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Adoption of Soil Management and Conservation Technologies by Small Scale Crop Farmers in South Eastern Nigeria: Implications for Sustainable Crop Production

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Abstract: The study assessed the adoption of soil management and conservation technologies by farmers in Southern Eastern Nigeria using Enugu State as a case study. A sample of 126 farmers, were selected from the area for the study. The study revealed that majority of the farmers (40.4%) were 50 years old and above. A large majority of the respondents (75.4%) had formal education, an important factor necessary for the adoption of these practices. The study further revealed that majority (68.3%) of the respondents did not have access to adequate land, while 56.3% depended on their personal savings as their major source of finance. Most of the respondents were small scale farmers. The study also showed that about 70% of the farmers adopted organic manuring, mulching and improved cropping. High cost of some recommended technologies, inadequate finance and inputs for demonstration as well as inadequate motivation of extension personnels were identified as constraints to adoption of recommended soil management and conservation technologies. A significant relationship ($p<0.05$) was observed between farmers' educational level and adoption of fertilizer application and improved cropping system as well as between their annual income and mulching, fertilizer application and terracing. Implication are that food crop production will not be sustainable, since the soil management and conservation technologies are not designed to suit the needs, conditions and farming systems of the study area to encourage farmers' participation and adoption.

Key words: Farmers, adoption, sustainable, soil management, conservation, technologies

INTRODUCTION

Food insecurity as a consequence of low agricultural output and the increasing demand for agricultural products by households and industries due to increasing population have remained a serious problem to governments in developing countries (Boserup, 1975) generally and Nigeria in particular. On the other hand, the need to increase agricultural production to keep pace with the rising demand for agricultural products and the necessity to concurrently retain the quality of land and the ecological balance of the production systems have remained a challenge to researchers and policy makers in Nigeria (Oldema *et al*., 1991; Opera, 1977).

Nigeria is experiencing serious environmental problems in this decade catalyzed by human activities ranging from agriculture to mineral exploitation Agricultural production over time has been reported to be a major factor in ecological imbalance. The outcome of uncontrollable land use and intensification of agricultural production often result in declining productivity and land degradation (Nweke and Okorie, 1983; Olayide and Falusi, 1977).

Farmers' agricultural practices, especially cropping patterns for arable crops have been associated with erosion hazards over time. For instance, the frequent burning of bushes and felling trees for fuel are known to expose the soil to erosion (Ofomata, 1981). The Nigerian Environmental Study Group (NEST, 1991) reported that the impact of erosion as a result of the cultural practices of farmers in Nigeria has been very devastating. The situation is more precarious in the some South Eastern States of Nigeria and especially Enugu State. The cost of addressing ecological damage is often enormous hence the adoption of measures aimed at checkmating its occurrence often becomes the best solution. It was in realization of the ecological problems caused by gully erosion that various soil management and conservation practices have been recommended to farmers through various government agencies such as the Federal Environmental Protection Agency (FEPA), States' Environmental Protection Agency (SEPA) and the States' Agricultural Development Programme (ADEP). These practices are concerned with the ways of managing the soil to promote dense vegetation and improve its structure to make it resistant to erosion and other forms of land degradation to engender sustainable agricultural production. These practices are grouped into agronomic, soil management and mechanical measures (Morqan, 1991).

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Despite the impressive results obtained from the recommended soil management and conservation practices by researchers in Nigeria, evidence of poor soil management and conservation still abound (Okigbo, 1977). This has been attributed, to a large extent, to the lack of awareness of these practices, farmers' skepticism about their workability under the existing farming systems as well as their low level of income. Low income level makes it difficult for the farmers to acquire the necessary inputs, hence non adoption. Soil management and conservation measures should be technically feasible, economically profitable and socially acceptable (Gipps, 1993). For local conservation technologies to be adopted by farmers there must be awareness campaigns conducted with deliberate respect for cultural and social norms especially where conservation activities are initiated by outsiders (CWN, 1992).

The Enugu State's Agricultural Development Programme (ENADEP), in its mandate, has been saddled with the task of educating farmers on the ways of managing and conserving the soil to reduce degradation, increase fertility and ultimately increase agricultural output in the State. However, it appears not much has been achieved in this direction.

