ASSESSMENT OF THE ADOPTION OF TROPICAL MANIHOT SERIES (TMS) 419 CASSAVA VARIETY BY FARMERS IN ANAMBRA STATE, NIGERIA

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ABSTRACT

The rate of adoption of TMS 419 cassava by farmers in Anambra State, Nigeria, was studied using one hundred and twenty respondents. These farmers were selected through multistage random sampling techniques. A well-structured questionnaire and oral interviews were employed to collect data for the study. Percentage responses and the Tobit model were used to achieve the study's objectives. The results of the socioeconomic characteristics of the farmers revealed that most of the farmers were elderly, educated, experienced, members of organizations, and had moderate household sizes. The analysis showed that the factors influencing the technology adoption rate were the level of education, access to extension services, and household size. However, the factors limiting the technology adoption included the high cost and scarcity of improved varieties, the high cost of labour, and poor access to credit. There is a need to enhance farmers' access to educational programs, labour-saving devices, and improved cassava varieties

Keywords: Assessment, Adoption, TMS 419, Cassava, Farmers, Tobit Model, Anambra State

INTRODUCTION

Cassava is a food security crop grown in the tropics and subtropics of Africa, Central America, and the Caribbean (Okoye, Okoye, and Ume, 2021). Beyond its nutritional value, cassava serves as a vital raw material for agro-industries, contributes to poverty alleviation, generates foreign exchange, and is used as livestock feed (Ravindran, 2021; Food and Agriculture Organization (FAO), 2022). Cassava possesses intrinsic characteristics that make it particularly appealing to smallholder farmers in Nigeria. These include its versatility, as it is rich in carbohydrates, especially starch, which is used in a wide array of industries, including food manufacturing, pharmaceuticals, textiles, plywood, paper, adhesives, and ethanol biofuel production. It is an all-year-round source of inexpensive calories, tolerant to marginal soils, and more resistant to drought, pests, and diseases (Khadijat, 2021). Additionally, cassava roots can be stored in the ground for months after maturation, and it is the highest-producing starchy staple crop, yielding 50–82 metric tons per hectare (The Guardian, 2020). Furthermore, cassava is propagated from stem cuttings, making planting material affordable and readily available. Its symbiotic association with soil fungi enhances phosphorus and micronutrient absorption by its roots (Ravindran, 2021; Salau, Nofiu, and Jimoh, 2019).

Global cassava production in 2021 was estimated at 308 million tonnes, with Africa accounting for approximately 203 million tonnes (56% of global production), followed by Asia (84 million tonnes) and the Americas (26 million tonnes). During this period, Nigeria retained its position as the world's highest cassava producer, with about 60 million metric tonnes (FAO, 2022). Among the improved varieties cultivated in Nigeria, TMS 419 is particularly notable. This variety grows straight, has narrow green shiny leaves, and reaches an average height of 4 meters, with a light brown stalk. Its tubers are characterized by white or light brown ash-coloured flesh and a cream-brown rind, with a medium-sized neck (National Root Crop Research Institute (NRCRI), 2019; Reuters, 2022). TMS 419 boasts higher starch content and improved production traits, making it suitable for industrial and domestic purposes, thereby encouraging increased farmer output (Owoseni, Okunlola, and Akinwalere, 2021). It meets the demands of cassava-related industries due to its starch-rich properties and offers good consumption qualities for local consumers (PwC, 2020). The starch content ranges from 63.08% to 73.93%, while the protein content is relatively low, ranging from 0.80% to 1.52% (Owoseni et al., 2021).

Empirical studies have shown that low production and productivity remain persistent challenges in the agricultural sector, including TMS 419 cassava production in Nigeria and other cassava-producing countries. These challenges limit the crop's ability to fulfil its traditional roles in economic growth and development (Anyanwu, 2015). In response, improved cassava technologies—including the use of fertilizers, pesticides, timely planting, weeding, and minimum tillage—were disseminated to cassava farmers by the Anambra State Agricultural Development Programme (ADP) and the Ministry of Agriculture in local government areas. However, limited follow-up by extension services, such as technical advice on line planting and the proper use of inputs, has hindered the adoption of these technologies. The moribund state of Nigeria's extension system, primarily due to the withdrawal of World Bank sponsorship, has exacerbated these challenges.

