DETERMINANTS OF SOIL MANAGEMENT PRACTICES AMONG SMALL SCALE FARMERS OF ARABLE CROPS IN NKANU EAST LOCAL GOVERNMENT AREA OF ENUGU STATE, NIGERIA

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Abstract: This study was conducted in Nkanu East LGA of Enugu State to assess the soil management practices (SMPs) operated by small holder farmers in the area. Multi-stage random sampling technique was used in the selection of 120 farmers for the study. Data were collected from the respondents through primary source upon the administration of structured questionnaire. The collected data were analysed with descriptive statistics, probability of use-level and tobit regression. The findings from the study showed that the major practices used by the farmers to maintain their soil fertility without adverse effect were application of organic manure, mulching, crop rotation, recycling of crop residue, planting of cover crops, multiple cropping etc. In the utilization of the SMPs, the mean use-level of SMP as obtained from the study was 0.46. This implies that the use-level was low as less than 45% of the farmers had the probability use-level of 0.110 – 0.464. The study indicated that among the factors that determine the SMPs, education, income, farm size and extension visits were significant and positively related to SMP while age and gender were negatively signed and significant at 1% level. The major constraints hindering the farmers from practicing the SMPs were inadequate finance, high cost of labour, cost of SMPs, high cost/unavailability of some farm inputs and poor knowledge of some of the SMPs. Policy measures should aimed at enhancing free access to credit through government's agencies, promotion of improved SMPs through extension services and design of special programme on on-farm demonstration on soil management for awareness creation among the farmers.

Keywords: Soil, management practices, use-levels, constraints, and smallholder farmers

Introduction

One of the most valuable things that human beings need for crop and livestock productions is soil. Soil is highly indispensable to farmers' day to day agricultural activities. Soil content is the root of food shortage, food insecurity or undernourishment (Ogunkunle, 2015). Soil is that natural resource or body of loose and unconsolidated materials that are found on the earth's surface, derived from weathered parent rock materials and decaying organic matters and is composed of solid particles with liquid and or gases occupying the spaces between the particles (Ohaeri, 2000). It is the loose surface materials consisting of inorganic particles and organic matter that covers most of the land surface (FAO, 2009). Soil is a factor in the agricultural economy and as long as agriculture remains a soil based industry, major increases in agricultural productivity and production is likely to be attained through soil management practices. The soil needs proper management to guaranty its life supporting and to get maximum yield.

Soil management concerns all operations, practices and treatments used to protect soil and enhance its performance (FAO, 2005). According to Badejo and Togun (2001), soil management practices is the sustainable food productivity potential of the soil. It is a device that protects the soil from degradation, increases its nutrients with locally sourced products from farm, such as recycled crop residue and animal manure, soil conservation, amendment and optimal soil health (Nwachukwu *et al.*, 2012). It involves the application of soil management practices that sustain food crop production without posing any adverse effect (Manning *et al*., 2011; George, 2013). Good soil management practice improves soil quality by using cover crops, soil conservation methods, adding organic matter and careful application of chemical fertilizers, pesticides and machineries used for farming purposes, while mismanagement of soil results in degradation of the soil through erosion, compassion, salinization, acidification and toxicity of soils by heavy metals (Peter *et al*., 2000).

Some farmers in order to ensure that the quality of the soil is maintained and not mismanaged, adopt the following practices; regular application of manure, growing of cover crops, mulching and planting of shelter belt around their farms, engage in crop rotation, intercropping, multiple cropping and minimum tillage (Ejike and Osuji, 2013). Some others engage in zero/minimum tillage, contour farming, strip cropping, alley farming, mixed farming and bush fallowing (Lal, 1990). These soil management practices seek to enhance soil nutrients, sustain crop growth and food production without any adverse effect (Iwena, 2008). They also increase farmers' output and food security. The type of soil management practices farmers adopt depends greatly on the nature of the soil.

