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Analysis of the Effects of Some Farming Practices Employed By Arable Crop Farmers on Soil Degradation in Imo State, Nigeria

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ABSTRACT

This study employed the use of the probit multiple regression model in analyzing the effects of farming practices employed by arable crop farmers on soil degradation. The objective was to identify any gap(s) that may exist in the current farming practices and the interventions required towards the evolution of more sustainable practices. A multistage sampling procedure was used in selecting 342 arable crop farmers from the study area. The study show that most of the arable crop farmers cleared and burnt their farmland before cropping, with majority (73.10%) allowing their farmlands to be left fallow for less than three years before farming on it again. Most of the farmers practice minimum tillage. Result of the probit multiple regression model shows that the practice of bush burning and clearing by the farmers will continue to encourage degradation. The effects of these farming practices on soil degradation culminated in continued crop low productivity. Education of arable crop farmers on alternative farming methods that could allow for the use of natural resources more sustainable is advocated for.

Keywords: Soil degradation, farming practices, arable crop, Imo State.

INTRODUCTION

There is a persistent decline in arable crop yield in most owner-managed farms due to reduction in soil quality. This situation becomes worrisome given increasing population (Onweremadu *et al.*, 2008). Odiette (1993) opined that the soil naturally replenishes itself when used "properly".

Several soil and soil-related constraints are adversely affecting agricultural productivity in the state(Onweremadu,1994; Onweremadu,2006). Poor farming practices such as tillage, clean weeding, packing of debris after weeding, inappropriate use of fertilizer, pesticides and herbicides, land clearance, overgrazing and overstocking, exposure of naked soil after harvesting as well as natural processes coupled with population- pressure are responsible for problems like soil erosion, water-logging, salinity, loss of organic matter and biodiversity (Zia*et al, 2005*). All these lead to decline in soil organic matter content especially with shortened bush fallow length (Onweremadu 1994). These changes in land use practices contribute to poor carbon sequestration of most Nigerian soils (Ahukaemere *et al.*, 2015).

Anosike, (2002) stated that, between 1981 and 1994, Nigeria lost 3.7 million ha of forest. At present only 4% of Nigerian rain forest cover is left. More than 11,000 species of animals and plants are threatened in the world with extinction (NCF, 2003). Soil degradation is expected to affect about 50 million people in Nigeria and could have long term impacts in excess of 83billion annually (World Bank, 1990).

According to Brabant (2010), soil degradation is a broad term that can be applied differently across a wide range of scenarios. He suggested four main ways of looking at soil degradation and its impacts, and they include:

- A temporary and permanent decline in the productive capacity of the land. This can be seen through loss of biomass, loss of actual productivity or in potential productivity loss or change in vegetative cover and soil nutrient.
- Action in the lands capacity to provide resources for human livelihoods. This can be measured from a baseline of past land use.
- Loss of biodiversity: A loss of range of species or ecosystem complexity as a decline in the environmental quality.
- Shifting ecological risk: increased vulnerability of the environment or people to destruction or crises. This is measured through a baseline in the form of pre-existing risk of crisis or destruction.

According to Mailumo *et al,* (2011) soil erosion is the leading cause of damage to our soils, today some farmers farming practices make soil erosion an ever increasing problem. In the other words, soil erosion results from the ways the people use the land (Hanyana, 2001). Many land owners cut down trees to create space in which to plant crops and raise animals which eventually lead to soil degradation (Ayoola, 2008). Hence the main objective of this study was to analysed the effect of the current farming practices adopted by arable crop farmers on soil degradation in the study area. Hence, the specific objectives of this study were to:

- identify arable crops production practices
- examine respondents sources of degradation issues;
- ascertain perceived practices that causes degradation
- ascertain the effect of arable crop farming practices on the land

