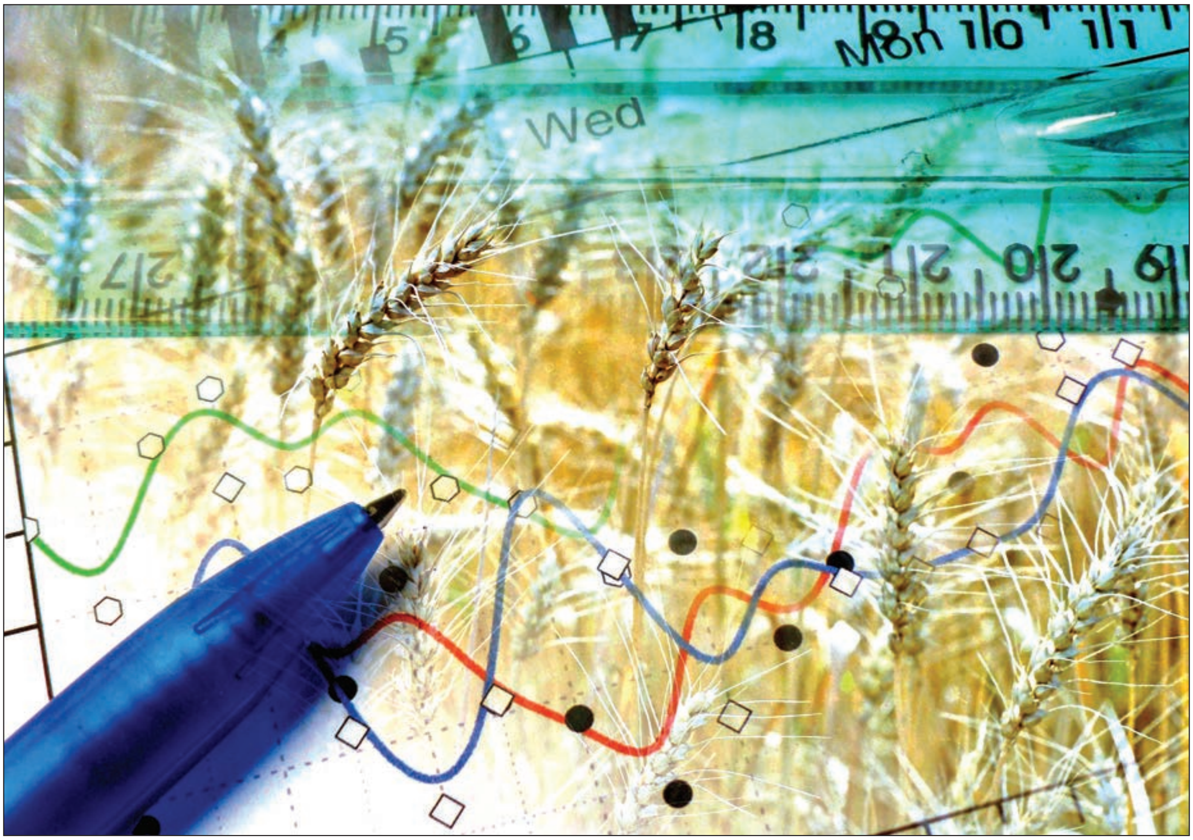

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Willingness-to-Pay for Agronomic Soil Conservation Practices among Crop-based Farmers in Ekiti State, Nigeria

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ABSTRACT

This study investigated the determinants of willingness-to-pay for agronomic soil conservation practices among crop-based farmers in Ekiti State, Nigeria. Multi-stage random sampling technique was employed to select 90 crop-based farmers from six communities across the three agricultural zones in the State. Data were collected with the used of structured questionnaire. The data collected were analysed using descriptive statistics, binary probit model and factor analysis. The results obtained from the analyses showed that the effects of soil degradation on agricultural production in the area include: Pollution, limited space for agricultural production, erosion, deteriorated environmental quality and reduced soil nutrients among others. The socio-economic attributes of the farmers that significantly influenced their willingness-to-pay for agronomic soil conservation measures include: age ($p<0.05$), education ($p<0.01$), farming experience ($p<0.05$), farm size ($p<0.01$) and household size ($p<0.05$). The factor constraints undermining effective application of agronomic soil conservation measures by crop-based farmers were inputs, finance, institutional challenge and environmental factor. Based on these findings, the study recommended socio-economic capacity building of crop-based farmers in effective application of agronomic soil conservation measures, provision of required infrastructural facilities, education and institutional supports to the farmers for sustained food production through sustainable and environmental friendly soil conservation measures.

