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Original Research

Evaluation of the Socioeconomic Risks of Soil Erosion: The cause of Chancho Watershed of Diga District, Western Ethiopia

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Abstract

Important sources of erosion threats were identified in the survey area. Data was collected from household respondents through questionnaires, interviews, target group discussions, and observation. Percentages were used for evaluation. The household samples were examined using software known as SPSS-20. The results of the analysis were interpreted using words, figures, and tables. Numerous factors, such as deforestation, high summer rainfall, topography, overgrazing, inadequate cultivation methods, plot slope, low contour farming practices, cleaning the farmlands rather than mulching after crops were harvested, and excessive cultivation, contributed to soil erosion in the area. The two most prevalent types of erosion in the survey area were rill erosion and gully erosion. The study found that the primary factors influencing the physical SWC structures were rainfall intensity, farm plot location, animals, lack of ground rules to maintain the practiced SWC structures, awareness, and farmland scarcity.

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INTRODUCTION

Evaluating the socioeconomic risks of soil erosion involves assessing the negative impacts on communities, economies, and ecosystems. Soil erosion is a significant environmental challenge that can lead to a range of socioeconomic consequences, particularly in regions that rely heavily on agriculture, such as Ethiopia. Here's a comprehensive framework to evaluate these risks: Pimentel (2006) has argued that the reduction in water availability due to land degradation and soil erosion is a major global threat to food security and the environment. The highlands of Ethiopia, Kenya, Tanzania, and Uganda in East Africa are particularly affected by land degradation, particularly in the form of soil erosion, nutrient depletion, and soil moisture stress (Hagos et al., 2023).

Gashaw et al. (2014) reported that 2 million hectares of land have been badly degraded; as a result, Ethiopia loses more than 1.5 billion tonness of topsoil from those highlands each year due to erosion (Teferi et al., 2016). Food production, both now and in the future, is seriously threatened by the degradation of agricultural land, especially in Ethiopia's highlands.

According to empirical research, high population pressure, land scarcity, and a critical lack of conservation resources for subsistence smallholder-poor farmers, as cited in (Gashaw et al., 2017), as well as widespread deforestation brought on by the high demand for wood fuel and grazing into steep land areas. Studies suggested that high rates of soil erosion in Ethiopia are mainly caused by extensive deforestation due to the prevalence of high demand for fuel wood collection and grazing into steep land areas (Haile & Fetene, 2011). Compared to sheet or inter-rill erosion, it removes a significant amount of topsoil (Hurni et al., 2015).Visible erosion characteristics such as rills, gullies, and concentrated accumulations are often indicative of hotspots, or regions that are heavily affected by soil erosion (Temesgen et al., 2014; Yirgu, 2022). Narrow channels called rills are formed when surface runoff gathers at low areas or depressions on sloping terrain. Sheet erosion and rill erosion have very different characteristics. It gets rid of hotspots, or areas of a region that are severely impacted by soil erosion, which is frequently indicated by visible erosion features including rills, gullies, and concentrated accumulations (Hagos et al., 2023). When surface runoff concentrates at low spots or depressions in sloping terrain, narrow channels known as rills are created. In contrast to sheet erosion, rill erosion has very distinct qualities. Compared to sheet or inter-rill erosion, it eliminates a significant amount of topsoil (Buraka et al., 2022; Endalew& Biru, 2022). Accelerated erosion brought on by increased population pressure is responsible for a growing amount of soil loss during the past century. According to Hagos et al. (2023), the primary drivers of soil erosion in the global context of human-induced soil degradation are deforestation, the removal of natural vegetation, and overgrazing. Pimentel, (2006); Buraka et al. (2022) estimate that around 2 billion hectares of land worldwide are affected by soil degradation caused by humans.

Population pressure, overgrazing and cultivation, deforestation, unsustainable agricultural production, erosive rainfall, and rugged terrain features are the main causes of land and soil degradation in Ethiopia, where a considerable amount of soil has been lost due to a variety of factors (Andualem et al., 2020**;** Yirgu, 2022; Djillo et al., 2024). Even though few farmers used some biological and physical land management techniques, the study area's soil erosion hazards were largely caused by high population pressure, continuous and steep slope cultivation, deforestation, active SWC practices, intense rainfall, particularly during the summer, and the lack of intervention from agricultural experts and stakeholders. The live animals that inhabit the research region significantly affect the soil water conservation methods of the area under examination. To close the knowledge gap, this study was carried out in Diga District, Western Ethiopia, to provide the required data regarding the state of soil erosion hazards, their effects on the local community's socioeconomic situation, and conservation measures that are appropriate for the area.

