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Factors Affecting the Adoption of Sustainable Land Management Practices in Semen Bench District, Southwest Ethiopia

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Abstract: Land degradation is among the most challenge and continuous environment problem in highland parts Ethiopia. To reverse the problem land degradation has introduced sustainable land management practices. The study was conducted in Semen Bench district, in southwestern Ethiopia to identify factor affecting the adoption of sustainable land management practices. The data were collected through house hold questionnaires survey, key informant interview and focus group discussions. Binary logic regression model was employed in estimated determinant of SLM. The results showed that 92.5% and 7.5% of the household adoption of sustainable land management practice were male and female respectively. The results showed that also sex, farmer's perception of land degradation, extension service and TLU positively significantly affect, while age and off-farm activities have a negative influence adoption of sustainable land management practices. The adoption of Sustainable Land Management practices is to incroprate the farmers best practices to advanced used for reducing erosion, rehabilitate degraded area, ensure food security and, improve fertility. Thus policy maker should take in to consideration the determinant factor affecting adoption of SLM when designing and adoption introducing SLM practices.

Keywords: Adoption, Binary Logistic Regression, Sustainable Land Management Practices

1. Introduction

Land is the most important natural resource that makes up the fundamental resource base in any agricultural production system; hence it needs to be managed effectively for the creation of wealth in many societies [42]. Land degradation is a global problem that affects both developing and high-income countries [36]. Globally, around 2 billion hectares or 54% of the Earth's land surface area is degraded [46] and affecting about 3.2 billion people around the world [32], especially the poorest Sub-Saharan Africa [35]. In many regions of Sub-Saharan Africa continuous cropping and use of inappropriate farming practices had massive negative environmental impacts characterized by declining soil fertility and erosion, degradation of vast expanses of arable land further causing low yields, food insecurity and perennial starvation [23].

Land degradation in the form of soil erosion and fertility loss has been the major factors responsible for the declining and low agricultural productivity, persistent food insecurity and rural poverty in Ethiopia [34]. Land degradation is rampant in Ethiopia, where more than 50% of the land is affected by soil erosion, 25% being seriously eroded and 4% of it has no longer be productive [47]. According to the author [4] indicated that soil loss due to erosion in the Ethiopian highlands is between 42 and 175.5 t ha^{-1} $year^{-1}$. It also, other studies in different part of the country reported substantial amount soil loss. For instance, 118 $ton^{-1}year^{-1}$ [1], 65.9 $ton^{-1}year^{-1}$ [5], 45 $ton^{-1}year^{-1}$ [29] and 30 $ton^{-1}year^{-1}$ [40] in Bench Maji Zone, North east Wollega, Chaleleka wetland catchment and Tana basin respectively.

To combating land degradation investing in the soil and water conservation for future generations is a major development task promoting sustainable land management

[25]. In 2008, Ethiopia launched Sustainable Land Management Programme (SLMP) in 36 woreda defined as the process of enhancing agricultural yields with minimal environmental impact and without expanding the existing agricultural land base-[27, 43, 45].

The different authors [22, 38] reported that the number of SLM practices adopted for sustainable land resource use is still very low. The adoption and implementation of SLM practices by Ethiopian farmers is constrained by personal, socioeconomic, biophysical and institutional factors [2, 3, 44]. The major socioeconomic factors that influence households decision to adopt soil and water conservation measures in Ethiopian highlands include sex and education level of household head, availability of labor force, cattle holding, and off/non-farm income [3, 8]. On the other hand, biophysical characteristics of plots, topography, and agro-ecological variations also influence the adoption decision of soil and water conservation and other sustainable land management practices [12, 33]. Furthermore, Amsalu A. *et al*. [8] revealed that the adoption level of SLM practices by self -motivated farmers remains very low and yet to bring to intended result in terms of improving the rural of live hoods households. Due to of these factors' still little adoption of sustainable land management practices in the study. Therefore; the current study was conducted to identify factors affecting the adoption of sustainable land management practices among smallholder farmer in the study.

2. Materials and Methods

2.1. Description of the Study Area

2.1.1. Location

This study was conducted in the Semen Bench district, Bench-Sheko Zone in Southwest Ethiopia. It lies between 6^0 59' 0" and 7^0 3'0" North latitude and 35^0 35'0" and 35^0 42'0" East longitude (Figure 1). It covers an area of 60,254 km^2 and comprises 23 kebeles (lowest administrative unit in Ethiopia).

