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Adoption of Improved Cassava Production Technologies Among Small-Scale Farmers in Anambra State, Nigeria

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Abstract: The study on the adoption of improved cassava production technologies among small-scale cassava famers in Anambra State, Nigeria, specifically; described the socioeconomic characteristics of small-scale cassava farmers, determine the adoption levels of improved cassava production technologies, examine the effects of socioeconomic variables on the adoption level and identified constraints to adoption of improved cassava production technologies in the area. A multi stage sampling technique was employed to randomly sample a cross section of 120 small-scale cassava farmers. Data were collected using a well-structured questionnaire. The data were analyze with a combination of tool like descriptive statistics, multiple regression and principal factor analysis. The study revealed that the average age of the cassava farmers was 44.08 out of which 51.67% are male. The average educational level (9.17), farming experience (14.89), household size (5.86), annual income (861.103 USD), farm size (0.15 ha) and extension contacts (3.59) were also revealed. The results further showed that out of the eleven (11) improved cassava production variables considered, the respondents have not fully adopted any of the technologies. Findings on influence of socioeconomic characteristics on adoption shows that F-statistic value of 4.05*** was significant at 1% level of significance, which implies that the predictor variables influenced adoption. Major constraints of the cassava farmers were rotated into three component factors which are institutional (25.4%), economic (17.7%) and managerial factors (12.6%) using principal factor analysis. A KMO of 0.580 and cumulative Eigen-value of 55.7% explained the variance of factors. We therefore encourage extension agents to sit up in disseminating recent innovation to farmers.

Keywords: Adoption, Improved Technologies, Small-Scale Farmers, Cassava Production, Anambra State

1. Introduction

Cassava plant is a native of South America which is botanically referred to as *Manihot esculanta* and commonly planted in the tropics for its starchy and tuberous roots used as food for many households [1]. Owing to the cassava importance in the nation's food and industrial sector, the Federal and some State Government initiated programs and policies aimed at revolutionizing the crop. Some of the policies/programs are Presidential Initiative on Cassava (PIC), Root and Tuber Expansion Programme (RTEP), Cassava Enterprise Development Project (CEDP), and Agricultural Transformation Agenda (ATA) among others [2]. Nigeria remain the highest producer of cassava in West African with an estimated 59 million tons output, researchers have argued that Nigeria's cassava production accounts for 20.4% share of the world's total production since 2017 [3], this share percentage made Nigeria the largest cassava producers in the world food market [4]. Apart from cassava's drought tolerant ability and resilience on marginal soil, it can be stored in the ground for more than two years, this potentials alone made the crop an important food security crop especially among rural household who cultivates the crop on a small-scale [5]. Since cassava has a very long chain in value addition, it can be locally processed into different food types which has provided an alternative source of food especially among poor household during the peak of Covid-19 pandemic when foods and survival became relatively expensive. Cassava can be locally processed in Nigeria in the form of cassava flour, starch, cassava chips and other local delicacy like *Garri (Eba), Akpu (Fufu), Abacha*, among others [1, 6].

Despite Nigeria's position in the world map when it comes to cassava crop, cassava delicacies became unbearably expensive in Nigeria since Covid-19 outbreak and rising insecurity issues which saw a number of people depending on other alternative food like a mixture of cassava and maize flour *(Alibo)* as food. This suggests the need to increase the production of cassava for local consumption and export purposes.

To increase cassava production, policymakers need to pay attention to studies conducted on improved cassava production technologies as well as recommendations made. There are a handful of studies in this line but the researchers suggestions seems not to have been effectively implemented. Worrisomely, Nsoanya and Nenna reports that timeliness and method of fertilizer application and prescribed use of herbicides and insecticides have not been appreciably adopted by farmers still exist [7]. There is an urgent need to increase adoption of agricultural technology associated with enhancing cassava yield, these technologies include improved varieties, fertilizer application, planting time, intercropping and use of pesticides and herbicides among others [8].

