INTERNATIONAL JOURNAL OF ADVANCED BIOLOGICAL RESEARCH

www.scienceandnature.org

BEHAVIOURAL ADAPTATIONS OF SMALL-HOLDER FARMERS IN SOIL EROSION ENDEMIC AREAS OF IMO STATE, NIGERIA

[a]Aja, O.O., [a]Ani, A.O., [a]Matthews-Njoku, E.C. & [b]Ifeanyi-Obi, C.C.
[a]Department of Agricultural Extension, Federal University of Technology, P. M. B. 1526, Owerri, Imo State, Nigeria.
[b]Department of Agricultural Economics & Extension, University of PortHarcourt, Rivers State, Nigeria

ABSTRACT
This study examined the behavioral adaptations of small-holder farmers in soil erosion endemic areas of Imo State, Nigeria. The study analysed the socio-economic characteristics of the small holder famers in the area, determined the various soil and water conservation practices adopted by the farmers, ascertained the changes that had occurred in fallow length and whether such changes were accompanied with adequate soil fertility maintenance or not. Data were collected through the use of structured and validated questionnaire from 250 small-holder farmers selected through a random sampling technique from communities that were experiencing soil erosion challenges in the state. The collected data were analysed using statistical tools such as frequency counts, percentages, and mean score. The results revealed that majority of the respondents were within the ages of 45- 54years (43.2%), had between 7–12 years of schooling (41.2%), and a farm size of 1.1 – 2.0ha (44%). It was also revealed that the average change in fallow length was 2.65years (from 4.83 to 2.18 years), the study further showed that the soil and water conservation practices adopted by farmers in the area included mulching (Mean = 3.68), cover cropping (Mean = 3.62) and mixed cropping (Mean=3.61). The results also revealed that majority (72.00%) of the farmers believed that reduction in fallow length in the area was not matched with adequate soil fertility maintenance. The study concluded that farm land use intensification without adequate soil fertility maintenance in an erosion prone area is an unsustainable practice, and capable of worsening the problems of soil erosion in the area. The study therefore recommended that the Imo State Agricultural Development Programme (IMOADP) should educate the farmers on ways of matching increasing farm land use intensification with adequate soil fertility maintenance.

KEYWORDS: Soil erosion, adaptations, farmers, endemic, fallow length.

INTRODUCTION

Soil erosion is currently rated the most important environmental problem in Southeast Nigeria in general and Imo State in particular. The rate of soil loss in this area has reached a disaster point, estimated at between 158.8 – 500 tons/hectare/year (Osuji, 1986; Odili, 2010; Aja, 2013). Ordinarily, erosion rates that exceed 10– 30 tons/hectare/year are considered problematic (Hanyona, 2001). This massive soil loss culminate to severe ecological damage, soil fertility depletion and decline in both land and agricultural productivity, resulting in acute food shortages and loss of livelihoods in the area (Onu, 2011; Umahi, 2011; Aja, 2013). Soil erosion exacerbation in Imo State is largely attributed to unsustainable land use practices that result to indiscriminate destruction of vegetative covers for agricultural purposes, road construction, and other land uses (Igbokwe *et al.*, 2008; Odili, 2010). Farm households that live in conditions that put their main source of livelihood at constant risks like farmers in the erosion endemic areas of Imo State will develop self-insurance strategies to reduce the effects of food insecurity and scarcity. These behaviouralmodifications are what is referred to in this study as behavioural adaptations. Earlier studies of such adaptations revealed an array of responses to the contemporary household food shortages, which may include intensification of resource use, changes in farming and cropping practices, use of inter-household transfers and loans, sale of household productive assets, forced migration, liquidation of savings, and changes in household consumption pattern (Igbozuruike; 1990; Aja, 2013). These adaptive behaviours are usually targeted at stabilizing or increasing immediate income generation at the household level, but these often have further detrimental consequences on the natural ecosystem and on the sustainability of agricultural productivity leading to greater food insecurity in the longer term. From the forgoing, deductive reasoning suggests that it is only through careful planning and interventions that farm households living in ecologically vulnerable areas can sustainably develop adaptive responses to such problems as posed by soil erosion in Imo State, without putting the farming environment and future generations at higher risks. But then, designing any effective intervention can only be possible if the current adaptive practices and location specific inhibiting and/or favourable factors such as cultural practices among the people are known. It is against this backdrop that this study tends to

