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ADOPTION OF CASSAVA PROCESSING TECHNOLOGIES AMONG ENTREPRENEURS IN EKITI STATE, NIGERIA

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ABSTRACT

Cassava products are among the cheap processed foods that are available, accessible and affordable by the majority of households in the developing countries including Nigeria. Therefore, this study assessed the adoption of cassava processing technologies among entrepreneurs in Ekiti State, Nigeria. However, the technologies for the processing are largely inadequate. Personal interview and 200 well-structured questionnaires were distributed among the cassava processors. Multistage sampling technique was used to randomly select 180 cassava processors and these were analysed using descriptive statistics and multiple regression model. The results showed that the cassava processing business was dominated by female households (70.4%) with an average age of 48 years. Majority (89.6%) of them were married with at most secondary school education (85.0%) and an average of 8 persons per household. The results also showed that cassava processing business were profitable in the area. It revealed that gari, lafun, fufu, pupuru, starch and tapioca were the main consumable products from cassava tubers in the area. Sieve, miller, peeler, hydraulic press, grater and dryer were the most commonly used equipment for processing cassava tubers into other forms. The results of multiple regression showed that age of the processors, processing experience, family size, education, total cost of processing and quantity of cassava tubers processed were the factors significantly affecting numbers of technologies adopted in the study area. Therefore, Government should make the environment conducive for the processors and help researchers to improve on the technologies and come up with affordable technologies.

Key words: Adoption, cassava, equipment, multiple regression, technologies

INTRODUCTION

Cassava is one of the major staple foods that can be processed to various products. Its vast uses have called for a drastic increase in the cultivation and production of cassava tubers in most part of the world most especially in developing countries such as Nigeria. Cassava is either eaten raw or turned to different processed forms that are largely consumed. Its uses in the industry and livestock feed, are well known, but are gradually increasing, in the industrial sector of the economy. As cash crops, cassava generates cash income for the largest number of

households in comparison with other staples (Nweke, 1994; Ijigbade *et al*., 2014). Cassava (*Manihot spp*) is an important subsistence food crop in the semi-arid areas and sometimes considered as famine reserve when cereals fail due to its drought tolerance and the root can readily be stored under the ground for a long period of time (Kapinga *et al.,* 2005). It has the ability to grow on marginal land where other food crops cannot grow well. Again, for high yield and productivity, moderate climatic condition and best soil properties like a light, sandy loam soil of medium fertility and good aerations or drainage are all crucial (Akanbi and Olabode, 2004; Ezekiel *et al*., 2012).

Furthermore, cassava production plays a key role in alleviating poverty in Nigeria, as it is virtually impossible that an average household will not consume cassava product in a day (Ayoade, 2012). This high demand generates employment. Therefore, cassava is an important factor in food security, poverty alleviation, rural – urban drift and reducing unemployment among others (Okpukpara, 2006). According to UNDP (2004), most of the rural population depends directly and indirectly on small – scale food production and processed products from the food crops. Therefore, processing activities have been a major occupation in the rural and urban areas which they see as a form of business that generate income for livelihood sustaining their livelihood. This has in turn served as a way of reducing poverty.

According to Oni (2006), cassava processing equipment is by far more widespread in the country than any other agricultural implements. Cassava roots are processed by a variety of methods into different products according to local customs and preferences.

Processing has been an integral part of cassava utilization because of the crop's poor storability and the need to reduce, if not eliminate the toxic substance that make it unfit for consumption (Ehinmowo and Fatuase, 2016). Turning cassava tubers into different forms using technologies requires different equipment and methods. Most of the technological methods for a particular product depends on the preference of the processor and the utility derived from using the technology. The adoption and utilization of these technologies now depend on the factors such as accessibility, availability and affordability by the processors.

Again, a wide range of social-economic, physical and technical characteristics of the processors influences the adoption of the technologies. This study therefore assessed the adoption of cassava processing technologies among entrepreneurs in Ekiti State, Nigeria. Ekiti State is one of the prominent cassava producers in Nigeria. The area has favourable climatic conditions for cassava production with good soil that supports optimum production of cassava. As a result of this, the area has attracted a good number of cassava processors. Cassava products are constantly available in the area and formed one of the major staple food popularly consumed in Ekiti State. It is on this note that the study specifically looks into the socio-economic characteristics of the respondents with their level of performance, identify main processed products from cassava tubers, examine different technologies adopted for processing cassava tubers, and estimate factors affecting the number of technologies adopted by the processors in the study area.