Key words: Soil degradation, soil conservation, sustainability, crop production, challenges, Ekiti state

INTRODUCTION

Soil is the most important resource on which sustainable agriculture and livelihood of the farmers is based. Therefore, proper management of this valuable resource is vital to uphold long-term agricultural productivity of the farm households. Probably, no less than a quarter of the world population belongs to farm households and most of which are in less developed countries of the world (Ellis, 2000), Nigeria inclusive. Hence, the increased pressure on the available soil for food production most especially among developing nations of the world. FAO (2007a) affirmed that the use of soil for agricultural production is one of the strongest influences affecting environmental quality in many developing countries. Specifically, practices like unguided application of agrochemicals, bush burning, deforestation, grazing, continuous tillage and uncontrolled farm mechanization affect the quality of soil and vegetation cover, thereby resulting into soil degradation.

Soil degradation is a phenomenon that is either natural or human-induced. Asadu *et al.* (2004) grouped soil degradation into soil erosion, soil infertility and soil pollution by soil spillage and industrial waste. Soil degradation is accelerated when the forest cover is removed, pastures are overgrazed and overall land use patterns are not sustainable. In Nigeria and other African countries, this phenomenon is being hastened by reduction in fallow periods and the shift from conventional bush fallowing system to permanent cultivation caused by population pressure and agricultural activities (Ameyan and Ogidiolu, 1989). Decline in agricultural productivity as a result of soil degradation is evaluated in terms of inputs use such as fertilizer/manuring, water management and tillage methods to boost production (Mbagwu, 2003). Due to changing human needs and competition for different uses of land, there is need for systematic land use and sustainable soil conservation approach. In affirmation, Yohanna *et al.* (2012) suggested that, a soil that has been degraded required fallowing and soil conservation activities for effective rehabilitation. Corroborating this fact, Panda (2007) emphasized that soil conservation remains the only known way to sustain the productivity of agricultural land.

Conservation of soil resources is a significant socio-environmental issue that affects the well being of people in farming communities in Nigeria. For instance, soil conservation activities in both short and long run increase crop yield and prevents further deterioration of cultivable soil. Badejo and Togun (2001) stated that, effective soil conservation on agricultural lands guarantees sustainable food productivity potential of the soil. Mekonnen and Michael (2014) noted that, the failure of farmers to adopt appropriate soil conservation practices contributes significantly to the degradation of a considerable portion of agricultural land. Effective soil conservation practices are classified into three major strategies which include: soil management, mechanical and agronomic soil conservation strategies (Junge *et al.*, 2009). At the community and government levels, soil conservation measures are soil management and mechanical-based such as: fencing, gully control, river bank protection, trail improvement, community based-irrigation schemes, afforestation, construction of water ways, supply of fertilizer inputs to farmers at subsidized rate, construction of drainage among others (Igbokwe, 1996). Whereas, at farm level, Mbagwu (2003) observed that, agronomic soil conservation strategies promote farm households capacity to cope with the threat of soil degradation and its associated low crop yield.

Agronomic measures in soil conservation include mulching and crop management such as cover cropping, fallowing, multiple cropping, intercropping, planting pattern and crop rotation (Junge *et al.*, 2009). These practices use the effect of surface covers to reduce erosion by water and wind in order to conserve the soil (Morgan, 1995). The report of AIB (2011) justified the need for increased adoption and practice of agronomic soil conservation measures by farmers being more economical, sustainable, effective and ecological friendly. In Southwest Nigeria and Ekiti State in particular where most of the cultivable soils are degraded due to excessive deforestation and other economic activities that threaten the natural environment, efforts aimed at bridging food production to meet the need of the growing population must be geared towards sustainable soil conservation practices such as agronomic measures. This is because, soil fertility is at present the most critical factor for sustainable crop production (Babatunde *et al.*, 1978).

