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Assessment of Factors Influencing the Adoption of Sustainable Land Management Practices at the Farm Level in Wondo Genet District, Sidama Regional State, Ethiopia

Tadege Teshome Gebremariam [a*]

[a] *Dilla University, Dilla, Ethiopia.*

Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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Abstract

The advancing threat of land degradation continues to put sustainable livelihoods at risk in the study area. Diverse array of farm level Sustainable Land Management technologies was recommended as a potential solution for combating land degradation. However, sustained use of these practices is far below the expectation. The current study was conducted with the objective of identifying the determinants of farm level implementation of sustainable land management practices among smallholder farmers in 2023. Systematic random sampling technique was employed for quantitative and qualitative data collection and data analysis were conducted using binary logit model and descriptive statistics.

The results off descriptive and inferential statistics and Binary logistic model result indicate that the determinants of SLM such as sex of the household, family size, and distance negatively influencing the farmers' decision to implement sustainable land management practices. While resource total livestock unit,

**Corresponding author: E-mail: fnts246@gmail.com;*

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extension services, access to credit, information landform are positively impelling the decision of farmers to implement sustainable land management practices. In addition, the key informant interview and focus group discussion revealed that there is a gap between the implementation of SLMP and land policy because of lack of well-organized institutional arrangements for the better implementation of SLM at farm plots. In general, the institutional linkage, strong follow-up and evaluation as well as bottom-up approach on building institutional capacities and strengthening and partnerships between the local, regional and national levels are should be needed for sustained implementation of SLM practices in the study area.

Keywords: Land degradation; sustainable land management; logit model.

1. Introduction

"Land degradation has been a major issue in Sub-Saharan African (SSA) countries. Land degradation has many causes that differ from place to place. The principal causes of land degradation can be divided into two categories: proximate and underlying causes according to" Pingali et al., (2014., 2019).

"Land degradation and declining soil fertility are serious global problems particularly whose economies depend on agriculture. These problems lead to losses in food production and endanger food security worldwide, particularly in developing countries" according to report of Zerihun Nigussie et al. (2017)

"One of the sub-Saharan African nations that are most severely impacted by land degradation is Ethiopia" (Federal Democratic Republic of Ethiopia FDRE, 2015). The minimum anticipated yearly costs of land degradation in Ethiopia vary from 3 to 4% of agricultural GDP (FDRE, 2015), without taking into consideration downstream and offsite impacts like flooding and infrastructure damage brought on by erosion.

According to Ephrem Tilauhun, & Isreal Zewide. (2021) "Over 40% of cultivated lands, 30% of forests, and 10% of grasslands are experiencing degradation. Likewise, millions of hectares of land are degraded each year across all climate zones. In Sub-Saharan Africa, land degradation has become a major challenge to agricultural productivity and food security, where the livelihoods of the majority of the rural poor largely depend on rain-fed agriculture".

One of Ethiopia's main environmental issues is soil erosion, which lowers the production of arable fields. Among the causes of soil erosion are erosive rains and rocky topography. According to Dimtsu (2018), "the average yearly rate of soil loss in the country is estimated to be 12 t ha-1 year-1; however, on steep slopes and in areas with little vegetation cover, this rate can reach 300 t ha-1 year-1". "Degradation in agricultural areas is accelerating due to ineffective planning and implementation methods for conservation and poor land and water management practices. Since steep slopes have been used for agriculture in the Ethiopia R for many years, they are vulnerable to significant soil erosion" (Mekuria et al., 2018). "The soil's chemically active components, such as organic matter and clay fractions, which are its most productive components, are removed by erosion. Additionally, it worsens soil structure and capacity to retain moisture by decreasing soil depth, raising bulk density, causing soil crusting, and lowering water infiltration. Crop yields are steadily dropping because of erosion and depleted fertility, and the typical Ethiopian farm family of roughly six people currently harvests less than a tone of grain every year, which is insufficient for the subsistence diet" (Alemu et al., 2013; Molla & Sisheber 2017; Shiferaw, 2002; Teketel, 2009)

Land degradation represents a serious developmental challenge in Wendogenet districts that it influences human livelihoods, with significant negative implications for sustained socio-economic growth and development in their surroundings. Although, Various authors conducted researches on SLM and the associated problems on the causes of land degradation by traditional land management practices and they reported as there are huge gaps managing the detrimental impacts of land degradation through SLM practices in most parts in highland parts of the country.