RESEARCH METHODOLOGY

Study Area

The study was carried out in Ekiti State, Nigeria. The State is one of the thirty six States constituting the Federal Republic of Nigeria. Ekiti State is made up of 16 Local Government Areas (LGAs). The State covers a land area of 5,435sq km with a population of 2.4 million (NBS, 2011). The State is situated entirely within the tropics and located between longitude 4° 5' and 5° 45' East of the Greenwich meridian and latitude 7° 15' and 8° 5' North of the equator. It is found to the South of Kwara and Kogi States, East of Osun State and bounded by Ondo State in the East and in the south (EKSG, 2010). The State enjoys a tropical climate with two distinct seasons: the raining season (April-October) and the dry season (November- March). Temperature ranges between 21°C and 28°C with a high humidity. Tropical forest exists in the south while savannah occupies the northern peripheries (EKSG, 2010).The State is largely agrarian as agriculture is the mainstay of the State economy. It employs 75% of the State's working population. The State is one of the largest producers of rice, kolanut, oil palm and cocoa in the country. It also produce crops like cassava, yam, cocoyam, maize, cowpea, citrus, plantain and fruits like cashew, mango and orange. The State is endowed with mineral deposits of value like Clay, Kaolin, Columbite, Cassiterite, Foundry Sand, Bauxite, Clarcomite and Charcoalnite Granite.

Method and Source of Data Collection

Primary data were used for this study. Primary data were collected through personal interview and structured questionnaire to obtain pertinent information that addresses the stated objectives. This study randomly administered questionnaire to 200 respondents.

Sampling Technique and Sample Size

Multistage sampling technique was used for the random selection of respondents in the agricultural zones in the State. In stage one, cluster sampling technique was used to disaggregate the State into three Agricultural Development Programme (ADP) zones, which are: Ekiti Central, Ekiti North and Ekiti South.In the second stage, simple random sampling was used to select Ado LGA in Ekiti Central ADP zone, Ikole LGA in Ekiti North ADP zone and Ekiti East LGA in Ekiti South ADP zone. The third stage was random sampling of four communities from each of these LGAs making a total of 12 communities. Lastly, fifteen (15) cassava processors were randomly selected from each community to make a total of 180 respondents.

Data Analytical Tools

Descriptive statistics such as mean, standard deviation, frequency distribution and percentage were used to describe the socioeconomic characteristics and performance of the cassava processors in the study area; identify the main cassava processed products and different technologies for processing cassava products. Again, multiple regression model was used to determine factors affecting the number of technologies adopted by the processors.

Model Specification

The model was used to examine the factors affecting the number of technologies adopted by the processors in the study area. The socio-economic characteristics and cost factors were used as explanatory variables that explain the number of technologies adopted by the respondents. The multiple regression

function postulated for this study is:

Implicit function, $Y = f\left(X_1, X_2, ...X_{11}, U_i\right)$
Explicit function,

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + U_i$$

Where;
Y = Number of technologies adopted by the ith processors,
X_1 = Age of the processor (in years)
X_2 = Gender of the processor
X_3 = Level of education (in category)
X_4 = Access to credit (Dummy, Yes = 1, No = 0)
X_5 = Quantity of cassava processed (kg) per trip
X_6 = Years of processing experience (years)
X_7 = Depreciation costs on fixed input (N)
X_8 = Cost of variable inputs (N)
X_9 = Marital status (Dummy, married = 1, not married = 0)
X_{10} = Location (Dummy, rural = 1, urban = 2)
X_{11} = Family size (number)
U_i = error term, and is normally distributed with zero mean and constant variance

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Cassava Processors in the Area

The results in Table 1 presents the summary of the variables used for this study and socioeconomic characteristics of the cassava processors in the study area. Majority (60.0%) of the respondents were between 39 and 49 years old with an average of 48years. This implies that most of the cassava processors in the study area are still agile, active and productive economically to effectively and efficiently carry out processing activities. The enterprise is dominated by female processors and about 74.1% of them had household size between 1 and 10 persons per house with a mean of 8 persons. The result is similar to the findings of Udensi *et al*. (2011) who opined that the likely differential adoption based on gender can be explained by the fact that women are more involved in cassava processing than men. Most (85.0%) of the cassava processors had at most secondary school education with an average years of processing experience of nearly 30 years. It was observed that many of the respondents were born into the business and it also has served as a family business in the area. Ehinmowo and Fatuase (2016) found out in their studies carried out in Southwest, Nigeria that majority (74%) of the entrepreneur were under 50 years and 80% were married with an average age of 43 years. Again, the level of accessing credit and the services of extension agents is very low in the study area, in which just 15.2% and 31.4% had access to credit and extension agents respectively. Majority (89.2%) of the sampled respondents were from rural location where the processing is carried out. The probable reason was as a result of closeness to the raw materials which is the cassava tubers.

