**TECHNICAL, ECONOMIC AND ALLOCATIVE EFFICIENCY AMONG CASSAVA FARMERS IN ABAK LOCAL GOVERNMENT AREA OF AKWA IBOM STATE, NIGERIA**

**ABSTRACT**

*The study stud analyzed the technical, economic and allocative efficiency among cassava farmers in Abak Local Government Area, Akwa Ibom State, Nigeria. The specific objectives were to; describe the socioeconomic characteristics of cassava farmers in the study area; determine the technical, economic and allocative efficiency of cassava farmers in the study area; analyze the profitability of cassava farming in the study area; estimate the determinants of technical and economic efficiency among cassava farmers in the study area; and examine constraints militating against cassava production in the study area. Multistage sampling procedure was used in selecting 120 respondents for the study. Primary data were obtained using structured questionnaire and the data obtained were analyzed using descriptive statistics, gross margin analysis, and stochastic frontier production function. The result showed that the mean age, household size, farming experience, and farm size of the sampled respondents were 39 years, 4 persons, 6 years and 1.9 hectares, respectively. The mean, maximum and minimum technical efficiency were 0.73, 0.95 and 0.38 while the mean, minimum and maximum economic efficiency for cassava production were 0.72, 0.35 and 1.00 respectively. The ratios of the marginal value product to marginal factor cost of labour (16.867) and cassava cutting (3.369) were greater than 1, signifying under-utilization of resources while farm size (0.190), and herbicide (-0.545) were over utilized. The results of the estimated stochastic production function and the determinants of technical inefficiency showed that farm size (p<0.01), cuttings (p<0.01) and labour (p<0.01) were found to be significant inputs in cassava production while household size (p<0.1), education (p<0.01), monthly income (p<0.01), membership of cooperative (p<0.01), access to credit (p<0.01), access to extension services (p<0.1), and (p<0.05) were the determinants of technical inefficiency of cassava production in the study area. The results of the estimated stochastic production function and the determinants of economic inefficiency showed that labour (p<0.01) was found to be significant input in cassava production while age (p<0.01), household size (p<0.05), education (p<0.01), farming experience (p<0.05), and access to extension (p<0.01) were the determinants of economic inefficiency of cassava production in the study area. Based on constraints militating against cassava production, the result showed that high cost of fertilizer (13.7%), theft (13.7%), lack of access to credit (13.7%), inadequate access to land (13.7%), and poor road network (13.7%) were the major constraints militating against cassava production while poor extension services (9.3%) and high cost of labour (8.5%) were the least constraints militating against cassava production in the study area. The study recommends that effective agricultural policies and programmes should focus on granting farmers improved access to farm credit and subsidized inputs as these would enable them increase their production efficiencies positively in the area.*

**CHAPTER ONE**

**INTRODUCTION**

1. **Background of Study**

Cassava (*Manihot esculenta*) is the only crop, from the roots and tubers crop group, cultivated in all tropical regions in the world, including all the sub-tropical countries in Asia. It is the fifth most important staple crop after maize, rice, wheat, and potatoes, and the second most vital African staple consumed per calorie, after maize. [Cassava](https://en.wikipedia.org/wiki/Cassava) (*Manihot esculenta*) production is vital to the [economy of Nigeria](https://en.wikipedia.org/wiki/Economy_of_Nigeria) as the country is the world's largest producer of the commodity. The crop is produced in 24 of the country's 36 states (Oni and Akanle, 2018). In 1999, Nigeria produced 33 million tonnes, while a decade later, it produced approximately 45 million tonnes, which is almost 19% of production in the world. The average yield per hectare is 10.6 tonnes (Eguono, 2015). According to FAO (2018), as of 2018, world cassava production stood at about 278 million tonnes; Africa total production was about 170 million tonnes (about 56% of world production) (FAOSTAT,2019). At the same period, Nigeria produced about 60 million tonnes (FAOSTAT, 2019). Nigeria is the largest cassava producer in Africa, accounting for about one-fifth (21%) of total production worldwide. The demand for cassava and its constituents is high in the domestic economy. Nigeria is the largest producer in West Africa, according to researchers. Nigeria's cassava production stands for 20.4% of the globe's total output since 2017 (Olutosin and Sawicka, 2019), Nigeria has become the world's largest producer of cassava as a result of this proportion. Major cassava producing states in Nigeria are Benue, Kogi, Cross River, Ondo, Imo, Akwa Ibom, and Rivers states (Daniels *et al.*, 2011). In Africa, cassava is one of the most important staple food crops that can thrive in any field and climatic conditions. It derives its importance from the fact that it’s starchy, thickened, tuberous roots are a valuable source of cheap calories. Cassava leaves which are about 7-12 percent protein are also used as a vegetable in traditional soups and stew. Cassava accounts for between 40-50 percent of all calories consumed in Southern and Central Nigeria (Chuks, 2014). Cassava is a good staple food, with nationally required food security minimum of 2400 calories per person per day (World Bank, 2010). Cassava could be processed domestically in Nigeria as cassava flour, starch, chips, and other Nigerian delicacies such as *Gai* (*Eba*), *Akpu*(*Fufu*)*,* and *Abacha*, among several others (Agricdemy, 2018). Its root starch is used in a wide array of industries, including food manufacturing, pharmaceuticals, textiles, plywood, paper, adhesives, and as feedstock for the production of ethanol biofuel (FAO, 2013).

Technical efficiency refers to how well farmers use inputs such as labor and manure in producing tomatoes. Recent studies have shown that technical efficiency in agricultural production is a critical factor in achieving sustainable food production (Battese and Coelli, 2015). Technical efficiency refers to maximizing the output of a given input mix. In the context of tomato production, it aims to increase the yield by using limited resources effectively.

Allocative Efficiency (AE) refers to the ability of a firm to produce at a given level of output using the cost-minimizing input ratios (Ettah and Angba, 2016). In Nigeria, root and tuber crops such as cassava (*Manihot* spp.) have a significant place in the economy (International Institute of Tropical Agriculture (IITA) (2016) and Nigeria Bureau of Statistics (NBS) 2016). These crops not only contribute to the share of agriculture in national economy but possess a great potential and comparative advantage to compete in the liberalized economy (Denen *et al.*, 2016). Similarly, cassava is grown by almost every household in Nigeria (Onubuogu *et al.*, 2014) and serves more as a major source of income especially for the increasing rural dwellers (Zamanti and Jaderka, 2016). Cassava is also identified as a promising crop for international trade, as demand for cassava derivatives, e.g. garri (a type of processed cassava), starch and tapioca doubled over the last two decades (Ettah and Angba, 2016).

**1.1 Statement of Problem**

The challenges faced by cassava farmers are therefore multifaceted and they range from population pressure, environmental degradation, natural disaster and social conflicts. Their low productivity may also be due to inadequate allocation of inputs, lack of improved technology and inefficiency in the use of productive resources. Due to several factors ranging from environmental, socio-economic, cultural and technological issues, cassava production has suffered severe setback in most farming communities in Nigeria; hereby hindering most farmers from attaining optimum level of production and hence profit (Ohen et al., 2014). To achieve optimum output and profit efficiency, farm resources have to be optimally and efficiently utilized and output price adjusts following demand capacity. The ability of cassava farmers to adopt new technology and achieved sustainable production depend on their level of profit efficiency, mostly determined by variable inputs and output prices as well as the cost of fixed factors of production. Inability of farmers to adequately address this issue has resulted to loss of substantial output and revenue accrued to them. If this situation occurs, farm resource use will be sub optimal and the profits accrue to farmers drastically reduced. This connotes that, sustainability of farm enterprise is hinged on tackling the issue of insufficient farm resource mix and output price cycling (Udoh and Idiong, 2000). There is a dearth of information on economic and allocative efficiency in cassava production as little or no study have rigorously estimated the relative efficiencies (allocative and economic) of resources use of cassava farmers in Akwa Ibom State, Nigeria. It is on these backdrops that the study rigorously addressed the following research questions;

1. What are the socio-economic characteristics of cassava farmers in the study area?
2. Are the cassava farmers technically, economically and allocatively efficient in the study area?
3. Is cassava farming profitable in the study area?
4. What are the determinants of technical, economic and allocative efficiency among cassava farmers in the study area?
5. What are the constraints militating against cassava production in the study area?

