International Journal of Community and Cooperative Studies
Vol.8 No.1, pp.23-34, June 2020
Published by ECRTD- UK
ISSN 2057-2611(Print), ISSN 2057-262X(Online)

FARMERS' ORGANISATIONS AND ITS CONTRIBUTION TO THE ADOPTION OF SOIL CONSERVATION PRACTICES: A CASE STUDY OF SMALLHOLDER FARMERS IN OYO STATE, NIGERIA

[1] Kehinde M. A., Kehinde A. D. and Akinola A. A.
[1]Department of Agricultural Economics, Faculty of Agriculture,
Obafemi Awolowo University, Ile Ife, Osun State, Nigeria.
Email: kehindeayodeji8@gmail.com

ABSTRACT: *As part of the efforts to reduce land degradation and improve agricultural productivity, farmers in the study area were introduced to various soil conservation practices through farmers' organisations. This study was however, conducted to determine the effect of farmers' organisation on soil conservation practices adopted in the study area. Data collected, through a multistage sampling procedure, were analysed with the aid of descriptive statistics and double hurdle regression model. Findings revealed that three conservation practices were adopted in the study area namely; cover cropping (14%), vegetative fallow (35%) and mulching (46%) while 5% did not adopt any practice at all. Findings also revealed significant difference in some socio-economic characteristics among the categories of adopters in the study area such as age of the household head ($P < 0.05$), off-farm income ($P < 0.01$) and farm size ($P < 0.01$). Double hurdle model results revealed in the first hurdle that, while, gender, age, off-farm income, valley location, and extension contact significantly influenced the adoption of cover cropping practice, age, off-farm income, farm size, and extension contact significantly influenced adoption of vegetative fallow system practice. The adoption of mulching practice is significantly influenced by education, farming experience, farmers' organization and household size. In the second hurdle, while, gender, age, off-farm income, valley location, and extension contact significantly influenced the adoption of cover cropping practice, gender, education, farm size, and farming experience significantly influenced the adoption of vegetative fallow system practice. The adoption of mulching practice is significantly influenced by gender, education, and farmers' organization. The study concluded that farmers' organization is one of the key factors influencing the three soil conservation practices (cover cropping, vegetative fallow system and mulching). Others were off-farm income, extension contact, farm size, and years of education. In line with the findings of the study, the study recommends that formation and strengthen of a farmers' organisation for increased uptake of soil conservation practices should be encouraged. In addition, effective strategies, programmes and institutional structures that would enhance education of farmers, frequency of extension contact and off-farm income should be put in place.*

KEYWORDS: farmers' organisation, soil, conservation, practices, smallholder farmers, Oyo State.

INTRODUCTION

Soil is an irreplaceable and fixed asset, which is limited in supply that is essential for food production (Babalola *et al*., 2009). Soil fertility serves as a medium for crop growth and sustainability. However, over the years, numerous economic factors such as population pressure, poverty, land tenure insecurity, policies and institutions, poor infrastructure and services, and some farming practices such as continuous tillage have led to massive soil fertility loss, estimated at 30 million tons per annum. (Olatunji, 2003; Kessler and Stroosnijder, 2006; Okoba *et al*., 2007; Tamene and Vlek, 2007).

In most communities, where most smallholder farmers cultivate land, soil fertility loss poses a serious threat to food security (Oladeji, 2007). The average annual loss of productive capacity through soil fertility depletion is estimated to be 25 million tones (Adediji, 2000; Eswaran *et al*., 2001). If this continues unabated, it will result to severe ecological damages, loss of soil structure, reduction of soil biodiversity, soil compaction, decline in agricultural productivity, low farm income, poverty, food insecurity and social disorder. Therefore, there is urgent need to conserve the soil fertility. Giller *et al*. (2009) and Kabubo–Mariara *et al*. (2010) opined and concurred that soil conservation practice either runoff management techniques or fertility sustaining techniques remained the panacea to the declining soil degradation problems.