Table 1: Summary Statistics of the Socio-economic and Processing Characteristics of the Respondents

Variables	Majority	Mean	Standard deviation	Minimum	Maximum
Age (years)	30 – 49 (60.0%)	48.2	23.3	28	69
Family size	1 – 10 (74.1%)	8.24	5.1	1	18
Sex	Female (70.4%)	-	-	0 (female)	1 (male)
Marital status	Married (89.6%)	-	-	0 (single)	1 (married)
Educational level	At most secondary school education (85.0%)		-	1 (no formal education)	4 (tertiary education)
Experience	11 – 30 (56.3%)	29.9	14.2	1	48
Access to credit	Access (15.2%)	-	-	0 (no access)	1 (access)
Access to extension agent	Access (31.4%)	-	-	0 (no access)	1 (access)
Location	Rural (89.2%)	-	-	0 (rural)	1 (urban)

Profitability Measures Associated with of the Cassava Processing in the Area

Again, based on the information on the costs and returns from processed cassava, the profit and gross margin were estimated for the sampled respondents. It is observed in Table 2 that about N208,425.10 (28.6%) of the total cost accounted for raw materials, while N105,000.00 (14.4%) accounted for labour employed in processing cassava tubers in the area. It was observed that N279,210.00 (38.3%) and N450,556.10 (61.7%) were fixed and variable costs respectively. The total revenue accrued from the average quantity processed (89.7 tons per annum) was N842,109.09. The gross margin is the difference between the total revenue and the total variable costs incurred by the processors, while the profit is the difference between total revenue and total cost (fixed plus variable costs). Therefore, the results of gross margin and profit with values of N391,552.99 and N112,342.99 respectively showed that the cassava processing is a profitable venture since both showed a positive value. The findings of this study corroborate the findings of Ijigbade *et al*. (2014) who affirmed that gari production was a profitable enterprise given a gross margin and profit of N24,582.18 and N16,582.18 per gari processing cycle respectively. Again, the value of Return on Investment (ROI) of 1.15 implies that cassava processing will realize N1.15 on each naira expended. Again, production efficiency of over 15.4% further confirmed that cassava processing is a highly profitable venture in the study area. *Ceteris paribus*, processors should be able to pay back loans even at commercial bank interest rate of at least 13% per annum. All these profitability measures confirmed and reiterated the profitability of cassava processing in the area.

Table 2: Costs and Returns Associated with Cassava Processing in the Area

Items	Mean (N)	Percentage (%)
Fixed Input		
Depreciation cost on sieve	15,670.00	2.15
Depreciation cost on skillet	22,900.00	3.14
Depreciation cost on grater	46,900.00	6.43
Depreciation cost on fryers	33,589.00	4.60
Depreciation cost on grinder	53,900.19	7.39
Depreciation cost on dryer	24,500.00	3.36
Depreciation cost on fermentation tank	48,200.00	6.60
Depreciation on other equipment	33,550.81	4.60
Total Fixed Cost (TFC)	279,210.00	38.26
Variable Input		
Cost of labour	105,000.00	14.39
Cost of raw materials	208,425.10	28.56
Cost of peeling	15,960.00	2.19
Cost of milling	54,070.00	7.41
Cost of pelletizing	15,890.00	2.18
Cost of maintenance	51,211.00	7.02
Total Variable cost (TVC)	450,556.10	61.74
Total Cost of production (TCP) = TFC + TVC	729,766.10	100.00
Total Revenue (TR)	842,109.09	
Gross margin = TR – TVC	391,552.99	
Profit = TR – TCP	112,342.99	
% profit or PE = (profit/TCP)*100	15.39	
ROI = TR/TCP	1.15	

ROI = Return on Investment; PE = Production Efficiency

Main Cassava Processed Products in the Area

Table 3 shows that the main processed cassava products in the study area. It was revealed that gari is the most (87.8%) product processed from cassava tubers in the area. Gari is granular flour processed from cassava tubers and it can be processed into forms which include: white and yellow gari. Nearly 68.9% of the respondents processed cassava tubers into flours popularly known as "lafun". This is a powdered form of cassava tubers after it has been dried and milled. It also contains some granular particles. About 61% of the sampled respondents processed cassava tubers into "fufu" in the area. Fufu is a fermented wet-paste processed from cassava tubers. Again, 45.0% of them processed cassava tubers into "pupuru" and this is also in powdered form but more finer than the flour form of cassava tubers. Nearly 44% of the sampled respondents turned cassava tubers into starch. Starch is a fine pulp form normally used in both home and industry. Some (34%) of the respondents processed cassava tubers into

animal feeds in the area, while 14% of them processed cassava tubers into tapioca. Tapioca is a form of processed cassava tubers that appears like flakes or irregular shaped granules.