**1.3 Objectives of the Study**

The broad objective of the study was to analyze the technical, economic and allocative efficiency among cassava farmers in Abak Local Government Area, Akwa Ibom State, Nigeria. The specific objectives were to;

1. describe the socio-economic characteristics of cassava farmers in the study area;
2. determine the technical, economic and allocative efficiency of cassava farmers in the study area;
3. analyze the profitability of cassava farming in the study area;
4. estimate the determinants of technical, economic and allocative efficiency among cassava farmers in the study area;
5. examine constraints militating against cassava production in the study area.

**1.4 Scope of the Study**

The study focused on the technical, economic and allocative efficiency among cassava farmers in the study area. The research was limited to only cassava farmers within the study area.

**1.5 Justification of Study**

This study aimed at opening a new dimension to farmers and policy makers on how to increase cassava production by determining the extent to which it is possible to raise efficiency of cassava farms with the existing resource base and available technology in order to address food the production problem in Nigeria. To be useful for policy intervention, the efficiency measurements in this study will be dis-aggregated into allocative and economic efficiencies using stochastic efficiency decomposition frontier analysis. The research will also be used as a reference material for further related research by students and academic researchers.

**CHAPTER TWO**

**LITERATURE REVIEW**

**2.1 Conceptual Framework**

**2.1.1 Productivity and Efficiency**

Productivity is the ratio of production output to constraining resources (inputs) (Sibiko, 2012). The measure of productivity is the total output per unit of total input (Fried et al., 2008). According to Coelli *et al.* (2002), productivity varies depending on the scale of operation, operating environment, production technologies, and operating efficiency. Productivity is simply a measure of productive efficiency. Similarly, according to Malinga *et al.* (2015), an increase in the efficient use of resources in the production process influences productivity. To enhance productivity, the efficiency of resource use must accompany the intensification of agriculture in the wetlands as farmers increase the use of technology in production.

Olayide and Heady (1982) attributed the issue of low agricultural productivity to inability of farmers to make use of available resources efficiently. Efficiency is an important factor of productivity growth. According to Kabwe (2012) efficiency could be considered as productivity at optimal values and can be investigated in three ways; technical, allocative and economic efficiencies. Fletschner et al., (2002) and Ajibefun (2008) defined price or allocative efficiency as ratio between minimum cost required to produce a certain level of output and the unit’s production costs if it were technically efficient. Heady (1982) stated that optimum productivity of resource implies an efficient utilization of resource in the production process. That is, attainment of a production goal without waste.

**2.1.2 Technical and Economic Efficiency**

Technical efficiency (TE) is explained by how best the resources (inputs) available in a farm are converted into products (outputs) which represent productivity (Malinga et al., 2015). Technical efficiency assesses whether the transformation of inputs achieves maximum output or attainment of maximum production without waste of resources. Allocative efficiency (AE) shows the ability of a producer to allocate the best proportions of inputs while considering the prevailing prices (Degla, 2015; Mutoko et al., 2015). Economic efficiency (EE) is thus clearly stated as the farm’s capability of producing maximum output at the minimum cost with a consideration of current technology for profit maximization (Aboki et al., 2013).

**2.1.3 Measurement of Efficiency**

**Data Envelopment Analysis (DEA)**

DEA model was formulated by Charnes et al. (1978) who carried on the seminal work of Farrel (1957) to incorporate many inputs and outputs simultaneously. DEA is a deterministic method used in measuring TE, which assumes all deviations from optimal output levels are due to inefficiency, rather than errors. According to Coelli et al. (2005), DEA uses the method of linear programming and creates a non-parametric frontier over sample data, and thereafter efficiency scores are then calculated in comparison to the frontier. Decision-Making Units (DMUs) are then compared to the best performer with a TE of 1 (Cesaro et al., 2009). Data envelopment method does not impose functional forms on the production frontier, which is a conventional practice for the parametric stochastic frontiers (KaraniGichimu et al., 2015). The method also differs from the parametric methods, as it does not make a priori assumptions. It makes the convexity and monotonicity assumptions creating room for a flexible frontier that enhance a functional form that is able to vary across all the DMUs. Despite the limitations of the deterministic DEA method, the approach has an advantage as it allows for the provision of information on input and output shadow prices of DMUs. It is also capable of handling multiple outputs and inputs, unlike SFA. The method nonetheless lacks robustness over outliers and its deterministic form makes it impossible to test for hypothesis (Chimai, 2011).

**Stochastic Frontier Analysis (SFA)**

This model was independently proposed by Aigner et al. (1977) and Meeusen & Van Den Broeck (1977). It separates the error term from the estimation of production function into inefficiency effects and random variations due to statistical noise and unlike DEA, it allows for hypotheses testing regarding the production structure and the level of inefficiency (Coelli et al., 2005). The most common model specifications of SFA are Cobb-Douglas (CD) and translog (Degla, 2015). In this study, the CD specification was used because it is self-dual and has been proven useful by many empirical studies related to agriculture in developing countries (Ogundari & Ojo, 2007; Tsue et al., 2012). Translog is faced by issues of collinearity due to increased numbers of variables as a result of multiplication of production factors during the model specification (Karani-Gichimu *et al.*, 2015).

**2.2 Theoretical Framework**

**2.2.1 Production Theory**

The production theory of the profit-maximizing peasant postulates that the peasant in attaining economic efficiency is aspired by dual goals: first, by attaining profit from the technical economic aspect of the farm as a business to produce the highest possible output which gives the highest net income measured either in monetary or physical terms; and second, by maximizing profit based on a behavioral content related to livelihood and the household need. This implies that the economic efficiency for a peasant farmer can be computed whether the producer is a subsistence farmer, or a fully commercial farmer (Ellis, 1993). Because it is a critical motive of a farm manager is to gain profit either in a monetary or physical unit, efficiency and profit maximization work together. An inefficient firm experiences lesser optimization of profits (Coelli et al., 2005). Two key methods are used to measure the production efficiency of a firm; namely, the stochastic frontier analysis (SFA), and the data envelopment analysis (DEA). The fundamental differences between the SFA and the DEA lie on whether the researcher intends to use a parametric or non-parametric method (Cooper et al., 2007). Based on the behavior assumptions of either cost minimization, revenue maximization, or profit maximization, the SFA and the DEA can utilize an input-oriented or output-oriented procedure to measures the overall efficiency. A fully efficient firm will have an inefficiency score of zero, and vice versa (Ellis, 1993). The study adopts the Stochastic Frontier Models because it relates to the actual performance of a firm to a standardized performance level of a given technology (Farrell, 1957). By comparing actual output values to a mean production frontier estimated, the technical efficiency effect is predicted; and similar comparison of relative output price and inputs to an optimized revenue frontier is used to predict the allocative efficiency effect.

**2.3 Empirical Framework**

**2.3.1 Socio-economic Characteristics of Cassava Farmers**

Adetarami *et al.* (2022) on the study “Use of Agricultural Programmes’ Technical Information on Adoption of Improved Technologies by Cassava Farmers in Ogun State, Nigeria” using descriptive statistics reported that 44.4% of the cassava farmers were between the ages of 21-40, with the mean age of 37.9 years. Majority (73.2%) of the respondents were male. 86.8% of the cassava farmers were married with a mean household size of 7 people.

Another study conducted by Uzochukwu *et al.* (2021) on the “Adoption of Improved Cassava Production Technologies among small-scale Farmers in Anambra State, Nigeria” using descriptive statistics revealed that majority (51.67%) of the small-scale cassava farmers in the study area are male while the remaining 48.33% are female. (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. 64.17% of small-scale cassava farmers are married, while others were found in otherwise category. (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 years.

