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Original Research

ASSESSING PERCEIVED BENEFITS OF SUSTAINABLE LAND MANAGEMENT PRACTICES AMONG SMALLHOLDER CROP FARMERS IN SOUTHEAST, NIGERIA

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ABSTRACT

Sustainable land management (SLM) has been identified as a veritable tool in ensuring a sustainable global food production system. This study assessed the benefits of sustainable land management practices based on the perceptions of smallholder crop farmers in Southeast Nigeria. The sample for the study comprised 360 respondents selected using a combination of purposive and random sampling from a sampling frame of Fadama III project Fadama User Groups FUGs involved in crop production. Primary data obtained from field survey using questionnaire and interview schedule were analyzed with descriptive and inferential statistics. General effects of SLM were found to include reduction in soil erosion (99%), improvement in soil fertility (99%), increased yield and income (96%) and improvement in climate change adaptation (79%). Mean Benefit Indexes (MBI) of major specific SLM practices were 0.97, 0.89, 0.85, 0.88, 0.90 and 0.82 for mulching, improved fallow, zero tillage, zero burning and agro-forestry respectively which all tested highly significant. Constraint to the utilization of SLM practices by the farmers included institutional/environmental, socio-economic and technical factors. It was recommended that policies aimed at enhancing the application of SLM practices should address the identified constraints.

Keywords: Perceived benefits, Sustainable land management practices, Smallholder crop farmers, Southeast Nigeria

INTRODUCTION

One of the major challenges facing the world today is how to generate enough food to feed the ever-growing human population in addition to the provision of adequate raw materials for industrial uses (Spiess, 2016; FAO, 2017; UN, 2017, Idris, Olutosin, Sakiru, and Oluwaseun, 2020). There are currently over 7.5 billion persons living in the world, with more than 30% living under food insecure conditions while another 20% are malnourished. In Nigeria particularly, out of a population of over 220 million, 57.7% are food insecure (FAO, IFAD, UNICEF, WFP and WHO. 2021).

In a bid to narrow the gap between population growth and food availability, national governments and international agencies have at different times come up with various initiatives geared towards addressing the issue. At the global level, there is the Sustainable Development Goals (SDGs), which is a scaled-up version of the defunct Millennium Development Goals. One specific target of the SDGs is to end hunger, achieve food security and improve nutrition while promoting sustainable agriculture (UN, 2017).

In order to achieve the foregoing, the sustainable management of land which is a basic agricultural production resource is of paramount importance. This is because global land availability is continuously being threatened by various degrees of land degradation resulting in significant levels of biodiversity loss. According to United Nations Department of Economic and Social Affairs (2012), it is estimated that an upwards of 60% of the world's ecosystem services have been degraded by human activities while as much as 83% of the global terrestrial land surface, has been affected either directly or indirectly by same in the past 50 years alone.

Globally, 75 billion tonnes of soil matter are lost annually due to wind and water erosion. In addition, reduction in global yield of crops due to soil degradation and water scarcity is estimated at 16%, while the estimated loss of income due to desertification and land degradation (US$ Dollars/year) in rainfed, irrigated and rangeland areas are estimated at 8.2, 10.8 and 23.3 respectively. This notwithstanding, there is equally a potential yield increase of 30 – 170% that is realizable with the implementation of SLM practices and technologies (UNCCD, 2009).

Considering the danger that land degradation and associated factors portend for the sustainability of human livelihoods, it becomes paramount that concerted efforts be made to address the problem. Consequently, efforts abound at international, national and sub-national levels towards stemming the tide of land degradation and biodiversity loss. For example, a major target of the SDGs under Goal Number 2 is to ensure sustainable food production systems and implement resilient agricultural practices that will among other things help to increase productivity, maintain ecosystems, strengthen capacity for adaptation to climate change and progressively improve land and soil quality (UN, 2023).

In Nigeria particularly, the Sustainable Land Management Sub-project of the Third National Fadama Development Project (Fadama III) was one of such initiatives. It was a sub-project wholly dedicated to the funding of sustainable land management activities among the project beneficiaries (World Bank, 2008; FMARD, 2014). The fund was intended to encourage and support activities that promote and implement sustainable land management strategies in such a way as to ensure that the implementation of project activities is environmentally sound and socially acceptable (Suleiman, 2013).