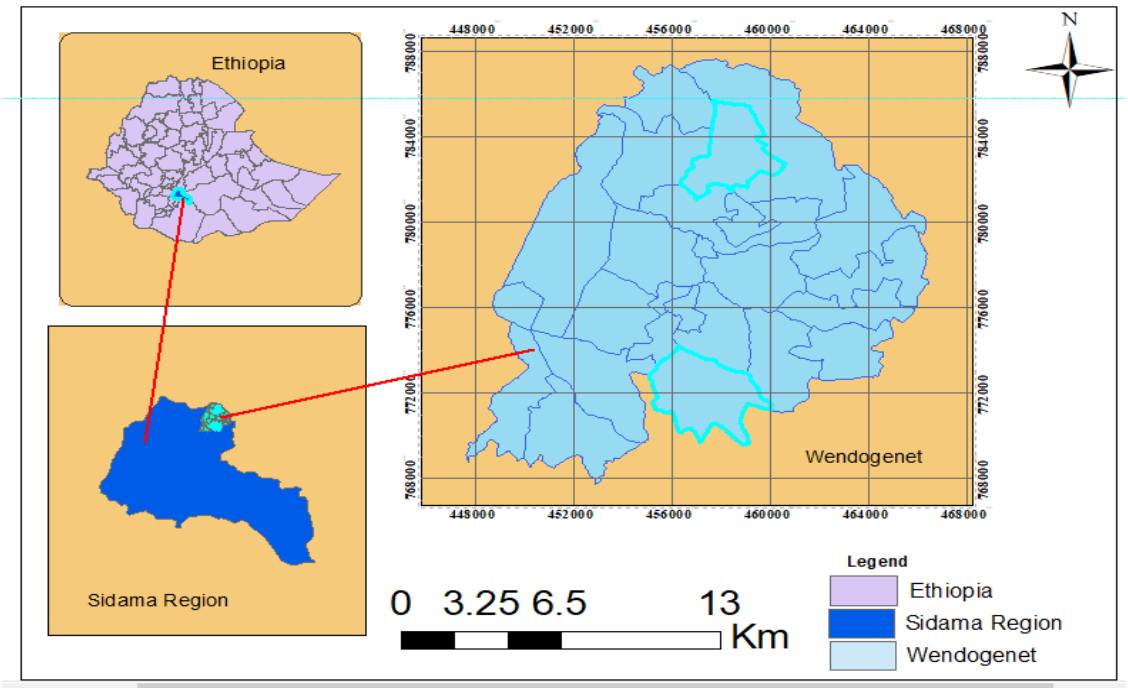

Fig. 1. Map showing the location of the study area

According to Wendogenet, office of agriculture and my personal observation indicated that land degradation in the study areas have been occurred in various forms such as depletion of soil nutrients, soil erosion, plant degradation, inappropriate agricultural practices, overgrazing and deforestation. This severe environmental degradation has had a magnifying effect on the local livelihoods that calls for pressing intervention measures. In addition, in this area, it may be recognized that historic unsustainable land use, excessive population strain, choppy spatial and temporal distribution of rainfall, hilly and rugged terrain (which lets in for smooth soil run-off), small and noticeably fragmented holdings together with insufficient funding in SLM, revolutionary growth of cultivation onto steeper slopes, lack of fallowing intervals, confined or lack of access to credit and inputs, intensify environmental degradation. This in turn led to land degradation and disturbing farmer's plots and their surrounding biodiversity. In any try to contribute in bridging the aforementioned gap, this study was aspired to assess factor of influencing the of farm level implementation of Sustainable Land Management practices, within the in Sidama Region with particular case from Wondogenet woreda. Therefore, it is critical that these issues particularly the main issues must be addressed as a matter of urgency. This study was initiated to generate and document information for policy makers & relevant local institutions to empower community, make awareness, and sensitize on how to deal with the issues to contribute to the SLM in the study areas.

2. Materials and Methods

2.1 Geographical Location

Wondogenet is found on the eastern escarpment of the central rift valley of Ethiopian in the Sidama Regional state. Geographically the woreda located between 5^0 30' N to 7^o 20' latitude and 37^0 05' E to37^0 50'E longitude. The elevation ranges from 1680 to 3960 m a.s.l.. The. The total area of the Woreda is 15,145 ha. 93.58. The topography of the Woreda is dominated by mountains and hills which cover 43.5% whereas flat areas and undulating surfaces share36.25% and 20.25% of the Woreda respectively.

3. Research Design

To attain the objective of the study, cross sectional survey research design was employed as the right research approach. This is because cross sectional survey research method was really worth important in describing and explaining the real situation of issues of the problem under investigation with in brief or short period. Moreover, to get the general picture of the problem under study ''Mixed Research Method Design'' was specially employed.