Esiobu (2019) analyzed the allocative efficiency of cassava farms in Imo State, Nigeria. The socio-economic characteristics result showed that the mean age was 47.00 years. Greater proportions (73.33%) were female. Majority (76.67%) were married with an average household size of 6 persons. The mean educational level and farming experience were secondary and 28years respectively. Average farm size and annual farm income were 1.42ha and N500,500.00 respectively. Reasonable proportions (81.11%) were members of cooperative society.

Ibeagwa *et al.* (2019) estimated the determinants of allocative efficiency of smallholder cassava farmers in Imo State, south east Nigeria. The socio-economic characteristics results showed that there were equal number of males and females among the farmers with majority of them being young and energetic, having some level of formal education and fairly large household sizes.

Akpan *et al.* (2017) analyzed economic efficiency and perceived constraints to small scale cassava production in Oruk Anam Local Government Area of Akwa Ibom State, Nigeria. Analysis of Socioeconomic characteristic of farmers revealed an average age of 44.89 years and household size of 6 members. About 79.00% of cassava farmers do not belong to any social organization, while the mean annual farming income stood at N37, 970.00 per person. The result also indicates that majority (66.00%) of cassava farmers in the study area acquired their farm lands through inheritance.

**2.3.2 Allocative Efficiency of Farmers**

Esiobu (2019) reported that estimated gamma (γ) parameter of stochastic frontier production function showed that about 82.7% variation in output among cassava farmers in the study area was due to differences in relative efficiency. The return to scale (RtS) was 0.549 in the study area. This indicates a positive decreasing return to scale and that cassava production was in stage II of the production region where resources and production were believed to be efficient. The mean allocative efficiency was 0.860. Ibeagwa *et al.* (2019) reported that the average allocative efficiency was 56% while the maximum and minimum allocative efficiencies was 92% and 48% respectively farmers in Imo State, south east Nigeria.

Sihlongonyane *et al.* (2014) analyzed economic efficiency of maize production in Swaziland. Descriptive statistics, Cobb-Douglas production function and Tobit regression were used to analyse the data. The results indicated technical efficiency of 64.7% suggesting that farmers could still improve the technical efficiency by 35.3%. While, allocative efficiency was 99.52%, suggesting that farmers were able to use minimum costs to get a given level of output. In terms of economic efficiency, farmers were 64.3% efficient. Sanyang (2014) assessed the technical, allocative and economic efficiency of rice farmers in Central Gambia using a Cobb-Douglas production function and its dual cost model. Inefficiency was found among farmers. The mean TE, AE, and EE were 65%, 67%, and 46%.

**2.3.3 Economic Efficiency of Farmers**

Findings of Akpan *et al.* (2017) also revealed that none of the cassava farmer reached the maximum profit efficiency frontier. The mean profit efficiency of 57.3% revealed an efficiency gap of 42.7%; implying that substantial portion of profit is not earned. Akpan *et al.,* (2012) used the stochastic profit model to study the efficiency of homestead-based cassava farmers in Cross River State, southern Nigeria. The maximum likelihood estimates of the specified models showed that, price of cassava stem, price of fertilizer, price of manure and wages were negatively related to farm level profit; whereas farm land had a positive significant relationship. Also, an average economic efficiency of 61.22% was discovered among sampled farmers.

Oladeebo and Oluwaranti (2012) examined profit efficiency among cassava producers in south western Nigeria. Results showed that about 51% of cassava producers had formal education; about 50% had more than ten years of farming experience while the average age, household size and farm size of the respondents stood at 46 years, 8 people and 3 hectares respectively. Result of the analysis further showed that the profit efficiency of farmers ranged between 20% and 91%, while the mean level of profit efficiency was 79% which implies that an estimated 21% loss in profit was due to a combination of both technical and allocative inefficiencies.

Akpan *et al.,* (2013) estimated translog stochastic profit function and profit efficiency model for cassava-based farmers in Southern Wetland region of Cross River State, Nigeria. Maximum likelihood estimates of the specified models showed that, price of cassava cutting, wages and price of manure impacted negative influence on cassava farm profit; while land area exhibited positive relationship. An average economic efficiency of about 0.58 was obtained.

**2.3.4 Determinants of Allocative Efficiency**

Esiobu (2019) reported that education, membership of cooperative, extension contact, farming experience and household size were farmers socio-economic characteristics that have a significant influence on their relative efficiencies. Ibeagwa *et al.* (2019) reported that allocative efficiency was positively influenced by household size, educational level, farm size and experience and negatively influenced by fixed cost of production. The result of Abdulai *et al.* (2017) showed that there is allocative inefficiency relative to all the production inputs under the prevailing prices. Land, seed and weedicides would be allocatively efficient by increasing their use by 26.6%, 10.52% and 39.9% respectively. Fertilizer and labour are currently being over-used and requires 82.8% and 94.5% reductions respectively to reach their allocatively efficient points.

In a study to estimate EE and TE of rice producers in Kou Valley of Burkina Faso, Ouedraogo (2015) used SFA in a Cobb-Douglas production function with its dual cost function. Literacy levels significantly and negatively influenced TE of the farmers while farming experience influenced it positively. Both household size and farming experience influenced AE positively.

Ahmed *et al.* (2015) and Sibiko (2012) used the SFA and Tobit model to measure efficiency and determining the factors influencing efficiencies. Both allocative and economic efficiency were found to be positively determined by education. AE and EE were both negatively influenced by extension access, which positively influenced TE.

**2.3.5 Determinants of Economic Efficiency**

Abdulai *et al.* (2017) assessed the economic efficiency of maize production in Northern Ghana. The mean estimates were 85.1%, 87.8% and 74.7% for technical, allocative and economic efficiencies respectively. Largely, maize production in the study area exhibited increasing returns to scale. The determinants of technical inefficiency were experience, agricultural extension service and gender. Akpan *et al.,* (2012) also found that farmer’s education, experience, household size, level of farming involvement, extension agent visit, soil management method adopted by farmers and farm size, were significant factors that affect farm-level economic or profit efficiency among homestead-based cassava farmers in the study area. Oladeebo and Oluwaranti (2012) reported that household size and farm size were the major significant factors which influenced profit efficiency positively. Akpan *et al.,* (2013) reported that level of farming involvement, farmer’s education, ability to predict rainfall, farming experience; household size, soil management technique adopted, extension agent visits and farm size were significant determinants of profit efficiency of cassava-based farmers in southern wetland region of Cross River State.

Empirical findings of Akpan *et al.* (2017) revealed that: level of farming involvement, farmers’ education; farming experience, household size, soil management technique adopted and farm size were significant variables affecting farm level profit efficiency among cassava farmers.

**2.3.6 Profitability and Technical Efficiency of Cassava Production**

Adeyemo, Oke and Akinola (2010) investigated the efficiencies of cassava production in Odeda Local Government of Ogun State. A random sample of 200 cassava producers was taken and subjected to budgetary and stochastic frontier analyses. Results indicated that TVC formed the bulk 91.6% of the TC while the TFC was just 8.4%. This implies that farmers who want to be cost efficient have to reduce TVC especially the cost of labour that is more than three quarter (68.2%) of the total cost. TFC is small (8.8%) probably because of very low cost of land rent (1.6%) in the area. The total profit of N95, 738.10 per hectare and percentage profit of 80% shows that cassava farming is a highly profitable venture in the area. Cost ratio (1.8) and percentage profit (80%) indicated that cassava farming was profitable in the area. Total variable and labour costs were 91.6% and 68.2% of the total cost respectively. The return to scale was 1.024.

Adeyemo *et al.* (2010) further reported that farm size (0.771) and quantity of planting stakes (0.203) significantly (p ≤ 0.01) affected cassava production. Age and farming experience contributed to technical inefficiency while cost of fertilizer, cost of herbicides, membership of cooperative and level of education enhanced technical efficiency. Efficiency of cassava growers ranged between 88.69 and 100 with a mean of 89.4.