systematically analyse the behavioural adaptations of small holder farm households in soil erosion endemic communities in Imo State, Nigeria. The specific questions of relevance to the study included: what are the socio-economic characteristics of farmers in the study area? What are the land tenure systems in the area? At what rates and frequencies are field cultivated in the area? What specific changes have taken place in fallow lengths as a response to soil erosion threats? What changes have occurred in the cropping patterns in the area? What are the soil and water conservation practices adopted by farmers in the area? What changes have taken place in the livelihood strategies and livelihood resources of the people?

The broad objective of this study was to analyse the behavioural adaptations of small holder farm households in soil erosion endemic areas of Imo State, Nigeria. The specific objectives were to: describe the socio-economic characteristics of small- holder farm households in soil erosion prone areas of Imo State, to determine the various methods of acquiring farm lands in the area, ascertain the changes in fallow lengths in soil erosion prone areas of Imo State, to identify the soil and water conservation methods commonly practiced by the farmers in the surveyed area, to determine whether reduction in fallow lengths were accompanied with soil fertility maintenance or not, and ascertain the livelihood strategies of the farmers in adaptation to soil erosion threats in the area.

METHODOLOGY

This study was conducted in Imo State, Nigeria. Imo State is among the five states that make up the southeast agro-ecological zone of Nigeria. It derives its name from Imo River which takes its origin from Okigwe/Awka upland. It lies within latitude $4^0 45^1$N and $7^0 15^1$N and longitude $6^0 50^1$E and $7^0 25^1$E, and covers a total land area of about 5100 square kilometers (www.imostate.gov.ng). Imo State has an estimated population of about 4.8 million people and an annual population growth rate of 3.35 percent (National Population Commission (NPC), 2010). The state has a high population density which varies from 230 persons per square kilometer in Oguta/Egbema areas to about 1400 persons per square kilometer in Owerri, Mbaise, Mbano, Orlu and Mbaitoli areas (Federal Republic of Nigeria Official Gazette, 2007). The population density of Imo State is by far higher than the national average which is 166.0 persons per square kilometer (National Bureau of Statistics (NBS), 2009), and this has been attributed to the increasing pressure on land, forests and other natural resources in the state (www.imostate.gov.ng).

With respect to relief and drainage, Imo State is underlain by the Benin formation of coastal plain sands. This formation is of tertiary age, deep, porous, fertile and highly leached. In some areas like Okigwe, impermeable layers of clay occur near the surface, while in other areas, the soil consist of lateritic material under a super-ficial layer of fine grained sand. There are few rivers with vast inter fluves which are characterized by dry valleys that carry surface drainage in periods of high rainfall. The main streams draining the state are Imo, Otamiri, Njaba, and Urasi Rivers – all of which have very few tributaries. With the exception of Imo River, that runs through the area underlain by the Imo shales, other rivers rise within the coastal plain sands.

Rainfall distribution is bi-modal with peaks in July and September and a two week break in August. The rainy season begins in March and last till October or early November. Rainfall is often at its maximum at night and during the early morning hours, and most times accompanied with violent storms which destroy crops, houses and other infrastructural installations such as electricity poles, and telecommunication masts. Annual rainfall varies from 1990mm – 2200mm. Temperatures are similar all over the state, with the hottest months being between January and March. The mean annual temperature is around 20^0c, while the annual relative humidity is 75 percent. The state lies within the rainforest agro-ecological zone of Nigeria (www.imostate.gov.ng).