Following from this, the Oyo State Agricultural Development Programme (OYSADEP) and research institutes like Institute of Agricultural Research and Training (IAR&T) and International Institute of Tropical Agriculture (IITA) had introduced various soil conservation measures to farmers in Oyo State. The soil conservation practices entail fertility management which involves the use of such techniques as mulching, tree planting, planting of multipurpose tree hedgerows, contour, vegetative fallow system, minimum tillage, double cropping, the establishment of cover crops, mineral, and fertilizers, among others. The literature highlights several benefits of these conservation practices, amongst which are an improvement in soil fertility, soil structure, labour savings, soil biodiversity, soil compaction, an increase in productivity, farm income, food security and environmental sustainability

Despite the evident efforts by Government and other research institutes to promote use of soil conservation practices among farmers, adoption of these practices by smallholder farmers is said to be still very low (Owombo and Idumah, 2015). Among other factor responsible for low adoption of soil conversation practice is lack of access to credit. Conley and Udry (2010) explained that farmers 'organisation can counteract the negative effect of lack of farmers' access to credit which hinders adoption. Thus, farmers' organisation creates the platform for acquisition of credit and other relevant resources such as information that promotes adoption. Moreover, information received through this platform reduce the uncertainty about a new technology's performance, and encourages the farmers to adopt such technology. Farmers' organisation has been found to have a key influence on adoption. However, only a limited number of studies have analyzed the role of farmers' organisation in the process of adoption.

Consequently, this paper analysed the effect of farmers' organisations on the adoption of soil conservation practices among smallholder farmers in Oyo State. Specifically, the study addressed following research questions: what are the socio-economic characteristics of the smallholder farmers? What are the conservation techniques used by the respondents? What are the effects of farmers' organisations on adoption and intensity of soil conservation usage?

Study areae

The study was carried out in Oyo State in South-Western geopolitical zone of Nigeria. It is bounded in the south by Ogun State, in the north by Kwara State, in the west, partly bounded by Ogun State and partly by the republic of Benin, while in the east by Osun State. It is located in Yoruba land in which the tenure system is predominantly patriarchal. It covers an area of 27,249 square kilometers. The land scape consists of old hard rocks and dome shaped hills, which rise gently from about 500 meters in the southern part and reaching a height of about 1,219 meters above sea level in the northern part. It comprises of 33 Local Government Areas (LGAs) and four agricultural zones of; Ibadan/Ibarapa, Ogbomoso, Saki and Oyo zones. These four agricultural zones were grouped by Oyo State Agricultural Development Programme (OYSADEP). There are two climatic seasons. These are the rainy and dry seasons and occur from March to October and from November to early March respectively. The average annual rainfall is 1420.06 mm and average daily temperature ranges between is 25 and 35^0c. The climate in the state favours the cultivation of crops like yam, cassava, millet, rice, plantain, cacao tree, palm tree and cashew. Oyo State is prone to soil erosion.

Sampling procedure and data

A multistage sampling procedure was used to select 180 respondents for the study. The first stage involved purposive selection of two agricultural zones in Oyo State namely Ogbomoso and Oyo, based on high incidence of soil erosion. The second stage involved a purposive selection of three LGAs from each of the agricultural zones, based on the intensity of soil erosion in the area. In the third stage, three villages were purposively selected due to high rate of soil erosion in the villages. The fourth stage involved random selection of 10 smallholder farmers in each of the villages. Primary data were collected on socio-economic characteristics of the farmers, (such as age, level of education, household size, farm size among others.), tenure related factors such as topography of the farm land, ownership of farm land, location of valley on the farm land among others) and poverty related factors such as; (employment income, access to credit). Data collected were analyzed with the aid of descriptive statistics and double hurdle regression model.

Analytical Technique

Descriptive statistics

Descriptive statistics was used to describe socioeconomic characteristics of the respondents and identify various types of soil conservation techniques used in the study area. It involved the computation of means, standard deviation, frequency counts and percentages.

Double hurdle regression model

Double hurdle model was used to determine the effects of farmers' organisations on decisions and intensity of soil conservation usage in the study area. The double-hurdle model is a parametric generalization of the Tobit model, in which two separate stochastic processes determine the decision to conserve and the intensity of soil conservation use. The model assumes that different set of variables separately affects the adoption and intensity of soil conservation hence, the rationale behind the choice of this model.