In the South eastern Nigeria in which the study area is located, most of the soils are formed from sandy materials and occur mainly in the high rainfall areas. The soils are fragile, highly leached, acidic and subjected to water erosion (Udo and Sobulo, 1981; Udo *et al*., 2016). They are easily degraded in terms of physical, chemical and biological properties as the land is opened up for cultivation and other kinds of uses (Udo *et al*., 2016). Couple with this situation is that majority of crop farmers in the zone practice unsustainable farming practices which deplete the soil fertility leading to low crop yields, low income and high poverty incidence of the crop farmers. The farmers in the area engage in improper removal of fallow cover, bush burning, over production of single crop, removal of trees, excess tillage of the fragile soil and grazing on the farm land (Agbanlahora *et al*., 2003). These practices lead to soil erosion, decline in soil fertility, low crop yield, farmers' income and increase in poverty level. These farmers are often hindered by the small farm size holdings which do not encourage soil improvement practices and farm mechanization (Olarinde *et al*., 2010; Nwaru, 2011). Also the characteristics of the farmers' farms which include land tenure, farm size, type of production and the nature of the soil significantly affect the soil management practices practiced by the farmers. Other factors that greatly affect the farmers from practicing good soil management are the farmers' age,

experiences, educational level, gender and income. These factors greatly determine to an extent the type of soil management practices the farmers practice. This situation calls for attention for proper soil management in order to ensure that sustainable agricultural productivity is maintained. Hence this study was then conducted in order to identify the types of soil management practices that are practiced by the farmers, estimate the use-levels of these soil management practices, analyse the determinants of the SMPs and examine the constraints hindering the use of the soil management practices in the study area.

Materials and Method

The study was conducted in Nkanu East LGA of Enugu State. The LGA is in Agbani Agricultural Zone of the state. It is within the coordinates of latitude 6^0 $30^/$ and longitude 7^0 $30^/$ and stands on estimated elevation of about 233 metres above sea level. The LGA has a population of 153,591 people with area of 804,629 Km^2 (FGN, 2010). The inhabitants of the LGA are predominantly farmers. They produce the following arable crops-yam, cassava, rice, cocoyam, sweet potato and vegetables. All these necessitated the choice of the area for the study.

The study adopted multi-stage (multiple stages) random sampling technique. The first stage involved random selection of six communities. Secondly, four villages were chosen from each community selected making 24 villages for the study. Thirdly and finally, 5 small holder arable crop farmers were randomly selected from each village, making a total of 120 respondents that were used for the study.

Data were collected through primary sources with the use of structured questionnaire. This was supplemented with oral interview. The data collected were soil management practices used by the farmers, socio-economic characteristics of the farmers, and other factors that affect soil management practices and the constraints hindering the uses of the SMPs. Extension agents from Enugu State Agricultural Development Programme (ENADEP) assisted the researchers in the administration and collection of the questionnaire.

The collected data were analysed with descriptive statistics, probability use-level, and tobit regression analysis. The type of SMPs and constraints militating against SMPs were analysed by using probability of use-level while the determinants of SMPs was achieved through tobit regression analysis. For the estimation of use-level, probability of use of sustainable soil management techniques as used by Iheke (2009), Iheke and Okeke (2010) and Osuji (2017) were adopted. In this study, 14 soil management practices were identified and the farmers indicated the ones they practiced in their land. For any one of them practiced, he/she scores one. Total score per respondent for the number of management practices used was expressed as the probability of ith use of SMP to the overall score of all the SMP. This is shown thus:

Prob. SMP use-level = U/V …… (1)

Where U = Number of SMP practiced by a farmer, V = Number of SMP available to all farmers in the study area which is 14. The outcome of this estimate from equation (1) is a continuous variable between 0 and 1. That is $0 \leq SMP \leq 1$.

In the analysis of determinants of SMPs, tobit regression analysis was used to achieve it. The model is stated as follows: Y = XiB + Ui …… (2)

Where Y = Latent variable that is observable,
Xi = Vector of independent variables;
B = Vector of unknown coefficients; Ui = Error term.

However, according to Osuji, (2017), substituting Y in equation (2) above for the probability of SMP use-level, tobit model is then specified thus:

Prob. SMP use-levels = XiB + Ui …… (3)

Where Prob. SMP use-level = Proportion of SMP by the farmers, B = Vector of unknown coefficients, Ui = Error term, Xi = A row of independent variable associated with observation i.