Random sampling technique was used to select 50 small-holder farm households each from five communities that were experiencing serious soil erosion challenges in the state. Thus, 250 households were sampled for the study. The communities selected were Urualla, Ihioma, Amucha, Okwudor, and Nekede. The list of the farmers was obtained through the help of resident agricultural extension agents and other key informants in the selected communities. Interview schedule and key informant interviews were used to collect data for the study. Two enumerators each from the selected communities were recruited, trained and used for the collection of data for the study. The data collected were analysed using descriptive statistical tools such as frequency counts, percentages, means and standard deviations. However, a 4-point Likert-type rating scale was used to measure agreement or otherwise with the listed soil and water conservation practices adopted by the farmers and changes in livelihood strategies and livelihood resources in objectives five and six respectively. The rating scale was operationalised thus: Strongly Agreed (4), Agreed (3), Disagreed (2) and Strongly Disagreed (1). The mean score was obtained by adding up the values of the scale (e.g. 4+3+2+1 =10) and divide by the number of scale (4) to give a mean score of 2.5, which was used as the discriminatory index, such that any mean score ≥ 2.5 was regarded as agreed while those < 2.5 was regarded as disagreed.

RESULTS & DISCUSSION

Socio – economic characteristics of the farmers

The results in Table 1 show that the mean age of the farmers was 47.40years. This implies that they were still young and active. The result also shows that most of the farmers (82 %) had one form of formal education or the other, ranging from primary to tertiary education. The mean years spent in school was 6 years, which implies that the farmers from the surveyed areas were educated. The table also reveals that the farmers had large household sizes with majority (54%) having between 5 – 8 persons per household. The average household size was 7 persons, indicating a large household size. A large household size could lead to increased demand on available natural

resources such as land especially in soil erosion prone areas. Table 1 also shows that the farmers were resource poor considering their farm sizes and income level. The average farm size was 1.62ha while the estimated average monthly income was N20,152.47. The table also shows that majority (86.4%) had no extension contact in month. Only few farmers (12.8%) had extension contact once in month. The result indicates that there was poor extension coverage in the area. A robust extension coverage is needed in ecologically unstable farming areas like the area under survey.

TABLE 1: Distribution of respondents according to socio-economic variables (n = 250)

Variables	Percentages (%)	Mean (X)
Age (in years)		
25 – 34	8.00	47.40yrs.
35 – 44	28.00	
45 – 54	43.20	
55 – 64	16.00	6.00yrs.
Above 64	4.80	
Total	100.00	
Years spent in school		7.00
0	18.00	
1 – 6	32.80	
7 – 12	41.20	1.62ha.
Above 12	8.00	
Total	100.00	
Household size	24.00	
1 – 4	54.00	N20,152.47
5 – 8	16.80	
9 – 12	5.20	
Above 12	100.00	
Total		
Farm size (hectares)	32.00	
0.1 – 1.0	44.00	
1.1 – 2.0	12.40	
2.1 – 3.0	7.20	
3.1 – 4.0	4.40	
Above 4.0	100.00	
Total		
Income per month (in	15.20	
naira)	24.80	
1,001.00 – 9000.00	34.00	
9,001.00 – 17,000.00	10.40	
17,001.00 – 25,000.00	9.60	
25,001.00 – 33,000.00	6.00	
33,001.00 – 41,000.00	100.00	
Above 41,000.00		
Total	86.40	
Extension contact per	12.80	
month	0.80	
No contact at all	0.00	
Once	100.00	
Twice		
More than twice		
Total		

Source: Field Survey data, 2013

Methods of acquiring farm lands in soil erosion prone communities

Result in Table 2 explains the different forms of acquiring farm lands in the area. The table shows that the traditional method of acquiring land by inheritance (80%) was the common practice. This method encourages land fragmentation and makes effective land use planning difficult (Ekong, 2003). Other methods of land acquisition in the area included lease (35.2%), gift (14.4%) and outright purchase (5.60). The result implies that only very few farm lands were acquired through outright purchase. This may be as a result of restrictions on sell of farm lands in south

eastern part of the country including the study area (Imo State) (Ekong, 2003).