The inability of smallholder farmers to adopt most technologies aimed at increasing production in Nigeria has been associated with many challenges, these challenges have limited production and market orientation of smallholder farmers [9]. Among these challenges are lack of knowledge on improved and modern production skills which is undoubtedly caused by the poor level of extension services [10]. Poor state of infrastructure such as roads, electricity, processing and storage facilities usually lead to high post-harvest losses and consequently, reduced profitability. Other issue to be tackled to improved adoption include high cost of labour, inadequate finance, farmer's access to credit, high cost of inputs and low government presence to subsidize farm inputs, heavy reliance on traditional tools, poor extension contact and bad road network [1]. In earlier study, Gbassey *et al*. noted that lack of information, unavailability of land and poor extension services were the obstacles to adoption of improved cassava production technologies [11].

Adoption of improved production technologies such as good site selection, land preparation, improved varieties, method of planting, spacing, time of planting, fertilizer application, weeding and harvesting is essential to increase productivity among the smallholder farmers [12]. Some studies have been conducted on adoption of new technologies for cassava production in Anambra State which have revealed slowly slow adoption while many aspects of technology adoption remain poorly understood [13]. It is against this backdrop that the researchers seeks to contribute in filling the existing gaps on the adoption of improved cassava production technologies in Anambra State which resulted to asking the following research questions:

i. What are the socioeconomic characteristics of small-scale cassava farmers?
ii. To what extent is the adoption of improved technologies for the production of cassava among small scale cassava farmers in the study area?
iii. Does socioeconomic variables influence adoption of improved production technologies for cassava farmers?
iv. Are there some constraints associated with the adoption of improved technologies?

2. Materials and Method

2.1. The Study Area

The study was carried out in Anambra State of Nigeria. The State comprises of twenty one (21) Local Government Areas (LGAs), 177 autonomous communities and four (4) Agricultural Zones (Aguata, Anambra, Awka and Onitsha zone). The State is located between latitudes 5°38′ N and 6°47′ N and longitude 6°36′ E and 7°21′ E. Anambra State is bounded in the North by Kogi State, in the West by River Niger and Delta State, in the South by Imo State and in the East by Enugu State. The National Population Commission (NPC) noted that the State has a population of 5,527,800 with the male population of 50.9% and female 49.1% [14]. It has a total land area of about 4,416 square kilometer (km^2), 70% of the land is suitable for agricultural production [15]. In Anambra State, rainy season last from April to November, while the dry season ranges from November to March. The mean annual rainfall is 2000 mm while the average annual temperature is 32°C and a minimum temperature is 23°C. The climate of the area is comparatively good and it is favorable for agricultural activities [15]. Major food crops cultivated in Anambra State are rice, cassava, maize, yam, cocoyam, plantain, banana among others. The number of farm families in the State is 338,721 with an average size of eight (8) persons per farm family or household [16]. The International Fund for Agricultural Development (IFAD) noted that Anambra State is one of the major State championing in cassava production in Nigeria [17].

2.2. Data Collection

The data for the study were collected from primary source through the use of structured interview schedule comprising closed and open-ended questions to elicit information from the respondents. The structure interview schedule was validated by lecturers in the Department of Agricultural Economics and Extension of Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus. 6 enumerators were properly trained for the work. The interview schedule was divided into five sections. Section 1 dealt with socioeconomic characteristics of the farmers; Section 2 was designed to collect information on the extent of adoption of improved cassava production technologies. Section 3 was designed to elicit information on effects of some socioeconomic factors influencing the adoption of improved cassava production technologies and Section 4 was designed to elicit information on constraints to the adoption of improved cassava production technologies.

A multi-stage sampling technique were employed for the selection of study representatives, in stage one, the sample frame or list of registered farming families were made available by the Anambra State Agricultural Development Programme (ASADE) in 2019 from where the study representatives were drawn. Stage State two witnessed the purposive selection of two agricultural zones (Aguata and Onitsha) due to high number of registered cassava farmers in the zone. In stage three, two LGAs (Aguata: Orumba south and Aguata, Onitsha: Ogbaru and Ihiala) were purposively selected based on cassava production comparative advantage. In stage four, two communities were randomly selected which later selected three villages from each community to make it a total of twenty-four (24) villages for the study. Furthermore, five small-scale cassava farmers were randomly selected from each village to make the study a total of one hundred and twenty (120) sample size.

3. Data Analysis

The data from the field were analyzed with a combination of analytical tools. The research question one and two were operationalized with descriptive statistics which include frequency distribution, percentage and mean scores and mean threshold from 5-point Likert scale. Also, research question three was operationalized with multiple regression analysis using the of ordinary least square regression approach, while research question four was operationalized with a principal factor analysis adopted from [18].

