DETERMINANTS OF LAND PRODUCTIVITY AMONG ARABLE CROP FARMERS USING SUSTAINABLE SOIL MANAGEMENT TECHNIOUES IN IMO STATE, NIGERIA.

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Abstract
The magnitude of soil management techniques engaged by the crop farmers determines to an extent the level of land productivity of the farmers. This study examined thedeterminants of land pproductivity among arable crop farmers using sustainable soil management techniques in Imo State, Nigeria. Multi-stage random sampling technique was used to select 209 arable crop farmers for this study. Information on the objectives of this study was elicited from the sampled respondents through a well-structured questionnaire. Data were analyzed using descriptive statistical tools such as the mean, productivity index and ordinary least squares multiple regression models. The mean productivity ratio was 0.049, which became a threshold for the classification of the productivity ratios of the farmers into high and low productivity. Results showed that majority of the arable crop farmers, 50.7 percent had a high productivity level relative to 49.3 percent with low productivity level. Extension contacts of the crop farmers may have guided the high productivity levels of the farmers. Constraints associated with land productivity were categorized into major and minor constraints. The major constraints includes scarcity of farmlands, high cost of farm inputs, inadequate capital, erosion challenges and poor storage facilities with mean values of 0.98, 0.97, 0.96, 0.94, and 0.93 respectively. Age of the farmer, household size, land tenure systems, farming experience, extension contact, level of education, and SSMT were significant determinants of land productivity of crop farmers at 1% and 5% levels. Policies to boost up the rural economy and land productivity should be formulated and implemented via the intensification of improved land management techniques, land reforms, and resource use efficiency of the farmers.

Keywords: Determinants; Land Productivity; Arable Crop Farmers; SSMT; Soil Quality

Introduction

Land productivity includes the output produced by a given level of input(s) in the agricultural sector of a given economy (Osuji, 2017). Literature reviews showed that agricultural productivity increases more in developed countries compared to less developed countries. This is due to high investment in research and development, labour, land and capital and improvement in the use of inputs such as fertilizer, machinery increases and others (Mapula et al. 2011). According to Chang and Zepeda (2010) labour productivity in China increased by 4.13% whilst that of the United States was 7.16% during 1987-1994. In general land productivity is higher in less developed countries as compared to developed countries due to land reforms. It must be noted that growth in agricultural productivity depends primarily on technological change, improved input use efficiency and conservation of natural resources. These in turn, depend crucially upon investments in agricultural research, extension and human capital.

Oluwatayo et al., (2008) further stated that increasing or sustaining agricultural productivity requires one or more of the followings: an increase in output and input with output increasing proportionately more than input; an increase in output while inputs remain the same; a decrease in both output and input with input decreasing more; or decreasing input while output remained same (Adewuyi, 2006; Oni et al., 2009). Increasing inputs in order to expand output involves raising both the quality and quantity of inputs which would involve mechanization of agriculture, use of high yielding varieties, use of fertilizer, irrigation, and use of agrochemicals such as herbicides and pesticides. According to Tessema (2015), agricultural productivity can be increased by using two ways. The first method is through improvement in technology given some level of input and the other option of improving productivity is to enhance the output per household labor ratio of rural household farmers, given fixed level of inputs and technology. Furthermore, agricultural production and productivity growth depend on a mixture of factors such as the use of sustainable soil management techniques (SSMT), agricultural ecological, micro and macro-economic policies, and trade at the international level etc. Other important factors include; land, labour and capital, etc (Osuji, 2017). In terms of growth, agricultural productivityplays a vital role in economic growth by linking the supply and demand side (Johnston and Mellor, 1961). For example, the agricultural sector supplies raw materials for industrial or other non-agricultural sectors and demands inputs from the modern sectors like science and information technology. In the demand side, increased agricultural productivity can raise the earnings of the rural population and thereby create more demand for local industrial products (Dethier and Effenberger, 2011). In this way, a link can be created between agriculture and modern sectors and that may create new employment opportunities and improve rural income and livelihood.
Productivity of land can be measured as partial and total factor productivity. Partialproductivity is a measure of

ratio of output to the individual inputs used in the production process (labour, land, capital, etc) while Total factor productivity is the ratio of total output to the total input used in the farm production process(Osuji et al., 2012).

However, empirical studies have revealed that 80% of farmers reside in rural areas and depend majorly on agriculture for meeting their daily necessities as well as for their livelihood. These groups of farmers have suffered low productivity of the land resulting fromland fragmentation, use of unsustainable techniques, poor capital, poor extension contacts, land tenure systems, lack of adequate farm information, illiteracy, etc (Osuji et al. 2013).Thus, this study set out to assess the determinants of land productivity among arable crop farmers using sustainable soil management techniques in Imo State, Nigeria which have not been documented before now, hence the need for this study.