The factors influencing farmers' decisions to adopt technical assistance for improved cassava technology remain underexplored in the study area. Therefore, this study aims to: (i) describe the socioeconomic characteristics of cassava farmers, (ii) ascertain the determinants of TMS 419 cassava variety adoption, and (iii) identify constraints to the adoption of improved cassava technology in the study area.

METHODOLOGY

Anambra State is located at longitude 6°36´-7°21´E or Greenwich Meridian and latitude 5°38´N – 6°47´N of Equator. Anambra State consists of 21 Local Government Areas with a total population figure of 3.261 million people (NPC, 2006) and a land mass of 4415.54 km^2. The inhabitants are agrarians and also engage in off-farm income-generating activities.

One hundred and twenty respondents were selected using multi-stage sampling techniques. In stage 1, three out of four Agricultural Zones were randomly selected. In stage 2, four Extension Blocks were purposively selected from each of the Zones. This brought to a total of twelve Blocks. In stage 3, a Circle is purposively selected from each Block. This brought to a total of twelve Circles. Finally, ten respondents were randomly selected from the list of improved farmers presented by the extension agent in charge of the Circle. This brought a total of one hundred and twenty respondents to the study.

Structured questionnaires and oral interviews were used to collect data for the study. The objectives of the study were addressed using percentage responses for objectives I and iii, while the Tobit model was used to achieve objective ii.

The Tobit model, as developed by Tobin, could be expressed as:

$Y^*=x\beta\ e$ ……………………………………………(1)

Where β is a vector of unknown coefficient, x is a vector of independent variables, and e is an error term that is assumed to be independently distributed with mean zero and a variance of S^2. Y^* is an unobservable latent variable. If the data for the dependent variable is above the limiting factor, zero is this case; Y is observable as a continuous variable. If Y is the limiting factor, it is held at zero. This is presented mathematically in the following two equations.

$Y = Y^*$ if $Y^* > Y_0$,

$Y=0$ if $Y^*<Y_0$………………………………......(2)

Where: Y_0 is the limiting factor. These two equations represent a censored distribution of the data. The Tobit model can be used to estimate the expected value of Y as a function of a set of explanatory variables (x) weighed by the probability that $Y_i \geq 0$. Dennis and Romanus (2018) show that the expected intensity of adoption

$\sum(Y)$ is $\sum Y = x\beta\ f(z) + \alpha f(z)$ and $Z = x\beta/\sigma$…………………………….(3)

Where f(Z) is the cumulative normal distribution of Z, f(Z) is the value of the derivative of the normal curve at a given point (unit normal density). Z is the Z score for the area under the normal curve and S is the standard error of the error term. The coefficients for variables in the model, β do not represent marginal effect directly but the sign of the coefficient will give the researcher information as to the direction of the effect

The model is specified in an implicit form as follows: $Y= F (X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8 + ei)$…………(4)

Where : Y = Adoption rates (%), X_1 = Age in years, X_2 = Educational level in years, X_3 = Household size in persons, X_4 = farming experience in years, X_5 = Membership of farmer organization(Dummy), ei = Error term.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

Table 1 describes the socioeconomic characteristics of the respondents.

Table I: Distribution of Respondent According to Socioeconomic Characteristics

Variables	Frequency	Percentage
Age		
Less than 20	3	2.5
21-40	35	29.2
41-60	60	50
62 and above	22	18.3
Level of Education		
No formal education	35	29.2
Primary school	60	50
Secondary school	20	16.7
Tertiary	5	4.2
Membership of Organization (dummy)		
Yes	20	16.7
No	100	83.3
Farming Experience		
1-10	11	9.2
11-20	26	21.7
21-30	52	43.3
31-40	31	25.8
Household Size		
1-5	22	18.3
6-10	35	29.2
11-15	34	28.3
16-20	17	14.2
Extension Services		
Had Access	40	33.3
No access	80	66.7

Sources: Field survey, 2024.

