



## AGRICULTURAL ORGANIZATIONS AND ADOPTION OF SOIL CONSERVATION PRACTICES AMONG SMALLHOLDER FARMERS IN OYO STATE, NIGERIA †

[ORGANIZACIONES AGRÍCOLAS Y ADOPCIÓN DE PRÁCTICAS DE CONSERVACIÓN DE SUELOS ENTRE PEQUEÑOS AGRICULTORES EN EL ESTADO DE OYO, NIGERIA]

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### SUMMARY

**Background.** As part of efforts to reduce soil degradation and improve agricultural yield, farmers in the study area learned about various soil conservation practices through agricultural organizations. **Objective.** This study, therefore, investigated the impact of agricultural organizations on the adoption of soil conservation practices. **Methodology.** Through a multi-stage sampling procedure, the data collected were analyzed with the aid of descriptive statistics and a double hurdle regression model. **Results.** The descriptive results revealed that three conservation practices were majorly adopted in the study area, namely, cover crop (25 adopters), vegetative fallow (63 adopters) and mulch (83 adopters). The result further revealed significant differences in some socioeconomic characteristics between the categories of adopters in the study area, such as the age of the farmers, off-farm income, farming experience and the household size. However, the study concluded that the majority of the smallholder farmers were male, small scale and at their productive age. According to the first hurdle, the factors responsible for the adoption of the three soil conservation practices were; off-farm income, extension contact, farm size, years of education and membership in the agricultural organization. In the same vein, the factors that contributed to the intensity of soil conservation practices were membership of the agricultural organization, farm size, location of a valley on the farm land and household size. **Implications.** The paper adds evidence for a better understanding of the nexus between the agricultural organisation and the adoption of soil conservation practices. **Conclusion.** Based on these findings, the study recommends encouraging the training and strengthening of agricultural organizations for better adoption of soil conservation practices. In addition, effective strategies, programs and institutional structures that improve farmers' education, the frequency of extension contacts and off-farm income should be established.

**Key words:** Agricultural Organizations; Soil Conservation Practices; Smallholder Farmers.

### RESUMEN

**Antecedentes.** Como parte de los esfuerzos para reducir la degradación del suelo y mejorar el rendimiento agrícola, los agricultores del área de estudio aprendieron sobre diversas prácticas de conservación del suelo a través de organizaciones agrícolas. **Objetivo.** Este estudio, por lo tanto, investigó el impacto de las organizaciones agrícolas en la adopción de prácticas de conservación del suelo. **Metodología.** A través de un procedimiento de muestreo de etapas múltiples, los datos recopilados se analizaron con la ayuda de estadísticas descriptivas y un modelo de regresión de doble obstáculo. **Resultados.** Los resultados descriptivos revelaron que tres prácticas de conservación se adoptaron mayoritariamente en el área de estudio, a saber, cultivos de cobertura (25 adoptantes), barbecho vegetativo (63 adoptantes) y mantillo (83 adoptantes). El resultado reveló además diferencias significativas en algunas características socioeconómicas entre las categorías de adoptantes en el área de estudio, como la edad de los agricultores, los ingresos fuera de la experiencia agrícola y el tamaño del hogar. Sin embargo, el estudio concluyó que la mayoría de los productores de cacao eran hombres, en pequeña escala y en su edad productiva. Según el primer obstáculo, los factores responsables de la adopción de las tres prácticas de conservación de suelos fueron; ingreso fuera de la finca, contacto

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de extensión, tamaño de la finca, años de educación y afiliación a una organización agrícola. De la misma manera, los factores que contribuyeron a la intensidad de las prácticas de conservación del suelo fueron la pertenencia a una organización agrícola, el tamaño de la finca, la ubicación del valle en la tierra de la finca y el tamaño de la familia.

**Implicaciones.** El documento agrega evidencia para una mejor comprensión del nexo entre la organización agrícola y la adopción de prácticas de conservación del suelo. **Conclusiones.** Con base en estos hallazgos, el estudio recomienda incentivar la capacitación y fortalecimiento de las organizaciones agrícolas para una mayor adopción de prácticas de conservación de suelos. Además, deben establecerse estrategias, programas y estructuras institucionales eficaces que mejoren la educación de los agricultores, la frecuencia de los contactos de extensión y los ingresos no agrícolas.

**Palabras clave:** organizaciones agrícolas; suelo conservaciones prácticas; pequeños agricultores.

## INTRODUCTION

Soil resources are important in maintaining the livelihood of humankind because they provide food, clean water, and air and serve as major transporter for biodiversity (Katsuyuki 2009; Keesstra *et al.*, 2016). Soil is a fixed and irreplaceable resource, limited in supply, mainly essential for the production of food and other necessities of life (Babalola *et al.*, 2009). Consequently, soil is the most important resource in agricultural production to realize the basic requirements of food and shelter of man (FAO, 2007). Therefore, proper soil fertility management is vital to uphold long-term agricultural productivity. The importance of soil fertility in agricultural production systems as a medium for crop growth, sustainability, productivity, and provision for plants and animals cannot be overemphasized. Nothing is more essential to the long term survival of the human species than the availability of fertile soils to maintain plant and animal populations. Yet, soils have been mined by erosion, constant cultivation and extraction of available nutrients. Over the years, numerous economic factors, such as population pressure, poverty, insecurity of land tenure, policies and institutions, poor infrastructure and services, and some agricultural practices such as continuous tillage, have caused a massive loss of soil fertility, estimated at 30 million tons globally (Olatunji, 2003; Kessler and Stroosnijder, 2006; Okoba *et al.*, 2007; Tamene and Vlek, 2007). For instance, population pressure leads to an increase in demand for food, which leads to continuous farming rather than shift cultivation. It has been observed that continuous farming practices damage soil components, exposing the soil to degradation. Beinroth *et al.* (1994) defined soil degradation as loss of actual or potential productivity due to factors that could be natural or anthropic. It is the decline in soil quality or reduction in its productivity. Madu (2001) also submitted that the negative impacts of soil degradation are loss of soil fertility, low yield, reduced cultivable lands, loss of farm crops, and diversion of huge sums of money from other social needs, among other things.

