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Soil Degradation Management Techniques Among Small Holders Farmers for Sustainable Crop Production in Ebonyi State, Nigeria

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Abstract
It is commonly observed that decline in soil quality leads to decrease in the production and high cost of food in Ebonyi State. This study therefore identified soil degradation management techniques among small holder farmers for sustainable crop production in the state. Three specific purposes and three corresponding research questions guided the study. The study was a descriptive survey design and used questionnaire to elicit information from 198 respondents made up of 162 crop farmers and 36 extension agents. Data gathered from the respondents were analyzed using mean to answer the research questions. The study identified minimum tillage, cover cropping, crop rotation and application of organic matter as techniques to prevent soil degradation. Techniques identified for controlling soil degradation are strip farming, mulching of soil, ridging across slopes and basal reinforcement of soil. Also, identified, are techniques to rehabilitate degraded soils such as addition of organic matter, crop livestock integration and agro-foresting practice. It was recommended that farmers should be trained to use these techniques.

Keywords: *Soil degradation, Management, Techniques, Small holder farmers, Sustainable, Crop Production*

I. Introduction

Farming is the largest economic activity in rural areas of Ebonyi State, where over 75% of the population engage in agricultural activities at subsistence level. This statement is in keeping with the reports of Food and Agricultural Organization of United Nation's (FAO, 2018). That more than 80% Nigeria farmers are small holder farmers.

Small holder farmers were explained by Mgbenka and Mbah (2016) as farmers who own small plots of farm land not more than 2 hectares. They are characterized by low farming inputs, low access to agricultural information, limited access to credit facilities and adoption of improved farm technologies (F.A.O, 2015, Mgbenka et al. 2016, and Egbe, 2018). According to Egbe (2018), small scale farmers operate under subsistence agriculture, depend largely on traditional methods of farming but produce over 90% of the food consumed in Nigeria. Again, Nigeria Federal Office of Statistics (FON, 2021), reported that small holder farmers are pivoted to Nigeria food security producing over 90% of the nation's agricultural product and more than 91% of food consumed by Nigerians. But, in spite of the contributions of small holder agriculture, Angba and Hon (2020) reported that small holder farmers face challenges of land tenure system, low level of irrigation, climate change and soil degradation.

Soil degradation is a fall in soil quality leading to low crop yield. It is a decline in soil quality, soil value and productivity due to breakdown in soil structure and loss of nutrient (Ajayi, 2015). It is a reduction in physical, chemical and biological properties leading to loss in organic matters destruction of soil structures, decrease in soil fertility, excessive flooding and pollutions of the soil (Egbe, 2017). He maintained that soil degradation is caused by excessive and inappropriate use of land for agriculture, pastoral, industrial, urban development and the weather changes. In the context of this study, soil degradation is the reduction or loss in soil capacity to benefit small holder crop farmers. It is the decline in soil capacity to provide ecosystem services such as ecological support, regulation of temperature and provision of food and fibre. This decline in soil fertility is caused by both natural and human induced factors. The natural factors according to Mohammed, Umar and Mohammed (2019) are erosion, floods, drought and climate change, while human induced factors include overgrazing of farm land, deforestation, excessive tillage, bush burning and other agro-ecological degradation practices. These practices coupled with over use of the land and poor soil management affect and change the dynamic properties of the soil.

The dynamic properties of soils are those properties that change with natural and anthropogenic disturbances and other stressors including poor agricultural actives (Skye, Candiss and Chatty, 2018). The dynamic properties include organic carbon content, bulky density, aggregate stability and soil water and nutrient availability (Skye et al, 2018). These soil properties influence and indicate soil functions and fertility. Thus, Eftene, Ignat, Chiurciu, Manea and Dumitru (2020) remarked that dynamic properties of soil are crucial for soil quality and are important keys of soil fertility and management. Then, farmers always strive to have increased

organic carbon, less bulky soils, stable soil aggregate and soils with enough available water and nutrients to avoid soil degradation and its effects.

Soil degradation has broad consequences, which according to Niki and Ole (2022) include both on-site and off-site effects. The on-site effects are reduction in soil productive capacity, pollution of the soil, reduction in land usable for agriculture, less fertility and moisture holding capacity, changes in soil pH and reduction in farm outputs, incomes and standard living of farmers. These on-site effects are directly on farmers making them loss farm investments and expected profits. The off-site effects are on the society such as rise in price of food items, poverty, diseases, widespread malnutrition, famine and reduction in people's standard of living. Soil degradation does not only impact negatively on agriculture and food system, but also on environment through decline in biodiversity, pollution and contamination of environment and diminution of important ecosystem functions (Issaka and Ashraf, 2017). From the foregoing, soil degradation remains a serious threat to agriculture, food system and food security. To avert the consequences of soil degradation, its management techniques are required.