3.1 Sampling Procedures and Sample Size Determination

Quantitative and qualitative research approaches were employed using cross-sectional survey. The study area was selected purposively based on its accessibility for transportation and communication. In addition to two study Kebeles were selected purposively. and finally, the respondent farmers were selected through simple random sampling from the sampling frame with probability proportional to size. The sample size was determined using a formula adapted in a rule of thumb. Developed via (Green, 1991) the rule of thumb, Where, N, is the sample size and `m` is the number of explanatory variables (Xi) where m=1, 2,…. 15.The study were Kebeles Bajja Fabirikka and Wosha Soyamma the size of households was 170 in Wosha Soyamma, 66 in and 104 in Bajja Fabirikka respectively. Thus, a total of 170 sample households were selected.

3.2 Data Types and Method of Data Collection

To obtain sufficient information, quantitative and qualitative data were gathered from both primary and secondary sources. The secondary data were obtained from various papers, while the primary data came from surveyed households, augmented by key informants, focus group discussions, and field observations

3.3 Analysis and Interpretation of Quantitative Data

Quantitative data generated from the questionnaire was tabulated and summarized by using descriptive statics such as percentage ,frequencies, average, Inferential statics such as t-test ,Chi-Square and Binary logistic Regression Frequency, percentage and average were used to analyze demographic and socio-economic characteristics of households that determine the sustained use of land management practice and t-test was used to analyze different socio economic factors that influence on the nature of land the land management practices employed by farmers in the study area and Chi-square was used to analyze the mean difference of socio economic and demographic factors influence land management practice between two groups (users of land management practice and non-users of land management practice among two kebeles) and results were summarized in the form of tables. The Binary Logistic Regression was used to analyze the determinant factors that influence sustainable land management practice in the study area.

3.4 Binary Logistic Regression

A logistic regression model was advanced to explore the personal, social, economic, institutional, technological and geographical factors influencing the adoption of SLM in this look at. A regression model, and its binary outcomes, helped the researcher to explore how every explanatory variable influences the possibility of the incidence of events (Long and Freese, 2006). The logistic regression version is the correct statistical devices to determine the impact of independent variables on based variables. In the logistic model, the coefficients are compared with the opportunity of an event going on or no longer going on and bounded between zero and 1 (Sheikh, 2003. The odds ratio and predicted chance of the unbiased variables suggested the impact of these variables at the likelihood of adoption of SLM practice if other variables stay the same. Hence, if the expected values of those variables are effective and significant, it can also mean that the farmers with higher values for these variables are much more likely to adopt progressed sustainable land management technology.

Where **P (i)** is a probability of adopting a given practice for the farmer and **Z (i)** is a function of **m** explanatory variables **(Xi),** and is expressed as:

$$Z_i = {}_0 + {}_1 + X_1 + {}_2X_2 + \ldots\ldots\ldots {}_mX_m \quad (1)$$

Where,

B_0 is the intercept and **βi** are the slope parameters in the model. The slope tells how the Log-odds in favor of adopting SLM practices change as independent variables change by a unit. Since the conditional distribution of the outcome variable follows a binomial distribution with a probability given by the conditional mean **P*i,*** interpretation of the coefficient was understandable if the logistic model can be rewritten in terms of the odds and log of the odds (Hosmer and Lemeshew, 1989.)Since the conditional distribution of the outcome variable follows a binomial distribution with a probability given by the conditional mean **P*i,*** interpretation of the coefficient will be understandable if the logistic model can be rewritten in terms of the odds and log of the odds.

The odds to be used can be defined as the ratio of the probability that a farmer uses or adopts the practice **P*i*** to the probability that he or she will not **P*i-1***
But,

$1\text{-}P_i =$ (2)

Therefore = = (3)

= = + (4)

And Taking the natural logarithm of the odds ratio of equation (5) will result in what is known as the log it models as indicated below:

$L_n = L_n = Z_i$ (5)

If the disturbance term **Ui** is taken in to account, the log it models becomes

$Z_i = o +$ (6)

Hence, the above econometric model was used in this study and treated against potential variables assumed to affect the farmer decision of SLM practice. The parameters of the model are estimated using the iterative maximum likelihood estimation procedure. The later yields unbiased and asymptotically efficient and consistent parameter estimates. Therefore, the above econometric model was used in this part of the study to identify determinant variables that influence adoption practices of land management in the study area.

3.5 Review of Major Variables

Dependent variable:

Determinants of farm level implementation of Sustainable Land Management practices among smallholder Farmers, which was, the dependent variable. The dependent variable for the adoption model indicates whether a household has implemented SLM practices (‘‘user’’ versus ‘‘non user’’).