Soil degradation is a phenomenon that is either natural or human-induced. Asadu *et al.* (2004) classified soil

degradation into soil erosion, soil infertility and soil pollution either by soil spillage or industrial waste, or both. Soil degradation caused by soil erosion has been estimated to affect about 80% of agricultural land in the World (Angima *et al.*, 2003; Rodrigo-Comino *et al.*, 2015; Molla and Sisheber, 2017). Soil erosion can be defined as the gradual washing away or removal of the top-most surface of the earth's crust, which includes: nutrients from the soil (Chup, 2007). The soil erosion removes the topsoil and deposits them into rivers, streams, and groundwater resources (Jimoh, 2003 and Isikwue, 2005). James and Ngala (2015) noted that soil erosion is the most widespread type of soil degradation in Nigeria, Oyo State inclusive, and has been recognized as a severe long-time problem in Southwestern Nigeria (Oyewole *et al.*, 2020). The soil of southwestern Nigeria is eroded mainly through water erosion as high intensity rainfall removes the topsoil (Babalola *et al.*, 2003). Typically, the soils are characterized by low productivity due to inadequate moisture retention capacity and low organic matter due to erosion (Cockroft and Olsson, 2000; Young and Young, 2001).

Soils in Nigeria suffer deficiencies such as a low percentage of organic matter and nitrogen, shallow depth and high acidity, which predispose about 63% of agricultural soils in Oyo State to low productivity (Lekwa and Whiteside, 1996). In most rural communities in Oyo State, where most smallholder farmers cultivate the land, over 80% of the cropland region is ravaged by erosion (NEST, 1991; James and Ngala, 2015). This poses a serious threat to farm productivity and food security (Oladeji, 2007). The average annual loss of productive capacity through soil fertility depletion is estimated to be 25 million tonnes (Adediji, 2000; Eswaran *et al.*, 2001). This has led to serious problems such as low yield, famine, low standard of living, decrease in the availability of fuelwood, food insecurity, poverty and migration of rural dwellers (Olatunji, 2003). Most times, rural farmers often suffer meagre returns from agricultural production owing to soil erosion. If this continues unabated, it will result in severe ecological damages, loss of soil structure, reduction of soil biodiversity, soil compaction, a decline in agricultural productivity, low farm income, chronic poverty, national food

insecurity and social disorder. Therefore, there is an urgent need to conserve soil fertility. The soil needs to be conserved because agriculture and related primary production activities depend on this soil. According to FAO (2001), declining soil productivity without appropriate soil conservation techniques means less food can be grown and the production of cash crops for export is endangered. Corroborating this fact, Panda (2007), Yohanna *et al.* (2012), and Mekonnen and Michael (2014) emphasized that soil conservation remains the only known way to sustain the productivity of agricultural land.

Soil conservation is the practice of shielding all surface deposits using soil conservation techniques, not merely the near-surface, organic layers that are subject to present-day weathering (Schwah *et al.*, 1993). Soil conservation techniques are a set of management practices to prevent the topsoil from being eroded or the soil from being degraded chemically or structurally due to overuse (Lal, 2015; Seenga, 2014; Dimelu *et al.*, 2013; Ezeaku, 2012). It is also a set of management strategies for the prevention of soil becoming chemically altered by salinization, acidification, and other chemicals, or by contamination. There are various soil conservation techniques that farmers can adopt to reduce soil erosion (Kabubo–Mariara *et al.*, 2010). However, effective soil conservation practices are classified into three major strategies which include: soil management, mechanical and agronomic soil conservation strategies (Junge *et al.*, 2009). Affirming this fact, 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 this, the Oyo State Agricultural Development Program (OYSADEP) and research institutes such as the Institute of Agricultural Research and Training (IAR & T) and the International Institute of Tropical Agriculture (IITA) had introduced several conservation measures of the soil to farmers in the State of Oyo. Soil conservation practices involve fertility management, which involves using techniques such as mulching, tree planting, multi-purpose tree hedge planting, contouring, fallow vegetative system, minimal tillage, double crop, and the settlement of crops, minerals, and fertilizers, among others. The literature by Onwudike *et al.* (2016) and Daudu *et al.* (2016) highlights several benefits of these conservation practices, including improved soil fertility, improved soil structure, labor savings, soil biodiversity, soil compaction, increased soil productivity, increased agricultural income, food safety and environmental sustainability. For instance, it has been noted that yields of crops are higher on farms with conservation practices than on farms

without conservation practices, even in the same ecological zone (Ibewiro *et al.*, 2000; Salako and Tian, 2003; James and Ngala, 2015).

Despite the obvious efforts of the government and other research institutes to promote the use of soil conservation practices among farmers and the benefit of soil conservation practices, the uptake of these practices by smallholder farmers is said to remain very low (Owombo and Idumah, 2015). The adoption and intensity of these practices usually involve risk among the farmers, which may be influenced by several factors, ranging from environmental factors, the farmers' socioeconomic characteristics, and the methods used by extension agents (Ndove *et al.*, 2006). Ndove *et al.* (2006) further noted that farmers are reluctant to invest in soil conservation practices because of high purchase costs. Therefore, the lack of working capital and access to credit is among the other factors responsible for the poor adoption of the soil conservation practice. Smallholder farmers more often lack access to credit services because of numerous reasons, including lack of collateral and the risky nature of agriculture in Nigeria (Oke *et al.*, 2019). Conley and Udry (2010) explained that agricultural organizations could counteract the negative effect of farmers' lack of access to credit that hinders adoption. Thus, the agricultural organizations create the platform for acquiring credit and other relevant resources, such as information that fosters adoption (Kehinde, 2021). Furthermore, the information received through this platform reduces uncertainty about the performance of new technology and encourages farmers to adopt that technology. The agricultural organization was found to have a key influence on adoption. However, only a limited number of studies have analyzed the role of agricultural organizations in the adoption process.

