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Determinants of farmers' sustainable land management practices implementation in Sekoru District, Jimma Zone, Oromia National Regional State, Southwest Ethiopia

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The overall objective of the study is to assess the determinants of farmers' implementation of sustainable land management practices. To achieve the objective of the study, cross sectional research design and mixed research approach were used. To answer research questions and attain those research objectives stated earlier, both primary and secondary data sources were employed. The primary data were gathered from respondents, while secondary data were gathered from document analysis. Stratified sampling technique was employed to select Kebeles from different agro-ecological zones. Purposive sampling was employed to select Kebeles from each agro-ecological zone. Simple random sampling was used to select 189 respondents from the Kebeles household heads. Quantitative data were analyzed using descriptive and inferential statistics methods whereas the qualitative data were analyzed using narration and statement. The findings of the study revealed that education level (p = 0.010), energy source (p = 0.003), farm distance (p = 0.032), livestock resources (p = 0.001), type of grazing (p = 0.025), access to credit (p = 0.010), low perceptions about soil erosion (p = 0.000), population pressure (p = 0.046) and physical factors (p = 0.015) like topography, climatic variability, etc., are the main determinants of farmers' implementation of SLM practices in the study area. Thus, to reverse these factors, the district agricultural office should disseminate the important farm equipment to the farmers in order to strengthen the continuous work on sustainable land management practices and also they should provide persistence information and training about sustainable land management practices.

Key words: Implementation of land management practices, determinants of land management implementation.

INTRODUCTION

Sustainable land management has emerged as a new approach to soil and water conservation efforts of Ethiopia in general and the study area in particular. This is not only because of the increasing population pressure on limited land resources, demanding for increased food production, but also by recognizing the fact that the

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degradation of land resources is accelerating rapidly in the area. The growing interest in the concept of sustainability was given added stimulus at the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in June 1992. Chapter 10 of Agenda 21 is concerned with the planning and management of land resources. For these reasons sustainable land management (SLM) is now receiving considerable attention from development experts, policy makers, researchers and educators.

Over the last two decades, the Ethiopian Government invested in a variety of SLM programs in order to address ongoing land degradation. Previous evaluations of SLM programs in Ethiopia estimate impacts on agricultural production derived implicitly from economic wise. However, these evaluations lack explicit measurement of changes in hydrological processes (Schmidt et al., 2017).

A study conducted by Tadele (2016) in Bale zone of South Eastern Ethiopia identified factors that are determining farmers choices of SLM. Accordingly, the significant factors include education level of household head, age of household head, family size, agro-ecology, income, market access, extension service, access to credit, farming experience, livestock ownership, land holding size, sex of household head, perception on soil fertility and training access to have an influence in the adaption of land management. On the other hand, a study conducted in Werra Jarso District by Mamuye (2015), identified that population growth, income level, urbanization, infrastructural development, policies at national and international levels and land tenure and property rights were the major factors affecting sustainable land use management.

Given this state of conditions, analysis of the issue of what specifically determines the decision taken by farmers to adapt SLM practices/technologies in Sekoru District is very important and relevant to formulate policy options and support systems that could accelerate use of soil conservation technologies. For a better understanding of the barriers and prospects faced by households when deciding to adapt SLM practices more detailed context specific household-level studies focused on determinants of SLM practices adaption by farmers are needed. As a result of the above reality, this paper attempted to assess the determinants of farmers' SLM practices implementation in Sekoru District, Jimma zone, Oromia Regional National State.

Study area

Sekoru (also spelt as Sokoru) is one of the districts in the Jimma zone, Oromia National Regional State of Ethiopia. Sekoru is named after the former highest administrative unit known as *Awraja* which used to cover much of the same territory as the current district, as well as its administrative center, Sokoru. Sekoru is bordered on the south by Omo Nada District, on the west by Tiro Afeta District, and on the north and east by the Southern Nations, Nationalities and Peoples Regional State. The Gibe River defines the northern boundary. Other towns include Deneba, Kumbi and Natri (Sekoru District Administration, 2019). Astronomically, Sekoru is located between 7^{o}35'00'' and 8^{o}15'00'' N latitudes and 37^{o}15' 00'' to 37^{o}38'00'' E longitudes. It is about 275 km away from Addis Ababa, the capital city of the country, 90 km away from Jimma town, administrative center of Jimma zone (SWoARD, 2019) (Figure 1).

Topography, climate and soil type

The relief patent includes high and medium rugged mountain ranges undulating to rolling plateaus and plains, gorges and deep incised river valleys. The altitude ranges from 1160 to 2940 m above mean sea level with the highest points Ali Derar, Ali Shashema and Kumbi. Perennial rivers of Sekoru include the Gilgel Gibe, a tributary of Gibe, and the Kawr; while seasonal streams include the Melka Luku, Getta and Karkari. It has an average temperature of 19^{0}°C. The major soil types in the study area are Nitisols, Fluvisols, Acrisols, and Vertisols, with the dominant soil being Nitisol (SWOARD, 2019).

Demography

The total population of Sekoru is about 136,320, (68,469 male and 67,851 female). 12,724 (9.33%) of its population were urban dwellers. The majority (91.63%) of the inhabitants are Muslims, while 6.99% of the population follows Ethiopian Orthodox Christianity, and the rest 1.19% were protestant. Concerning the ethnic diversity, Oromo (77.73%), Yem (8.19%),

Kebena (3.69%), Hadiya (3.4%), Amhara (2.7%), and the Sebat Bet Gurage (1.72%) are the six largest ethnic groups; the remaining ethnic groups make up 2.57% of the population. Afan Oromo is spoken as mother tongue by 83.74%, 4.62% spoke Amharic, 3.8% spoke Kebena, 3.43% spoke Yemsa, and 3.1% spoke Hadiya; the remaining 1.31% spoke all other primary languages reported (CSA, 2008).

Agriculture

The farming system of the study area was mixed farming. The farmers of Sekoru District produce about 18 varieties of crops. However, maize and *teff* are the principal crops grown by the farmers. The study area is conducive for livestock production having large market potentials for livestock and livestock products. The livestock depends on grazing land, forest land and crop residue to survive and there is no improved forage in the study area (SWOARD, 2019).

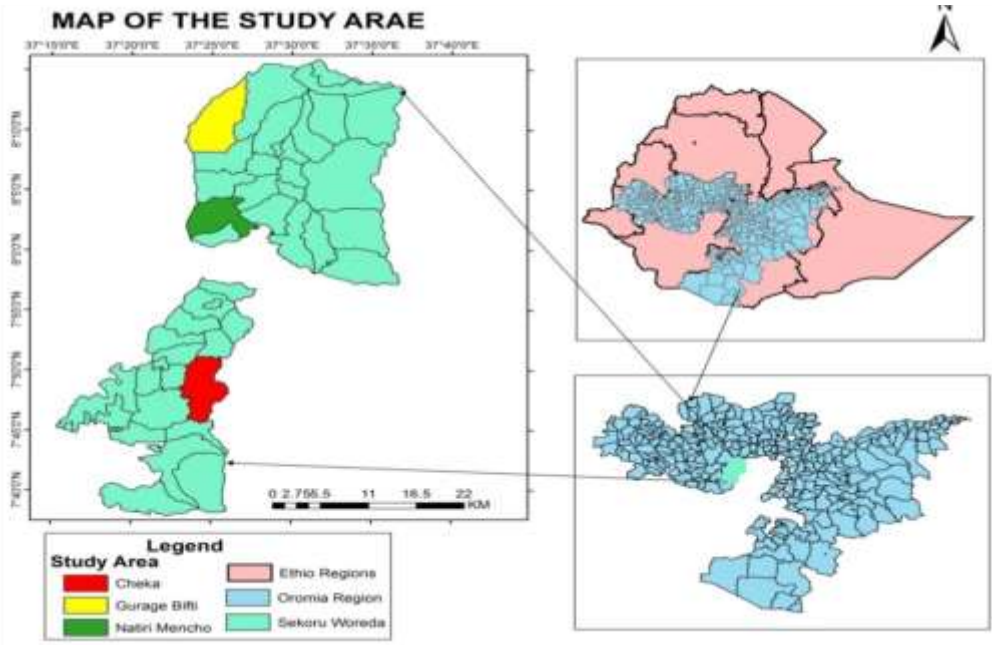

Figure 1. Map of the study area.