The study district is bounded in the north byYeki, in the northeast by Chena, in the southeast by Shay Bench district, in the south by south bench woreda and west by Mizan Aman town in the Bench Sheko Zone.

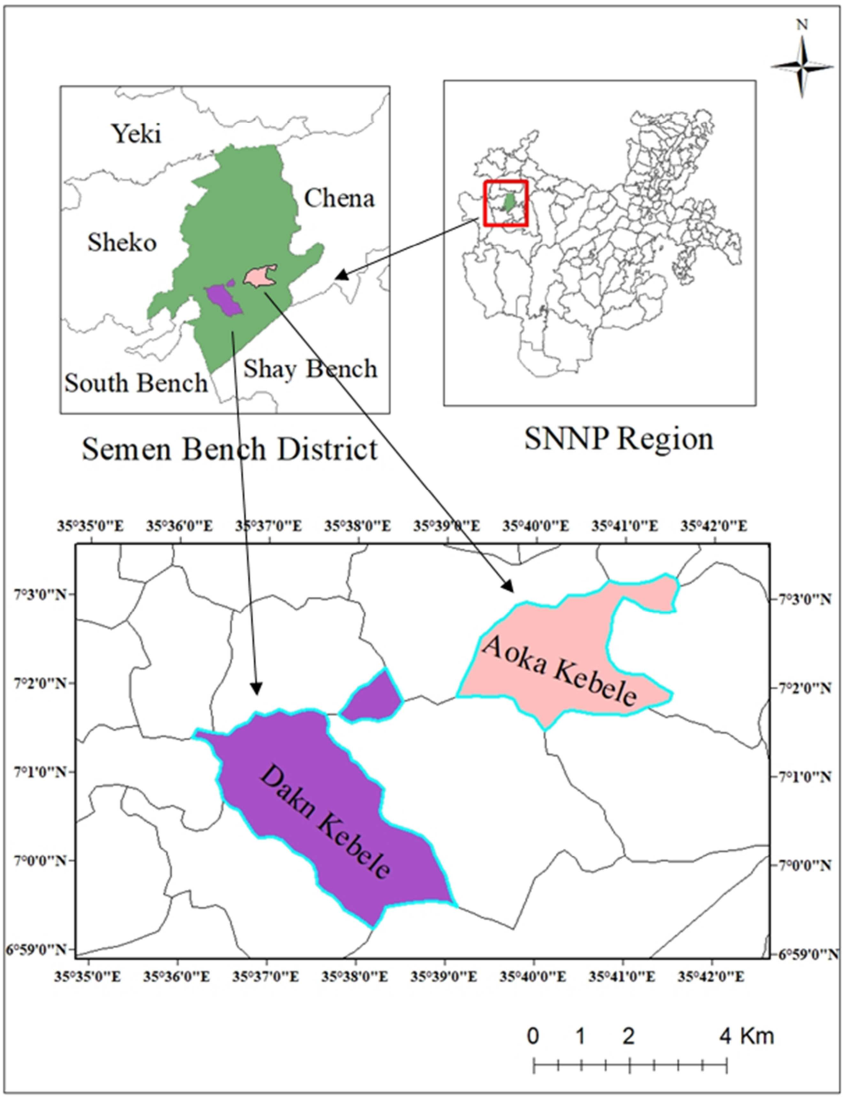

Figure 1. *Location Map of the study area.*

2.1.2. Topography, Soil Type and Climate

The topography is characterized by few plains, rugged topography, undulating landscape, plateau, and steep slopes. Topographically Semen Bench Woreda altitude ranges from 1001 to 2500m. The climate is dominantly warm and humid where the estimated annual rainfall ranges from 400 to 2000mm, while the mean annual temperature varies between 15 and 27°C [20]. Nitisols, leptosols, and fluvisols are the dominant soil groups in the study area [14].

2.1.3. Crop Production and Economy

The livelihood of the community is mainly based on mixed farming system. The crops grown in the study area are maize, mango, coffee, avocado, papaya, and banana. In addition, root and tuber crops such as sweet potato, enset, and taro. The main livestock reared are cattle, sheep, goats, and donkeys.

2.2. Sampling Technique and Sample Size Determination

In this study, a Multi-stage sampling technique was used. In the Semen Bench district, were selected purposively based on based on the coverage and implementation of SLM practice relative to other districts in Bench-Sheko zone and preliminary field survey. Two Kebeles from the district also were selected purposively based on SLM project implementation different type practice. Subsequently, households in the chosen kebeles were splilt into two group. The startum represent the program participants (adopter), whereas the stratum two reperesents the non- participants (non-adopter).