Soil management is explained by Amusa, Enate, Oketobo and Okon (2016) as interventions, operations, practices and treatment used to protect and or enhance soil performance. It encompasses a number of techniques or strategies used to prevent, control and to restore degraded soils. It involves giving support, making provision, regulating use of land and engaging acceptable farm practices (Ebe, Obike andNnamani, 2019).Soil management is explained in this study as actions taken to prevent soil degradation, control soil degradation and the actions for rehabilitating degraded soils for sustainable crop production. The issue of managing soils, especially, at farm level, should not be taken for granted, given that soil resource is the productive base for food crop. For farmers to sustainably manage the soil to maintain its value for adequate food production, certain soil degradation management techniques are needed.

Soil degradation management techniques are explained in this study as measures, actions or mechanisms to be utilized to prevent, control and rehabilitate or restore degraded soils. The techniques for preventing soil degradation are utilized to block the sources or causes and these techniques according to Ogunkunle (2018) include minimum tillage mulching, growing cover crops, and other good farm practices that will remove the source of soil degradation. The control techniques come at the stage when degradation of soil has begun; and then control interventions are to stop or halt further degradation. The techniques to use at the control stage according to Ajayi (2015) include strip farming, terracing, basal reinforcement, crop rotation and other structural measures. In the other hand, a degraded soil requires treatments to restore it fertility. Thus, Osuji (2017) stated that degraded soils require organic inputs, mulching, growing of cover crops and making ridges across the slope. These actions will help to revive physical condition of the soil, replenish lost nutrients, create a desirable nutrient balance, and prevent build up of pests. But, farmers, especially, small holders are hindered by small farm size holding and other variables from adopting soil management techniques for sustainable crop production.

Sustainable crop production was defined by Imadi, Shazadi and Hakeem (2016) as agricultural production that does not impose harm to environment, biodiversity and quality of crops. The authors added that producing crops sustainably increases the ability of crop production system to maintain stable levels of food production for long term without increasing the demand and use of chemical inputs. It deals with keeping the soil alive with organic matter which ensures improved nutrient quality, food safety and food quality (Lewandowski, Hardlein and Kaltschmitt, 2019). Infact, sustainable crop production provides food for the present society and keeps the environment safe for production of food for future generation. It is explained in this study as the production of crop to meet the food need of the present society without compromising the ability of the soil to produce enough food for future generation. It is the practice that nurtures the society, environment and the economy; as it involves the production of crops in high quantity and quality, without negative effect in the environment now and in future. However, most farmers in the study area according to Egbe (2018) do not fully observe sustainable crop production. The author stressed further that the bulk of farmers in Ebonyi State are small holder rural dwellers who continuously farm on degraded and fragmented pieces of land.

Ebonyi State is an agrarian State with over eighty-five percent (85%) estimated populated earning their living from agricultural sector (Egbe, 2018). The author reported further that there is reduction in yields of major annual crops such as yam, cassava, maize, and rice due to soil degradation and climate change.

Despite the seriousness of soil degradation problems in the study area such low crop yield, high cost of food, and poverty, there is no empirical data on soil degradation management techniques. Presently, there is no identified techniques for small holder crop farmers to adopt to manage soil degradation. It is against this background that this study is carried out to determine soil degradation management techniques to be used by small holder farmers for sustainable crop production in Ebonyi State.

Purpose of the Study

The main purpose of this study was to determine soil degradation management techniques among small holder farmers for sustainable crop production in Ebonyi State. Specifically, the study sought to:

1. Ascertain preventive techniques for managing soil degradation among small holder farmers in Ebonyi State.
2. Identify control techniques for managing soil degradation among small holder crop farmers in Ebonyi State.
3. Find out rehabilitative techniques for managing degraded soils among small holder crop farmers in Ebonyi State.

Research Questions

These research questions guided the study.

1. What are the preventive techniques for managing soil degradation among small holder crop farmers in Ebonyi State?
2. What are the control techniques for managing soil degradation among small holder crop farmers in Ebonyi State?
3. What are the rehabilitative techniques for managing degraded soils among small holder crop farmers in Ebonyi State?

II. Methodology

This study was carried out in Ebonyi State, Nigeria. Ebonyi was chosen for the study because it is an agrarian state, dominated with small holder crop farmers who now suffer from soil degradation.

Multi-stage cluster sample procedure involving a combination of purposive and random sampling were used to draw the sample. The first stage involved purposive selection of two local governments from each of the three agricultural zones of the state, giving a total of six local governments. The second stage, was also purposive selection of three communities from each of the six local governments already selected. The selected local governments and communities were among those that state government has created awareness on soil and water conservation.

The third and the last stage was a simple random sampling of nine (9) crop farmers and two (2) extension agents from each of the 18 communities purposively selected. This gave a total of 198 respondents made up of 162 crop farmers and 36 extension agents. Any item with mean of 2.50 and above was accepted as a technique otherwise rejected.

III. Results And Discussions

The results of this study are presented in order of research questions using tables.

Research Question 1

What are the preventive techniques for managing soil degradation among small holder crop farmers in Ebonyi State?