There are well-established research studies on the willingness to pay for soil conservation practices (Amusa *et al.*, 2015), economic analysis of soil conservation practices (Tanagahari, 2006), and determinants of soil management practices (Raufu and Adetunji, 2012). Nevertheless, this study differs from these related studies. It aimed at determining the impact of agricultural organizations on uptake and intensity of use for soil conservation practices; none exists to the authors' best knowledge. There have been not many efforts to investigate the relationship between agricultural organizations and soil conservation practices among smallholder farmers, which accordingly is the focus of this study. The objectives of this study are twofold. First, profile the various types of soil conservation practices used by the smallholder farmers to mitigate soil erosion in the study area. Secondly, it evaluates the impact of the agricultural organization on uptake and intensity of

use for soil conservation practices. The study's novelty also lies in the adoption of the double hurdle model to generate the impact coefficient of agricultural organizations on the soil conservation practices uptake after accounting for the selection bias problem. The paper contributes to the literature in the following ways. Firstly, the results of this study have contributed to identify implemented soil conservation practices by farmers and their effectiveness. Secondly, the result will be used as a stepping stone to examine farmers' perception of soil conservation measures in the study area with modification to immediate issues and factors influencing the usage.

## MATERIALS AND METHODS

### Area of study

The study was conducted in the State of Oyo, in the geopolitical zone of southwestern Nigeria. It borders to the south with the state of Ogun, to the north with the state of Kwara, to the west, partly with the state of Ogun and partly with the Republic of Benin, while to the east with the state of Osun. It is found in the Yoruba lands, where land possession is predominantly patriarchal. It covers an area of 27,249 square kilometers. The terrestrial landscape consists of ancient hard rocks and dome-shaped hills, which rise gently from about 500 meters in the southern part and reach a height of about 1,219 meters above sea level in the northern part. It consists of 33 Local Government Areas (LGA) and four agricultural areas of; Ibadan / Ibarapa, Ogbomoso, Saki and Oyo. These four agricultural zones were grouped by the Oyo State Agricultural Development Program (OYSADEP). There are two weather seasons. These are the rainy and drought seasons and occur from March to October and November to early March, respectively. The average annual rainfall is 1420.06 mm and the average daily temperature fluctuates between 25 and 35 ° C. The state's climate favors the cultivation of crops such as yams, cassava, millet, rice, banana, cocoa, palm and cashew nuts. The state of Oyo is subject to soil erosion.

### Sampling procedure and sample size

A multistage sampling procedure was used to select 180 participants for the study. The first stage involved the purposive selection of two agricultural zones in the State of Oyo, namely Ogbomoso and Oyo agricultural zones, based on the high incidence of soil erosion in the zones. The second stage involved a purposive selection of three LGAs from each agricultural zone based on the intensity of soil erosion in the area. In the third stage, three villages were purposively selected due to the high rate of soil erosion in the villages. The fourth stage involved the simple random selection of 10 smallholder farmers in each of the villages.

Information was collected on farmers' socioeconomic characteristics (such as gender, age of the farmers, years of farming experience, and educational status among others) types of conservative techniques (mulching, cover crops, vegetative fallow system) factors influencing decisions and intensity of use of soil conservation in the study area.

### Analytical techniques and model

Data were analyzed with the aid of descriptive statistics and double hurdle regression model (Adeyemo and Kehinde, 2019 and Adeyemo and Kehinde, 2020).

#### Descriptive statistics

Descriptive statistics were used to describe the socio-economic 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

##### Theoretical double hurdle regression model

Following Adeyemo and Kehinde (2019), and Adeyemo and Kehinde (2020), double hurdle model was used to determine the impact of agricultural organizations on decisions to conserve and the 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.

The double-hurdle model has an adoption (D) equation given by:

$$D_i^* = 1 \dots \text{if } D_i^* > 0,$$

$$D_i^* = 0 \dots \text{if } D_i^* \leq 0 \quad (1)$$

$$D_i^* = \alpha X_i + \mu_i$$

Where;

$D_i^*$  is the latent variable that takes the value 1, if the farmer uses some soil conservation practices and 0, if otherwise;  $X_i$  is a vector of independent variables affecting the use of soil conservation practices  $\alpha$  is a vector of unknown parameters;  $\mu_i$  is residuals that are independently and normally distributed with mean

zero and a constant variance  $\sigma^2$ .  $i = 1, 2 \dots n$ . ( $n$  is the number of observations)

The second hurdle involves an outcome equation, which uses a truncated model to determine the extent of adoption (intensity of use) of the soil conservation practices. This second hurdle will use observations only from those respondents who indicated a positive value of the use of soil conservation. The truncated model, which closely resembles the Tobit model, is expressed as:

$$Y_i = \{ Y_i^* \text{ if } Y_i^* > 0 \text{ and } D_i^* > 0 \} \quad (2)$$

$$Y = \beta X_i + \varepsilon_i \quad (3)$$

Where;

$Y_i$  is the observed response to the intensity of use of soil conservation;  $X_i$  is a vector of explanatory variables hypothesized to influence the intensity of soil conservation use;  $\beta$  is a vector of parameters and  $\varepsilon_i$  is the standard error term.

The decision on whether or not to conserve soil and how much of that soil conservation to use can be jointly modeled if they are made simultaneously by the household; independently modelled if they are made separately; or sequentially modelled if one is made first and affects the other one as in the dominance model (John *et al.*, 2009).

The error terms, are distributed as follows:

$$\mu_i = N(0,1)$$

$$\varepsilon_i = N(0, \sigma^2) \quad (4)$$

The model is dependent if there is a relationship between the decision to conserve and the intensity of conservation.