Accordingly, using systematic sampling technique, 124 representatives sample household (80 adopter and 44 non-adopter) were selected (Table 1). The sample size was determined by following the formula by Cochran [10] as follows.

$$n = \frac{z^2 pqN}{e^2(N-1)+z^2 pq}$$

Where: n= the sample size, N= the total number of households of the target population; z=1.96 (confidence level 95% level of significance); e=0.05 (5%, acceptable error margin); p=0.1 (proportion of sampled households; q= 0.9 (estimate of the proportion of households to be sample).

Table 1. *Distribution of sampled household heads in study Kebele.*

Kebeles	Total housed hold			Sample Housed hold		Total	K^{th} interval
	Adopter	Non- adopter	Total	Adopter	Non-adopter	Sample	household
Dakn	403	215	618	42	23	65	10
Aoka	357	197	554	38	21	59	9
Total	760	412	1172	80	44	124	

Source: SBDAO, (2020)

2.3. Data Sources and Data Collection Techniques

Both qualitative and quantitative data type was collected with the primary and secondary sources. Primary data were collected through household survey, observation, focus group discussion and key informant interview. Moreover, secondary data were collected from relevant published and unpublished documents such as journal articles, district annual report documents, census records, project reports, research papers and data files from web sites.

2.4. Data Analysis

2.4.1. Descriptive Statistics

The collected data were analyzed by using both descriptive and econometric methods. The chi-square was applied to analyze categorical and dummy variables and T-test was used to analyze continuous variables of socio - economic characteristics of sample households. The factor affecting adoption of SLM practices analyzed by used to binary logistic regression model. Furthermore, qualitative data gathered using focus group discussions, field observation and key informant interviews were presented simple narrations.

2.4.2. Binary Logistic Regression

A binary logistic regression model was used to analyze the relationship between the dichotomous dependent variable and the independent variables [26]. It enabled to determine the impact of multiple independent variables on the dependent variable. Logistic regression mode was developed to explore the personal/social, economic, institutional, and physical factors influencing the adoption of SLM in the study area. The model helps to explore the degree and direction of the relationship between dependent and independent variables in the adoption of introduced SLM practice at the household level. The binary logistic regression model used to explore factors affecting the adoption of SLM practice. The model is specified as follows:

$$\ln(P) = \ln\left(\frac{pi}{1-pi}\right) = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 \ldots\ldots \beta\, nXn + \varepsilon i$$

Pi is a probability of being adopter of SLM practices
$\beta 1, \beta 2 \ldots \beta$ n coefficients of explanatory variables
Xi is predictor variables (can be categorical or continuous)
εi is error term
$\beta 0$ is an intercept
1- Pi is not adopter of SLM practices.
e represents the base of natural logarithms (2.718)

Table 2. *Definition and unit of measurement of variables used in binary logistic model.*

Dependent variable			
Adoption of sustainable land management practice		**Dummy (1. Yes 2. No)**	
Variable Code	**Type and description**	**Unit of measurements**	**Expected Sign**
SEXHH	Dummy, Sex of households	1 if male, 2 otherwise	+
AGEHH	Continuous, Age of household	Year	+
FAMSIZE	Continuous, family size	Number	+
EDUHH	Dummy, Education of household	1iliterate, 2 otherwise	+
OFF FARM	Dummy, Off farm participate	1 yes, 2otherwise	-
FARMSIZE	Continuous, cultivated land	Hectares	+
DISTFARM	continuous, Distance to main farm	Kilo meter	-
TLU	Continues, Livestockholding (TLU)	Number	-
EXTN	Dummy, Accesstoextension serves	1 if yes, 2 otherwise	+
CREDIT	Dummy, Credit access	1if yes 2, otherwise	+
SLOP	Categorical, slop of the plot	1ifsteep, 2gently, 3, flat	+
PERCEP	Dummy, soil erosion controlled	1 yes, 0 otherwise	+

3. Results and Discussion

3.1. Socio –Economic and Biophysical Characteristics of Sample Households

As shown in Table 3, 92.5% and 7.5% of the respondent engage of implementation of sustainable land management practice were male and female headed households respectively.

Chi-square test results show that there is a statistically significant difference between adopters and non-adopters in terms of sex of the household heads at ($p<0.05$). This result was in line with the study [39] which reported that male headed households are more likely to adopt conservation measures than female headed households because male headed households have more access to information on conservation practices than female.