Table 3: Main Processed Products from Cassava Tuber in the Area

Products	Frequency	Percentage
Gari	158	87.8
Fufu	124	61.1
Lafun	110	68.9
Pupuru	81	45.0
Starch	79	43.9
Tapioca	25	13.9
Animal feeds	61	33.9

Note: Multiple choices allowed

Different Improved Technologies for Processing Cassava Tuber into Products

The common equipment used in the processing of cassava tubers into different consumable forms were sourced from Philip *et al*. (2005) and Ijigbade *et al*. (2014). This was listed for the processors to choose as applicable in processing cassava tubers into their desired forms. Therefore, Table 4 presents the percentage of the number of technologies adopted in processing cassava tubers into main products which include: gari, fufu, lafun (flour), pupuru, starch, tapioca and animal feeds. It is revealed from Table 4 that sieve, miller, peeler, hydraulic press, grater, fermentation tank and dryers were very relevant in turning cassava tubers into other consumable forms, while fryer, grinder and pelletizer were specifically made for some products like gari, lafun, pupuru and animal feeds.

Again, the other equipment was sparingly adopted and they are: slicer, soaker, shredder, immersor, crusher, extractor, pulper, sedimentor, washer and so on. Many of the sampled processors were not aware of the technologies, while some were not available, accessible and affordable to the processors. From the observations from the field survey, it was noted that some of the processors were limited financially to acquire these tools and some needed electricity to operate which was epileptic in the study area. The respondents also complained on the cost of fuel most especially with the recent hike in the cost of fuel. The results of this study were in one way or other similar to the findings of Osuji (1983), Philip *et al*. (2005), Ijigbade *et al*. (2014) and Ehinmowo & Fatuase (2016) who opined that cassava processors adopted different technologies in processing cassava tubers into other forms in Eastern Nigeria, Nigeria, Ondo State and Southwest, Nigeria respectively in their studies. It further revealed that 67% of the women entrepreneur adopted improved technologies with cassava mechanical grater being the most used improved technology while the factors affecting adoption of the technologies were educational status, source of information, credit and raw material.

Table 4: Percentage (%) Number of Technologies Adopted by the Processors of Cassava tubers in the Area

Technologies	Gari	Fufu	Lafun	Pupuru	Starch	Tapioca	Animal feeds
Sieve	93.7	83.1	87.9	74.3	94.3	90.0	7.3
Skillet	97.4	-	-	45.7	-	14.7	-
Miller	100.0	92.1	78.9	64.1	87.2	81.4	67.8
Peeler	98.0	96.1	98.0	98.0	78.2	97.3	56.7
Hydraulic press	91.6	91.6	92.1	93.4	69.4	81.4	6.1
Grater	100.0	98.1	10.1	49.6	71.2	84.1	-
Fryers	100.0	-	-	43.1	-	89.1	-
Grinder	-	-	89.7	92.4	-	93.1	59.1
Hammer mill	79.2	51.3	49.2	61.7	52.1	63.4	50.7
Fermentation tank	52.1	70.2	14.3	72.1	79.2	54.3	2.6
Dryer	10.5	98.1	99.5	91.4	91.2	98.3	89.1
Pelletizer	-	-	-	-	-	-	100.0
Others	11.3	14.7	10.0	-	21.0	10.0	40.0

Factors Affecting the Number of Technologies Adopted by the Processors

The factors affecting the numbers of technologies adopted by the cassava processors in turning cassava tubers into different products were examined using multiple regression model as presented in Table 5. Given the value of R^2 of 0.9983, it implies that about 99.8% of the variations that occurs in the number of technologies adopted were accounted for by the explanatory variables. The results further showed that out of eleven variables considered for this model, seven of them were statistically significant in addressing the variations in the numbers of technologies adopted for the processing of cassava tubers into other food forms.

The coefficients of age and sex had negative relationship with the numbers of technologies adopted, while other variables had positive association with the dependent variable. Age of the processor was statistically significant in influencing the number of technologies adopted. This implies that a unit increase in the age of the processor will decrease the number of technologies adopted in processing cassava tubers by 19.4%. The probable reason is that aged processors might find it hard to handle some of the equipment because of the energy required to operate the machines and technologies know how.