Materials and Method

This research was conducted in Imo State of Nigeria, which is located in the South-eastern part of Nigeria with a land area of 5,530 sq km. The State lies between latitudes $4^0 45^I$N and $7^0 15^I$N and Longitudes $6^0 50^I$E and $7^0 25^I$E. The State shares boundaries with Abia and Cross Rivers State to the East, Delta State to the West, Rivers State to the South and Enugu and Anambra State to the North (ISSYB, 2004). The State has Owerri as its capital and made up of 27 (twenty-seven) Local Government Areas which are grouped into three agricultural zones namely Owerri, Orlu and Okigwe. Farming is the predominant occupation of the rural inhabitants. Multi-stage sampling technique was used for this study. In the first stage, two local government areas (LGAs) were purposively selected from each of the three agricultural zones of the State namely (Owerri, Okigwe and Orlu). The selection of theseLGAs was based on their predominant agricultural activities and use of sustainable soil management techniques (SSMT). The LGAs selected were Ngor-Okpala and Ohaji-Egbema from Owerri zone, Nwangele and Isu from Orlu zone while Isi-alaMbano and Obowo were selected from Okigwe zone, respectively. Six (6) local government areas were used for this study. The second stage involved a random sample selection of arable crop farmers from the list of registered arable crop farmers using SSMT, kept with the zonal ADP's in each of the selected LGAs from the various zones of the State. Owerri zone has 122 registered arable crop farmers while Orlu and Okigwe zones have 130 and 109 arable crop farmers. This shows that there are unequal numbers of arable crop farmers across the three zones; hence an equal representation of sample was made from a proportion of 70 percent of the total population from each zone. This gave a sample size of 85 for Owerri zone, 91 for Orlu zone and 76 for Okigwe zone giving a total of 252 arable crop farmers across the six LGAs. However, the study eventually used only 209 valid questionnaires for analysis. Data were analyzed using descriptive statistical tools such as the mean, productivity indexand ordinary least squares multiple regression models. The land productivity levels was classified into high and low productivity using the mean score obtained across the farmers in the area (Ehirim *et al*. 2013).

The mean value was estimated as;

$$\boldsymbol{X = \frac{LPithF}{n}} \quad \text{-------} \quad \text{eqn.1}$$

Where

LP = Land productivity of the ith farmers

n = Sample size

X = Mean

Hence; any ith farmer's productivity ratio ≥ X is declared a high productivityand lowproductivity, if otherwise

Land productivity index model is specified as follows;

$$LP = \frac{Topt}{Tipt} \quad \text{--------} \text{ eqn.2}$$

Where

LP = Land productivity

Topt = Total output

Tipt = Total Input

The multiple regression modelsareexplicitly expressed as follows;

Linear: $Y = b_0 + b_1X_1 + b_2X_2 + \ldots + b_{10}X_{10} + e$ --eqn.3

Semi-Log: $Y = b_0 + b_1LnX_1 + b_2LnX_2 + \ldots + b_{10}LnX_{10} + e$ ------ eqn.4

Exponential: $LnY = b_0 + b_1X_1 + b_2X_2 + \ldots + b_{10}X_{10} + e$ --- eqn.5

Cobb-Douglas: $LnY = Lnb_0 + b_1LnX_1 + b_2LnX_2 + \ldots + b_{10}LnX_{10} + e$ ---eqn.6

Where

Y = Land Productivity (Naira)

X_1 = Age (Years)

X_2 = Household size (N0. of Persons)

X_3 = Farm size (Hectares)

X_4 = Land tenure systems (Inheritance =1, rented =0)

X_5= Labour supply (mandays)

X_6= Farming experience (No of years)

X_7= Access to credit (Naira)

X_8 = Extension contact (No of visits)

X_9= Level of education (N0. of Years)