In the first hurdle, probit model was used to determine effects of farmers' organisations on decision to conserve. The dependent variable was the probability of decision to use soil conservation and the independent variables are multidisciplinary explanatory variables including farmer, farm and institutional factors postulated to influence decision to conserve soil. The estimated model is specified explicitly as follows:

$Y=b_0+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+b_6X_6+b_7X_7+b_8X_8+b_9X_9+b_{10}X_{10}+b_{11}X_{11}+b_{12}X_{12}+b_{13}X_{13}+b_{14}X_{14}+b_{15}X_{15}+\varepsilon_i$……1

Where;

Y is decision to conserve (1 or 0)
b_0 is intercept
$b_1$to b_{15} is the components and parameters to be measured
X_1 is age of farmers (years),
X_2 is education in number of years spent in schools (years),
X_3 is membership in farmers' organization (1 for members, 0 for non-member),
X_4 is farming experience (years),
$X_5$is off-farm income (₦),
X_6 is sex of household head (1 for male, 0 for female),
X_7 is Farm size (ha),
X_8 is number of contacts with extension agent (#)
X_9 is Household size
X_{10} is access to credit (access = 1, no access = 0)
X_{11} is asset of farmer (land owned by farmer = 1, otherwise = 0)
X_{12} is labour used (man-days)
X_{13} is slope of farmland (steep slope =1, otherwise = 0)
X_{14} is land located on valley (location on valley = 1, Otherwise = 0)
X_{15} is land located on highland (highland = 1, Otherwise = 0)
ε_i is the error term.

In second hurdle, truncated regression model was used to determine the effects of farmers' organisations on the intensity of soil conservation use. The dependent variable is land area under each of the soil conservation method. The estimated model is specified as follows:

$Y=b_0+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+b_6X_6+b_7X_7+b_8X_8+b_9X_9+b_{10}X_{10}+b_{11}X_{11}+b_{12}X_{12}+b_{13}X_{13}+b_{14}X_{14}+b_{15}X_{15}+\varepsilon_i$ ……2

Where;

Y is land area under each of the soil conservation method
X_1 is age of farmers (years),

X_2 is education in number of years spent in schools (years),
X_3 is membership in farmers' organization (1 for members, 0 for non-member),
X_4 is farming experience (years),
$X_5$is off-farm income (₦),
X_6 is sex of household head (1 for male, 0 for female),
X_7 is Farm size (ha),
X_8 isnumber of contact with extension agent (#)
X_9 is Household size
X_{10} is access to credit (access = 1, no access = 0)
X_{11} is asset of farmer (land owned by farmer =1, otherwise = 0)
X_{12} is labour used (man-days)
X_{13} is slope of farmland (steep slope =1, otherwise = 0)
X_{14} is land located on valley (location on valley=1, Otherwise = 0)
X_{15} is land located on highland (highland = 1, Otherwise = 0)
$\varepsilon_i$is the error term.

RESULTS AND DISCUSSION

Adoption typology of the respondents

Figure 1 reveals the adoption typology of the respondents in the study area. Non- adopters were 5%, the presence of non- adopters could be ascribed to lack of information and encouragement from concerned organization. About 13.9%, 35.0% and 46.1% percent of the respondents adopted cover cropping, vegetative fallow system and mulching practices, respectively. Mulching is the most adopted soil conservation practice, while cover cropping is the least adopted in the study area. The low involvement in the adoption of cover cropping might be due to scarcity of labour at the peak of the season because of the seasonality of Nigerian agricultural system (Akinbile and Odebode, 2007; Akinola, 2008). Relative high numbers of mulching adopters could be attributed to effective extension service, high literacy level, and presence of farmers' organization (Junge *et al*., 2009).