Under the sub-project framework, the recommended SLM practices include agronomic practices (agro-forestry, cover cropping, intercropping and mixed cropping); structural and mechanical erosion control practices (contour ploughing, ridge tying, tree planting and wind break); soil management practices (composting, improved fallow, liming and fertilizer application); cultivation practices (zero/minimum tillage, ridging and zero burning); water management practices (small earth dam, drainage and mulching) (Okereke, 2016).

In order for target beneficiaries of any government's intervention to fully utilize the opportunities available to them, they must of essence be able to appreciate the benefits associated with the acceptance of such interventions. In the case of incentives to adopt recommended sustainable land management practices in a farming system, the recipients must be convinced of the economic, environmental and other contributions of the recommendations to the various aspects of their overall wellbeing and livelihood. Such knowledge in turn, motivates them to adopt and continue to use the recommended practices in their production activities.

A number of researches have been carried out on various drivers of adoption and utilization of SLM practices. Stotz (2009) noted that successful adoption of sustainable land management practices by farmers depended on factors such as the availability and suitability of best SLM practices that increase yields while reducing land degradation. In addition, such SLM practices should be adaptable to local environment, help in achieving short-term land productivity and have relatively short establishment time as well as involve practices that are easy to learn.

Indeed, there are evidences that the adoption of sustainable agricultural practices including SLM technologies can create multiple benefits such as reduction in production costs, reduction in farm drudgery, system sustainability, environmental benefits like climate change adaptation and mitigation as well as increased output (Kassie, and Zikhali, 2009; United Nations, 2017; Mamoudou, Yang and China, 2019).

FMARD (2014) enumerated benefits gained by the adopters of SLM practices to include increased food security; improvement in the provision of local energy; provision of local fresh and clean water; mitigation of soil degradation and enhancement of soil development. Others are increase in soil moisture; enablement of soil biodiversity functions as well as enhanced primary production and nutrient cycling. These are in addition to preservation of biodiversity at the farm level through agro-forestry, intercropping, fallow, and preservation of locally adapted seed; reconstitution of carbon pools in soil and vegetation cover; decrease in atmospheric CO_2 and global warming among others.

Sequel to the above, this study was carried out to assess the extent of awareness and appreciation of the benefits of selected sustainable land management practices among smallholder crop farmers in Southeast Nigeria. The study also further assessed the factors that constituted constraints to the utilization of sustainable land management practices among the farmers. The study was necessitated by the fact that available literature shows a missing gap in knowledge in this regard with particular reference to the study area.

METHODOLOGY

The Study Area

The study area is southeast Nigeria which is made up of Abia, Anambra, Ebonyi, Enugu and Imo states. Based on the last official national census, the population of the area was 16,395,555 composed of 8,184,951 males and 8,210,604 females NPC (2006). Geographically, the area is located in the rain forest vegetation belt of Nigeria and farming is the predominant economic activity of the people in the area (Ifeanyi-Obi and Asiabaka, 2014).

Data Collection

The list of Fadama user groups (FUGs) under the Third National Fadama Development Project of Nigeria formed the frame for sample selection. The sample consisted of 360 smallholder crop farmers who are members of the selected FUGs. Multi-stage sampling procedure was used in selecting the respondents. At the first stage, purposive sampling was used to select three states (Ebonyi, Enugu and Imo) from southeast Nigeria, based on proximity for ease of coverage.

At stage two, three (3) local government areas were purposively selected in each of the 3 states selected in stage one based on the preponderance of crop farmers' FUGs in the areas. Stage three involved the purposive sampling of four (4) Fadama Community Associations (FCAs) with preponderance of FUGs involved in crop production from each of the nine (9) LGAs selected at stage two which gave a total of thirty-six (36) FCAs.

Then stage four involved the random sampling of two (2) FUGs involved in crop production giving a total of seventy-two (72) FUGs. Finally, five (5) crop farmers were randomly selected from each of the 72 FUGs to give a total of 360 respondents used in the study. Data were collected from the respondents through field survey using questionnaire augmented with interview schedule.

Analytical Techniques and Models

Descriptive statistics (mean, frequency, percentage, benefit index) and inferential statistics (factor analysis) were used in analysing the data obtained from the field survey. Data were collated, cleaned and analysed using data management and analysis software which include Microsoft Excel, STATA and SPSS.