MATERIALS AND METHODS

The study was carried out in Imo State, Nigeria. Imo State was selected because of proximity cost and familiarity to the researcher. The State is located in the southeastern region of Nigeria and shares common boundaries with Abia State on the East and Northeast, Rivers State on the south and Anambra State on the West and North West. The State lies between latitudes $5^{o}45'$N and $6^{0}35$N of the equator and longitudes 6°35'E and 7°28'N of the Greenwich Meridian. (Microsoft Corporation, 2009). It has a total land area of about 5,067.20 km^2 (Ministry of Lands Owerri, 1992). The State has an average annual temperature of 28 °C, an average annual relative humidity of 80%, average annual rainfall of 1800 to 2500 mm and an altitude of about 100m above sea level (Imo ADP, 1990). The State has three agricultural zones, (Owerri, Orlu and Okigwe agricultural zone), 39 blocks and 326 circles. These divisions are for administrative and extension services and not for any agro-ecological differences (Nwajiuba *et al.*, 2008). It is also delineated into 27 local government areas. The population of the state is 3,934, 899 persons with many subsisting in farming (NBS, 2007). A multi-stage sampling procedure was used for the selection of the respondents. The first stage was the purposive selection of the three agricultural zones of the State. The reason was to ensure proper representation of the State.

The second stage was the purposive selection of three blocks each from the three agricultural zones of the state. These blocks were those with the highest incidence of soil degradation problems in the state. The third stage is the random sampling of two circles from each of the nine blocks already selected. The fourth stage was the random sampling two sub-circles. The last stage was the random selection of arable crop farmers from each of the 36 sub-circles to make up a total of 360 respondents. But, only 342 questionnaire forms were properly completed and retrieved for data analysis.

Analytical Technique

The probit model based on standard cumulative distribution function is a suitable functional form used in estimating quantitative dependent variable. This was used to determine the respondents' decision on the

effect of their farming practices on the soil. The probit model is based on probability density function and the relationship between the variables is specified below:

$$Yi = (Xi\ \beta) = \int_{-\infty}^{(xi\beta i)} \frac{1}{2\pi} \exp\left(\frac{-u^2}{2}\right) du$$

Where Y = intensity of soil degradation. Four indicators/variables were used for measuring this intensity). The mean number of degradation problems encountered by respondents were used to classify them into groups i.e <2 = 0 (low intensity) and ≥ 2 =1 (high intensity).

$X_1 – x_7$ are dummy variables, x_1 = bush clearing/burning (yes =1, No = 0),

X_2 = Tillage = (complete tillage=1), minimum tillage = 0), X_3 = cropping practices (sole cropping = 1, mixed cropping = 0), X_4 = weeding frequency (> 3 times =1, ≤ 3 =0), X_5 = manner of weeding (packing = 1, without packing = 0), X_6 = use of fertilizer (Yes = 1, No = 0), X_7 = use of pesticides (yes = 1, No = 0). The parameters of the probit model were estimated through the maximum likelihood method as follows:-

$$r^2 = \frac{C}{N + C}$$

Where C = goodness of fit and N = sample size

RESULTS AND DISCUSSION

Farming Practices Employed by Arable Crop Farmers

From the results presented in Table 1, most (96.20%) of the respondents cleared and burnt their farmlands before cropping. Majority of the farmers (73.10%) also allowed their farm lands to be left fallow for less than 3 years. These findings are in line with Kumar, (1993) who opined that long period of bush fallow is no longer a common practice among farmers in West African because of population pressure on available farmland.

Allowing farmlands to be left fallow for long periods increases soil fertility, crop yield and reduces disease and pest population build up on farmland as well as lowering the rate of soil degradation. Most of the farmers (84.80%) practiced minimum tillage which agrees with the assertion of Ike, (2008) that intensive cropping could be avoided without hindering crop yield. Mixed cropping was also a common practice by most (85.15%) of the farmers. This is in consonance with the finding of Osabuomen, *et al.* (2011) who identified some of the advantages farmers derived from mixed farming as stability of income, better utilization of the land, reduced risk against total crop failure and flexibility in the use of labour.