Where: $X_1 - X_{10}$ are the independent variables defined below: X_1 =Age (Year), X_2 = Gender (Dummy, Male = 1, female = 0), X_3 = Educational level (Year), X_4 = Household size(Number), X_5 = Farming experience (Year), X_6 = Number of extension visit (Number), X_7 = Farm size (Hectare), X_8 = Annual income (₦), X_9 = Mode of land acquisition (Dummy, Communal = 1, Others = 0), X_{10} = Topography (Dummy, Flat land = 1, Hilly land = 0) β_0 = Coefficient, B_1-B_{10} = Parameter estimate, U = Error term

Results and Discussion

Types of soil management practices

Table 1 shows the results of soil management practices being practiced by small holder arable crop farmers in the study area. The Table shows that 76% of the farmers use organic manure, 70% practice mulching, 65% recycle crop residue or plough back their crop residue into the soil. The high result obtained in the use of organic manure by the farmers could be that the organic manure is rich in both macro and micro nutrients which maintain soil fertility and are required for optimum crop growth and yield of the crops. This result of high utilization of organic manure by the arable crop farmers is in tandem with the findings of Nwachukwu *et al*. (2012); Mazza and Olojede (2016). Also the high response on practicing of mulch may be as result of the nature of south east soils which are mainly sandy loam and are easily subjected to erosion and mulching is known to be one of the practices against erosion. The mulch also suppresses weeds, increases water infiltration and promotes soil biological activities (FAO, 2006). The ploughing back of crop residue into the soil also enriches the soil.

In the same vein, 64.2, 63.3, 61.7, 60 and 60% of the respondents practice shifting cultivation, crop rotation, planting of cover crops, bush fallow and multiple cropping as methods of soil management. These results agree with findings of Ejike and Osuji (2013); Iwena (2008) who posited that over 50% of farmers in Imo State adopted soil management techniques that cut across application of organic manure regularly, mulching, crop rotation, growing cover crops, multiple crops, shifting cultivation and bush fallowing as ways of enhancing nutrients, sustaining crop growth and food production without adverse effect. The least used practices as contained in the Table 1 were contour bonds and planting of wind breaks which recorded only 6.7 and 4.2% respectively. Most of the respondents had little or no knowledge of these practices. This could be attributed to the fact that most of the farmers had flat land; therefore, their land was not hilly as to practice contour bonds.

Table 1: Distribution of respondents according to soil management practices used by the farmers

Soil Management Practices	*Frequency	%
Crop residue recycling	78	65.0
Minimum/zero tillage	55	45.5
Multiple cropping	72	60.0
Mulching	84	70.0
Use of inorganic manure	43	35.8
Use of organic manure	92	76.7
Planting of cover crops	74	61.7
Crop rotation	76	63.3
Liming	34	28.3
Mixed farming	57	47.5
Shifting cultivation	77	64.2
Contour bonds	8	6.7
Planting of wind breaks	5	4.2
Bush fallow	73	60.8

Source: Field survey data, 2018; ***Multiple responses recorded**

Table 2: Estimated use-level of soil management practices among small holder farmers in the study area

Use-level of SMP (Probability)	Frequency	%
0.110 – 0.180	3	2.5
0.181 – 0.251	5	4.2
0.252 – 0.322	24	20.0
0.323 – 0.393	13	10.8
0.394 – 0.464	7	5.8
0.465 – 0.535	23	19.2
0.536 – 0.606	25	20.8
0.607 – 0.677	7	5.8
0.678 – 0.748	6	5.0
0.749 – 0.819	4	3.3
0.820 – 0.890	2	1.7
0.891 – 0.961	1	0.8
Total	**120**	**100**
Mean	**0.46**	
S.D.	**0.17**	

Source: Field survey data, 2018

Use-levels of soil management practices by the arable crop farmers in the study area

The use-levels of soil management practices as presented in Table 2 indicates that the use-level ranged from 0.110 – 0.961. The mean use-level of SMPs as obtained from the study was 0.46. This mean probability use-level of the SMP of 0.46 was threshold for classifications of the SMPs into high and low use levels. With the mean use-level of 0.46, the finding implies that less than 45% of the small holder farmers in the study area had probability use levels of SMPs which ranged from 0.110 – 0.464. This result is similar to the findings of Osuji (2017) who obtained mean use-level of 0.47 in Imo State. The result indicates that the farmers had low use-level of SMP in the study area. This could be due to poor knowledge of these practices or lack of fund or other logistics to carry out these SMP practices. This result is in line with the findings of Iheke (2009), Ejike and Osuji (2013) and Osuji (2017).

