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Determinants of Soil and Water Conservation Measures for Sustainable Land Management Practices at Farm Level in Bati District, Ethiopia

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ABSTRACT

Land degradation poses a significant challenge to agricultural production in various parts of the world, particularly in developing nations such as Ethiopia. The study examines the adoption of soil and water conservation measures at the farm level in the Bati district, Ethiopia, and identifies the implications of dynamic land use and land cover changes for sustainable land management practices. The data were collected from both primary and secondary sources. Primary data was obtained through surveys, group discussions, interviews, and observations, while secondary data was gathered from published and unpublished materials like books, journals, reports, maps, and photographs from relevant offices. The study employed a multistage sampling procedure to select 339 sample households. Descriptive statistics, binary logistic regression models, and GIS software (ArcMap) were used to analyse and interpret the data. It estimates the determinants of soil and water conservation measures. Major findings of the study include farmers with a positive perception of SWC are 7.5 times more likely to adopt these practices; extension services and farmer training significantly influence the adoption of SWC practices; the sex of the household head, slope of the farmland, and distance from home negatively impact adoption; 75.2% of farmers have adopted SWC practices, but challenges like labour, money, and awareness remain; cultivated land area has increased significantly: 2,879.21 ha/decade between 1988 and 1998, 10,279.26 ha/decade between 1998 and 2008, and 4,105.53 ha/decade between 2008 and 2018. The study recommends the development of conservation plans and strategies to effectively assess soil erosion hazard and land cover dynamics.

Key words: Land management; land use; land cover; adoption; binary logistic regression model; Bati district

INTRODUCTION

Land degradation affects food security and the environment and poses a serious threat to agricultural production, especially in developing countries like Ethiopia FAO (2006). Comparably, research by Babu et al. (2023) demonstrated that soil erosion results in a decrease in soil fertility, which lowers agricultural productivity and creates food insecurity. Numerous initiatives have been launched on a national, regional, and international scale to mitigate the detrimental impacts of soil erosion. The factors influencing the worldwide and regional acceptance of soil and water conservation (SWC) cannot, however, be generalized. Investigating the current dynamism based on the actual circumstances of the study location is crucial. However, because of its rapidly expanding population, Ethiopia must raise its annual grain food output by at least one million metric tons (MoARD, 2010). Additionally, it showed that 50% of agricultural soils and one-third of all areas are deteriorated in some way. Therefore, although their acceptance is still below expectations, soil and water conservation techniques are essential for sustainable land management practices. The study focuses on the food insecurity and soil erosion problems in the Bati district of the Oromia special Zone of the Amhara National Regional state of Ethiopia.

In Ethiopia, one effective strategy to counter the threat of various forms of land degradation is sustainable land management. Nevertheless, little is known about the decisions made by households to utilize sustainable land management techniques Etsay et al. (2019). Soil and water conservation have historically been a part of farming techniques for thousands of years, according to Habtamu et al. (2024). In the Ethiopian Highlands, despite significant efforts to use contemporary soil and water conservation practices (SWCPs), soil erosion

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worsened following the significant shift in land use that occurred in the 1970s due to social and political developments.

The factors influencing the adoption of sustainable land management practices (SLMPs) and soil and water conservation (SWC) measures in Ethiopia's Bati District have been the subject of several research. Soil erosion, decreased soil fertility, and land degradation provide serious issues for this area. Here are a few actual examples: According to a research by Kidane (2008), the adoption of physical SWC methods in Bati District was favourably connected with education, farm size, and availability to extension services. In the neighbouring Jeldu District, Kassie et al. (2013) conducted a study and discovered that the adoption of SLMPs was significantly influenced by soil erosion severity, land ownership, and loan availability. The adoption of land management practices was shown to be highly influenced by education, family size, plot slope, and extension services in a study conducted by Gebreyesus et al. (2011) in the Medego watershed of the Tigray region.

Ethiopia's Semi-Arid Tropics: The Case of Bati District and the Determinants of Physical Soil and Water Conservation Practices (Tafa et al., 2022): This study found a number of important factors, such as land ownership, fertility, slope, and plot features, as well as education level and the availability of extension services. Most studies don't specifically examine how Bati District's population density affects SWC adoption. It is acknowledged, nevertheless, as a possible component in land use and resource management. Denser populations may put more strain on the earth's resources, which may encourage the establishment of SWC policies to prevent land degradation and guarantee sustainable land usage.

In addition, the area features a dense population, deteriorated pasture land, and a rough terrain that makes soil erosion worse. Furthermore, drought, flooding, and livestock epidemics were found to be the most common types of climate-related shocks that exacerbated the issue of food security and soil erosion in the research area (Misganaw et al., 2014). Consequently, researchers have identified the following research gaps.

