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IMPACT OF ADOPTION OF CASSAVA VALUE ADDED TECHNOLOGIES ON WOMEN CASSAVA FARMERS WELFARE IN ABIA STATE, NIGERIA

BY

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Abstract
This study analyzed effect of adoption of cassava value added technologies on welfare of women cassava farmers in Abia state, Nigeria. Structured questionnaire was administered on 270 respondents selected using multistage random sampling. Data were analyzed using descriptive statistics, adoption scale analysis, z-test, and multiple regression model. Result showed that mean age and cassava farm size of the respondents were 48.54 years and 0.42 hectare respectively. About 65.93% of them were married, with as much as 81.11% attaining diverse levels of formal education. Meanwhile, 54.44% and 46.67% of them obtained information on cassava value addition technologies from Agricultural Development Programme and National Root Crop Research Institute, Umudike respectively. Cassava value added technologies such as garri ($\bar{X}$ = 4.30), cassava fufu ($\bar{X}$ = 3.66), high quality cassava flour ($\bar{X}$= 3.02), cassava chips ($\bar{X}$ = 3.18) and fermented flour ($\bar{X}$ = 3.01) were adopted by the women farmers. Also, adoption of cassava value added technologies impacted positively on income and expenditure level of the women farmers. Results of the multiple regression analysis using linear functional form as lead equation showed that age, education level, marital status, extension contact, processing cost, annual income, group membership, access to credit and quantity of cassava produced influenced adoption of cassava value added technologies. Major constraints associated with the adoption were inadequate capital ($\bar{X}$= 2.13), lack of market ($\bar{X}$= 2.11), low access to credit ($\bar{X}$= 2.10), inadequate knowledge of technologies ($\bar{X}$ = 2.03), high cost of equipment/facilities ($\bar{X}$ = 2.02) and scarcity of labour ($\bar{X}$= 2.00). It was recommended that training on cassava value added technologies and provision of credit facilities to women cassava farmers should be intensified. This will enable them adopt value added technologies and improve their welfare.

***Keywords**: Adoption, cassava, value added technologies, women farmers*

INTRODUCTION

Cassava (*Manihot species*) is the most popular and widely cultivated crop in Nigeria in terms of area planted and total number of farmers involved in its cultivation (Ebewore and Okedo-Okojie, 2016; Oyelere, 2020). Nigeria produces over 54 million metric tons (MT) of cassava per annum (FAOSTAT, 2021), making her the highest cassava producer in the world, producing about a third more than Brazil and almost double the production capacity of Thailand and Indonesia. Cassava production in other African countries who are also major producers pales in comparison to Nigeria's substantial output (Chukwuji, 2008). In Nigeria, cassava is an important source of dietary carbohydrate, and provides calories daily for over 60 million people (Ebewore and Okedo-Okojie, 2016). However, A major limitation of cassava is the rapid post harvest deterioration of its roots, which usually prevents their storage in fresh state for more than a few days (Nneoyi *et al*., 2008). As a result, value needs to be added to cassava roots in order to increase the shelf life and help produce various forms of cassava products.

Value added technologies are the processes of changing or transforming a product from its original state to a more valuable state (Mmasa, 2013). It is the act of adding value to a product with the view of improving certain characteristics

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(FAO, 2011). Cassava value added technologies helps to reduce bulk and improve product quality. It facilitates transportation and marketing, reduce cyanide content and improve palatability of the product (Odebode, 2008). Cassava value addition makes it possible for the availability of food in different forms appeasing to the eyes of consumers, gives good taste to the product and also ensures that consumers are left with choices to make (Puja, 2008). The need to add value to cassava is made more imperative by the global demand for cassava and its products, which competes with local demand (Agbarevo and Okeke-Sam, 2015).

Value addition to cassava involves undertaking one or more of the following activities; washing, sorting, packing, weighing and storage. The major processed forms of cassava based products fall into four general categories; meal, flour, chips and starch which can be summarized in three levels that are: Level 1 - Post-harvest level/primary processing includes proper cleaning, sorting, grading and packing of raw cassava for sale. This is the most common type of value addition practiced by farmers. Level 2 – Secondary/basic processing involves steaming and boiling cassava roots. In addition it takes the form of grinding cassava into flour and packaging the flour into different sizes. Level 3 – which is the high end processing involves activities such as frying sliced roots to obtain noodles, candy and desserts (Lebot, 2009). It also involves baking of bread, buns, dried flakes, biscuits, cooked slices, cakes and frying of doughnuts. This level also involves actual packaging of processed cassava products, branding, and marketing. The Intermediate products of cassava such as flour, paste and puree are produced by the food industry in developed countries and used as export commodity (Ramanatha *et al*., 2010). These value additions to cassava create wider opportunity for cassava accessibility to consumers, because they have more diverse spread of options for consuming cassava and significantly reduce post-harvest losses (Okeke *et al*., 2009).