TABLE 2: Distribution of the respondents according to methods of acquiring farm lands in soil erosion prone communities (n = 250)

Methods of acquiring farm lands	*Percentage (%)
Inheritance	80.00
Lease	35.20
Outright purchase	5.60
Gift	14.40

Source: Field survey data, 2013 * = Multiple response

Change in fallow length

One of the major ways of expanding the scale of farm operation by farmers in soil erosion prone areas was by shortening fallow periods. This section sought to examine the nature of farmers' shortened fallow periods as a response behavior to soil erosion challenges. To measure this variable, the respondents were asked to rate the average length of fallow of their farm land units before and after the onset of soil erosion threats. The result in Table 3 shows that over three quarter (77.6%) of the farmers observed a fallow length of between 3 – 8 years before the onset of soil erosion threats in the area but after the onset of soil erosion threats, 88 percent of the farmers observed a fallow length of 2 years and below. The result indicates that the average length of fallow has been reduced from 4.8 years to 2.18 years before and after the onset of soil erosion threats, indicating an average change in fallow length of 2.65 years. This result is in support of the findings of Onu *et al* (1997), that farmers in soil erosion prone areas are likely to intensify cultivation of their available croppable lands through reduction of fallow length, increased crop cycles and densities.

TABLE 3: Distribution of the respondents according to changes in fallow length

Before soil erosion threat		After soil erosion threat	
Fallow length (in years)	Percentage (%)	Fallow length (in years)	Percentage (%)
0 - 2	16.00	0 - 2	88.00
3 - 5	40.80	3 -5	12.00
6 - 8	36.80	6 - 8	0.00
> 8	6.40	> 8	0.00
Total	100.00	Total	100.00
Mean = 4.83years		Mean = 2.18years	
Average change in fallow length = 2.65years			

Source: Field survey data, 2013

Soil and water conservation methods commonly practiced by the farmers

The result in Table 4 shows that the soil and water conservation methods commonly practiced by farmers in surveyed area included Mulching (Mean = 3.68), cover cropping (Mean = 3.62), Mixed cropping (Mean = 3.61) and conservation tillage (Mean = 3.12). Other methods included application of organic fertilizers (Mean = 3.49), application of inorganic fertilizers (Mean = 3.44), crop rotation (Mean = 2.86), bush fallowing (Mean = 2.81) and water harvesting (Mean = 2.66). The result further shows that use of buffer strips (Mean = 1.24), terracing (Mean = 1.28), and alley cropping (Mean = 1.99) were not commonly practiced by the farmers. The result is in agreement with the findings of odunze (2002), Adekalu *et al* (2006), and Salako *et al* (2006), who observed that mulching is a commonly practiced soil conservation method. They noted that it reduces the splash effect of rain, decreases the velocity of runoff, and hence reduces the amount of soil loss. The materials for mulching has also been reported to be readily available in the humid and semi – humid tropics (Lal, 2000). It has been reported also that most of the commonly practiced soil conservation methods such as cover cropping, mixed cropping, and crop rotation are compatible with the local environment in terms financial and labour cost requirements, availability of materials, and ease of application (Lal, 2000). Other methods such as terracing and alley cropping are not commonly practiced in the area. This may be as a result of high cost requirement, complexity of application and labour intensive nature of such methods. Igbokwe (1996) observed that though permanent structures such as terraces are effective soil conservation technologies, high labour intensity, time – consuming regular inspections, high consumption of scarce farm land, and the large amount of construction materials required are factors that constrain farmers from installing and maintaining terraces. The implication of this result is that the designing of technologies aimed at soil conservation in the surveyed area should be location specific.

TABLE 4: Distribution of the respondents according to their agreement or otherwise with listed location specific soil and water conservation methods commonly practices

Soil and water conservation practices		Mean score	Std. Deviation	Decision
1.	Mulching	3.68	1.2482	A
2.	Use of cover crops	3.62	0.2831	A
3.	Use of mixed cropping	3.61	1.0201	A
4.	Alley cropping	1.99	1.0009	D
5.	Use of buffer strips	1.24	0.0442	D
6.	Ridging across the slope	2.41	1.9100	D
7.	Contour farming	2. 61	0.4120	A
8.	Bush fallowing	2.81	0.6991	A
9.	Use of conservation tillage	3.12	0.6822	A
10.	Crop rotation	2.86	0.2913	A
11.	Application of inorganic fertilizers	3.44	1.6031	A
12.	Application of organic fertilizers	3.49	0.5538	A
13.	Water harvesting	2.66	0.9299	A
14.	Construction of catchment ditches	3.90	0.7381	A
15.	Terracing	1.28	0.4629	D