Independent variables:

It is assumed that implementation of sustainable land management practices were affected by different factors and the decision of households' want to implement sustainable land management practices subject to various relevant constraints. These include sex, age, family size, educational level, off farm activity, farm experience, land size, distance, TLU, access to credit, extension services, information, Information and land form.

4. Results and Discussion

4.1 Sustainable Land Management Practices and Determinant Factors

Table 1 showed that among the total sustainable land management user respondents, 77.7% of them were male whereas, 62.1% of non-user respondents were female. The *Chi*-square analysis ($\chi^2(1)$ =26.24, p<0.01) revealed a statistically significant relationship between sex and sustainable land management practice. The result implied that male household heads had a larger probability of implementing sustainable land management practices than female household heads in the study area. The key informants also argued that male household heads could practice sustainable land management than female-headed households since females are responsible for domestic issues than outside concerns. According to different research finding, women are often faced with more labor constraints than male farmers and male-headed households. Also, women are sometimes inhibited from making decisions about land management practices while their husbands are away.

Table 1. Sex of the household head and land management practice

Sex	Sustainable land management practice						x^2	p-value
	Non-user		User		Total			
	n	%	*n*	%	*n*	%		
Male	22	37.9	87	77.7	109	64.1	26.24	0.000
Female	36	62.1	25	22.3	61	35.9		
Total	58	100	112	100	170	100		

Source: Own survey data (2024)

The results of Table 2 showed a significant difference between the perception of user respondents and non-user respondents on age. The result of the independent samples *t*-test was significant (t = 2.09, $p<0.05$), indicating that the null hypothesis can be rejected. This finding suggests that respondents' mean perception of the age significantly differed between the user respondents (Mean = 45.57) and non-user respondents (Mean = 49.69). The result implies that sustainable land management user respondents' average age was significantly lower than the average age of non-user respondents. Thus, younger household heads have a larger probability of using sustainable land management practices than older household heads. Young farmers might have longer planning horizon and more flexible in deciding to practice new ideas and technologies, while the old farmers have shorter planning horizon and they are physically weak, more resistance to change and hence less interested in practicing SLM practices and soil conservation practices.

As shown in Table 2, there is a significant difference between user respondents' perception and non-user respondents on the family size. The independent samples *t*-test was significant (t = 2.39, $p<0.01$), indicating that the null hypothesis can be rejected. This finding suggests that respondents' average family size significantly differed between the user respondents (Mean = 6.00) and non-user respondents (Mean = 6.98). The result implies that user respondents' average family size was significantly lower than the average family size of non-user respondents on the family size. Therefore, households with large family sizes had a lower chance of using sustainable land management practices. The key informant interview results revealed that most of the time, large family members have less practice of sustainable land management. with larger number of economically active labor are supposed to be better in undertaking different land management practices, since they are less likely to have shortage of labor which is required to do land management activities.

Table 2 showed a significant difference between sustainable land management user respondents and non-user respondents on the land size. The result of the independent samples *t*-test was statistically significant (t = -3.43, $p<0.01$), indicating that the null hypothesis can be rejected. This finding suggests that respondents' average land size in hectare significantly differed between the user respondents (Mean = 1.07) and non-user respondents (Mean = 0.58). "The result implies that those respondents who had a large land size have a better chance of using sustainable land management practice than households with low land size. The key informants and focus group discussion members also argued that farmers with large farm sizes are expected to implement sustainable land management practices since they plan and use different management practices due to the large landholding size. According to different research finding, farmer's having Large farm sizes are expected to practice better land management practice, this is due to farmer's perception to large farm size is very high because farmers having large farm size are practiced better land management practice by planning different land management technologies. Also Another previous study indicates farm size to have positive and significant influence on adoption of SLMP". According to Alem-meta Assefa. (2019) "the age of the household head increases their decisions to adopt land management practices also increases".

As we can see from Table 2 showed a significant difference between sustainable land management user respondents and non-user respondents on the distance. The result of the independent samples *t*-test was significant (t = 8.62, $p<0.01$), indicating that the null hypothesis can be rejected. This finding suggests that respondents' mean perception of the distance significantly differed between the user respondents (Mean = 1.14) and non-user respondents (Mean = 3.31). The result implies that user respondents' average distance was significantly lower than the average distance of non-user respondents on the distance. Therefore, household heads who travel a longer distance from their home to farmland have less likely to use sustainable land management practices.