Eze and Nwibo (2014) analyzed the economic and technical efficiency of cassava production in Ika North East Local Government Area of Delta State. A multistage random sampling was used to select a total of 120 respondents used for the study. Data used for the study was from primary source, which was collected using a well structured questionnaire. Both descriptive and inferential statistics were used to analyze the data based on the objective of the study. Cassava production was profitable in the area with a profit margin of N200,400.00 per a hectare. The Benefit Cost Ratio shows that in every N1.00k invested by farmers, N1.00k was realized as profit. The multiple regression result showed R2 value of 0.833 or 83.3%. The coefficients of farm size, labour and cassava stem were positively signed. Farm size, labour, fertilizer and cassava cuttings were underutilized because their efficiency index was greater than one.

**2.4.6 Constraints Militating Against Cassava Production**

Egwuma *et al.* (2019) estimated the profitability of small-scale cassava production in Ado-Ekiti Local Government Area of Ekiti State, Nigeria. The result on constraints militating against cassava production in the study area revealed that the major constraints identified to be affecting cassava production were transportation problems, inadequate access to credit, inadequate labour supply, high cost of inputs, inadequate extension services, pests and diseases and inadequate storage facilities.

Sanusi *et al.* (2020) analyzed the economics of cassava production: prospects and challenges in Irepodun Local Government Area, Kwara State, Nigeria. The major challenges identified in cassava enterprise were huge transportation cost, high cost of production, lack of improved cassava cultivars, and lack of market linkages.

Alabi and Safugha (2022) determined output of cassava (*Manihot* species) production in Abuja, Nigeria. The result revealed that the constraints facing cassava producers were the unavailability of improved cassava cuttings, the high cost of farm inputs, insecurity, inadequate extension services, and inadequate finances.

**2.4 Analytical Framework**

**2.4.1 Stochastic frontier production function**

Timmer (1971) developed a strategy that involves eliminating a portion of farmers who are close to the estimated border and re-estimating the frontier using the smaller sample in order to address the weakness of the deterministic approach of Aigner and Chu (1968). However, Timmer's probabilistic technique has not been extensively adopted due to the arbitrary nature of the choice of which percentage of observations to delete (Coelli, 1995). Farmers who outperform will be regarded as outliers in the process of regulating the outliers so that the amount of inefficiency is not inflated.

**2.4.2 Descriptive Statistics**

This describes the characteristics of the responses (data obtain from field work) such as the average of variables such age, income, household size etc. Descriptive statistics include mean, percentages and frequency. This method is very easy and simple to understand.

**CHAPTER THREE**

**RESEARCH METHODOLOGY**

**3.1 Description of Study Area**

The study was conducted in Abak Local Government Area. Abak Local Government Area is located in the rain forest belt of the Niger Delta region of Nigeria between longitude 070 27l 06ll - 070 50l 06llE and latitude 040 50l 27ll - 500 50l 90llN. It is naturally endowed with a large expanse of fertile land of clay, sandy and loamy soils. The study area has perennial streams, abundant rainfall of over 250mm per annum, a total landmass of 305 km2 and a population of over 700,000 by 2006 census gazetted into 5 clans and 91 villages. The local government area was stratified with a frame survey into 5 clans.

**3.2 Method of Data Collection**

The Primary data used for the study were obtained by using structured questionnaire.

**3.3 Sampling Technique and Sample Size**

Multistage sampling procedure was used in selecting the respondents used for the study. In the first stage, 3 clans were randomly selected from the 5 clans. The second stage also involved random selection of 2 villages each from the selected clans, giving a total of 6 villages. The final stage involved a random selection of 20 cassava farmers making a total of 120 respondents for the study.

**3.5 Data analysis**

Method of data analysis used were based on the objectives.

**Objective 1&5:** descriptive statistics such as mean, tables, percentage, frequency count was used.

**Objective 2:**

**Technical Efficiency**

The stochastic frontier production function was used to analyze the technical efficiency. The production technology employed by the farmers will be assumed to be specified by the Cobb–Douglas frontier production function (Tadesse and Krishnamoorthy, 1997), defined as:

lnYi = lnβ0 + β1lnX1i + β2lnX2i + β3lnX3i + β4lnX4i + Vi – Ui ……. (1)

where:

Y – Cassava Output (kg),

X1 – farm size (hectares),

X2 – herbicides (litres),

X3 – cuttings (kg),

X4 – labour (mandays),

Vi – random errors,

Ui – technical inefficiency as defined below,

Ui = δ0 + δ1Z1i + δ2Z2i + δ3Z3i + δ4Z4i + δ5Z5i + δ6Z6i + δ7Z7i + δ8Z8i + δ9Z9i + δ10Z10i + δ11Z11i ……… (2)

where:

Z1 – Gender (dummy)

Z2 – Age (years)

Z3 – Household Size (numbers)

Z4 – Marital status (dummy)

Z5 – Education (years)

Z6 – Monthly Income (₦)

Z7 – Farming experience (years)

Z8 – Membership of cooperative (dummy)

Z9 – Access to credit (dummy)

Z10 – Access to extension services (dummy)

Z11 – Farm size (hectares)

The estimates for all the parameters of the stochastic frontier production and the inefficiency model are simultaneously obtained using Stata 12 as used by Kavoi and Mbeche (2016).

**Economic Efficiency**

The stochastic frontier production function was used to analyze the technical efficiency. The production technology employed by the farmers will be assumed to be specified by the Cobb–Douglas frontier production function (Tadesse and Krishnamoorthy, 1997), defined as:

lnYi = lnβ0 + β1lnX1i + β2lnX2i + β3lnX3i + β4lnX4i + Vi – Ui …….(3)

where:

Y – Cassava Output (₦),

X1 – farm size (₦),

X2 – herbicides (₦),

X3 – cuttings (₦),

X4 – labour (₦),

Vi – random errors,

Ui – technical inefficiency as defined below,

Ui = δ0 + δ1Z1i + δ2Z2i + δ3Z3i + δ4Z4i + δ5Z5i + δ6Z6i + δ7Z7i + δ8Z8i + δ9Z9i + δ10Z10i + δ11Z11i ……… (4)

where:

Z1 – Gender (dummy)

Z2 – Age (years)

Z3 – Household Size (numbers)

Z4 – Marital status (dummy)

Z5 – Education (years)

Z6 – Monthly Income (₦)

Z7 – Farming experience (years)

Z8 – Membership of cooperative (dummy)

Z9 – Access to credit (dummy)

Z10 – Access to extension services (dummy)

Z11 – Farm size (hectares)

The estimates for all the parameters of the stochastic frontier production and the inefficiency model are simultaneously obtained using Stata 12 as used by Kavoi and Mbeche (2016).

**Allocative Efficiency**

The Stochastic Frontier Production function (SFPF) using the Cobb-Douglas functional form was used to determine the production function in this study. The production function model was explicitly specified in its linear form as:

ln Y1 = β0 + β1lnX1 + β2lnX2 + β3lnX3 + β4lnX4 + ε ………(5)

Where,

ln = natural logarithm

Y = value of cassava output (N)

X1 = farm size (ha),

X2 = herbicides (litres)

X3 = cuttings (bundle)

X4 = labour (mandays)

β1 – β4 = coefficient of the parameters to be estimated

εi = error term

Β0 = intercept

**Allocative efficiency model**

The estimated coefficients of the relevant independent variables were used to compute the Marginal Value Products (MVP) and their corresponding Marginal Factor Costs (MFC).

The equation is: r=MVP/MFC….. (6)

Where,

r = efficiency ratio

MVP= Marginal Value Product of variable input

MFC = Marginal Factor Cost

The value of MVP was computed using the regression coefficient of each input and the price cassava output was expressed as stated thus:

MVPx= bi × Py …….(7)

Where,

Py = price per unit of output

bi = regression coefficient of input i (I = 1, 2,...n)

MVPxi = Marginal Value Product of input xi.