National Root Crop Research Institute (NRCRI) Umudike, has developed several cassava value added technologies aimed at addressing the high perishability of cassava tuber and meet rise in consumers demand. According to Aniedu *et al.*(2012), these emerged as a result of rising demand for making cassava products available in more widely and readily useable forms. The development of diverse value added technologies for cassava is timely, appropriate and vital in the current effort to curb hunger, poverty and social conflict in Nigeria. NRCRI have trained and re-trained rural women on cassava value added technologies in South East Nigeria and beyond, with the purpose of promoting new and improved forms of processing, utilization and packaging of cassava for sustainable food production, income generation, increased source of food vitamins and possible foreign exchange earnings in the country (Oti and Aniedu, 2011; Nwakor *et al*, 2011).

Anyiro and Onyemachi (2014); and Aniedu (2014) noted that encouraging women cassava farmers to adopt value addition technologies in their production chain could enable them limit post-harvest losses and maximize the economic potentials of the crop. Adoption of value addition technology refers to the acceptance and consistent utilization of innovations pertaining to processing farm products into various forms (Kassal, 2000; Oyemade, 2003; Oladele and Adu, 2003). Value added products that can be made from cassava roots by women cassava farmers include garri, fufu, tapioca, chips, pellets, flour, alcohol, starch and high quality cassava flour (HQCF) (Adebayo, 2009). Onuekwusi *et al.* (2017) noted that the adoption of value addition technologies could lead to significant increase in income and living standard of women farmers in developing countries such as Nigeria.

However, it had been noted that constraints such as weak agricultural research, high cost of technology, poor extension linkage with farmers, inaccessibility of necessary financing, illiteracy of farmers, and poor development of agricultural input and extension services impedes adoption of innovations in Nigeria agriculture (Nwosu, 2005; Agbarevo and Okeke-Sam, 2015). These problems could hamper impact of cassava value added technologies on livelihood outcomes of women farmers. In the light of the foregoing, the study seeks to: (i) describe socio-economic characteristics of women cassava farmers in Abia State; (ii) identify sources of information on cassava value added technologies to women cassava farmers in the study area; (iii) determine level of adoption of cassava value added technologies by women cassava farmers in the study area; (iv) determine impact of adoption of cassava value added technologies on welfare (income and expenditure level) of women cassava farmers in the study area; (v) determine factors that influence adoption of cassava value added technologies by women cassava farmers in the study area; and (vi) identify problems that militate against adoption of cassava value added technologies by women cassava farmers in the study area.

Hypotheses

HO_1: Adoption of cassava value added technologies has no significant effect on income and expenditure level of women cassava farmers in the study area.

HO_2: Adoption of cassava value added technologies by women cassava farmers is not significantly influenced by age, household size, education level, marital status, extension contact, processing experience, processing cost, annual income, group membership, access to credit and quantity of cassava produced.

RESEARCH METHODOLOGY

Area of Study

The study was conducted in Abia State, Nigeria. Abia State was created on 27th August, 1991 from old Imo State, with its capital at Umuahia. The state has 17 Local Government Areas (LGAs) clustered within three agricultural zones namely: Aba, Umuahia and Ohafia agricultural zones. Abia state has a land area of 7,677.20 Km^2 with a population of about 2.833,999 million persons comprising 1,434,193 males and 1,399,806 males (NPC, 2006). The state is located between latitudes $5^0$47´ N and $6^0$12´ N of the Equator and between longitudes $7^0$23´ E and $8^0$02´ E of the Greenwich Meridian. Abia State is bounded on the north and northeast by the states of Anambra,

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Enugu, and Ebonyi, to the west of Abia is Imo State, to the east is Akwa Ibom State and to the south is Rivers State. The climate is tropical with dry and raining seasons. It has an annual rain fall of about 668 mm. A large portion of the people are engaged in agriculture and cultivate mostly cassava, yam, maize, cocoyam, rice, plantain, oil palm and cashew. Livestock are also kept especially on a small scale basis (Iheke, 2006; Nwaru, 2005).