Recognizing, most especially the significance of sustainable soil conservation measures on agriculture, there is need to strengthen the knowledge of agronomic soil conservation practices among crop-based farmers and other stake holders in Nigerian agriculture. This study estimated the willingness-to-pay for agronomic soil conservation practices among crop-based farmers in Ekiti State, Nigeria. Although, empirical studies evident in Tanagahari (2006) investigated economic analysis of soil conservation practices in Benue State, Raufu and Adetunji (2012) also examined the determinants of land management practices among crop farmers in South-Western Nigeria. The focus of these two studies was broadly on soil conservation practices which are grouped into; soil management, mechanical and agronomic soil conservation strategies without any attempt to empirically investigate the determinants of any of the three soil conservation strategies among crop-based farmers. Therefore, this study in addition to estimating farmers' willingness-to-pay for agronomic soil conservation practices also investigated agronomic soil conservation practice combination among the farmers, the effects of soil degradation on crop production and challenging factors facing farmers in agronomic soil conservation practice in the area.

METHODOLOGY

Study area: The study was carried out in Ekiti State, South-west Nigeria. The state is located between longitudes 4°45′ and 5°45′ East of the Greenwich meridian and latitudes 7°15′ and 8°15′ North of the equator. Topographically, the state is mainly an upland zone rising above 250 m above sea level (ESG., 2013). The population of Ekiti State as reported by National Population Commission NPC (2006) is 2,384,212 people with more than 80% of the population engage in farming as main source of livelihood (Amusa *et al*., 2011). Ekiti State has 16 administrative local government areas divided into three agricultural zones namely; Zone A, B and C. Ekiti State is suitable for livestock rearing, production of cash crops such as cocoa, coffee, cola nut and food crops, such as; yam, cassava, cocoyam, plantain and so on (Kuponiyi and Bamigboye, 2009).

Sampling procedure: Multistage random sampling technique was used in selecting the respondents. Two local government areas were randomly selected from each of the three agricultural zones making six local government areas. From each of the six local government areas, one farming community was selected making six communities for the study. With the assistance of key informants, the list and location of crop-based farmers in each of the selected communities were compiled from which the sample for the study was drawn. For logistic convenience, 15 farmers were randomly sampled from each of the six communities across the state totaling 90 crop-based farmers in all.

Data collection: Structured questionnaire was used for data collection. This focused mainly on socio-economic characteristics of the farmers, agronomic soil conservation practice combination by the farmers, effects of soil degradation and challenges facing farmers in agronomic soil conservation practices in the area. The data for the study were collected in October-November, 2013 with the help of six extension agents in the state.

Estimation procedure: The data collected were analyzed using descriptive statistics (frequency, mean and charts), probit model and factor analysis as detailed below.

Mean rating: To identify the perceived effects of soil degradation in the study area, mean rating technique was employed using 4-point rating scale. The 4-point rating scale was categorized as Very Serious (VS) = 4, Serious (S) = 3, Less Serious (LS) = 2 and Not Serious (NS) = 1. The mean ratings of the farmers based on the 4-point rating scale were graded using boundary limit.

Response categories		Ordinal values	Boundary limit
Very Serious (VS)	=	4	3.50-4.00
Serious (S)	=	3	2.50-3.49
Less Serious (LS)	=	2	1.50-2.49
Not Serious (NS)	=	1	1.00-1.49

The boundary limits of 1.00-1.49; 1.50-2.49; 2.50-3.49 and 3.50-4.00 were used to interpret the results and categorize the mean values of the effects of soil degradation as: Very Serious, Serious, Less Serious and Not Serious, respectively.