As summarized in Table 2, there is a significant difference between sustainable land management user respondents and non-user respondents on their livestock amount in TLU. The result of the independent samples *t*-test was significant (t = -8.69, $p<0.01$), indicating that the null hypothesis can be rejected. This finding suggests that respondents' mean perception of the TLU significantly differed between the user respondents (Mean = 6.47) and non-user respondents (Mean = 2.12). The result implies that user respondents' average livestock amount was significantly higher than the average livestock amount of non-user respondents on the TLU. Thus, household heads who had larger livestock in TLU had a greater chance to use sustainable land management practices. Similarly Saguye (2017) implies that "number of TLUs is positively related to the decision of compost/manure investment. This is because animal manure is one of the major inputs for compost/manure production. Also Wealthy farmers or farmers having livestock had accesses to more manure and implement more soil fertility management practices than other farmers that do not have livestock)".

4.2 Sustainable Land Management Practices under Implementation

"The results of Table 4 showed that 35 % of sampled respondents use agroforestry for sustainable land management practice, Agroforestry practices have been claimed to have the potential of improving agricultural land productivity status and alleviating adverse environmental effects in both at local and global level". Also Agroforestry is not only used economic sustainability by providing increasing crop production and source of fuel but also it conserves plants which are environmentally suitable. The age of the household head had a negative and significant effect on the adoption of inorganic fertilizer 23.6% of them used Fanjuu. The construction of Fanya juu reduces or stops the velocity of over land flow and consequently soil erosion Also according to Atnafe, (2015) reported the majority of farmers adopt Fanya juu due to less labor demanding.

The other, 25.5% and 15.9% of sampled respondents used intercropping cropping as sustainable land management practice types, the finding of Ministry of Agriculture (2001) reported that, the aim of intercropping is to increase productivity of the land and to protect the soil against erosion.

The 15.9 % of sampled respondents, used soil bund in their plots. soil bund is used to control runoff and erosion from cultivation fields by reducing the slope length of the field, which ultimately reduces and stops velocity of runoff. Usually, it is constructed in fields that have slope less than 10% and it is effective in controlling soil loss, retaining moisture and ultimately enhancing productivity of land.

Generally according to the result of table 4 indicated that the primary type of land management practice was agroforestry. The key informants also revealed that most of the household are users of agroforestry followed by Fanjuu and inter cropping. The focus group discussants also added that the primary objectives of agroforestry were improving soil fertility and used as shade. Likewise, it provides multi-services such as protect soil erosion, easy to apply on the plot and help farmers to get fuel.

Regarding land management practice benefits, 90.2% of sampled respondents believed that land management practice is essential, while 9.8% of sampled respondents replied that land management practice has no importance. It indicated that most sampled respondents in the study area believed that land management practice has its benefit. As a result, 82.9% of sampled respondents indicated they faced losses because of not practicing sustainable land management practice. Similarly, the results of the key informant interviews and focus group discussion results revealed that implementing sustainable land management practice is very important for better productivity and income. In contrast not practicing SLM leads to decrease of productivity and expose the land for erosion.

Table 2. Educational Level and Land Management Practice

Education Level	Land Management Practice						x^2	p-value
	Non-user		User		Total			
	n	%	*n*	%	*n*	%		
Did not attend formal education	22	37.9	11	9.8	33	19.4	41.43	0.000
1-4	19	32.8	15	13.4	34	20.0		
5-8	11	19.0	26	23.2	37	21.8		
9-12 and above	6	10.3	60	53.6	66	38.8		
Total	58	100	112	100	170	100		

Table 3. Mean comparison of continuous variables

Variables	Sustainable land management practice				t-test	p-value
	Non-user		User			
	Mean	SD	Mean	SD		
Age	49.69	11.722	45.57	12.438	2.087	.038
Family size	6.98	2.572	6.00	2.529	2.388	.018
Land size in hectare	.5810	.48917	1.0696	1.02655	-3.426	.001
Distance in km	3.3057k	2.07022	1.1421	1.20223	8.617	.000
TLU	2.1057	2.66911	6.4663	3.30335	-8.688	.000

Table 4. Types of Sustainable land management practice and related issues

Variables	Categories	*n*	%
Types of land management practice^	Agro forestry	55	35.0
	Inter cropping	40	25.5
	Fanjuu	37	23.6
	Soil bund	25	15.9

4.3 Factors Influencing the Implementation of SLM Practices

The Binary Logit Model was adopted to identify factors affecting the implementation of sustainable land management. Before applying the model, a Multicollinarity problem among the independent variables was tested using the contingency coefficient (CC) and Variance Inflation Factor (VIF). Likewise, whether the model adequately fits the data or not was tested by Hosmer and Lemeshow goodness of fit test. The results of these tests indicated that there is no problem to continue the analysis.