Determinants of soil management practices among small holder farmers in Nkanu East LGA

The result of determinants of SMPs among smallholder crop farmers in the study area is presented in Table 3. The result shows that the LR (X^2) was significant at 1% level. This depicts that the model had goodness of fit. The result from the Table indicates that out of ten independent variables, six were significant at 1 and 5% levels. From the significant variables, four were positive and two negative.

The coefficients of farm size, educational level, number of extension visits and income were positive and significant at 1 and 5% levels respectively indicating that these variables had direct relationship with the probability of practicing SMPs. This implies that as the farm size, educational level, income and number of extension visits to the farmers increase, the probability of farmers using or adopting the SMP will increase. In terms of income and farm size, farmers who have more income tend to use best SMPs in their farms in order to increase their productivity, total yield and income while farmers who have large farm sizes always like to purchase more inputs and adopt SMPs in a bid to increase farm productivity and farm income. This is in line with *a priori* expectation and supports the findings of Prokopy *et al*. (2008) and Osuji (2017). Similarly the direct relationship of educational levels of farmers with SMPs indicates that farmers with high educational attainment easily respond to innovative farm techniques in order to enhance their productivity while farmers with low educational level do not have the willingness to take the risk of practicing SMP for fear of low yields. This corroborates the findings of USDA, (2011). The number of extension visits was positively related with probability of practicing SMPs. This implies that with increase in the extension visits, farmers are likely to increase their SMPs through growing cover crops, mulching their farms, using organic manure etc which invariably maintain the fertility of the soil and hence increase productivity.

Conversely, age and gender were negatively signed and significant at 1% level of probability. This implies that these variables were inversely related with the probability of practicing SMPs. The negative sign indicates that as the farmers advance in age, the willingness of using improved SMPs declines. This is consistent with *a priori* expectation and findings of Onyenweaku *et al*. (2010). Gender also showed that inverse relationship with the SMP but significant at 1% level. This implies that female farmers have the likelihood of using improved soil management than the male farmers. This result contradicts the findings of Ukoha *et al*. (2007) who reported a positively signed and insignificant relationship.

Table 3: Estimated determinants of soil management practices among small holder farmers in Nkanu East LGA

Variables	Parameters	Coefficients	Standard Error	Z-Statistics
Intercept	B_0	4.6699	2.2556	2.0696**
Age	B_1	-0.4444	0.1104	-4.0545***
Gender	B_2	-6.0922	1.7706	-3.4393***
Educational level	B_3	0.0052	0.0020	2.1363**
Household size	B_4	1.3069	0.9471	1.3801
Years of farming experience	B_5	0.1956	0.1585	1.2264
Number of extension visit	B_6	1.0445	0.4953	2.1111
Farm size	B_7	5.4296	1.4034	3.8710***
Income	B_8	0.0005	0.0020	2.5000**
Mode of land acquisition	B_9	0.7515	0.6164	1.2208
Topography	B_{10}	-0.7696	0.6060	-1.2700
LR (X^2)	**140.78**			
Pseudo (R^2)	**0.4481**			
Number of observation	**120**			

Source: Field survey data, 2018

Constraints to the use of soil management practices in Nkanu East LGA

Table 4 presents the constraints identified as factors hindering the use of improved SMPs in the study area. The respondents indicated inadequate finance (100%) as a major constraint limiting their use of improved SMPs. Other constraints noted by the respondents were high cost of labour (98.3%), poor knowledge of the practices, high cost/unavailability of some farm inputs (80.8%) as their major constraints to the use of soil management practices. These findings agrees with Amusa *et al*. (2016) who found high cost of farm inputs and inadequate farm labour and high cost of available farm labour for effective soil management practices as major challenges to farmers' practice of soil management.