This relationship can be expressed as follows:

$$\rho = (Cov(\mu_i \varepsilon_i)) / \sqrt{Var(\mu_i) Var(\varepsilon_i)} \quad (5)$$

If  $\rho = 0$  and there is dominance [(the zeros are only associated with non-adoption, not standard corner solutions), then the model decomposes into a Probit for adoption decision and truncated for the intensity of conservation on soil (John *et al.*, 2009)]. Smith (2003) assume that the error terms  $\mu_i$  and  $\varepsilon_i$  are independently and normally distributed.

Finally, the observed variable in a double-hurdle model is:

$$Y_i = D_i^* Y_i^* \quad (6)$$

The Log likelihood function for the double hurdle model is given by:

$$\text{Log L} = \varepsilon \ln [1 - \Phi(\alpha z_i (\beta x_i / \sigma))] + \varepsilon \ln [\Phi(\alpha z_i / \sigma) \varphi(Y_i - \beta x_i / \sigma)] \quad (7)$$

Where  $\Phi$  denotes the standard normal cumulative distribution function (Univariate or Multivariate) and  $\varphi$  is the univariate standard normal probability distribution function  $Z_i$ ,  $X_i$ ,  $\beta$ ,  $\alpha$ ,  $\sigma$  as defined earlier. Under the assumption of independence between the error terms  $\mu_i$  and  $\varepsilon_i$ , the model as originally proposed by Cragg (1971) is equivalent to a combination of a truncated regression model and a univariate probit model.

### Empirical double hurdle regression model

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

$$D_i = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7 + b_8 X_8 + b_9 X_9 + b_{10} X_{10} + b_{11} X_{11} + b_{12} X_{12} + b_{13} X_{13} + b_{14} X_{14} + b_{15} X_{15} + \varepsilon_i \quad (8)$$

Where;

$D_i$  is the decision to conserve (1, If the farmer conserved the soil or 0= if otherwise),  $b_0$  is intercept.

The explanatory variables are defined as follows:

$X_1$  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 gender 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 (numbers persons in the household),  $X_{10}$  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.

In the second hurdle, a truncated regression model was used to determine the impact of agricultural

organizations on the intensity of soil conservation use. The dependent variable is land area under each of the soil conservation practices. The estimated model is specified as follows:

$$Y_i = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + b_{12}X_{12} + b_{13}X_{13} + b_{14}X_{14} + b_{15}X_{15} + \varepsilon_i \quad (9)$$

Where;

$Y$  is land area under each of the soil conservation practices

The explanatory variables are defined as follows:

$X_1$  is age of farmers (years),  $X_2$  is education in number of years spent in schools (years),  $X_3$  is membership in agricultural organization (1 for members, 0 for non-member),  $X_4$  is farming experience (years),  $X_5$  is off-farm income (₦),  $X_6$  is gender 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)  $\varepsilon_i$  is the error term. The presence of these variables will be

based on apriori expectation on the inputs used. The explanatory variables included in this study were those socioeconomic variables that were expected to influence socio-economic factors affecting soil conservation practices among smallholder farmers in Oyo state.

## RESULTS AND DISCUSSION

### Profile of soil conservation practices adoption in the area of study

The number of non-adopters of any soil conservation practice in the study area is 7 persons. The presence of non-adopters might be due to the lack of information and the support of the concerned organization in the study area. Approximately 25, 63 and 83 smallholder farmers in the study area adopted cover crops, vegetative fallow systems, and mulching practices, respectively. Mulching is the most adopted soil conservation practice, while the cover crop is the least adopted in the study area. Low cover crop adoption may be due to labor shortages at the peak of the season due to the seasonality of the Nigerian agricultural system (Akinbile and Odebode, 2007; Akinola, 2008). A relatively large number of mulch users could be attributed to effective extension service, a high level of literacy and the presence of an agricultural organization (Junge *et al.*, 2009).

**Table 1. Description of variables.**

Variables	Value/ measure	Expected sign	Studies
Age	Years	±	Akinola <i>et al.</i> , 2010; Onu, 2013
Education	Formal education =1 Informal=0	+	Bamire <i>et al.</i> , 2002; Akinola <i>et al.</i> , 2010
Membership in agricultural organization	Member=1, Non-member=0	+	Bamire <i>et al.</i> , 2002; Akinola <i>et al.</i> , 2010; Kehinde, 2021
Farming experience	Years	±	Godoy <i>et al.</i> , 2001; Clay <i>et al.</i> , 2002
Off-farm income	Naira (₦)	+	Akinola and Owombo, 2012
Sex	Male=1, Female=0	+	Alene <i>et al.</i> 2000
Farm size	Hectares	±	Akinola <i>et al.</i> , 2010, 2011
Number of contacts with an extension agent	Number of visits	+	Owombo <i>et al.</i> , 2011; Kidane, 2001
Household size	Number of members	±	Bekele and Mekonnen, 2010; Akinola and Owombo, 2012
Credit use	Access; yes=1, no=0	+	Owombo <i>et al.</i> , 2011; Holden and Shiferaw, 2002; Bekele and Drake, (2003)
Asset	Access; yes=1, no=0	±	Bekele and Mekonnen, 2010
Labour used	Man-days	±	Bekele and Mekonnen, 2010; Akinola and Owombo, 2012
Slope of the land	Steep slope =1, otherwise = 0	±	Onu, 2013
Land located on a valley	Valley=1, otherwise=0	+	Onu, 2013
Land located on highland	Highland=1. Otherwise=0	+	Onu, 2013

### **Intensity of soil conservation practices adoption in the area of study**

The soil conservation practices adopted by the respondents in the study area were intensively used differently. About 56.1% of the plots owned or operated upon were uncovered, while the cover cropping adopters covered 43.9% of the farmland. Only 8.9% of the portion of land owned or operated upon were not vegetatively fallowed while 91% of the farmland were fallowed. The area of farmland not mulched were 23.9% while the area of land mulched was 76.1%. The reason for the high rate of vegetative fallow system and mulching usage may be attributed to the presence of an agricultural organization, according to Kehinde (2021).