1. Absence of data on the efficacy of accepted SWC measures: While the research focuses on the factors that influence SWC adoption, there is a dearth of information regarding the measures' ability to reduce soil erosion and increase land productivity. This data is essential for determining areas that require improvement and evaluating the true impact of actions put in place.
2. Limited examination of certain SWC practices: While the study discusses a number of SWC metrics, it doesn't go into detail about the uptake and efficacy of particular activities. Examining every kind of metric could yield important information on which approaches work best for the various farm kinds and land conditions in the Bati district.
3. Inadequate information about changes in land cover: Although the study identifies changes in land cover between 1988 and 2018, it doesn't explain why these changes occurred or how they affected agricultural productivity and soil erosion. A more thorough knowledge of the problem would come from looking into the factors that lead to the conversion of land cover and how they relate to the preservation of soil and water.
4. Inadequate attention to social and cultural factors: While the study focuses on agricultural training programs and extension services, it leaves out important social and cultural components that could affect adoption choices. Comprehending these variables may facilitate the customization of intervention tactics to more effectively align with the beliefs and values of farmers.
5. Limited examination of long-term sustainability: The study concentrates on how SWC measures are now being adopted, but it doesn't look into the variables affecting these practices' long-term sustainability. Ensuring long-term success requires examining the opportunities and challenges associated with developing and maintaining sustainable land management practices across time.
6. Disregard for gender and equity issues: Neither gender inequality nor the unique requirements and difficulties faced by female farmers in implementing SWC measures are discussed in the research. Future studies must incorporate a gender analysis in order to guarantee fair distribution of resources and encourage sustainable land management techniques for all.
7. Narrow geographic analytical scope: Because the study only examines the Bati district, it cannot be applied to other parts of Ethiopia. A more comprehensive understanding of SWC methods and their efficacy nationwide would be possible by broadening the scope of future research to encompass a variety of situations and agricultural landscapes.
8. Ignorance of the effects of climate change: The study makes no mention of the potential effects of climate change on the uptake and efficacy of SWC measures. Developing resilient and sustainable land management strategies for the future requires taking into account the predicted effects of climate change on temperature changes, precipitation patterns, and extreme weather events.

Further research can provide a more comprehensive understanding of the factors influencing the adoption of SWC measures and their effectiveness in reducing soil erosion and advancing sustainable land management practices, which is essential for developing actions and policies that can effectively guarantee Ethiopia's long-term environmental sustainability and food security. In addition, not much research has been done on the determinants of adopting soil and water conservation measures in this area. Therefore, by addressing the aforementioned research gaps, the study seeks to close these knowledge gaps.

The conceptual framework illustrates the relationships between several elements and how those relationships affect farmers' decisions to implement soil and water conservation practices on their farms. Institutional, physical, demographic, and socioeconomic factors all have a significant impact on the adoption and use of these metrics (Fig. 1).