Sampling Technique

The population for this study consists of all women cassava farmers in the study area who had benefitted from training on cassava value addition organized by government and/or private agencies. Multistage random sampling technique was used to select respondents for the study. In the first stage, two agricultural zones were randomly selected from the three agricultural zones that make up the State. In stage two, three extension blocks were selected from each of the selected zones. This gave six extension blocks. Stage three involved random selection of three extension circles from each of the blocks to give eighteen extension circles. List of women cassava farmers who had benefitted from cassava value addition trainings in each selected circle was formulated with the help of extension agents. The list served as the sampling frame from which 15 women cassava farmers were randomly selected from each of the eighteen extension circles to give a sample size of 270 women cassava farmers who served as respondents for the study.

Method of Data Collection

The study made use of primary data which were collected from the respondents following a field survey using pre-tested and structured questionnaire. Data were collected from the women farmers on socio-economic characteristics such as age, household size, marital status, education level, cassava farm size, quantity of cassava produced, membership to cooperative societies, access to credit and access to extension agents. Also, data on sources of information on cassava value addition technologies, types of cassava value addition technologies practiced, level of adoption of cassava value addition technologies, welfare indices and constraints to adoption of cassava value addition technologies were collected.

Method of Data Analysis

Descriptive and inferential statistics were used in analyzing the data collected. Objective I (describe socio-economic characteristics of the respondents) and objective ii (identify sources of information on cassava value added technologies) were analyzed using descriptive statistics.

Level of adoption of cassava value added technologies was determined using adoption scale analysis. It was achieved with the aid of a 7 point Likert type scale graded thus; unaware = 0, Aware = 1, interest = 2, evaluation= 3 trial = 4, accept = 5 and satisfaction = 6. In accordance with Okoye *et al*., (2009) the mean adoption level was determined as follows:

$$\overline{X_s} = \frac{\Sigma x}{n} \quad \dots \qquad (1)$$

Mean score was computed by multiplying the frequency of each response pattern with its appropriate nominal value and dividing same with the number of respondents to the terms. This is summarized with the equation below.

$$\overline{X_s} = \frac{\Sigma fn}{nr} \quad \dots \qquad (2)$$

Where: $\overline{X}$ = Mean score; $\sum$ = summation; F = frequency; n = Likert nominal value;

nr = Number of respondents.

$$\overline{X} = \frac{0+1+2+3+4+5+6}{7} = \frac{21}{7} = 3.0$$

Decision Rule: Below 1.0 = Unaware stage; 1.0 - 1.49 = Awareness stage; 1.50 - 1.99 = Interest stage; 2.0 - 2.49 = Evaluation stage; 2.50 - 2.99 = Trial stage; 3.0 and Above = Adoption of cassava value added technology

Z- test was used to determine impact of adoption of cassava value added technologies on welfare of women cassava farmers. Women farmers per capita expenditure and income were used as proxy variables to check welfare outcomes of adoption of cassava value added technologies by the women farmers. The Z- test model is expressed below as follows:

$$Z = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \quad \dots \qquad (3)$$

Where: $\overline{X}_1$ = Sample mean of income/expenditure of women cassava farmers after adoption

$\overline{X}_2$= Sample mean of income/expenditure of women cassava farmers before adoption

S_1^2= Sample variance of income/expenditure of women cassava farmers after adoption

S_2^2= Sample variance of income/expenditure of women cassava farmers before adoption

n_1/ n_2 = number of women cassava farmers after and before adoption of cassava value added technologies

The z-test was carried out at 5.0% alpha level

Multiple regression analysis was used to determine factors that influenced adoption of cassava value addition technologies among women cassava farmers in the study area. The model used is specified implicitly below as follows:

$Y = F(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, e)$ … (4)

Where: Y = Adoption of cassava value addition technologies (mean adoption score)

X_1 = age (years); X_2 = household size (number of people feeding from same pot); X_3 = education level (schooling years); X_4 = marital status (married = 1; otherwise = 0); X_5 = extension contact (number of contacts); X_6 = cassava processing experience (years); X_7 = processing cost (Naira); X_8 = annual income (Naira); X_9 = group membership (yes = 1; no = 0); X_{10} = access to credit (yes = 1; no = 0); X_{11} = quantity of cassava produced (tonnes); e = Error term.