MATERIALS AND METHODS

Description of the study area

The study was carried out in the Diga District of the Oromia National Regional State in Western Ethiopia's East Wollega Zone. The study region lies 12 kilometres from Nekemte Town and 340 km from Addis Ababa. Diga District is situated between 36030'2" and 36004'6" E Longitude and 8090'3" and 8061'3" N Latitude (Figure 1). In terms of geography, the district is adjacent to Sasiga to the north, Leka Dulecha to the south, Guto Gida to the east and West Wollega zone to the west, Chewaka District to the south-west, and Benishangul Gumuz Regional State to the north-west. The district's total area was around 60.131 km²/59545.141 hectares. Diga town was part of the site area.

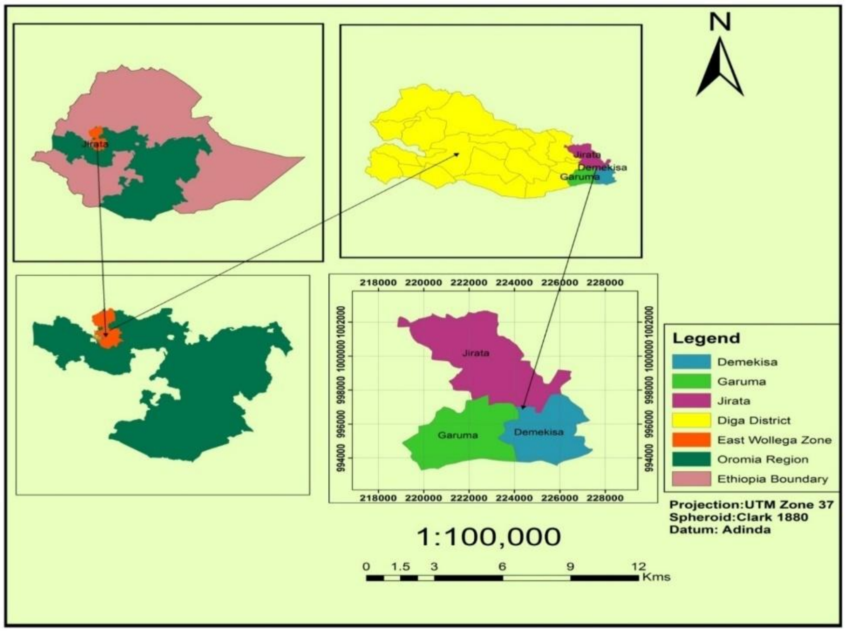

Figure 1. *Location map of Diga District*

The research area has two biological zones: the lowland, which accounts for about 51.4% of the climatic conditions with an annual rainfall range of 1200 - 2100 mm, and the midland (medium temperate), which accounts for about 48.6%. The long rainy season, which runs from June to September, has the highest rainfall, while the short-wet season, which runs from March to May, has the lowest. The region's average yearly temperature was 180°C at its lowest point and 32°C at its highest. (Source: Agriculture Office, Diga District).

Diga District has three different kinds of soils according to the FAO's 2007 categorisation of the world's soils. About 54,744.7 hectares of the Diga District are made up of dystric nitosols, which are among the greatest productive soils. The remaining territory of the district is made up of orthic acrisols and dystric gleysols. The predominant hue of the soil was red. The lowlands are black, while the midlands are crimson.

The primary landform of Diga District is almost a slope, with a slope of 0–55% and a few minor undulations. Sandy loam, Sandy clay, and Sandy clay are abundant in the district; their respective percentages are 40%, 30%, 20%, and 10%, and they all have good agricultural potential. High pH values of less than 5.5, a sign of acidity, are seen in these soils. Their thick clay and red soils, which are primarily located on flat to sloping terrain in high rainfall locations, have a high capacity to carry moisture. The region is generally between 1200 and 2220 meters above sea level (source: DAO, 2016) and is divided into two agroecological zones: the lowlands, which make up 51.4%, and the midlands, which make up 48.6%. The midlands are steep, once-forested areas that are rapidly losing their trees. Because the slopes are too steep, scattered populations often cultivate the tops and bottoms of the hills, leaving them vulnerable to soil erosion. The community uses the many rivers and streams in the Diga district for irrigation, drinking, and other uses. The Didessa River is currently used as a recreational area; the Maka and Dimtu Rivers are used for small-scale irrigation and provide Nekemte town with sand; and the Chancho River provides drinking water to Nekemte town. Other rivers include the Gulufa, Kiki, Bareda, Sororo, and others. According to local elders and the Diga district water source office, all these rivers are tributaries of the Didessa River.

Cultivated land, grassland, eucalyptus plantations, water bodies, barren (degraded) land, and built-up areas are the different forms of land use and land cover in the study region. Below the eucalyptus plantation, the mountainside and the steep slopes of the streams have been left as cattle pasture areas. These units are naturally covered with grassy shrubs and sporadic trees. The catchment area is dotted with cultivated land, which makes up most of the land use (Figure 2).

