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MICRO-LEVEL ANALYSIS OF DETERMINANTS OF CROP FARMERS' ADAPTATION INTENSITY TO ENVIRONMENTAL DEGRADATION IN ORLU AGRICULTURAL ZONE, IMO STATE, NIGERIA

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ABSTRACT

The study analysed determinants of intensity of crop farmers' adaptation measures to environmental degradation in Orlu agricultural zone, Imo State. The study adopted the multistage random sampling and convenient sampling techniques in the selection of respondents. The main tool for data collection is the questionnaire. Data collected were analyzed using descriptive statistics and multiple linear regression model. Majority (94.00%) of the farmers declared that the major cause of environmental degradation in the area was erosion. Also, another greater proportion of the farmers (84.00%) reported that flood is a major cause of environmental degradation in the area. Mulching was the most commonly used adaptation method identified by the farmers (78.00%). The result from the regression analysis indicate that the determinants of intensity to environmental degradation adaptation measures by crop farmers were their age, gender, educational level, membership to farmer groups, income, experience, household size, and farm size. Majority of farmers (60.00%) were constrained with inadequate information on appropriate adaptation option and 56.00% were constrained with inadequate capital. These analyses of adaptation and the factors that influence the intensity of adaptation to environmental degradation for crop production in Orlu agricultural zone, Imo State suggest that a number of different policy options must be pursued to achieve farmers' effective adaptation.

Keywords: environmental degradation, causes, adaptation measure, adaptation intensity, determinants, constraints
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INTRODUCTION

Environmental degradation has become an important development challenge to many countries in the world. This in no doubt will negatively impact on achieving the Millennium Development Goals, particularly the goal of achieving environmental sustainability. Agriculture will also be affected as the farming activities are largely dependent on the

environment. The main causes of environmental degradation particularly in the rainforest region of Nigeria have been linked to climate change (WACDI, 2011).

Climate change is expected to increase with increased frequency and intensity of extreme weather conditions in rainforest region of Nigeria (Babatunde *et al.*, 2011). The implications for the region are that the region would generally experience wetter than average climate, more extreme weather conditions, particularly erosions, windstorms and floods. Agriculture remains the main source of livelihoods for most rural communities in the rainforest region of Nigeria.

Environmental degradation as a result of climate change is expected to have greater negative impacts on poorer farm households as they have the lowest capacity to adapt to changes in climatic conditions and more vulnerable to hazards of environmental degradation. Adaptation measures are therefore important to help these communities to better face extreme weather conditions and associated climatic variations (Adger *et al*. 2003). Adaptation has the potential to significantly contribute to reductions in negative impacts from environmental degradation, changes in climatic conditions as well as other changing socioeconomic conditions, such as volatile short-term changes in local and international markets (Kandlinkar and Risbey 2000). Therefore, an analysis of farmers' perception of the causes of environmental degradation and adaptation measures to environmental degradation is important for the agricultural communities of Nigeria's rainforest region.

Some attempts have been made to study farmers' perception to climate change in the rainforest region of Nigeria (WACDI, 2011; Nwajiuba *et al.*, 2008). Though, WACDI identified many climate change related hazards, they did not focus their study in such a way to ascertain farmers' perception of the causes of such hazards.

A few studies published to date investigated the determinants of farm-level adaptation options to climate change in the context of rainforest region of Nigeria. Onyeneke and Nwajiuba (2010) investigated socio-economic effects of crop farmers' adaptation measures to climate change in the South-eastern rainforest zone of Nigeria using multinomial logit model. The study found that the socioeconomic characteristics of farmers significantly affected the uptake of adaptation measures to counteract the negative effects of climate change. The researchers adopted the multinomial logit model (MNL) in their analysis. Their study provided insights on the determinants of the choice of adaptation to climate change by crop farmers in the area, but intensity of the adaptation measures was missing in their analysis.