To identify problems constraining adoption of cassava value added technologies (objective vii), a list of possible constraints was prepared using three point Likert type scale and the respondents asked to indicate their perceived constraints. The following scaling procedure was adopted; very serious constraint = 3; serious constraint = 2; not serious constraint = 1. The values on the Likert type scale were

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summed to 6 and divided by 3 to give 2.0 which served as cut-off score. The respondents mean score were calculated for each response item such that mean scores higher or equal to 2.0 were regarded as major constraints, while mean scores less than 2.0 were regarded as minor constraints to adoption of cassava value addition technologies.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Respondents

The distribution of the respondents according to their socio-economic characteristics is shown in Table 1. With respect to age, Table 1 shows that 33.33% of the women cassava farmers were within the age range of 40 - 49 years. The mean age of the women cassava farmers was 48.54 years. Drawing from Pandey and De (2015) classification of farmers by age (< 36 years = young farmers; 36 – 50 years = middle aged farmers; > 50 years = old farmers) the mean age of the women cassava farmers indicates that they were mostly middle aged and still energetic and capable of withstanding any stress associated with practice of adding value to cassava. This is likely to favour adoption of cassava value addition technologies among the women farmers. However, there is contention on the direction of the effect of age on adoption (Carolyn *et al*., 2015). The ability of a farmer to bear risk and be innovative has been reported to decrease with age (Nwaru, 2004). The table also shows that 65.93% of the farmers were married, while 17.78% were single. This shows that the married class dominated among the women farmers who received training on cassava value addition technologies in the study area, This must have been necessitated based on the need to gain more knowledge on value addition to enhance their income as well as diversifying livelihood sources. The result further indicates that 47.41% of the respondents had secondary education, 23.33% had primary education, 6.67% had tertiary education, while 22.59% had no formal education. Ebewore and Okedo-Okojie (2016) asserted that widespread illiteracy among farmers hinders understanding of information at their disposal. Therefore, educated farmers are expected to be more receptive to technologies, while farmers with low level of education or without education would be less receptive to utilization of new technologies (Okoye, 2009).

Table 1: Distribution of the respondents according to socio-economic characteristics

Variables	Frequency	Percentage (%)	Mean
Age (years)			
20-29	27	10.00	
30-39	51	18.89	
40-49	90	33.33	48.54
50-59	57	21.11	
60-69	27	10.00	
70 and above	18	6.67	
Marital Status			
Single	48	17.78	
Married	178	65.93	
Widow	42	15.56	
Divorced/separated	2	0.83	
Education Level			
No formal education	51	18.89	
Primary school education	63	23.33	
Secondary School education	138	51.11	
Tertiary school education	18	6.67	
Size of Cassava Farm (hectare)			
0.1 - 0.5	153	56.67	0.42
0.6 - 1.0	98	36.30	
>1.0	19	7.03	
Membership of Cooperatives			
Yes	132	48.89	
No	138	51.11	
Credit Access			
Yes	120	44.44	
No	150	55.56	

Source: Field survey data, 2021

Additionally, the mean size of the respondents cassava farm was 0.42 hectares, indicating that the respondents were majorly small scale farmers. The few respondents (7.03%) who allocated more than 1.0 hectare to cassava production may be the ones that produce cassava for commercial purposes. About 48.89% of the respondents belonged to cooperative societies, while, 51.11% of them did not belong to cooperative societies. Belonging to cooperative societies enhances participation in an intervention programme, as well as access to information on improved technologies (Odoemenam, 2007). Farmers communicate most frequently and effectively with those who are familiar to them and are more likely to obtain information from and be influenced in their adoption decision by other farmers. The benefits of group membership include: access to credit, information sharing, group marketing, shared labour, joint input purchase, group training, lobbying for favourable agricultural policies and unity among member farmers (Agoh, 2018). The table reveals that 55.56% of the respondents had no access to credit . Access to credit makes it possible for farmers to purchase inputs including equipment used in cassava value addition and this helps to increase quantity of cassava to which value is added. The result is in support of earlier finding by Awotide *et al.* (2013) that many farmers in Nigeria had no access to credit facilities.

Sources of Information on Cassava Value Added Technologies

The distribution of the respondents according to sources of information on cassava value added technologies is shown in Table 2. The table shows that 54.44% of the women cassava farmers obtained information and training on cassava value addition technologies from extension agents domiciled within Agricultural Development Programme (ADP), while 46.67% of them received information on cassava value added innovations from National Root Crop Research Institute, Umudike (NRCRI). The greater number of respondents that

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obtained information and training on cassava value addition technologies from ADP and NRCRI confirms their statutory mandate and contribution towards improving welfare of rural farmers through training and extension programme. Internet as a source of information to the least number of respondents (5.56%) indicates that the level of use of ICTs as a means of sourcing agricultural information among rural women in the study area was still low and lends credence to Osondu and Ijioma (2015) assertion that level of use of ICTs among women farmers in Nigeria was low.