Land use type

The major land use types of the study area include agricultural land, forest land, bush land, grass land, settlement and bare land. A survey of the land in the District showed that 36.6% was arable or cultivable, 16.8% pasture, 17.2% forest, and the remaining 29.4% is built-up or degraded. The Abelti-Gibe State Forest covers 159 square kilometers of the forested area. *Teff* is one important cereal crop. Although coffee is an important cash crop of this District, less than 20 square kilometers are planted with the crop.

METHODS

Study design and approach

This thesis aimed to assess the current determinants of farmers' SLM implementation in Sekoru District using descriptive analysis. Cross-sectional study design was used for this study. It is a design that is rooted in positivists' philosophical outlook. Positivists believe in the objectivity of the material world (Creswell, 2009). This study involved both quantitative and qualitative data in relation to the issue under study. Thus, mixed research approach was employed for this study.

Sample size determination and sampling methods

The formula developed by (Yamane, 1967) was used to determine the sample size at 93% confidence level:

$$n = \frac{N}{1 + N(e)^2}$$

Where n = the desired sample size; N = Population size of the household head; e = level of precision (7%)

$$n = \frac{2835}{1 + 2835(0.07)^2}$$

n = 188.19≈ 189

Therefore, the total sample size for this study was 189 household heads. Table 1 shows the proportional allocation of sample size.

Combinations of sampling techniques were employed to select sample household heads for the study. Accordingly, stratified, purposive and simple random sampling techniques were used at different stages to collect data. Stratified sampling technique was employed to select *Kebeles* from different agro-ecological zones. Accordingly, in the first stage, 34 *Kebeles* of the Sekoru District were stratified in to traditional agro-ecological zones (High, Middle and Low altitude) on the basis of the classification devised by the Ministry of Agriculture (MoA, 2000). Areas falling between 2,300 and 3,200 meter above mean sea level were labeled as highlands; those falling between 1,500 and 2,300 meter above mean sea level were labeled as midlands while those between 500 and 1,500 meter above mean sea level were lowlands. In the second stage, one *Kebele* from each agro-ecology was selected purposively. Accordingly, Cheka kebele from highland (*Baddaa*), Natri Mencho from middle altitude (*Badda-daree*) and Gurage Bifti from low altitude (*Gammoojjii*) were purposively selected based on representativeness of the *Kebeles* to determinants of sustainable land management practices implementation (SWOARD, 2019). Proportional allocation was used to allocate adequate samples to each *Kebele*. Finally, simple random sampling technique was used to select sample households from each *Kebele*.

To minimize the rate of nonresponse rate, the enumerators were oriented well, they were provided with incentives. Since the sources of data were household heads, the enumerators collected data by going to their home.

Data sources and data gathering techniques

The study employed both primary and secondary data sources. Most primary data were collected from respondents through close and open ended questionnaires. They were gathered using semi-

Table 1. Proportional allocation of sample size.

Kebeles	Total household heads	Proportional allocation	Sample size
Cheka	1069	$\frac{1069 \times 188}{2835}$	71
Natri Mencho	987	$\frac{987 \times 188}{2835}$	66
Gurage Bifti	779	$\frac{779 \times 188}{2835}$	52
Total	**2835**		**189**

Source: Own Survey, 2020.

structured questionnaires, interview guide and different observation check lists. Key informant interview was employed for the purpose of qualitative data. Key informant interview was conducted with different experts and individuals including *Kebeles* extension workers and district agricultural office. Secondary data were gathered from different published and unpublished materials and from different District Administration reports and other relevant documents of the District. Observation checklist was prepared to crosscheck the data found from different sources and the reality. This method is one way of collecting the qualitative data by gathering first- hand data from concerned bodies and farmers who live in the study area.

Data analysis techniques

The research employed both qualitative and quantitative analytical techniques. In quantitative research approach, both descriptive and inferential statistics were employed. Most of the quantitative data were analysed using SPSS software. Binary logistic regression, cross-tabulation table, chi-square test and percentage were the widely used statistical techniques. Qualitative data collected through key informant interviews and observations were analyzed using textual analysis.

Model specification

Explanatory variables: The supposed explanatory factors identified by the writers included age, sex, educational level, land holding size, farmland distance, livestock holding, and farmers' perception, off farm activities, credit services, extension services and topography (Table 2).

Logistic regression sometimes called logistic model or logit model was used to analyze the relationship between multiple independent variables and categorical dependent variables. The general formula for the binary logistic regression is presented as follows:

$$Li = \ln_e(P_i/1 - P_i) = Zi = \alpha+\beta_1X_1 + \beta_2X_2 + \ldots \beta_KX_K + \epsilon_i$$

Where **Li** is the log of the odds ratio; **e** is the base of natural logarithms; **α** is a constant; $X_1, X_2, \ldots, X_k$ are explanatory variables; $\beta_1, \beta_2, \ldots, \beta_k$ are estimated parameters corresponding to each explanatory variable; k is number of explanatory variables; and ϵ_i is the random error. To test the overall good fitness of binary logistic regression model, Hosmer-Lemeshow test of goodness-of-fit was utilized.

RESULTS

The main body of the paper focused on four major areas. The first part focused on assessing respondents' socio-demographic and economic characteristics. The second part of the study focused on assessing over-view of SLM Practices in the study area. The third section focused on socio-economic, institutional and bio-physical challenges of implementation of successful SLM practice. The last part was dedicated to the identification and elaboration of significant explanatory variables influencing implementation of SLM Practices. Accordingly, the sections are presented one after the other subsequently.

Socio- demographic and economic characteristics of respondents

As it can be seen in Table 3, the study covered a total of 189 household heads. For the three *Kebeles*, 92% were male headed household and the rest 8% were females. Most of the respondents (33%) were found within 41-50 age intervals.

A considerable number (26%) of the respondents fell in the age group of 31 to 40, followed by those who were between 51 and 60 years. The proportion of respondents above 60 years constituted only 10%. Concerning religion, 3 religions are practiced in the study area, but the followers of Islam constituted the majority in all *Kebeles.* Of the total respondents, 87 % of them were married, 8% were divorced, 4% were unmarried and the rest 1% was widowed. In relation to educational level, majority of the respondents 59% could not read nor write in Cheka *Kebele* and followed by 71% and 77% in Natri Mencho and Gurage Bifti *Kebeles* respectively. Only 32 % of the respondents could read and write in the selected *Kebeles*. This level of education obviously can affect the adaption and implementation of technologies in relation to SLM.