CONCEPTUAL FRAMEWORK

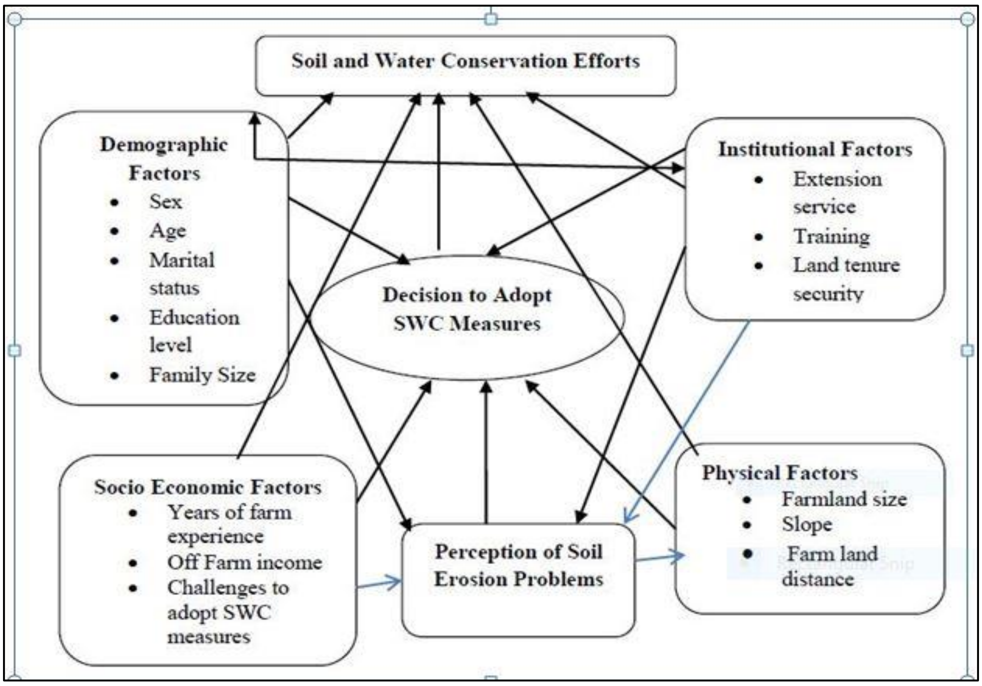

Fig 1: Factors Influencing Farmers Decision to adopt SWC Measures

METHODS AND MATERIALS

Description of the Study Area

The study area for this research is in the Bati district in the north-eastern Ethiopian highlands. It is located around 420 kilometres from Addis Ababa and 42 kilometres from Kombolcha Town. The 32 Kebeles that make up the Bati district are part of the Oromia special zone of the Amahara National Regional State, 26 of which are classified as rural and 6 as urban. Geographically, the Bati district lies between latitudes $10^0$50'N and $11^0$30'N and longitudes $39^0$45'E and $40^0$15'E (Fig. 2).

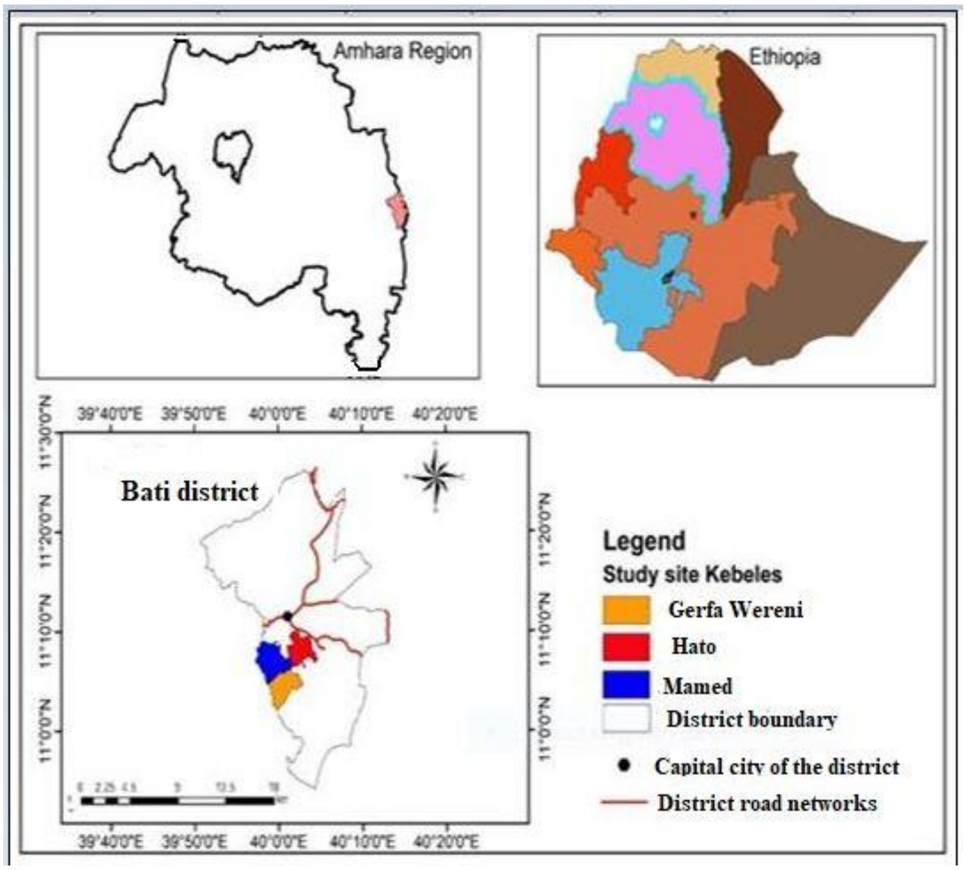

Fig 2: Map of the study Area

The research region gets unimodal rainfall, with the highest amount falling between July and September, a moderate monthly rainfall between May and June, and a very small monthly rainfall between October and March, according to data gathered from the Kombolcha Meteorological Station (2019) report. The average annual rainfall in the studied region is 894 mm, ranging from 546 mm to 1242.1 mm (Fig. 3).

