DETERMINANTS OF ARABLE CROP FARMERS' USE-LEVELS OF SUSTAINABLE SOIL MANAGEMENT TECHNIQUES IN IMO STATE, NIGERIA

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ABSTRACT

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Efficient use levels of sustainable soil management techniques (SSMT) are sine qua-non for increased food production. Hence, the study assessed the determinants of use-levels of sustainable soil management techniques of arablecrop farmers 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, probability use-levels of SSMT and Tobit regression model. The Table revealed that about 96.2 percent of the farmers had contact with extension agents during the cropping season which aided their exposure to improved soil management techniques. Mean probability use levels of the sustainable soil management techniques was 0.470, with less than 46 percent of the farmers having probability use levels which ranges from 0.116 - 0.470, which implies that minority of the farmers in the area had relatively low use level of sustainable soilmanagement techniques. Findings further reveal that age of farmer, sex of farmer, education, net farm income, farm size, extension contacts, farming experience and cost of land improvement practices were significant determinants of use levels of sustainable soil management techniques. Hence, farmers in the area should be encouraged to effectively adopt improved soil management techniques without prejudice or bias as to improve food production always.

Keywords: *SSMT, Arable Crop Farmers, Tobit Model, Food Production*

INTRODUCTION

Sustainable soil management techniques refers to diverse activities that facilitates food crop production without disposition of the land to deterioration and degradation. According to Adams (2006), it is concerned with all the operations that enhance the efficiency of the soil by protecting it from deterioration and destruction. An efficient soil management technique as well as standard ecological, economic and environmental principles is a *sine qua non* to agricultural sustainability. It has the ability to resist erosion.According to Akande(2008), combination of good soil management practices with accepted ecological and economic principles are more likely to ensure agricultural sustainability. Waikato (2009) noted such good soil management practices as effective soil cover, proper clearing of land and tilling with less disturbance as well as fertilizer application as recipe for reducing soil degradation. Amos (2010)opined that the productivity of agricultural lands should be boosted by guarding them against losses arising from compaction, erosion and decline of organic matter. Good soil management techniques must be profitable as well as anchored on sound scientific principles and simultaneosly meet the needs of the society (George, 2013) asthis involves the application of soil practices that are economically viable, sociallyacceptable, environmentally friendly and technically appropriate for sustainable agricultural production. This implies unceasing availability of soil and retention of its economic viability without depletion while meeting the food demands of the present and future generations (Kate-Robert, 2010). Sustainable land management techniqueis the adoption of land use systems through appropriate management practices which enables soil users to maximize the economic and social benefits from the soil while maintaining or enhancing the ecological support functions of the land resources (FAO, 2009). Beddoea (2009), stressed the relevance of implementation of sustainable soil management techniques (SSMT)to future generations which is vital for agricultural production and ecosystems.

In recent times however, low use of sustainable soil management techniques have been attributed to factors beyond the control of the farmers. These factors have been recognized as related to poverty status of the farmers, religious, cultural, and other environmental factors. More so, these factors make farmers resort to the use of varying soil management techniques which lead to soil erosion, as well as other environmental degradation issues. However, the rate at which farmers use a particular technology depends on their level of exposure. This highlights the importance of education in the adopting soil management techniques. Hence, extension contacts further play a major role in helping farmers to adopt good soil management techniques. According to Iheke and Nwaru (2014) agricultural extension services provide informal training that boosts the potential of the farmers, enhancing their ability to understand and accept innovations that promote their use of SSMT which translates to improved agricultural productivity. Empirical studies have also shown that large farm size, level of education, farming experience, capital, environmental awareness, and access to informationraises the use levels of sustainable soil management techniques of the farmers. Akande (2008) also confirmed the positive relationship between large farm size and increase use levels of improved techniques as it enables farmers to expand their production capacity. The determinants of use level of sustainable soil management techniques in Imo State have not been documented, hence, the need for this study.