The other important issues that displayed in Table 3 were households' family size and occupation. Accordingly, 59% of the respondents in the three *Kebeles* possessed 6-10 family size which necessitated additional plot of farming land for their children. Concerning occupation of the respondents, the most important ones were farming (98.4%) and cattle rearing (87.8%). Trading and carpentry constituted 24.9 and 9% respectively. 5%

Table 2. Explanatory variables.

Variable	Nature of variable	Expected sign in binary logistic model	Explanations
Socio-economic			
Age of the HH	Continuous	-	The older the age of the respondents, the lower the implementation of SLM
Sex of the HH	Categorical	-	Females are expected to be lower implementers
Education level	Categorical	+	The higher the education level, the better the implementation
Land holding size	Continuous	-	The larger the land size, the lower the attention given to the intensive farming
Farmland distance	Continuous	-	The farther the farmland distance, the lower options to use organic fertilizers, etc.
Livestock holding	Categorical	+	Serves as sources of income, manure, etc.
Farmers' perception	Categorical	-/+	Positive perception promotes implementation of SLM and vice versa.
Land resource	Categorical	+	Having own plot of land promotes implementation of SLM
Off farm activities	Categorical	-	The more the diversified sources of income, the less attention given to the soil conservation
Institutional factors			
Credit service	Categorical	-	The better the credit access, the better it enhances to invest on SLM
Extension services	Categorical	-	The better they possess know-how, the better they are implementing SLM
Topography	Categorical	+	The more the rugged topography, the better they obliged to implement conservation mechanisms.

Source: Own Survey, 2020.

of the respondents in Natri Mencho *Kebele* were participating in other occupations which involved the selling of fuel wood and charcoal. Unless it is managed properly, farming and cattle rearing have direct impact on the implementation of SLM.

Some characteristics of respondents' nexus implementation of SLM Practice

To examine the nexus between implementation of SLM practices and some of the socio-demographic characteristics of respondents, the researcher used a cross-tabulation and chi-square test. According to the cross-tabulation table result, the actual percentage of males who are implementing SLM practices was greater than females. Similar to common sense, male respondents appeared to be at better position in implementing SLM practices (Table 4). An attempt was also made to test whether the observed difference between males and females is statistically significant.

To do so, the researcher used the chi-square test as shown in Table 4. As the P (Pearson's Chai Square value= 0.159) is greater than the alpha value (α = 0.05), the null hypothesis must be accepted. Meaning, there is no statistically significant difference between males and females in implementing SLM practice in the study area. The Phi and the Cramer's values were also calculated to see the strength of the association. The calculated value was 0.103, which indicates that there is no association between the two.

Similarly, respondents' implementation of SLM was also examined in relation to their level of education using the cross-tabulation and the chi-square test (Table 5). Accordingly, the ability to implement SLM practice increases with increasing level of education, so that, the two are directly related. To confirm whether the observed association observed between level of education and SLM practices implementation was statistically significant or not, the Pearson chi square test was used as shown in Table 5.

Since the P- value (<0.001) was less than α -value (α=0.05), the H_0 was rejected. This indicates that there is statistically significant association between respondents'

Table 3. Socio-demographic and economic characteristics of respondents.

Socio-demographic and economic characteristics	Cheka *Kebele*		Natri Mencho		Gurage Bifti		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Household heads'sex								
Male	67	94	60	91	47	90	174	92
Female	4	6	6	9	5	10	15	8
Total	71	100	66	100	52	100	189	100
Household heads'age category								
< 20	-	-	1	2	-	-	1	1
21-30	6	8	4	6	11	21	21	11
31-40	14	20	18	27	17	33	49	26
41-50	21	30	28	42	14	27	63	33
51-60	17	24	9	14	10	19	36	19
>61	13	18	6	9	-	-	19	10
Total	71	100	66	100	52	100	189	100
Household heads' religion								
Islam	44	62	43	65	32	66	119	63
Orthodox	14	20	11	17	11	21	36	19
Catholic/protestant	13	18	12	18	9	13	34	18
Total	71	100	66	100	52	100	189	100
Household heads' marital status								
Married	61	86	58	88	46	88	165	87
Unmarried	3	4	4	6	1	2	8	4
Divorced	6	8	4	6	5	10	15	8
Widowed	1	2	-	-	-	-	1	1
Total	71	100	66	100	52	100	189	100
Household heads' education level								
Cannot read and write	42	59	47	71	40	77	129	68
Grade 1-12	29	41	19	29	12	23	60	32
Total	71	100	66	100	52	100	189	100
Household heads' family size								
0-5	21	30	19	29	23	44	63	33
6-10	45	63	40	61	27	52	112	59
11-15	5	7	7	10	2	4	14	8
Total	71	100	66	100	52	100	189	100
Household heads' occupation								
Farming	69	97	65	98	52	100	186	98.4
Cattle rearing	55	77	59	89	52	100	166	87.8
Trading	11	6	27	41	9	17	47	24.9
Carpenter	7	4	4	6	6	12	17	9
Others	-	-	5	8	-	-	5	3

Source: Own Survey, 2020.

education levels and implementation of SLM practices at 0.05 level of significance. The calculated Phi and Cramer's Values (<0.001 each) indicate that there is a strong relationship between respondents' education level and implementation of SLM practice.

Similarly, the Pearson's chi- square value of implementation of SLM practice by HHH occupation was 0.067. Hence, the P-value is greater than the alpha value

Table 4. Sex of the respondents and SLM practice implementation nexus.

Kebele	Kind of test	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	3.285	1	0.070
Natri Mencho		5.795	1	0.016
Gurage Bifti		2.550	1	0.110
Total		1.987	1	0.159

Source: Own survey, 2020.

Table 5. Respondents' level of education and SLM practice implementation nexus.

Kebeles	Kind of tests	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	36.074	1	<0.001
Natri Mencho		1.021	1	0.312
Gurage Bifti		5.223	1	0.022
Total		35.066	1	<0.001

Source: Own survey, 2020.

Table 6. Household heads' occupation and SLM practice implementation nexus.

Kebele	Kind of tests	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	2.043	1	0.153
Natri Mencho		0.001	1	0.980
Gurage Bifti		2.383	1	0.123
Total		3.366	1	0.067

Source: Own survey, 2020.

Table 7. Types of off farm activities.

Household Heads' off-farm activities	*Kebele*							
	Cheka		Natri Mencho		Gurage Bifti		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Daily labor	4	5.6	8	12.1	8	15.4	20	10.6
Petty trading	12	16.9	26	39.4	11	21.2	49	26
Quarry	-	-	-	-	-	-	-	-
Selling fuel wood and charcoal	2	2.8	22	33.3	4	7.7	28	14.8
Carpentry	8	11.3	3	4.5	9	17.3	20	10.6

Source: Own survey, 2020.

(α= 0.05). This indicates that there was no occupation based difference in implementing SLM practices in the study area (Table 6). Therefore, fail to reject null hypothesis.

Over-view of SLM in the study area

The most comprehensive definition of SLM, according to Haymanot (2018), is the combination of technologies, policies and activities aimed to integrate socio-economic principles with environmental concerns so as to simultaneously maintain or enhance production, reduce the level of production risk, protect the potentials of natural resources and prevent soil and water degradation is economically viable and socially acceptable.

According to the information that was obtained from the key informant interview made with informants, the

Table 8. Off-farm activities and implementation of SLM practice nexus.