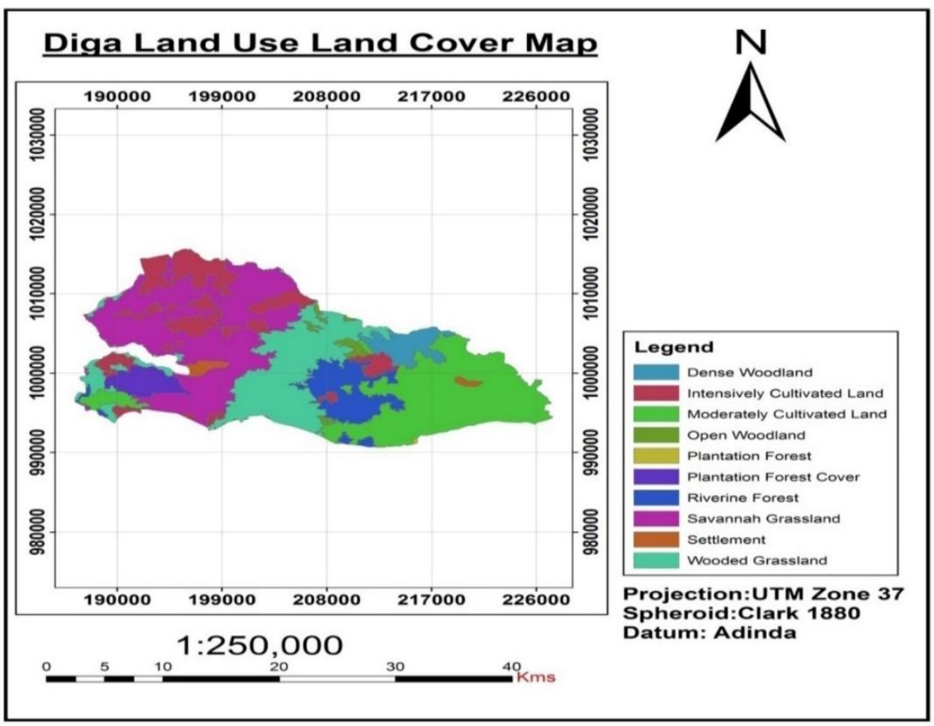

Figure 2. *Diga District Land Use Land Cover Map.*

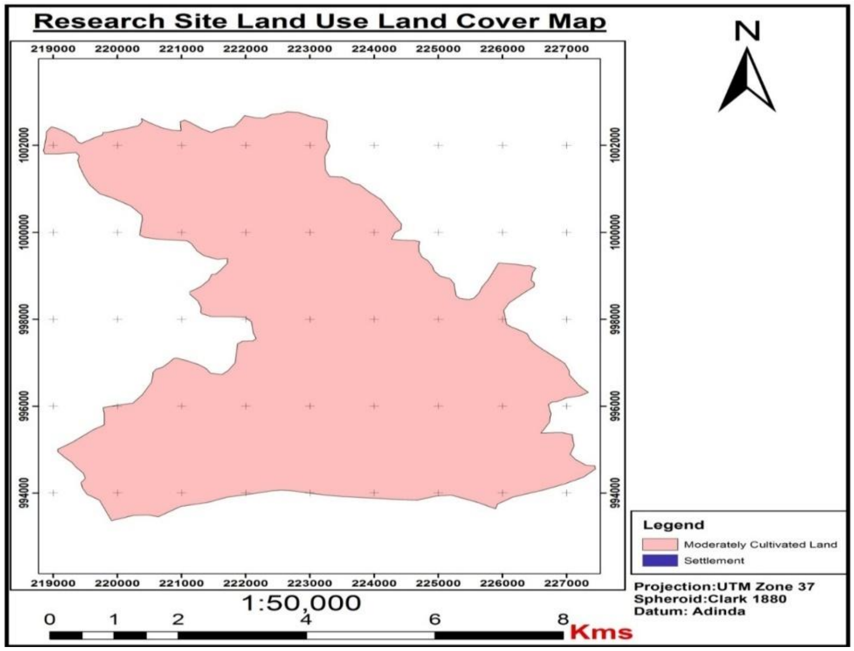

Figure 3. *Land Use Land Cover Map of the study area.*

Highland, midland, and lowland are the three primary agroecological zones that make up Diga District, each with unique proportions. There are hills and mountains in the Diga District, and the slopes are marked by ups and downs. Out of the 84,954 people living in the Diga district, 41,249 are men and 43,705 are women (CSA, 2007). The study area's inhabitants mostly rely on mixed agricultural operations that use oxen and the labour of their families. A few families operate in trade and crafts. When it comes to farming, harvesting, tearing down, and building houses, the communities' band together and support one another. In low-lying areas without oxen, some families use hoes to plough a small area of ground and garden root crops and farmed crops. Rainfall and a few streams were used to irrigate crops (Figure 3).

