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Analysis of the effect of arable crop production practices among farmers on environmental degradation in Edo State, Nigeria

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ABSTRACT

This study employed the use of the Probit Multiple Regression Model in analysing the effect of arable crop production practices employed by farmers in Edo State on environmental 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 multi-stage sampling technique was employed in selecting 150 arable crop farmers drawn from the study area. This study show that most of the arable crop farmers cleared and burnt their farmland before cropping, with majority (80.7%) allowing their farmlands to be left fallow for between two and three years before farming it again. Most of the farmers practiced zero tillage. Result of the Probit Multiple Regression Model, the practice of bush burning/clearing by the farmers would continue to encourage environmental degradation. Complete tillage did not result in the degrading of the environment. The critical environmental issues emanating from this study are soil nutrient depletion through bush clearing/burning, soil degradation by erosion, weed and pest invasion; all culminating in sustained low productivity. Sustained growth in agricultural productivity and farmers' prosperity without environmental exploitation and degradation is possible. Education of arable crop producers can be used to teach such economic planning that would help reduce the problem of poverty and allow for resource-poor smallholder rural farmers to improve their indigenous knowledge and technical knowhow to harness the natural environment in a more sustainable and prosperous manner.

Key Words: Arable Crop, Production. Environmental Degradation, Farmers, Edo State.

INTRODUCTION

From creation, the earth was designed with the capacity to sustain man without losing its original qualities. The soil naturally replenishes itself when used "properly". Man's activities in his quest to conquer the earth have caused vital damages to this natural balance. We now

frequently hear of increasing concerns about "worn-out soils" resulting from continuous cropping to feed the ever increasing world population. Today, a growing understanding of the ecological damage inflicted by poor land management practices is generating new interests in a sustainable agriculture in which soil nutrient cycling plays a central role [1]. "Environmental disasters, cost world 70 billion dollars-united nation; 526 significant natural disasters within 9 months of 2002 cost countries 56 billion dollars during the period January-September 2002; 195 from Asia, 149 America, 99 Europe, 48 Africa and 45 Australia" [2]. Between 1981-94 Nigeria lost 3.7 million ha of forest. At present only 4% of Nigeria rainforest cover is left. More than 11,000 species of animals and plants are threatened in the world with extinction [3]. Desertification has affected 350,000km^2 of land and is still advancing at the speed of 0.6km per annual [4]. Soil degradation is estimated to affect about 50 million people in Nigeria and could have long term impacts in excess of $3billion annually [5]. Thus, both in terms of economic impact and number of people affected, soil degradation is a serious threat to Nigerian environment and, by extension, economy.

That Nigeria is still grappling with fundamental issues of food security and sustainable agriculture on a land mass that is about 80% arable is indefensible. According to [6], crop production alone contributes 85% to Nigeria's agricultural GDP. More than 90% of the agricultural output is accounted for by smallholder farmers with less than two hectares under cropping. It is estimated that about 75% (68 million hectares) of the total land area has potential for agricultural activities with about 33 million hectares under cultivation. Over the years, Nigeria has devoted large hectarage to the cultivation of arable crops, however, productivity has remained low, a phenomenon that has entangled the farmers in a vicious circle of poverty. Among factors accounting for the low productivity of these farmers are, the use of obsolete cultural practices, scanty plant stands, poor weed control, non-usage of fertilizer, organic manures and other improved agricultural inputs including the management of the crop under degraded soil condition [7]. Consequently, a determined and well-targeted effort must be made to improve on food security for the ever increasing Nigerian population. More than before, there is now an urgent need to optimize the use of available hectarage for arable crops production, since the current practice of increasing output through larger hectarage is not sustainable, due to competing alternatives for land by other sectors of the economy in line with developmental trends.