The regression model was implicitly specified as:

$$Y^* = f(X_1, X_2, X_3 \ldots X_{10} \ldots e_i)$$

Where:

Y^* = latent score on adoption index of improved cassava production technologies

X_1 = sex (dummy; male = 1, female = 0).

X_2 = age (years).

X_3 = marital status; (dummy, married = l, otherwise = 0).

X_4 = Education; (measured by the number of years spent in formal education).

X_5 = Farming experience (measured in years).

X_6 = Household size (measured by the number of people living under one roof and eating from the same pot).

X_7 = Annual income (measured in naira and kobo).

X_8 = farm size (measured in ha)

X_9 = Extension contacts (measured by number of times visited by extension agents in the last one year).

X_{10} = Membership of farmer's organization (dummy; yes = 1, no = 0).

e_i = Stochastic error term.

The principal factor analysis (PFA) was defined as:

$$Z_i = \delta_{i0} + \delta_{i1}F_1 + \delta_{i2}F_2 \ldots + \delta_{im}F_m + e_i$$

where Zi is the $p \times 1$ vector of measurements or observations, δ_{i0} is the $p \times 1$ vector of means, δ_{i1} - δ_{im} is the $p \times m$ matrix of factor loading (regression weight), F_1-F_m is the m x 1 vector of factors, e_i is the m x 1 vector of residual variables or unobserved stochastic error term with zero mean and finite variance. For the vectors, p is the number of measurement on a subject, and m is the number of common factors [19].

4. Results and Discussions

4.1. Socio-economic Characteristic of Cassava Farmers

The socioeconomic characteristics of small-scale cassava farmers are presented in table 1. The table revealed that:

4.1.1. Sex of the Respondents

The study shows that majority (51.67%) of the small-scale cassava farmers in the study area are male while the remaining 48.33% are female. This indicates that small-scale cassava farming in the area is male dominated. This result was in agreement with the earlier findings of [8] on the adoption of improved cassava production and processing technologies in Oshimili Delta State, Nigeria in whose study revealed 65% of the farmers as male.

4.1.2. Age of the Respondents

Findings in table 1 show that greater proportion (37.50%) of respondents' age fell within the age bracket of 51 years and above, 21.67% fell within the age bracket 41-50 years, 17.50% fell within the age bracket 21-30 years, 15.00% fell within the age bracket 31-40 years and the remaining 8.33% fell within the age bracket of less than 21 years. The average age was 44.08. This means that most of the cassava farmers are at their productive age which enables them to actively participate in adoption of modern agricultural production technologies. These findings are in line with the study of [19] on the analysis of factors influencing adoption of good agricultural practices (GAP) among cassava farmers under Nigeria Agricultural Transformation Agenda whose average age of cassava farmers was 46 years.

4.1.3. Marital Status of the Respondents

The study shows that majority (64.17%) of small-scale cassava farmers are married, while others are were found in otherwise category. This result indicates that cassava farming in the area was dominated by married farmers. This is in agreement with [20] on the study of analysis of factors influencing adoption of good agronomic practices (GAP) among Cassava Farmers under Nigeria agricultural transformation agenda whose findings revealed 68.33% married cassava farmers.

4.1.4. Respondents Level of Education

Information on table 1 shows that greater proportion (36.67%) of small-scale cassava farmers in the study area had secondary education, 30.00% had primary school, and 25.80% had tertiary education while 8.33% had no formal education. The average years of formal learning was 9.17. This implies that most of the cassava farmers' in the study area at least attempted secondary school. These findings corroborate with the study of [21] on assessment of cassava processing technologies usage among rural women in Kwara State, Nigeria whose findings revealed that 93.3% of the respondents had good educational background.

4.1.5. Respondents Farming Experience

The study found that greater proportion (29.17%) had 6-10 years farming experience, 27.50% had farming experience between 16-20 years, 20.83% had farming experience 21 years and above, 20.00% had farming experience between 11-15 years, while 2.50% of cassava farmers in the study area had 1-5 years farming experience. The average farming experience was 14.89, revealing that the respondents had adequate farming experience which is one of the important factors in adoption of modern agricultural innovation. This result is in line with earlier finding of [22] in the study on determinants of adoption and farmers' preferences for cassava varieties in Kabare Territory, Eastern Democratic Republic of Congo whose study revealed that 66.8% of the farmers had an experience ranging between 11 to 20 years.