Table 2: Distribution of the respondents according to source of information on cassava value addition technologies

Extension Access	* Frequency	Percentage
Agricultural Development Programme (ADP)	147	54.44
Tv/radio	37	13.70
Internet	15	5.56
Farmers/women association	85	31.48
Friends	49	18.15
National Root Crop Research Institute (NRCRI)	126	46.67

Source: *Field survey data, 2021*
***** Multiple responses recorded: n = 270

Level of Adoption of Cassava Value Added Technologies by Women Cassava Farmers

The level of adoption of cassava value added technologies among the women cassava farmers was investigated and the result presented in Table 3. Table 3 shows that garri ($\bar{X}$= 4.30), cassava fufu ($\bar{X}$ = 3.66), high quality cassava flour ($\bar{X}$ = 3.02) cassava chips ($\bar{X}$= 3.18) and fermented flour ($\bar{X}$ = 3.01) all had mean score values that are greater than the Likert critical score of 3.0, implying that these cassava value added technologies were adopted by the women farmers. Adoption of these post harvest value added technologies is expected to increase shelf life, income and food security of the rural poor (Nungo *et al.,* 2007). The table also shows that the grand mean score ($\bar{X}$= 2.22) for adoption of cassava value added technologies by the women farmers was low, suggesting that there were still gaps in adoption of most of the other cassava value added technologies extended to the women farmers. This implies that ample opportunities exist to increase level of adoption of cassava value added technologies among women farmers by exposing them to more information and training on these technologies.

Table 3: Level of adoption of cassava value added technologies by the women cassava farmers

Cassava Value Added Technologies	Unaware (0)	Aware (1)	Interest (2)	Evaluation (3)	Trial (4)	Accept (5)	satisfaction (6)	Total	Mean Score
Cassava fufu	0(0)	60(60)	27(54)	30(90)	42(168)	51(255)	60 (360)	987	3.66
HQCF	72 (0)	24(24)	24(48)	15(45)	33(132)	45(225)	57 (342)	816	3.02
Garri	0(0)	24(24)	27(54)	33(99)	30(120)	72 (360)	84 (504)	1161	4.30
Cassava strip	99(0)	45(45)	36(72)	12(36)	15(60)	33(165)	30 (180)	558	2.07
Cassava starch	102(0)	33(33)	12(24)	18(36)	27(108)	39(195)	39 (234)	648	2.40
Cassava bread	132(0)	45(45)	18(36)	9(18)	21(84)	24(120)	21 (126)	438	1.62
Cassava cake	90(0)	48(48)	30(60)	18(54)	6(24)	36(180)	27 (162)	528	1.96
Cassava chin chin	159(0)	45(45)	21(42)	3(9)	15(60)	18(90)	9 (54)	300	1.11
Cassava croquette	177(0)	39(39)	36(72)	0(0)	3(12)	15(45)	6 (36)	204	0.76
Fermented flour	69(0)	30(30)	18(36)	18(54)	30(120)	57(285)	48 (288)	813	3.01
Cassava doughnut	171(0)	39(39)	15(30)	6(18)	18(72)	6(30)	15 (90)	279	1.03
Cassava chips	24(0)	69(69)	24(48)	24(72)	30(120)	45(225)	54 (324)	858	3.18
Cassava pellet	207(0)	24(24)	6(12)	3(9)	9(36)	9(45)	12 (72)	198	0.73
Grand mean									2.22

Source: *Field survey data, 2021*
Figures in parenthesis are Likert nominal score
Decision Rule: > 1.0 = unaware; 1.0-1.49 = aware; 1.50-1.99 = interest; 2.0-2.49 = evaluation; 2.50-2.99 = trial; 3.0 and above = adopted

Impact of Adoption of Cassava Value added Technologies on Income and Expenditure Level of Women Cassava Farmers

The result of z-test analysis for difference in the mean monthly income and expenditure level of the women cassava farmers before and after adoption of cassava value added technologies is shown in Table 4. The table shows that the mean monthly income of the women cassava farmers before and after adoption of cassava value added technologies was 19, 172.62 Naira and 26, 029.47 Naira respectively. The mean difference between both variables (mean monthly income

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before adoption and mean monthly income after adoption) was 6, 856.85 Naira. The z-test result showed that this was statistically significant at 5.0% alpha level, implying that the monthly income of the women cassava farmers after adoption of cassava value added technologies was significantly greater than their income before adoption of cassava value added technologies. This lends credence to Onuekwusi *et al.* (2017) reported that adoption of value added technologies impacted positively on income of women cocoyam farmers in Abia State.