As indicated in table 3, about 36.3% and 68.2% of the respondent's adopter and non-adopter, respectively, engaged off farm activity respectively. These indicated statistically significant difference between adopter and non-adopter in terms of participation off farm activities. This implies that the household involvement on off-farm activities to decrease participation of sustainable land management. This result agrees with the finding [9] which indicated that household involvement off farm activities negatively affected participation of land owners to conserve and involve on soil and water conservation practice.

To get access to extension services of non-adopter and adopter were 38.6% and 82.5%, respectively. Chi-square test results show that there is a statistically significant difference between adopters and non-adopters in terms of extension services of the household heads at ($p<0.01$). This implies that farmers who have aware and informed with extension agents about importance implementation SLM practice more participate than the farmers who do not have aware and informed. This result is in line with findings [41] which indicated that, more contacts with extension agents with the farmer become aware will increase farmer's participation in soil and water conservation practices.

Table 3 shows that with a mean age of adopter and non-adopter respondents were 45.5 and 44.5 years respectively. The result indicated that statistically significant difference between adopters and non-adopter of SLM practices in term of age ($p<0.05$). This result was in line with the study [28] which explained that the age of the respondents had a significant relation with the adoption of soil and water conservation practices.

The mean family size of adopter and non-adopter household were 3.34 and 3.28 members per household respectively. The result indicated that there was with statistically significant difference between the adopters and non-adopter of SLM practices in term of family size ($p<0.05$) (Table 3). This result agrees with the finding [24] which reported that farmers have larger family sizes are more likely to implement sustainable land management practices.

According to the table 3, mean farm distance from residential area of adopter and non-adopter household were 1.37 and 1.57 kilometer respectively. The result indicated that there statistically significant difference between the adopters and non-adopter of SLM practices in term of distance ($p<0.05$). This result is in line with findings [2] who reported that farmers give more attention to farm plots closer to homestead areas than distant farm plots.

The livestock holding adopter and non-adopter of household is 3.14 and 3.42 TLU respectively. Table 3 showed that there was statistically significant difference between the adopter and non-adopter in term of cattle holding ($p<0.05$). This implies that farmers with relatively higher ownership of livestock holding tend less to adopt SLM practices than those whose ownership is relatively smaller. This result is in line with findings [7] who revealed that the higher number of livestock size negatively significant influence on adoption stone terrace. Similarly; Tesfaye *etal* [43] also reported that large-scale cattle ownership has a detrimental impact on land management practice adoption and sustainability due to difficult to manage install feeding.

Table 3. *Socio -economic and biophysical characteristics of sample households.*

Variable		**Adoption of SLM practice**						**χ2-value**	**P-value**
		Adopter (N=80)		**Non-adopter (N=44)**		**Total (N=124)**			
		N	**%**	**N**	**%**	**N**	**%**		
Sex	Male	74	92.5	32	72.7	106	85.5	8.94	.003***
	Female	6	7.5	12	27.3	18	14.5		
Education	Illiterate	47	58.8	24	54.5	71	57.3	0.205	0.65
	Literate	33	41.2	20	45.5	53	42.7		
Off farm Activities	Yes	29	36.3	30	68.2	59	47.6	11.6	.001***
	No	51	63.7	14	31.8	65	52.4		
Extension service	Yes	66	82.5	17	38.6	83	66.9	24.5	.000***
	No	14	17.5	27	41.4	41	33.1		
		Mean	SD	Mean	SD	Mean	SD	t-value	
Age		42.93	6.18	40.2	5.79	41.48	5.98	2.56	0.012**
Family size		3.34	1.29	3.28	1.38	3.08	1.33	2.09	0.039**
Farm size		1.98	0.78	1.84	0.96	1.91	0.87	0.84	0.40
Farm distance		1.36	0.55	1.57	0.54	1.47	0.54	-2.11	0.037**
TLU		3.14	0.72	3.42	0.63	3.28	0.67	-2.13	0.035**

Source: Survey data, 2020
***, ** and * shows significant at 1%, 5% and 10% level of significance respectively

3.2. Factors Affecting Adoption of SLM Practices

The results of the binary logistic regression model analysis revealed that the adoption of sustainable land management practices in the study area is influenced by several factors. Among the factors considered in the model, six variables were found to have a significant influence on household's participation in sustainable land management practices from these, four variables were found to have a significant and positive influence on household's participation in sustainable land management practice were sex, access to extension service, perception of land management, and TLU. On the other hand age and off farm income were found to have a significant and negative influence on household's participation on sustainable land management practice (Table 4).