Data for answering this research question are presented in Table 1

Table 1: Mean Ratings of Respondents' opinions on Preventive Techniques for Managing Soil Degradation among Small Holder Crop Farmers

S/N	Item Statement	x	SD	Remarks
1	Zero or minimum tillage	2.97	0.47	Agree
2	Growing of cover crops	2.82	0.49	Agree
3	Crop rotation	3.15	0.42	Agree
4	Nutrient recycling	2.97	0.48	Agree
5	Application of organic residues	3.48	0.39	Agree
6	Use of good quality irrigation water	2.77	0.50	Agree
7	Avoidance of bush burning	3.10	0.43	Agree

Data presented in table 1, revealed that all the seven items had means above the cut-off point of 2.50, signifying that each is accepted as a techniques for preventing soil degradation. The standard deviation ranged from 0.39 – 0.50, testifying the close range of respondents opinions.

Research Question 2

What are the control techniques for managing soil degradation among small holder crop farmers in Ebonyi State?

Data for answering this research question are presented in Table 2

Table 2: Mean Ratings of Respondents' opinions on Control Techniques for Managing Soil Degradation among Small Holder Crop Farmers

S/N	Item Statement	x	SD	Remarks
1	Terracing of farm land	2.61	0.52	Agree
2	Strip farming	2.59	0.53	Agree

3	Sufficient soil cover through mulching	2.83	0.41	Agree
4	Stabilizing soft soils	3.11	0.33	Agree
5	Use of basal reinforcement	2.70	0.45	Agree
6	Leaching of excess salts from soil	2.51	0.57	Agree
7	Ridging across the slopes	2.91	0.36	Agree
8	Crop rotation practice	2.97	0.34	Agree

Data presented in table 2, show that the eight items had mean rating above cut-off point of 2.50. This signifies that each of the items was accepted as techniques for controlling soil degradation. The close range of standard deviation from 0.33 to 0.57 indicates that respondents are not far from each other in their opinion.

Research Question 3

What are the rehabilitative techniques for managing soil degradation among small holder crop farmers in Ebonyi State?

Data for answering this research question are presented in Table 3

Table 3: Mean Ratings of Respondents' opinions on Rehabilitative Techniques for Managing Soil Degradation among Small Holder Crop Farmers

S/N	Item Statement	x	SD	Remarks
1	Drainage control is a technique to manage degraded soils	2.71	0.63	Agree
2	Use of organic amendments is a technique use to manage degraded soils	3.42	0.50	Agree
3	Crop livestock integrated farming is a technique to manage degraded soils	3.07	0.59	Agree
4	Retention of crop residues rehabilitates soil degradation	3.13	0.55	Agree
5	Use of mulch materials restores degraded soils	3.11	0.56	Agree
6	Agro-forestry system is a technique to restore degraded soils	3.23	0.52	Agree
7	Integrated water management rehabilitates degraded soils	2.65	0.66	Agree

Data presented in table 3, revealed that all the seven (7) items had means above cut-off points of 2.50. This implies that each of the items is a technique for managing degraded soils. The standard deviations of the items ranged from 0.50 to 0.66. This close range indicates that respondents are close in their opinions.

IV. Discussions Of Findings

The discussions of findings were made on basis of research questions.

Findings on the preventive techniques for managing soil degradation include minimum tillage, growing of cover crops, crop rotation, organic materials, and good quality irrigation water. These findings agree with Ogunkunle (2018) who reported that minimum or zero tillage restores soil fertility. These findings also agree with the reports of Kwadzo and Quayson (2021) that organic manures, mulching, crop rotation, cover cropping and nutrient recycling are fertility management techniques needed by small scale farmers. The high mean ratings enjoyed by organic residues, crop rotation and avoidance of bush burning expressed importance of these farm practices as techniques for managing soil degradation.

The findings of this study on control techniques as terracing, strip farming, sufficient soil cover, ridging across the slope and stabilization of soft soils are indications that erosion causes soil degradation in the study area. The findings are in keeping with reports of Aura (2016) who recommended the use of structural measures such as barriers across slops, cross bars and fibres to stabilize soft soils in erosion prone areas.

This study identified addition of organic amendments, crop rotation, crop livestock integration and agro-forestry as techniques to restore degraded soils. These findings agree with Osuji (2017) who reported that degraded soils need to replenish lost nutrients through addition of organic materials and nutrient recycling. The findings on drainage control, integrated water management and agro-forestry are in line with the content of F.A.O (2017) document which recommended drainage control, agro-forestry system, organic farming and re-vegetation of degraded areas to improve its fertility.

V. Conclusion

It is the wish of farmers to have sustainable crop production but this is hindered by soil degradation which lowers soil value and crop yields. However, this study has identified techniques for managing soil degradation. With the identified techniques, farmers can prevent, control and or rehabilitate degraded pieces of land. Based on these findings, it is recommended that:

1. Government of Ebonyi State should provide necessary incentives to enable farmers manage soil degradation for sustainable crop production.
2. Extension agents should train and make farmers aware of the identified techniques for managing soil degradation

3. Farmers should accept to engage in training from time to time on soil management techniques for sustainable crop production.

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