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Efficiency of Resource Utilization among Elderly Cassava Farmers in Ogbadibo Local Government Area, Benue State, Nigeria

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Abstract

The study evaluated the efficiency of resource use among elderly cassava farmers in Ogbadibo Benue State, Nigeria using a multi-stage random sampling technique to select respondents with descriptive statistics and stochastic production frontier model as tools of analysis. Findings revealed mean age of 55.43 years. Majority (79%) had attained some levels of formal education, predominantly married (61.66%), and mostly male (60%), 58.33% identified farming as their primary source of income, mean farming experience was 20.99 years, mean household size of six persons and mean annual farming income of ₦118,050.80. The elasticity coefficients from stochastic frontier indicated that farm size (0.3209) and fertilizer use (0.0640) had positive and significant effects at the 1% level. Labor (-0.1749) and chemical inputs (-0.0361) had negative and significant coefficients at the 1% level. The coefficient of cassava bundles was positive (0.1566), significant at the 10% level, implying that increasing the use of cassava bundles would enhance yield. The technical efficiency analysis revealed that household size (-0.1151) and educational level (-0.3838) were significant at the 1% level and negatively associated with technical inefficiency. Age was found to have a positive coefficient (2.2494). The mean technical efficiency was 74%. The study concludes that aged cassava farmers were operating below the production frontier. The study recommends the need to subsidized inputs to encourage elderly farmers in cassava production, education of farmers on the use of resources is also advocated, gender bias policy towards female that will encourage them in cassava production is also recommended.

Keywords: Stochastic analysis, Elderly farmers, Cassava and Technical efficiency.

Introduction

Nigeria's rural economy still remains basically agriculture. The main source of income and a major factor in Nigeria's economic expansion is agricultural production (Akinboro, 2014). In general, a major determinant of agricultural production yield is resource utilization. The primary resource inputs utilized in agricultural production include land, labor, capital-seeds, machinery, herbicides, chemicals, fertilizer, pesticides, and management, according to Nkang and Ele (2014).

Nigeria has a vast area of 923,768 km^2, an estimated 68 million hectares of arable land, an abundance of natural forest and rangeland encompassing 37 million hectares, and a variety of livestock and animals, according to the Food and Agriculture Organization (FAO, 2018). The country's environment is conducive to agriculture, and its coastline boasts approximately 960 kilometers of marine resources, according to the organization. The organization claims that Nigeria's agricultural resources also include vast lakes and rivers that span 120,000 square kilometers.

Given that land is the most valuable resource and is used extensively in farming, agriculture has significant land-related constraints compared to other economic sectors. However, the already overburdened land resources are under more and more strain due to population growth. Improving land, a limited resource, is necessary to boost productivity in economies with limited resources. The second most crucial and costly resource in crop production, according to the study of Nkang and Ele (2014), is labour. The amount and extent of operations are determined by the usage of capital, which encompasses all man-made productive assets employed in production, such as cash, equipment, seeds, chemicals, fertilizer, and machinery. Because some crops, like cassava, can withstand harsh weather conditions and less fertile soils, less fertilizer is used in these crops. Crop production also makes use of management. In agricultural production, it involves making decisions about the utilization of resources or the combination of other resources.

Growing food insecurity and vulnerability for millions of people around the world indicates that food production and distribution systems are broken. Farmers need to optimize resource use efficiency by using best management practices that help in timely planting, reduce cost, improve soil health, increase profits, help in adapting to terminal heat stress and reduce environmental footprints while improving their production outcomes. Therefore, Resource use efficiency is critical in crop production as it can reduce production costs, increase yields, promote sustainability, and enhance food security (Golmei *et al*, 2022)

Resource use efficiency is the ability to maximize output while minimizing input, which is an essential factor in crop production. The efficient use of resources is crucial in agriculture, as it can reduce production costs, increase yields, and enhance the sustainability of agricultural practices (Golmei *et al*, 2022).