With respect to effect of adoption of cassava value added technologies by the women cassava farmers on their expenditure level, result of the z-test analysis as presented in Table 4 further shows that the mean monthly expenditure of the women cassava farmers before and after adoption of cassava value added technologies was 18, 341.57 Naira and 23, 688.03 Naira respectively. The mean difference between both variables (mean monthly expenditure before adoption and mean monthly expenditure after adoption) was 5, 346.46 Naira. This difference was statistically significant at 5.0% alpha level, implying that adoption of cassava value added technologies significantly impacted positively on expenditure level of the women cassava farmers. These findings indicates that welfare of the women cassava farmers improved as a result of adoption of cassava value added technologies.

Based on these findings, the hypothesis that adoption of cassava value added technologies had no significant effect on income and expenditure level of women cassava farmers ($H0_1$) was rejected.

Table 4: Z-test result of difference in women farmers income and expenditure before and after adoption of cassava value added technologies

Variables	Individual mean	Mean difference	Standard error	z-value	Sig (2-tailed)
Mean monthly income after adoption (₦)	26,029. 47	6,856.85	3912. 32	2.52**	0.012
Mean monthly income before adoption (₦)	19,172.62				
Mean monthly expenditure after adoption (₦)	23,688.03	5, 346.46	3115.14	2.13**	0.033
Mean monthly expenditure before adoption (₦)	18,341.57				

Source: *Field survey data, 2021*
***significant at 5.0% alpha level

Factors that influenced Adoption of Cassava Value added Technologies by Women Cassava Farmers

The result of the multiple regression analysis used to determine factors that influenced adoption of cassava value added technologies by the women cassava farmers is presented in Table 5. Four functional forms (linear, exponential, semi-log and double-log) of the regression model were tried out to determine the best fit model. The F-values of all the tried functional forms were significant at 1.0% alpha level indicating goodness of fit and implying that any of the functional forms can be used for predictive purposes. However, the linear functional form provided the best fit and was selected as the lead equation having produced the highest R^2 value of 0.841, F-value of 67.340 and number of significant coefficients (eight). Over all, eight out of the eleven independent variables included in the regression model were found to be significant determinants of adoption of cassava value added technologies.

Specifically, the coefficient of age (-0.122) was negative and significant at 5.0% alpha level. This implies that the younger the age of the women farmers, the higher their level of adoption of cassava value added technologies. This is logical, as older women farmers are likely to be less energetic and may therefore find it difficult to engage in numerous value addition activities which require quite some energy (Falola *et al.,* 2013). Additionally, according to Ijioma and Osondu (2013) younger farmers are more receptive to innovations than older farmers. The result lends credence to findings of Agoh (2018) among male and female post harvest processors of sweet potato in Imo State, Nigeria.

Education level had a positive coefficient (0.242) that was significant at 1.0% alpha level, implying that the variable had direct effect on adoption of cassava value added technologies and as such increase in formal education of the women cassava farmers resulted to increase in adoption of cassava value added technologies. Formal education influences other factors like management and helps one to grasp issues better, anticipate, appreciate and respond to market needs. Education enhances ability of individuals to process information and make the best out of any situation, thus enabling them to minimize risk and face uncertainties (Tura *et al.,* 2010). According to Birthal *et al.* (2005) education level positively influences adoption of value addition technologies in terms of training and skills required to grasp and undertake value addition practices. Osondu *et al.* (2014) reaffirmed this view when they posited that the level of education of a farmer not only increases farm productivity but also enhances the acquisition and utilization of information by farmers on improved technologies. This result agrees succinctly with Omoare *et al.* (2014) report that farmers with higher level of formal education had better access to information and

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knowledge that are beneficial to the adoption of value addition technologies.

Extension contact posted a positive coefficient (0.188) that was significant at 5.0% alpha level. This implies that women farmers who had more contact with extension agents are likely to adopt more cassava value addition technologies than those who did not. This might have resulted from the fact that extension contact provided farmers with much needed information, such as how to add value to their raw farm outputs and transform them into more consumer-ready products. This finding is in consonance with results obtained by Orisakwe and Agomuo (2011); and Ojo and Ogunyemi (2014) in Imo State and Ekiti State, Nigeria respectively, but contradicts finding of Ademiluyi (2014) among maize farmers in Bassa Local Government Area of Plateau State, Nigeria.

The coefficient of processing cost (-0.265) was negative and significant at 1.0% alpha level, implying that processing cost was inversely related to the adoption of cassava value addition technologies among the women cassava farmers. Thus, as the cost of adding value to cassava increases, adoption of cassava value addition technologies decreases. This result lends credence to Agoh (2018) finding that high processing cost was an impediment to adoption of value addition technologies among male and female processors in Abia State, Nigeria.