4.1.6. Household Size of the Respondents

Entries in Table 1 shows that greater proportion (49.17%) of the respondents had household size of between 1-5 persons, 48.33% had household size between 6-10 persons and 2.50% had household size 11 persons and above. The mean household size was approximately 6 persons. This means that cassava farmers had enough household size and doesn't depend on hired labour because they would make use of labour provided by family members. This agrees with findings of [23] on the study of factors determining adoption of new agricultural technology by smallholder farmers in developing countries whose findings revealed that household size is simply used as a measure of labour availability.

4.1.7. Annual Income of the Respondents

Information in Table 1 shows that majority (50.00%) of the respondents' earned between 380 – 679 USD per annum, 42.50% earned between 680 – 979 USD, 6.67% earned 980 USD and above, while 0.83% earned between < 380 USD. The mean annual income of the respondents was 861.103 USD. This is an indication that cassava production is a profitable enterprise hence, farmers can use the income generated to acquire modern technologies in cassava production. This agrees with the findings of [24] on the study of adoption of indigenous methods for the treatment of malaria among cassava farmers in Akwa Ibom State, Nigeria.

4.1.8. Farm Size of the Respondents

Findings in Table 1 shows that greater proportion (43.33%) of the respondents had farm size between 0.2-0.4 hectares, 31.67% had farm size of between 0.41-0.6 hectares, and 16.67% had farm size of less than 0.2 hectare while 8.33% had farm size of 0.6 and above hectares. The mean farm size was 0.15 ha. The farmers land is in smallholding which could pose challenge to adoption of agricultural technologies disseminated in for of mechanization process. This agrees with [25] in the study on sustainable efficiencies in small scale cassava farmers in Oruk Anam Local Government Area of Akwa Ibom Sate, Nigeria who revealed that farm size impacted positively on sustainable allocative efficiency in small scale cassava farming

4.1.9. Respondents Number of Extension Contact

Entries in Table 1 shows that majority (52.50%) of the respondents had between 4-6 times of contact per annum with extension agents, 45.83% of the respondents had 1-3 times of contact with extension agents while 1.67% had 7 times and above contact with extension agents per annum. The mean contact with extension agents per annum was approximately 4.00 times which showed that the respondents contact with extension agents was between 4 times per annum which is not sufficient. This is in agreement with findings of [26] on the study of the effect of information sources on farmers' adoption of *sawah* eco-technology in Nigeria who revealed that majority (87.3%) of the farmers had an extension contact.

4.1.10. Membership of Cooperative

The results in Table 1 show that majority (51.67%) of cassava farmers are members of 3-4 cooperative groups, while 48.33% of the cassava farmers are members of 1-2 cooperative groups. The mean score is 2.53 meaning that cassava farmers in the study area organized themselves into various cassava production organization. This is in agreement with earlier findings of [27] on the study of community-based organization and their effect on the adoption of agricultural technologies in Uganda who revealed that farmers who participated more in community-based organizations are likely to engage in social learning about technology. Belonging to a social group enhances social capital allowing trust, idea and information exchange [28].

4.2. Level of Adoption of Improved Cassava Production Technologies

Table 2 shows the results of the adoption of improved cassava production technologies. The adoption of improved cassava production technologies was subjected to 5-point Likert scales as: awareness (1), interest (2), evaluation (3), trial (4) and adoption (5) to determine the mean threshold of adoption among cassava farmers. The scale was used to ascertain the adoption stages of agricultural technologies (AT) among cassava farmers. The study had a cluster mean of 3. The result showed that improved cassava production technologies has not been fully adopted by all the farmers. The result indicated that majority of the respondents were still at the evaluation stage of adoption in the study areas. This approach was adopted from [37] who classified their work in 5 stages of adoption (awareness, interested, evaluation, trial and adopted). Based on the 11 variables of improved cassava production technologies considered, time of planting is in the awareness stage. Input from approved dealer, planting space and depth and herbicide for weed control are in interest stage. Also, site selection, land preparation (tractorization), use of improved variety, fertilizer application and time of harvest are in evaluation stage. Furthermore, ridge planting and processing are in trial stage of adoption. Summarily, the grand mean (cluster mean) of 3 is an indication that the farmers are still evaluating the available technologies in their areas.