The study therefore sought to identify the various soil management and conservation technologies recommended by the agency and adopted by farmers in the State, determine the relationship between some socio-economic characteristics of the farmers and their adoption of the recommended practices determine the factors that militate against the adoption of these recommended practices by farmers and the attendant implications for sustainable agricultural production in the State.

MATERIALS AND METHODS

The study was carried out in Nsukka zone of the Enugu State (ADP), in South Eastern Nigeria. Nsukka is one of the most populated zones in the State with a population estimate of 695,497 persons (1991 National Census). A good number of the people are either full-time or part-time farmers who grow such major tuber crops as yams, coco yams, cassava; or grains such as maize, beans and rice. They also engage in many off-farm economic activities such as trading and tailoring. Twenty one villages in the zone were selected for the study. Six farmers were randomly selected from each of the selected villages giving a representation sample of 126.

A study instrument (a structured questionnaire) was designed and pr-tested on 13 respondents (about 10% of the total sample size) who were not included in the study in order to determine its reliability. The split-half technique was used to administer the instrument and the Spearman-Brown formula was then applied to estimate the Reliability Coefficient. A split-half reliability coefficient of 0.81 was obtained which indicates that the instrument had a high internal consistency.

Following the pre-test, a refined questionnaire was then administered to the 126 respondents to elicit information on some socio-economic characteristics of the respondents such as age, level of education, years of farming experience, sources of finance, land related variables including land accessibility, plots owned by respondents and land ownership structure. Information were also collected on farmers' adoption of chosen soil management and conservation practices, factors militating against adoption of these practices as well as factors affecting effective environmental extension service. Frequency distribution tables (descriptive statistics) were used to present this information. A chi-square analysis (inferential statistics) was then used to determine if a significant relationship existed between some socio-economic characteristics of the respondents and their adoption behaviour.

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

Age of respondents: Results of the survey (Table 1) indicate that majority of the respondents (40.4%) were 50 years of age and above. This may be attributed to the migration of the youths from the rural to the urban areas in search of white collar jobs and to enjoy most of the social amenities that are not available in the rural areas.

Table 1: Socio-economic characteristics of farmers

Characteristics	Frequency	Percentage
Age		
20-29	18	14.3
30-39	21	16.7
40-49	36	28.6
50 and above	51	40.4
Total	126	100.0
Educational level		
No school	23	18.3
Primary chool	30	23.8
Secondary school	42	33.3
Tertiary institution	31	24.6
Total	126	100.0
Years of farming		
1-3	14	11.1
4-6	28	22.2
7-9	46	36.5
10 and above	38	30.2
Total	126	100.0
Sources of finance		
Personal savings	71	56.3
Relative/friends	15	11.9
Financial institution	14	11.1
Cooperatives and others	26	20.7
Total	126	100.0

Source: Field survey (2001).

Educational level of respondents: The study also revealed that majority of the respondents (75.4%) attained up to the secondary level of education (Table 1), wile only 18.3% had no formal education. This means that majority of the respondents were literate enough to understand the modern technologies and this accounted for their positive response to some of the recommended soil management and conservation technologies (Table1).

Years of farming of respondents: Table 1 also shows that majority of the farmers (66.7%) had been in the farming business for seven or more years and therefore were probably well acquainted with the traditional soil conservation and management practices. However, farmers' years of farming experience could have a negative effect on the acceptance of new practices since most farmers, particularly small-scale farmers' exhibit conservative attitude towards change. The longer a farmer adopts a traditional soil conservation technology, the more difficult it becomes to change to a new one.

Sources of finance for farming activities: The survey (Table 1) further indicates that majority of the respondents (56.39%) depended on personal savings as the primary source of finance for their farming activities, while only 11.1% claimed to have borrowed money from the bank and other credit institutions. Farmers' dependence on personal savings which often is inadequate and unreliable is likely to affect their rate of adoption of recommended soil management and conservation technologies that usually require the purchase of somewhat expensive materials.

Accessibility to land by respondents: Table 2 indicates that 68.3% of the respondents had no access to adequate land for their farming activities, while 31.7% claimed to have access to land. This result suggests that although a good number of the inhabitants in the zone were farmers, lack of access to land by majority of the farmers would undermine early adoption of recommended soil management and conservation practices.

