A TOBIT ANALYSIS OF PROPENSITY TO ADOPT SOIL CONSERVATION PRACTICES AMONG ARABLE CROP FARMERS IN DELTA STATE, NIGERIA

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Abstract. *This study determined the propensity of arable crops farmers to adopt soil conservation practices. A total of 150 farmers were systemically selected from 6 local government areas in Delta State Data were collected from the respondents using interview schedule and questionnaire. Data were analyzed using both descriptive and inferential statistics. Results show that majority of the respondents were women. Most of the respondents (62%) were in the age bracket of 30-50 years. Most of them had one form of formal education or the other with average household size of 3 persons and average farm size of 1.5 hectare. Most (65.3%) of the contact farmers were visited fortnightly. All the farmers were engaged in the use of soil conservation practices, however, there is generally low propensity to adopt such practices among the respondents. Marital status, educational level, household size, farm size, farming experience and extension visit had significant relationship with propensity of farmers to adopt soil conservation practices. It was therefore recommended that there is need to increase extension-farmer contact, trained and recruit more extension agents, encourage farmer-farmer extension and encourage group visit with farmers.*

Keywords: Tobit analysis, propensity to adopt, soil conservation arable crop, farmers, Delta State Nigeria.

INTRODUCTION

Many cultivation practices tend to degrade soil over time (Lutz *et al*, 2005). Cultivation exposes to water and wind erosion, repeated tillage weakens soil structure, continuous cropping depletes the soil of nutrients and use of machines compact the soil. Delta State often witness heavy rainfall which make the area particularly vulnerable to degradation a problem exacerbated by climate change and population pressures which opened up new areas yields.

There are predictions of the catastrophic effect soil degradation will have on agricultural productivity in Africa. According to Biot *et al* (1992), there are many cases of claims of declines in agricultural productivity. Given the various effects of soil degradation on crop productivity, soil conservation methods which are known to slow down or arrest degradation have been taught to farm households (Lutz *et al*, 2005). These conservation methods include a large range of options including cultural practices such as contour plowing, ridging and minimum tillage, vegetative practices such as grass strips, use of compost, bush fallow, tree planting, strip cropping and vegetative barriers. cover crops, The contribution of farmers to the problem of environmental degradation, their factors, impact and possible way

through which they can help to redress the situation make them a significant stakeholders in ensuring that natural resources and their immediate environment are sustain ably managed (Fakoya, 2000).

The importance of farmers' adoption of new agricultural technology has long been of interest to agricultural extensionists (Oladele, 2005). Researchers conducted by social scientists all point to the fact that demographic characteristics of farmers, characteristics of innovations, awareness information sources, attitude, belongingness to groups and knowledge influence adoption behaviour of farmers. Rogers and Shaemaker (1971) defines adoption of innovations as the decision to apply on innovation and its continued usage. So many factors relating to the farmers and the farm innovations influence adoption of agricultural innovations. These factors are economic, technical, social and physical factors. As cited by Oladele (2005), recent studies in Europe Charmala and Hossian (1996), Frank (1997); in Asia Sharma and Pradhed (1996), Petel *et al* (1996); and in Africa Abdelmagid and Hassan (1996); on Onasanya (2007) have identified farm and technology specific factors, institutional, policy variables and environmental factors to explain the patterns and intensity of adoption.

Eze *et al* (2006) form positive and significant relationship between age and adoption. Ofuoku, *et al* (2008) discovered significant positive relationship between marital status, household size, participation in household decision making and adoption of integrated pest management. They however found a significant negative relationship between years of experience and adoption. Contrarily Voh (1982) established that household size is not significantly related to adoption.

Voh (1982) as cited by Oladele (2005) like wise established that socio-economic status of farmers is positively and significantly related to adoption. The implication is that enhanced socio-economic status leads to the tendency to adopt innovation. However, Igoden *et al* (1988) opined that farmers who are more exposed to extensions information have a high propensity to adopt innovations than those with poor exposure to extension information.

The critical question challenging agricultural practice now in the presence of environmental degradation, is to what extent have farmers adopted soil conservation practices. This is important for the fact that it has been established that some farmers have abandoned adoption of agricultural technologies. Oladele (2005) has been able establish that farmers in South-Western Nigeria discontinued the adoption of agricultural technologies. This is more so as Adesina and Baidu-Forson (1995) stated that farmers' perceptions affect the adoption of improved varieties of sorghum and mangrove rice in Burkina Faso and Guinea respectively. A lot of studies have been carried out on adoption of improved crop and livestock production technologies, but not much has been done on soil the medium which supports both of the farmers justifies further study.