The main crops cultivated in the midland region include barley, wheat, beans, peas, potatoes, onions, and maize. Corn, sorghum, oil crops, bananas, sugar cane, tomatoes, almonds, avocados, and mangos are all produced in the lowland region. Cattle, goats, sheep, mules, donkeys, and fouls are the main animals raised in the region. However, because the locals employed antiquated production techniques, the output was unsatisfactory. The district of Diga is divided into two urban and twenty-one rural kebeles.

Other organisations include 2100 the Five Rural Development (known locally as Shanee Misooma Baadiyyaa), 422 Kebeles Development groups, and 63 Rural Development Zones. Numerous traditional social groups, such as Dabo, are also present in the studied region. Dabo is used when building a house, harvesting and producing crops, and generally when the head of the household is unable to complete the task alone. According to DAO, community leaders, and elders, "Edir" and "Eukub" are both used to improve social bonds within local communities, save money for rituals like weddings and funerals, and assist one another in times of need.

Methods of research

Sources of data and the sampling process

The data was collected through structured questionnaires administered to a sample population. Key variables examined include age, gender, educational attainment, marital status, employment status, and geographic location. Since a descriptive survey design is more suited to characterise the state of soil erosion and the variables influencing the adoption of soil and water conservation measures in the research area, it was used to validate the extent of erosion and the livelihood difficulties faced by the chosen households. Additionally, a hybrid research technique was used, primarily utilising both quantitative and qualitative methods. Researchers now have the chance to evaluate the data and gain a deeper understanding of a study subject thanks to mixed research methodologies (Jackson, 2013).

Household surveys, interviews, focus groups, and archive sources were used to gather the data from primary and secondary sources. In this instance, a household survey was carried out with the help of field assistants from December 2018 to April 2019 with 181 respondents in three sample Kebeles of the study area. Interviews and group discussions involving women, agricultural professionals, and elders were used to collect qualitative data. The Diga district population office and neighbouring kebeles of meteorological observatory sites provided the demographic and precipitation data for the study period. The Ministry of Water, Irrigation, and Energy of Ethiopia provided the soil map. On October 11, 2020, a Landsat 8 satellite image was captured and obtained from the USGS website (http://earthexplorer.gov). 350 ground truth reference data points, with 50 reference points for each land use/cover type were collected from the field using GPS.

Additionally, the research subjects were chosen using multi-state sampling approaches. Given the dominance of damaged terrain and the frequency of soil erosion, the Domba watershed was specifically chosen for the first stage of this project. Because croplands are exposed to significant erosion effects, three sample kebeles (Demeksa, Garuma, and Jirata) were also specifically chosen for the second stage According to Berthet et al. (2013), the type of research design, the intended degree of confidence in the findings, and the demographics of the population all influence the minimum sample size. Given that the study's target population was 2136 and less than 10,000, Lewis's formula was utilised to compute sample size. In this case, the sample size considered was 181. The formula was

$$n = \frac{N}{1 + Ne^2} = 181$$

Where n- sample size, N- Population size 1450, **e**- Level of precision, e = 0.07 used to calculate level and with 0.07% errors

In this study, the researcher used the systematically at an interval based on the following formula.

$$K = \frac{N}{n} = 8$$

Where K=Sample border (frame), N=total number of households (1450), and n=Sample size (Burns, 1994). From the total population, the researcher encompasses n= 181 HHs as representative by using sample determining formula. The selection would be based on the proportion of the total population for each kebele for the research study.

Statistical Data Analysis

The impact of erosion hazards on soil productivity will be evaluated statistically using

Arc GIS software and one-way analyses of variance. The SPSS-20 program was used to examine the data. By questionnaires, interviews, field observations, and target group discussions, household respondents' trends and experiences with socioeconomic and land use information, as well as SWC practices on their farmland, were gathered. The data was then analyzed using percentages. Figures, tables, and words would all be used to interpret the analysis's ultimate output. A percentage, table, image, and text would all be used to interpret quantitative data.

RESULTS AND DISCUSSION

Understanding the socio-demographic characteristics of respondents is critical for interpreting survey results and ensuring that findings are representative of the target population. This section provides an analysis of the socio-demographic attributes of the respondents who participated in the survey.