Kebele	Kind of tests	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	0.240	1	0.624
Natri Mencho		2.468	1	0.116
Gurage Bifti		0.000	1	1.000
Total		3.296	1	0.069

Source: Own survey, 2020.

Table 9. Energy sources used by the respondents.

Energy sources	*Kebele*							
	Cheka		Natri Mencho		Gurage Bifti		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Bio-gas	1	1.4	1	1.5	-	-	2	1
Fuel wood	71	100	58	87.9	52	100.0	181	96
Animal dung	9	12.7	29	43.9	8	15.4	46	24.3
Crop residue	17	23.9	35	53.0	48	92.3	100	52.9
Electricity	-	-	15	22.7	-	-	15	8
Petroleum	6	8.5	19	28.8	10	19.2	35	18.5

Source: Own survey, 2020.

management of farmland was mostly done using traditional SLM practices such as traditional terracing (*kaba*), unplowed strip(*gepo*), check dam, traditional diversion ditch (*bo'oo lolaa*), planting trees, contour plowing, green manuring, fallowing, inter cropping, crop rotation and crop residue. The common modern SLM practices used to manage farm land in the study area was compost and artificial fertilizer. The results from the researcher's observation indicate that the SLM practice in the study area was at its minimum level. So, the next section tried to inculcate the issues in relation to the applicability of SLM using cross-tabulation and different tests.

Socio-economic, institutional and bio-physical challenges of implementation of successful SLM practices

Socio-economic challenges

Off-farm activities: In relation to the type of off farm activities, Table 7 shows that daily labor, petty trading, selling fuel wood and charcoal and carpentry were attended by 10.6, 26, 14 and 10.6% of the respondents respectively. Majority of them were participating in petty trading. In *Kebele* wise, Natri Mencho *Kebele* leads in petty trading (39.4%) and selling fuel wood and charcoal (33.3%). This showed how the selling of fuel and charcoal as energy source was affecting the SLM practices. No one participated in quarry in the three *Kebeles* and this needs due attention.

The impact of off- farm opportunities on sustainable land management is theoretically ambiguous. Off-farm income may enable households to the finance or purchase of inputs for land investments, but such opportunities may und ermine on-farm activities, especially labor intensive activities. Pender et al. (2001) found that increased use of fertilizer was less common in communities where off-farm income was important. Similarly, the same authors found that households for whom off-farm is their primary income were more likely to invest in stone terraces in Tigray. On the other hand, a study made by Bekele and Stein (1998) showed a negative relationship between off-farm works and SWC technologies.

To examine the nexus of implementation of SLM practices and off-farm activities of respondents', the researcher used a cross-tabulation and chi-square test (Table 8). According to the cross-tabulation result, the observed percentage of respondents who responded yes was greater. An attempt was also made to test whether the off-farm activity was statistically significant. To do so, the researcher used the chi-square test.

Since the P- value (0.069) was greater than α -value (α=0.05), the research failed to reject the null hypothesis. This indicates that there was no statistically significant association between respondents' off-farm activity and implementation of SLM practices at 0. 05 level of significance. The calculated Phi and Cramer's Values (0.624 each) indicated that there was no relationship between respondents' adaption to SLM practices and off-

Table 10. Energy sources and SLM practice implementation.

Kebele	Kind of test	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	17.780	1	0.000
Natri Mencho		36.656	1	0.000
Gurage Bifti		20.313	1	0.000
Total		73.279	1	<0.001

Source: Own survey, 2020.

Table 11. Respondents' land resources.

Farm size (ha)	*Kebeles*						Total	
	Cheka		Natri Mencho		Gurage Bifti			
	No	%	No	%	No	%	No	%
0-2	55	77.5	41	62	4	7	100	53
2.1-4	12	16.9	24	36	14	27	50	26
4.1-6	4	5.6	1	2	34	66	39	21
Total	71	100	66	100	52	100	189	100

Source: Own survey, 2020.

farm activities.

Energy sources: In countries where energy sources are directly dependent on the natural environment like forest, it is quite obvious that the extraction and consumption of the energy sources can affect the SLM. As indicated in Table 9, the type of energy sources used by the respondents mostly included fuel wood (96%), crop residue (52.9%) and animal dung (24.3%). It can be understood from Table 10 on how the respondents were dependent on the biological energy sources which could directly contribute in affecting SLM.

In the three *Kebeles*, energy source is determinant for the implementation of the SLM as the study area is dependent on fuel wood, charcoal, animal dung, etc. as sources of energy. According to the interview made with informants, the main energy sources in the three *Kebeles* are directly extracted from the environment especially in Natri Mencho *Kebele*. Selling of fuel wood and charcoal was the main livelihood for many of the *Kebele's* dwellers. In addition to this, crop residue and animal dung which were of the most important biological ingredient in making and adding humus in the soil content were being used as energy sources. This was directly affecting the soil fertility and crop productivity.

As the P (< 0.001) is less than the alpha value (α = 0.05), the null hypothesis must be rejected. Meaning, there was statistically significant association between energy sources and implementation of SLM practice in the area under consideration. The Phi and the Cramer's values were also calculated to see the strength of the association. The calculated values were <0.001, which indicates that there is strong association between the two.

Land resources

As it can be perceived from Table 11, most of the respondents have their own plot of land. Large farm size (Gurage Bifti *Kebele*) is not encouraging them to implement SLM. This was because of the fact that they are exercising extensive farming than intensive farming. Contrary to this in *Kebeles* where there is smaller farm size (Natri Mencho and Cheka), farmers are better in implementing SLM practices especially through intensive farming. Farmers having large farm sizes are expected to practice better land management practice. This is due to the fact that farmers that have large farm size are expected to practice better land management by planning different land management technologies. In this context farmers having small land farm size are relatively small or not implementing good land management practices (Motuma, 2017). Even though this is the finding that was pointed out by Motuma, the reality in the study area is not showing this. Table 12 shows the farm size and SLM practice implementation nexus.

To examine the nexus between Sustainable Land Management Practice implementation and farm size of the respondents, the researcher used a chi-square test as shown in Table 12.

Here, in Gurage Bifti *Kebele,* the P-value is 0.477 which is greater than the alpha value (0.05); therefore, it failed to reject H_0. This indicates that there was a statistically significant difference between land size and implementation of SLM practices in the *Kebele* at 0.05

Table 12. Farm size and SLM practice implementation nexus.

Kebele	Kind of tests	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	33.898	1	0.000
Natri Mencho		20.323	1	0.000
Gurage Bifti		0.506	1	0.477
Total		33.013	1	0.000

Source: Own survey, 2020.

Table 13. Farm distance.

Farmland distance (km)	*Kebele*							
	Cheka		Natri Mencho		Gurage Bifti		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
0-0.5	62	87.3	35	53.0	44	84.6	141	74.6
1.6-3	9	12.7	21	31.8	8	15.4	38	20.2
3.1- 4.5	-	-	8	12.1	-	-	8	4.2
>4.6	-	-	2	3.0	-	-	2	1
Total	71	100.	66	100.	52	100	189	100

Source: Own survey, 2020.

Table 14. Farmland distance and SLM practice implementation.