Number of farm plots owned and ownership structure: The study further revealed that 70.7% of the respondents owned between 1.0 and 8 plots (Table 2), with a plot size estimated to be 0.15 hectare. This implies that majority of the respondents were small-scale farmers. Also majority of the farmers (49.4%) acquired their plots by inheritance-while 2.26% had theirs on lease. Ownership by inheritance often results in the fragmentation of land and continued land-ownership tussles. On the other hand, lease ownership makes it difficult for the lessee to embark on long term investment on the land such as tree crop planting.

Table 2: Land accessibility, number of plots owned and land ownership structure of respondents

Variables	Frequency	(%)
Accessibility to land		
Accessible	40	31.7
Not accessible	86	68.3
Total	126	100.0
No. of plots owned		
1-4	37	29.4
5-8	52	41.3
9-12	24	19.0
13 and above	13	10.3
Total	126	100.0
Ownership structure		
Inheritance	86	49.4
Purchased	13	7.5
Leased	41	22.6
Community owned	34	19.5
Total	174	100.0

Note: Total frequency exceeded 126 as a result multiple responses. Source: Field survey (2001)

Table 3: Adoption rates of selected soil management and conservation technologies of farmers (N = 126)

Technologies	Frequency[a]	(%)
Mulching	110	87.3
Manuring	106	84.1
Liming	84	66.6
Fertilizer application	92	73.0
Cover crop planting	73	57.9
Tree crop planting	79	62.7
Terracing	31	24.6
Incomplete land clearing	92	73.0
Improve tillage practices	74	58.7
Earth dam construction	27	17.8
Water channel construction	98	77.8
Improved cropping system	101	80.2

Note: Frequency indicates total number of adopters of each technology, Source: Field survey (2001)

FARMERS' RATE OF ADOPTION OF THE RECOMMENDED SOIL MANAGEMENT AND CONSERVATION TECHNOLOGIES

The study revealed that more than 80% of the respondents adopted mulching, manuring and improved cropping system out of all the recommended practices (Table 3). The high adoption rate for organic manuring, mulching and improved cropping system was attributed to their simplicity, moderate cost and importance in increasing fertility and output. The construction of earth dams and terracing were not popular because of the cost implications and labour constraints. Hence, more than 75% of the respondents did not adopt these practices.

RELATIONSHIP BETWEEN SOME SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS AND THEIR ADOPTION BEHAVIOUR

Table 4, 5 and 6 show the results of the chi-square analysis. The analysis reveals a significant relationship ($p<0.05$) between farmers' level of education and their

Table 4: Chi-square results showing the relationship between educational level of the respondents and their rate of adoption of some recommended soil management and conservation technologies

Technologies	Adoption	Low	Medium	High	χ^2	Level of sig.
Mulching	Adopted	18	43	32	1.02	NS
	Not adopted	05	10	8		
Fertilizer	Adopted	18	30	44	19.9	S
application	Not adopted	25	9	5		
Manuring	Adopted	23	47	34		
	Not adopted	3	10	7	0.92	NS
Improved	Adopted	14	52	35		
Cropping system	Not adopted	12	4	9	16.7	S

*p<0.05; Critical χ^2- value = 5.50, Note: NS = not significant; S = significant

Table 5: Chi-square results showing the relationship between age of the respondents and their rate of adoption of some recommended soil management and conservation technologies

Technologies	Adoption	Young	Middle	Old	χ^2	Level of sig.
Mulching	Adopted	24	50	16	5.07	NS
	Not adopted	14	12	10		
Manuring	Adopted	28	42	30		
	Not adopted	3	12	11	3.29	NS
Fertilizer	Adopted	27	42	33		
application	Not adopted	10	6	70	3.00	NS
Improved						
cropping system	Adopted	19	49	23		
	Not adopted	1	16	8	3.69	NS

*p<0.05; Critical χ^2 - value = 5.50, Note: NS = not significant; S = significant

Table 6: Chi-square results showing the relationship between income of the respondents and their rate of adoption of some recommended soil management and conservation technologies

Technologies	Adoption	Low	Medium	High	χ^2	Level of sig.
Mulching	Adopted	16	34	60	20.7*	S
	Not adopted	10	4	2		
Fertilizer	Adopted	18	32	42		
application	Not adopted	19	10	5	17.8*	S
Terracing	Adopted	4	9	18		
	Not adopted	14	32	23	14.0*	S

*p<0.05; Critical χ^2 -value = 5.50, Note: NS = not significant; S = significant

adoption of fertilizer and improved cropping. This implies that, farmers who attained some level of education adopted fertilizer application and improved cropping more than those who did not. However, there was no significant relationship (p>0.05) between level of education and adoption of manuring and mulching. This was expected since these constituted part of the traditional soil management and conservation practices. The table also reveals that, there was no significant relationship (p>0.5) between the age of the respondents and their adoption of mulching, manuring, fertilizer application and improved cropping system (Table 5). This was due to the fact that majority of the respondents were in the older generation age bracket. These farmers had practiced the traditional methods for decades and it would be unexpected for them to suddenly change to the modern methods introduced to them.

