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The Effect of Agricultural Land Management Practices on the Efficiency of Maize Farmers Production Cost and the Returns in Ogo-Oluwa Local Government Area, Oyo State Nigeria

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Abstract

This study examined two research questions: (1) what are the effects of land management practices on the efficiency of maize farmers in the Ogo-Oluwa Local Government Area of Oyo State Oyo and (2) what are the costs and returns of maize farmers in the Ogo-Oluwa Local Government Area of Oyo State In a multi-stage random sampling process, 120 maize farmers in the study area were selected and the data was collected using structured questionnaires and interview plans. The first stage involved the targeted selection of the Ogo-Oluwa local government area from the 33 local government areas in Oyo State due to the dominance of rural farmers in that area. The second stage was the random selection of two districts in the local government area. In the third phase, five villages were randomly selected from the two districts to select a total of ten villages. The fourth stage was the proportional selection of twelve local farmers from each village to give the total of one hundred and twenty local farmers from the villages making up the sample size. Descriptive statistics, gross profit analysis and stochastic frontier model were used to analyze the objectives of the study. The result showed that the gross profit analysis of maize production in the study area is profitable, and the main factors affecting the efficiency of farmers were the size of arable land, labor costs, seed costs, fertilizer costs and costs of herbicides. The study concluded that maize production in the study area is profitable and maize farmers are in the middle category of adopters of farming practices. More awareness of the relevance of land management practices is needed among maize farmers.

Keywords: Socio-Economic characteristics of Farmers, Life Cycle Cost Analysis, Land Management Practices, Efficiency of Maize Farmers and Constraints Associated with Maize Production.

Introduction

Land is the basic natural resource that provides habitat and food for living organisms (Bangladesh, 2001). According to Babalola 2012, land is a critical input for agricultural production. With around 98 million hectares of land, it is evident that Nigeria is richly endowed. Martin (2010) describes land as nature's gift to man, which remains the most important factor of production. He states that while land is immobile in its physical form, its product can be moved from one part of the earth to another. However, the exploitation of land through practices such as overgrazing, overuse of fertilizers, soil erosion, soil acidification and overpopulation have major impacts on land productivity. There is clear

evidence of land degradation in every region of Nigeria, which varies by kind, duration, intensity, and socio-economic implications (Aruleba, 2004). Historically, African farmers regulated soil fertility on their fields by leaving land fallow. As the population grew, however, fallow land diminished and many farmers adopted intensive land-use strategies that necessitate the use of fertilizers to restore nutrients. (FAO, 2010). Land Management Practices (LMPs) are the procedures typically employed by farmers to maximize crop yields by enhancing soil structure quality and cropland fertility. Farmers' land management strategies differ in different ecological zones. The effects of these land management strategies on crop yields vary among ecological zones. This likely holds true for all agricultural nations, including Nigeria. When selecting the agricultural site for agricultural objectives, notably for the production of food and export commodities, numerous agronomic considerations must be addressed. Soil erosion, which can occur naturally or as a result of human endeavors to enhance the standard of living, is one of the most important challenges of the agricultural land use system in Nigeria. An awareness of the qualitative interplay between land use and management, as well as attitudes toward management, is essential for reversing resource sustainability and food sustainability and ensuring continuing and profitable food production despite natural resource degradation.

Maize (Zea mays) is grown in around 160 nations on nearly 150 million tons and accounts for 36% (782 MT) of global grain production (Rana et al., 2018). It is known as the world's largest caloric source (19.5%), which is higher than the caloric content of rice (16.5%) and wheat (15.0%). It ranks third in global importance after wheat and rice (World Atlas, 2017). In sub-Saharan Africa, maize is the most important grain crop, with an estimated 50 percent of the continent's people cultivating it. It is the most important cereal crop in West Africa and the most important grain crop in Nigeria. Midway through the 1980s, the introduction of hybrids (e.g., F1 and F2) increased production increases. Recent declines in productivity have caused swings in maize production. In 2017, 10.4 million tons were produced, which is insufficient to feed the nation's expanding population (World Atlas, 2017a, b).