Table 4. *Binary Logit model estimation for factor affecting adoption of SLM practices.*

Explanatory variables	**B**	**S. E.**	**Sig.**	**Exp (B)**
Sex	1.680	.830	0.043**	5.363
Age	-.119	.060	0.049**	.888
Family size	-.347	.224	.120	.707
Education	-.710	.641	.268	.492
Off farm income	-1.529	.620	0.014**	.217
Farm size	.053	.355	.881	1.055
Farm distance	.811	.531	.127	2.249
TLU	.879	.451	0.051*	2.409
Extension service	1.795	.617	0.004**	6.017
Credit service	.165	.654	.801	1.179
Slope	-.228	.463	.623	.796
Perception	2.934	.677	0.000***	18.811
Constant	-3.662	4.031	.364	.026

Pearson chi-square =79.996 prob> chi2=.00
-2 log likelihood = 81.301 Sample size =124
***, **, and * indicates significance at 1%, 5%, and 10% level respectively.
Source: Own computation result, 2020

Sex of household: Sex is one of factor influencing adoption of introduced sustainable land management. As shown in Table 4 the odds ratio revealed that the probability of the male household heads implementing the introduced SLM practices increase with 5.363 than female headed households ($p<0.05$). This result was agrees with the findings of [30] who found that male headed households have a higher chance to participation in soil and water conservation practices.

Age of household: the age of household is found to be statistically negatively significant ($p<0.05$). The odds ratio indicates one year increase household head decreases the adoption of introduced SLM practices by a factor of 0.888 (Table 4). The result was in line with the finding of [45] who reported that age of household heads was negatively at statistically significant at less than 5% level of probability.

Off farm activities: adoption of SLM practices found to be negatively influenced by off farm activity. The result of the regression analysis revealed that the off-farm activity is found to be statistically negatively significant ($P<0.01$) (Table 4). The odd ratio value revealed that the probability of implementing sustainable land management practices was decreased by 0.217 times for household heads engaged in off farm activity. This implies that off-farm activities may have a negative effect on the adoption of sustainable land management due to reduced labor availability. The result was in line with the finding [37] which reported that off farm activities can negatively influence farmers to participate of sustainable land management practices.

Extension service: In extension services are intended to educate farmers and assist in resolving their agriculture related problems, there by motivating them to decide to participate in land management programs hence increased production. The result of the regression analysis revealed that frequency of extension agent contacts household was statistically positively significant influenced introduced SLM practices ($p<0.01$) (Table 4). This means as the frequency of access to extension services helps farmers to gain better understanding of the potential effects of soil erosion.

The odds ratio showed that farmers who have access to extension services probability to adopt the introduced sustainable land management are increases by a factor of 6.017. The result was in line with the finding of [15, 19, 45] who reported that farmers who receive better information from extension agents have willing to implement new soil and water conservation practices and maintain the existing practices.

Perception of farmer SLM: There is a general understanding that the better the farmers perceive problems of land degradation, the better they can act to achieve sustainable land management practices. the result of the regression analysis revealed that the farmer perception of SLM is found to be statistically positively significant ($p<0.01$) (Table 4). This implies that the better the farmers perceive the problem of soil erosion, the more likely the farmers to adopt sustainable land management practice on their lands.

The odds ratio showed that farmers who have good perceived the lands degradation and soil erosion influence the probability increases by a factor of 18.81 adopt the introduced sustainable land management practice. This result agrees with the findings [21, 31] who reported that better p'erception and knowledge of farmers about the soil erosion problem contribute to the sustainable use of introduced soil and water conservation practices.

Livestock (TLU): This variable represents the livestock holding of the household in tropical livestock unit. The result of the regression analysis revealed that the livestock is found to be statistically positively significant ($p<0.01$) (Table 4). The odds ratio of showed that keeping all factors an increase in livestock ownership by one TLU increases the probability of manure application by 2.409. This result might be due to the fact farmers who own relatively more livestock size make use of animal manure. The result was in line with the finding [13] indicated that the positive relationship between adoption of SWC practices and number of livestock.

4. Conclusion

The adoption of Sustainable Land Management practices is quite crucial to increase agricultural productivity, minimize land degradation, rehabilitate degraded area, ensure food security and improve the livelihoods of smallholder farmers. The adoption of SLM practices in is positively influenced by the sex, perception of farmer, extension service and TLU while, age and off farm activities are the variables with signficant negative influnced the adoption of SLM practices. Moreover, further research need to be conducted on the use of sustainable land management on socio-economic aspects for a better understanding of the sustainable use of the land resource.

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