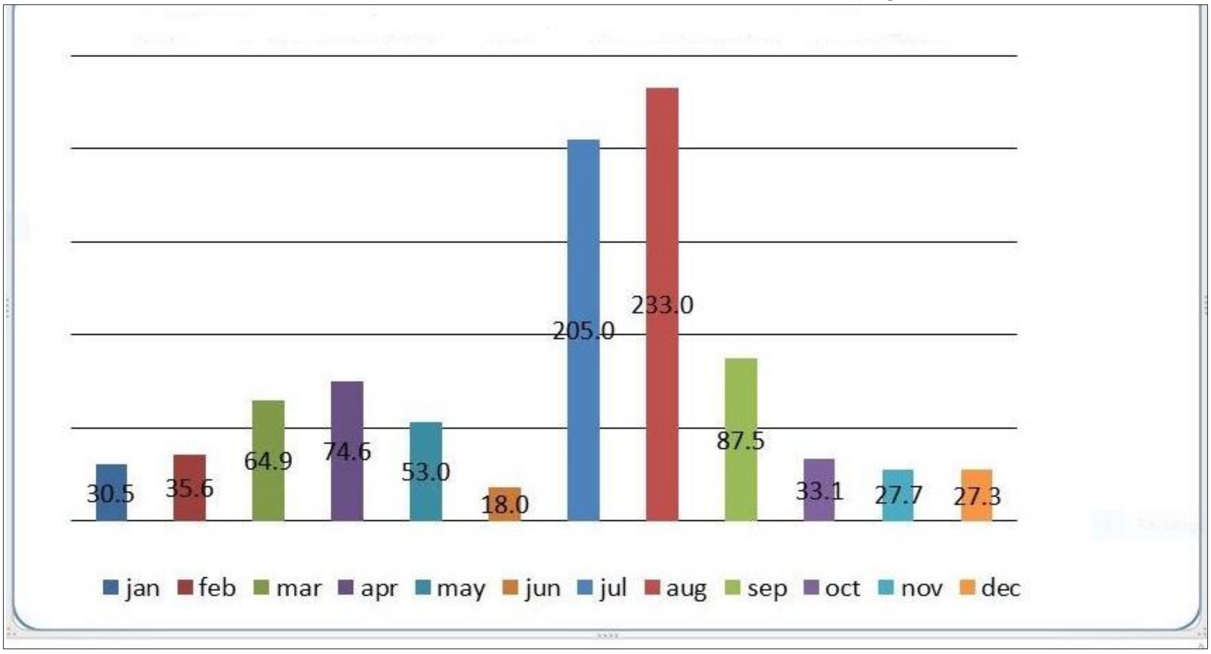

Fig3: Average Rainfall distribution of the study area, 1995-2017

The Kombolcha Meteorological Station (2019) provided 23 years of temperature data (1995-2017), which indicates that the average yearly temperature is 20.50C. Figure 4 shows that the lowest recorded annual temperature was 8.2^{0}C in 2007 and the highest recorded annual temperature was 29.3^{0}C in 1996.

The study's multi-phase sampling technique was used to choose Kebele Administrations (KAs) and agricultural households. In the first step, the district was divided into three height groups: low, intermediate, and high. Following that, the 26 KAs in the district were graded according on their altitude, conservation efforts, and application of SWC principles. Specifically, ten highlands and sixteen lowland KAs were selected. Based on the application of SWC principles and conservation initiatives, one highland and two lowland KAs were chosen for the second stage using simple random sampling.