The results further showed that out of eleven (11) improved cassava production variables considered, the respondents have not adopted any of the technologies. The non-adoption of any of the variables considered has a big concern to extension delivery system. Scholars like Nenna succinctly stated that extension service bears a great potential for improving the productivity of natural resources, promoting the right attitude among natural resource managers. Furthermore, extension service is recognized as an essential mechanism for information delivery and advice as input into modern resource management [29]. This measure was adopted because a one-time used of technology package does not guarantee its adoption.

Table 1. *Socioeconomic characteristics of cassava adopters.*

Sn.	Variable	Frequency	Percentage	Mean
1	Sex			
	Male	62	51.67	
	Female	58	48.33	
2	Age			
	Less than 21 years	10	8.33	
	21-30 years	21	17.50	44.08
	31-40 years	18	15.00	
	41-50 years	26	21.67	
	51 and above years	45	37.50	
3	Marital status			
	Married	77	64.17	
	Otherwise	43	35.83	
4	Level of education			
	No Formal education (0)	10	8.33	
	Primary (1-6)	36	30.00	9.17
	Secondary (7-12)	44	36.67	
	Tertiary (13 and above)	30	25.00	
5	Farming experience			
	1-5 year(s)	3	2.50	
	6-10 years	35	29.17	14.89
	11-15 years	24	20.00	
	16-20 years	33	27.50	
	21 years and above	25	20.83	
6	Household size			
	1-5 persons	59	49.17	
	6-10 persons	58	48.33	5.86
	11 persons and above	3	2.50	
7	Annual income from all sources (USD)			
	< 379	1	0.83	
	380 - 679	60	50.00	
	680 - 979	51	42.50	861.103
	980 and above	8	6.67	
8	Farm size (ha)			
	Less than 0.2	20	16.67	
	0.2-0.4	52	43.33	0.15
	0.41-0.6	38	31.67	
	0.61 and above	10	8.33	
9	Extension contacts			
	1-3 contact(s)	55	45.83	
	4-6 contacts	63	52.50	3.59
	7 contacts and above	2	1.67	
10	Membership of cooperation			
	1-2	58	48.33	
	3-4	62	51.67	2.53

Source: Field Survey Data, 2020. USD1 = NGN380.

Table 2. *Level of adoption of improved cassava production technologies.*

SN.	Variables	Awareness	Interest	Evaluation	Trial	Adoption	Mean Score	Remarks/Decision
1	Site selection	29 (1)	2 (2)	25 (3)	61 (4)	3 (5)	3	Evaluation stage
2	Land preparation (tractorization)	22	29	41	28	0	3	Evaluation stage
3	Input from approved dealer	38	47	7	26	2	2	Interest stage
4	Use of improved variety	0	22	40	58	0	3	Evaluation stage
5	Ridge planting	0	0	11	109	0	4	Trial stage
6	Time of planting	114	0	5	0	1	1	Awareness stage
7	Planting space and depth	69	9	17	24	1	2	Interest stage
8	Fertilizer application	9	22	42	47	0	3	Evaluation stage
9	Herbicide for weed control	29	51	35	5	0	2	Interest stage
10	Processing	0	0	34	86	0	4	Trial stage
11	Time of harvest	30	1	6	83	0	3	Evaluation stage
	Cluster mean						3	Evaluation stage

Source: Field Survey Data, 2020.