In Benue State, Nigeria, cassava (Manihot esculenta) is the most important crop. It is a perennial woody shrub that is grown primarily for its tuberous roots and leaves. Its growing significance among Nigerian crops is linked to both its rising demand as food and food security (FAO, 2018). Efficient farms make better use of existing resources and produce their output at the lowest possible cost (Adegbite & Adeoye, 2015).

A global trend, particularly in China, is the aging of agricultural labourers, or farmers. Li and Sicular, (2013), have noticed an accelerating trend towards aging of the agricultural labour force in China. According to them, results from the stochastic frontier production function and efficiency analysis reveal that household-level technical efficiency increases until maximum efficiency is reached when the average age of the household labor force is 45, after which efficiency declines. The impact of elderly farmers on agricultural land use efficiency in areas with varying levels of economic development was examined by Yang and Hu (2011), who came to the conclusion that households with a large proportion of young workers had higher land use efficiency than those where older workers performed the majority of the labour.

Numerous research on agricultural resources, production, and management have been conducted, efficient resource use given their level of technology (Nwosu & Chidebelu, 2014), Food and Agriculture Organisation (FAO, 2018), Nweze Panwall, 2016), Agom *et al*, (2012) to mention but a few. However, no research has been specifically carried out on efficiency of resource utilization among aged cassava growers in Benue State's Ogbadibo Local Government Area, of Benue State, hence the importance of this study. The objectives of this study were to: describe the socioeconomic characteristics of the elderly cassava farmers and to determine the degree of their technical efficiency. It was hypothesized that the elderly cassava farmers are not efficient.

Research Methods

The research was in Ogbadibo Local Government, one of the twenty-three local government areas in Benue State, Nigeria created in 1991. There are thirteen council wards in all. Its name comes from the local brook known as Ogbadibo. Makurdi is 250 kilometers west of Ogbadibo Local Government Area. Its land area is 598 km2, and as of 2021, its population is expected to be 186,627. Udenu and Igbo Eze-north Local Government Areas of Enugu State to the west and south, respectively, and Okpokwu Local Government

Area to the east and Olamaboro Local Government Area of Kogi State to the north enclose the local government area.

Since the majority of the residents of Ogbadibo Local Government are farmers who produce commercial amounts of cassava, millet, sorghum, maize, palm oil, and palm wine, the local markets are frequently bustling with traders from neighboring states as well as other regions of Benue State. Large reserves of kaolin and coal can be found in Orokam and Owukpa, respectively. A dialect of Idoma is the primary language spoken by residents of the Ogbadibo local government region.

A multi-stage sampling technique was used to select the aged farmers that made up the sample because it was practically impossible to cover all of the aged farmers in the study area. First, five council wards that were notable for having high cassava farming activities were chosen purposefully; next, two communities from each of the five council wards were chosen proportionately using simple random sampling, for a total of 10 communities; then, in the third and final stage, 12 elderly farmers were chosen from each community using a proportionate sampling to give every community equal number making a total of 120 elderly farmers for the study.

A questionnaire based on the study's goals was used to gather data from primary sources in order to extract the necessary information. Descriptive statistics such as frequency distribution, percentages, means, tables, and inferential statistics (stochastic production frontier) were used to analyze the data. The following metrics were used to measure the study's variables: A dummy 1 denoted male and 2 denoted female for the measurement of sex.

Age is the amount of years that a person has been alive. The actual number of years the respondent had lived at the time of the study was used to calculate age in this study. Education: A respondent's total years of formal schooling were used to calculate their level of education. The total number of persons that share a pot and live in a household is known as the household size.