Agricultural management practices, resource depletion, population pressures, fragile ecosystems, poverty, land tenure, insufficient knowledge of appropriate technologies, technical know-how, insufficient incentives, and naturally unpredictable farmer perceptions and attitudes are all contributors to low productivity. These factors influence and affect overall production performance and management techniques, resulting in the country's low maize yield. In Oyo State, maize is not always accessible in sufficient quantities despite the country's abundant maize harvest and its importance as a food source.

This must be unrelated to the fact that many farmers rely mostly on traditional farming techniques and consequently make efficient use of available resources. Farmers in Oyo State utilize agroforestry, shifting crops, ridges over slopes, crop rotation, cover crops, fertilizer application, mulching, fertilizer application, irrigation, drainage, bush burning, and tree planting to block the wind. To attain optimal crop yields, farmers must implement sustainable agricultural management methods.

Statement of the Problem

Farming practices used by maize farmers in the study area: crop rotation, intercropping, manure application, cover crops, intercropping. Many farmers in the study area use their land resources for their profit without thinking about the land or neighboring areas. Poverty leaves some of them little or no choice but to overexploit their meager resources to the point of depleting the country. Land that is overexploited or abused can affect and reduce maize productivity. Land degradation and crop productivity are interrelated, as land degradation increases, crop productivity will decrease. It affects crops in so many ways, shortening crop lifespans, reducing soil nutrient levels, weakening the crop stem and can reduce crop yields. It also causes a loss of soil fertility through erosion by washing away the top layer of soil and leaving the barren soil, reducing crop productivity. Various factors are responsible for the low productivity of these farmers, including the use of obsolete crop practices, sparse crops, inadequate weed control, pest infestation, and disease, the non-use of fertilizers, organic fertilizers, and other improved agricultural inputs, as well as the management of crops among degraded ones. Soil conditions (FAO, 2013).

As a result of soil erosion, depleting soil nutrients, also known as soil infertility, washes away the soil's critical growth-promoting nutrients and particles. Lack of access to credit prevents farmers from acquiring agricultural inputs, preventing them from reaching their production potential. Also contributing to the decline in agricultural production is the migration of dynamic rural residents to urban areas, resulting in a dearth of graduates who are expected to accept and adapt new advances that can make farming a lucrative career. When rural local farmers lack access to expertise and information that would help them achieve optimum agricultural yield, not only do they grow in the dark, but they are forced to seek formal jobs in urban centers as their only means of survival.

Poor water management has resulted in irrigation issues that have made it impossible for farmers to reach the anticipated production increase. Despite the economic significance of maize to the dense population in the study area, insufficient maize was produced to meet people's food and industrial demands. This might be due to the low productivity of maize and the failure of farmers to embrace improved maize production technology.

Literature Review

Babalola (2013) Evidence from Ogun State on Sustainable Land Management Practices and Profit Efficiency of Maize and Cassava in Nigeria. This study assessed the impact of Sustainable Land Management Practices (SLMP) on the productivity of maize and cassava in Ogun State, Nigeria. A stratified sampling method was utilized to choose 388 participants for this investigation. The obtained data included the socioeconomic characteristics of the farmers, the input and output values, and the SLMPs employed. Soil Management Practices investigated included Structural and Mechanical Erosion Control (SMEC), Agronomic Practices (AP), and Cultivation Practices (CP) (SMP). The data were analyzed using descriptive statistics and the stochastic marginal profit function. The findings of this study indicate that the implementation of SLMPs considerably reduces profit inefficiencies.

Kayode *et al.* (2013), investigated the factors influencing the adoption of land management methods among male and female tillers in the Nigerian state of Kogi. The respondents were chosen through a multistage sampling technique. The data were collected using a structured questionnaire and analyzed using descriptive and inferential statistics. One hundred sixty-three respondents were polled for information (163). It was determined that years of schooling increased the rate of adoption of farming practices among female farmers, but land size was the most influential factor among male respondents.

Oyewo (2011) considered the technical efficiency of maize-producing farmers in Oyo State, Nigeria, using cross-sectional data gathered using a multi-level sampling technique, and then examined the factors that cause the difference in the efficiency index. Using a multilevel sample technique, 120 maize farmers in the research region were selected. Data was collected and submitted to inferential statistics; a stochastic marginal production model was employed in the research to establish the relationship between maize production and input level in the study area. Therefore, it was determined that existing technology allows for a 0.39% increase in maize production. As a result, the analysis confirmed that additional land may still be available for maize production in the region at the current level of consumption.