### **Demographic and socio-economic characteristics of the respondents**

Table 2 reveals the differences in socioeconomic and demographic characteristics between the categories of farmers in the study area. The study results revealed that there were variations in some demographic and socioeconomic characteristics between the categories of adopters in the study area. Result from Table 2 shows that agricultural works are dominantly practiced by male farmers. The majority (90.6%) of the respondents are males. The low percentage of female farmers might be because they are less likely to command the resources such as (land, credit or information) to take full advantage of soil conservation practices (Ogunlela and Mukhar, 2009). According to McCarthy and Sun (2009), women in agriculture are generally more involved in off-farm activities such as (buying and selling farm produce), especially in African Countries. All non-adopters and vegetative fallow system adopters are married, 92% of adopters of cover cropping are married while 98.8% of adopters of mulching are married. The result indicates that most of the respondents are married, which implies that most respondents have family responsibilities. According to Akinola and Adeyemo (2013), it is expected that married farmers have a greater number of labour for farm work. If primary school completion is taken to be a sound literacy level, the result revealed that approximately 78.3% of the respondents could read or write. In summary, it can be deduced from the above that the literacy level of the respondents is very high. Therefore, literate farmers are expected to use the conservation measures effectively. This could be attributed to the fact that higher education gives farmers the ability to interpret and respond to new information much faster than their counterparts with lower education (Odeno *et al.*, 2009). The average age of those who did not adopt soil conservation practices is 52 years. The average age of the adopters ranges from 45.44 years to 53.03 years.

F-Test reveals a significant difference ( $p < 0.001$ ) between the age categories of farmers. This result could indicate that farmers in the study area are in their economically active age. This could have a significant bearing on their decision to use soil conservation practices in several ways (Akinola *et al.*, 2010; Adeyemo, 2011; Onu, 2013). The average farm size for the entire sample is 4.69 hectares and ranges from 3.44 hectares to 4.11 hectares among adopters. There are no significant differences between the categories of farmers due to the size of the farm. This is possible as a farmer who has a relatively large plot of land can rent out part of his land to earn income and run his production activity (Akinola *et al.*, 2010; 2011; Perseverance *et al.*, 2012). This finding further implies that the majority of the farmers operate on small-scale production. The reason is that, they had a farm size of fewer than five hectares which was considered as small-scale. The average household size is 7.55 for non-adopters, 6.44 for cover crops, 7.28 for vegetative followers, and 8.31 for mulch adopters. F-Test reveals a significant difference ( $p < 0.05$ ) between farmers' categories for household size. This indicates that the household is the main supplier of labour available for agriculture and farming is majorly maintained by the household. This reiterates the fact that large household size is assumed to be an indicator of labour availability and that such a household would like to adopt soil conservation practices to improve its food security (Nnadi and Akwiwu, 2006; Idrisa *et al.*, 2012). The average number of hired labor used in the last cropping season among the adopting category in the study area is 13 for non-adopters and 33, 42, and 47 for cover cropping, vegetative fallowers, and mulch adopters, respectively. The results revealed that farmers who do not adopt soil conservation practices hired the least number of labour than those who do. Farmers in the study area are mostly smallholders and they rely mainly on the household labour supply to carry out both the farm and non-farm (domestic and social) activities. The number of extension visits among non-adopters was 77.8% and ranged between 96.8% and 100% among adopters. The result indicates that those who adopted soil conservation practices were the most visited in the last growing season. Visits by extension agents determine the rate at which knowledge is gained about a given (new) technology due to constant interactions (Junge *et al.*, 2009). Frequent contacts will enhance farmers' exposure to improved production packages (Owombo *et al.*, 2011). The average years of farming experience among non-adopters is 11.1 years and ranges from 16 to 40 years among adopters. The F-value showed a significant difference ( $p < 0.001$ ) between the categories of farmers by farming experience. This shows that most of the respondents have been into farming, practicing soil conservation measures. This finding reiterates that the quantum of experience could influence farmers'

readiness to adopt soil conservation practices (Rahman *et al.*, 2002; Ajewole, 2010). This means that the adopters have accumulated a lot of experience from their previous farming practices. Non-adopters recorded an average of ₦ 3,410.00 (\$ 8.21) as non-farm income in the study area. The income outside the farming ranged from ₦6,480.00 (\$15.61) to ₦ 56,500.00 (\$136.07) among adopters. F-value showed significant differences ( $p < 0.05$ ) among the means of off-farm income of the adopters. The result suggests that the availability of capital makes the adoption of soil conservation measures feasible. This agrees with the findings that increased off-farm income increases the adoption of technologies (Onweremadu and Njoku, 2007; Tiamiyu, 2008). Majority (64.4%) of the respondents had access to credit. The result agrees with the findings of Amani (2005). This implies that most of the respondents have access to formal credit for maintaining production on their farmland. Membership in agricultural organizations is a measure of social capital. It has been found to influence the social interaction and exchange of ideas among farmers (Bamire *et al.*, 2002; Akinola *et al.*, 2010; Akinola and Owombo, 2012; Kehinde and Ogundeji, 2022). The result revealed that up to two-thirds (63.7%) of the sampled farmers belong to one organization or another.

#### **Impact of agricultural organization on adoption and Intensity of soil conservation practice**

##### **Impact of agricultural organization on the adoption of soil conservation practice**

The impact of agricultural organization in adopting soil conservation practices among respondent categories is presented in Table 3. The result showed that the log probability function for cover crops, vegetative fallow, mulch adoption is -79.6242, -43.2505 and 76.1668, respectively. The chi-squared value for cover crops, vegetative fallow, mulch adoption is 43.68, 26.07 and 43.24, respectively. These values showed that the whole model fits well and is significant at an alpha level of 1%. These values supported the fitness of the model. The entire model was significant at 1 percent level of probability. The estimated first hurdle regression result establishes relationship between agricultural organizations and soil conservation measures in the study area.