Probit model: Binary probit model was used to estimate farmers' willingness-to-pay for agronomic soil conservation practices in the area. The willingness-to-pay was obtained from a dichotomous (discrete) choice question with Yes = (1) if willing to invest in agronomic soil conservation practices or No = (0) if not willing. The hypothesized determinants of farmers' willingness-to-pay for agronomic soil conservation practices in this study are:

X1 = Ages of household head continuous (in number of years)
X2 = Years of education continuous (in number)
X3 = Farm income continuous (in Naira ₦)
X4 = Years of farming experience continuous (in number)
X5 = Farm size continuous (in number of ha)
X6 = Household size continuous (in number of persons)
X7 = Extension visits (in number) continuous (no of times in last cropping season)
X8 = Land ownership dummy (1 if farmer owned land, 0 otherwise)

The explicit form of the binary probit model is specified as:

$$Pr\ (Y = 1/X) = ß_0+ß_1X_1+ß_2X_2+ß_3X_3+ß_4X_4+ß_5X_5+ \ldots\ldots\ldots\ldots\ldots\ldots +e$$

Where:

Y = Dichotomous probability estimate with 1, if farmers were willing-to-pay for agronomic soil conservation practices and 0 if otherwise
$ß_0$ = Intercept
$ß_1, \ldots ß_{10}$ = Coefficients of the independent variables
$X_1, \ldots X_{10}$ = Determinants of farmers' willingness-to-pay for agronomic soil conservation practices'
e = The stochastic error term

Factor analysis: Exploratory factor analysis procedure was employed to identify challenging factors facing farmers in agronomic soil conservation practices in the area. The challenges noted by the farmers were grouped into four factors using principal component factor analysis with iteration and varimax rotation and factor loading of 0.40. The model is represented as:

$$
\begin{aligned}
Y_1 &= a_{11}X_1+a_{12}X_2+* * *+a_{1n}X_n \\
Y_2 &= a_{21}X_1+a_{22}X_2+* * *+a_{2n}X_n \\
Y_3 &= a_{31}X_1+a_{32}X_2+* * *+a_{3n}X_n \\
* &= \qquad\qquad\qquad * \\
* &= \qquad\qquad\qquad * \\
Y_n &= a_{n1}X_1+a_{n2}X_2+* *+a_{nn}Xn
\end{aligned}
$$

Where:

$Y_1, Y_2 \ldots Y_n$ = Observed variables/challenges to farmers in agronomic soil conservation practices.

a_1-a_n = Factor loadings or correlation coefficients.

$X_1, X_2, \ldots X_n$ = Unobserved underlying challenging factors facing farmers in agronomic soil conservation practices.

RESULTS

Agronomic soil conservation practice combination among the farmers: The result presented in Table 1 showed the multiple responses of majority of the farmers (86%) responded in affirmation to the use of one form of agronomic soil conservation practices or the other. For instance, about 86% of the farmers practiced mulching, 78% practiced intercropping, 73% engaged in multiple cropping practice while land fallowing as agronomic soil conservation was practiced by about 51% of the farmers. Only about 38, 29 and 26% of the respondents practiced cover cropping, changing planting dates and crop rotation, respectively as agronomic soil conservation measures in their farmlands.

The bar chart (Fig. 1) further illustrated the degree of usage of the identified agronomic soil conservation measures by the farmers in the study area.

Table 1: Multiple responses of percentage distribution of agronomic soil conservation practice combination by crop-based farmers in Ekiti state

Agronomic soil conservation practices	Frequency	Percentage (%)
Mulching	77*	85.6
Cover cropping	34*	37.8
Fallowing	46*	51.1
Multiple cropping	66*	73.3
Intercropping	70*	77.8
Changing planting dates	26*	28.9
Crop rotation	23*	25.6

*Multiple responses, field survey (2013)

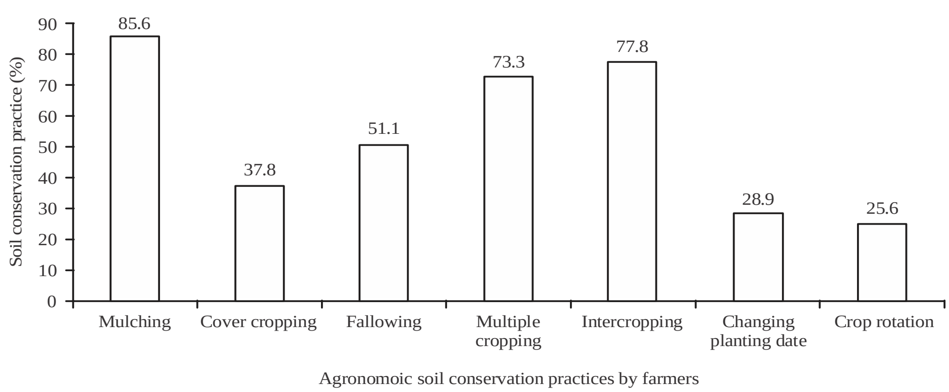

Fig. 1: Bar chart showing percentage distribution of agronomic soil conservation practices employed by crop-based farmers in Ekiti state, field survey, 2013