Table 1

Socio-Demographic Characteristics of Respondents

N:120 Respondents					
Sex	Respondent	%	Ethnic group of the respondents	Respondent	%
Marital status			Total	120	100.0
Single	24	20.0	Occupation of the respondents		
Married	75	62.5	Mixed agriculture	49	40.8
Widowed	10	8.3	Only farming	15	12.5
Divorced	8	6.7	Only livestock rearing	30	25.0
Silent	3	2.5	Trading	17	14.2
Total	120	100.0	Employed	9	7.5

The questionnaires were created to make it possible to collect trustworthy data on the socio-demographic traits of the sample households from the homes. Table 1 illustrates that many respondents—78, or 65.0%—were men, while 42, or 35.0%, were women. The age group of 35–44 years old accounted for fifty-two (51.7%) of the household heads, followed by 25–34 years old, which made up forty (33.3%), and 45–54, 55–64, and under 25 years old, which made up six (5%), five (4.2%), and seven (5.8%) of the total. The age group of 55–64 years old made up the smallest percentage. Married respondents make up the biggest percentage of the household heads (75, or 62.2%), followed by single household heads (24, or 20%), and those who are divorced, widowed, or silent (8, or 6.7%), 10 (or 8.3%), and 3 (2.5%), respectively. 11 (9.2%) of the sample households had completed elementary school first cycle education (Grades 1-4), 24 (20%) of the respondents had completed secondary school education (Grades 9–12), and 61 (50.8%) of the household heads had completed elementary school second cycle education (Grades 5-8). Twenty-two others, or 18.3%, were illiterate. Most respondents completed the second cycle of elementary school education (Table 1). Most of the sample HHHs received their education in the second cycle of elementary school (grades 5-8). Since every household is a farmer, they do not have enough time to pursue higher education while juggling their farming and family responsibilities. The other significant factor is that they were unable to pay for further schooling due to the low level of their economy. Understanding the causes of soil erosion, its effects, ways to improve soil fertility and conservation techniques all depend heavily on education.

A total of 120 (100%) of the sample househ old heads were farmers, meaning that farming w as their main source of income. The mixed farming system comprising both crop production and livestock production, or animal rearing, is what defines farming in the studied region. However, the study's findings showed that petty dealing and employment accounted for 17 (14.2%) and 9 (7.5%) of the household respondents' secondary occupations, respectively. Consequently, based on the data from the poll, 28 (21.7%) of the survey area sample households work in secondary occupations.

Using specially created questionnaires, data on socioeconomic and land use circumstances were gathered from sample houses to assess the state of conservation and soil erosion in the survey region. The research area's primary erosion causes were determined. Soil erosion in the region was caused mostly by deforestation, poor agriculture practices, overgrazing, steep slope cropping, and significant summer rainfall (Table 2).

Table 2

Socio-Economic and Land Use information

N:120 Respondents					
The major food crops produced	Frequency	%	Use physical soil and water conservation measures	Frequency	%
Teff	88	73.3	Yes	91	75.8
Wheat	14	11.7	No	29	24.2
Sorghum	4	3.3	Type of SWC measures used		
Maize	6	5.0	Planting trees	33	27.5
Finger milet	7	5.8	Water ways	11	9.2
Nugi	1	.8	Terracing	46	38.3
Total	*120*	*100.*	Check dams	1	.8
Condition of crop production during the last five years			Silent	29	24.2
Decreased	110	91.7	*Total*	*120*	*100.*
The same as previous	4	3.3	Challenges that affect the traditional physical SWC		
Unknown	2	1.7	Slop of the plot	19	15.8
Increased	4	3.3	Intensity of Rainfall	44	36.7
Total	*120*	*100.*	Animals	54	45.0
The reason for crop production decreased			Shortage of farmland	3	2.5
Soil fertility decline	59	49.2	*Total*	*120*	*100.*
Existence of severe soil erosion	40	33.3	The main causes of soil erosion hazards		
Reduction of supply of fertilizer	21	17.5	Over grazing	18	15.0
Total	*120*	*100.*	Poor Cultivation practices	68	56.7

***Table 1* Continues.**

More responsible for the loss of Soil productivity			Deforestation	8	6.7
Farmers	25	20.8	Cultivation of steep slop	9	7.5
Da	39	32.5	Over cultivation	15	12.5
Community leaders	12	10.0	Soil erodibility	2	1.7
All concerned bodies	44	36.7	*Total*	*120*	*100.*
Total	*120*	*100.*	Type of Erosion more Prominent in the area		
The shortage of farmland can cause the soil erosion hazards			Sheet wash erosion	21	17.5
Yes	81	67.5	Rills formation	52	43.3
No	39	32.5	Gully formation	11	9.2
Total	120	100.	Through seasonal stream channels	15	12.5
Most types of livestock dwelling in the study area			Through perennial stream channel	21	17.5
Cattle	101	84.2	*Total*	*120*	*100.*
Sheep	17	14.2	Rate of soil erosion in the area		
Donkey	2	1.7	Very low	10	8.3
Total	*120*	*100.*	Low	34	28.3
Where do the local people of the study area graze their livestock?			Moderate	21	17.5
On community grazing land	55	45.8	High	54	45.0
On forested land	11	9.2	Very high	1	.8
On cultivated fields	36	30.0	Getting agricultural extension services		
On barren fields	12	10.0	Yes	101	84.2
Along the stream channels	6	5.0	No	18	15.0
Total	*120*	*100.*	Silent	1	.8
The soil type of Chancho watershed			*Total*	*120*	*100.*
Clay	1	.8	Extension service providers		
Clay loam	52	43.3	Development Agents	97	80.8
Silt	41	34.2	Agricultural Experts	18	15.0
Loam	19	15.8	Nongovernmental organs.	4	3.3
Others	7	5.8	Silent	1	.8
Total	*120*	*100.*	*Total*	*120*	*100.*
The main agents of soil erosion in the study area					
Rain falls	59	49.2			
Topography	40	33.3			
Wind	21	17.5			
Total	*120*	*100.*			