The results in Table 3 revealed that age of the household head is statistically significant ( $p < 0.1$ ) and positively influenced the adoption of cover cropping practice. The result suggests that an additional unit in age of the respondents increased adoption of cover cropping practice by 2.5 percent. This is an indication

that older farmers have more experience, resources and authority that give them more possibilities for adopting cover cropping practice. This conform to the expectation of the study that expected sign of age could be positive or negative and in agreement with previous studies such as Bayard *et al.* (2007) and Abdulazeez *et al.* (2014). Furthermore, the result shows that credit access is significant ( $p < 0.05$ ) and positively influenced the adoption of cover cropping practice. The result reveals that an increase in the credit accessed by farmers by ₦1.00 increased the adoption probability of cover cropping practice by 0.03 percent. This implies that increased credit access in turn increased the respondents' adoption, which indicates that the availability of credit to the farmers can influence the adoption of cover cropping practice. This conformed to the expectation of the study carried out by Owombo *et al.* (2011) which states that when credit is readily available to the farmers, it can make farmers to adopt a technology. The coefficient of off-farm income is significant ( $p < 0.001$ ) and positively influenced the adoption probability of cover cropping practice in the study area. The result shows that an increase in off-farm income by ₦1 increased adoption probability of cover cropping by 0.02 percent. This indicates that high income is associated with resource ownership and control. This conforms to the expectation of the study and previous study conducted by Bayard *et al.* (2007) that within a community with limited resources, farmers with higher income can adopt soil conservation measures to improve their production. The coefficient of farm size is significant ( $p < 0.05$ ) and positively influenced the adoption of cover cropping practice. The result reveals that an increase in the size of the farmland by one hectare increased the adoption of cover cropping by 0.11 percent. This indicates that the larger the farm size, the greater the likelihood that a farmer will adopt cover cropping practice. This conforms to the expectation of the study and previous studies carried out by Bekele and Drake (2003) that farm size could stimulate better adoption of soil conservation practices. Extension visit has a positive influence on adoption of cover cropping practice and was statistically significant ( $p < 0.001$ ). The result shows that an increase in the contact an extension agent had, with a farmer increased the adoption probability of cover cropping by 0.41 percent. This is an indication that agricultural extension agents provide various information on how to improve farming activities. This agrees with the previous study conducted by Chi and Yamada (2002) that through effective demonstration by extension agents, farmers tend to appreciate the benefit that could be derived from adoption of soil conservation practices.



**Table 2. Demographic and socio-economic characteristics of the respondents.**

Variables	Non-adopter (n=9)	Cover cropping (n=25)	Vegetative fallow system (n=63)	Mulching (n=83)	pooled	F-value
Male (%)	77.8	88.0	92.1	91.6	90.6	
Married (%)	100.0	92.0	100.0	98.8	98.3	
Education (%)	44.6	84	90.5	71	78.3	
Age	52	45.44	48.49	53.03	50.33	4.86 ***
Household size	7.55	6.44	7.28	8.31	7.65	2.09 **
Farm size	3.44	4.86	4.11	3.92	4.69	0.95
Extension visit (%)	77.8	100	96.8	98.8	83.4	
Farming experience	11.1	40.0	28.6	15.7	26.11	4.06 ***
Off farm income (₦)	3,410.00	6,480.00	52,100.00	56,500.00	45,000.00	2.20 **
Labour	13	33	44	47	41	
Access to credit	11.1	76.0	82.5	53.0	64.4	
Membership of Agricultural organization	38.6	88.9	64.0	68.8	63.7	

Source: Field survey, 2017.

The coefficient of age reveals that age of farmers is statistically significant and positively influenced adoption probability of vegetative fallow system practice. The result reveals that an increase in the age by a year increased adoption probability by 0.74 percent. The result implies that the older the household head, the higher the probability of adoption of vegetative fallow system practice in the study area. This conforms with previous studies on technology adoptions such as Deressa *et al.*, (2009) that older farmers have more experience which gives them possibilities for trying soil conservation practices. The coefficient of off-farm income is significant ( $p < 0.05$ ) and positively influences the adoption probability of vegetative fallow system practice. The result reveals that an increase in off-farm income by ₦1 increased the adoption probability of vegetative fallow system practice by 0.02 percent. This implies that increase in off-farm income increased adoption of vegetative fallow system practice by the farmers in the study area. These agreed with the previous studies by Bayard *et al.* (2007) that within a community with limited resources, farmers with higher income can take the risk of establishing their farms. The coefficient of farm size is significant and positively influenced adoption of vegetative fallow system. The result reveals that increase in the size of the farmland by one hectare increased the adoption of cover cropping by 14.93 percent. This indicates that the larger the farm size, the greater the likelihood of adopting vegetative fallow system practice. This conforms to the previous studies carried out by Aklilu and De Graaf (2007) that large farm size could enhance better adoption of conservation practices. The coefficient of extension visits is significant ( $p < 0.1$ ) and has a positive influence on the adoption of vegetative fallow system. The result

reveals that increase in the contact an extension agent(s) had, with the farmers in turn increased the adoption probability of vegetative fallow system practice in the study area by 6.27 percent. This implies that the more the extension visits, the greater the likelihood of a farmer adopting vegetative fallow system practice in the study area. These agreed with the expectation of the study and the outcomes of previous studies conducted by (Abdulai and Huffman, 2005) that extension agents influence level of adoption to choose the best conservation practice that best suits them.