The prevailing market price of cassava inputs was used as the Marginal Factor Cost (MFC). The values of the ratios are interpreted thus:

1. If r < 1, implies that the resource was over-utilized hence signifying that increment of the resource in question will boost the profitability of cassava.

ii. If r > 1, means under-utilization of the resource. The implication is that there is inverse relationship between the said resource and profit.

iii. If r = 1, implies efficient of resource use

**Objective 3**

Gross margin was used to estimate the difference between total revenue and total variable cost in cassava production.

GM=TR – TVC

Where

GM =Gross margin

TVC=Total variable cost

TR = Total revenue

**CHAPTER FOUR**

**RESULTS AND DISCUSSION**

**4.1 Socioeconomic Characteristics of the Respondents**

This chapter presents the results of the findings from the field data. It also presents the analysis of the data and discussion of the results.

**Gender**

Gender distribution based on gender as shown in Table 4.1 revealed that greater proportion (51.7%) of the sampled respondents in the study area were male. This implies that male dominated cassava production activities in the study area, this result proves positive since men tends to have unparalleled access to agricultural resources (Ankrah *et al.,* 2020). Another implication would be that the dominance of males could be due to the high level of physical activities such as clearing, bed making,weed control, pest and disease control and harvesting that characterize cassava production of which many females might not be able to cope with.

**Age**

Age distribution of respondents is presented in Table 4.1; the result showed that the mean age of the sampled respondents were 39 years. These results imply that those involved in farming in the study area are in the prime age of strength and vigour that is required to perform many of the farm operations. This has a positive implication for cassava production in the area, because the farmers are still energetic, rational decision makers and can effectively withstand the rigours, strain and stress involved in cassava production. The result agrees with the findings of Adetarami *et al.* (2022) that the younger the farmer is, the higher the zeal into more lucrative income generating activities.

**Marital Status**

Distribution of respondents according to marital status presented in Table 4.1 showed that majority (67.5%) of the sampled respondents were married. This means that cassava farming in the area is majorly practiced by married people. The result implies that most of the farmers would derive their labour from household members. Farmers who are married would tend to have access to family labour supply, this would reduce the cost of hiring labour for some production activities, thereby increasing farm net returns. This result is in agreement with Adetarami *et al.* (2022) and Uzochukwu *et al.* (2021) who opined that cassava farming household was dominated by married farmers.

**Household Size**

Distribution of respondents according to household size is presented in Table 4.1; the result showed that the mean household size of the sampled respondents were 4 persons. This implies that the study area is dominated by cassava farmers with moderate household sizes. A moderate household size reduces the cost of hired labour and ensures availability of labour. Household size has inverse relationship with agricultural production because as household size increases there is more family labour to be supplied which would in turn reduce hired labour cost. However, this assertion is expected to hold when other members of the household are engaged in farming activities. This finding supports the result of Adetarami *et al.* (2022) and Uzochukwu *et al.* (2021) who reported that large and average household size compliments labour to enhance production and reduce cost of hired labour.

**Education**

The result presented in Table 4.1 shows that the average years spent in formal education in the study area was 9.2 years which implies that most of the respondents had completed primary education and would be literate enough to adopt new technologies brought to them by extension agents to increase output and revenue. Adeosun *et al.* (2022) affirmed that education could positively influence farmers' efficiency level. It is expected that a higher level of education will contribute significantly to decision making of a farmer and the ability to adopt new technology.

**Membership of Cooperative**

Distribution of respondents based on membership of cooperative presented in Table 4.1 revealed that majority (61.7%) were members of farmers association. The result simply explains that greater proportion of the respondents were aware of the benefits of joining farm cooperatives in the study area. Membership of cooperatives provides basic production information required by farmers for better performances. Cassava farmers by virtue of membership of cooperatives, share knowledge and experience with other farmers to improve production.

**Access to Credit**

Distribution of respondents based on access to credit presented in Table 4.1 revealed that greater percentage (51.7%) had no access to credit facilities in the study area.

The result simply explains that greater proportion of the respondents were not aware of some credit information and may not have the required collateral security for accessing credit from formal institutions. Cassava farmers by virtue of having access credit facilities, acquire improved inputs and adopts technology rapidly to boost production and increase farm net returns.

**Access to Extension Services**

Distribution of respondents based on access to extension services presented in Table 4.1 revealed that majority (62.5%) had no access to extension services in the study area. Cassava farmers by virtue of having access to extension services, have access to new innovations to improve production, acquire needed skills for pest and disease control as well as gaining relevant marketing information.

**Farm Size**

Distribution of respondents based on farm size presented in Table 4.1 revealed that the mean farm size was 1.9 hectares indicating that the cassava farmers were into small scale production. These results indicated that the respondents were small scale farmers as usually characterized with majority of the farmers in Nigeria. According to Omotilewa *et al.* (2021) most farmers in Nigeria are predominantly smallholders with average farm size of between 1 and 2 hectares. The result corroborates with that of Esiobu (2019) who reported an average farm size of 1.42 hectares.

**Farming Experience**

Distribution of respondents according to their production experience as presented in Table 4.1 revealed that on the average, the respondents spent about 6 years in production. The findings corresponds with those of Adetarami *et al.* (2022) as they noted that the number of years of farming experience of a farmer may give an indication of the practical knowledge acquired on how to overcome certain inherent production problems and could impact positively on farm income.

**Monthly Income**

Distribution of respondents according to monthly income is presented in Table 4.1; the result showed that the mean monthly income of the sampled respondents was ₦122,429.2. This implies that the farmers were earning above minimum wage (₦30,000) due to their level of experience and knowledge on cassava farming. Another implication would be that their monthly income may be inadequate to afford some basic farm inputs required for optimum production. As a result of this, cassava farmers in the study area would tend to operate on a small scale of production.

**Table 4.1 Distribution of Respondents Based on their Socio-economic Characteristics**

|  |  |  |
| --- | --- | --- |
| **Variables** | **Frequency (n=120)** | **Percentage (%)** |
| **Gender** |  |  |
| Male | 62 | 51.7 |
| Female | 58 | 48.3 |
| **Age (Mean = 39years)** |  |  |
| Below 30 | 13 | 10.8 |
| 30 - 40 | 71 | 59.2 |
| Above 40 | 36 | 30.0 |
| **Marital Status** |  |  |
| Single | 32 | 26.7 |
| Married | 81 | 67.5 |
| Divorced | 7 | 5.8 |
| **Household Size (Mean = 4 persons)** |  |  |
| Below 4 | 47 | 39.2 |
| 4 - 5 | 58 | 48.3 |
| Above 5 | 15 | 12.5 |
| **Education (Mean = 9.2years)** |  |  |
| Below 6years | 18 | 15.0 |
| 6years - 12years | 80 | 66.7 |
| Above 12years | 22 | 18.3 |
| **Membership of Cooperative** |  |  |
| Yes | 74 | 61.7 |
| No | 46 | 38.3 |
| **Access to Credit** |  |  |
| Yes | 58 | 48.3 |
| No | 62 | 51.7 |
| **Access to Extension Service** |  |  |
| Yes | 45 | 37.5 |
| No | 75 | 62.5 |
| **Farm Size (Mean = 1.9ha)** |  |  |
| Below 1ha | 5 | 4.2 |
| 1ha - 3ha | 114 | 95.0 |
| Above 3ha | 1 | 0.8 |
| **Farming Experience (Mean = 6years)** |  |  |
| Below 5years | 39 | 32.5 |
| 5years - 10years | 80 | 66.7 |
| Above 10years | 1 | 0.8 |
| **Type of Labour** |  |  |
| Family | 61 | 50.8 |
| Hired | 59 | 49.2 |
| **Monthly Income (Mean = ₦122,429.2)** |  |  |
| Below ₦100,000 | 21 | 17.5 |
| ₦100,000 - ₦150,000 | 73 | 60.8 |
| Above ₦150,000 | 26 | 21.7 |

**Source:** Field Survey Data, 2023.

**4.2 Technical, Allocative and Economic Efficiency**

**Technical Efficiency**

Analysis of cassava farmers in the study area revealed that the mean, maximum and minimum technical efficiency were 0.73, 0.95 and 0.38 as presented in Table 4.2, respectively. This implies that cassava farmers with the best practice in the study area is 0.95 while cassava grower with least practice is 0.38. Also, if the mean cassava grower in the sample was to obtain the technical level of its most efficient counterpart, then the average cassava grower could obtain a 23% cost saving [i.e., 1-(0.73/0.95) x 100]. In like manner, computation for the least economically efficient cassava farmer will require efficiency gain of about 60% [1-(0.38/0.95) x 100] to be able to experience the status of the most economically efficient cassava growers in the sample. The research work further inferred that wide gap exists for improvement in the level of technical efficiency of cassava production in the study area. The result showed that cassava farmers in the study area are moderately efficient in producing cassava at a given level of output using the cost minimizing input ratio.