Majority (72.80%) of the respondents weeded their farms at most three times, while 82.10% percent did not pack the weed out of the farmland. Only 11.70% of the respondents use herbicides while they generally practice the use of pesticides (74.89%) and fertilizer (39.7%). These findings are in line with Ayoola, (2008), who is of the view that the usage of chemical inputs by farmers in the tropics is minimal.

Table 1: Distribution of Respondents by Farming Practices Employed (N = 342)

Farming Practices	Frequency	Percentage
Cleaning and burning of farmland:		
	Yes – 329	96.20
	No – 13	3.80
Period allowed for land fallow:		
	< 2 years – 250	73.10
	< 3 years – 92	26.90
Type of tillage:		
	Minimum – 290	84.80
	Complete – 52	15.20
Cropping Pattern:		
	Mixed – 291	85.10
	Sole/Mono – 51	14.90
No. of weeding/annum:		
	< 3 – 236	72.80
	< 3 – 106	27.20
Weeding pattern:		
Weeding and packing	41	17.90
Weeding without packing	281	82.10
Use of fertilizers:		
	Yes – 136	39.70
	No – 206	60.30
Use of herbicides:		
	Yes – 40	11.70
	No – 302	88.30
Use of pesticides:		
	Yes – 256	74.80
	No – 86	25.20

Source: Field Survey; 2014

Respondents Sources of Information on Soil Degradation

Table 2 revealed that the main source of information on soil degradation was through direct observation (90.60%). This may be due to the fact that majority of the farmers have farmed for fairly long period of time and as such had noticed the changes in soil nutrient and productivity. Fertility trend as observed by farmers could easily be noticeable looking at growth characteristics of crops involved. Radio ranked second (53.20%) as the source of information. The radio is known to be an effective channel of communication through which rural population, largely non-literate who seldom has access to written forms of information can be reached (Ifeanyi-Obi, 2013).

Extension agents ranked third (41.20 %), followed by television (38.90 %), fellow villagers (34.50 %), newspaper (34.20 %) and mobile phones (5.80 %).

Table 2: Distribution of Respondents by Sources of Information on Soil Degradation

Source of Information	Frequency	Percentage
Newspaper	117	34.20
Television	133	38.90
A Extension agent	141	41.20
Through fellow villagers	118	34.50
Radio	182	53.20
Direct Observation	310	90.60
Mobile Phones	20	5.80

Source: Field survey, 2014 Multiple responses

Perceived practices that cause soil degradation

Table 3, shows the various practices that can cause soil degradation based on the farmer's perception. Using a discriminating index of ≥ 2.5 for serious and < 2.5 for not serious, the result indicate that the perceived practices that cause soil degradation include dumping of non-biodegradable trash (mean = 3.18), overgrazing and over drafting (mean = 2.85) and land clearance (mean = 2.75).

The result further revealed that there were other practices perceived by the respondents as causing soil degradation though not considered serious based on the rating. They include sole cropping (mean = 1.88) and soil pollution (mean = 1.64).

The high rating of dumping of non-biodegradable trash such as nylon indicates the reason for farmer aggressiveness whenever they discover that people dump pure-water nylon or other plastic thrash on their farms thus converting it to dustbins. Also, the high rating of harvesting by heavy equipment such as tractors as causing soil degradation may be one of the reasons in addition to high cost why farmers in the area seldom use tractors and harvesters. These findings agree with the work of Ayoola, (2008); Kichei and Akeredolu, (1991); Odiette, (1993); and Ohazuruike *et al*. (2003).