Objectives of The Study

This study was conducted to determine the propensity of farmers to adopt soil conservation practices in Delta State. Specifically it sought to:

{i} identify the farmers socio-economic characteristics
{ii} ascertain the soil conservation practices
{iii} determine the level of adoption of soil conservation practices,

{iv} categorize farmers based on adoption level of soil conservation practices and

{v} estimate farmers' propensity to adopt soil conservation practices

MATERIAL AND METHOD

The study was conducted in Delta State. The three agricultural zones of the Agricultural Development Programme, of the state were used. A multi-stage and random sampling technique was used to select the sample size. First, three (2) Local Government Areas were selected from each of the three (3) Zones resulting in the selection of six (6) Local Government Areas for the purpose of this study.

Secondly, twenty-five (25) contact crop farmers were systematically selected from each Local Government Area, using snowball method to prevent selection of farmers who were decreased on the list of contact farmers. This exercise resulted in the selection of one hundred and fifty (150) contact farmers.

Data were collected from the respondents with the use of structured interview schedule for the less formally educated and those who had no formal education, while questionnaire was used for those that had reasonable level of formal education.

The data collected were analysed with the application of descriptive statistics such as frequency counts and percentages for objectives "I", "ii", "iii" and "iv". While objective "v" was addressed with the use of Tobit model to estimate the propensity of farmers to exhibit adoption behavior.

Measurement of variables

***Adoption level of soil conservation practices*.**

The farmers were asked to indicate the type and usage of soil conservation technologies they are involved in. the responses were computed to determine the usage level by the farmers.

The farmers' usage of each of the soil conservation technologies was summed up and expressed as percentage of the overall score for the practices as follows:

$Z = x/y \times 100$

Where:

z = the usage level of soil conservation practices

X = participatory score of farmers in soil conservation practices

Y = the overall score of all farmers' soil conservation practices

Based on the farmers' "Z-value", they were grouped into high and low usage levels. Farmer whose Z-value was above the overall mean score of usage was categorized as been high usage level, while those who had below the mean score were categorized as being in low usage level.

Model Specification

The decision to adopt soil conservation practices embodies both the socio-economic characteristics of the farmers, the endogenous (the characteristics and benefits of the practices) and the exogenous (institutional characteristics of the technology} such

that the observed adoption of a soil conservation practices is hypothesized to be an end result of these farmers' socio-economic characteristics, and these exogenous and endogenous variables at different points on the time and innovativeness continuum.

In order to achieve the objectives of this study, the Tobit model was used to estimate the farmers' propensity to exhibit adoption behavior. The Tobit model originally developed by Tobit (1958) is expressed as follows:

$Y = X\beta + \varepsilon$

Where β is a vector of unknown coefficients, X is a vector of independent variables, and ε is an error term that is assumed to be independently distributed with mean zero and a variance of S^2. Y is a latent variable that is observable. If data for the dependent variable is above the limiting factor, zero in this case, Y is observed as a continuous variable. If Y is at the limiting factors, it is held at zero. This relationship is presented mathematically in the following two equations: $Y = Y^*$ If $Y^* > Y_0$ $Y = 0$ if $Y^* <= Y_0$.

Where Y_0 is the limiting factor. These two equations represent a censored distribution of the data. The Tobit model can be used to estimate the expected value of Y1 as a function of a set of explanatory variables (X) weighted by the probability that $Y_1 > 0$ (Tobin, 1958}. Maddala (1983) shows that the expected intensity of adoption, E(Y) is:

$\varepsilon (Y) = X \beta F (z) + \sigma f (z)$ and $z = X \beta / \sigma$.