Table 4: Distribution of the respondents according to the use of soil management practices

Constraints	*Frequency	%
Insufficient extension service	92	76.7
Topography of land	7	5.8
High cost of labour	118	98.3
Poor knowledge of the practice	112	93.3
High cost/unavailability of farm inputs	97	80.8
Inadequate finance to carry out the practices	120	100
Inadequacy of farm land	29	24.2
Land tenure system	58	48.3
Tedious nature of the soil management practices	43	35.8
Cost of the soil management practices	104	86.7

Source: Field survey data, 2018; ***Multiple responses recorded**

On the other hand, topography of land (5.8%) and inadequate of farm land (24.2%) were observed as the least constraints to the use of SMPs. The reason for the low responses could be that most of the farmers' lands were flat and they had large expanse of land for crop cultivation. This even devoid the farmers of practicing contour ridging.

Conclusion

The result of the study indicated that SMPs being practiced mostly by the farmers to maintain the fertility of their soils without adverse effect were use of organic manure, mulching, recycling of crop residue, crop rotation, bush fallow, planting of cover crops and multiple cropping. The mean probability use-level of SMP was 0.46 indicating that the farmers had low use-level of the SMPs in the study area. Results obtained from tobit regression showed that educational level, income, farm size, and number of extension visits were positively signed and significant at 1 and 5% levels while age and gender had indirect relationship with use-level of SMP. The major constraints hindering the farmers from using improved SMPs were inadequate finance, high cost of labour, cost of the SMPs, high cost/unavailability of some farm inputs and poor knowledge of some of the practices.

These SMPs were believed by the respondents to be quite costly. Therefore, government (Federal and State) through their agencies should adopt policy measures that will enhance free access to credit by these small holder farmers. Policy measures by government should aim at promoting SMPs through increased extension services and design of special on-farm demonstration programmes on soil management. This will help to create more awareness among the farmers and raise their interest on soil management because soil is the base for crop and livestock productions.

Conflict of Interest

The authors declare that there is no conflict of interest related to this study.

References

Agbanlahora MU, Aromolaran AB & Aibonib VI 2003. Sustainable soil management practicesin small farms of Southern Nigeria: A poultry-food crop integrated farming approach. *J. Sustainable Agric.*, 22(4): 51-62.

Amusa TA, Enete AA, Oketobo EA & Okon UE 2016. Determinants of soil management practices among small holder farmers in Ekiti State, Nigeria. *Nig. Agric. J.*, 46(2): 25-34.

Badejo MA & Togun AO 2001. *Strategies and Tactics of Sustainable Agriculture in the Tropics*, College Press Ltd, Ibadan, Oyo State.

Ejike RD & Osuji EE 2013. The role of women in sustainable conservation agriculture as a viable alternative to traditional farming practices in Imo State, Nigeria. An abstract proceeding of the 27th Annual Conference of Farm Management Association of Nigeria held at University of Ilorin, Kwara State, Nigeria, 26th-30th Aug, pp. 23-29.

Federal Government of Nigeria (FGN) (2010). 2006 Population and Housing Census, Priority Table,Volume 111, Population, Distribution by Sex, State, LGA & Senatorial District, National Population Commission, Abuja, Nigeria, P.53.

Food and Agricultural Organisation (FAO) 2005. Agricultural workers and their contributions to sustainable agriculture and rural development. Internal Union of Food and Agriculture. pp. 13-16.

FAO 2006. World programme for the census of agriculture. In: FAO, Statistical development series. FAO, No 11, FAO/Rome(Italy), Statistics Division, p. 160.

FAO 2009. Country support tool for scaling up; Sustainable land management in Sub-Saharan Africa, Food and Agricultural Organisation of United Nations, Rome, Italy, pp. 12-18.

George JH 2013. Sustainable agricultural land management practices of arable crop farmers in Florida. University of Florida, pp. 19-25.