MATERIALS AND METHODS

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 km^2. The State lies between latitudes 4° 45´ N and 7° 15´ N and Longitudes 6° 50´ E and 7° 25´ 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. The selection of these LGAs 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-ala Mbano and Obowo were selected from Okigwe zone. A total of six (6) local government areas were used for this study. The second stage involved a random sampling of arable crop farmers from the list of registered arable crop farmers that are using SSMT documented by the zonal ADP's. Owerri zone has 122 registered arable crop farmers while Orlu and Okigwe zones have 130 and 109 arable crop farmers respectively. This shows that there are unequal numbers of arable cropfarmers across the three zones, hence unequal 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 209 valid questionnaires for analysis. Data were analyzed using descriptive statistical tools, probability use-levels of SSMT and Tobit regression model. The probability use-levels of SSMT are expressed as follows;

$$Prob.SSMT\ Use\ level = \frac{U}{V}\ where;0\ \leq SSMT\ Use\ level\ \leq 1 - - - \qquad eqn.1$$

Where;
U = No. of SSMT adopted by a farmer
V = No. of SSMT available to all farmers in the study area which is sixteen (16)

Sixteen (16) SSMT were identified and the farmers were asked to indicate all the management techniques which they had used in sustaining the land. For any one of them practiced, he gets a score of one. The total score per respondent for the number of techniques used is expressed as the probability of ith use of the SSMT to the overall score of all the SSMT.

The Tobit model is thus, explicitly specified as follows;

Prob.SSMT Use-levels = $X_iB + U_i$ --- --- ---- eqn.2

Where
Prob.SSMT Use-levels = Proportion of SSMT used by the farmers.
B = Vector of unknown coefficients
U_i = Error term, assumed to be independently distributed with mean zero and constant variance
X_i = Vector of independent variables; which include
X_1 = Age of farmer (years)
X_2 = Sex of farmer (male = 1, female = 0)
X_3 = Education (No. of years spent in school)
X_4 = Household size (No. of persons)
X_5 = Net farm income (Naira)
X_6 = Farm size (Hectare)
X_7 = Returns from off-farm activities (Naira)
X_8 = Distance of farm from farmer's homestead (kilometers)
X_9 = Labour supply (mandays)
X_{10} = Cost of land improvement practices (Naira)
X_{11} = Extension contacts (No. of visits)
X_{12} = Farming experience (No. of years spent on arable crop production)

RESULTS AND DISCUSSION

Extension contact of arable crop farmers in Imo State

The distribution of farmers based on extension contact is shown in Table 1. The Table revealed that about 96.2 percent of the farmers had contact with extension agents during the cropping season while 3.8 percent had no contact with extension agents.This implied that, on the average most of the household farmers were exposed to sustainable soil management techniques coupled with other technical innovations from the extension agents. Thus the utilization of these innovations tends to increase the land productivity andnet income of the crop farmers. This is in line with Iheke (2006) who reported that as change agents, extension workers serve as channels for diffusion of technical knowledge and innovations. Similarly, Ephraim *et al*. (2015) further reported that extension contacts enhance information dissemination among arable crop farmers.

Use levels of sustainable soil management techniques of arable crop farmers in Imo State

The distribution of the use levels of sustainable soil management techniques of arable crop farmers areshown in Table2. It could be deduced from the Table that the mean probability use levels of the sustainable soil management techniques was 0.47, which became a threshold for the classification of the sustainable soil management techniques into high and low use levels. The mean value obtained in this study was quite different from Ehirim *et al.* (2013) who reported a mean value of 19.0. Moreover, less than 46% of the arable crop farmers had probability use levels of sustainable soil management techniques which ranges from 0.116 - 0.470.This implied that minority of the farmers in the area had relatively low use level of sustainable soilmanagement techniques. This could be probably due to the poor exposure of these soil management techniques to the farmers by the extension agents, coupled with the practicability and technicality associated with these techniques. This poor exposure of these techniques by the extension agents could be due to lack of funds for logistics, motivations by the government and other agencies and sometimes negative attitudes of the extension workers to work (Edward *et al.* 2010). Similarly, majority of the farmers seem to be aware of improved techniques but finds it difficult to use them. All these frustrate technology adoption and use levels of the rural farmers. This supports the findings from Ejike and Osuji (2013) and Aphunu and Ajayi (2013). Furthermore, empirical studies revealed that rural farmers are conservative and less receptive in adopting improved soil management techniques and this could possibly lead to the low use levels of the sustainable soil management techniques. This further agrees with the findings from Fakoye *et al.* (2002) and Onasanya (2007) who reported that rural farmers have an inherent conservative nature in adopting a new technology. However, majority of the farmers, 20.1% had probability use-levels which range from 0.471-0.541, which is an indication of high use level of sustainable soil management techniques in the area.