Adesiyan (2015) examined the performance of maize production in Osun State and the factors influencing maize production in the Ilesa East and Ilesa West local government areas. Using standardized questionnaires, 100 randomly selected respondents provided information. Multiple regression and housekeeping were utilized to examine the data. Therefore, maize production in the research area will increase if the government, private investors, or non-governmental organizations provide input support such as fertilizer, land, credit facilities, and increased education.

Eririogu *et al.* (2019) studied income diversification and sustainable land management strategies. This study sought to examine the sustainable land management methods and income diversification techniques of rural cassava and yam-based smallholder farmers in Imo State, Nigeria, utilizing cost-route data from a sample of 120 farmers. Statistical descriptions, the Sustainable Land Management Index (SLMI), the t-test, and the binary probit model. All cassava-based farmers utilized mixed and mixed cropping (100.00%), mulching (95.00%), and compost and manure (96.6%), according to the results. While the majority of farmers that grew yams utilized intercropping and intercropping (98.33%), mulching (91.67%), and compost/manure (90.00%), they also utilized intercropping and intercropping (98.33%). In the study region, sustainable labor-saving farming techniques must be explored and incorporated into cassava and yam production systems, as well as commercial sources (markets) of organic fertilizer. To implement sustainable agricultural techniques, farmers must

Through realistic land reform regimes, access to farms and titles ought to be enhanced. Agricultural systems have an effect on soil quality throughout time.

Abdullaleem *et al.* (2019) investigated the maize production efficiency of smallholders in south-western Nigeria. This study examined the resource utilization efficiency of maize

production by smallholder farmers in south-western Nigeria. Two hundred and seventy (270) farmers were chosen for this study using a multi-level sample technique. Using well-structured questionnaires, primary data were collected. As analytical techniques, descriptive statistics, gross margin analysis, and stochastic marginal production function were employed. According to the findings, the average age of the farmers was 47.7 years.
Idowu *et al.* (2019) explored the technical efficiency of maize producers in Nigeria's Oyo State. Recent declines in maize yield have been attributed to issues such as outmoded agricultural management practices, poor resource utilization, a vulnerable ecology, land tenure, and others. Therefore, this study investigated the technical efficiency of maize farmers in the Nigerian state of Oyo. Using a multistage sampling strategy and stochastic marginal analysis as the analysis method, primary data were obtained. The data indicate that more farmers are male (70.56%), that the majority are married (76.49%), that 78.88% have completed elementary, secondary, or tertiary education, and that 34.4% have access to financing. The average agricultural experience is 7.11 years, with 83.89 percent of farmers having experience between 0 and 10 years. The average farm size is 19.12 hectares, and the median farmer income is $51512.2 x.

Agricultural Land Management Practice in Nigeria

A wide range of farming practices, including the application of chemical fertilizers and manure, intercropping and crop rotation, were very popular. These practices generally require little technical skill, show positive short-term benefits, and have a short set-up time, suggesting that the benefits of increased productivity can be realized fairly quickly. In Nigeria, agricultural land use supports the livelihood of the majority of people by providing 80% of jobs, and agricultural products contribute 43% to gross domestic product (GDP). Land use for agricultural activities is an economic activity that is highly dependent on weather and climate to produce the food and fiber necessary to sustain human life (Apata, 2019). Therefore, land use for agriculture is expected to be vulnerable to climate variability and change.

Maize Production

Maize (Zea mays) is now the third most important staple food in the world and a staple food of major socioeconomic importance in sub-Saharan Africa (Food and Agricultural Organization, 2009). It is considered one of the longest-established food crops. Maize is also grown in several regions of the world and is considered to be the world's best adapted crop. Over time, maize served not only as a source of food for humans and livestock, but also as a source of income and foreign exchange. In Nigeria it is the third most important grain after sorghum and millet. Grains produced in Nigeria are maize, rice, cowpea, soybean, sorghum, millet and peanut. The larger proportion of grain produced in Nigeria is maize as it can thrive under different ecological conditions. Adekunle and Nabinta (2000) reported a sustained increase in maize production.
The economic importance of maize spans various spheres of human life, it also serves as food for human consumption, such as porridge, popmaize, thick porridge and boiled grains