Farming experience was measured in years. Contact with extension agents is numbers of times a farmer has met with extension agent in a year, it was measured in numbers, annual income is the total money earned in a year, and it was measured in naira (₦). Farm size is the total land area cultivated by the farmer, it was measured in hectares (Ha). Married=1, Single=0 was used as a dummy to measure marital status and Divorce or separated =2). Quantity of herbicides was measured in litres (L), Fertilizer was measured in kilogram (Kg)

Model specification

The Cobb - Douglas Stochastic Frontier Model

To estimate the Maximum Likelihood Estimates of parameters in the Cobb-Douglas production function, the Frontier 4.1 statistical software, created by Coelli (1995), was utilized. This approach integrates the inefficient error components with the proposed efficiency determinants. The following is the specification for the function:

$$lnY_i = \beta_0 + \beta_1 lnX_1 + \beta_2 \, lnX_2 + \beta_3 lnX_3 + \beta_4 X_4 + \beta_5 lnX_5 + (v_i - u_i) \; v_i \sim N(0,\sigma^2_v) \ldots\ldots\ldots\ldots..(1)$$

Where:
Ln=Natural logarithm
Y_i = Quantity of cassava output (kg), X_1 = Labour of i*th* farmers (man-days), X_2 = fertilizer used by i*th* farmer (kg), X_3 = chemicals used by i*th*farmer (l), X_4 = cassava cutting bundles by i*th* farmer (kg), X_5 = farm size cultivated by *ith* farmer (ha)

V_i= Error term which is a free variable
U_i= Error term, which refers to technical inefficiency effect or non-random variables
β_0= Intercept
The coefficients are β_1- β_5
The socioeconomic traits of farmers which are the causes of the technological inefficiency model is defined by: $U_{ij}= r_0+ r_1Z_1+ r_2Z_2+ r_3Z_3+ r_4Z_4+ r_5Z_5+ r_6Z_6+ r_7Z_7+ e_i$ .... (2)

Where:
r_0= constant, r_1 to r_7 = parameters to be evaluated, and |ui| = ith farmer's inefficiency
$u_i= u_i \sim N^+(0,\sigma^2_u)$

The independent variables are denoted by z_1... Z_7 specified as farm and farmer-specific variables
Z_1 = Age of respondents (years)
Z_2 = Educational attainment (years)
Z_3 = Experience in farming (years)
Z_4 = Number of people in a household (number)
Z_5 = Number of extension contact (number)
Z_6 = Membership in a cooperative (dummy = 1 if member, and 0 otherwise)
Z_7 = Credit access (1= access and 0 otherwise)

Results and Discussion

Socioeconomic Attributes of the Participants

Age, educational attainment, marital status, household size, farming experience, extension contact, source of income, annual farm income and farm size are among the socioeconomic factors of the respondents that were analyzed (Table 1).

According to table 1's age distribution, the majority of respondents (45.50%) were 40 years of age or under, 33.33% were between 53 and 60, 21.67% were between 61 and 68, and a minority (2.50%) were beyond 70. The respondents' average age was 55.43 years. This suggests that the majority of cassava farmers are elderly, yet they may possess a wealth of expertise that leads to greater farming innovation. This is completely consistent with the idea put forth by Ume *et al.* (2020) that older farmers have greater farming operations experience.

According to the respondents' educational attainment, the majority (28.33%) had only completed elementary education, 26.67% had completed post-secondary education, 24.17% had completed secondary school, 17.50% had neither formal nor informal education, and 3.33% had received casual education. This suggests that the majority of responders had completed at least primary school and were read. This supports the conclusions of Gani *et al*. (2019), who suggested that Nigerian farmers were literate.

According to the marital status findings in Table 1, the majority of respondents (61.66%) are married, followed by widows and widowers (26.67%), separated people (8.33%), and single people (3.33%). This demonstrates the high percentage of married cassava producers in the research area. The implication is that married farmers typically have a large family workforce and participate in additional farming activities to supplement their income and support their families. This is consistent with Angba & Iton's (2020) findings that married couples control the majority of the cassava producing industry, which suggests that they have a good probability of obtaining a large number of family workers for their production and processing operations.

According to the results on respondents' size of the household, the majority (62.51%) have four to six members, 20.00% have seven to nine members, and 14.17% have one to three individuals and more than nine members. Six people made up the respondents' average household size. The implication is that the respondents are involved in cassava cultivation because they have a big household size to support family labor. This result is consistent with that of Ogah *et al.* (2021), who discovered that high household sizes can occasionally be beneficial if labour can be easily obtained at reasonable prices, leading to higher output.