The study further revealed that there was a significant relationship (p<0.05) between the respondents' annual income and adoption of mulching, fertilizer application and terracing (Table 6). This implies that, farmers within the high income level were likely to adopt these recommended soil management and conservation practices than those within the low income group, who may not be able to afford the cost of adoption of these improved practices. High cost of innovation is one of the known factors that hinder adoption of innovation (Ekong, 1988).

Table 7: Factors militating against adoption of recommended soil management and conservation technologies as perceived by the respondents (N = 126)

	Level of seriousness					
	Very serious		Serious		Not serious	
Identified factor	Freq.	%	Freq.	%	Freq.	%
Land tenure system	83	65.9	31	24.6	12	9.5
Small size of plot	56	44.4	49	38.9	21	16.7
Lack of technical advice	78	61.9	36	28.6	12	9.5
Lack of necessary inputs	94	74.6	18	14.3	14	11.1
Lack of credit	89	70.6	22	17.5	15	11.9
Low level of education	27	21.4	35	27.8	64	50.8
Low level of income	55	43.7	32	25.4	39	30.9
Shortage of labour	63	50.0	25	19.8	38	30.2

Source: Field survey (2001)

CONSTRAINTS TO ADOPTION OF RECOMMENDED SOIL MANAGEMENT AND CONSERVATION METHODS

Table 7 indicates that land tenure system, inadequate technical advice, inadequacy of necessary inputs like credit and labour were identified by the respondents as the most serious constraints that hindered their adoption of the soil management and conservation practices recommended to them by the ENADEP. Other constraints identified include, low level of income and small size of farm plots owned by the respondents. These results agree with the findings of (Okigbo, 1977; Onu, 1986; Udoh, 1998).

The study also revealed that lack of inputs for demonstration, such as seeds, fertilizers and required farm implements inadequate transportation and lack of motivation of extension personnels were the major hindrance to effective extension in the area.

IMPLICATIONS FOR SUSTAINABLE FOOD CROP PRODUCTION/RECOMMENDATIONS

Two major components of environmental extension, namely soil management and conservation were investigated in this study. These components involve ways of managing the soil to promote dense vegetation and prevent erosion and other forms of land degradation, with the ultimate aim of sustaining food crop production.

- The study revealed that, there were higher adoption rates for some technologies recommended to the farmers. The reason adduced for such high rates include simplicity, lower cost and enhancement of soil fertility vis a vis output. Implication is that soil management and conservation technologies should be designed to suit the farmers' needs and conditions if sustainable food crop production is to be enhanced in the area.
- To engender the adoption of soil management and conservation technologies that the farmers believed were quite expensive (terracing and construction of earth dams) government through its agencies should adopt policy measures that will enhance unfettered access to credit by these small-scale farmers in the area.
- Since extension has a crucial role to play in promoting sustainable agricultural practices the extension workers as important actors, lack of motivational factors and logistic support is likely to hinder the discharge of their duties. Thus, the absence of effective extension contact with farmers is likely to affect the adoption of modern and effective soil management and conservation practices by farmer. This will, in turn, result in the degradation of land resources and hence, hampering sustainable food crop production in the area.

CONCLUSION

Soil degradation, most often than not, results from poor soil management and conservation practices commonly adopted by farmers with increasing awareness of the linkage between resource degradation and the deteriorating quality of life, it is becoming clearer that soil degradation contributes to low agricultural yields. For effective conservation of the available arable soil to be achieved, both the extension workers and farmers have crucial roles to play. Although the study has identified some improved soil management and conservation technologies recommended to farmers in the area, a number of constraints that hindered farmers' adoption of these technologies have been identified. These constraints ranged from high cost of technology, inadequacy of necessary inputs and lack of adequate credit to farmers to near absence of motivation and logistic support to extension workers.

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