Kebele	Kind of tests	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	0.151	1	0.697
Natri Mencho		25.159	1	<0.001
Gurage Bifti		27.628	1	<0.001
Total		33.013	1	<0.001

Source: Own survey, 2020.

level of significance. The calculated Phi and Cramer's Values (0.477 each) indicate that there is a no relationship between respondents' farm size and SLM implementation in the *Kebele.* However, this was not the case for the rest two *Kebeles.* Since the P- value (<0.001) for the two *Kebeles* (Cheka and Natri Mencho) was less than α -value, the H_0 was rejected. This indicated that there was a statistically significant association between respondents' farm size and SLM implementation at 0. 05 level of significance. The calculated Phi and Cramer's Values (<0.001 each) indicated that there was a strong relationship between implementation of SLM and respondents' farm size. In a nut shell, since the P- value (<0.001) was less than α -value, the H_0 was rejected and there was a statistically significant association between farm size and implementation of SLM practices in the district.

Farmland distance

As can been seen from Table 13, majority of the respondents (74.6%) responded that the farm distance from their home area is within 0-0.5km which means that they could be located around their home area.

Farm land distance from the home area was an important factor determining implementation of SLM practices in the study area especially in Natri Mencho and Gurage Bifti *Kebeles*. According to the interview made with the informants, the distances the farmers were walking to arrive at their farm land was longer and even sometimes it was as far as 9 km.

According to the interview, the farm distance was affecting the access to labor supply, the application of organic fertilizers especially the making and using of compost and above all the time it consumes. To examine the nexus between sustainable land implementation and farm distance, the researcher used chi-square test as follows.

Table 14 indicates that, in Cheka *Kebele,* the P-value was 0.697 which was greater than the alpha value (0.05). Therefore, the study failed to reject H_0 in the *Kebele.* This indicated that there was a statistically significant difference between farmland distance and implementation

Table 15. Respondents' farming experience.

Respondents farming experience (years)	*Kebele*							
	Cheka		Natri Mencho		Gurage Bifti		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
1-5 years	11	15.5	12	18.2	5	9.6	28	14.8
6-10 years	12	16.9	19	28.8	12	23.1	43	22.8
>10 years	48	67.6	35	53.0	35	67.3	118	62.4
Total	71	100.	66	100.	52	100.	189	100

Source: Own survey, 2020.

Table 16. Farming Experience and SLM Practices Implementation Nexus.

Kebele	Kind of tests	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	1.890	1	0.169
Natri Mencho		13.616	1	<0.001
Gurage Bifti				<0.001
Total		10.288	1	<0.001

Source: Own survey, 2020.

of SLM practices in the *Kebele* at 0.05 level of significance. The calculated Phi and Cramer's Values (0.697 each) indicated that there was no relationship between respondents' farm size and SLM implementation in the *Kebele.* However, this was not the case for the rest two *Kebeles* (Natri Mencho and Gurage Bifti). Since the P- value (Pearson's chi-square test, for instance, was <0.001) for the two *Kebeles* (Cheka and Natri Mencho) was less than α -value (α=0.05), the H_0 was rejected. This indicated that there was a statistically significant association between respondents' farmland distance and SLM implementation at 0. 05 level of significance. The calculated Phi and Cramer's Values (<0.001 each) indicated that there was a strong relationship between implementation of SLM and farmland distance. In a nutshell, since the P- value (Pearson's chi-square test, was <0.001) was less than α -value (α=0.05), the H_0 was rejected and there was statistically significant association between farmland distance and implementation of SLM practices in district.

Farming experience

Majority of the respondents (62.4%), according to Table 15, responded that their experience was above 10 years. As farmers accumulate experience over time, they progressively switch from traditional agricultural technologies to improved technologies on the basis of observed performance and learning by doing. Learning by doing depends on the release of new agricultural technologies; furthermore, if researchers fail to keep developing superior technologies, these technologies are unlikely to achieve significant progressive implementation (Anderson and Tushman, 1990).

Farming experience is also among important factors determining SLM. From Table 16, farming experience was not a significant factor determining the implementation of SLM in the study area. Majority of the respondents (49 out of 96) responded that farming experience has no significant impact on the SLM implementation. 47 respondents responded that farming experience has impact on the implementation of SLM in the study area. So, farming experience has no impact on the implementation of SLM as the majority responded that it has no impact. According to the interview that was made with informants, even though the farmers have an elongated farming experience, it has no significant impact on the adaption of modern SLM because of the fact that their experience in relation of adapting modern SLM was affected by traditional knowledge.

To examine the nexus between sustainable land management implementation and farming experience of the respondents, the researcher used a chi-square test as shown in Table 6.

Since the P- value (Pearson's chi-square test was <0.001) was less than α -value (α=0.05), the H_0 was rejected. This indicates that there was significant association between respondents' farming experiences and implementation of SLM practices at 0.05 level of significance.

Livestock resources

As depicted in Table 17, all of the respondents had their

Table 17. Livestock resources.

Livestock resource	*Kebele*							
	Cheka		Natri Mencho		Gurage Bifti		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	71	100.	66	100	52	100	189	100
Total	71	100.	66	100	52	100	189	100

Source: Own survey, 2020.

Table 18. Livestock resources and SLM practice implementation.

Kebele	Kind of tests	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	36.074	1	<0.001
Natri Mencho		26.409	1	<0.001
Gurage Bifti		6.266	1	0.012
Total		66.091	1	<0.001

Source: Own survey, 2020.

Table 19. Type of respondents' grazing.

Type of grazing	*Kebele*							
	Cheka		Natri Mencho		Gurage Bifti		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Free and unregulated	19	26.8	35	53.0	45	86.5	99	52.4
Regulated by number of animals grazed	35	49.3	23	34.8	3	5.8	61	32.3
Regulated by number of days grazed	16	22.5	8	12.1	6	11.5	30	15.9
Regulated by season	19	27.8	43	65.2	49	94.2	111	58.7

Source: Own survey, 2020.

own livestock resources. Livestock is the major component of the agricultural system in Ethiopia. Wealthy farmers or farmers having livestock access more manure and implement more soil fertility management practices than other farmers that do not have livestock (Michael, 2007). Here, Michael tried to look at the positive impact of the livestock resource forgetting the negative impact especially in the form of overgrazing, hence aggravating soil erosion. In the study area, livestock resource has both negative and positive impact on the implementation of SLM practices (Table 18).

In order to realize the nexus between livestock resources and SLM implementation, the researcher employed chi-square test as should in Table 18

Since the P- value (Pearson's chi-square test is <0.001) is less than α -value (α=0.05), the H_0 was rejected. This indicates that there was significant association between respondents' livestock resources and implementation of SLM practices at 0.05 level of significance. The calculated Phi and Cramer's Values (0.000 each) indicates that there was strong relationship between livestock resource and implementation of SLM practice.

Type of grazing

It is clearly shown in Table 19 that majority of the respondents (52.4 and 58.7%) responded that the dominant type of grazing type in the study area was unregulated free type and that regulated by season. This type of grazing was obviously known to be affecting grazing as well as fallowing land, hence it was affecting SLM.

According to the informants, the grazing type especially in Natri Mencho and Gurage Bifti *Kebele* was free and regulated by season type. This type of grazing causes deterioration of grasslands, removal of crop residues through feeding animals, etc. affecting the implementation of SLM practices. As can been seen from Table 20, the type of grazing was highly significant in Cheka and Natri Mencho *Kebele* where there was scarcity of grazing land.

Table 20. Type of grazing and SLM practice implementation nexus.