Note: B=Beta Coefficient, S.E=Standard Error, *p < 0.1, ** p < 0.05

The estimated regression coefficients of the logit model, together with the significance levels, are portrayed in Table 4.. The likelihood ratio statistics (x^2 = 175.63, p < 0.001) from the logit model indicated strong explanatory power. The logit model's parameter estimates provide only the direction of the independent variables' effect on the dependent variables; estimates do not represent the magnitude of change or its probability.

Sex: According to the results of Table 4, the sex of the household head has a negative and statistically significant effect on sustainable land management practice (B = -2.71, p <0.05). The odds of respondents who were female being sustainable land management practice users is 0.07 times lower than those respondents who were male. The result revealed that sampled respondents who were female have less chance to be sustainable land management practice users than were the male household head. Being male or female has its own implication in implementing sustainable land management practices of the given area but male-headed households more likely to conserve soil, more likely to change crop varieties and more likely to plant trees. He also added that being male household head is proposed as positive effect for better implementation of sustainable land management adoption.

Family size: The sampled household head's family size has a negative and statistically significant effect on the involvement of sustainable land management practice (B = -0.58, p < 0.05). It can be inferred from the values of the odds ratio that if the Family size of a sampled household head increased by one unit, the response variable, which is the involvement of sustainable land management practice, will be expected to decrease by 0.56 regardless of other independent variables in the model. The result indicated that large family size discourages the household head to use sustainable land management practice. In connection to different finding, household size is related to the socio-economic status, which determines the status of rural sustainable land management practices. The larger the household size, greater are the chance of deforesting land and/or degrading farm land. In. Accordingly, household with large family size hypothesized as positive and negative on adoption.

Education level: According to the results of Table 4, Education level has a positive and statistically significant effect on sustainable land management practice (B =1.11, p <0.05). The odds of respondents who had a better

education level being sustainable land management practice users are 3.04 times higher than those who had lower education levels. The result revealed that sampled respondents who had a better education level had a better chance of being sustainable land management practice users than had lower education level household heads. The report further noted that education level affects household's decision, which determines the welfare of the society such as income, health, and their attitudes towards using of sustainable land management. It may also enable the households to have broad vision about sustainable land management practices or overall the surrounding environments. Mamuye (2015) also argues that "education levels of households are the major factors affecting sustainable land management practices".

Distance: The Distance of the sampled household head has a negative and statistically significant effect on sustainable land management practice ($B = -0.77$, $p < 0.05$). It can be inferred from the values of the odds ratio that if the distance of a sampled household head increased by one unit, the response variable, the involvement of sustainable land management practice, will be expected to decrease by 0.46 of other independent variables in the model. The result indicated that distance discourages sustainable land management practice usage. Similarly, Gemechu (2016) also found that distance from homestead was found negatively and significantly, that influenced the use of introduced sustainable land management practices. As distance of a plot from homestead is far, farmers are not interested to implement sustainable land management practices due to inconvenience in controlling and close supervision.

TLU: The TLU of the sampled household head has a positive and statistically significant effect on sustainable land management practice($B = 0.33$, $p < 0.1$). It can be inferred from the values of the odds ratio that if the TLU of a sampled household head increased by one unit, the response variable, the involvement of sustainable land management practice will be expected to be positive by 1.39 regardless of other independent variables in the model. The result indicated that TLU has a positive effect on sustainable land management practice usage. One of the key components of this strategy involves the use of land management practices across the country such as composting, livestock manure, inorganic fertilizers, crop rotation, integrated methods, Etc. These practices are effective in enhancing soil fertility Taye Alemu et al. (2022)

Access to credit: According to the results of Table 4. access to credit has a positive and statistically significant effect on sustainable land management practice ($B = 2.03$, $p < 0.1$). The odds of respondents who had access to credit being sustainable land management practice users are 7.60 times higher than those who had no access to credit. The result revealed that sampled respondents who had access to credit have a better chance of being sustainable land management practice users than had no credit household head access. According to Haryanto et al., (2023), access to credit is one of the major drivers of farmers' investment on SLM technologies and it improves the problem of liquidity and enhances the use of agricultural input in production as it is often claimed in development theory.

Extension service: According to the results of Table 4, extension service has a positive and statistically significant effect on sustainable land management practice ($B = 2.02$, $p < 0.1$). The odds of respondents who had extension service being sustainable land management practice users are 7.58 times higher than those who had no extension service. The result revealed that sampled respondents who had extension service had a better chance of being sustainable land management practice users than a household head who had no extension service. Similarly, with this finding, Nkamleu, & Adesina, (2000) indicated that implementation rate would be high if farmers are regularly advised by competent extension agents, with adequate support materials provided in a coordinated way.