are notable foods consumed by majority of Nigerians, mainly in the south of Nigeria (Olaniyan, 2015 and Oyewo, 2011). Industrially, maize is the main ingredient of animal feed for poultry, brewery for beer and malt beverage, ethanol for biofuel, starch and syrup for medicinal purposes (Monsanto, 2014), the starch can be used as converter dextrin, syrup and sugar; The oil obtained from it is used to prepare soups or to refine cooking and salad dressing. Also, it is a source of employment for millions of Nigerians, from the farmers who grow maize to all the value chain actors involved in its production for different end uses.

Productivity measures in Agriculture

Agricultural productivity is the measure of the amount of agricultural output produced for a given amount of input or set of inputs. There are different ways to define and measure productivity. For example, the amount of output per unit input (e.g tons of wheat per hectare of land) or an index of many outputs divided by an index of many inputs (Wiebe, 2003). The amounts of output relative to the amount of inputs are the traditional measures of productivity. If output increases at the same rate as input, productivity remains unchanged. On the other hand, if the output growth rate exceeds the growth rate in the use of inputs, productivity is positive.

Factors influencing agricultural productivity growth

Conventional inputs such as land, labor, water, chemical fertilizers and physical capital, etc. in the role of human capital, research and technological development or technology transfer, public investment in agricultural research, advisory services and infrastructure development, sustainable management of natural resources, political reform and political stability, etc .are important strategies that are closely linked to agricultural productivity. There are several factors that can help increase agricultural productivity. The importance of education, human capital, for productivity growth cannot be overstated.

Efficiency

Technical efficiency is a component of economic efficiency and reflects a farmer's ability to maximize output from a given input level (i.e. output orientation) (Adesiyan 2015). Farmer age and education, access to extension, access to credit, family size, tenancy, and farmer access to fertilizers, agrochemicals, tractors, and improved seed variables are reported by many studies to have positive effects on technical efficiency (Amos 2007; Ahmad et al 2002; Kibaara 2005; Tchale and Sauer 2007; and Basnayake and Gunaratne 2002).

Method and Empirical Result

This study addressed two research questions: (1) what are the costs and revenues of maize producers in the Ogo-Oluwa Municipality of Oyo State and (2) what is the impact of land management practices on the efficiency of maize farmers in the Ogo-Oluwa Municipality of Oyo State of Oyo. This study was conducted in the Ogo-Oluwa administrative area in the Ogbomoso agricultural zone in the state of Oyo. This municipal area consists of various

villages that are rural in nature. Ogbomoso is located approximately at the intersection of 8oo8 north latitude and 4o15 east longitude and an altitude of 213 asl. Ogbomoso is considered an inferred savanna vegetation zone and a lowland rainforest area. The zone experiences both wet and dry seasons annually (Oyewo, 2011).

Sampling Techniques and Sample Size

Multi-stage sampling technique was used to select respondents for the study. The first phase involved the targeted selection of the Ogo-Oluwa local government area from the thirty-three local government areas in Oyo State due to the dominance of rural farmers in that area. The second stage was the random selection of two districts in the local government area. In the third stage, five villages were randomly selected from the two districts to select a total of ten villages. The fourth stage was the proportional selection of twelve local farmers from each village to give the total of one hundred and twenty local farmers from the villages making up the sample size.

Source Data and Method of Data Collection

Primary data was used and was collected through the use of well- structured questionnaires and interview schedule.

Method of Data Analysis

Descriptive statistics, Gross margin analysis and stochastic frontier model were used to analyze the objectives of the study.

Descriptive statistics

Descriptive statistics such as mean, frequency and percentage were used to describe the socioeconomic characteristics of maize farmers and to identify the limitations faced by the maize farmers in adopting the applied land management practices.