Table 2: Major effects of soil degradation on agricultural production in the area

	(N = 90)		
Effects of soil degradation	$\bar{X}$	SD	Remarks
Soil/land pollution for agriculture	3.33	0.854	S
Reduced agricultural yields	3.51	0.548	VS
Deteriorated soil fertility condition	3.56	0.674	VS
Limited space for agricultural production	3.42	0.678	S
Poor quality of farm products	3.17	0.754	S
Serious land and water erosion	3.23	0.865	S
Deteriorated environmental quality (pollution)	3.00	0.798	S
Poor soil structure for agricultural production	3.27	0.989	S
Low soil moisture for crop growth	2.40	1.197	LS
Reduced chemical properties and soil nutrients	2.55	1.023	S
Reduced activities of soil organisms such as earthworms	3.02	0.978	S
Negative health implication to livestock and the farmers	2.65	0.999	S

X: Mean, SD: Standard deviation, VS: Very serious, S: Serious, LS: Less serious, field survey (2013)

Effects of soil degradation on agricultural production in the area: The result in Table 2 presents mean ratings of some effects of soil degradation on agricultural production in the study area. The identified effects of soil degradation on agricultural production with their corresponding mean values include; Soil/land pollution for agriculture (3.33), limited space for agricultural production (3.42), poor quality of farm products (3.17), serious land and water erosion (3.23), deteriorated environmental quality (pollution) (3.00), poor soil structure for agricultural production (3.27), reduced chemical properties and soil nutrients (2.55), reduced activities of soil organisms, such as earthworms etc (3.02) and negative health implication to livestock and the farmers (2.65). The mean values of these effects of soil degradation on crop production were within the range of 2.50-3.49 on a 4-point rating scale. This indicates that the nine identified items are serious effects of soil degradation on agricultural production in the study area.

Two out of the twelve identified items in the table, specifically, items 2 and 3 had mean values of 3.51 and 3.56, respectively which fell within the range of 3.50-4.00 on a four-point rating scale. This shows that the two identified items are very serious effects of soil degradation on agricultural production in the study area.

Determinants of willingness-to-pay for agronomic soil conservation practices: Farmers willingness-to-pay for agronomic soil conservation practices was hypothesized to be influenced by their socio-economic characteristics. The result of the binary probit model analysis presented in Table 3 showed that the explanatory power of the specified variables as indicated by the pseudo R^2 value of (0.674) was good. This indicates that the estimated independent variables are responsible for about 67% variation in farmers' Willingness-To-Pay (WTP) for agronomic soil conservation options. The overall goodness of fit as reflected by Prob>Chi^2 (0.000) was also good. In terms of consistency with a priori expectations on the relationship between the dependent variable (WTP) and the explanatory variables, the model seems to have behaved well. Out of the eight explanatory variables specified in the model, five were statistically significant at 1 and 5%. The parameter estimates of the probit model only provided the direction of the influence of the explanatory variables on farmers WTP for agronomic soil conservation practices and did not show the actual magnitude of change or probabilities in the coefficients. Thus, the marginal effects (dy/dx) from the probit model, which measure the expected change in probability of WTP for agronomic soil conservation practices with respect to a unit change in an independent variable was also presented in the Table 3.