Nearly all sampled homes (88, or 73.3%) practice teffe cultivation, which is listed first in Table 1 above. 110 (91.7%) of the studied HHHs indicated that the production of food crops had dropped during the previous five years, as Table 2 above illustrates. Restore biological variety in the soil. Ninety-one (75.7%) of the respondents said that various SWC measures were applied on the farmlands. Among other things, the survey area was used for waterways, terracing, and planting young trees. To increase the soil fertility of the farmlands in the research area, crop rotation was also employed as a conservation strategy. However, most farmers in the sample had fields that were grown using a standard rotation sequence, which included successive plantings of finger millet, maize, and Noug (Niger seed). Noug (Niger seed) is a legume that increases soil fertility, while finger millet is regarded as a crop that depletes the soil. This result was found to be consistent with studies that revealed cereals such as finger millet, sorghum, and maize reduce soil fertility. Crop rotation is used to decrease erosion and increase soil organic matter. Accordingly, rill erosion (52, or 43.3%), gully erosion (11, or 9.2%), and sheet wash erosion (12, or 17.5%) were the commonly observed cases (Figure 4-7).

Figure 4. *Observed erosion types of the study area.*

The study's findings showed that animals (54, or 45%), summer rainfall intensity (44, or 36.7%), farm plot location, animals, and a lack of farmlands (81, or 67.5%) are the primary factors affecting the physical SWC structures. The summer months are particularly prevalent for significant soil erosion caused by flowing water. Furthermore, the geography of the region had a negative impact on the development of livestock production and food crop production in the research area (Table 2).

Figure 5. *Soil Water Conservation Practices and it's Challenges*

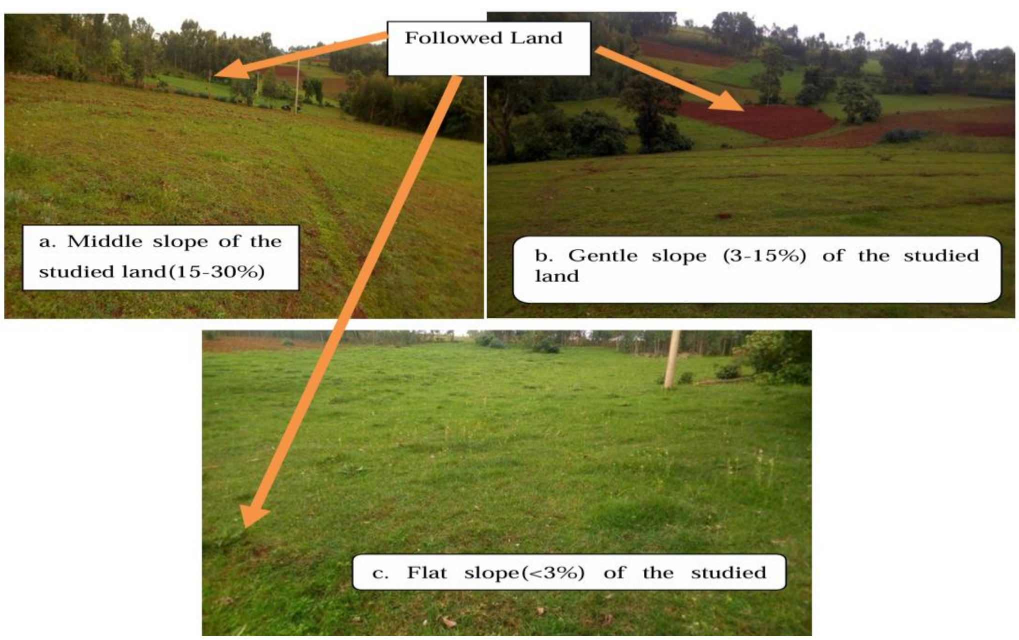

Figure 6. *Topography of the studied area and effect of farm plot position on SWC Practices (Source: Diga District Agricultural Office)*