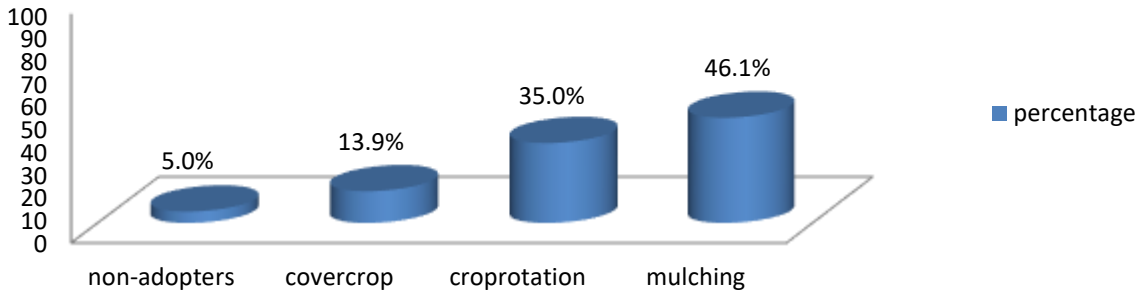

Fig. 1: Adoption typology of soil conservation practice

Socio-economic characteristics of the respondents

Table 2 reveals dissimilarities in the socio-economic and demographic characteristics among the categories of farmers in the study area. The findings of the study revealed that there were variations in some demographic and socio-economic characteristics among the categories of adopters in the study area. The average age of the non-adopter of soil conservation practices was 52 years. The average age of the adopters ranged from 45.44 years to 53.03 years. F-test revealed a significant difference among categories of farmers for age ($P \leq 0.01$). This could indicate that farmers in the study area are in their economic active age. The average farm size for the entire sample was 4.69 hectares and ranged from 3.44 hectares to 4.11 hectares among the adopters. There was no significant difference among categories of farmers for farm size. The average household size was 7.55 for non-adopters, 6.44 for cover croppers, 7.28 for vegetative followers, and 8.31 for mulching adopters. F-test revealed a significant difference among categories of farmers for household size ($P \leq 0.05$). The average number of hired labour used in a year among the category of adopters in the study area was 13 for non-adopters and 33, 42, and 47 for cover cropper, vegetative followers and mulching adopters, respectively. The findings revealed that farmers who do not adopt any soil conservation practice employed the least labour compared to those who adopts.

The number of extension visits among the non-adopters was 77.8% and it ranged from 96.8% to 100% among the adopters. The result indicates that adopters of soil conservation practices were most visited in the last cropping season. The average years of farming experience among the non-adopter was 11.1 and it ranged from 16 to 40 years among the adopters. F-value showed significant difference among categories of farmers for farming experience ($P \leq 0.01$). This means that the adopters have gathered much experience from their previous farming practices. The non-adopters recorded an average of ₦3, 410.00 as off-farm income in the study area. The off-farm income ranged from ₦6, 480.00 to ₦56, 500.00 among the adopters.

Table 2: Demographic and socio-economic characteristics of the respondents

Variables	Non-adopter (9)	Cover cropping (25)	Vegetative fallow system (63)	Mulching (83)	F-value
Age	52	45.44	48.49	53.03	4.86
Household size	7.55	6.44	7.28	8.31	2.09
Farm size	3.44	4.86	4.11	3.92	0.95
Extension visit (%)	77.8	100	96.8	98.8	
Farming experience	11.1	40.0	28.6	15.7	4.06
Off farm income (₦)	3,410.00	6,480.00	52,100.00	56,500.00	1.20
Labour	13	33	44	47	

Source: Field survey, 2017

Effect of farmers' organization on adoption and intensity of soil conservation practice

Effect of farmers' organization on adoption of soil conservation practice (first stage)

Effect of farmers' organization on the adoption of soil conservation practices among the categories of respondents were presented in Table 3. The result showed that the Log likelihood function for cover cropping, vegetative fallow system, mulching adoption were -79.6242, -43.2505 and -76.1668, respectively. These values showed the entire model is of good fit and significant at 1 percent alpha level.

The adoption of cover cropping was positively and significantly influenced by off-farm income (P<0.01), valley location (P<0.1), gender (P<0.1) and extension contact (P<0.01). Increases in the off-farm income, valley location, gender and number of extension contact of the farmers would increase the adoption of cover cropping. However, the age of farmers was negative and significantly influenced the adoption of cover cropping (P<0.1). This is in agreement with the expectation of the study and previous studies such as Akinola *et al*. (2010); Onu, (2013) and Akinola and Owombo (2010).