Education, which is respondents' ability to read or write, is significant and positively related to mulching practice in the study area. The coefficient of education is significant ( $p < 0.05$ ) and positively influenced the adoption of mulching practice. The result suggests that an increase in years of education resulted in an increase in adoption probability of mulching practice in the study area by 1.39 percent. This implies that the more educated a farmer is, the greater the likelihood that he would adopt mulching practice in the study area. This conformed to the expectation of the study and agreed with previous studies conducted by Alene *et al.* (2000) that higher education gives farmers the ability to respond to and interpret information much faster than their counterparts with lower education. Furthermore, the coefficient of farmers' year of farming experience is significant ( $p < 0.05$ ) and positively influenced adoption of mulching practices. The result shows that an increase in the number of years of farming experience increased the adoption probability of mulching by 0.87 percent. This indicates that experienced farmer understands and interprets information on the adoption of mulching practice. This

agrees with the study and consonance with Nnadi and Amaechi (2007) that explained increased years of farming experience as a valuable asset in technology adoption. Membership of agricultural organizations is significant ( $p < 0.05$ ) and positively influenced the adoption of mulching practice. The result reveals that membership in farmers association increased the adoption probability by 0.43 percent. This indicates that the more the respondents join farmer's association, the more the adoption probability of mulching practice in the study area. This was expected of the study and outcome of previous studies by Idrisa *et al.* (2012) and Nyanga (2012) which states that membership could enhance farmer's level of exposure to useful information discussed at their meetings on adoption of improved technologies, while also enjoying assistance in form of credits and other incentives often extended to farmers' unions and organizations by governments, NGOs in order to expand both their output and income. Similarly, the coefficient of household size is significant ( $p < 0.001$ ) and has a positive influence on the adoption of mulching practice. The result reveals that an additional unit of labour from household increased the adoption probability by 9.30 percent. This implies that farmers with large number of people in their households are more eager to practice mulching in the study area. This was expected of the study and outcome of previous study by Oluoch-Kosura *et al.* (2001), Bamire and

Fabiyi (2002), Bekele and Drake (2003), Nnadi and Akwiwu (2008) that the larger the household, the more the pressure to ensure food security and high predisposition to adoption. The coefficient of asset is significant and it influences the adoption of mulching practice, positively. The result reveals that an effective contact with the farmer increases the adoption probability of mulching by 9.86 percent. This indicates that effective contact with the farmer who owns productive assets could increase the likelihood of adopting mulching practice. This is expected of the study and outcome of previous studies by Kabubo-Mariara *et al.* (2006), Deininger *et al.* (2009) that farmers would have the assurance of future return on their asset and this would enable them to invest more in mulching practice.

### Impact of an agricultural organization on the intensity of soil conservation practice

The impact of agricultural organization on the intensity of soil conservation practices among the categories of respondents is presented in Table 4. The result showed that the log probability function for cover crops, vegetative fallow system, adoption of mulch is -79.6242, 31.3343 and -44.6326, respectively. These values showed that the whole model fits well and is significant at an alpha level of 1%. The coefficient of gender is significant ( $p < 0.1$ ) and

**Table 3. Impact of agricultural 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)
Agricultural 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	0.0000	0.0000

Source: Field survey, 2017

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

Data in Parentheses ( ) represents the standard error

Only marginal coefficients are reported in the Table

positively influenced the intensity of cover cropping. The result shows that an effective contact with a male household head increased the intensity of cover cropping practice by 0.0765 hectares. This is because men generally have high risk-bearing ability than their female counterparts. This conformed to the studies conducted by Akinola and Adeyemo (2008), Ogunlela and Mukhtar (2009), Alene *et al.* (2000) and Adeyemo (2011) that the women who engage in farming activities are less likely to take full advantage of technology compared to men who adopt very fast. The result also shows that the coefficient of the age of farmers is significant ( $p < 0.1$ ) and positively influenced the intensity of cover cropping practice in the study area. The result shows that an increase in the age by a year increased the intensity of cover cropping practice by 0.0001 hectares. This implies that older farmers have more experience, resources and authority that give them more possibilities for using cover cropping than the younger farmers. This agreed with the expectation of the study and previous study by Amusa *et al.* (2015) that older farmers are more willing to practice soil conservation in their farmlands than the younger ones.

The coefficient of off-farm income is significant ( $p < 0.001$ ) and positively influenced the intensity of cover cropping practice. The result reveals that an increase in off-farm income by ₦1 increased the intensity of cover cropping practice by 0.0016 hectares. This implies that the more the income realized from off-farm engagements, the more the hectares of land acquired. Hence, increase in the income from off farm engagements increased the intensity of use of cover cropping. These agreed with the expectation of the study and the previous study by Lapar *et al.* (1999) that off-farm income provides more money to acquire more hectares of land. The coefficient of location of valley on the farm land in the study area is significant ( $p < 0.1$ ) and had a positive influence the intensity of adoption of cover cropping practice. An increase in the valley of the farm land by one unit increased the intensity of adoption of cover cropping by 0.0409 hectares. This is an indication that location of valley on farm land increases the adoption of soil conservation practices. This agreed with the findings of Onu (2013) that farmers whose farmland is located in a valley tend to use soil conservation practices to protect the soil from agents of degradation. Extension visit has a positive influence on adoption of cover cropping practice and is statistically significant ( $p < 0.001$ ). The result shows that an increase in the contact an extension agent has with a farmer increased the intensity of cover cropping by 0.1413 hectares. This is an indication that agricultural extension agents provide various information on how to improve farming activities. This agrees with expectation of the

study and previous studies conducted by Chi and Yamada (2002), Yirga (2007).