A functional and result based agricultural system still remains the best and fastest means of empowering and transforming the lives of the rural poor, who constitute a large percentage of the Nigerian population. These farmers are characterized by use of primitive implements, low–level inputs, low–yielding crop varieties, high land and labour intensity, including pests and diseases [8]. These resource-poor smallholder farmers [9] who contribute more than 90% of agricultural output in Nigeria in particular [6] and Sub-Saharan Africa in general [10], must be assisted to rise beyond their current level of subsistence. In an attempt to raise productivity, smallholder farmers are encouraged to adopt different production technologies and move on to higher levels of profitability through improved land management practices. This is more auspicious now in the wake of a looming "global food crisis" that threatens to reduce world food production by as much as a quarter. These farmers need to learn new and sustainable ways of growing their crops to avoid the imminent displacement and marginalization that is bound to take place in a fast changing world. In Nigeria, some components of increased crop production technology are; improved cultural practices, use of fertilizers, minimum tillage, use of pesticides amongst others [8].

Improved land management practices, based on a humane and sustainable system and sound ecological principles would go a long way in sustaining the earth. This would ultimately improve productivity and by extension, farmers' profitability and prosperity, *ceteris paribus*.

The main objective of this study was thus to analyze the effect of the current farming practices adopted by arable farmers on the environment in the study area. This would provide an empirical guide for the identification of any gaps that may exist in the current farming practices employed and the interventions required towards more sustainable development. To produce arable crops, farmers carry out series of crop production practices like: bush clearing/bush burning, stumping, tillage, cropping, weeding, and application of farm chemicals. These various crops production practices can help to boost or reduce the capacity of the environment to sustain living things, but these depend on the level and manner of implementation of these practices and the farmers' knowledge of the importance of the environment to man's continuous existence. Hence the specific objectives of this study are to: identify arable crop production practices of farmers in the study;examine respondents sources of environmental issues; ascertain the effect of arable crop production practices on the environment; and make possible recommendation based on findings.

MATERIALS AND METHODS

Study Area

This study was carried out in Edo State, Nigeria. The State lies within the geographical co-ordinates of Longitude 05^0 04` East and $06^0$ 43` East and Latitude 05^0 44` North and $07^0$ 34` North of the Greenwich. It is bounded in the North by Kogi State, in the South by Delta State, in the West by Ondo State and in the East by Kogi and Anambra States.

The State is characterized by a tropical climate, which ranges from humid to sub-humid at different times in the year. The three distinct vegetations identified in the State are Mangrove Forest, Fresh Swamp and Savannah vegetations. The mean annual rainfall in the Northern part of the State is between 127cm-152cm while the Southern part of the State receives about 252cm-254cm of rainfall annually, with average temperature ranging from a minimum of 24^0c to a maximum of about 33^0c. The State has an estimated population of about four million people.

Sampling Procedure

A multi-stage sampling technique consisting of three stages (two stages of random sampling and one purposive sampling method) was adopted in selecting the respondents for this study. Firstly, a lucky dip method was used in selecting five out of the 18 Local Government Areas (LGAs) i.e. Esan South-West, Etsako West, Igueben, Ovia North-East and Uhunmwode LGAs. These five LGAs made up the blocks.

Secondly, three villages (cells) were randomly selected from each block, for a total of 15 cells. These 15 cells made up the farming communities.

Finally, 10 arable crop farmers were randomly selected from each cell to make up a total of 150 respondents. The questionnaire for data collection was evaluated for validity using expert advice and reliability using test-retest technique. The reliability coefficient (r) was 0.74.

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 environment. The Probit Model is based on probability density function and the relationship between the variables is specified below:

$$Y_i = f(X_i\,\beta) = \int_{-\infty}^{(Xi\beta i)} \frac{1}{2\pi} \exp\left(\frac{-u^2}{2}\right) du$$

Where; Y = Intensity of environmental degradation (four indicators/variables were used for measuring this intensity). The mean number of environmental 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, Zero 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 Pobit Model were estimated through the maximum likelihood method as follows;

Coefficient of Determination: The proposed model for determining the combined influence (Pseudo R^2) of the explanatory variables on the dependent variable is;

$R^2 = \frac{C}{N+C}$ Where C= Goodness of Fit and N = Sample Size.

RESULTS AND DISCUSSION

Arable Crop Production Practices by Farmers

From the result presented in Table 1, most (96.6%) of the respondents cleared and burnt their farmlands before cropping. Majority of the farmers (80.7%) also allowed their farmlands to be left fallow for between two and three years before farming it again, while the remaining 19.3% allowed their farmlands to be left fallow for more than three years. This finding is in line with that of Kumar [11] that long periods of bush fallow is no longer a common practice among farmers in West Africa because of population pressure on available land. 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 erosion.