Ukwuru & Egbonu (2013) expressed a similar opinion, pointing out that big household sizes help cassava growers by offering family labor, which results in a more effective use of resources and increased output. According to table 1's findings, 40.0% of respondents were women and 60.0% of respondents were men. This suggests that the majority of the research area's cassava producers are men. This could be because women handle the processing and marketing tasks, while men are typically regarded as doing the majority of agricultural producing activities. According to research by Nnadozie (2015), processing in agriculture is typically considered an interior activity that is typically performed by women, whereas farming is a masculine activity.

The result as shown in table 1 further revealed that most (58.33%) of the respondents engaged in farming as their major source of income, 19.17% are into tailoring, 10.83% of the respondents derive their income from trading activities, 6.67% are into fishing, 2.50% earn income from driving while 0.8% of the respondents are into carpentry, mechanics and aluminium work as their source of income. This suggests that full-time farmers make up the majority of responders who earn most of their income from farming activities.

Research on farming experience revealed that a greater percentage of respondents (44.17%) had between 6 and 16 years of experience, 22.67% had between 28 and 38 years, 21.67% had between 17 and 27 years of experience growing cassava, and 9.17% were into cassava farming for more than 38 years while 2.50% have 5 or less years of farming experience. The respondents had an average of 20.99 years of farming experience. Given their extensive expertise in cassava cultivation suggests that they are seasoned farmers. This is consistent with Ume *et al.* (2020), who stated that cassava growers have extensive farming expertise.

The majority of cassava farmers (49.17%) have farms between 1 and 3 hectares, 48.33% have farms between 4 and 6 hectares, and 2.50% have farms between 7 and 9 hectares, according to table 1's distribution of cassava farmers by farm size. 3.68 hectares is the average farm size of the respondents. This suggests that the vast majority of those surveyed are small-scale farmers with less than five hectares under cultivation. According to Agwu & Anyanwu's (2019) research, cassava farmers are small-scale producers who primarily produce at the subsistence level.

Table 1 also revealed that 43.33% of respondents have contact with extension agents, whereas the majority (56.67%) does not. In the research area, this suggests that the majority of farmers do not interact with extension agents. In contrast, Umeh *et al.* (2013) reported an average of two interactions with extension agents.

According to the results of the respondents' annual farm income obtained from farming activities, the majority (82.50%) earns between N50001 and N150000, 13.33% earn between N150001 and N250000, 3.33% earn between N250001 and N350000, and 0.83% earn between N3500001 and N450000 annually. The yearly income was N118050.8 on average. This suggests that the majority of those surveyed are low-income farmers who work for subsistence.

Table 1: The Respondents' Socioeconomic Characteristics in the Study Area Were Distributed as Follows, n=120

Variables	Frequency	Percentage	Mean
Age (years)			
≤45	51	42.50	55.43
53-60	40	33.33	
61-68	26	21.67	
≥70	3	2.50	
Educational Level			
None	21	17.50	
Casual Education	4	3.33	
Elementary Education	34	28.33	
Secondary Education	29	24.17	
Postsecondary Education	32	26.67	
Marital Status			
Single	4	3.33	
Married	74	61.66	
Widowed/Widowed	32	26.67	
Separated	10	8.33	
Sex			
Men	72	60.0	
Women	48	40.0	
Household size			
1-3	17	14.17	6
4-6	62	62.51	
7-9	24	20.00	
>9	17	14.17	
Source of Income			
Farming	70	58.33	
Trading	13	10.83	
Carpentry	1	0.83	
Aluminum Work	1	0.83	
Mechanics	1	0.83	
Tailoring	23	19.17	
Fishing	8	6.67	
Farming Experience (years)			20.99
≤5	3	2.50	
6-16	53	44.17	
17-27	26	21.67	
28-38	27	22.50	
>38	11	9.17	
Land owned (hectares)			
1-3	59	49.17	3.68
4-6	58	48.33	
7-9	3	2.50	
Extension Contact			
Yes	52	43.33	
No	68	56.67	
Annual Farm Income (₦)			