Kebele	Kind of tests	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	42.202	1	<0.001
Natri Mencho		41.469	1	<0.001
Gurage Bifti		0.601	1	0.438
Total		67.903	1	<0.001

Source: Own survey, 2020.

Table 21. Respondents perception about SLMP.

Respondents' perception on the importance of SLM practices	*Kebele*							
	Cheka		Natri Mencho		Gurage Bifti		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	35	49.3	63	95.5	52	100	150	79
No	36	50.7	3	4.5	-	-	39	21
Total	71	100	66	100	52	100	189	100

Source: Own survey, 2020.

Contrary to this, there was ample of land resource in Gurage Bifti *Kebele*. The average land size that was held by the farmers in the three *Kebeles* was higher in Gurage Bifti *Kebele*. So, the *Kebele* has no exaggerated grazing problem.

In order to realize, the nexus between livestock resources and SLM implementation, the researcher employed chi-square test as shown in Table 20. In Gurage Bifti *Kebele,* the P- value (Pearson's chi- square test, for instance, is 0.438) was greater than α -value (α=0.05). Therefore, the study failed to reject H_0. This indicated that there was a statistically significant difference between grazing type and implementation of SLM practices at 0.05 level of significance. The calculated Phi and Cramer's Values (0.438 each) indicate that there was no relationship between grazing type and implementation of SLM practice. But in the *District* as a whole*,* since the P-value (<0.001) was less than α -value (α=0.05), the H_0 was rejected.

This indicates that there was a statistically significant association between grazing type and implementation of SLM practiced at 0. 05 level of significance. The calculated Phi and Cramer's Values (0.000 each) indicated that there was a strong relationship between grazing type and implementation of SLM practices at 0. 05 level of significance.

Respondents' perception about SLM

In the study area, except in Gurage Bifti *Kebele,* low perception has an impact on the implementation of SLM. Generally, in the *district*, low perception has impact on the implementation of SLM as it is indicated by the chi^2 test which showed that there is a statistical association between perception and implementation of SLM practices (Table 21).

As the researcher identified from the key informant interviews, farmers have a good awareness about SLM practices and also the advantages and disadvantages of not practicing SLM. Also in the three *Kebeles* compared to previous time, awareness of farmers about SLM practices a day was better because the farmers know about SLM practices and which practice was better for which landform and soil type and also which practice was good to produce more. The majority of the respondents (79%) in the study area had better awareness about the importance of SLM practices but with less practicability. The perception of farmers about the problem of land degradation plays a vital role in implementing SLM practice. The empirical evidence on farmers' perception in implementing SLM was mixed. Some authors linked farmers' management initiation to the visible indicators of land degradation and perceptive severity of the problem (Aklilu, 2006; Tesfaye, 2003; Yilkal, 2007). Table 22 shows the household heads' perception about the benefit of SLM and SLM practice nexus.

In order to examine the nexus between low perception and SLM implementation, the researcher employed chi-square test as shown in Table 22. As the P-value (<0.001) was less than the alpha value (α = 0.05), the null hypothesis was rejected. Meaning, there is statistically significant association between perception and implementation of SLM in the study area under consideration. The Phi and the Cramer's values were also calculated to see the strength of the association. The

Table 22. Household heads' perception about the benefit of SLM and SLM practice nexus.

Kebele	Kind of tests	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	40.410	1	<0.001
Natri Mencho		42.759	1	<0.001
Gurage Bifti		0.265	1	0.606
Total		53.942	1	<0.001

Source: Own survey, 2020.

Table 23. Access to credit.

Access to credit	*Kebele*							
	Cheka		Natri Mencho		Gurage Bifti		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	37	52.1	34	51.5	25	48.1	96	50.8
No	34	47.9	32	48.5	27	51.9	93	49.2
Total	71	100	66	100.0	52	100.0	189	100

Source: Own survey, 2020.

calculated values were 0.000, which indicated that there was a strong association between the two.

Institutional challenges

Access to credit

Access to credit, according to literatures, is among the most important factors determining implementation of the SLM practices. Table 23 revealed that majority of the respondents 96 (50.8%) had access to credit. The rest 93 (49.2%) responded that they had no access to credit service. Within *Kebeles*, there was no difference except in Gurage Bifti *Kebele* where majority 27 (51.9%) of the respondents were lacking access to credit service.

According to the respondents, the most important source of credit for them included: credit and saving institutions, rich farmers, and banks. The most important source of credit services among the listed ones was credit and saving institution. The respondents were using the credit they were obtaining for different purposes. These purposes included: to purchase livestock, to purchase farm equipment, to practice SLM, to purchase grain for food and to purchase fertilizers and pesticides.

Factors affecting access to credit

Obviously, access to credit could be affected by different factors. Similarly, in the study area, the access to credit was also being affected by different factors and these factors were explained in Table 24. Accordingly, these hindrances included: none was willing to give credit (14.8%), fear of inability to payback (28.3%), high interest rate (26%), low perception to credit (37%), forbidden religiously because of interest (78.3%) and absence of institution to facilitate the purpose (18%). Absence of institution here meant absence of institutions that are giving interest free credit service. As can be seen, religion plays important role in affecting access to credit service in the study area (Table 25).

As it was obviously known, the district was known for Islamic religion. This religion ignores access to credits having interest. The major reason behind in accessibility of credit was the fact that there was absence of institutions providing credit free of interest. So, non-Muslims had better access to credit services.

According to Haymanot (2018), access to credit was 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 was often claimed in development theory. As described by Pender and Kerr (1998) and Holden et al. (2004), credit helps to reduce the extent to which household plan about the future and this would enable them to make more investment in land conservation practices. In order to realize, the nexus between access to credit and SLM implementation, the employed chi-square test as shown in Table 22.

Since the P- value (<0.001) was less than α -value (α=0.05), the H_0 was rejected. This indicated that there was a statistically significant association between respondents' SLM implementation and access to credit at 0. 05 level of significance. The calculated Phi and Cramer's Values (0.000 each) indicated that there was a

Table 24. Factors affecting access to credit.

Factors affecting access to credit	Response	*Kebele*							
		Cheka		Natri Mencho		Gurage Bifti		Total	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%
None is willing to give credit	Yes	-	-	14	21.2	14	26.9	28	14.8
	No	71	100	52	78.8	38	73.1	161	85.2
	Total	71	100	66	100	52	100	189	100
Fear of inability to payback	Yes	-	-	29	43.9	15	28.8	44	28.3
	No	71	100	37	56.1	37	71.2	145	76.7
	Total	71	100	66	100	52	100	189	100
High interest rate	Yes	-	-	27	40.9	22	42.3	49	26
	No			39	59.1	30	57.7	140	74
	Total	71	100	66	100	52	100	189	100
No need of credit	Yes	10	14.1	37	56.1	23	44.2	70	37
	No	61	85.9	29	43.9	29	55.8	119	63
	Total	71	100	66	100	52	100	189	100
Forbidden religiously because of interest.	Yes	56	78.9	46	69.7	46	88.5	148	78.3
	No	15	21.1	20	30.3	6	11.5	41	21.7
	Total	71	100	66	100	52	100	189	100
Absence of institution to facilitate the purpose	Yes	1	1.4	18	27.3	15	28.8	34	18
	No	70	98.6	48	72.7	37	71.2	155	82
	Total	71	100	66	100	52	100	189	100

Source: Own survey, 2020.

Table 25. Access to credit and SLM practice implementation nexus.