X_{10}= SSMT (N0. of techniques used)

e = random error term

$b_o, b_1, b_2 \ldots, b_{10}$ = regression coefficients

Ln = natural logarithm

Results and Discussion

Productivity Ratios of Arable Crop Farmers using SSMT

The distribution of the farmers based on productivity ratios are shown in Table 1. It could be deduced from the Table that the mean productivity ratios was 0.049, which became a threshold for the classification of the productivity ratios of the farmers into high and low productivity as shown in Table 2 below. The mean productivity ratioof 0.049 implies that arable crop farmers in the area had a marginal increase in land productivity as a result of the usage of the sustainable soil management techniques introduced to them. The low standard deviation of theproductivity ratios of the farmers further indicates that the farmers were able to utilize the sustainable soil management techniques introduced to them. 6.7 percent of the farmers are within the range of 0.001-0.009 which implies that these groups of farmers recorded the least productivity ratios. This could be due to poor exposure of the sustainable soil management techniques coupled with the practicability and technicality of some of the techniques. Other pertinent reasons could be due to the conservative and less receptive nature of rural farmers in adopting improved soil management techniques. This corroborates the findings of Ejike and Osuji (2013) and Osuji, (2017). 12.4 percent of the farmers are within the range of 0.010-0.019 while 19.1 percent of the farmers are within the range of 0.020-0.029. Consequently, 17.7 percent of the farmers had a high productivity ratio of 0.050-0.059 and 0.070-0.079 with 8.6 percent of the arable crop farmers. This also indicates efficient use of the improved soil management techniques by the farmers (Osuji, 2017).

Table 1: Distribution of Farmers based on Productivity Ratios

Productivity Ratios	Frequency	Percentage
0.001-0.009	14	6.7
0.010-0.019	26	12.4
0.020-0.029	40	19.1
0.030-0.039	23	11.0
0.040-0.049	22	10.5
0.050-0.059	37	17.7
0.060-0.069	29	13.9
0.070-0.079	18	8.6
Total	209	
Mean	0.049	
SD	0.017	

Source: Field survey data, 2015

Classification of Land Productivity of the Arable Crop Farmers Using SSMT

The classification of the land productivity of the arable crop farmers using sustainable soil management techniques are shown in Table 2. The Table, revealed that majority of the arable crop farmers, 50.7 percent had a high productivity level relative to 49.3 percent with low productivity level. The classification of the land productivitylevel of the arable crop farmers originated from the mean productivity ratioof 0.049 as shown in Table 1 above. Any ith farmers 'productivity ratio greater or equal to the mean productivity ratio is classified as high productivity level and low productivity level, if otherwise. However, the high productivity level recorded in the area could be attributed to the informal interaction of the arable crop farmers, coupled with increased participation in agricultural seminars and workshops. This supports the findings from; Onyenweaku and Mbuba (1991); Owuor *et al., (*2007) and Osuji (2017) who reported that regular participation in agricultural workshop tends to provide farmers with reliable information on a wide range of agricultural technologies. The frequency of participation in agricultural workshop is very crucial as it guides the farmers on new farm practices which enhances the output and income of the farm households. NAERLS and NFRA (2009) further reported that organized agricultural workshops enables farm households to be better informed with improved agricultural techniques which help to improve landproductivity and income level. Furthermore, extension contacts of the farmers may have also aided the high productivity level recorded by the farmers in the area (Osuji, 2017).

Table 2: Distribution of Farmers based on Classification of Land Productivity

Land Productivity Levels	Frequency	Percentage
High Productivity	106	50.7
Low Productivity	103	49.3
Total	**209**	

Source: Field survey data, 2015

Constraints to Land Productivity of the Arable Crop Farmers

The distribution of the arable crop farmers based on constraints to land productivity is shown in Table 3 below: The Table showed that the constraints associated with land productivity is categorized into two namely major and minor constraints. The major constraints includes scarcity of farmlands, high cost of farm inputs, inadequate capital, erosion challenges and poor storage facilities with mean values of 0.98, 0.97, 0.96, 0.94, and 0.93, respectively. This implies that these constraints are fundamental to the low productivity encountered by the farmers. Osuji (2017) reported that high costs of farm inputs coupled with poor capital and storage facilities are frustrating the efforts of the arable crop farmers towards increasing their farm productivity. However, the minor constraints to land productivity of the farmers include inadequate markets (0.84), land fragmentation (0.68), pests and diseases (0.52), climatic variations (0.49) and Poor road networks (0.48). It could be seen from the result that these constraints impeded the land productivity of the farmers but where not that severe as to the major constraints.

Table 3: Distribution of Farmers based on Constraints to Land Productivity

MajorConstraints	*Frequency	Mean	Rank
Scarcity of farmlands	206	0.98	1st
High cost of farm inputs	204	0.97	2nd
Inadequate capital	202	0.96	3rd
Erosion challenges	198	0.94	4th
Poor storage facilities	196	0.93	5th
MinorConstraints			
Inadequate markets	177	0.84	6th
Land fragmentation	144	0.68	7th
Pests and Diseases	109	0.52	8th
Climatic variations	104	0.49	9th
Poor road networks	101	0.48	10th

Source: Field survey data, 2015

Determinants of Land Productivity of the Arable Crop Farmers Using SSMT

The four functional forms of the model were fitted in to assess the determinants of land productivity of the arable crop farmers using sustainable soil management techniques. Double-Log function was selected as the lead equation based on having the highest number of significant variables, highest R^2 and F-statistics and was further used for interpretations. The result showed that the co-efficient of multiple determination (R^2) was 0.8682. This implies that 86.8% variations of the dependent variable were explained by independent variables investigated. The f-value was highly significant at 1% and indicates the fitness of the model.