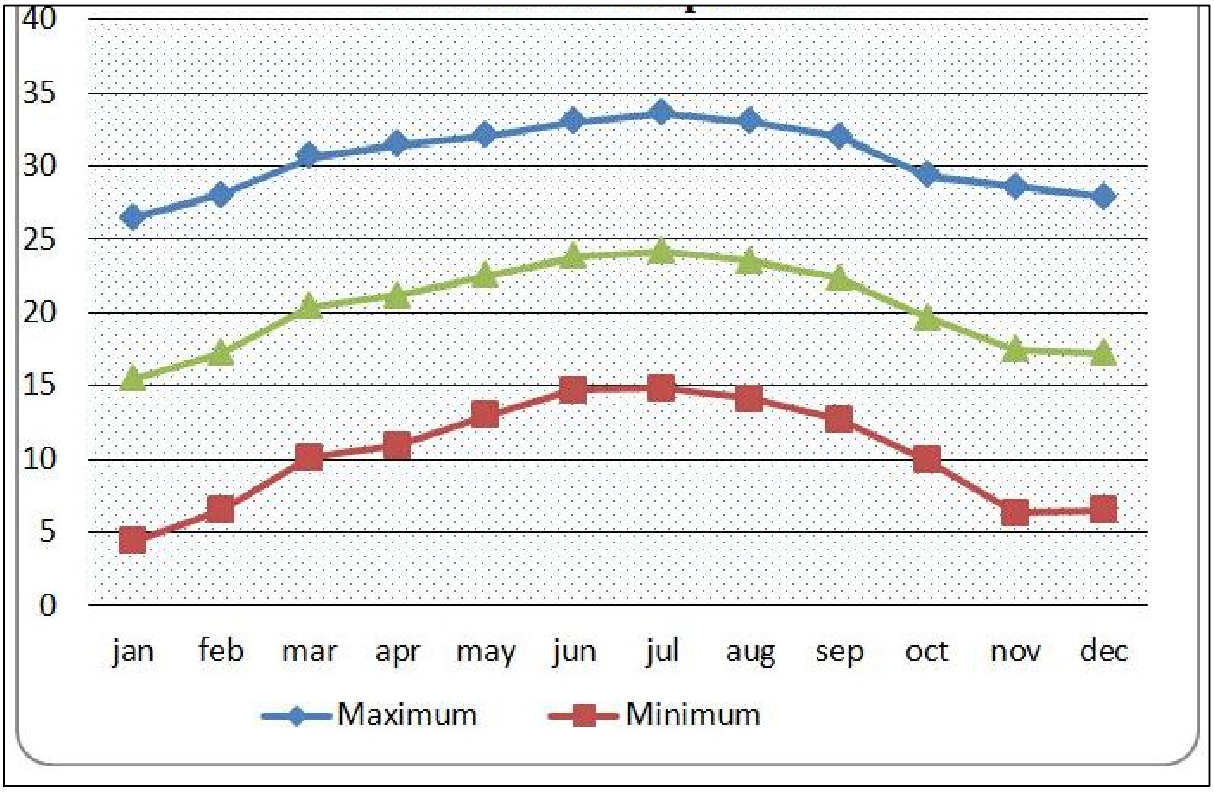

Fig 4: Mean Annual Temperature of the study area, 1995-2017

The concurrent mixed method design was a mixed research design used in this study to combine quantitative and qualitative research approaches. In order to supplement and fill in the gaps in the quantitative data, qualitative methods were utilized to gather and assess non-numerical data. Quantitative methods were used to gather data on the quantifiable relationships between the factors influencing the adoption of soil and water conservation practices and the adoption of those practices. Using a probability correlated with household size, 339 farm households were ultimately selected at random from each of the three KAs. Yemane's (1967) simplified formula, which had a 95% confidence level, 0.5 degree of variability, and a 5% (0.05) accuracy level, was used by the study to establish the required sample size.

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

Where, n = the sample size.

N= the total households heads size.

e = the precision level which is (e= 5% or 0.05).

With confidence level is 95% at p=0.5.

Based on the above formula calculated the sample households as follow:

The total households of sample *kebeles* are 2232.

n=2232/(1+2232 (0.05)2)

n=2232/(6.58) = 339 households

Sources of Data

For this study endeavour, both primary and secondary sources of data were used. Primary data was acquired through a range of techniques, including surveys, group discussions, interviews, and observations, whereas secondary data was acquired from published and unpublished materials, such as journals, reports, maps, and photos from pertinent agencies. The study examined changes in land use and land cover between 1988 and 2018, in addition to collecting data on agricultural output, population, geography, climate, soil and water conservation measures, and institutional support for farming households. The ownership of land and cattle, farming practices, perceptions of the risks connected with soil erosion, demography, and institutional variables were among the socioeconomic and environmental concerns that were the main focus of the study. Following the consideration of these variables, reasonable results were reached.

Data Collection

It appears that combinations of qualitative and quantitative methods were employed during the data collection process to discover more about the initiatives taken by the research region to preserve soil and water. Field observation, the first step, provided a basic understanding of the conservation efforts, while informal conversations with important informants and extension specialists allowed for the gathering of further data and perspectives on the subject.

The second phase, the official household survey, may collect a particular and quantitative collection of data from farm homes. This data most likely includes the demographics of the households, their farming practices, socioeconomic status, and their opinions about soil and water conservation measures. Last but not least, the focus group discussions with farmers provided an opportunity to gather thorough information and opinions on the topic from a variety of people with varying degrees of experience. This most likely allowed for a deeper understanding of the institutional and societal factors that could influence the research area's adoption and sustainability of soil and water conservation methods. Because of this multi-step approach to data collection, the acceptance and sustainability of the soil and water conservation strategies in the research area, as well as the potential influencing factors, seem to have been thoroughly comprehended overall.

Satellite Imageries

Satellite imagery from 1988 (ETM) to 2018 (ETM) was made available on the United States Geological Survey (USGS) website in order to compare and detect changes in land use and cover and their effects on sustainable land management in the study area. These data were used to produce the historical land use and land cover maps of the research area (Table 1).

Table 1 Satellite data and sources

S. No	Date of acquisition	Satellite Image	Path	Row	Resolution	Sources	Sensor Name
1	January,1988	Landsat5	168	53	30mx30m	United States Geological Survey (USGS) website	TM
2	February1998	Landsat5	168	53	30mx30m	(USGS) website	TM
3	January 2008	Landsat7	168	53	30mx30m	(USGS) website	ETM
4	January 2018	Landsat8	168	53	30mx30m	(USGS) website	OLI TIRS

Methods of Data Analysis

In this scientific investigation, we employed descriptive statistics, such as mean, total, standard deviation, percentiles, and charts, to investigate both qualitative and quantitative data. We also employed the binary logistic regression model in conjunction with maps that depicted changes in land cover and use. The qualitative information was obtained through focus groups and key informant interviews, which were then collected, organized, summarized, and assessed. With regard to the household survey data, we employed the binary logistic regression model, the Statistical Package for Social Sciences (SPSS version 21), and descriptive statistics such as mean, standard deviation, and percentage. Furthermore, we used ArcMap GIS software to map the land use and land cover of the research region. This allowed us to ascertain and investigate the impacts of sustainable land management practices on soil and water