Table 1: Distribution of farmers based on extension contacts

Extension contacts	Frequency	Percentage
Contacts	201	96.2
No Contacts	8	3.8
Total	209	100

Source: Field Survey, 2016

Table 2: Distribution of farmers based on use levels of SSMT

Prob. Use levels of SSMT	Frequency	Percentage
0.116-0.186	7	3.3
0.187-0.257	12	5.7
0.258- 0.328	36	17.2
0.329-0.399	28	13.4
0.400-0.470	11	5.3
0.471-0.541	42	20.1
0.542-0.612	26	12.4
0.613-0.683	29	13.9
0.684-0.754	14	6.7
0.755-0.825	4	2.0
Total	209	100
Mean	0.47	
SD	0.11	

Source: Field Survey, 2016

Determinants of use-level of sustainable soil management techniques of arable crop farmers in Imo State

The estimated determinants of use levels of sustainable soil management techniques of arable crop farmers are presented in Table 3.The chi square was highly significant at 1% and this confirmed the fitness of the model. The coefficient of household size, return from off farm activities, distance of farm from farmers homestead and labour supply were not significant. The coefficient of age was negative and highly significant at 1% level of probabilityimplying an inverse relationship between age and use level of sustainable soil management techniques. This implies that older farmers are less receptive and more conservative to try new and improved farm techniques. This is consistent with the findings from Onyenweaku *etal*. (2010), who reported that older farmers are less willing to consider new techniques and hence reluctant to change the status quo; that is their old ways of doing things which might affect use levels of sustainable soil management techniques. However, this contradicts the findings of Fakoya*et al*. (2002) who reported a positively effect of age stating that older farmers have higher accumulated capital, more contacts with extension workers, better preferred by credit institutions and larger family size, all of which make them more prepared to adopt improved technology.

The coefficient of sex was negative and significant at 5% level of probability implying an inverse relationship between the sex of a farmer and use levels of sustainable soil management techniques. The negative sex coefficient denoted that female farmers have lesser probabilities of using improved technology than their male counterparts. This was true because female farmers face greater time constraints than the male farmers due to pressure of household work imposed by gender-based division of labour. This is consistent with the findings from Edward *et al*. (2010). This also contradicts the findings from Ukoha *et al*. (2007) and Osuji *et al*. (2013) who reported a positively signed and insignificant gender implying that male farmers are more likely to adopt sustainable soil management techniques than their female counterparts. This is probably due to the fact that male farmers have more access to land, extension contacts, technology, credit, etc. due to cultural restrictions.

The coefficient of education was positive and highly significant at 1% probability level indicating a direct relationship between this variable and use level of sustainable soil management techniques. This implied that education increases the ability of the farmer to adopt and use improved farm techniques. The level of farmers' education has profound effect on technology adoption and this could be related to the fact that educated farmers are more responsive to changes in trends and risk averse. This finding is in line with the observations of Asfaw and Admassie (2004), Henri-Ukoha *et al.* (2014) who stated that the level of education of a farmer does not only increases his farm productivity but also enhances his ability to understand, evaluate and adopt new production techniques. Prokopy *et al.* (2008) and Ofuoku *et al.* (2009) further stated that increase in educational attainment of the farmers exposes and facilitates adoption of improved soil management techniques through information sharing and distribution.

The coefficient of net farm income was positive and significant at 5% probability level, indicating a direct relationship with use level of sustainable soil management techniques. This implied that any increase in net farm income increases the use level of sustainable soil management techniques. Increase in net farm income empowers farmers to adopt more sustainable soil techniques and enhance the use of more agricultural inputs such as seedlings, chemicals, organic and inorganic manures. This is in line with *a priori* expectations. Nwaru (2004) reported that increase in net farm income enables farmers to participate more in the input market that is farmers are in a better position to acquire the necessary farm implements, inputs and other productive resources required to improve productivity.

The coefficient of farm size was positively related to the use level of sustainable soil management techniques and was significant at 1% level of probability. This implied that a unit increase in farm size of the arable crop farmers will lead to a corresponding increase in the use level of sustainable soil management techniques. Larger farm sizes drives farmers to purchase more production inputs and to exploit new innovations in a bid to increase farm productivity and farm income. This is consistent with *a priori* expectations. In addition, Ofuoku *et al*. (2009) stated that the farmer's decision to adopt a new technology is largely determined by the size of the farms. That is the larger the size of the farms, the more likely a farmer is willing to adopt a new technology. The coefficient of cost of land improvement practices was negatively related to sustainable soil management techniques and significant at 5% probability level. Thus, this indicated an inverse relationship with the use level of sustainable soil management techniques. This implied that any increase in the cost of land improvement practices will lead to a decrease in the use level of sustainable soil management techniques. This is consistent with the findings from Ehirim *et al*. (2013) who stated that an increase in the cost of land improvement practices lowers the farmer's rate of adoption and use of improved soil techniques. Thus, Prokopy *et al*. (2008) reported that high cost of land management practices deters farmers especially those in rural areas from adopting improved soil management techniques probably due to resource-poor of the rural farmers.