Table 3: Distribution of Respondents Based on Perceived Practices that Cause Soil Degradation

Practices	VS	MS	S	NS	Total	Mean	Remarks
Land Clearance.	95(27.8)	126(6.0)	68(19.9)	56(16.4)	342	2.75	Accept
Poor Farming Practice.	34(9.9)	95(27.8)	102(29.8)	111(32.5)	342	1.88	Reject
Overgrazing/ Over drafting.	121(35.4)	94(27.5)	84(24.6)	43(12.6)	342	2.85	Accept
Soil Pollution.	23(6.7)	41(12.0)	67(19.6)	211(61.7)	342	1.64	Reject
Harvesting by Heavy Equipment.	137(40.1)	142(41.5)	52(15.6)	11(3.2)	342	3.18	Accept
Monoculture	64(18.7)	87(25.4)	100(29.2)	91(26.6)	342	2.36	Reject
Dumping of Non-Biodegradable Trash	196(57.3)	111(32.5)	30(8.8)	5(1.5)	342	3.45	Accept
Grand Mean	670	696	503	525	2394	2.63	Accept

Numbers in parenthesis are the percentages.

Source: Field Survey, 2014

VS= Very Serious MS= Moderately Serious S= Serious

NS= Not Serious

Effects of Farming Practices Employed

Table 4, shows the probit multiple regression parameter estimates of the effects of farming practices on the soil. Coefficient of determination of the model was 0.487 indicating that up to 49 % variation in the dependent variable were explained by the set of explanatory variable of the model.

As shown in the table, only three of the explanatory variables (use of pesticides, cropping pattern and bush burning/clearing) demonstrate statistically significant effect on soil degradation, with bush clearing/burning showing a higher probability of contributing to soil degradation based on the farmers' perception. This invariably infers that the continuous practice of bush burning/clearing by the farmers would continue to encourage soil degradation in the study area. This is in line with the findings of Osabuomen and Okedo-Okogie (2011) that bush burning accelerates soil degradation.

Use of pesticide was significant at 1% level while cropping pattern was significant at 5% level of probability. Fallow period was positively related to degradation showing that reduction in it may cause degradation. Tillage type had a negative relationship with soil degradation because majority of the farmers (84.80 %) practice minimum tillage which is friendly to the soil. Number of weeding per annum did not encourage degradation; this is because majority of the farmers (72.80 %) weeded for less than 3 times per annum. The implication is that high frequency of weeding which leaves the soil bare can induce degradation.

Use of chemical fertilizer and herbicide was practiced by few of the farmers; and this had a negative relationship with the intensity of soil degradation. This is probably because the quantity of fertilizers used was too small to impact negatively on the soil. Farmers exploit the land and the natural fertility of the soil through continuous cropping and deplete the soil nutrients; and these constitute major concerns with respect to the long term adverse effect on soil productivity.

Table 4: Probit multiple regression parameter estimates of the effect of farming practices on soil degradation

Explanatory variables	Coefficient	Standard error	Z-value
Constant intercept	3.593	4.469	0.804
Fallow period	0.976	0.592	1.650
Clearing/burning of farm land	0.067	0.278	2.393**
Tillage type	-2.425	1.437	-1.688
Cropping pattern	1.328	0.567	2.343**
Weeding pattern	-1.171	4.316	-0.041
Use of fertilizer	-1.932	1.837	-1.032
Number of weeding	-0.188	0.251	-0.752
Use of herbicides	-0.0248	1.352	-0.184
Use of pesticides	1.944	0.467	4.159***

Pseudo R^2 (R^2)=0.487
Goodness of fit=325.95
Significant at 1% level =***
Significant at 5% level =**
Source: Field Survey; 2014

CONCLUSION

Based on the findings of this research, it was concluded that most arable crop farmers in the study area cleared and burnt trash on their farmlands before cropping. Majority of the farmers allows their farmland to be left fallow for less than three years before cultivating on it again. Most of the farmers practice minimum tillage, mixed cropping and weed their farms at most three times. Few of the farmers use herbicides, while they generally practice the use of pesticides and fertilizer application.

RECOMMENDATIONS

The probit multiple regression result shows that continuous practice of bush burning/clearing by the farmers would continue to encourage soil degradation in the study area. Based on these, the study recommends that education of arable crop farmers by extension agents and NGOs on the use of alternative farming practices that is environmentally friendly and sustainably soil use resources should be carried out.

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