2019).

For example, while the average price of a ton of roots was US \$55.5 across the five states, the average prices

Table 6. Percentage of households selling into cassava roots products.

Traditional		Industrial	
Product	% of HHs producing/selling into value chain	Product	% of HHs selling into value chain
Gari	100	High quality cassava flour	28
Lafun	72	Starch	37
Pupuru	12	Ethanol	18
Tapioca	43	Odourless fufu	32
Wet fufu	62	Animal feed	10

Source: Field Survey Data (2015).

Table 7. Level of association between selected socio-economic characteristics and varieties grown.

Variable	Chi-square value χ^2	p- value
Headship of household	0.196	0.658
Occupation of household head	2.24	0.004
Income source of household head	4.90	2.97
Respondents' access to land	2.19	0.138

P<0.05 level of significance.

Table 8. Relationship between cassava varieties grown and processed products.

Variable	z-test score value	p-value
Cassava varieties grown	-772.01	0.05

of these processed products: high quality cassava flour, starch and ethanol were US \$816.5, 684.8 and US \$709.4, respectively (Adebayo, 2016).

Conclusion

Smallholder farmers still plant local varieties which yield significantly less than the widely available improved varieties. Farmers continue to plant the local varieties for home consumption. Continued planting of local varieties is understandable as the farmers are risk averse and would want to ensure the household food security.

RECOMMENDATIONS

Farmers can increase their income from sale of fresh cassava roots by planting improved varieties that are proven to be disease tolerant and higher yielding. These improved varieties have a higher starch content and attract higher price premium from processors.

It is therefore, recommended that smallholder farmers adopt the planting of improved varieties and the

associated good agronomic practices to increase their yield within the same farm size. In addition, farmers should add value to their cassava through processing into other forms that have higher gross margins and also target specific products in the choice of which varieties planted.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENT

The authors are immensely grateful to the Bill and Melinda Gates Foundation for the funding of the CAVA2 Project.

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