Nwosu *et al.* (2012) investigated determinants of intensity of poultry farmers' adaptation measures to climate change in Imo State, Nigeria using the Tobit model. Though, they

provided incisive insight on poultry farmers' adaptation to climate change, their study did not consider the determinants of intensity of crop farmers' adaptation to climate change and environmental degradation. This has left a void in research. This study will adopt the multivariate regression analysis to fill this gap and further provide a better understanding of the factors shaping intensity of adaptation measures by crop farmers in the zone. By this foregoing, a better knowledge of farmers' perception regarding causes of environmental degradation, current adaptation measures, their determinants and constraints to adaptation will be important to inform policy for future successful adaptation of the agricultural sector in the region.

METHODOLOGY

The study was carried out in Orlu agricultural zone of Imo State, Nigeria. The zone is bordered by Anambra State to the north, Owerri agricultural zone to the west and south, and Okigwe agricultural zone to east. The zone has an average annual temperature of 28 °C, an average annual relative humidity of 80%, average annual rainfall of 1800-2500mm and an altitude of about 100m above sea level (Imo ADP, 1990). The zone has ten Local Government Areas (LGAs) namely Orlu, Orsu, Isu, Oru West, Oru East, Nwangele, Njaba, Nkwerre, Ideato North and Ideato South. These divisions are for administrative convenience and not for any agro-ecological difference. The population of the zone is 1,328,521 persons (NBS, 2007) with many subsisting in farming. Multistage random sampling and convenient sampling techniques were adopted for the selection of respondents for this study. Four Local Government Areas (LGAs) were randomly selected from the area. In each of the LGAs two communities were randomly selected. In each of the communities, eight crop farmers were conveniently selected. In all sixty four (64) crop farmers were targeted for this study. Out of the 64 farmers targeted 60 responded giving a high response rate of 93.75 percent which was largely attributed to systematic planning of the study and cooperative nature of the respondents. The main tool for data collection was the questionnaire. Data collected were analysed using descriptive statistics and multiple regression analysis. The implicit model of the regression is written as $Y = f(X_1,X_2,X_3,X_4,X_5,X_6,X_7,X_8,X_9,e)$: Where ;

Y = Adaptation intensity (%)

The estimation procedure involved in the calculation of intensity of environmental degradation adaptation measures. The intensity was calculated as the percentage of measures adopted in relation to the total number of environmental degradation adaptation measures identified in the area (Nwosu *et al*., 2012). This was the dependent variable. The calculation of intensity of environmental degradation adaptation intensity is necessary since it would not

be appropriate to lump a farmer who has adopted 4 measures together with a farmer who has adopted 7 of them.

X_1 = Age of farmer (years)
X_2 = Gender of farmer (Dummy variable; male = 1, female = 0),
X_3 = Marital Status of farmer (Dummy variable; married = 1, unmarried = 0),
X_4 = Education level of farmer (years spent in school),
X_5 = Group Membership (Dummy variable; yes = 1, no = 0),
X_6 = Income of farmer (Naira),
X_7 = Experience in farming (years),
X_8 = Household size (number of persons),
X_9 = Farm size (hectares),
e = error term

RESULTS AND DISCUSSION

Farmers' Perception of the Causes of Environmental Degradation in the area

Entries in Table 1 show farmers' perception to the causes of environmental degradation in Orlu Agricultural Zone. An overwhelming majority (94.00%) of the farmers declared that the major cause of environmental degradation in the area was erosion. Erosion is very visible in all the local government areas visited. This is threatening farmlands and even structures in the area. Also, another proportion of the farmers (84.00%) reported that flood is a major cause of environmental degradation in the area. Flood occurred also in many communities in the area. These two factors (erosion and flood) are products of excessive amount of rain falling within a very short period of time. This corroborates with the prediction of BNRCC (2011) that rainfall and extreme weather events are likely to increase in the rainforest zone of Nigeria. This calls for resilient adaptation measures in that ecological zone. Bush burning (78.00%) and continuous cropping (58.00%) were other causes of environmental degradation in the area as reported by the farmers. Bush burning is a general practice by many farmers in Imo State. This is no doubt increases Carbon Dioxide content in the atmosphere which is a major culprit to global warming and environmental degradation. Continuous cropping could be as a result of increasing pressure on cultivable lands in the area.