Table 3: Parameter estimates and marginal effects of the probit model analysis of socio-economic determinants of farmers' willingness-to-pay for agronomic soil conservation practices

	Parameter estimates		Marginal effects	
Variables	Coefficients (β)	Std. error	Change in Prob.	Std. error
Age (No. of years)	0.03495 (2.46)**	0.02230	0.01760 (2.46)**	0.00712
Education (number of years)	0.23613 (2.69)***	0.083970	0.07245 (2.68)***	0.02693
Income (in naira ₦)	0.00841 (0.15)	0.053060	0.01269 (0.17)	0.01763
Farming experience (number of years)	0.07442 (2.43)**	0.030670	0.02384 (2.43)**	0.00998
Farm size (in hectare (ha)	-0.89492 (-2.65)***	0.337970	-0.01674 (-2.65)***	0.11024
Household size (number of persons)	3.58066 (2.12) **	0.180800	0.01206 (2.12) **	0.05543
Extension visits (number of visits per season)	-0.14770 (-1.48)	0.099910	-0.04732 (-1.48)	0.03257
Farmland ownership* (1 if owned the land, 0 otherwise)	1.80773 (1.68)	1.075660	0.02440 (1.68)	0.31120
Constant	0.92011 (2.25)	0.848030		

***Denotes $p \leq 0.01$, **Denotes $0.01 < p \leq 0.05$, Figures in parenthesis () are z-ratios, LR chi^2: 30.54, Pseudo R^2: 0.674, Prob> chi^2 : 0.000, No. of observation = 90, For the marginal effects, (*) dy/dx is for discrete change of dummy variable from 0-1 z and p>|z| correspond to the test of the underlying coefficient being 0, Field survey (2013)

The age of the farmers was significant (p<0.05) and positively related with willingness-to-pay for agronomic soil conservation practices. This implies that older farmers are more willing to practice agronomic soil conservation in their farmlands than the younger ones. The result of the marginal effect on age suggests that an additional one unit in age of the farmers would result in 0.017 (1.7%) increase in probability of willing to practice agronomic soil conservation. Education of the farmers was significant (p<0.01) and positively related with willingness-to-pay for agronomic soil conservation practices. This entails that educated farmers are more willing to practice agronomic soil conservation in their farmlands than the uneducated counterparts. The result of the marginal effect on farmers education suggests that an additional one unit in years of education of the farmers would result in 0.072 (7.2%) increase in probability of becoming willing to practices agronomic soil conservation.

Farmers' years of farming experience was also positive and significantly influenced willingness-to-pay for agronomic soil conservation practices at p<0.05. In other word, experienced farmers are more likely to be more willing to practice agronomic soil management practices to conserve their farmlands from degradation. The result of the marginal effect on farmers experienced implies that an additional one unit in years of farming experience of the farmers would result in 0.023 (2.3%) increase in probability of willing to practice agronomic soil conservation.

The coefficient of farm size was significant (p<0.01) but negatively related with willingness-to-pay for agronomic soil conservation practices. The indication of the negative relationship was that, as farmers farm size increases, the likelihood of practicing agronomic soil conservation measures reduces. The result of the marginal effect on farm size suggests that an additional one unit in farm size would result in 0.016 (1.6%) decrease in probability of willing to practices agronomic soil conservation. Household size was positive and significant (p<0.05) with farmers' willingness-to-pay for agronomic soil conservation practices. The effect of household size implies that farmers with large number of people in their households are more willing to practice agronomic soil conservation practices.

Challenging factors facing crop-based farmers in agronomic soil conservation practice in the area: Table 4 presents the varimax-rotated challenging factors facing crop-based farmers in agronomic soil conservation practice in the area. From the data presented in the table, four factors were extracted based on the responses of the farmers that constituted the respondents for the study. Only variables with factor loadings of 0.40 in absolute terms and above were used in

Table 4: Varimax rotated challenging factors facing farmers in agronomic soil conservation practices in the area (N = 90)