Figure 7. *Effect of farm plot position on SWC practices*

Table 3

Socio-economic and land Use Information

Items	Agree (N=41)	Disagree (N=41)
Use common crop rotation	41(100%)	-
Grass strip	17(41%)	24(59%)
Contour farming	28(68%)	13(32%)
Intercropping	19(46%)	22(54%)
Planting cover crops	21(51%)	20(49%)
Main agents of soil erosion		
Intensive rainfall	38(93%)	3(7%)
Topography	38(93%)	3(7%)
Wind	23(56%)	18(44%)
Use a scientific farming system	10(24%)	31(76%)
Physical swc measures		
Mulching of your farmlands	9(21%)	32(78%)
Planting trees	37(90%)	4(10%)
Waterways	41(100%)	-
Terracing	26(63%)	15(37%)
Check dams	11(27%)	30(73%)
Residue recycling	28(68%)	13(32%)
challenges of traditional swc structures		
Intensity of rainfall	41(100%)	-
The slope of the plot	35(85%)	6(15%)
Lack of awareness	36(88%)	5(12%)
Animals	41(100%)	-

According to the results of the household survey, intercropping and grass strips have a bigger impact on increasing farmland production in the research area. Only 17 (41%) and 19 (46%) of the 41 HHHs' croplands, respectively, used conservation techniques to preserve soil fertility.

However, as can be seen from Table 3, most of the farmland assessed adopted a set of methods, which included 51% growing cover crops, 28 (68%) contour farming, and 100% common crop rotation. Tree planting, waterways, terracing, residue recycling, check dams, and mulching were reported to be 90%, 100%, 63%, 68%, 27%, and 21% of farmland practices, respectively, by 41 studied HHHs. According to the sampled HHHs, the plot's slope and the intensity of the rainfall 41 (100%). The biggest problems with typical SWC structures were animals (41; 100%), lack of knowledge (36; 88%), and the slope of the plot (35; 85%). The problem of soil erosion may not be improved by implementing a single technique; instead, a collection of activities will yield greater improvements.

Twenty respondents were chosen from the entire sample to participate in a group discussion. As was mentioned, the investigated property faced a significant challenge in the summer months due to the loss of fertile soil caused by runoff. Farmers in the examined area may not be fully aware of the various soil erosion control techniques, according to 15 (75%) of the respondents. Tree-planting activities were implemented. However, most trees planted were eucalyptus trees, which have a significant impact on the nutrients in the soil from the topmost to the lowest point of the ground.

Intensity of summer rainfall 12 (60%), plot slope 8 (40%), overgrazing 13 (65%), poor cultivation practices 14 (70%), cover cultivation 12 (60%), lack of ground rules to accumulate the area's traditional SWC to sustain the healthy soil for future generations 16 (80%), and deforestation 11 (55%) were the primary agents and causes of soil erosion hazards in the studied area. The home farm holdings were the primary location for most of the crops of the food crops (maize with potatoes, haricot beans, and cabbages). It also increases soil fertility through crop variety and provides soil cover to lessen erosion and the impact of raindrops on the soil.

According to the report, 15 (75%) of the soil erosion types in the area were gully and rill erosion. Both on-site and off-site consequences result from soil erosion in the areas under study. On-site effects typically resulted in the loss of rich soil, whereas off-site effects included the accumulation of sediments on flat, sloping (0–3%) crop-cultivated fields and an increase in the nutrient contents of the off-site areas (17–85%).

CONCLUSION

This analysis provides a clear picture of the socio-demographic characteristics of respondents, forming a basis for analysing survey responses. Future studies could enhance rural participation to ensure a more representative sample. The study also revealed that the major causes of erosion in the area were identified. Accordingly, the heavy rainfall of the summer season, topographic factors, over-cultivation, over-grazing, poor cultivation practices, the slope of the plot, lack of contour farming, cleaning the farmlands rather than mulching, and deforestation were the main causes of soil erosion problems in the area. In relation to this, the prominent types of erosion in the survey area were gully erosion, erosion through perennial stream channels, and rill erosion. In the study area, different types of SWC measures were used on the farmlands. Terracing, planting of young trees, and waterways were practiced widely in the survey area among others. Crop rotation was also used as a conservation measure to improve the soil fertility of the farmlands in the study area. The result of the study indicated that the main challenges that affect the physical SWC structures mainly come from the intensity of rainfall during the summer season, the position of the farm plots, animals, the absence of ground rules to keep the practiced SWC structures, awareness, and shortage of farmlands. Especially, the severe soil erosion by running water is very common during the summer season. In addition to this, the topography of the area adversely affected the production of food crops development in the study area.