Environmental Degradation Adaptation Measures

The adaptation methods for this study are based on asking farmers about their perception of the causes of environmental degradation and the actions they take to counteract the negative impacts of environmental degradation. The adaptation measures that farmers report may be

profit driven, rather than environmental degradation driven. Despite this missing link, we assume that their actions are driven by environmental degradation, as reported by farmers themselves (Maddison, 2006; Nhemachena and Hassan, 2007). Table 2 reveals that mulching was the most commonly used adaptation method identified by the farmers (78.00%). Higher adoption of mulching as an adaptation method could be associated with the lower expense and ease of access by farmers. Cover cropping (58.00%), building wooden bridges (58.00%), planting trees (54.00%) and refilling (54.00%) were other identified environmental degradation adaptation measures identified by farmers. These measures indeed are all geared towards counteracting the negative impacts of environmental degradation.

Determinants of Intensity of Adaptation Measures to Environmental Degradation by Crop Farmers

Multiple linear regression analysis was done to ascertain the determinants of intensity of environmental degradation adaptation measures by crop farmers in Orlu agricultural zone, Imo State. The value of the coefficient of multiple determination is 0.915 (91.5%) indicating that the explanatory variables jointly explained 91.5% of the variation in adaptation intensity. This shows a very good fit for the model. The interpretation of the regression is thus:

Age of the farmers had negative and significant effect on the intensity of environmental degradation adaptation. This agrees with the findings of Shiferaw and Holden (1998) who stated that a negative relationship exists between age and adoption of improved soil conservation practices, and that age decreases the probability of uptake of adaptation measures to climate change.

Gender had a positive coefficient and was significantly related to intensity of environmental degradation adaptation by crop farmers. The result indicates that male-headed households adapt more readily to environmental degradation than female-headed households. This could be because male-headed households are more likely to get information about new technologies and undertake risky businesses than female-headed households (Asfaw and Admassie, 2004). Another reason is that, having a female head of household may have negative effects on environmental degradation adaptation, because women may have limited access to information, land, and other resources due to traditional social barriers (Tenge *et al.*, 2004).

Education was significantly and positively related to intensity of environmental degradation adaptation by crop farmers. Education plays a major role in benefits that accrued from the environmental degradation and climate change adaptation interventions in that, better educated individuals are more likely to understand and value more the environmental

degradation and climate change adaptation interventions than their less educated counterparts. In addition, more educated individuals tend to earn higher incomes and thus be able to easily implement the environmental degradation adaptation interventions more easily.

There was a positive and significant association between group membership and intensity of environmental degradation adaptation. This means that farmers that belong to one farmers' association or the other had a more likelihood to adapt to environmental degradation than others. Group membership ensures greater access to much needed funds for farming. It also augments access to management information needed for the crop production. Access to information on sources of new inputs is believed to contribute towards optimal use of scarce resources. There was discernible association between membership to a farmer group and intensity of adaptation. Membership in farmer associations/groups may confer many advantages like price information, inputs for crop production or credit. Each of these elements obtained by virtue of becoming a member of farmers' association is part of social capital (Nwosu *et al.,* 2012). Close friends outside with whom inputs are shared and exchanged for both economic and emotional support on reciprocity basis such activities play an important role in removing obstacles to crop production. Discussion with friend provides specific information about use of sound crop production practices.

Household income sources in rural areas are as diverse as farmers' activities even within agricultural sector. Farmers' income as obtained in this study are from all types of income sources during last year from (non-farm and farm employment) sale and consumption value of crop produced, livestock sale and consumption, petty trading and pension. It was found that farmers' total income and intensity of adaptation were positively related and significant.

Experience in crop production positively and significantly influences the intensity of environmental degradation adaptation. More experienced farmers may be less risk averse and have more knowledge in crop production and are better socially, politically and economically placed to access modern technology than less experienced farmers and hence a higher level of adaptation of this practice.