Where F(z) is the cumulative normal distribution of z, f(z) is the value of the derivative of the normal curve at a given point {unit normal density), z is the Z-score for the area under the normal curve, and is the standard error of the error (Oladele, 2005). The coefficients for variables in the model, β, do not represent marginal effects directly, but the sign of the coefficient will give the researcher information as to the direction of the effect. The definition of variables used in the estimated Tobit model is as follows:

Y = Farmers' propensity to adopt (high = 1, low = 0

X_1 = Gender (male = 1, female = 0)

X_2 = Marital Status (married = 1, otherwise = 0)

X_3 = Level of education (tertiary = 3, secondary = 2, primary = 1, none = 0)

X4 = Household size (7-9 people = 2, 4-6 = 1, 1-3 = 0)

X5 = Farm size (> 6ha = 3; 5-6ha = 2; 3-4ha = 1; < 3ha = 0)

X6 = Farming experience (> 20yrs = 4; 16-20 = 3; 11-15 = 2; 6-10 = 1; 5 and below = 0)

X7 = Extension visit (Yes = 1; no = 0)

RESULTS AND DISCUSSION

Socio-economic characteristics of the farmers

Table 1 indicates that most (87.33%) of the respondents are females. This implies that women are more involved in arable farming than men. This confirms the findings of Uzokwe and Ofuoku (2006) who discovered that women are more involved in farming activities than men. The farmers were mostly (62%) in the range of 30-50years. The implication is that most of them are energetic and are capable of facing the challenges involved in farming activities. Very few (10%) of them had no formal education; 31.33% had primary education while 58% had secondary and tertiary education. This shows that most of them are educated. Majority (47.33%)

had household sizes of between 4-6persons. Members of the household form part of farm labour. Most (62%) had farms of the sizes of between 1 and 2 hectares. They are mostly smallholder farmers with average farm size of 1.5ha. this congruent with Ononsanyo (2007) in his study in Ogun State.

The implications of the above findings are that those farmers have many mouths to feed and this could contribute to the pressure the farmers exert on environmental resources (Onosanya, 2007) and soil resource in particular in order to have food security. Most (65.3%) of the farmers were visited by extension agents twice monthly, while 34% were visited once monthly. Extension visit is fair, but poor for contact farmers as all contact farmers are supposed to be in frequent contact with extension agents (fortnightly).

Table 1

Socio-Economic Characteristics Respondents

Variables	**Frequency**	**Percentage (%)**
Gender		
67 Male	19	12.67
Female	131	87.33
Age {years}		
< 30	36	24
30-40	62	41.33
41-50	31	20.67
51-60	17	11.33
> 60	4	2.67
Marital Status		
Married	89	59.33
Single	53	35.33
Divorced	5	3.33
Widowed	3	2
Educational Level		
No formal education	15	10
Primary education	47	31.33
Secondary education	24	16
NEC/OND	15	10
HND	23	15.33
B.Sc.	26	17.33
Household Size (persons)		
01-Mar	35	23.33
04-Jun	71	47.33
07-Sep	27	18
Above 9	17	11.33
Farm Size {ha}		
01-Feb	93	62
03-Apr	41	27.33
05-Jun	9	6
> 6	7	4. 0
Frequency of extension visit (monthly)		
0 times	0	0
1 time	51	34
2 times	98	65.33
3 times	1	0.67
4 times	0	0

Source: field survey, 2009.

Soil Conservation Practices Used By the Farmers

All the farmers (Table 2) engage in one soil conservation practice or the other. It shows low adoption of tree planting (37.33%) which is very environmentally friendly. In his study, Onosanya (2007) also discovered that there was low adoption in tree planting in Ogun State, Nigeria.

Table 2

Soil Conservation Practices Engaged in by the Farmers

Practices	Frequency	Percentage (%)
Mulching	67	49.13
Erosion control	60	40
Tree planting	56	37.33
Composting	72	48
Crop rotation	131	87.33
Bush fallow	145	96.67

Source: field survey, 2009.

Table 3 indicates that most (56.67%, 60%, 62.67% and 52%) were not practicing mulching, erosion control, tree planting and composting respectively. Erosion control was practiced by only 40% of the farmers. This implies that not all the farmers are being affected by erosion. This supports Onosanya (2007) as he listed the aforementioned practices as having low usage level among farmers. Tree planting will always help to check soil erosion in the area.

Table 3

Usage of Soil Conservation Practices For Sustainable Agriculture

Usage level of practice	Frequency	Percentage (%)
Mulching:		
Never use mulch	85	56.67
Rarely use mulch	42	28
Often use mulch	25	16.67
Erosion control		
Do not control erosion control	90	60
Planting of cover crops	46	30.67
Planting of cover crops and ridges	14	9.33
Tree planting		
Do not plant tree	94	62.67
Plants few around farm	32	21.33
Plants many around farm	24	16
Composting		
Do not use compost	78	52
Use compost occasionally	56	37.33
Use compost often	16	10.67
Crop rotation		
Never practice	19	12.67
Practiced occasionally	22	14.67
Practiced often	109	72.67
Bush fallow		
Do not practice fallow	5	3.33
Engage in fallow for 3-5 years	120	80
Fallow for more than 5years	25	16.67

Source: field survey, 2009.