Most (88.7%) of the farmers practiced zero tillage, which agrees with the assertion of Ike [8] that intensive cropping could be avoided without hindering crop yield. Mixed cropping was also a common practice by most (85.3%) of the farmers. This again is in consonance with the findings of Ike [8], who identified some of the advantages farmers derive 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. These benefits undoubtedly contributed to the high rate of respondents involved in mixed cropping. Majority (72.7%) of the respondents weeded their farms at most three times while 80.0% did not pack the weed out of the farmland. None of the farmers used herbicides, while they generally practiced the use of pesticide and fertilizers. These findings are in line with that of Olayemi [12] that the usage of chemical inputs by farmers in the Tropics is minimal.

Table 1: Farming Practices Adopted by Arable Crop Farmers(N=150)

Farming Practices	Frequency	Percentage
Clearing/Burning of Farmland:		
Yes	145	96.6
No	5	3.4
Period **allowed for Land Fallow**		
2-3 years	121	80.7
>3 years	29	19.3
Type of Tillage		
Zero	133	88.7
Complete	17	11.3
Cropping Pattern		
Mixed	128	85.3
Sole	22	14.7
No of Weeding/annum		
≤ 3	109	72.7
> 3	41	27.3
Weeding Pattern		
Weeding and Packing	27	18.0
Weeding without Packing	123	82.0
Use of Fertilizers		
Yes	60	40.0
No	90	60.0
Use of Herbicides	-	-
Use of Pesticides:		
Yes	111	74.0
No	39	26.0

Source: Computed from field survey Data.

Respondents Sources of Information on Environmental Issues

Table 2 reveal that most (34.2%) of the respondents got information on the environment and environment related matters during their schooling days; some (25.4%) from electronic and print media, agricultural development programme (ADP), (21.7%); and while others got their information from friends (18.6%). The implication is that majority (78.3%) of the respondents have no access to ADP information, hence technical guidance on environmental issues is scarce. As stated earlier in table 1 above , majority(79.3%) of the respondents had formal education which enables them to avail themselves with the different materials containing varieties of environmental issues.

Table 2: Respondents' Sources of Information on Environmental Issues

Sources	Frequency*	Percentages
Agricultural development project (ADP)	78	21.7
At school	123	34.2
Electronic and print media	92	25.5
Friends	67	18

Source: computed from field survey data **Multiple responses*

Effect of Arable Crop Production Practices on the Environment

As shown in Table 3, only two of the explanatory variables (tillage practice and bush clearing/burning) demonstrated statistically significant effect on environmental degradation, with bush clearing/burning showing a higher probability of contributing to environmental

degradation, based on the farmers' perception. This invariably infers that the continuous practice of bush burning/clearing by the farmers would continue to encourage environmental degradation in the study area. This finding agrees with the findings of Isichei and Akeredolu [13] that bush clearing and burning encourage environmental degradation.

Table 3: Probit Multiple Regression Parameter Estimates of the Effect of Arable Crop Production Practices on the Environment

Explanatory Variables	Coefficients	Standard Error	t-values
Constant Intercept	2.330	0.290	8.021
Bush Clearing/Burning (X_1)	0.067	0.278	2.393**
Complete Tillage (X_2)	- 0.169	0.131	3.295*
Sole Cropping (X_3)	0.040	0.112	0.357
Weeding Frequency (X_4)	0.036	0.087	0.418
Manner of Weeding (X_5)	*0.039*	*0.102*	*0.380*
Use of Fertilizer (X_6)	*-0.010*	*0.082*	*0.126*
Use of Pesticides (X_7)	*0.019*	*0.095*	*0.200*

Pseudo R^s =71.2 ; Goodness of fit Chi = 37 0.67; Prob. > Chi = 0.000.
**Significant at 1% level (t=2.998). **Significant at 5% (t=1.895).*
Source: Computed from field survey Data.

Complete tillage (statistically significant at 5% level) had a negative relationship with environmental degradation, with the implication that complete tillage do not result in the degrading of the environment, based on the farmers' perception. This may be due to the fact that only 11.3% of the respondents practiced complete tillage (Table 1).