Household size positively and significantly influences the intensity of environmental degradation adaptation. This indicates that household size increases the uptake of adaptation measures to environmental degradation. Large household size is normally associated with a higher labour endowment, which would enable a household to accomplish various agricultural tasks. This result agrees to the findings of Croppenstedt *et al*. (2003) who argued that households with a larger pool of labour are more likely to adopt agricultural technology and use it more intensively because they have fewer labour shortages at peak times.

There was a positive and significant relationship between farm size and intensity of environmental degradation adaptation. These tallies with economic theory in that, larger enterprises tend to have greater output than very small enterprises due to economies of maximization of output and profit. Also, adoption of an innovation will tend to take place earlier on larger farms than on smaller farms (Gbetibouo, 2009). This result agrees to the findings of Daberkow and McBride (2003) which indicated that given the uncertainty and the fixed transaction and information costs associated with innovation, there may be a critical lower limit on farm size that prevents smaller farms from adapting. As these costs increase, the critical size also increases. It follows that innovations with large fixed transaction and/or information costs are less likely to be adopted by smaller farms.

Constraints to Adaptation

From the responses, the researchers delineated five broad categories of constraints to environmental degradation.

Inadequate capital: Specific categories encapsulated in this category are inadequate finance, lack of managerial ability, lack of technologies and poor leadership position.

Inadequate information: Farmers' specific constraints listed in this category include poor information on appropriate adaptation measures and poor access/exposure to mass media.

Shortage of farm labour: This covers scarcity of farm labour.

Shortage of land: The option in this category is shortage of land and land tenure arrangement.

Poor market outlets: This specifically involves poor access to input and output markets, and bad roads.

The analysis of constraints to adaptation to environmental degradation in the Orlu agricultural zone indicates that there are five major constraints to adaptation. These are inadequate information on appropriate adaptation option confirmed by 60.00% (majority) of the farmers, inadequate capital cited by 56.00% of the farmers, shortage of labour reported by 30.00% of the farmers, shortage of land confirmed by 28.00% of the farmers, and poor access to market agreed by 26.00% of the farmers. Most of these constraints are associated with lack of information and poverty. For instance, lack of information on appropriate adaptation options could be attributed to the dearth of research on environmental degradation and adaptation options in the area (Onyeneke and Madukwe, 2010; Gbetibouo, 2009). Lack of finance hinders farmers from getting the necessary resources and technologies that facilitate adapting to environmental degradation. Adaptation to environmental degradation is costly (Deressa *et*

al., 2008), and the need for intensive labour use may contribute to this cost. Thus, if farmers do not have sufficient family labour or the financial means to hire labour, they cannot adapt. Shortage of land has been associated with high population pressure, which forces farmers to intensively farm a small plot of land and makes them unable to prevent further damage by using practices, such as continuous and multiple cropping that compete for agricultural land. Poor access to market entails poor link to input and output markets, and this hinders farmers' adaptation to environmental degradation.