**Economic Efficiency**

As presented in Table 4.2, the mean, minimum and maximum economic efficiency for cassava production were 0.72, 0.35 and 1.00 respectively. The results showed that economic efficiency for cassava farmers ranged between 0.35 and 1.00 implying that a wide gap exists between the best economically efficient farmers and the worst economically efficient farmer in the group. The mean economic efficiency is 0.72 indicating that cassava farmers in the study area were reasonably economically efficient in the utilization of limited inputs. The estimated result equally suggests that for a standard cassava cassava producer in the study area to obtain the status of the most economically efficient farmers in the group, the farmers must achieve efficiency profit of 28% [i.e., 1- (0.72/1.00) x 100]. The finding equally depicts that the least economically efficient cassava farmer in the study area will need efficiency profit of about 65% [i.e., 1-(0.35/1.00) x 100] to be able to achieve the status of the most economically efficient producers in the category examined.

**Table 4.2 Distribution of Efficiency among Cassava Farmers in the Study Area**

|  |  |  |
| --- | --- | --- |
|  | **Technical Efficiency** | **Economic Efficiency** |
| **Mean** | 0.73 | 0.72 |
| **Minimum** | 0.38 | 0.35 |
| **Maximum** | 0.95 | 1.00 |

Source: Field Survey Data, 2023.

**Allocative Efficiency of Cassava Farmers**

The result of Cobb Douglas production function presented in Table 4.3 showed that the coefficient of multiple determination was 0.58, indicating 0.58 percent variation in output value in cassava was explained by the independent variables in the function. It is therefore follows that other factors not in the analysis accounted for the remaining 0.42% of variations in output value. The F – statistic was significant at 1% probability level, denoting that the estimated R– square was significant and by implication, the estimated equation had goodness of fit. Among the various independent variable, labour had positive regression coefficients (1.2341) and was statistically significant at 1% level. This positive nature of the relationship of the labour means increase in one unit of labour would cause the quantity of output produced to increases by certain percentage of 1.2341%.

**Table 4.3: Production Function Estimates For Allocative Efficiency**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Variables*** | ***Coefficient*** | ***Std. Error*** | ***t*** | ***P>/t/*** |
| Farm size | 0.0929087 | 0.1809009 | 0.51 | 0.609 |
| Herbicide | -0.0929687 | 0.1085365 | -0.86 | 0.393 |
| Cuttings | 0.098608 | 0.1895291 | 0.52 | 0.604 |
| Labour | 1.2341 | 0.1300311 | 9.49 | 0.000\*\*\* |
| Constant | 3.384265 | 1.08852 | 3.11 | 0.002 |
| Number of obs = 120 |  |  |  |  |
| F( 4, 115) = 39.21 |  |  |  |  |
| Prob > F = 0.0000 |  |  |  |  |
| R-squared = 0.5769 |  |  |  |  |
| Adj R-squared = 0.5622 |  |  |  |  |

**\*\***\* = 1% level of significance

**Source**: Field survey data, 2023.

The allocative efficiency of cassava farmers is shown in Table 4.4. The coefficients of double log (Cobb Douglas) functional form was used to compute the allocative efficiency indices (β1 -β4 ). The ratios of the marginal value product (MVP) of each factor input to their respective acquisition cost were computed to obtain the allocative efficiency of the cassava farmers. The result indicated that none of the variables considered had efficiency ratio that is equal to 1 (one).

The ratios of the marginal value product to marginal factor cost of labour (16.867) and cassava cutting (3.369) were greater than 1, signifying under-utilization of resources. This implies that the resource inputs were used at less than optimum profit level. So, increasing the level of use of the resources will lead to profit optimization (Wilcox *et al.*, 2016). Ume *et al.* (2020) was in agreement to these assertions but Okoye *et al.* (2015) contradicted that in their study and reported that the employment of large number of labour in a small sized farm could result to over-utilization. The under-utilization of resources could be correlated to unavailability and high cost of improved varieties of cassava (Wossen *et al.,* 2017).

The over-utilized resources as shown in the Table were farm size (0.190), and herbicide (-0.545), implying that less of the profit maximization of the resource was used. The possible reasons for the over utilization of the resources of land and farm size could be due to uncontrolled use of herbicides and farm sizes.

**Table 4.4** Allocative Efficiency of Cassava Farmers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **MVP** | **MFC** | **r (MVP/MFC)** | **Conclusion** |
| Farm size | 1904.62835 | 10000 | 0.190 | Over Utilization |
| Herbicide | -1905.85835 | 3500 | -0.545 | Over Utilization |
| Cuttings | 2021.464 | 600 | 3.369 | Under Utilization |
| Labour | 25299.05 | 1500 | 16.867 | Under Utilization |

**Source:** Field survey data, 2023.

**4.3 Cost and Return and Profitability of Cassava Production in the Study Area**

The result of the costs and return analysis is presented in Table 4.5. The result shows that the total variable cost was estimated to be ₦147,947 per farmer. The total revenue was valued at ₦535,288.33 per farmer. The gross margin was calculated by subtracting the total variable cost from total revenue which gave ₦387,341.25 per farmer while the gross margin per hectare was ₦261,717.25 indicating cassava production was profitable.

**Table 4.5: Cost and Retruns of Cassava Production in the Study Area**

|  |  |  |
| --- | --- | --- |
| **Variables** | **Amount (₦)** | **Percentage (%)** |
| Fertilizer | 1,967 | 1.33 |
| Rents | 28,508 | 19.27 |
| Herbicide | 12,633 | 8.54 |
| Pesticide | 1,483 | 1.00 |
| Cuttings | 38,002 | 25.69 |
| Labour | 46,612 | 31.51 |
| Transportation | 18,742 | 12.67 |
| **Total Variable Cost** | **147,947** | **100.00** |
|  |  |  |
| **Returns** |  |  |
| Cuttings | 252,511.67 |  |
| Tubers | 282,716.67 |  |
| **Total Revenue** | **535,288.33** |  |
| **Gross Margin** | **387,341.25** |  |
| **Average Farm Size** | **1.48** |  |
| **Gross Margin/Hectare** | **261,717.25** |  |

**Source:** Field Survey Data, 2023.

**4.4 Determinant of Inefficiencies Among Cassava Farmers in the Study Area**

**Determinant of Technical Efficiency Among Cassava Farmers**

The results of the estimated stochastic production function and the determinants of technical inefficiency for the cassava farmers are presented in Table 4.6. The Wald statistic of 296.58 is highly significant at 1% level and this indicates the model fit is good. Four of estimated variables (farm size, cuttings and labour) were found to be significant inputs in cassava production and they are all significant at 1% level of significance.

Farm Size: The coefficient of farm size was positively signed and statistically significant at 1%. This implies that increasing the farm size cultivated by the farmers will lead to proportionate increase in total cassava outputs. Again, the statistical significance indicated by farm size of the farmers signifies that farm size contribute to outputs of the farmers. This conforms to the a priori expectation.

Cuttings: Quantity of cuttings used by the farmers was negatively related to total output and statistically significant at 5%. This signifies that increasing use of cassava stem will result to a unit decrease in total cassava output. Again, statistical significance indicated that the use of cassava stem is associated with outputs of farmers. Thus, the a priori expectation was not met. The result obtained could be as a result of using species that have low yields.