Though the effects of the other variables were not shown to be statistically significant, only the use of fertilizer had a negative relationship with the intensity of environmental degradation. This is probably because the quantity of fertilizer used was too small to impact negatively on the environment. This is in consonance with the conclusion of Ayoola [14] that the level of inorganic fertilizer usage in Nigeria is very low relative to Asia and some other African countries such as South Africa, Malawi, Benin and Ethiopia and that adverse soil conditions due to wide spread erosion and weed/pest invasion would reduce the efficiency of applied fertilizers. Farmers exploit the land and the natural fertility of the soil through continuous cropping and deplete the soil nutrient; and these constitute major concerns with respect to the long-term adverse effects on soil productivity.

CONCLUSION AND RECOMMENDATIONS

It was shown in this study that most of the arable crop farmers in the study area cleared and burnt their farmland before cropping, with majority of them (80.7%) allowing their farmlands to be left fallow for between two and three years before farming it again, while the remaining 19.3% allowed their farmlands to be left fallow for more than three years. Most (88.7%) of the farmers practiced zero tillage, mixed cropping and weeding of their farms at most three times. None of the farmers used herbicides, while they generally practiced the use of pesticide and fertilizers.

Result of the Probit Multiple Regression Model inferred that the continuous practice of bush burning/clearing by the farmers would continue to encourage environmental degradation in the study area. Complete tillage did not result in the degrading of the environment, based on the farmers' perception.

Within the limits of statistical reliability, it would be safe to conclude that substantial gaps exist in the current farming practices adopted by arable crop farmers in the study area. The critical environmental issues emanating from this study are soil nutrient depletion through bush clearing/burning, soil degradation by erosion, weed and pest invasion; all culminating in sustained low productivity and by implication, perpetual poverty of the respondent. Sustained growth in agricultural productivity and farmers' prosperity without environmental exploitation and degradation is possible. It is important to understand that neither a lack of technology nor a lack of understanding of ecological processes is a bottle neck to sustainable agricultural system today. Agro-ecosystems that are biologically sustainable must be put in place, taking into account soil nutrient cycles and other factors. But the mass of famers cannot use this knowledge and survive under the current economic-social-political structure. Education of arable crop producers can be used to teach such economic planning that would help reduce the problem of poverty and allow for resource-poor smallholder rural farmers to have enough money and technical knowhow to harness the natural environment in a more sustainable and prosperous manner. Some other plausible solutions to these problems of environmental degradation would include the teaching of farmers and technicians in rural regions on the best ways to cultivate and harvest crops. The main goal here is to help the people and government just enough until they learn to provide for themselves. Again, there is one neat and simple solution which is a change to a conserver society which does not generate the problems of mindless commitment to growth and greed society.

Implication for extension

Sustainable agricultural system is a challenge to today's' ever growing world population and food security, especially in sub-Sahara Africa. analysis have shown that farmers through indigenous knowledge are aware of the negative effect arable cropping activities on the environment as extension contact was with respondents was just 21.7% while majority (78.3%) had no contact with extension personnel and by implication lacked technical guidance from extension service. Hence to achieve a desired sustainable environment that will support a viable arable crop production sub sector, effective extension delivery must be put in place. This will lead to attainment of enough production in basic food commodities especially in cereals that is being imported and possible export crops production as part of 5^{th} national development plan(1986-1990) as envisaged by federal ministry of agriculture(1996) which was never attained. Extension delivery as mandate of the various agricultural development programmes (ADPs) in Nigeria should strengthen the Research-Extension-Farmers-Input-Linkage-System (REFILS) by taking advantage of the interest and indigenous knowledge of farmers as a suitable environment and condition for improving farmers knowledge on how to harness the natural environment in a sustainable manners in the course of carrying out arable cropping activities through teaching in areas as; primary components of the soil; nutrient depletion level; proven technical farming systems; suitable use of agro-chemicals; effective pest and disease control methods; and genetic breed of crop varieties that are suitable for tropical climate without distorting environment. Extension should sensitize government to support arable crop farmers by improving infrastructure, access to institutional credit, technical assistance and improvement of rural social institutions that will check the present persistent poverty status of the farmers through adequate environmental friendly inputs supply in achieving sustainable agriculture.

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