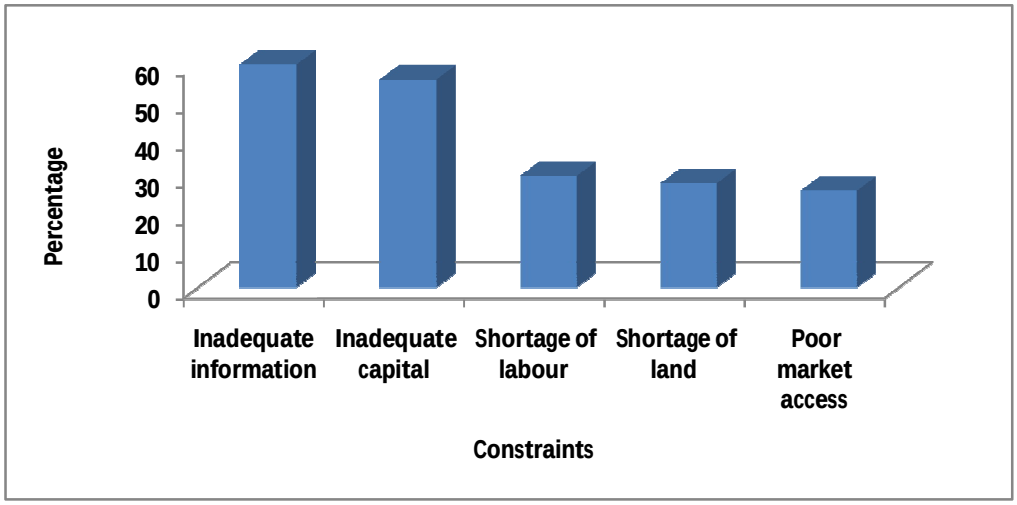

Figure 1: Constraints to Adaptation
Source: Field survey, 2012

CONCLUSION

There are several causes of environmental degradation in the area. These include erosion, flooding, bush burning, continuous cropping, use of chemicals in farming and deforestation.

The farmers in Orlu agricultural zone studied adapt in various ways to environmental degradation. Most of the farmers studied have taken steps to adjust their farming activities. The common adaptation practices used by farmers in Orlu agricultural zone of Imo State, Nigeria are mulching, cover cropping, building wooden bridges, planting trees and refilling. Greater adoption of mulching as an adaptation method could be associated with the lower expense and ease of access by farmers. The determinants of intensity to environmental degradation adaptation measures by crop farmers are their age, gender, educational level, membership of farmer groups, income, experience, household size, and farm size. The main constraints to adaptation to environmental degradation are inadequate information on appropriate adaptation option, inadequate capital, shortage of farm labour, shortage farm land and poor market access.

RECOMMENDATIONS

The results of this research have some policy implication for development of agriculture in this zone through adaptation to environmental degradation. In terms of the effect of this research on policy change of the government, it is suggested that government should ensure that farmers have access to affordable credit and land to increase their ability and flexibility to change production strategies in response to environmental degradation. The analysis of adaptation methods to environmental degradation and its constraints suggest a number of policy options that raising awareness of environmental degradation and its causes, and the appropriate adaptation methods, facilitating the availability of credit, investing in yield-increasing technology packages to increase farm income, creating opportunities for off-farm employment, conducting research on use of new crop varieties that are better suited to wetter conditions, investing in education, and encouraging informal social networks.

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APPENDIX

Table 1: Distribution of the farmers' perception of the causes of environmental degradation in the area

Cause	Frequency	Percentage
Deforestation	19	38.00
Bush Burning	39	78.00
Continuous Cropping	29	58.00
Use of Chemicals in Farming	17	34.00
Erosion	47	94.00
Flood	42	84.00

Note: Multiple responses

Source: Field Survey, 2012

Table 2: Distribution of farmers' environmental degradation adaptation measures

Adaptation Measures	Frequency	Percentage
Migration	3	6.00
Cover Cropping	29	58.00
Mixed Farming	2	4.00
Planting Trees	27	54.00
Terracing	3	6.00
Building wooden Bridges	29	58.00
Using Organic Fertilizer	1	2.00
Mulching	39	78.00
Refilling	27	54.00

Note: Multiple responses

Source: Field Survey, 2012

Table 3: Results of Multiple Linear Regression Estimates of Determinants of Intensity of Environmental Degradation Adaptation Measures by Crop Farmers

Variable	Coefficients	t-ratio	Sig.
(Constant)	-7.316	-.292	.771
Age	-1.868	-3.040***	.004
Gender	41.276	8.176***	.000

Marital Status	5.269	1.174	.246
Education	5.662	6.288***	.000
Group Membership	22.716	4.765***	.000
Income	.000	4.040***	.000
Experience	7.113	6.876***	.000
Household Size	6.824	6.520***	.000
Farm size	6.814	2.145**	.037
R^2	.915		
F-ratio	59.455***		.000

*** Significant at the 1% level; ** Significant at the 5% level;

Source: Field survey, 2012