Again, years of processing experience was also significant in affecting the number of technologies adopted in the processing of cassava tubers into products. This implies that a unit increase in the years of processing experience will increase the number of technology adopted by 2.8 units. The years of experience will increase the knowledge and understanding of processing and this might call for the use of different equipment to achieve the task if the equipment performs the task better or faster than the other.

Family size was also had positive coefficient and significantly affect the number of tech-

nologies adopted for processing cassava tubers into other consumable forms in the area. It implies that an additional household size will increase the number of technologies adopted in the processing of cassava tubers by 5.8 units. Increased in family size has been noted for a source of family labour. This will help the processors to have more equipment that the able family members can as well handle for processing cassava tubers. This result disagreed with the findings of Udensi *et al.* (2011) who reported that household size were negatively and significantly related to adoption of cassava technologies in their study carried out in South-Eastern Nigeria.

Educational level of the processors is very germane in the processing ventures. This showed a positive coefficient and statistically significant at 5% level in affecting the number of technologies adopted by the processors. It means that an additional educational qualification will increase the number of technologies adopted for processing cassava tubers in the area by 42.9%. It can be deduced that educated processors will process better with improved technologies vis-à-vis accrue more revenue than uneducated counterpart in the area. The result was in support of Ijigbade *et al.* (2014) that was carried out among gari processors in Ondo State, in which educational status was statistically significant in affecting adoption of gari processing technologies in the area.

The coefficient of depreciation costs on fixed items was positive and statistically significant in addressing number of technologies adopted in the area at 1% level of probability. It means that a unit increase in the cost of fixed items will increase the number of technologies adopted by 10 units for the processing of cassava tubers into other forms. It can be deduced that since most of the technologies adopted for processing cassava tubers are fixed inputs, this will increase the number and as well the assets of the processors in the area.

Cost of variable items had positive and significant effect in adopting technologies for processing cassava tubers. It means that a unit increase in the cost of variable items will increase number of technologies adopted, while the quantity of cassava processed influence the number of technologies adopted for the processing of cassava tubers into different forms. This implies that a unit increase in their values will increase numbers of technologies adopted in the study area. The result agreed with Udensi *et al*. (2011) who stated that cassava yield and average income had a positive relationship with the adoption of the improved technologies in the study area.

Table 5: Results Factors Affecting the Number of Technologies Adopted by the Processors using Multiple Regression

Variable	Coefficients	Standard error	z-value	p-value
Age	-0.1936***	0.0554	-3.49	0.000
Experience	2.7769***	0.6615	4.20	0.000
Marital Status	0.1031	0.1949	0.53	0.597
Family size	5.8297***	1.3556	4.30	0.000
Access to credit	0.2113	0.2212	0.96	0.339

Location	0.1110	0.1335	0.83	0.406
Education	0.4291**	0.1766	2.43	0.015
Sex	-0.1476	0.6985	-0.21	0.833
Depreciation cost on fixed inputs	10.3392***	2.5697	4.02	0.000
Cost of variable items	1.46e-06*	7.64e-07	1.91	0.056
Quantity of cassava processed	2.34e-06*	1.24e-06	1.74	0.082
R^2	0.9983			
Adjusted R^2	0.9980			

For significant level:
*** means 1%
** means 5%
* means 10%
Straight line method of depreciation was used.
Cost price – salvage value divided by number of years.
But since we can't estimate salvage value practically, we used:
Cost Price / number of years.

CONCLUSION AND RECOMMENDATIONS

It was found from the study that cassava tubers are processed into various products like gari, fufu, lafun, pupuru, starch, tapioca and animal feeds which were very germane in sustaining food security in the study area. The business is dominated with economic and productive married female households with a fair level of education. It was also affirmed that the business is profitable and serves as a good source of income for livelihoods in the area. Different equipment s like sieve, skillet, miller, peeler, hydraulic press, grater, fryers, grinder, hammer mill, fermentation tank, dryer, pelletizer and others were used in processing cassava tubers into products but most of the processors are constraint in adopting some of the technologies. Factors like age of the processors, processing experience, family size, education, total cost of processing and quantity of cassava tubers processed were statistically significant in addressing the numbers of technologies adopted by the cassava processors in the study area. Therefore, it is recommended that government should encourage the women and youth in the business by providing incentives such as credit facilities and good infrastructure. This will generate more jobs and income to the people. Government should also encourage educated people to go into the enterprise and educate the processors on modern ways of processing cassava through extension agents. The equipment and tools used by the processors should be subsidized for affordability and thereby improve and increase the quantity of cassava products for consumption in the area.

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