The binary logistic regression model was used to explore determinants of soil and water conservation measures in the study area. As a result, the model is specified as follows:

$$\boldsymbol{ln}(\boldsymbol{Y}) = \boldsymbol{ln}\left(\frac{\boldsymbol{Y}}{\boldsymbol{1-Y}}\right) = \boldsymbol{\beta_0} + \boldsymbol{\beta_1 X_1} + \boldsymbol{\beta_2 X_2} + \ldots\ldots\ldots + \boldsymbol{\beta_k X_k} + \boldsymbol{u_i}$$

Where,

Y = The predicted probability of the event (SLM practices), which is coded with 1= adopter of SLM practices; and 0 = non-adopter of SLM practices,

$1 - Y$ = The predicted probability of the other decision (non-adopter of SLM practices)

β_0 = Constant

β_k = Coefficients of explanatory variables

X_k = Predictor variables

u_i = Error term

Rationale for the selection of the binary logistic model

Logistic regression is an appropriate analysis to conduct when the dependent variable is dichotomous (binary). Like all regression analyses, the logistic regression is a predictive analysis. Logistic regression is used to describe data and to explain the relationship between the dependent and independent variables. Consequently, in this study, the model produced by the binary logistic regression was checked for the goodness of fit by using different statistical methods. Accordingly, the regression analysis was run using forward stepwise likelihood ratio (Forward-LR) method. This method revealed that nine explanatory variables were statistically significant and played a major role in on soil and water conservation practices at farm level. The Omnibus Tests of Model Coefficients were significant at 0.000; the Hosmer and Lemeshow chi-square statistic test for the model were 8.974 with 8 degrees of freedom and significant at 0.344. On the other hand, the pseudo R^2 statistic was 0.326 showing that almost 33% of the likelihood of a household being able to adopt the SWC practices and it was explained by the predictors in the model. Therefore, in all standards, the model was found appropriate and well fitted to the available data because its *p*-value is greater than 0.05.

RESULTS AND CONCLUSIONS

The association between farmers' adoption rates of SWC techniques and their opinions about soil and water conservation (SWC) was examined in the study using a binary logistic regression model. The results showed a significant and positive connection between these parameters at the 5% statistical significance level. **Table 2** demonstrates that when farmers have a higher positive opinion of SWC practices, they are 7.5 times more likely to adopt them.

Table 2 Result of logistic regression analysis

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1[a]	SEXHH(1)	-1.844	.435	17.954	1	***.000	.158
	AGE	.045	.175	.066	1	.797	1.046
	MSHH(1)	.623	1.183	.277	1	.599	1.864
	ESHH	18.164	21419	0,000	4	.999	77.343
	FAMSIZE	-.071	.185	.146	1	.702	.932
	CHASWC	.487	.129	14.277	1	***.000	1.627
	PSWCPCSE	2.126	.441	23.284	1	***.000	8.385
	PSWCICP	2.012	.504	15.925	1	***.000	7.475
	LANDSIZHH	.331	.189	3.082	1	.079	1.392
	SLOPCFLD	-.670	.187	12.891	1	***.000	.512
	DISFLH	-.418	.199	4.400	1	*.036	.659
	YFE	-.177	.179	.981	1	.322	.838
	OFIG	.288	.358	.648	1	.421	1.334

	EXTSER	1.173	.368	10.150	1	**.001	3.232
	GTRASWCM	.883	.368	5.755	1	*.016	2.418
	USLLT	-.976	.459	4.523	1	*.033	.377
	Constant	-23.995	21203.246	.000	1	.999	.000

A. Variable(S) Entered On Step 1: SEXHH, AGE, MSHH, ESHH, FAMSIZE, CHASWC, PSWCPCSE, PSWCICP, LANDSIZHH, SLOPCFLD, DISFLH, YFE, OFIG, EXTSER, GTRASWCM, USLLT

*, **, and *** indicate statistical significance at 10%, 5%, and 1% probability levels respectively

In other words, farmers who have positive opinions of SWC techniques are more likely to use them than those who do not (**Fig. 5**). These findings are consistent with those of previous studies conducted by (Wagayehu and Lars, 2003; Paulos et al. 2004; Chilot, 2007).

Fig. 5 Partial view of SWC measures conducted in the study area

According to the data analysis, of the sample houses, 24.8% did not implement soil and water conservation techniques, while 75.2% did. The chi-square test showed a significant link between the adoption of SWC practices and the sex of the household head, with a p-value of less than 0.05. Numerous factors that influenced the local acceptance of SWC technologies were identified by the study. These included the head of the household's sex, amount of education, and size of family; all of these were significant at the 5% confidence level. Having a big family, in particular, makes it simpler for them to implement certain SWC practices on their farm. This has a positive effect on how SWC techniques are implemented. This finding is consistent with a study done by Woldeamlak (2003) that determined a labour shortage was the cause of the lack of interest in SWC efforts.