The adoption of vegetative fallow system was positively and significantly influenced by off-farm income (P<0.05), farm size (P<0.01), and extension contact (P<0.1). Increases in the off-farm income, farm size, and number of extension contact of the farmers would increase the adoption of vegetative fallow system. However, the age of farmers was negative and significantly influenced the adoption of vegetative fallow system (P<0.1). This is in agreement with the expectation of the study and previous studies such as Bayard *et al*., (2007), Oluoch-Kosura *et al*., (2001), Bamire and Fabiyi (2002).

The adoption of mulching practice was positive and significantly influenced education (P<0.05), farmers' organization (P<0.01), farming experience (P<0.01) and household size (P<0.01). Increases in the education, farm experience, farmers' organization and household size would increase the adoption of mulching. This conforms to the apriori expectation of the study and previous studies such as Bekele and Drake (2003); Aklilu and De Graaf (2007), Idrisa *et al*., (2012); Bekele and Mekonnen (2010), Mignouna *et al*., (2011).

Table 3: Effect of farmers' organization on adoption of soil conservation practice

Variables	Cover cropping	Vegetative fallow system	Mulching
Gender	0.054* (0.0765)	0.235 (0.5745)	0.106 (0.6234)
Age	-0.096* (0.0001)	-0.085* (0.0074)	0.967 (0.0006)
Education	0.362 (0.0063)	0.444 (0.0305)	0.041**(0.0139)
Farming experience	0.676 (0.0002)	0.055 (0.0280)	0.034** (0.0087)
Credit access	0.166 (-0.0007)	0.864 (0.0625)	0.839 (0.0544)
Off-farm income	0.003***(0.0001)	0.020** (0.0002)	0.844 (0.0002)

Farmers' organization	0.379 (-0.02850)	0.434 (-0.1383)	0.002***(0.0043)
Farm size	0.924 (-0.0003)	0.003*** (0.1493)	0.481 (0.0189)
Slope	0.141 (-0.2154)	0.650 (0.578)	0.270 (-0.6472)
Valley location	0.063* (0.0409)	0.796 (0.3345)	0.376 (0.5533)
Highland	0.323 (-0.1072)	0.527 (0.4147)	0.178 (0.6134)
Extension contact	0.005*** (0.0413)	0.079* (0.0627)	0.721 (0.2346)
House hold size	0.991 (0.0001)	0.572 (0.0517)	0.003*** (0.0930)
Log likelihood	-79.6242	-43.2505	-76.1668
Significance level	0.0000		

Source: Field survey, 2017

Note: ***= significant at 1%, **= significant at 5%, *= significant at 10%.

Effect of farmers' organization on intensity of soil conservation practice (second stage)

Effect of farmers' organization on the intensity of soil conservation practices among the categories of respondents were presented in Table 4. The result showed that the Log likelihood function for cover cropping, vegetative fallow system, mulching adoption were -79.6242, -31.3343 and -44.6326, respectively. These values showed the entire model is of good fit and significant at 1 percent alpha level. Results revealed that gender of respondents was positive and significantly influenced the intensity of use of cover cropping ($p<0.1$), vegetative fallow system ($p<0.01$) and mulching practices ($p<0.1$), respectively.

The intensity of cover cropping was positive and significantly influenced by off-farm income ($P<0.01$), valley location ($P<0.1$) and extension contact ($P<0.01$). Increases in the off-farm income, valley location and number of extension contact of the farmers would increase the intensity of cover cropping adoption. However, the age of farmers was negative and significantly influenced the intensity of adoption of cover cropping ($P<0.1$). This is in agreement with the expectation of the study and previous studies such as Akinola *et al*. (2010), Onu (2013) and Akinola and Owombo (2010) that off-farm income and extension contact are positive determinants of technology adoption.

The intensity of vegetative fallow system was positive and significantly influenced education ($P<0.05$), farming experience ($P<0.1$) and farm size ($P<0.1$). These are in agreement with the expectation of the study and Akinola *et al*. (2010), Onu (2013) and Akinola and Owombo (2010) that education and farm size are positive determinants of technology adoption.