50001-150000	99	82.50	118050.8
150001-250000	16	13.33	
250001-350000	4	3.33	
350001-450000	1	0.83	

Source: Field Survey, 2022

Stochastic Frontier Function's Parameters of the Elderly Cassava Farmers

From 0 to 1, the estimate of gamma represents the degree of inefficiency in the variable parameter. The gamma estimate illustrates the degree of variance brought on by the elderly cassava producers' technical inadequacies. The outcome shows that the estimated gamma parameter (γ) is statistically different from zero (Table 2) and tiny (0.43). In contrast to random variability, this suggests that variations in the application of best practices are the primary cause of the aged cassava farmer's output deviating from the maximum output. The inefficiency of resource management accounts for 43 percent of the difference in output among older cassava producers.

Additionally, the variance parameter's sigma squared (δ) estimate is 0.0005282. Because of their socioeconomic features, the elderly cassava farmers may be somewhat inefficient, as indicated by this significant finding at the 1% level. As a result, the traditional production function does not adequately describe the data. Therefore, using the Maximum Likelihood Estimator (MLE), the diagnostic statistics results validate the validity of the stochastic frontier production function, showing that inefficiencies are widespread and affect the productivity of the elderly cassava farmers in the research area.

Findings from Table 2 revealed that the coefficient of cassava cuttings (0.1566069) is has a correct sign and is significant at 10%, an indication that a 1% increase in cassava cuttings boosts production by 15%. This may be due to the fact that as more cuttings are used, the production scale will be increase which will lead to increase in output. This is in line with Agwu & Anyanwu (2019) who reported increase in output of cassava as a result of increases in cassava cuttings.

Furthermore, the coefficient of fertilizer (0.064045) correctly signed and significant at 1%. This means that a 1% rise in fertilizer use will expand cassava yield by 6%. This may be due to the fact that fertilizer application helps to enhance the soil fertility thereby leading to increase in yield. This study gives credence to the report of Desalegn *et al* (2017) that application of soil amendment seems to be economically efficient in increasing output.

Chemicals (-0.0360949) has negative sign and significant at 1% level meaning that increase in chemical use by 1% will reduce cassava output by 3%. This may be due to the fact that chemicals may be overused this will make the soil to be acidic thereby decreases output. This disagrees with Omolara *et al.* (2017) who found that increase usage of agrochemicals leads to increase in output.

From Table 2, it can be seen that the coefficient of labour (-0.1748932) is negative and significant at 1%, an indication that when labour is increased by 1%, cassava yield decrease by 0.1748932 units. This can be attributed to the fact that law of diminishing marginal utility might have set in and labour is not properly used. Also, family labor may be overused because farming household doesn't pay for family labour, again there may be over reliance on family labour. This is supported by Angba & Iton (2020).

At the 1% level of significance, the results from Table 2 also showed that the farm size coefficient (0.3209461) was favorably significant. This suggests that cassava production will rise by 32% with an increase in farm size. This may be explained by the fact that a larger farm will yield a larger production scale, which in turn will produce more.

The return to scale can be found by adding together these elasticities, The return to scale of the elderly cassava farmers was 0.33 indicating that their output was declining. A drop in output results from an increase in input most likely due to inefficient utilization of resources.

Technical Inefficiency of the Elderly Framers

The variation in the efficiency level of different farms is explained by the coefficient of the factors included in the inefficiency model. Technical efficiency is decreased when an independent variable of the inefficiency function has a positive value, which raises the inefficiency factor. On the other hand, a negatively signed coefficient of the inefficiency function's independent variable lowers the inefficiency value and raises technical efficiency. The lower portion of Table 2 displays the findings from the inefficiency effects model.

According to the findings, at the 10% level of significance, the age coefficient (2.249356) is positive and significant. This suggests that technical efficiency will decline with age. This implies that a farmer's efficiency will decline as he ages because his capacity to labour will diminish. This study supports Obayelu *et al.* (2013)'s findings that farmers' efficiency declines with age. At 1%, the coefficient of household size (-0.1151331) is significant and negative. This suggests that a larger household will result in more technical efficiency and less technical inefficiency.