Labour: The coefficient of labor had a positive sign and was significant at 1% implying that increasing labor will cause increases in output. It should be noted that cassava production is labor intensive and the producers resort to the use of family labor in order to cut cost of hiring labor. However, increase use of family labor can result in labor saturation and lower returns on labor use and inefficiency. The result corresponds with the findings of Nkang *et al.* (2014).

**Technical Inefficiency**

Household size returned positive and significant at 10%, it follows that increase in household size would result in increased levels of technical efficiency of the cassava farmers. Cassava farming requires a lot of farm hand and given the fact that farming is still at the subsistence level in the study area, increases in household sizes would make labour readily available and reduce high cost of hired labour. This result disagrees with that of Orewa and Izekor (2012), whose results had negative coefficients but significant.

Monthly income was positive and significant at 1%, it follows that increase in farmer’s monthly income would result in increased levels of technical efficiency of the cassava farmers. The result implies that farmers with high income would have the capacity to afford production resources and hence, ensuring efficient use of these resources.

Membership of cooperative was positive and significant at 1%, it implies that by virtue of belonging to cooperative societies, farmers would tend to be technical efficient in combination of production resources due to training and advisory services provided by the cooperatives. The result obtained is in line with Liu *et al.* (2019) who found that membership of cooperatives provide their members with the greatest increase in efficiency.

Access to credit is regarded as an important intervention for improving the incomes of the rural population, mainly by mobilizing resources to more productive uses. Access to credit had a positive coefficient and significant at 1% level of probability. The result implies that farmers who have access to credit facilities would tend to be more technically efficient in utilizing production resources due to the credit obtained for production which would be paid back depending on the due date. The result obtained is in line with Masuku *et al.* (2015) who also found that farmers who have access to credit are more technically efficient than farmers who have no access to credit

The coefficient of education is surprisingly positively related to technical inefficiency implying educated farmers are less technically efficient than the uneducated ones. Education was found to positively and significantly determine technical inefficiency 1% significance level. Specifically, the coefficients indicate that an increase by 1 year of education increases technical inefficiency. It indicates that less-educated farmers are more technically efficient than their counterparts. It might be due to the increased probability of more educated farmers participating in other livelihood options, and hence reducing their time and knowledge input into cassava farming. This result is similar with the results reported by [Wollie *et al.* (2018)](https://www.frontiersin.org/articles/10.3389/fsufs.2021.758951/full#B76) where the cassava farmers' level of education positively contributed to cassava production inefficiency. However, it is not in line with the finding of [Soukkhamthat and Wong (2016)](https://www.frontiersin.org/articles/10.3389/fsufs.2021.758951/full#B68) who found that education is negatively determining cassava production inefficiency.

The coefficient of access to extension services was negatively associated with technical 1% significance level. The finding indicated that the use of extension services improves the farmers' technical efficiency that is in line with prior expectations. This finding is consistent with results reported by  [Teferra *et al.* (2018)](https://www.frontiersin.org/articles/10.3389/fsufs.2021.758951/full#B74), and partially consistent with findings of [Dogba *et al.* (2020)](https://www.frontiersin.org/articles/10.3389/fsufs.2021.758951/full#B15).

Farm size showed a negative and significant difference in technical inefficiency at 5% significance levels. It shows that farmers who owned larger farm sizes were technically more efficient than those who owned less farm sizes. This may be related to the importance of farm size in the cassava production process. This findings disagrees with the results reported by  [Tafesse *et al.* (2020](https://www.frontiersin.org/articles/10.3389/fsufs.2021.758951/full#B72)).

**Table 4.6** Maximum likelihood estimates of the stochastic frontier production

function and determinants of technical inefficiency of broiler farmers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Variables*** | ***Coefficient*** | ***Std. Err*** | ***t*** | ***P-values*** |
| Farm size | 0.9059896 | 0.1391105 | 6.51 | 0.000\*\*\* |
| Herbicides | -0.1278877 | 0.0945085 | -1.35 | 0.176 |
| Cuttings | -1.166653 | 0.4642063 | -2.51 | 0.012\*\* |
| Labour | 0.4365544 | 0.150902 | 2.89 | 0.004\*\*\* |
| Constant | 14.12827 | 3.005412 | 4.70 | 0.000\*\*\* |
| /Insig2v | -2.645412 | 0.2700802 | -9.79 | 0.000 |
| /Insig2u | -1.652173 | 0.3189186 | -5.18 | 0.000 |
| ***Inefficiency model*** |  |  |  |  |
| Gender | 0.0304499 | 0.0220198 | 1.38 | 0.170 |
| Age | 0.0028137 | 0.0019081 | 1.47 | 0.143 |
| Household size | 0.0504881 | 0.0292107 | 1.73 | 0.087\* |
| Marital status | 0.0015174 | 0.0138731 | 0.11 | 0.913 |
| Education | 0.0879756 | 0.0117653 | 7.48 | 0.000\*\*\* |
| Monthly income | 1.44e-06 | 3.33e-07 | 4.32 | 0.000\*\*\* |
| Farming experience | -0.0068059 | 0.0041323 | -1.65 | 0.102 |
| Membership of cooperative | 0.1949483 | 0.0252251 | 7.73 | 0.000\*\*\* |
| Access to credit | 0.07824 | 0.0213708 | 3.66 | 0.000\*\*\* |
| Access to extension services | -0.0434569 | 0.0240573 | -1.81 | 0.074\* |
| Farm size | -0.0251547 | 0.0124925 | 2.01 | 0.047\*\* |
| Wald Chi2 = 296.58 |  |  |  |  |
| Prob> Chi2 = 0.000 |  |  |  |  |

**Source:** Field Survey Data, 2023. *Computed Using Stata 12*

\*\*\* = 1% level of significance, \*\* = 5% level of significance, \* = 10% level of significance

**Determinant of Economic Efficiency Among Cassava Farmers**

The results of the estimated stochastic production function and the determinants of economic inefficiency for the cassava farmers are presented in Table 4.7. The Wald statistic of 1.37e+09 is highly significant at 1% level and this indicates the model fit is good. Labour was found to be significant at 1% level while the remaining variables were not significant.

The coefficient of labor had a positive coefficient and was significant at 1% implying that increasing cost of labor will cause increases in output. This could be traced to an increase in scale of production, farmers cultivating larger expanse of land would tend to need more workforce for operations. It should be noted that cassava production is labor intensive and the producers resort to the use of family labor in order to cut cost of hiring labor. However, increase use of family labor can result in labor saturation and lower returns on labor use and inefficiency. The result corresponds with the findings of Nkang *et al.* (2014).

The coefficients of age was also positively signed and significant at 1% level. The implication is that older farmers tended to be more efficient in resource use than young ones. Younger farmers, though having more physical strength, lack managerial experience leading to inefficiency (Adewayi *et al.*, 2013). This finding is consistent with [Wollie *et al.* (2018)](https://www.frontiersin.org/articles/10.3389/fsufs.2021.758951/full#B76), and [Kollie (2020)](https://www.frontiersin.org/articles/10.3389/fsufs.2021.758951/full#B37) who showed that the age of the cassava farmer is positively related to cassava production inefficiency.

Household size had negative coefficient with a statistical significance of 5% which implies that, increase in this variables will lead to decrease in profit inefficiency, but increase in profit efficiency of farmers in the study area. Household labour is enhanced by increase in family size and is the cheapest and most available form of labour to small scale arable crop farmers (Akpan *et al.,* 2017). These possibilities lead to increase in economic efficiency of farmers, or a reduction in their inefficiency index.

Education has a 1% statistical negative effect on cost inefficiency. Education obviously will improve farmers’ production efficiency as it will enable him to access improved technology and best practices available to the enterprise. This corroborates the results of similar efficiency studies (Dogba *et al.,* 2020), that higher acquisition of formal education enhances the ability of the farmer to make “better and timely” market decisions.

Farming Experience had negative coefficient with a statistical significance of 5%, farming experience has negative effects on economic inefficiencies. The implication is with more experience in cultivating cassava, a farmer can rectify some of the defects in cost implications and find new ways to access information about markets [inputs and output]. This result aligns with results of Abdul-kareem and Sahinli (2018), that farming experience improves the efficiency and profitability of cassava.