Benefit-Index Estimation

The perceived benefits of selected SLM practices and technologies were determined using the Benefit-Index model adapted from Suleiman (2013) as stated below.

$$BI = \frac{X_1 + X_2 ....X_m)}{n}$$

Where;

BI = Benefit-index for each SLM practice utilized by farmers

X_1 .... X_m = Benefit indicators for each SLM practice adopted (with values ranging from 0 to 1.

n = Number of benefit indicators under each SLM practice

Factor Analysis Model

In order to obtain the factor loadings of each of the variables necessary for isolating and classifying the constraints to utilization of SLM practices by farmers, the factor analysis model presented below was used.

$$Xij = \varphi_{i1}F_{i1} + \varphi_{i2}F_{i2} + \varphi_{i3}F_{i3} + ... \varphi jmF_ik + e_ij$$

Where;

Xij = Observation on variable Xj for the ith sample member

F_ik = Score on factor Fk (k = 1,2,3, ..., m)

F1 – Fm = Common factors
$e_i j$ = The value on the residual variable Ej for the ith sample member
φji ......φjm = Factor loadings (regression weights)
The associated assumptions were applied accordingly while the suitable number of factors was subjectively selected based on varimax rotated factor matrix obtained using SPSS analytical software.

In running the analysis, a number of preliminary investigations including Bartlett's test of Sphericity and Cronbach alpha reliability test were conducted to ascertain the suitability of the data and other necessary conditions for the use of the technique. The final selection and classification of the variables under various components was based on the Kaiser rule of thumb that variables with greater or equal to 0.4 should be regarded as having loaded high under a given component.

RESULTS AND DISCUSSIONS

Perceived General Effects of Sustainable Land Management Practices

Table 1 shows the general effects of sustainable land management based on the farmers' perceptions.

Table 1: Distribution of respondents according to general effects of sustainable land management practices

Effects	Frequency	Percentage
Increased yield and income	345	95.8
Improved soil fertility	355	98.6
Enhanced climate change adaptation	283	78.6
Reduction of soil erosion	358	99.4
Total	***1341**	

Source: Field Survey Data * Multiple responses obtained

Almost all the respondents (99.4% and 98.6%) perceived reduction in soil erosion and improvement in soil fertility respectively as general effects of sustainable land management practices in the agro-ecosystem. Then 95.8% of them acknowledged SLM practices as being instrumental to the raising of crop yield resulting in increased farm income. Similarly, 79% saw improvement in climate change adaptation as a major effect of sustainable land management on the agricultural production activities of the farmers. This means that the application of sustainable land management practices indeed had far-reaching implications on the social, economic and environmental ramifications of agricultural sustainability in the study area.

Results above go to confirm the findings of some previous studies by various authors. For example, Félix, Arnaud, Moriaque, Saïdi, Julien, Lambert, Gbèwommindéa, Roméo, Firmin, Charlotte, Pascal, and Mélanie (2022) reported that SLM measures had significant effects on soil erodibility as direct seeding and application of maize residue reduced the rate of soil erosion significantly. In a similar vein, SLM practices were found to contribute significantly to the boosting of the fertility status of soils especially with respect to organic carbon as well as nitrogen and phosphorus content of the soil.

This is in addition to the mitigation of climate change effects as well as reduction in soil erosion (Martínez-Menaa, Carrillo-Lópeza, Boix-Fayosa, Almagrob, García Francoc, Díaz-Pereiraa, Montoyaa, de Ventea (2020). Mahammad, Daniel and Paul (2020) had equally observed that sustainable land management is crucial in improving the livelihoods of the farm households in terms of enhanced income generation.

Specific Effects/Benefits of Sustainable Land Management Practices

Benefit index estimation was carried out to determine the level of acceptability of certain factors as benefits of adopting given sustainable land management practices by the respondents and the result is presented in Table 2.

Result shows that all the sustainable land management practices considered in the study recorded benefit indexes above 0.5 and tested statistically significant either at 1%, 5% or 10% levels. Specifically, windbreak, mulching, ridging/ridge tying, mixed cropping, liming/fertilizer application and zero burning had indexes of 0.99, 0.97, 0.94, 0.93, 0.91 and 0.90 respectively and tested highly significant. Other sustainable land management practices with benefit indexes that were significant at 1% were intercropping/strip cropping (0.89), improved fallow (0.89), composting (0.88), zero tillage (0.85) and tree planting/agro-forestry (0.82) and contour farming (0.5). Then use of drainage channel as a sustainable land management option had a benefit index of 0.78 and tested significant at 10% level (Table 2).