Challenging variables against the farmers	Components: Input factor	Financial factor	Institutional factor	Environmental factor
Illiteracy of the farmers	-0.273	0.434	0.381	-0.260
Lack of extension visits to the farmers	0.366	-0.238	0.402	0.105
Poor access to conservation information by farmers	0.483	0.040	-0.330	-0.207
Tedious nature of agronomic soil conservation practices	-0.146	0.364	0.015	0.379
Lack or low financial capacity of the farmers to invest in agronomic soil conservation practices	-0.290	0.550	0.345	0.032
Lack of access to supporting facilities e.g, cooperative, adult education programme	-0.332	0.118	0.537	0.253
Unwillingness of the farmers to practices agronomic soil conservation	-0.265	0.070	0.203	-0.143
**Poor knowledge of the importance of agronomic soil conservation by most farmers	0.050	0.056	0.415*	-0.662*
High cost of farm inputs required in agronomics soil conservation practices	0.570	0.270	0.154	0.337
Rough topography of the farm land	0.134	0.234	0.265	0.661
Poor nature of the soil to support soil conservation in the area	-0.250	-0.106	0.254	-0.469
Inadequate knowledge of some agronomic soil conservation practices	0.196	0.564	0.023	0.044
Poor access to and control of farm resources e.g. land by most of the farmers	-0.520	-0.361	0.384	0.106
Low level of farming experience by most of the farmers in the area	0.175	0.224	0.041	0.462
Poor drainage or erosion control in the area	0.239	0.252	0.156	0.244
The nature of land tenure system in the area	0.050	0.383	-0.551	0.228
Inadequate farm labour to support in agronomic soil conservation practices	0.615	0.200	0.083	-0.099
**Continuous cultivation of the farm lands	0.440*	0.369	-0.015	-0.475*
Porous nature of the soil in water holding capacity	0.322	0.116	-0.301	0.348
Insufficient knowledge of credit source to support agronomic soil conservation in the farm	0.101	-0.660	0.243	-0.080
High cost of available farm labour for effective practice of agronomic soil conservation by farmers	0.440	-0.233	-0.092	-0.111
Subsistence scale nature of crop production of most farmers in the area	-0.090	0.219	0.315	0.390
Low fertility of most of the farm lands in the area	0.329	0.074	0.381	-0.315
Inadequate institutional support from government for intensified agronomic soil conservation by farmers	0.397	-0.025	0.685	-0.174
Lack of collateral security required to secure loan for intensified agronomic soil conservation operations	0.054	0.214	0.336	0.360

Factor loading of 0.40 is used at 10% overlapping variance, variables with factor loadings of less than 0.40 were not used, **variables that loaded in more than one factor were discarded, field survey (2013)

naming the challenging factors. Variables that had factor loading of less than 0.40 in absolute terms and those that loaded in more than one factors were not used (Madukwe, 2004). The next step was to give each factor a denomination according to the set of variables or characteristics it was composed of. In this regards, the variables with factor loading of 0.40 and above were grouped into four major challenging factors namely: Input factor, financial factor, institutional factor and environmental factor.

Under input factor, the specific challenging variables against farmers' practice of agronomic soil conservation measures with their corresponding factor loading include: poor access to conservation information by farmers (0.483), high cost of farm inputs required in agronomics soil conservation practices (0.570), poor access to and control of farm resources e.g. land by most of the farmers (0.520), inadequate farm labour to support in agronomic soil conservation practices (0.615) and high cost of available farm labour for effective practice of agronomic soil conservation by farmers (0.440). Under financial factor, the specific challenging variables against farmers practice of agronomic soil conservation measures with their corresponding factor loading include: Illiteracy of the farmers (0.434), lack or low financial capacity of the farmers to invest in agronomic soil conservation practices (0.550), inadequate knowledge of some agronomic soil conservation practices (0.564) and insufficient knowledge of credit source to support agronomic soil conservation in the farm (-0.660). The specific variables that loaded under institutional factor with their corresponding factor loading were: Lack of extension visits to the farmers (0.402), lack of access to supporting facilities e.g, cooperative, adult education programme (0.537), the nature of land tenure system in the area (-0.551) and inadequate institutional support from government for intensified agronomic soil conservation by farmers (0.685). Under environmental factor, the specific challenging variables undermining farmers practices of agronomic soil conservation with their corresponding factor loading were: rough topography of the farm land (0.661), poor nature of the soil to support soil conservation in the area (-0.469) and low level of farming experience by most of the farmers in the area (0.462).

DISCUSSION

Agronomic soil conservation practices among the farmers were: intercropping, multiple cropping, mulching, cover cropping and crop rotation. The findings supported the report of FAO (2007a) which identified mulching, multiple cropping, intercropping and fallowing as common agronomic soil conservation practices among farmers in sub-saharan African. In addition, Junge *et al*. (2009) enumerated agronomic soil conservation measures commonly practiced among farmers to include: mulching and crop management practices which consist of cover cropping, fallowing, multiple cropping, intercropping, planting pattern/time and crop rotation. These practices according to Morgan (1995) use the effect of surface covers to reduce erosion by water and wind in order to conserve the soil.