The intensity of mulching adoption was positive and significantly influenced education ($P<0.01$), farmers' organization ($P<0.01$) and extension contact ($P<0.1$). These are in agreement with the expectation of the study and Akinola *et al*. (2010), Onu (2013) and

Akinola and Owombo (2010) that education and extension contact positive determinants of technology adoption.

Table 4: Effect of farmers' organization on intensity of soil conservation practice

Variables	Cover cropping	Vegetative fallow system	Mulching
Gender	0.054* (0.0765)	0.009***(-0.1371)	0.592* (0.0393)
Age	0.096* (0.0001)	0.651 (0.0012)	0.496 (0.0019)
Education	0.362 (0.0063)	0.046** (0.0068)	0.006*** (0.0074)
Farming experience	0.676 (0.0002)	0.093* (0.0007)	0.831 (0.0001)
Credit access	0.166 (-0.0007)	0.534 (0.0003)	0.685 (-0.0002)
Off-farm income	0.003***(0.0001)	0.186 (0.0002)	0.742 (0.0005)
Farmers' organization	0.379 (-0.0285)	0.713 (-0.0093)	0.011*** (0.1133)
Farm size	0.924 (-0.0003)	0.002*** (0.0037)	0.125 (-0.0047)
Slope	0.141 (-0.2154)	0.828 (0.0208)	0.189 (-0.1259)
Valley location	0.063* (0.0409)	0.446 (-0.0750)	0.308 (0.1014)
Highland	0.323 (-0.1072)	0.261 (0.0835)	0.698 (0.0284)
Extension contact	0.005*** (0.0413)	0.570 (0.0731)	0.0096* (0.0879)
House hold size	0.991 (0.0001)	0.819 (-0.0018)	0.158 (0.0113)
Log likelihood	-79.6242	-31.3343	-44.6326
Significance level	0.0000		

Source: Field survey, 2017

Note: ***= significant at 1%, **= significant at 5%, *= significant at 10%.

CONCLUSION

There are three categories of adopters in the study area with variations in their socio-economic characteristics. They include the adopters of cover cropping, vegetative fallow system and mulching practices. Of all the conservation practices, Mulching is the most adopted soil conservation practice, while cover cropping is the least adopted in the study area. In the first hurdle, while, gender, age, off-farm income, valley location, and extension contact significantly influenced the adoption of cover cropping practice, age, off-farm income, farm size, and extension contact significantly influenced adoption of vegetative fallow system practice. The adoption of mulching practice is significantly influenced by education, farming experience, farmers' organization and household size. In the second hurdle, while, gender, age, off-farm income, valley location, and extension contact significantly influenced the adoption of cover cropping practice, gender, education, farm size, and farming experience significantly influenced the adoption of vegetative fallow system practice. The adoption of mulching practice is significantly influenced by gender, education, and farmers' organization. The study concluded that farmers' organization is one of the key factors influencing the three soil conservation practices (cover cropping, vegetative fallow system and mulching). Others includes off-farm income, extension contact, farm size, years of education, membership of farmers' organization. All these significant variables should be taken into consideration in an effort to increase the uptake of soil conservation practices.

In line with the findings of the study, the study recommends that formation and strengthen of a farmers' organisation for increased uptake of soil conservation practices should be encouraged. In addition, effective strategies and institutional structures that would enhance education of farmers, frequency of extension contact and off-farm income should be put in place.

REFERENCES

Adediji, A. (2000). The Politics on Erosion Issues.In Jimoh, H. I. and Ifabiyi, I. P. (2000), Comtmporary Issues in Environmental Studies.Haytee press and publishing comp. Ilorin, Kwara State, Nigeria.

Akinbile, L.A.(1997). "Measurement of agricultural indigenous knowledge of crop farmers in two agroecological zones of Oyo State, Nigeria.Unpublished Ph.D Thesis, University of Ibadan.80-196.

Akinola, A.A and Adeyemo, R. (2008).Adoption and Productivity of Improved Rice Varieties in Osun State, Nigeria.*Ife Journal of Agriculture*. 23(1):104-116.