Table 2: Benefit indices of sustainable land management practices adopted by farmers

SLM Practices	Perceived Benefits	Benefit Indexes (BI)	Mean BI	t-test
Mulching	Reduces erosion	0.95		
	Lowers evaporation	0.99		
	Increases water infiltration	0.98	0.97	143.61***
	Adds organic matter to the soil	0.97		
	Increases yield	0.98		
Contour farming	Reduces erosion	0.49	0.50	99.00***
	Aids water retention	0.50		
Improved fallow	Improves soil regeneration	0.94		
	Increases yield	0.94	0.89	18.79***
	Adds organic matter to the soil	0.94		
	Agro-climate risk adaptation	0.75		
Intercropping/Strip cropping	Lowers evaporation	0.89		
	Increases water infiltration	0.90		
	Adds organic matter to the soil	0.89	0.89	310.04***
	Increases yield	0.90		
Zero tillage	Reduces soil erosion	0.86		
	Reduces weed competition	0.83	0.85	113.67***
	Improves soil regeneration	0.86		
	Increases yield	0.86		
Ridging/Ridge tying	Moisture retention	0.95		
	Reduces loss of soil	0.94	0.94	195.84***
	Reduces weed competition	0.93		
	Increases yield	0.93		
Composting	Adds organic matter to the soil	0.90		
	Reduces soil runoff	0.90		
	Moisture retention	0.83	0.88	65.02***
	Reduces weed competition	0.90		
	Increases yield	0.88		
Liming/fertilizer application	Reduces soil acidity	0.91		
	Adds organic matter to the soil	0.89	0.91	135.49***

	Increases yield	0.91		
Mixed cropping	Reduces weed competition	0.95		
	Reduces insect pests	0.87	0.93	30.44***
Zero burning	Adds organic matter to the soil	0.91	0.90	180.99***
	Encourages soil water retention	0.90		
Tree planting/agro-forestry	Reduces soil erosion	0.76		
	Agro-climate-risk adaptation	0.76	0.82	13.00***
	Improves soil fertility	0.95		
Wind breaks	Agro-climate risk adaptation	0.99	1.00	199.00***
	Reduces soil erosion	1.00		
Drainage channels	Agro-climate risk adaptation	0.65	0.78	6.00*
	Reduces soil erosion	0.91		

Source: Computed from field survey data *** Significant at 1%, *Significant at 10%

On individual basis, all the items perceived as benefits of each of the sustainable land management practices in the study area had indexes ranging between 0.49 and 0.99 with overall mean of 0.88 which tested highly significant. In relation to the specific perceived benefits derived from the utilization of various SLM practices among the respondents, it is evident from Table 2 that most of the benefits were cross-cutting in terms of the SLM practices generating them. Specifically, mulching, contour ploughing, zero tillage, composting, agro-forestry, wind break and drainage channels all contributed to erosion reduction.

Improved soil regeneration and fertility as a benefit of SLM practices were associated with the utilization of improved fallow, zero tillage, composting, liming/fertilizer application, mixed cropping and zero burning. In addition, the respondents observed that yield increase of crops was a benefit derivable from SLM practices such as mulching, improved fallow, intercropping, zero tillage, ridge tying, composting, liming/fertilizer application and agro-forestry.

Mulching, intercropping, ridge tying, composting and zero burning were also perceived as being instrumental to the improved soil moisture following the adoption of such SLM practices by farmers. Then improved fallow, tree planting, wind breaks, and construction of drainage channels were all SLM practices that led to better adaptation to agro-climatic risk by farmers in the study area.

Constraints to Utilization of Sustainable Management Practices by Smallholder Crop Farmers

Specific factors constraining the utilization of SLM practices by the small holder farmers were identified based on the perceptions of the respondents. Factor analysis was then used to categorize and classify the variables under three principal components based on the output of the varimax rotated factor matrix using the Kaiser rule of thumb. These are institutional/environmental, socio-economic and technical factors.

The variables that loaded high which were use in categorizing and naming factor 1 as institutional/environmental factors were Vo_1 - Limited access to land for tree planting/expansion (0.57), Vo_2 - Bush burning by wildfire (0.65), Vo_3 - Cattle invasion of farm land (0.70), Vo_4 - Government interference on personal lands (0.50), Vo_{15} - Inadequate information to farmers (0.62) and Vo_{18} - Problem of land tenure system/insecurity of tenure (0.70). Others are Vo_{19} - Inter-personal and Inter-communal land conflicts (0.699), Vo_{20} – Long term nature of some SLM practices (0.76), Vo_{21} - Fear of introducing new threats to the environment (0.64), Vo_{23} – Lack of access to formal credit (0.59), Vo_{25} – Poor access roads to farm lands (0.73), Vo_{26} - Land fragmentation-related challenges (0.419) and Vo_{27} – Lack of access to extension services (0.50).