Iheke OR & Okeke CI 2010. Factors affecting the adoption of environmental management systems by crop and livestock farmers in Umuahia Agricultural Zone of Abia State, Nigeria. *J. Sustainable Agric. and Enviro.*, 12(2): 96-102.

Iheke OR 2009. Effect of sustainable land management practices on agricultural production: The case of arable crop farmers in Abia State, Nigeria. *Int. J. Agric. and Rural Dev.*, II(2): 39–44.

Iwena OA 2008. *Essentials of Agricultural Science for Senior Secondary Schools.* Tonad Publishers Ltd, Ibafo, Ogun State, pp. 44-49.

Lal R 1990. *Soil erosion in the Tropics: Principles and Management*, McGraw-Hill, New York.

Manning S, Booms FO, Von-Hagen & Reinecke J 2011. National contexts matter: The Co-evolution of sustainability standards in global value chains. *Ecological Economics*, 49(1): 104-109.

Mazza M & Olojede JC 2016. Utilization of organic farming technologies among small holder farmers in Imo State, Nigeria. *The Nig. Agric. J.*, 47(2): 94-101.

Nwachukwu OI, Nyong AE & Opara UD 2012. Effects of manures and ash on soil properties, yield and nutrient uptake of amaranthus in an ultisol of South east Nigeria. *Nigeria J. Soil Sc*., 22(2): 70-78.

Nwaru JC, Iheke OR & Onyenweaku CE 2011. Impact of migrant remittances on the welfare of arable crop farm

households in South East Nigeria. *Human Ecology Review*, 18(2): 159–166.

Ogunkunle AO 2015. Soil quality maintenance by sustainable land use management: An imperative for food security. *Nig. J. Soil Sc.*, 25: 11-45.

Ohaeri AA 2000. The economics of soil fertility management practices among small-scale farmers in Orumba South Local Government Area of Anambra State. M. Sc. Thesis, Department of Agricultural Economics, University of Nigeria, Nsukka.

Olarinde LO, Abdoulaye JB, Maman TN & Adekunle A 2010. Adoption and farmers exposure to soil and water management (SWM) practices in the Sahel Savana of West Africa: Average treatment effect (ATE) estimation. A paper presented at the joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa, pp. 78-82.

Onwenweaku CE, Nwachukwu IN & Opara TC 2010. Productivity growth in food crop production in Imo State, Nigeria. *Afr. Crop Sci. J.*, 18(3): 89-95.

Osuji EE 2017. Determinants of arable crop farmers' use-levels of sustainable soil management techniques in Imo State, Nigeria. *Nig. J. Agric. Food and Envt.*, 13(3): 163-168.

Peter G, Francesco G & Montague Y 2000. Integrated nutrient management, soil fertility and sustainable agriculture: Current issues and future challenges. IFPRI, Washington DC.

Prokopy LS, Floress K, Klottho-Weinkauf D & Baumgart-Getz A 2008. Determinants of agricultural best management practices adoptions: Evidence from the literature. *J. Soil and Water Conservation*, 3(5): 300-311.

Udo BT, Esu IE, Ibia TO, Onweremadu EU & Unyienyin SE 2013. Agricultural potential of the beach ridge soils of Niger Delta, Nigeria. *Malaysian J. Soil Sc.*, 17: 17-39.

Udo BT, Onweremadu EU, Uzoho BU & Nnauike EC 2016. Effect of land use type on soil characteristics and land degradation in Owerri, South eastern Nigeria. *J. Agric., Food and Enviro.*, 12(3): 189-197.

Udo EJ & Sobulo RA 1981. Acid Sands of Southern Nigeria. Soil Science Society of Nigeria (SSSN), Special Publication Monograph, No. 1.

Ukoha OO, Mejeha RO & Nte IN 2007. Determinants of farmers' welfare in Ebonyi State, Nigeria. *Pak. J. Sc.*, 4(3): 351-354.

United State Department of Agriculture (USAD) 2011. Conservation effects assessment projects (CEAPs). Fact Sheet. Htt://www.soil.ncsu.edu/publications/NIFACEAP.