Table 1 shows that 68.33% of the respondents were above 41 years old, while 31.67% were below 41 years in the study area. Older farmers are often risk-averse and conservative toward adopting new technologies, as they fear losing the wealth they accumulated during their youth (Anyanwu, 2015). On the other hand, younger farmers tend to be more innovative, adaptive, and energetic, enabling them to withstand the physical demands of farming compared to their older counterparts (Ume et al., 2020).

Additionally, the majority of respondents (71.93%) attained various levels of formal education, while 29.17% had no formal education. Farmers with formal education are more likely to adopt and utilize improved agricultural technologies that can enhance their standard of living (FAO, 2022). Furthermore, 83.3% of the respondents were members of cooperative organizations, while only 17.7% were not. Literature indicates that cooperative members have better access to information on improved cassava innovations and essential material inputs such as fertilizers and pesticides through their membership (Ume et al., 2020).

Moreover, 69.16% of the sampled farmers had 21–40 years of farming experience, while 30.84% had 1–20 years of experience. Long farming experience implies greater practical knowledge in addressing farming challenges, which can lead to higher yields (Anyanwu, 2015). The household size distribution revealed that the majority of farmers (29.2%) had household sizes ranging from 6 to 10 people, while the smallest proportion (14.2%) had household sizes of 16–20 people. Larger households with members of working age can provide labour during peak farming seasons, enhancing farm productivity (NRCRI, 2020). However, Ume and Kaine (2021) argue that this assertion holds only if household members are of labour age. Finally, Table 1 indicates that only 35.3% of the respondents had contact with extension agents, while the majority (66.7%) did not. This highlights poor extension outreach, which negatively affects the adoption of agricultural innovations and ultimately leads to reduced crop profitability (Khadijat, 2021).

Determinants of TMS 419 Cassava Variety Adoption

The result of ascertaining the determinants of TMS 419 cassava variety adoption is presented in Table 2. The results of the Tobit regression in Table 2 show that the coefficient of the farmer's age had an inverse relationship with technology adoption at the $p < 0.01$ level of significance. This implies that as farmers grow older, their ability to carry out the manual labour associated with technology adoption, especially labour-intensive crop technologies, decreases. However, old age is often linked to long years of farming experience, which could positively influence farmers' adoption decisions (Khadijat, 2021). This finding aligns with the work of Okoye, Okoye, and Ume (2021), who reported similar results. Moreover, the coefficient of education level showed a positive association with technology adoption at the $p < 0.01$ level of significance. Farmers with formal education are often less risk-averse and more likely to adopt technologies that could enhance their welfare compared to their less-educated counterparts (Khadijat, 2021). This is likely because educated farmers are typically more receptive, better evaluators of technologies, and willing to adopt innovations that promise economic benefits. Additionally, the coefficient of household size was positive and statistically significant at the $p < 0.05$ level. This implies that as household size increases, the adoption of cassava technologies also improves. Larger households, particularly those with working-age members, can provide more family labour for farm activities and adapt to innovative changes (NRCRI, 2019).

Table 2; Result of ascertaining the determinants of TMS 419 cassava variety adoption

Variable	Coefficient	Std Error	Z	P>|z|
Constant	1.456	0.018	(13.451)***	0.008
Age	-0.016	0.005	(-3.450)***	0.012
Household size	2.065	0.075	27.553***	0.0011
Farm. Experience	0.063	0.821	0.914	0.009
Organization	0.060	0.817	0.814	0.015
Extension Visit	0.017	0.0137	1.308*	0.0090
Household size	0.039	0.018	2.167**	0.0021
No of Observation	120			
LR chi^2 (19) =	85.16			
Pseudo R^2	0.4223			
Probit> chi^2	0.0036			
Log likelihood	-57.5574			