The coefficient of annual income (0.802) was positive and significant at 10.0% alpha level. This implies that increase in annual income of the women cassava farmers resulted to increase in adoption of cassava value added technologies. The economic status of the women farmers plays a significant role in their adoption of cassava value addition technologies. This is especially true when adoption of a given cassava value added technology involves purchasing new implement or equipment which usually is dictated by an individual's financial capability (Onyemauwa, 2012; Ben-Chendo *et al.* 2014). According to Olumba and Rahji (2014) the adoption of a given technology requires some financial commitments and increase in income from a given farm enterprise enables farmers to meet these commitments (cost of adoption), thereby increasing adoption level. This finding lends credence to Badru (2002) assertion that farmers with smaller annual income are more constrained to adopt agricultural technologies. Agoh (2018) obtained a similar finding among male and processors of sweet potato in Imo State, Nigeria.

Table 5: OLS regression estimates of factors that influenced adoption of cassava value added technologies among women cassava farmers in Abia State, Nigeria

Variables	Linear+	Exponential	Semi-log	Double-log
Constant	44.257	9.508**	2016.896***	93.812
	(1.594)	(2.071)	(3.935)	(1.544)
Age	-0.122**	-0.040**	-39.441**	0.231
	(-2.235)	(-2.477)	(-2.101)	(1.318)
Household size	0.265	0.002	83.552	0.394
	(1.314)	(1.472)	(1.602)	(0.672)
Education level	0.242**	0.167	221.759	0.192**
	(2.255)	(1.078)	(2.543)	(2.543)
Marital status	-0.221	-0.075	-58.232	-0.153*
	(-1.247)	(-1.314)	(-0.348)	(-1.932)
Extension contact	0.188**	0.001	300.487***	0.849**
	(2.470)	(1.343)	(4.220)	(2.101)
Processing experience	0.272	0.007	32.118	0.689
	(1.401)	(1.121)	(0.616)	(0.343)
Processing cost	-0.049***	-0.055*	-84.962*	-1.065***
	(-3.462)	(-1.719)	(-1.678)	(-3.461)
Annual income	0.802*	0.122**	30.483*	0.643*
	(1.864)	(2.269)	(1.784)	(1.903)
Group membership	1.752*	0.095**	45.272	0.192
	(1.811)	(2.069)	(1.068)	(1.564)
Access to credit	0.131**	0.235	16.182*	0.178*
	(1.976)	(1.125)	(1.729)	(1.729)
Quantity of cassava produced	0.386*	0.000	312.246*	0.049*
	(1.743)	(0.282)	(1.680)	(1.810)
R Squared (R^2)	0.841	0.748	0.785	0.808
Adjusted R^2	0.789	0.711	0.734	0.751
F-value	67.340***	30.444***	43.099***	58.116***

***Source**: Field survey data, 2021*

***, **, * Significant at 1.0%, 5.0% and 10.0% alpha levels respectively.

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Figures in parenthesis are t-values; + = lead equation.

The coefficients of group membership (1.752) and access to credit (0.131) were positive and significant at 10.0% and 5.0% alpha level respectively. This implies that belonging to cooperative societies and having access to credit facilities increased the women farmer's level of adoption of cassava value addition technologies. This result makes sense as women farmers within a group get to share ideas and information among themselves, lend to each other within the group, avail themselves to training and also produce and market as a group thereby taking advantage of economies of scale as transaction costs are reduced. According to Natson *et al.* (2018) farmers learn about available technologies from fellow farmers and other development agencies in contact with farmers' cooperative societies and such medium ensures faster adoption of innovations. On the other hand, credit access will empower them to purchase necessary equipment and expand their micro enterprises thereby facilitating adoption of cassava value added technologies. Thus, accessing credit facilities enables women cassava farmers to overcome financial encumbrances associated with adoption of cassava value addition technologies. According to Olanguju (2007) farmers without ready cash and who have no access to credit usually find it difficult to adopt innovations. This result agrees succinctly with Adeyonu *et al.* (2016) finding that farmers with access to credit have higher likelihood to be adopters of value addition technologies than those who do not have such access.

The coefficient of quantity of cassava produced (0.386) was positive and significant at 10.0% alpha level. This implies that the higher the quantity of cassava tubers produced by the women cassava farmers the higher their level of adoption of cassava value added technologies. The posture of this result can be attributed to the fact that increased production ensures availability of surplus farm output for value addition. Rono *et al.* (2006) and Agoh (2018) in their separate studies found that processors of sweet potato who had surplus harvests of sweet potato were more likely to add value for consumption than those who did not.