Access to extension had negative coefficient with a statistical significance of 1% level, the estimates of access to extension services have negative relationships to economic inefficiencies. This implies that farmers accessing more extension services tended to learn contemporary methods for reducing production cost inefficiency. The result also alludes that extension services link farmers to economic agents and markets: an opportunity which gives farmer advantage along the cassava value chain. The results conforms with the findings of Mutoko *et al.* (2015).

**Table 4.7** Maximum likelihood estimates of the stochastic frontier production

function and determinants of economic inefficiency of broiler farmers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Variables*** | ***Coefficient*** | ***Std. Err*** | ***t*** | ***P-values*** |
| Land | 2.03e-10 | 2.87e-06 | 0.00 | 1.00 |
| Herbicides | -6.85e-10 | 2.30e-06 | -0.00 | 1.00 |
| Cuttings | 8.67e-10 | 5.60e-06 | 0.00 | 1.00 |
| Labour | 0.1494895 | 4.28e-06 | 3.5e+04 | 0.000\*\*\* |
| Constant | 9.093994 | 0.0000523 | 1.7e+05 | 0.000 |
| /Insig2v | -41.04887 | 598.0225 | -0.07 | 0.945 |
| /Insig2u | -1.560888 | 0.1290994 | -12.09 | 0.000 |
| ***Inefficiency model*** |  |  |  |  |
| Gender | -0.020392 | 0.0176808 | -1.15 | 0.251 |
| Age | 0.0135181 | 0.0028675 | 4.71 | 0.000\*\*\* |
| Household size | -0.0984613 | 0.0438978 | 2.24 | 0.027\*\* |
| Marital status | -0.010904 | 0.0208485 | -0.52 | 0.602 |
| Education | -0.1783279 | 0.330913 | -5.39 | 0.000\*\*\* |
| Monthly income | -2.21e-08 | 5.00e-07 | -0.04 | 0.965 |
| Farming experience | -0.0164331 | 0.0061964 | -2.65 | 0.009\*\* |
| Membership of cooperative | 0.0424925 | 0.0379082 | 1.12 | 0.265 |
| Access to credit | 0.0433368 | 0.032116 | 1.35 | 0.180 |
| Access to extension services | -0.2735915 | 0.0361533 | 7.57 | 0.000\*\*\* |
| Farm size | 0.0248132 | 0.0187737 | 1.32 | 0.189 |
| Wald Chi2 = 1.37e+09 |  |  |  |  |
| Prob>Chi2 = 0.000 |  |  |  |  |

**Source:** Field Survey Data, 2023. *Computed Using Stata 12*

\*\*\* = 1% level of significance, \*\* = 5% level of significance, \* = 10% level of significance

**4.5 Constraints Militating against Cassava Production in the Study Area**

The constraints militating against cassava production are presented in Table 4.8. The result showed that high cost of fertilizer (13.7%), theft (13.7%), lack of access to credit (13.7%), inadequate access to land (13.7%), and poor road network (13.7%) were the major constraints militating against cassava production while poor extension services (9.3%) and high cost of labour (8.5%) were the least constraints militating against cassava production in the study area. The cost of agricultural inputs such as fertilizers and transporting farm inputs and farm produce to the market were cumbersome which would reduce their gross margin. Potential cassava farmers gets discouraged from investing in this enterprise due to the rate at which the cost of farm inputs and other resources are increasing coupled with lack of access to credit facilities would been helpful in salvaging their situations in terms of purcashing of farm inputs.

**Table 4.8 Distribution of Constraints Militating against Cassava Production**

|  |  |  |
| --- | --- | --- |
| **Constraints** | **Frequency** | **Percentage** |
| High cost of fertilizer | 120 | 13.7 |
| Theft | 120 | 13.7 |
| Lack of acces to credit | 120 | 13.7 |
| Poor extension services | 81 | 9.3 |
| Inadequate access to land | 120 | 13.7 |
| Inadequate capital | 120 | 13.7 |
| High cost of labour | 74 | 8.5 |
| Poor road network | 120 | 13.7 |

**Source:** Field Survey Data, 2023.

**CHAPTER FIVE**

**SUMMARY, CONCLUSION AND RECOMMENDATION**

**5.1 SUMMARY**

The study stud analyzed the technical, economic and allocative efficiency among cassava farmers in Abak Local Government Area, Akwa Ibom State, Nigeria. The specific objectives were to; describe the socioeconomic characteristics of cassava farmers in the study area; determine the technical, economic and allocative efficiency of cassava farmers in the study area; analyze the profitability of cassava farming in the study area; estimate the determinants of technical and economic efficiency among cassava farmers in the study area; and examine constraints militating against cassava production in the study area.

The result of socioeconomic characteristics showed that greater proportion (51.7%) of the sampled respondents in the study area were male. The mean age, household size, farming experience, and farm size of the sampled respondents were 39 years, 4 persons, 6 years and 1.9 hectares, respectively.

The mean, maximum and minimum technical efficiency were 0.73, 0.95 and 0.38 while the mean, minimum and maximum economic efficiency for cassava production were 0.72, 0.35 and 1.00 respectively. The ratios of the marginal value product to marginal factor cost of labour (16.867) and cassava cutting (3.369) were greater than 1, signifying under-utilization of resources while farm size (0.190), and herbicide (-0.545) were over utilized.

The result shows that the total variable cost was estimated to be ₦147,947 per farmer. The total revenue was valued at ₦535,288.33 per farmer. The gross margin was calculated by subtracting the total variable cost from total revenue which gave ₦387,341.25 per farmer while the gross margin per hectare was ₦261,717.25 indicating cassava production was profitable.

The results of the estimated stochastic production function and the determinants of technical inefficiency showed that farm size (p<0.01), cuttings (p<0.01) and labour (p<0.01) were found to be significant inputs in cassava production while household size (p<0.1), education (p<0.01), monthly income (p<0.01), membership of cooperative (p<0.01), access to credit (p<0.01), access to extension services (p<0.1), and (p<0.05) were the determinants of technical inefficiency of cassava production in the study area.

The results of the estimated stochastic production function and the determinants of economic inefficiency showed that labour (p<0.01) was found to be significant input in cassava production while age (p<0.01), household size (p<0.05), education (p<0.01), farming experience (p<0.05), and access to extension (p<0.01) were the determinants of economic inefficiency of cassava production in the study area.

Based on constraints militating against cassava production, the result showed that high cost of fertilizer (13.7%), theft (13.7%), lack of access to credit (13.7%), inadequate access to land (13.7%), and poor road network (13.7%) were the major constraints militating against cassava production while poor extension services (9.3%) and high cost of labour (8.5%) were the least constraints militating against cassava production in the study area.

**5.2 Conclusion**

The study investigated the technical, economic and allocative efficiency of cassava production in Abak Local Government Area, Akwa Ibom State, Nigeria. The result showed that cassava farmers in the study area were moderately technically and economically efficient but were allocatively inefficient. The result of the allocative efficiency showed that none of the respondents achieved absolute efficiency of resource use as they either underutilized or over utilized the farm resources. The over utilized resources were herbicide, and farm size, while the underutilized resources were cuttings and labour. This showed that none of the production inputs was optimally allocated and utilized. In spite of the constraints faced by farmers in the study area, the result from the analysis of this study showed that the cassava farming was profitable, although farmers still have the potential to improve their performance in the study area.

**5.3 Recommendations**

Based on the findings of the study, the following recommendations are suggested;

1. Effective agricultural policies and programmes should focus on granting farmers improved access to farm credit and subsidized inputs as these would enable them increase their production efficiencies positively in the area.
2. There is need therefore for training and re-training of extension agents on improved production and management practices to enable them disseminate same to farmers on the need to use available resources efficiently.
3. Cassava farmers should be assisted to organize themselves into groups/ cooperatives in order to access credit facilities and land for cultivation.

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