Akinola, A.A., Alene, A.D., Adeyemo, R., Sanogo, D., Olanrewaju, A.S., Nwoke, C., Nziguheba, G.and Diels, J.(2010).Determinants of Adoption and Intensity of use of Balanced Nutrient Management SystemsTechnology in the Northern Guinea Savanna of Nigeria.*Quarterly Journal of International Agriculture,49*(1), 25-45.

Akinola, A. and Owombo.P .(2012). Economic Analysis of Adoption of Mulching Technology in Yam Production in Osun State, Nigeria. *International Journal of Agriculture and Forestry*, 2; 1, 2012, 1-6.

Aklilu, A. and De Graaff, J. (2007).Determinants of Adoption and Continued Use of Stone Terraces for Soil and Water Conservation in an Ethiopia Highland Watershed.*Ecological Economics*, 61: 294-302.

Alene, A. D., Poonyth, D and Hassan, R. M. (2000). Determinants of Adoption and Intensity of use of Improved rice Varieties in the Central Highlands of Ethiopia: A Tobit Analysis *Agrekon (South African Journal of Agricultural Economics)*, 39(4):633-643.

Babalola, O., Jimba, S.C., Maduakolam, O. and Dada, O.A. (2009). Use of Vetiver Grass for Soil and Water Conservation in Nigeria. *Ecosystems*. 1:416-426.

Bamire, A.S., Fabiyi, Y.L. and Manyong, V.M. (2002). Adoption pattern of fertilizer technology among farmersin the ecological zones of South-western Nigeria: A Tobit analysis. *Australian Journal of Agriculturalresearch, 53*, 901-910. http://dx.doi.org/10.1071/AR01095.

Bayard, B., Jolly, C.M. and Shannon, D.A. (2007).The economics of adoption and management of alley cropping in Haiti.Journal of Environmental Management, 84:62- 70.

Bekele, W. and Drake, L. (2003).Soil water conservation decision and behaviour of subsistence farmers in the Eastern highlands of Ethiopia a case study of the Hunde-Lafto area. *Ecological Economics*. 46(3):437-451.

Bekele, G.andMekonnen, A. (2010). Investment in Land Conservation in Ethiopia Highlands: A Household Plot-Level Analysis of the Roles of Poverty, Tenure Security, and Market Incentives. *Environment forDevelopment Discussion paper series*, 10-09.

Clay, D. C., Kelly, V., Mpyisi, E. and Reardon, T. (2002). Input Use and Conservation Investments among Farm Households in Rwanda: Patterns and Determinants. In Barret, C. B.Place, F. and A.A.A Solid (Eds.),*National Resources Management in Africa agriculture: Understanding and improving current practices.*Willingford, Oxfordshires, UK: (AB). http://dx.doi.org/10.1079/9780851995847.0103.

Cragg, J. (1971).Some statistical models for limited dependent variables with application to the demandfordurablegoods.*Econometric.* 39,829-844. http://dx.doi.org/10.2307/1909582

Conley T.G., and Udry C., 2010, Learning about a new technology: Pineapple in Ghana. American Economic Review. 100, 35-69.

Eswaran, H., Lal,R. and Reich, P.F. (2001). Land degradation: an overview. *In* Responses to Land Degradation, ed. E.M. Bridges, I.D. Hannam, L.R. Oldeman, F.W.T. Pening de Vries, S.J. Scherr, and S. Sompatpanit. Proceedings of the 2nd. International Conference on Land Degradation and Desertification, KhonKaen, January 1999. New Delhi: Oxford Press.

Godoy, R., Kirby, K. and Wikkie, D. (2001). Tenure Security, Private time Preference, and Use of Natural Resources among Lowland Bolivian Ameridians. *Ecological Economics,* 38: 105-118.

Giller, K. E., Witter, E., Corbeels, M., andTittonell, P. (2009). Conservation agriculture and smallholder farming inAfrica: The heretics' view. *Field Crops Research, 114*(1), 23-34.

Holden, S. and Shiferaw, B. (2002). Poverty and land degradation: peasants' willngnesss to pay to sustain land productivity. In national resource management in Africa agriculture: understanding improving current practices. 91-102.