Numerous other variables, such as farm experience, the farmer's attitude toward SWC, field slope, extension services, and farmland's distance from house, were also found to be statistically significant. The analysis also revealed that between 1988 and the end of 2018, the area under cultivation increased, as seen in **Figure 6**.

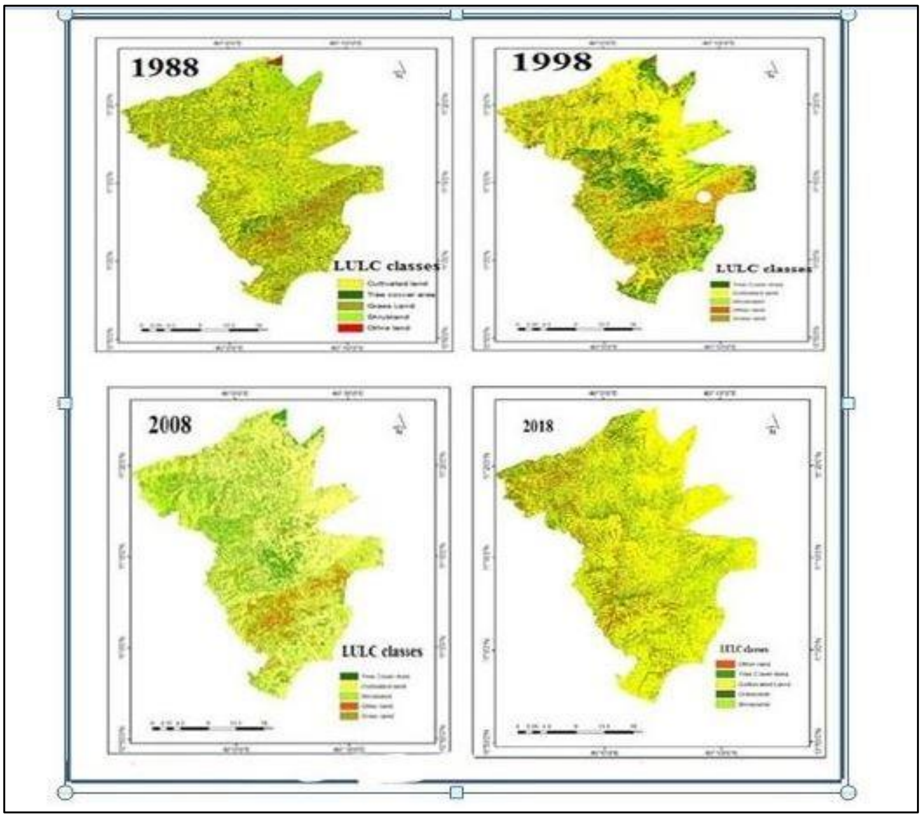

Fig 6: Land use-land cover change map of the study area

According to the study, farmers' decisions to adopt soil and water conservation techniques were positively influenced by extension services, farmer training, perceptions of soil erosion, and soil and water conservation. The adoption of SWC methodologies and extension services were found to be strongly correlated by the study. This result supports Tesfaye's (2003) study, which postulated that extension services enhance SWC processes. Thus, providing extension services can help farmers get beyond challenges and successfully apply SWC techniques. The adoption of these techniques was negatively and significantly impacted by variables like the sex of the household, the farmland's slope, and its distance from the farmhouse. Farmers were 7.5 times more likely to implement soil and water conservation methods when their impression of these practices improved. In the research region, 75.2% of practices for conserving water and soil were adopted. It has been discovered that farmers' struggles with labour, finances, crop field constraints, and lack of knowledge prevent them from implementing soil and water conservation techniques.

The study underscored the significance of tackling these obstacles and offering extension services to encourage farmers to adopt soil and water conservation practices for sustainable agriculture and environmental preservation. The results of the binary logistic regression model showed that the decision of farmers to adopt soil and water conservation practices was positively correlated with factors like farmer training, extension services, perception of soil and water conservation practices, and acknowledging soil erosion as a problem. Conversely, the decision was negatively correlated with the sex of the household head, slope of the farmland, and distance of the farmland from the homestead. The study's results also revealed a strong relationship between the use of SWC techniques and farming experience, with younger farmers adopting these practices at a higher rate than older ones. However, the results of earlier research by Long (2003) and Wagayehu (2003) demonstrated that because soil conservation involves more time and takes land out of production, farmers' opinions of SWC measures are negatively impacted by it. Table 3 displays the rate of change in cultivated land over three 10-year intervals: 1988–1998; 1998–2008; and 2008–2018. 2879.21 hectares every ten years for the years 1988–1998; 10279.26 ha every ten years for the years 1998–2008; and 4105.53 ha every ten years for the years 2008–2018. The years 1998–2008 saw the quickest rate of change. In total, more than 17264 hectares of land from different land use types were turned into agricultural land; between 1988 and 1998, this quantity climbed by 16.7%; between 1998 and 2008, it increased by 59.5%; and between 2008 and 2019, it increased by 23.8%.