Information: According to the results of Table 4, information has a positive and statistically significant effect on sustainable land management practice ($B = 1.63$, $p < 0.1$). The odds of respondents who had information about sustainable land management practice being sustainable land management practice the user is 5.12 times higher than those respondents who had no information about sustainable land management practice. The result revealed that sampled respondents who had information about sustainable land management practice had a better chance of being sustainable land management practice users than households with no information about sustainable land management practice. The study conducted by Adimassu & Kessler (2013), also showed that accesses to persistence information is a major factor which positively influence farmers' investment in sustainable land management practices. This indicates that lack of access to adequate information affects farmers' decision in implementing SLM practices.

Table 5. Results of binary logistic regression model

Variables	B	S.E	Wald	p-Value	Exp(B)
Age of the household	-0.059	.046	1.657	.198	.942
Sex of the household	-2.708**	1.198	5.107	.024	.067
Family size	-.580**	.292	3.949	.047	.560
Education level	1.112**	.502	4.913	.027	3.041
Non-farming activities	1.394	.971	2.060	.151	4.029
Farm experience	1.144	.648	3.114	.078	3.139
Land size	0.246	1.102	.050	.823	1.280
Distance	-.767**	.307	6.245	.012	.464
TLU	0.325*	.174	3.480	.062	1.385
Access to credit	2.029*	1.204	2.840	.092	7.604
Extension services	2.025*	1.093	3.434	.064	7.580
Information	1.633*	.987	2.738	.098	5.121
Land form	2.021*	1.102	3.361	.067	7.545
Constant	1.698	3.619	.220	.639	5.465
Number of observation	170				
LR $Chi^2(13)$	175.63				
Prob >Chi^2	0.000				
Pseudo R^2	0.89				

*Note: B=Beta Coefficient, S.E=Standard Error, *p < 0.1, ** p < 0.05*

Landform: According to the results of Table 4., landform has a positive and statistically significant effect on sustainable land management practice (B =2.02, p <0.1). The odds of respondents who had steep slope land being sustainable land management practice users are 7.55 times higher than those with no steep slope land. The result revealed that sampled respondents who had steep slope land had a better chance of being sustainable land management practice users than households with no steep slope land When the farmer's farmland is very stepper, it is very inclined to practice land management practices to protect the soil from erosion and improve their production output.

4.4 Implementation of SLM Principles in the Farmers Plot

Concerning the sustainable land management principles implemented in the farmers plot, 62.9% of sampled respondents replied that SLM management intervention progressively processed from the upper part of the farm pilot to the lower part of the farm. Similarly, 57.6% of sampled respondents argued that the current SLM management activities are cost effective and environmentally friendly. Equally, 52.4% of sampled respondents replied that they are using SLM to overcome land degradation. Correspondingly, 50.6% of sampled respondents responded that they combine their experience with scientific knowledge for SLM activities.

On the other hand, 60.6% of sampled respondents reacted that not all stakeholders such as youth, women, men, and landless people are involved in sustainable management activities. Likewise, 62.9% of sampled respondents replied that they will not continue SLM activities in my farm pilot in the future. Similarly, 64.1% of sampled respondents responded that individuals' participation is not ensured by providing tangible economic benefits. Equally, 75.3% of sampled respondents replied that there are no continuous monitoring and participatory evaluation of the community's overall sustainable land management performance.

4.5 SLM Practice in Relation to Policy and Institutional Arrangement

The Government of Ethiopia has developed a wide range of policies, strategies, legal frameworks and proclamations to address environmental problems relevant for the promotion and implementation of SLM practices in recent years. "Sustainable land management is a major challenge in Ethiopia. The problem is great in areas where land degradation, and the risks of production failure are high, in the Study area. In recent years, several environmental and natural resources management policies and legislative framework, which stems from the existing constitution has increasingly been developed, adopted and extensively encouraged to combat the problem of land degradation in the country. These policies, proclamations and strategies entails for optimal and sustainable use of land resources through community based participatory approach. As noted from document

review, some of these policies and strategies relevant to the environment and natural resources management include: the Agricultural Development Led Industrialization (ADLI) policy, the Conservation Strategy of Ethiopia (CSE), the environmental law of Ethiopia, the Forestry Action Plan (EFAP), the three subsequent poverty reduction plans (Sustainable Development Plan to Reduce Poverty (SDPRP), the National Population Policy (NPP), the National Food Security Strategy (NFSS), the forest policy among others (FDRE, 2015), Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) and Growth and Transformation Plan (GTPI & II) to mention but a few" (Yesuph et al., 2020).