Idrisa, Y.L., Ogunbameru, B.O. and Madukwe, M. C. (2012).Logit and Tobit analyses of the determinants of likelihood of adoption and extent of adoption of improved soybean seed in Borno State, Nigeria. *Greener Journal of Agricultural Sciences*. ISSN: 2276-7770, 2 (2), 37-45.

Junge, B., Deji, O., Arabio, R., Sikoye, B. and Spahr, K.(2009). Farmers' adoption of soil conservation technology: a case study of Osun state, Nigeria. Journal of agricultural education and Extension, 15(3), 257-274.

Kabubo-Mariaura, J., Linderhof, V.andKruseman, G. (2010). Does land tenure security matter for investment insoil and water conservation? Evidence from Kenya.*African Journal of Agricultural Resource andEconomics, 4*(2), 123-139.

Kidane, G. (2001). Factors influencing the adoption of new wheat and maize varieties in Tigray, Ethiopia: The Case of HawzienWoreda. M.S.C. Thesis Presented to School of Graduate Studies of Alemaya University, Ethiopia. 140.

Kessler, C.A and Stroosnijder, L., (2006). Land degradation assessment by farmers in Bolivian mountain valleys. Land Degradation and Development. 17 (3): 235–248.

Lapar, M.L.A. andPandey, S. (1999). Adoption of soil conservation: The case of Philippine Uplands. Agric. Econ, 21:241-256.

Mignouna, D. B., Manyong, V. M., Rusike, J., Mutabazi, K. D. and Senkondo, E. M. (2011). Determinants of Adopting Imazapyr-Resistant Maize Technologies and its Impact on Household Income in Western Kenya.*AgBioForum, 14(3): 158-163*

Murck, B.W., Skinner, B. J and Porter, S. C. (1996).*Environmental Geology*.John Wily and Sons.Inc. New York.

Nigerian Environmental Study/Action Team (NEST) (1991): "Nigeria's Threatened Environment: A National Profile".

Nkonya, E. (2004). Strategies for Sustainable Land Management and Poverty Reduction in Uganda. Research Report of the International Food Policy ResearchInstitute 133, 1–136.

Okoba, B.O., Tenge, A.J., Sterk, G. and Stroosnijder, L. (2007). Participatory soil and water conservation planning using an erosion mapping tool in the central highlands of Kenya. Land Degradation and Development 18(3): 303–319.

Olatunji, O. J. (2003). The Effect of Socio Characteristic of Farmers on Land Degradation in the Derived Guinea-Savannah Ecological Zone of Nigeria. *International Journal of Environmental Issues*.1(1): 237-241.

Oluoch- Kosura, W.A, Marenya, P.P and Nzuma, M.J. (2001). Soil fertility management in maize based production system in Kenya. Current options and the future strategies. Paper submitted at the seventh Eastern and Southern Africa regional maize conference, Nairobi. 350-355

Onu, D.O. (2013). Farm Level Analysis of Investment Behaviours in Soil Conservation and Erosion Control Practices in the Ecologically Vulnerable Communities in Southeast Nigeria.*Agriculture and Biology Journal of North America* ISSN Print:2151-7517, ISSN Online: 2151-7525, doi:10.5251/abjna.2013.4.4.441.458 © 2013, ScienceHuβ, http://www.scihub.org/ABJNA

Owombo, P. T., Akinola, A. A., Ayodele, O. O.and Koledoye, G. F. (2011). Economic Impact of AgriculturalMechanization Adoption: Evidence from Maize Farmers in Ondo State, Nigeria. *Journal of Agriculture andBiodiversity Research, 1*(2), 25-32.

Owombo, P. T. and Idumah, F. O. (2015). Determinants of Land Conservation Technologies Adoption among Arable Crop Farmers in Nigeria.*Journal of sustainable Development*, 8(2):220-229.

Tamene, L. and Vlek, P.L.G. (2007). Assessing the potential of changing land use for reducing soil erosion and sediment yield of catchments: a case study in the highlands of Northern Ethiopia. Soil Use and Management 23 (1): 82–91.

Yitayal, A. (2004). Determinant of Use of Soil Conservation Measures by Small Holder Farmers; in Jimma Zone, Dedo District. An Msc Thesis Presented to School of Graduate Studies of Alemaya University.