4.3. Influence of Socioeconomic Characteristic on Adoption of Improved Cassava Production Technologies

Table 3 reflects the results of multiple regression analysis on adoption of improved cassava production technologies in Anambra State, Nigeria. The influence was predicted as:

$$\text{Adoption } (Y^*) = 3.324 + 0.033 \text{ (sex)} + 0.002 \text{ (age)} - 0.141 \text{ (MS)} + 0.038 \text{ (edu)} + 0.014 \text{ (exp)} - 0.004 \text{ (HHS)} + 0.000 \text{ (income)} - 0.022 \text{ (FS)} - 0.017 \text{ (ext)} - 0.116 \text{ (coops)}$$

The coefficient of multiple determinant (R^2) value of 0.271 is an indication that 27.10% of the variations in adoption of improved cassava production technologies was explained by joint actions of the independent (socioeconomic characteristics) variables (regressors), while the remaining 72.90% unexplained was as a result of error beyond the control of the small-scale cassava farmers. This R^2 value was in agreement with the assertion of Sarstedt and Mooi (2014) who contend that R^2 value of 0.25 is accepted while studying human behavior since human behaviour is unpredictable, but for scientific research or experiment; only R^2 value of 0.5 and above is accepted. Corroboratively, [30-32] contend that R^2 value of 0.25 is accepted for behavioural study but considered as weak effect size. The F-statistics (4.05***) was significant at 1% level of significance which implies that the predictor variables influenced technology adoption in the study area, this formed the basis for the rejection of the null hypothesis that socioeconomic variable does not influence technology adoption.

The study established that sex, age, household size, annual income and extension contact do not influence adoption of improved cassava production technologies among cassava farmers in Anambra State.

The coefficient of marital status (0.141) was negatively significant at 5% level of significance, this implies that 5% increase in the number of small-scale cassava farmers that are not married will reduce adoption by 14.4%. Adoption is labour intensive and may require the joint effort of both partners which validates this result and suggests that extension agents should target more married farmers in the area.

As expected by *a-priori* expectation, the coefficient of level of education (0.038) was positive and significant at 1% level of significance, this implies that 1% increase in the number of farmers that are educated among small-scale cassava farmers will increase technology adoption by 3.8%. Ideally, education will increase their literacy level to improve their ability to follows some adoption instruction for an improved yield. This finding is in agreement with the study of [33] on constraint to adoption of good agronomic practices among rice farmers in Anambra State Value Chain Development Programme. The study equally alighned with study of [34] on adoption of root and tubber technologies dessiminated by the National Root Crop Research Institute in Anambra State, Nigeria.

The coefficient of farming experience (0.014) was positive and significant at 5% level of significance, this implies that a marginal increase in the number of years the farmers spent in cassava farming will increase their adoption of improved cassava production technologies by 0.014 unit or 1.4%. The implication is that the more experienced the farmers are the more they are willing to try new things for a better result, since their old ways have yielded no result. This finding is in consonance with the result of [22] on determinant of adoption and farmer's preferences for cassava varieties in Kabare Territory, Eastern Democratic Republic of Congo and [35] on the study of adoption of cassava production technologies by farmers in Awgu Local Government Area of Enugu State, Nigeria.

The coefficient of farm size (0.022) was negative and significant at 10% level of significance. This implies that marginal increase in farm size will reduce the adoption of agricultural technology of cassava farmers by 2.2%. Adoption is demanding and time consuming, these farmers may not afford the practice of good agronomic practices on large scale farming in absence of mechanization. This finding opposed the study of [36] whose findings revealed that as farm size increases, the higher the probability of adopting improved cassava production technologies.

Finally, the coefficient of cooperative membership (0.116) was negative and significant at 10% level of significance. This implies that 10% increase in the number of farmers that are not members of agricultural cooperative will reduce the adoption of improved cassava production technologies by 11.6%. This result has proven the importance of organizing farmers into a formidable group to enable them access extension packages.

These further validates or established that the determinants of improved technology adoption by small-scale cassava farmers are *marital status, level of education, farming experience, farm size and cooperative membership*.

Table 3. *Socioeconomic characteristic influence on adoption of improved cassava production technologies.*

Technology adoption	Coefficient	S. E	t-ratio
Sex	0.033	0.066	0.5
Age	0.002	0.002	1.09
Marital status	-0.141	0.067	-2.09**
Level of education	0.038	0.007	5.30***
Farming experience	0.014	0.006	2.37**
Household size	-0.004	0.014	-0.28
Monthly income	0.000	0.000	0.35
Farm size	-0.022	0.012	-1.70*
Extension contact	-0.017	0.018	-0.96
Cooperative membership	-0.116	0.065	-1.79*
Constant	3.324	0.188	17.64***
Diagnostic tools			
F-stat.	4.05***		
R^2	0.271		
Observation	120		

Source: Field Survey Data, 2020 (*, **, ***) Significant at 10%, 5%, and 1% respectively.