Constraints to Adoption of Cassava Value Added Technologies by Women Cassava Farmers

The constraints limiting adoption of cassava value added technologies by the women cassava farmers was investigated and the result presented in Table 6. Table 6 shows that in descending order of magnitude, inadequate capital ($\bar{X}$ = 2.13), lack of market ($\bar{X}$= 2.11), low access to credit ($\bar{X}$= 2.10), inadequate knowledge of technologies ($\bar{X}$ = 2.03), high cost of equipment/facilities ($\bar{X}$ = 2.02) and scarcity of labour ($\bar{X}$ = 2.00) were perceived by the women cassava farmers as major problems hindering adoption of cassava value added technologies.

Table 6: Perceived constraints to adoption of cassava value added technologies (n = 90)

Constraints	Very Serious (3)	Serious (2)	Not Serious (1)	Total	Mean Score
Low access to credit	114 (342)	69 (138)	87 (87)	567	2.10
Poor access to extension agents	63 (189)	60 (120)	147 (147)	456	1.69
Inadequate knowledge of technologies	96 (288)	87 (174)	87 (87)	549	2.03
High cost of equipment/facilities	90(270)	96(192)	84(84)	546	2.02
Socio-cultural restriction	72 (216)	75 (150)	123 (123)	489	1.81
Inadequate capital	102 (306)	72 (144)	126 (126)	576	2.13
No retraining facilities	48 (144)	75 (150)	147 (147)	441	1.63
Lack of market	99 (297)	102 (204)	69 (69)	570	2.11
Scarcity of labour	96 (288)	78 (156)	96 (96)	540	2.00
Limited land	63 (189)	102 (204)	105 (105)	498	1.84

Source: *Field survey data, 2021*

Figures in parenthesis are Likert nominal score

*Constraint with mean score ≥ 2.0 is deemed a major problem

Inadequate capital and low access to credit being perceived as major constraints to adoption of cassava value added technologies by the women cassava farmers lends credence to Agoh (2018) assertion that women farmers were mostly resource poor and generally lack adequate capital and access to credit facilities with which to procure equipments and other necessary inputs. Inadequate knowledge and lack of market for some technologies constrained the women farmers from adopting technologies. This suggests the need of exposing the women to more training on cassava value added technologies and having organized market available as an incentive for those who adopt the technologies to prevent discontinued adoption. Meanwhile, the high cost of equipment and scarcity of labour perceived as major problems constraining the women farmers suggest that cassava processing is a labour intensive activity and accessing energy and time saving machines by the women will help reduce associated drudgery. According to Aniedu *et al.* (2012) for rural poor women to adopt or utilize value added technologies the challenges faced by them should be addressed. These results lends credence to Akinnagbe (2010) and Fefa (2012) report that inadequate capital, low access to credit, scarcity of labour and high cost of processing equipment/facilities were problems constraining cassava processing in Nigeria. Onuekwusi *et al.* (2017) obtained similar results among women cocoyam farmers in Abia State, Nigeria.

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Conclusions

Several cassava value addition technologies had been adopted by the women cassava farmers but adoption gaps of cassava value addition technologies still exist in the study area. The welfare of the women farmers improved significantly as a result of adoption of cassava value added technologies. Factors such as age, education level, extension contact, processing cost, annual income, group membership, access to credit and quantity of cassava produced significantly influenced the women farmers adoption of cassava value added technologies.

Recommendations

Based on the findings of this study, the following recommendations suffice:

i. Adoption of cassava value added technologies impacted positively on women cassava farmers welfare. Government at all levels should promote policies and implement actions that will enhance access of women cassava farmers to trainings on cassava value added technologies. To this end, government should take measures that will enhance extension service delivery to women farmers. This will enable women farmers earn more income and improve their welfare. Thus, helping to reduce level of poverty amongst them.

ii. Different cassava processing equipment should be made available to women cassava farmers at subsidized rate. This will increase rate of adoption of cassava value added technologies among women cassava farmers.

iii. Policy makers should come up with loan packages intended specifically for people interested in adding value to agricultural products. Mechanisms should also be put in place to monitor how the funds borrowed are used. This will reduce the financial encumbrances associated with adoption of cassava value added technologies and increase adoption rate.

iv. Women farmers need to be sensitized on the importance and impact of adopting value added innovations. To this end, seminars on adoption of value added innovations should be held in designated venues in all rural communities of the study area. Attempts should be made to motivate women farmers to attend in mass.

v. Women cassava farmers should be encouraged to form and belong to cooperative societies. This will avail them access to various opportunities such as training, credit facilities, inputs and markets.

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