The coefficient of age of the farmer was significant at 5% and was negatively related to land productivity. This implies that increase in age of the farmers by 1% will lead to a corresponding decrease in land productivity by 67.7%. As farmers advance in age, the strength to do most of the farm work depreciates leading to low productivity of the land. This is in line with Osuji (2017).

The coefficient of household size was positively related to land productivity and was significant at 5% level. This implies that increase in household size of the farmers increases the productivity of the land. This could be so because the farmers were able to harness the household size available to them. This disagrees with the findings of Obasi et al. (2013).

The coefficient of land tenure systems was highly significant at 1% and was negatively related to land productivity. This implies that low farm productivity is associated with rented lands. This is true because the cost of renting a farm land is on the increase and this reduces the available capital of the farmers in procuring other farm inputs such as agro-chemicals, fertilizers, seedlings, etc

The coefficient of farming experience had a positive relationship with land productivity and was highly significant at 1%. This implies that an increase in farming experience of the farmers by 1% will result to a corresponding increase in land productivity by 68.9%. Experienced farmers are generally better and knowledgeable enough to access the relevance of new technologies through interaction with other farmers and the outside world which conforms to the findings of Osuji et al., (2014) and Ofuoku *et al.*, (2009).

The coefficient of extension contact was highly significant at 1% and positively related with land productivity. This implies that increase in extension contacts of the arable crop farmers will definitely lead to an increase in land productivity of the farmers. Extension contacts are known to engender innovative effectiveness, knowledge transfer, and information dissemination and adoption drive of the farmers in general. This is in tandem with Fakoye (2000).

The coefficient of level of education was also highly significant at 1% and positively related with land productivity. This also implies that increase in level of education of the arable crop farmers increases the productivity of the land. Education increases the ability of a farmer to understand, evaluate and adopt new production techniques in line with the observations of Asfaw and Admassie (2004).

The coefficient of SSMT was significant at 5% with a positive relationship with land productivity. This implies that the adoption and use of the sustainable soil management techniques increased the productivityof the farmers by 67.6% in line with Osuji (2017).

Other variables such as farm size, labour supply, and access to credit were not significant and this might be due to statistical errors encountered in the process.

Table 4: Determinants of Land Productivity of the Arable Crop Farmers Using SSMT

Variables	Coefficients	t-values	Significant levels
Constant	0.1417	1.2004	NS
Age of farmer (X_1)	-0.6773	-2.6097	**
Household size (X_2)	0.5523	2.5467	**
Farm size (X_3)	0.7086	1.0045	NS
Land tenure systems (X_4)	-0.8189	-3.4065	***
Labour supply (X_5)	-0.0451	-1.0022	NS
Farming experience (X_6)	0.6890	4.9753	***
Access to credit (X_7)	0.0776	0.9968	NS
Extension contact (X_8)	0.8765	3.2128	***
Level of education (X_9)	0.7509	2.9065	***
SSMT (X_{10})	0.6760	2.5005	**
R^2	0.8682		
F-value	44.678		
N	209		

Source: Field survey data, 2015

Note: ***; ** indicates statistically significant at 1 percent, and 5 percent level of significance respectively. NS; indicates non-significant.

Conclusion and Recommendations

Findings of the study revealed thatthe mean productivity ratio was 0.049, which became a threshold for the classification of the productivity ratios of the farmers into high and low productivity. Results showed that majority of the arable crop farmers, 50.7 percent had a high productivity level relative to 49.3 percent with low productivity level. The high productivity level recorded in the area could be attributed to the informal interaction of the arable crop farmers, coupled with increased participation in agricultural seminars and workshops. The major constraints perceived in the area includes; scarcity of farmlands, high cost of farm inputs, inadequate capital, erosion challenges and poor storage facilities with mean values of 0.98, 0.97, 0.96, 0.94, and 0.93, respectively. The coefficient of age of the farmer, household size, land tenure systems, farming experience, extension contact, level of education, and SSMT were significant at 1% and 5% levels and were important determinants of land productivity of crop farmers.Policies to boost up the rural economy and land productivity should be formulated and implemented via the intensification of improved land management techniques, land reforms, and resource use efficiency of the farmers.

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