Table 6. SLM principles implemented in the farmers plot

No.	Variables	Yes	No	Rank
1.	Does SLM to overcome land degradation.	89 (52.4)	81 (47.6)	4
2.	SLM management intervention progressively processed from upper part of the farm plot the lower part of the farm plot.	107 (62.9)	63 (37.1)	1
3.	The overall SLM plans are prepared by me with the technical advice from experts.	86 (50.6)	84 (49.4)	5
4.	Does SLM technologies in accordance with their suitability to my plots.	97 (57.1)	73 (42.9)	3
5.	The current SLM management activities are cost effective and environmentally friendly.	98 (57.6)	72 (42.4)	2
6.	Does your experience with scientific knowledge for SLM activities.	86 (50.6)	84 (49.4)	6
7.	Does participation of SLM practices provides me tangible economic benefits.	61 (35.9)	109 (64.1)	9
8.	All stakeholders (such as youth, women, men and landless people etc.) are involved in the SLM activities.	67 (39.4)	103 (60.6)	7
9.	There is continuous monitoring and evaluation of the overall performance of SLM activities by the community.	42 (24.7)	128 (75.3)	10
10.	Have you continue SLM activities in your farm pilot in the future	63 (37.1)	107 (62.9)	8

"The goal of these policies, strategies and plans is to promote all national efforts towards the efficient, equitable, and optimum utilization of the available natural resources for significant socio-economic development on sustainable basis. Furthermore, natural resources management related the federal and regional governments of the country issued Proclamation" (Yesuph et al., 2020).

"According to key informant interview and FGD results indicate that, in some cases, they are not still optimally implemented and enforced on the ground. To date, SLM activities have only scarcely been integrated in agricultural practice and it is apparent from field that some of the structures are intentionally removed from the farm. Hence, soil erosion damages are still observed on a regular basis. Furthermore, at present no effective and sustainable legal measures are taken when some of the aforementioned regulations are disregarded" (Yesuph et al., 2020).

Finally, researcher identified that policy and institutional limitations at national, regional and local level, from through document analysis and physical observation. Three core issues were perceived as the main institutional limitations: the processes of policy formulation and implementation, the available institutional capacity and the lack of institutional collaboration. Those limitations hinder better implementation of SLM practices in the study area.

Generally, that a much more bottom-up approach, building institutional capacities and strengthening and partnerships between the local, regional and national levels are needed for the horizontal and vertical implementation of SLM practices in Ethiopia.

5. Conclusion

The advancing threat of land degradation continues to put sustainable livelihoods at risk in the study area diverse array of farm level Sustainable Land Management technologies was recommended as a potential

solution for combating land degradation. However, sustained use of these practices is far below the expectation. According to this study, the primary type of sustainable land management practice in the study area includes agro-forestry, Fanyajuu, strip cropping and soil bund. Although there are the polices and proclamation that are developed as guidelines for SLM approaches which is already introduced by the government of Ethiopia. However, The SLM activities would not be continued after the program's has ceased because of absence of continuous monitoring and participatory evaluation of the community's overall SLM performance on ground. The main factors that affect the implementation of sustainable land management practice are the sex of the household head, family size, education level, distance, TLU, access to credit, extension services, information, and landform.

In general, Education level, TLU, access to credit, extension services, information, and landform influence the sustainable land management practice positively

6. Recommendation

To increase the implementation level of SLMP, the researcher forwards the following recommendations based on the main findings of the study. Education level is a factor that affects the use of sustainable land management practice. Therefore, Kebele and Woreda governmental bodies and non-governmental organization should encourage local farmers to learn formal and non-formal education by launching action plan which attract local farmers to join education centers and by building formal and adult education centers. Credit availability helps the farm households to use sustainable land management inputs. Therefore, governmental and non-governmental financial organization should giving or arranging different credit alternatives or access for farmers with low rate of interest.

Extension agents such as Woreda experts and Kebele's development agents should be strengthen for updated extension services and follow up on SLMP for its continuity. Awareness should be created especially for Female headed household to contribute for implementation of sustainable land management practice. The government and non-governmental organizations should empower female households to implement sustainable land management though training by reinforcing female households and promoting gender equality. The policy should consider a bottom-up approach that can build institutional capacities and strengthening and partnerships between the local, regional and national levels are needed for the horizontal and vertical implementation of SLM practices.

Disclaimer (Artificial Intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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Competing Interests

Author has declared that no competing interests exist.

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