Kebele	Kind of tests	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	11.746	1	0.001
Natri Mencho		1.160	1	0.281
Gurage Bifti		19.810	1	0.000
Total		25.273	1	0.000

Source: Own survey, 2020.

strong relationship between SLM implementation and access to credit.

Extension service

The respondents were requested to respond whether they were getting extension service or not. Majority of them (53%) had no access to extension service. Natri Mencho (50%) and Cheka *Kebele* (46.5%) had better access to the extension service (Table 26). This is probably because of the fact that Gurage Bifti is located in remote rural area.

According to the information obtained from the respondents, sources of extension service were: government extension officers/DA, Farmers' Association and NGOs. DA s are the most important sources of extension services for the respondents.

Extension services were given for different purposes. These purposes in the study area included SLM practices, crop diversification and animal husbandry. The informants also pointed out that there was the need to improve on the extension services given for the implementation of SLM practices. According to my informants, most of them were never getting sufficient extension services. Only 1% was getting extension service once a week (Table 27).

As indicated in the Table 28, access to extension service has impacted on SLM in the two *Kebeles,* Cheka and Gurage Bifti. As attempted by the study, to evaluate the ease of access to extension service, remote *Kebeles* were not exposed to this extension service. Natri *Kebele* is located on the high way to Addis Ababa hence it could easily be accessed by the *Kebele* Development Agents

Table 26. Extension service access.

Access to extension service	*Kebele*							
	Cheka		Natri Mencho		Gurage Bifti		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	33	46.5	33	50.0	23	44.2	89	47
No	38	53.5	33	50.0	29	55.8	100	53
Total	71	100	66	100	52	100	189	100

Source: Own survey, 2020.

Table 28. Access to extension service and SLM practice implementation nexus.

Chi-square tests					
	Value	df	Asymptotic significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	6.570	1	0.010		
Continuity correction	5.844	1	0.016		
Likelihood ratio	6.611	1	0.010		
Fisher's exact test				0.013	0.008
Linear-by-linear association	6.535	1	0.011		
No. of valid cases	189				

Source: Own survey, 2020.

Table 29. Persistent information and SLM practices implementation.

Kebele	Kind of tests	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	1.693	1	0.193
Natri Mencho		1.062	1	0.303
Gurage Bifti		0.413	1	0.521
Total		1.144	1	0.285

Source: Own survey, 2020.

(DA). Respondents could get the extension service frequently. Contrary to this, Cheka and Gurage Bifti *Kebeles* were located in remote areas and this was affecting access to extension services from DA and other district officials. In order to realize, the nexus between access to extension service and SLM implementation, the study employed chi-square test as shown in Table 28

Since the Fisher's exact test is 0.013 there was a statistically significant association between the two variables. Therefore, the H_0 was rejected. This indicates that there was a statistically significant association between SLM implementation and access to extension service at 0.05 level of significance.

Informal education through extension workers would enhance SLM practices among peasants. This was due to the role that extension services play in providing informal education to farmers who might be illiterate on different aspects of farming activities (Tegen, 2014). Access to extension services was also important to enhance the awareness level of the farmers.

In order to realize, the nexus between access to persistent information and SLM implementation (Table 29), the researcher employed chi-square test.

Since the P- value (Pearson's chi-square test, for instance, is 0.285) was greater than α -value (α=0.05), the H_0 was accepted. This indicated that there was a statistically significant difference between SLM implementation and access to persistent information at 0.05 significance level. The calculated Phi and Cramer's Values (0.285 each) indicated that there was no relationship between SLM implementation and access to persistent information.

The majority of the respondents (60 out of 111) responded that lack of information had no impact on the implementation of SLM. A study conducted by Haimanot (2018), showed that, contrary to the study area, accesses to persistence information was among major factors which positively influenced farmers' investment in land

Table 30. Bio-physical factors and SLM practice implementation nexus.

Kebeles	Kind of tests	Value	df	Asymptotic significance (2-sided)
Cheka	Pearson chi-square	7.491	1	0.006
Natri Mencho		29.381	1	<0.001
Gurage Bifti		1.997	1	0.158
Total		31.331	1	<0.001

Source: Own survey, 2020.

management practices. This implies that lack of access to adequate and persistence information affects farmers' decision in implementing SLM practices.

Bio-physical challenges

The study areas were located in rugged topographic area. According to the interview that made with respondents from the agricultural office experts, the most important physical factor affecting the adaption of SLM in the study areas included the slope and climate change. In Natri Mencho and Gurage Bifti *Kebeles*, desertification and shortage of water were the dominant physical factors. But, in Cheka *Kebele*, slope of the farm land was significant. Table 30 also depicted that the physical factors were highly significant in determining implementation of the SLM.

The different physical constraints that affected the promotion of SLM were the nature of topography, climate variability, and the associated run-off. A study done in Tigray by Dagnew (2007) revealed run-off affected almost all stone terraces constructed by farmers on their farm land.

In order to realize, the nexus between bio-physical and SLM implementation, the researcher employed chi-square test shown in Table 30.

Since the P- value (<0.001) was less than α -value (α=0.05), the H_0 was rejected. This indicates that there was a statistically significant association between bio-physical factors and implementation of SLM at 0. 05 level of significance. The calculated Phi and Cramer's values (0.000 each) indicated that there was stronger relationship between bio-physical factors and implementation of SLM.

Identification of significant explanatory variables influencing implementation of SLM practices

The binary logit regression model was employed to estimate the effect of explanatory variables on the implementation decision of household heads. Table 31 showed the odds ratio, p value and marginal effect of explanatory variables on the dependent variable that is, implementation of sustainable land management practices.

To test the overall good fitness of a binary logistic regression model, Hosmer-Lemeshow test of goodness-of-fit was utilized. Accordingly, the P-value was found to be 0. 539, which was greater than the alpha value (α = 0.05). Hence, the null hypothesis was accepted. Therefore, the model was a good fit.

Elaboration on significant explanatory variables

Education level

It was assumed that education is associated with implementation of SLM practices. The result from binomial logistic regression model in Table 32 indicated positive sign for education level variable (β of 2.247), which implied a positive association between education level and implementation of SLM practices. This showed that as level of education decreases, implementers reduce their implementation to SLM practices. Since the Sig. statistic or p-value (.010) was smaller than the chosen significance level (α= 0.05), the association between education level and implementation of SLM practices was statistically significant that is, the level of education affects to the variance in probability of adapter's embracing performance.

In other ways, as Wald statistic of education level (6.615) was outside of 93% confidence interval (0.022 – 0.515), the developed research suggested that there was significant association between education level and implementation of SLM practices accepted. The result from binomial logistic model can be interpreted as, other variables being constant; decrease in education level could lead to reduction in implementing SLM practices by 0.106. In other ways, decrease in one year schooling decreases the odds ratio in favor of non-defaulting by a factor of 0.106, ceteris paribus. This implied that education played great role in raising the level of awareness, exposure to technologies, access to information and to manage resources properly which boosts production and then improves implementation of SLM practices.

Energy source

It was assumed that energy is associated with implementation of SLM practices. The result from binomial logistic regression model in Table 32 indicates

Table 31. Binary logistic regression model results on factors affecting farmers' decision in implementing sustainable land management practices.