Source: Field Survey,2024.
*, ** and *** imply significance at 10%, 5% and 1% respectively, Figures in parentheses are the t-ratio

However, findings from Okoye et al. (2021) and Ume, Uloh, Onyeke, and Nwose (2020) suggest a contrasting perspective. They observed a negative relationship between larger household sizes and technology adoption, arguing that an increase in dependent populations within households could lead to consumption-oriented economies with limited savings to procure necessary material inputs for technology adoption. Furthermore, the coefficient of extension contact showed a positive relationship with technology adoption at the $p < 0.01$ level of significance. This finding aligns with the work of Olutosin and Otekunrin (2019), who reported that extension services play a crucial role in facilitating technology adoption by providing farmers with information on the proper application of technologies and access to technological inputs. However, this result contrasts with Owoseni, Okunlola, and Akinwalere (2021), who noted that factors such as high farmer-to-extension agent ratios and the negative attitude of extension agents could contribute to a negative impact on technology adoption.

Constraints to the Adoption of TMS 419 Cassava

The constraints to the adoption of TMS 419 cassava in the study area are shown in Table 3

Table 3 Constraints to the adoption of TMS 419 Cassava with ranking

Problems	*Freq.	Percentage	Ranking
High cost and scarcity of improved variety	99	82.5	1st
Poor access to credit	98	81.7	2nd
High cost of labour	97	80.8	3rd
Low soil fertility	57	47.5	4th
Pests and Diseases	34	28.3	5th

Source Survey Data, 2024 *Multiple Responses

Table 3 indicates that the high cost and scarcity of TMS 419 planting material were significant challenges faced by the farmers, as represented by 82.5% of the total respondents, ranking it as the primary constraint. According to FAO (2022), limited access to farm inputs hinders farmers' ability to adopt new technologies. Consequently, there is a pressing need to subsidize improved farm inputs, which are often scarce and expensive in sub-Saharan Africa. Without this intervention, the adoption decisions of resource-poor farmers will continue to be adversely affected (Olutosin and Otekunrin, 2019).

Additionally, poor access to credit, reported by 81.7% of respondents, emerged as another significant barrier to technology adoption among cassava farmers. Owoseni et al. (2021) emphasized the critical role of credit in facilitating technology adoption, enabling farmers to procure essential inputs and hire labour for technology implementation. Furthermore, 80.8% of the respondents identified the high cost of laboUr as a hindrance to adoption, particularly for labour-intensive innovations. Ume et al. (2020) attributed the high labour costs to the rural-to-urban migration of able-bodied youth in search of white-collar jobs. Those who remain in rural areas often charge higher wages to meet urban standards of living.

The adoption of the improved TMS 419 cassava variety can significantly enhance food security and farmers' income. However, its adoption is influenced by factors such as household size, education level, and extension contact. Major constraints to adoption include poor access to credit, unavailability and high cost of planting materials, and high labour costs.

Based on these findings, the following recommendations are proposed to improve the adoption of TMS 419 cassava by farmers in the study area:

1. **Enhance Farmers' Education**:
   Farmers' educational status should be improved through adult education programs, workshops, and seminars. These initiatives will broaden farmers' knowledge and improve their capacity to adopt technologies, ultimately boosting productivity.
2. **Introduce Labor-Saving Devices**:
   Affordable and efficient labour-saving devices, such as hand-driven ploughs, should be developed and made available to genuine farmers at subsidized prices. This intervention will reduce the high labour costs that prevail in the area.
3. **Ensure Availability and Affordability of TMS 419 Cassava**:
   The availability and affordability of TMS 419 planting materials must be prioritized to discourage farmers from resorting to local varieties. Local varieties are genetically inferior and more susceptible to pests and diseases, which negatively impact yields.
4. **Motivate Extension Agents**:
   Government agencies and Non-Governmental Organizations (NGOs) should provide incentives to extension agents to enhance their performance and ensure they remain committed to their duties. This will improve farmers' access to technical guidance and support, facilitating the adoption of innovative practices.

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