One explanation for this is that as household size increases, more labour will be available to be used on the cassava farm; this may lead to faster operation on the farm thereby increasing efficiency. This also implies that there is specialization among the labourers and work will be done efficiently. This finding is in agreement with Ukwuru and Egbonu (2013), Ogah *et al*, (2021) that large household sizes can sometimes be beneficial since labour can be easily obtained at reasonable prices, increasing output.

From Table 2, the coefficient of educational level is negative (-0.3837905) and is significant at 1% indicating that additional education of the farmer will make them more efficient as they acquire more managerial ability which enhances their decision making. This study agrees with Nnadozie (2015) who posited that educated farmers tend to be more efficient than illiterate ones.

Table 2. The Stochastic Production Frontier Function of Technical Efficiency of Elderly Cassava Farmers: Maximum Likelihood Estimates (MLE)

Variables	**Coefficient**	**Std. Error**	**z-Stat**	**P>|z|**
Cuttings (bundles)	0.1566069	0.09211	1.70***	0.089
Fertilizer (kg)	0.064045	0.0578226	3.11*	0.009
Chemicals (litre)	-0.0360949	0.0563241	-3.64*	0.000
Labour (man day)	-0.1748932	0.1273062	-3.37*	0.007
Farm size (hectare)	0.3209461	0.0574893	5.58*	0.000
Constant	6.716127	0.2154325	31.18*	0.000
Inefficiency Effect				
Age	2.249356	1.351538	1.66***	0.096
Household size	-0.1151331	0.3514466	-2.33*	0.007
Educational level	-0.3837905	0.2956476	-3.30*	0.000
Constant	-11.49079	5.272883	-2.18	0.029
sigma	0.0005282	0.165881	2.6e-271	1.1e+264
Gamma	0.430521	0.7568	1.76***	0.012

Log likelihood = 9.0617543

Prob> chi2 = 0.0000

***** = important at 1%, *** = important at 10%

Source: Field data, 2022

Efficiency in Technology Analysis

The distribution of technical efficiency among the elderly cassava farmers in the research region showed that average technical efficiency was 74%, (Table 3), minimum technical efficiency was 71%, and maximum technical efficiency was 78%. This suggests a lack of technological efficiency among the farmers. Thus, on this we accept the null hypothesis that elderly cassava growers are not technically efficient in the research area.

The technical efficiency distribution among the elderly cassava farmers in the study area revealed that the estimated technical efficiency differ with the mean technical efficiency (Table 3) of 74%, the minimum technical efficiency of 71% while the maximum technical efficiency is 78% This implies that the farmers are not technically efficient. Therefore, the null hypothesis that elderly cassava farmers are not technically efficient in the study area is hereby accepted.

Table 3: Technical Efficiency Among Elderly Cassava Producers

N	**120**
Average	**74.19772%**
Highest	78.4119%
Lowest	71.30674%
Deviation from mean	0.1293496

Source: Field data (2022)

Conclusion and Recommendations

Cassava farming is primarily done by men, according to a study on the resource use efficiency of elderly cassava farmers. Additionally, it was disclosed that the respondents' average age was 55.43 years. The majority of those surveyed were married, literate, and had completed at least primary school. The respondents' mean household size was six persons, as was also disclosed. Additionally, the survey discovered that the farmers have a low yearly income and an average of 20.99 years of farming experience. With a mean technical efficiency of 7.8, the study concluded that older cassava growers lacked technical efficiency. Age, education, and household size are the main factors that affected efficiency. The report suggests that the government should provide price subsidies for price of farming inputs used in cassava production so as to encourage more aged farmers to venture into cassava production. Government at the state and local levels should employ more extension agents and reinforce the existing ones in order for them to bridge the gap between the farmers and innovations in farming thereby exposing farmers to new method of farming and improved cultivars of cassava that will increase output level. Gender bias policy in favour of female folks should be established to support women in cassava production. The elderly cassava farmers should be encouraged with incentives like inputs to boost their morals in cassava farming.

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