Gross Margin Analysis

The Gross Margin analysis was used to estimate the costs and returns of maize farmers in the study area. The gross margin is the difference between the gross revenue and total variable cost. Where,

Gross Margin (GM) = TR – TVC (1)

% Margin = GM/TVC × 1oo/1 (2)

The formula for the net profit analysis is given by:

TR=Q*P

Π = TR – TC (3)

TC = TVC + TFC (4)

Where; π = Net profit (N)

TC = Total cost (N), TVC= Total variable cost (N), TFC = total fixed

Cost (N), TR = Total returns and P = Price

Stochastic Frontier Model

The stochastic frontier model was used to analyze the effect of agricultural land management practices on the efficiency of maize farmers in the study area. The stochastic production function limit enables the simultaneous estimation of the individual technical performance of the interviewed farmers as well as determinants of the technical performance.

A Cobb–Douglas Production form of the frontier used for this study is presented as follows:

$LnY = \beta_0+\beta_1 lnX_1+\beta_2 lnX_2+\beta_3 lnX_3+\beta_4 lnX_4+\beta_5 lnX_5+U_1+V_1$

Where

Y = Efficiency of Maize farmers

X_1= Farm size

X_2= Cost of labour

X_3= Cost of seed

X_4= Cost of fertilizer

X_5= Cost of herbicide

Inefficiency model

$Ui\ \delta_0 + \Sigma\ \delta i\ Zi$

$Ui\ \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i}$

Where Z_1 = Age

Z_2 = House hold size

Z_3 = Farming experience

Z_4 = Farm size

Z_5 = Crop rotation

Z6 = Fertilizer application

Z_7 = Multiple cropping

Z8 = Mono cropping

Z_9 = Tillage

Z_{10} = Cover cropping

Xi = The vector of input quantities of the *i*th farmer,

βi = The vector of unknown parameter to be determined,

Vi = Random variables

Ui = Non-negative random variables which are assumed to account for inefficiency in production.

Empirical Result

The empirical result of the study was vividly explained below: The study found that 36.67% of the respondents were under or equal to 30 years old, 62.57% of the maize farmers were married and the majority of the respondents were male (55th .83%). , 49.16% had 4 6 members, 34.17% had secondary education, 79.15% of those surveyed in the study area produced both family and market products, 46.66% had farming experience less than or equal to 5.73 .33% had a farm size of at least 2 hectares of land, 33.33% of the respondents

in the study area acquired their farmland through family inheritance, 52.50 belong to the cooperative, 49.17% of the respondents in the study area employed wage workers.

Analysis of the effect of agricultural land management practices on efficiency of maize farmers in the Study Area

The coefficient and associated statistical test results obtained from the stochastic marginal production function used to explain the influence of production inputs on farmers' maize production and also to determine agricultural land management on farmers' efficiency and inefficiency are presented in Table 13.

The result revealed that the size of arable land, labor cost, seed cost, fertilizer cost and herbicide cost with coefficients of 0.941312, -0.205838, -0.2533227, 0.2476768 and -0 ,5030042. are each important and all significant with a probability of 1%. The size of agricultural land is significant and positive at 1%, the variable representing farm size is positive and significant at 1%. This implies that an increase in farm size per unit leads to an increase in farmer output and vice versa.

The variable representing labor costs is negative and significant at 1%, meaning that an increase in labor costs per unit leads to a decrease in farmers' production and vice versa. The variable representing seed cost is negative and significant at 1%, implying that an increase in unit seed cost leads to a decrease in farmers' production and vice versa. Fertilizer costs are significant and positive at 1%, implying that a one unit increase in seed increases farmers' production inversely, the variable representing herbicide costs is negative and significant at 1%, implying that an increase in unit costs of herbicides will lead to a decrease in the production of farmers and vice versa.

The inefficiency result shows that the variables household size, farm size, fertilizer application and monoculture influence the inefficiency of farmers in the study area and are all significant (1%, 1%, 10% and 5%, respectively). The variables representing household size are positive and significant at 1%, implying that a one unit increase in household size leads to a reduction in farmer inefficiency and vice versa. The variable representing farm size is positive and significant at 1%, meaning that increasing farm size by one unit reduces farmer inefficiency and vice versa. While the variable representing fertilizer application is negative and significant at 10%, this implies that increasing the unit in practice fertilizer application will reduce farmer inefficiency and vice versa. Also, it is found that the variable representing mono-cropping is significant and negative at 5%, implying that an increase in the practice of mono-cropping will increase farmer inefficiency and vice versa.