Factors	B	S.E.	Wald	df	Sig.	Exp(B)	93% C.I. for EXP(B)	
							Lower	Upper
Age of respondents	-0.394	0.407	0.937	1	0.333	0.674	0.322	1.410
Sex of respondents	0.523	1.847	0.080	1	0.777	1.687	0.059	47.890
Religion	-0.022	0.653	0.001	1	0.973	0.978	0.300	3.192
Education level	2.247	0.874	6.615	1	**0.010	0.106	0.022	0.515
Marital status	-0.340	0.813	0.175	1	0.675	0.712	0.163	3.103
Off-farm activities	-2.355	1.298	3.294	1	0.070	0.095	0.009	0.996
Energy source	-2.958	1.001	8.732	1	**0.003	0.052	0.008	0.318
Land use security	0.942	0.974	0.935	1	0.333	2.566	0.439	14.991
Farm Distance	-1.894	0.884	4.590	1	0.032	0.150	0.030	0.747
Farming experience	-0.219	0.993	0.049	1	0.826	0.803	0.133	4.855
Livestock	-3.349	1.042	10.327	1	**0.001	0.035	0.005	0.232
Type of grazing	-2.506	1.118	5.022	1	**0.025	0.082	0.011	0.619
Access to credit	-2.432	0.941	6.679	1	**0.010	0.088	0.016	0.483
Extension services	-0.422	0.937	0.203	1	0.652	0.656	0.120	3.581
Physical factors	-2.516	1.039	5.866	1	**0.015	0.081	0.012	0.531
Low perceptions	-5.798	1.634	12.592	1	**0.000	0.003	0.000	0.059
Population pressure	-1.740	0.874	3.968	1	0.046	0.175	0.036	0.854
Farm size	-1.346	1.029	1.709	1	0.191	0.260	0.040	1.681
Constant	29.780	7.345	16.439	1	0.000	8.577E+12		

Number of observation: 189, B=regression coefficient, Exp (B) =odds ratio, Sig. =significance, S.E. =Standard error,-2Loglikelihood=261.962, Cox ans Snell R Square=0.658, Nagelkerke R Square=0.877
Source: Binary Logistic Regression Model Output, 2020.

Table 32. Hosmer-lemeshow test.

Hosmer-Lemeshow test			
Step	**Chi-square**	**df**	**Sig.**
1	6.973	8	0.539

Source: Own survey, 2020.

negative sign for energy source variable (β of -2.958), which implies negative association between energy source and implementation of SLM practices. This shows that as the society relies on natural environment for energy sources through the exploitation of charcoal, crop residue, animal dung and fuel wood, they clear the forest affecting their implementation to SLM practices. Since the Sig. statistic or p-value (0.003) was smaller than the chosen significance level (α= 0.05), the negative association between energy sources and implementation of SLM practices was statistically significant that is, the type of energy source affects the variance in probability of implementer's embracing performance.

In other word, as Wald statistic of energy source (8.732) is outside 93% confidence interval (0.008–0.318), the result of the model suggests that there is significant association between energy sources and implementation of SLM practices hence it is accepted. The result from binomial logistic model can be interpreted as, other variables being constant; excessive reliance on biological energy sources could lead to reduction in implementing SLM practices by 0.052. In other words, decrease in reliance on the direct exploitation of energy from natural environment through deforestation, etc. decreases the odds ratio in favor of non-defaulting by a factorof.052 ceteris paribus. This implies that energy sources play great role in deforestation, using crop residue and animal dung for energy sources affects implementation of SLM practices.

Livestock holding

Where credit markets are imperfect, the size of livestock

holding may ease capital/cash constraints. It also reduces subjective rate of time preference (Holden et al., 1998) and provide security (lower risk) to land uses, which may enhance conservation investments. On the other hand, more specialization in livestock, away from cropping, may reduce the economic impact of soil erosion, and /or increase the availability of manure needed to counter the process of nutrient depletion and thus lower the need for soil conservation. Livestock size can also exacerbate land degradation through over grazing hence affecting sustainability of land productivity.

Livestock size was assumed to be associated with implementation of SLM practices. The result from binary logistic regression model indicated a negative sign for livestock size variable (β of -3.349), which implied a negative association between livestock size and implementation of SLM practices. This shows that as the size of livestock increases, it also increased the depletion of grazing area and fallow land hence affecting implementation of SLM practices. Since the Sig. statistic or p-value .001 was smaller than the chosen significance level (α= 0.05), the negative association between livestock size and implementation of SLM practices was statistically significant that is, the size of livestock affects the variance in probability of adapter's embracing performance.

On the other side, as Wald statistic of livestock size (10.327) was out side of 93% confidence interval (0.005 –0.232), the result of the model suggested that there was significant association between livestock size and implementation of SLM practices hence it was accepted.

The result from binomial logistic model can be interpreted as; other variables being constant, larger livestock size could lead to reduction in adapting SLM practices by 0.035. In other words, decrease in livestock size increases the odds ratio in favor of non-defaulting by a factor of.035 ceteris paribus. This implied that livestock size play great role in affecting adaption of SLM practices.

Low perceptions/lack of attention

The other factors affecting farmers' decision in implementing sustainable land management practices was lack of attention for sustainable land management practices. This variable had odd ratio and P value of .003 and 0.000 respectively and this was negatively related to farmers' decision to implement sustainable land management practices and was significant at 1% level of significance.

The odd ratio indicated that the likelihood of implementing sustainable land management practices decreased by 0.003 times as the household heads paid less attention towards sustainable land management practices was increased.

The marginal effect of lack of attention of the household head on implementing sustainable land management practices with a value of -5.099 implied that keeping other factors constant, the likelihood of implementing sustainable land management was decreased by -50.99% as the household heads were paying less attention. This might be due to the fact that those household heads having less attention towards sustainable land management have a little awareness about the practices or they were reluctant to implement the practices.

This finding is in agreement with the previous work of Haymanot (2018), which indicated that lack of giving sufficient attention to land resources negatively affected the farmers' decision to invest on land management practices.

Physical factors

Physical factors are assumed to have association with implementation of SLM practices. The result from binary logistic regression model indicated a negative sign for physical factors variable (β of -2.516), which implied a negative association between physical factors and implementation of SLM practices. This shows that physical factors like topography (slope) and climatic characteristics decreased the implementation of SLM by affecting erosion, etc.

Since the Sig. statistic or p-value (0.015) was smaller than the chosen significance level (α= 0.05), the negative association between physical factors and implementation of SLM practices was statistically significant that is, the type of land form affected the variance in probability of interpreter's embracing performance.

On the other side, as Wald statistic physical factors (5.866) was out side of 93% confidence interval (0.012 – 0.531), the result of the model suggested that there was a significant association between physical factors and implementation of SLM practices hence it was accepted.

The result from binomial logistic model can be interpreted as; other variables being constant, the more rugged topography and the more the drier climatic characteristics could lead to reduction in implementing SLM practices by.081. This implies that physical factors play a role in affecting implementation of SLM practices.

Conclusion

The survey data and the key informant interview result indicated that there were many variables determining farmers' SLM practice implementation in the study district. These variables included level of education, off farm activities, sources of energy, farmland distance, livestock resources, grazing type, access to credit, poverty, perception, population pressure and bio-physical (slope, rainfall type, climate variability, run-off,

desertification). Therefore, giving emphasis to indigenous land management and land use practices which can meet the need of the growing population, economically and environmentally sustainability based on agro-ecology such as, compost, agroforestry, improved crop seeds and physical land management practices is highly important in the study area.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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