Table 3: Varimax rotated factor matrix of constraints to the adoption of sustainable land management practices by smallholder farmers

Variables	Factors		
	1. Institutional/ Environmental Factors	2. Socio-economic Factors	3. Technical Factors
Vo_1 Limited access to land for tree planting/expansion	0.571	0.431	-0.243
Vo_2 Bush burning by wildfire	0.646	0.360	0.088
Vo_3 Cattle invasion of crop land	0.695	-0.161	0.001
Vo_4 Government interference on personal lands	0.496	0.090	0.163
Vo_5 Unavailability of mechanized labour	0.022	-0.116	0.631
Vo_6 Inadequate training on SLM	0.437	0.729	-0.045
Vo_7 Capital intensive nature of some SLM technologies	0.146	0.329	0.506
Vo_8 High cost of labour	0.248	0.627	0.285
Vo_9 High cost of some SLM input requirements	0.352	0.767	-0.173
Vo_{10} Poverty	-0.174	0.720	0.265
Vo_{11} Inadequate structures for acquisition of technical know-how	0.018	0.015	0.734
Vo_{12} Lack of awareness of social capital	0.001	0.552	0.194
Vo_{13} Inadequate capital assets/fund	0.558	0.134	0.436
Vo_{14} Inadequate government technical support	0.329	0.134	0.482
Vo_{15} Lack of relevant information	0.616	0.143	0.019
Vo_{16} Unpredictable weather	0.305	0.386	0.379
Vo_{17} Inadequate supply of farm inputs	0.484	0.591	-0.304
Vo_{18} Problem of land tenure system/insecurity of tenure	0.704	0.231	0.072
Vo_{19} Inter-personal and Inter-communal land conflicts	0.699	0.271	0.030
Vo_{20} Long term nature of some SLM practices	0.758	-0.180	0.186
Vo_{21} Fear of introducing new threats to the environment	0.635	0.419	-0.038
Vo_{22} Labour intensiveness of some SLM applications	0.069	0.599	0.288
Vo_{23} Lack of access to formal credit	0.586	0.066	0.298
Vo_{24} Lack of access to recommended SLM technologies	0.001	0.027	0.418
Vo_{25} Lack of good access roads to farm lands	0.731	0.091	-0.068
Vo_{26} Land fragmentation-related challenges	0.419	0.690	-0.257
Vo_{27} Lack of access to extension services	0.501	0.308	-0.044
% of explained variation	30.34	10.84	9.26
Cronbach α	*0.897	*0.768	*0.538

Note: Coefficients in table represent regression weights $* = \alpha > 0.5$
Source: Computed from field survey data

The socio-economic factors were isolated based on the variables with high loading under factor 2. These include Vo_6 - Inadequate training on SLM (0.44), Vo_8 - High cost of labour (0.63), Vo_9 - High cost of input requirements for SLM (0.77), Vo_{10} – Poverty (0.72), Vo_{12} - Lack of awareness of social capital (0.55), Vo_{17} - Inadequate supply of inputs (0.59), and Vo_{22} - Labour intensiveness of some SLM applications (0.60).

The remaining variables that loaded high under factor 3 were used in naming the third cluster as technical factors. These variables include Vo_5 – Unavailability of mechanized labour (0.63), Vo_7 - Capital intensive nature of some SLM technologies (0.51), Vo_{11} – Inadequate structures for acquisition of technical know-how (0.73), Vo_{13} - Inadequate capital assets for implementation of SLM (0.44), Vo_{14} - Inadequate technical support from government (0.48) and Vo_{24} - Lack of access to recommended technologies (0.42).

CONCLUSION

It is evident from the findings of the study that the smallholder farmers are well abreast with the benefits derivable from the incorporation of recommended sustainable land management practices in their farming systems. However, there are several factors that constrain them from effective utilization of the practices, which include institutional/environmental, socio-economic and technical factors. Therefore, any meaningful attempt at encouraging the farmers to utilize SLM practices on sustainable basis towards enhancing agricultural productivity must take into cognizance the need to address the identified constraints. This can be achieved through appropriate policies and positive actions by all relevant stakeholders including the farmers.

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