Table 1: Estimates of Parameters of Stochastic Frontier Production Function on effect of agricultural land management practices on efficiency of maize farmers

Variables	Coefficients	Standard error	Z-Value
Farm size	.941312	.0019493	482.89***
Cost of labour	-.0205838	.0001707	-120.61***

Cost of seed	-.2533227	.0019998	-126.68***
Cost of fertilizer	.2476768	.0018417	134.48***
Cost of herbicide	-.5030042	.0012322	-408.23***
Inefficiency Model			
Constant	-29.18918	91.06924	-0.32
Age	-3.514874	2.710576	-1.30
Household size	2.239347	.7966577	2.81***
Farming experience	.7262821	.8028905	0.90
Farm size	1.495118	.4891832	3.06***
Crop rotation	.1703461	.9359564	0.18
Fertilizer application	-1.490939	.8778677	-1.70*
Multiple cropping	-.4975983	.937266	-0.53
Mono cropping	-2.366609	1.150659	-2.06**
Mixed cropping	-.8257297	.9408309	-0.88
Tillage	.8619164	3.68024	0.23
Cover cropping	.3995852	3.993823	0.11
Constant	4.183179	7.7787	0.54
Sigma-squared	4.59e-07	.0000209	

Source: Field Survey Data Regression Result 2021

Life Cycle Cost Analysis and returns of Maize farmers in the Study area

The result in Table 12 shows the cost and yield analysis of the maize farmers in the study area. This involves estimating the total cost (total variable cost and total fixed cost) of maize production, total revenue (TR) and net revenue (NR) from production, which in purely economic terms represents profit. Gross margin analysis was used to estimate this. It involves adding the total variable cost (TVC) and total fixed cost (TFC) to get the total cost (TC), then the total revenue from the sale of the cocoa produced by the farmers was calculated. Then total variable costs were subtracted from total sales to get gross margin. Finally, the net revenue (profit) was calculated by subtracting the total costs from the total revenues, giving the profit that the maize farmers made from their production. The table showed the cost of variable items (knife, hoe, wheelbarrow, labor, seed, fertilizer, herbicide, transportation, sack, storage, rake, basket), cost of fixed items (land depreciated), total cost (which is the sum of variable and fixed costs), total income from maize production, gross margin and profit. Total variable cost, total fixed cost, and total cost were found to be 316,824.8462, 92903.13, and 409724.9762, respectively. Total Revenue, Gross Margin, and Profit were also found to be 1,249549.981 and 932,725.1352, respectively. This indicates that maize production is profitable in the study area.

Table 2: Cost and Returns Analysis of Maize in the Study Area

Items	Costs (₦)
Total Variable cost	316,824.85
Total Fixed cost	92,903.13
Total cost	409,725
Total Revenue	1,249,549.98
Gross Margin	932,725.14
Profit	839,822.00

Source: Field survey, 2021

Conclusion

The study concluded that the majority of respondents were under or equal to 30 years of age, most maize farmers were married, the majority of respondents were male, the majority had 4 to 6 members, most had secondary education, most farmers produced both for family and market, majority had farming experience less than or equal to 5, most had farm size less than or equal to 2 hectares of land, most respondents belong to a cooperative, majority of respondents in the study area are employed. The study shows that maize production in the study area is profitable.

The study further found that farm size, labor costs, seed costs, fertilizer costs, and herbicide costs are factors that determine the profitability of maize farmers in the study area. This concludes that household size, farm size, fertilizer application, and monoculture are important factors in maize farmers' choice of land management practices. The results of the study indicate that maize farmers fall into the middle category of adopters of agricultural practices.

Recommendations

- More awareness among maize farmers of the importance of agricultural land management practices is still needed to encourage increased adoption of land management practices that will increase soil fertility and boost maize production;
- Although maize production proved profitable despite the pest and disease challenge, maize farmers were still able to increase their gross margin by controlling pests and diseases and/or providing good storage facilities to sell for a better margin in the off-season;
- Maize farmers should have access to credit with little or no interest rates to improve their income;
- The government should support farmers with credit facilities;
- Land management practices that are currently in use but have the potential to improve maize production should be identified and promoted in the study area.

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