CRediT authorship contribution statement

Getahun Kitila: Conceptualization, Writing – original draft, Investigation, Data curation Methodology, Visualization, Writing - Review & Editing **Tariku Dame:** Validation, Resources, Formal analysis**,** Supervision.

Declaration of Competing Interest

The authors declare that there is no conflict of interest.

Data availability

The datasets are available from the first author on reasonable request

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REFERENCES

Andualem, T. G., Hagos, Y. G., Kefale, A., & Zelalem, B. (2020). Soil erosion-prone area identification using multi-criteria decision analysis in Ethiopian highlands. *Modeling Earth Systems and Environment*, *6*(3), 1407–1418. https://doi.org/10.1007/s40808-020-0075-2

Berthet, V., Gaweda, B., Kantola, J., Miller, C., Ahrens, P., Elomäki, A. (2023). Interpreting the Data. In: Guide to Qualitative Research in Parliaments. *Palgrave MacMillan, Cham*. https://doi.org/10.1007/978-3-031-39808-7_6.

Buraka, T., Elias, E., Suryabhagavan, K. V., & Lelago, A. (2022). Assessment of soil erosion risks in response to land-use and land-cover changes in Coka watershed, Southern Ethiopia. *GeologyEcologyandLandscapes*, *8*(2), 140153. https://doi.org/10.1080/24749508.2022.2109825

Djillo, S. C., Wolka, K., & Tofu, D. A. (2024). Assessing soil erosion and farmers' decision of reducing erosion for sustainable soil and water conservation in Burji woreda, southern Ethiopia. *Scientific Reports*, *14*(1). https://doi.org/10.1038/s41598-024-59076-6

Endalew, T., & Biru, D. (2022). Soil erosion risk and sediment yield assessment with Revised Universal Soil Loss Equation and GIS: The case of Nesha watershed, Southwestern Ethiopia. *ResultsinGeophysicalSciences*, *12*,100049. https://doi.org/10.1016/j.ringps.2022.10004

Gashaw, T., Tulu, T., & Argaw, M. (2017). Erosion risk assessment for prioritization of conservation measures in Geleda watershed, Blue Nile basin, Ethiopia. *Environmental systems research*, *6*(1). https://doi.org/10.1186 / s40068-016-0078-x

Gashaw, T., Bantider, A., & Mahari, A. (2014). Evaluations of Land Use/Land Cover changes and Land Degradation in Dera District, Ethiopia: GIS and Remote sensing based analysis. *International Journal of Scientific Research in Environmental Sciences*, *2*(6), 199–208. https://doi.org/10.12983/ijsres-2014-p0199-0208

Hagos, Y. G., Andualem, T. G., Sebhat, M. Y., Bedaso, Z. K., Teshome, F. T., Bayabil, H. K., Kebede, E. A., Demeke, G. G., Mitiku, A. B., Ayele, W. T., Alamayo, D. N., Demissie, E. A., & Mengie, M. A. (2023). Soil erosion estimation and erosion risk area prioritization using GIS-based RUSLE model and identification of conservationstrategies in Jejebe watershed, Southwestern Ethiopia. *Environmental Monitoring and Assessment*, *195* (12). https://doi.org/10.1007/s10661-023-12136-2

Haile, G. W., & Fetene, M. (2011). Assessment of soil erosion hazard in Kilie catchment, East Shoa, Ethiopia. *Land Degradation and Development*, *23*(3), 293–306. https://doi.org/10.1002/ldr.1082

Hurni, K., Zeleke, G., Kassie, M., Tegegne, B., Kassawmar, T., Teferi, E., Moges, A.,Tadesse, D., Ahmed, M., Degu, Y., Kebebew, Z., Hodel, E., Amdihun, A., Mekuriaw, A., Debele, B., Deichert, G., & Hurni, H. (2015). *Economics of Land Degradation (ELD) Ethiopia Case Study: Soil degradation and sustainable land management in the rainfed agricultural areas of Ethiopia: An assessment of the economic implications*. https://doi.org/10.7892/boris.72796

Pimentel, D. (2006). Soil erosion: a food and environmental threat. *Environment Development and Sustainability*, *8*(1), 119–137. https://doi.org/ 10.1007/s10668-005-1262-8

Teferi, E., Bewket, W., & Simane, B. (2016). Effects of land use and land cover on selected soil quality indicators in the headwater area of the Blue Nile basin of Ethiopia. *Environmental Monitoring and Assessment, 188*(2). https://doi.org/10.1007/s10661-015-5086-1

Yirgu, T. (2022). Assessment of soil erosion hazard and factors affecting farmers' adoption of soil and water management measure: A case study from Upper Domba Watershed, SouthernEthiopia. *Heliyon*, *8*(6)e09536. https://doi.org/10.1016/j.heliyon.2022.e09536