As captured in Table 4, only few (24%) of the farmers were categorized as high adopters of soil conservation practices, 26.69% were categorized as medium Level adopters of soil conservation practices, while 49.33% fell into the category of low adopters of soil conservation practices. This indicates that the adoption of soil conservation practices among arable formers in the study area is generally low. This again is a confirmation of the findings of Onosanya (2007) in his study of Ogun State farmers' use of environmentally sustainable agricultural practices.

Table 4

Level of Usage of Soil Conservation Practices (SCP)

Usage score	Frequency	Percentage (%)
High usage level SCP (60.0-90.0)	36	24
Medium usage level of SCP (50.0-59.9)	40	26.67
Low usage level of SCP (< 50.0)	74	49.33

Source: field source, 2009.

Estimation of farmers' propensity to adopt soil conservation practices

The results of the model of farmers' propensity to adopt soil conservation practices indicate that six of the seven independent variables significantly influence the farmers propensity to adopt soil conservation practices in the study area. These include marital status, educational level, household size, farm size, farming experience and extension visit. Marital status (x_2) is significant at 5% level of significance. This may be attributed to the fact that when farmers are not married, they will have a low propensity to adopt soil conservation practices as they have less number of people to cater for. Educational level (X_3) is similarly significant, but at 10% level of significance. This implies that the more educated a farmer is the higher his/her propensity to adopt soil conservation practices. According to Ajaiand Banmeke (2007), farmers with higher level of education would have higher perception about environmental problems than those with low level of educational qualification. Igodan *et al* (1988) opined that argued that farmers who are more educated exposed to formal education have a high propensity towards adoption.

Table 5

Estimated Tobit Model Of Farmers' Propensity To Adopt Soil Conservation Methods

Variables	coefficient	Z-statistics
Intercept	0.59975	0.777
Gender (X_1)	0.21417	1.419
Marital status (X_2)	-0.00093	-2.110**
Educational level (X_3)	0.06996	1.863*
Household size (X_4)	-0.14652	-3.336***
Farm size (X_5)	0.25613	2.743***
Farming experience (X_6)	0.81623	1.828*
Extension visit (X_7)	0.54961	2.989**
Log likelihood	-54.25994	
Standard error of regression	0.00106	
*** significant at 1%		
** significant at 5%		
* significant at 10%		

Household size (X_4) significantly relates with propensity to adopt soil conservation practices at 1% level of significance. The result shows that farmers with small household will have low propensity to adopt soil conservation practices. Arene (1994)reported a positive and significant relationship between adoption and household size.

Farm size (X_5) also significantly associates with the propensity of farmers to adopt soil conservation practices at 15 level of significance. This implies that a unit increase in farm size will lead to a unit increase in propensity of farmers to adopt soil conservation practices. Farming experience (X_6) significantly associates with propensity to adopt soil conservation practices at 10%. This means that the more experience a farmer has in farming the more the likelihood of him/her propensity to adopt soil conservation practices. Ajayi and Banmeke (2007) argued that the more experienced a farmer is the higher his level of perception of the environment, hence propensity to adopt soil conservation practices, this is congruent with Oladele (2005) who opined that high experience among farmers influences their better understanding of messages and enhances the accuracy of implementation of technology packages.

CONCLUSIONS

This study has established that arable crop farmers are aware of and engage in soil conservation practices such as mulching, erosion control, tree planting, composting, crop rotation and bush fallow. It was established that arable crop farmers generally have low propensity to adopt soil conservation practices in the study area, but they have high knowledge of soil conservation practices. It has empirically provided insights into the determinants of the propensity of the farmers to adopt soil conservation practices. It is suspected that extension visit is affected by the dearth of extension agents.

Recommendations. Based on the findings of this study, it is recommended that: frequency of extension visit should be improved upon. This will translate into frequency of contact between contact farmers and their non-contact farmers' audience; more extension agents should be trained and recruited; farmer-farmer extension should be encouraged among arable crop farmers; extension agents should adopt the strategy of meeting farmers in groups. This will save time and days for visit and will enhance the level of outreach.

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