4.4. Challenges of Adoption of Improved Cassava Production Technologies

The result of the challenges of adoption of improved cassava production technologies by small-scale cassava farmers is presented in Table 4. Principal factor analysis (PFA) was adapted from [36] and was used to select the least number of factors which can account for the common variance (correlation) of a set of variables. Down the table was a model adequacy analysis result. The rule of thumb in [37] suggested that Kaiser-Meyer-Okin (KMO) is a test that measures sampling adequacy for each variable in a model, the KMO value of 0.5 is adequate to proceed with the PFA analysis, while total variance of factor explained value of 53% is the benchmark value enough to explain the factors. Thus, the KMO of 0.580 and total variance of factor explained of 55.7% (table 4) was in agreement with the assertion [37]. The PFA was rotated into three component factors named as institutional, economic and managerial factors as adapted from [38].

The institutional factor explained 25.4% of the variance of factors constraining the adoption of improved cassava production technologies by small-scale cassava farmers. The economic factors explained 17.7% of the variance of factors constraining the adoption of improved cassava production technologies by small-scale cassava farmers and managerial factors explained 12.6% of the variance of factors constraining the adoption of improved cassava production technologies by small-scale cassava farmers. Hence, the three factors cumulatively explained 55.7% of the total variance of factors constraining the adoption of improved cassava production technologies by small-scale cassava farmers in the area.

Table 4. *Challenges of Adoption of Improved Cassava Production Technologies.*

Sn.	Constraints	Institutional	Economic	Managerial
1	Poor access to credit	0.785		
2	Inadequate extension contacts	0.744		
3	High cost of labour	0.546		
4	Poor government support		0.859	
5	Unavailability of demanded input		0.679	
6	High technical involvement		0.537	
7	Farm size/land fragmentation			0.776
8	Improved varieties are not compatible with soil in my area.			-0.756
9	Level of education			0.405
	Model adequacy			
	Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO)	0.580		
	Eigenvalues:			
	Factor 1	25.416		
	Factor 2	17.667		
	Factor 3	12.634		
	Total variance of factor explained %	55.717		

Source: Field Survey Data, 2020. Note: % variance of factors. Total Variance of factors.

Subsequently, the variables that constitute the institutional factors with their effect size are poor access to credit (0.785), inadequate extension contact (0.744), and high cost of labour (0.546). The economic factors with their effect size are net gain (0.859), unavailability of demanded input (0.679), and net farm income (0.537). Finally, the managerial factors with their effect size are farm size/land fragmentation (0.776), improved varieties (-0.756) are not compatible with soil in some of areas (-0.756), and level of education (0.405).

Policymakers should prioritize their effort in addressing the three constraining factors according to available funds as paying attention to these will improve technology adoption by the farmers.

5. Conclusion and Recommendations

Conclusion

The study concluded that majority of the technologies are were on in evaluation stage which means that the cassava farmers have not reached adoption stage in the study area. Rural farmers who are the major cassava producers in Anambra State can contribute more to food security and encourage economic growth if they are motivated to adopt more improved productive cassava technologies. The efficient and effective use of improved cassava production technologies would enhance increased farmers productive potentials, hence, increase income, sustainable livelihood, reduced poverty and overall state of food security in Nigeria. The study also have established that marital status, level of education, farming experience, farm size and cooperative membership are the determinants of technology adoption which means that extension agents should look-up to the aforementioned variables when whne planing on dessiminating technology packages to the farmers.

Reccommendations

1. Governemnt should provide adequate fund/credit to cassava farmers and also increase their access to credit. To achieve this, government should come up with policy that would assist cassava farmers with adequate empowerment.
2. Extension agents should sit up to their responsibilities of disseminating recent innovation to the end users (farmers).
3. Since socio-economic variables such as eductional level of farmers has been determined to be a factor for adoption, government should endeavor to encourage beneficiaries to enroll in formal or adult eduction programme. This is necessary because it will improve the literacy level of farmers and enhace their knowledge on improved cassava production technologies.
4. Farmers should be encouraged to develop the ability of learning modern technologies that come across them so as to increase their production and productivity.

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