Some of the notable effects of soil degradation on agricultural production include: soil/land pollution for agriculture, limited space for agricultural production, poor quality of farm products, serious land and water erosion, deteriorated environmental quality and poor soil structure for agricultural production. The finding agreed with the report of UN/FAO (2005) that soil erosion and degradation problems affects agricultural production inform of reduced agricultural yields per hectare, poor soil structure for agricultural production, reduced activities of soil organisms such as earthworms and consequently deteriorated soil fertility condition. Nkoya *et al*. (2004) in a study established that soil degradation, soil erosion and nutrient depletion contribute significantly to low agricultural productivity and thus food insecurity in many developing countries.

Socio-economic characteristics of the farmers such as age, education, years of farming experience, farm size and household size significantly influence their willingness-to-pay for agronomic soil conservation practices. The report of FAO (2007b) showed that there is positive relationship between education and adoption of organic agriculture. Ogundele and Okoruwa (2006) stated that to be competent enough to handle all the vagaries of agriculture, farmers need experience through the years he has stayed in the farm to increase farm output. Ballayan (2000) stated that soil conservation practices are not only cost but labour intensive in cultivable soil management and maintenance. Igbokwe (1996) reported that high labour intensity among others are some of the problems of soil conservation.

The study found that challenging factors facing crop-based farmers in agronomic soil conservation practice in the area include: Input, financial, institutional and environmental factors. The findings of this study agreed with that of Amusa *et al*. (2011) who found that high cost of farm input and inadequate access to inputs constitute major challenges of farmers in Ekiti State. In addition, Fadayomi (1988) stated that high cost of inputs, farm labour and associated low level capital investment in agriculture due to low farm income are some of the major challenges facing most African farmers. Enete (2003) reported that most financial institutions in developing countries do not usually lend to agriculture, not only because the farmers lack the basic collateral as a result of poverty, but also because the farming is considered very risky. This finding supports that of Abah (2011) whose findings showed that lack of capital/credit for expansion, high cost and low profit as part of the challenges of farmers in the use of organic manure for soil conservation.

Inadequate extension contacts and supporting facilities are some of the institutional challenges facing farmers as Madukwe (1996) noted that ineffective transfer of agricultural technology through extension agents is a major problem facing agricultural development in Nigeria. Adekunle (2009) reported that some farmers are not willing to plant trees for soil conservation due to non-availability of land, problems of land tenure, long gestation period of trees, lack of planting materials (seeds and seedlings), lack of technical expertise, lack of incentive and poor government policies. Blosser (1953) found that rough topography of the farmland is a major challenge of farmers in soil conservation practices.

CONCLUSION

The study estimated the determinants of willingness-to-pay for agronomic soil conservation practices among crop-based farmers in Ekiti State, Nigeria. In carrying out the study, effort was made to investigate agronomic soil conservation practice combination by the farmers, the effects of soil degradation on crop production and farmers' challenging factors in agronomic soil conservation practice in the study area. Out of the seven agronomic soil conservation measures, mulching, intercropping, multiple cropping and fallowing are most practiced by the farmers. The identified effects of soil degradation on agricultural production in the area include: Pollution, limited space for agricultural production, erosion, deteriorated environmental quality among others reduced soil nutrients. The socio-economic attributes of the farmers that significantly influenced willingness-to-pay for agronomic soil conservation measures include: age of the farmers, education, farming experience, farm size and household size. The factor constraints undermining effective application of agronomic soil conservation measures by crop-based farmers in the study area were farm inputs, finance, institutional challenge and environmental factor.

The foregoing suggest socio-economic capacity building of crop-based farmers in effective application of agronomic soil conservation measures to sustain food production on the degrading and threatened soil in the state. In particular, credit facilities should be made available to the farmers in form of soft loans to enable them procure necessary inputs to cope with the challenges of managing soil fertility and productivity. Provision of required infrastructural facilities, education and institutional supports to the farmers should be made a priority by government for sustained food production through sustainable and environmental friendly soil conservation measures.

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