Table 3 Land use/Land covers change detection (1988, 1998, 2008 and 2018)

LU/LC	1988		1998		2008		2018		Rate of change in ha			
	Areal coverage in		Areal coverage in		Areal coverage in		Areal coverage in					
	ha	percent	ha	percent	ha	percent	Ha	percent	1988-1998	1998-2008	2008-2018	1988-2018
Cultivated Land	52681.3	46.53	55560.51	49.07	65839.77	58.17	69945.3	61.77	+2879.21	+10279.26	+4105.53	+17264
Tree Cover Area	25119.63	22.18	23605.65	20.86	18415.53	16.26	10567.17	9.33	-1513.98	-5190.12	-7848.36	-14552.46
Grassland	25704.63	22.7	11017.44	9.73	11852.91	10.46	10129.95	8.94	-14687.19	+835.47	-1722.96	-15574.68
Shrub land	7107.93	6.27	10759.41	9.50	14694.84	12.97	14341.05	12.66	+3658.41	+3935.43	-353.79	+7233.12
Other land	2605.95	2.30	12276.45	10.84	2416.41	2.13	8235.99	7.27	+9670.5	-9860.04	+5819.58	+5630.04
Total	113219.46		113219.46		113219.46		113219.46					

In addition, the agricultural land underwent notable temporal and spatial changes. A chi-square test analysis at the 0.05 level of significance shows a strong correlation between adoption problems and the use of SWC techniques on farms (Table 4). This suggests that the challenges farmers face—such as a lack of labour, limited resources, a shortage of crop land, and a lack of knowledge—are impeding the adoption of SWC practices.

Table 4 Challenges to adopt SWC conservation practices

Adoption of SWC practices	Challenges to adopt SWC										Total	Chi-Square Test
	Shortage of money	%	Shortage of Labour	%	Shortage of Technical suppose	%	Reduce Crop Land	%	Shortage of Awareness	%		
Adopters	90	35.3	89	34.9	19	7.4	36	14.1	21	8.2	255 (100 %)	Df= 4
Non-adopters	15	17.8	25	29.8	5	5.9	21	25	18	21.4	849 (100 %)	X^{22}=20.910
Total	105	30.9	114	33.6	24	7.1	57	16.8	39	5.6	339 (100 %)	Sig.V = 0.000

*Significant at 0.05 significant level

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Around 75.2% of household heads who are farmers have implemented soil and water conservation practices, but remain unsure about their effectiveness on their farmland. Lack of funds, shortage of labour, inadequate support from stakeholders, limited land availability, and lack of awareness about soil erosion were cited as primary reasons for not adopting these practices. Extension services, farmer training, farmer perception of soil and water conservation, and perception of soil erosion significantly influenced farmers' decisions to adopt soil and water conservation practices in a positive manner. Factors such as the sex of the household, the slope of the farmland, and the distance of the farmland from the homestead had a negative and significant impact on the adoption of these practices. It is recommended to develop conservation plans and strategies to assess the spatial variability of soil erosion hazard and land cover dynamics effectively. Effective institutional support and awareness programs are needed to encourage farmers to adopt soil and water conservation measures. Addressing challenges such as labour, financial constraints and awareness can help in increasing the adoption of soil and water conservation practices for sustainable land management.

Overall, the evidence suggests that a combination of socio-economic, land and farm characteristics, institutional factors, and potentially population density influence the adoption of SWC measures and SLMPs in Bati District. Policymakers and development practitioners need to consider these factors when designing programs to promote sustainable land management practices. It is important to note that these are just a few examples, and further research is needed to fully understand the complex determinants of SWC adoption in Bati District.

Recommendations

- Develop and distribute educational materials: Awareness programs should be designed to inform farmers about the benefits of SWC practices and address their concerns.
- Provide financial and technical support: This could include grants, subsidies, and loans for purchasing materials and equipment.
- Improve access to extension services and training: This will equip farmers with the knowledge and skills needed to successfully implement SWC practices.
- Develop site-specific SWC plans: These plans should take into account the specific needs and constraints of each farm.
- Promote farmer-to-farmer learning: This can be done through field demonstrations, farmer groups, and exchange programs.
- Address the challenges of female-headed households: This could include providing targeted support or tailoring programs to their specific needs.
- Develop SWC measures suitable for different land slopes: This will ensure that

all farmers have access to appropriate solutions.

- Support research on SWC practices: This will help to identify the most effective and cost-effective methods. By addressing these factors, policymakers and development practitioners can create an enabling environment that encourages farmers to adopt SWC practices for sustainable land management.

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