The coefficient of the extension contacts was positive and highly significant at 1% probability level, indicating a direct relationship with the use level of sustainable soil management techniques. This implied that a unit increase in extension contacts will lead to a unit increase in the use levels of sustainable soil management techniques in the area. Extension contacts are known to engender innovativeness effectiveness, knowledge transfer, and information dissemination and adoption drive of the farmers in general. It is the major medium for adopting improved soil management techniques. This is consistent with *apriori* expectations and the findings from Ofuoku *et al.* (2009), who stated that the more the farmers are exposed to extension contacts, the more likelihood to adopt and use sustainable soil management techniques.

The coefficient of farming experience was positively related to the use level of sustainable soil management techniques and also significant at 1% probability level. This implied that an increase in farming experience of the arable crop farmers will lead to a corresponding increase in the use levels of sustainable soil management techniques. Experienced farmers are generally better and knowledgeable enough to access the relevance of new technologies through interaction with other farmers and the outside world. The number of years spent by a farmer gives an indication of the practical knowledge he has acquired and this helps him in overcoming certain inherent farm production problems.This conforms to *a priori* expectations and the findings from Nwaru (2004), andAkinbile and Odebode (2007) who opined that the more experienced a farmer is, the more likelihood to use improved soil techniques. They further stated that farmers with long years of farming experience are more knowledgeable in utilizing the factors of production and other farm inputs and this invariably leads to increased outputs and income of the farmers. Similarly, Omonona *et al*. (2006) viewed farmers with long years of experience to have acquired better understanding on how to handle changing climatic conditions, pest and disease infestation, soil improvement techniques etc. with consequential high productivity and income. However, this observation contradicts the findings from Onyenweaku (1991) and Etim and Edet (2007) who stated that as farming experience of a farmer increases, the age of the farmer also increases.Thus, because of the drudgery in farm operations, the energy available for work decreases with increase in farming experience. This could lead to reduction in cultivable lands with reduction in income and increase in poverty.

Table 3: Determinants of use levels of sustainable soil management techniques of arable crop farmers

Variables	Parameters	Coefficients	t-values	Std Error
Constant	b_o	0.0716	2.2098**	0.0324
Age of farmer	b_1	-0.8559	-3.6012***	0.2377
Sex of farmer	b_2	-0.0903	-2.2401**	0.0403
Education	b_3	0.6419	3.6112***	0.1778
Household Size	b_4	-0.8701	1.0583NS	0.8222
Net farm income	b_5	0.0772	1.9884**	0.0388
Farm size	b_6	0.0641	3.2419***	0.0198
Return from off farm activities	b_7	0. 1409	1.0416NS	0.1353
Distance of farm from farmers homestead	b_8	0.0644	1.5012NS	0.0429
Labour supply	b_9	0.5883	1.4034NS	0.4192
Cost of land improvement practices	b_{10}	-0.5661	-1.9901**	0.2845
Extension contacts	b_{11}	0.0524	3.4614***	0.0151
Farming experience	b_{12}	0.9431	3.2019***	0.2945
LR (χ^2)		188.97***		
Log likelihood		146.93		
Pseudo (R^2)		0.6719		
n		209		

Source: Field survey data, 2016

Note:***; ** indicates significant at 1%, and 5% respectively. NS indicates non-significant.

CONCLUSION AND RECOMMENDATION

The findings of the study revealed that extension contacts play a major role in exposing the soil management techniques to the farmers. Extension services provide informal training that helps to unlock the natural talents and inherent enterprising qualities of the farmer, enhancing their abilities to understand and evaluate and adopt new production techniques leadingto increaseduse intensity of sustainable soil management techniques. Also age of farmer, sex of farmer, education, net farm income, farm size, extension contacts, farming experience and cost of land improvement practices were significant determinants of use levels of sustainable soil management techniquesin the area. Hence, farmers in the area should be encouraged to effectively adopt improved soil management techniques without prejudice as to improve food production.

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