The result of the second hurdle regression estimates reveals that the coefficient of gender is significant ( $p < 0.001$ ) but negatively influenced the intensity of vegetative fallow system practice. The result reveals that an effective contact with a male farmer reduced the intensity of vegetative fallow system practice by 0.1371 hectares. The indication of the negative relationship is that female headed household use vegetative fallow system practice more than male headed household. This conforms to the expectation of the study and previous study carried out by Burton *et al.* (1999) that female-headed households engage in vegetative fallow system practice due to low technicalities involved. The farmers' education coefficient is significant ( $p < 0.05$ ) and positively influenced the intensity of vegetative fallow system practice. The result suggests that an additional unit in years of education of the farmers increased the intensity of vegetative fallow system by 0.0068 hectares. This indicates that the more educated a farmer, the more he is to diagnose and observe the benefits of new technologies. Hence, more hectares of land are cultivated. This also agrees with the apriori expectation of the study and conformed to previous studies by Oluoch-Kosura *et al.* (2001) and Bekele and Mekonnen (2010) that educated farmers understand and adopt conservation technique more than illiterate farmers. Farmers' years of farming experience is significant ( $p < 0.1$ ) and positively influenced intensity of vegetative fallow system practice in the study area. The result implies that an additional unit in years of farming experience of the farmers increased the intensity of vegetative fallow system practice by 0.0007 hectares. This indicates that the number of years of experience a farmer had in farming increases the intensity of vegetative fallow system practice in the study area. This agrees with expectation of the study and in consonance with Nnadi and Amaechi (2007) that explained increased years of farming experience as a valuable asset in adoption process. The coefficient of farm size is significant ( $p < 0.001$ ) and positively influences the intensity of vegetative fallow system practice. The result reveals that an increase in the farm land size increased the intensity of vegetative fallow system by 0.0037 hectares. This indicates that farmers who had more assets had more dispositions to use soil conservation practices than those who had less. This agrees with expectation of the study and previous studies by Aklilu and De Graaf (2007) that larger farm owners have more flexible in their decision-making, and have greater access to discretionary resources and more opportunities to use soil conservation practices.

**Table 4. Impact of agricultural 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)
Agricultural 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	0.000	0.000	0.000

Source: Field survey, 2017

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

Data in Parentheses ( ) represents the standard error

The results of the intensity of mulching practice in the study area is also presented in Table 4. The coefficient of gender is significant ( $p < 0.1$ ) and has a positive influence on intensity of mulching practice. The result reveals that a contact with male household head increased the intensity of mulching practice by 0.0393 hectares. This indicates that male-headed households use mulching practice than female-headed households. This also conforms with expectation of the study and previous studies carried out by Akinola and Adeyemo (2008) that male farmers are more involved in farming than their female counterparts, this might be due to many socio-cultural values and norms. The coefficient of years of education is significant ( $p < 0.001$ ) and positively influences the intensity of mulching practice. A unit increase in the years of education of the farmers in the study area increased the intensity of mulching practice by 0.0074 hectares. This indicates that an educated farmer understands technology more than illiterate farmers. This agrees with expectation of the study and previous studies by Boz *et al.* (2011) and Idrisa *et al.* (2012) that farmers' exposure to education will increase their ability to use necessary information to alleviate their farming practices by continuous use of conservation practices. Membership of agricultural organization was significant ( $p < 0.001$ ) and has a positive influence on intensity of mulching practice. Effective contact with a member of agricultural organization increased the intensity of mulching by

0.1133 hectares. This is an indication that the more social organizations the farmers belong to and actively participate, the more likelihood of their predisposition to intensify the usage of mulching practice. This was expected of the study and outcome of previous studies by Alemitu (2011) and Mignouna *et al.* (2011) that farmers who participate in different agricultural organizations have access to agricultural information and use improved technology effectively. The coefficient of extension visits is significant ( $p < 0.1$ ) and has a positive influence on the intensity of mulching practice. The result reveals that an increase in the contact an extension agent(s) had with the farmers in turn increase the intensity of mulching practice in the study area by 0.0879 hectares. This implies that the more the extension visits, the greater the likelihood that a farmer would use mulching practice in the study area. This agreed with the expectation of the study and previous studies carried out by Knowler and Bradshaw (2007) that farmers who tend to have freedom of mobility, participate in different extension programs, have access to agricultural information, and use improved technology effectively.

## CONCLUSIONS

This study investigated the impact of agricultural organization on the adoption and intensity of soil

conversation practices. There are three categories of adopters in the study area with variations in their socioeconomic characteristics. However, the study concluded that majority of the smallholder farmers were male, small scale and at their productive age. Of all the conservation practices, vegetative fallow system and mulching were the most adopted practices. According to the first hurdle, the factors responsible for adoption of the three soil conservation practices were; off farm income, extension contact, farm size, years of education and membership of agricultural organization. In the same vein, the factors contributing to the intensity of soil conservation practices were membership of agricultural organization, farm size, valley location on the farmland, and household size. The study, therefore, concluded that there was dissimilarity in the factors affecting the adoption and intensity of each of the soil conservation practices. Agricultural organization is the key factor influencing the most technical soil conservation practices (mulch). Therefore, the study encourages the training and strengthening of agricultural organization for better adoption of soil conservation practices. Policymakers should focus on pioneering effective institutional structures that would enable the establishment of extension services systems to promote uptake of farming technologies. This would work towards filling the existing gap especially from the government side. Extra earnings from off-farm activities helped smallholder farmers overcome serious liquidity constraints in the study area. Therefore, strategies designed to increase off-farm income-earning activities should be encouraged.

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**Compliance with ethical standards.** The research presents original data that are not submitted to other journals at the same time. Besides, the research was conducted according to the established procedures of the Obafemi Awolowo University, Ile-Ife, Nigeria.

**Ethical approval.** This study was ethnically approved by the Postgraduate Committee of Obafemi Awolowo University, Ile-Ife, Nigeria.

**Statement of informed consent.** Verbal and written informed consent were obtained from the respondents for their anonymized information to be published in this article.

**Data availability.** Data are available with the corresponding author at: (kehindeyodeji8@gmail.com) upon reasonable request.

**Author contribution statement (CRediT).** **M. A. Kehinde:** Conceptualization, project administration, writing – original draft, writing – review and editing. **A. D. Kehinde:** Methodology, data curation, formal analysis, writing – original draft, writing – review and editing. **A.A. Akinola:** Conceptualization, supervision. **A. A. Ogundeji:** Supervision.

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