Source: Field survey data, 2013 A = Agreed, D = Disagreed

Reduction in fallow length and maintenance of soil fertility

This section sought to determine whether reduction in fallow length was accompanied with soil fertility maintenance or not. From the result in Table 5, majority (72%) of the farmers believed that they accompanied fallow length reduction with inadequate soil fertility maintenance. The table further shows that about one quarter (24.8%) of the farmers reduced fallow length without soil fertility maintenance. Only a small proportion (3.2%) of the farmers matched fallow length reduction with adequate soil fertility maintenance. This result reveals that most of the farmers resorted to farm land use intensification without adequate soil fertility maintenance. The implication of this finding is that if the trend is not checked, the already vulnerable soil and other land resources in the area will be put at higher risks, and it will negatively affect food production in the area.

TABLE 5: Distribution of the respondents according to reduction in fallow length with/without soil fertility maintenance

Reduction in fallow length with/without soil fertility maintenance	Percentage (%)
1. Reduction in fallow length accompanied with adequate soil fertility maintenance	3.20
2. Reduction in fallow length accompanied with inadequate soil fertility maintenance	72.00
3. Reduction in fallow length without soil fertility maintenance	24.80
Total	100.00

Source: Field survey data, 2013

Livelihood strategies of the farmers in adaptation to soil erosion threats in the area

This section sought to examine the livelihood coping strategies with soil erosion threats. The result in Table 6 shows that majority (68%) of the farmers resorted to portfolio diversification through increased crop combination and animal production per unit farm land. This could be as a way of maximizing the use of available farm lands and reduce vulnerability to erosion risks by spreading the risks across different streams of production. Babatunde and Matin (2009) observed that livelihood diversification among poor rural households are not only for increasing household income but for risks management. The table also shows that most (72.02%) of the farmers now engage more in non – farm income generating activities. As farm enterprises are threatened by soil erosion, the chances are there that most households may resort to other means of income generation such as wage labour, trading, craft making, etc, other than farming. If well planned, re-orienting rural people away from farming could help in reducing pressure on available farm lands especially in soil erosion prone areas. Also, the result in Table 6 shows that some of the farmers resort to seasonal (53.9%) and permanent out – migration to seek better livelihood opportunities elsewhere. An unplanned migration could affect food production and demand, and in severe circumstances could lead to disruption of the social order in the society. It is evident from the study that most of the households exhibit different response behaviours to situations that threaten their livelihoods such as soil erosion.

TABLE 6: Distribution of the respondents according to changes in livelihood strategies

	Changes in livelihood strategies	*Percentage (%)
1.	Increased crop combination and animal production	68.00
2.	Increased engagement in non-farm economic activities	72.02
3.	Seasonal out –migration during off season	53.90
4.	Permanent out-migration to seek better livelihood opportunities elsewhere	38.22
5.	Increased dependence on remittances for sustenance	49.02

Source: Field survey data, 2013 * = Multiple response

CONCLUSION & RECOMMENDATIONS

Soil erosion remains one of the most important environmental challenges to farmers in Imo State. In response to soil erosion threats in the area, the farmers exhibit different forms of adaptation behaviours, some of which further compound the problem and put the already fragile soil to greater risks. Among the unsustainable response behaviours include increased farm land use intensification without adequate soil fertility maintenance and uncontrolled migration in search of better livelihood opportunities. To this end therefore, the study recommended the following:

1. The Imo State Agricultural Development Programme (IMOADP) should increase its extension coverage on soil conservation and with special focus on farmers in soil erosion prone areas.
2. Unsustainable farm land use such as reduction in fallow length, increased crop cycles and densities without adequate soil fertility maintenance should be discouraged by the state government and other relevant stakeholders.
3. Out – migration of the farmers from the soil erosion threatened areas should be closely monitored by relevant government agencies.

REFERENCES

Adekalu, K.O., Okunade, D.A. & Osunbitan, J.A. (2006) Compaction and mulching effects on soil loss and runoff from two southwestern Nigeria agricultural soils, *Geoderma*, 1370: 226-230

Aja, O.O. (2013) Soil Erosion and its Effects on Rural Households' Livelihood activities in Imo State, Nigeria. An M. Sc. thesis submitted to the Department of Agricultural Extension, Federal University of Technology Owerri, Nigeria.

Babatunde, R.O. & Matin, Q. (2009) Patterns of income diversification in rural Nigeria: Determinants and impacts, *quarterly Journal of International Agriculture*, 48(4): 305-320.

Ekong, E.E. (2003) Rural Sociology: An Introduction and Analysis of Rural Nigeria. Dove Educational Publishers, Uyo, Nigeria.

Hanyona, S. (2001) Soil erosion threatens farmlands of Saharan Africa, *The Earth Times.* Retrieved on January 12, 2012 from http://www.forests.org/archeive/african/ soearthe. htm.

Igbokwe, E.M. (1996) Soil and Water Conservation Systems under threat: A visit to Maku, Nigeria. In: C. Reij, I. Scoones, and C. Toulmin (Eds), Indigenous soil and water conservation in Africa, *Sustaining the soil*, Vol.6: 219-243. London: Earthscan Publication.

Igbokwe, J.I., Akinyede, J.O., Dang, B., Alaga, T., Ono, M. N., Nnodu, V.C. and Anike, L.O. (2008) Mapping and monitoring of the impact of gully erosion in Southeast Nigeria with satellite remote sensing and geographic information system, *the international archives of the photogrammetry, remote sensing and spatial information sciences*, vol. xxxvii, part B 8, Beijing.

Igbozuruike, U.M. (1990) Socio-economic impact of soil erosion in South-eastern Nigeria, Proceedings of the national seminar on erosion ravages in South-eastern Nigeria, held at the Federal University of Technology Owerri, Nigeria.

Imo State Government (undated) About Imo State. Retrieved on January 30, 2012 from http://www.imostate. gov.ng/ info/ about/imo.htm.

Lal, R. (2000) Mulching effects on soil physical quality of an Alfisol in western Nigeria, *Land Degradation and Development* 11:383-392.

National Bureau of Statistics (NBS) (2009) Social Statistics in Nigeria, National Bureau of Statistics (NBS), Abuja, Nigeria.

National Population Commission (NPC) (2010) Population distribution by sex, states, LGAs and senatorial districts, 2006 population and housing census, priority tables vol. III, NPC, Abuja, Nigeria. Retrieved on May, 7, 2012 from http://www.population.gov.ng/2006/nationalandstatepopulationandhousing/htm.

Odili, N. O. (2010) Prevention and control of soil erosion in Imo State, a paper presented at the sensitization workshop on prevention and control of soil erosion in the 27 local government areas of Imo State, Nigeria.

Odunze, A.C. (2002) Mulching practice in a semi-arid zone of Nigeria for soil erosion control and grain yield of maize, *Journal of Sustainable Agriculture Vol.* 20(1):31-39.

Onu, D.O., Osuji, G.E., and Offor, M.C. (1997) Small farm households' coping strategies in the erosion prone areas of Southeastern Nigeria: Implications for the sustainability of agricultural productivity in the ecologically vulnerable areas of Nigeria. A Research report submitted to Nigerian Environmental Study Action Team (NEST), Ibadan, Nigeria.

Onu, N.N. (2011) Training in Geophysics: The challenges of oil exploration, gully erosion and water resources development, 18th Inaugural lecture of the Federal University of Technology Owerri, Nigeria, March 16.

Osuji, G.E. (1986) Evaluation of cropping management factor in the Universal Soil Loss Equation (USLE) under natural rainfall conditions of Southeastern Nigeria. Proceedings of the National Seminar on Erosion ravages in Southeastern Nigeria, held at the Federal University of Technology Owerri, Nigeria, May 29 – 31.

Salako, F.K., Kirchhof, G., and Tian, G. (2006) Management of a previously eroded tropical Alfisol with herbaceous legumes: Soil loss and physical properties under mound tillage, *Soil and Tillage Research*, 89:182-195.

Umahi, H. (2011) Erosion kills Southeast: The devastation in Abia, Anambra, Ebonyi, Enugu and Imo States, The Sun Newspaper, Saturday, November 26, Pp. 61 – 64.