Assessment of Farmland Degradation and Restoration Potential: In the case of Sire District, Ethiopia

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Abstract- Farmland degradation is a common problem in Ethiopia's agricultural lands, and it is caused by anthropogenic and natural causes, resulting in ecological and socio-economic problems. The study was initiated to assess the farmland degradation and restoration potential in the Sire District, Oromia Region. A household survey including semi-structured interviews, field observations, FGDs, and key informant interviews was used to collect and evaluate the causes & consequences of farmland degradation and the challenges and opportunities of degraded farmland restoration. Likewise, multiple linear regression analysis was conducted using SPSS. According to the findings of the household survey, the main causes of farmland degradation were deforestation, poor farming systems, soil erosion, intensified rainfall, over-cultivation, over-grazing, cultivation of steep lands, and wind speed. As a result, crop production yield has been decreasing over time, and the effect of farmland degradation is expressed by the loss of crop production yield per hectare. The major challenges that hindered the rehabilitation and restoration of degraded farmland in the study area were land ownership, the slope of the farmland, poor extension service, lack of capital, input materials for SWC structures, rainfall amount, and shortage of labour. The main opportunities for degraded farmland restoration in the study area included the availability of natural resource conservation practices, the high interest and willingness of local people, the availability of human labour, the presence of large degraded areas, government policy direction and support, and the availability of physical SWC materials.
In conclusion, the result of this assessment study indicated that the degraded farmlands have different restoration potential throughout the study area, and farmer-managed natural regeneration and different agroforestry practices are recommended for the degraded farmlands' rehabilitation and restoration.

Index Terms- Farmland degradation, Rehabilitation and Restoration, Crop production

I. Introduction

Land degradation in Ethiopia has emerged as a critical issue that significantly impacts various dimensions of individuals' lives, encompassing social, economic, and political factors (Berry L., 2003). It is one of the country's most significant obstacles to agricultural development and food security. The rate of the country's farmland degradation is very high. Severe to moderate farmland degradation affects a major section of the agricultural land, which is primarily found in the country's highlands (Praol Nyol, 2018). Farmland degradation refers to the loss of biological, economic, and quality features of the farmland as a result of changes in chemical, physical, and biological components (K.G. Turner et al., 2016). According to Le QB, et al. (2012), farmland degradation is ''the persistent reduction of the production capacity of a farmland, which may be manifest through any combination of several interrelated processes, such as soil erosion, deterioration of soil nutrients, loss of biodiversity, deforestation, or declining vegetative health''. It may be caused by erosion, loss of soil organic matter, soil acidity, deforestation, desertification, salinization, soil compaction, and such other phenomena that make farmland unfavorable for crop production (K.G. Turner et al., 2016).

Farmland degradation is the consequence of multiple processes that both directly and indirectly reduce the utility of farmland. It is defined by the FAO as a "process that reduces the soil's existing and/or potential capacity to produce goods and services." Farmland degradation is an ecological phenomenon that disrupts dry regions and harms agricultural land's economic and natural

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quality. In addition, farmland degradation is the continuing deterioration of the environment and production (Bai ZG and Dent DI, 2008). Agricultural activities are inherently vulnerable to a variety of risks and uncertainties, including biophysical, abiotic, biotic, climatic, environmental, and economic risks and uncertainties. On farms, rehabilitation and restoration methods are seen as a powerful instrument for improving food security, resilience, and climate change adaptation in impoverished, subsistence farming communities (Eyasu, E., 2003).

To recover the degraded farmlands, sustainable land management methods and treatments are necessary. Farmers use strategies such as natural regeneration of farmland, integrated watershed management, and soil and water conservation methods to rehabilitate and restore degraded farmlands, thereby regenerating the ecosystem's resource base (Reij, C., & Garrity, D., 2016). To rehabilitate and restore the degraded farmland, the farmers have to use a simple, rapid, and low-cost method of restoring and rehabilitating the farmland. The methods that promote the systematic regrowth of existing trees or seeds, conserve water and soil resources, and enhance soil fertility should be implemented to maintain land resources (Shibru T., 2010). Natural regeneration and restoration of trees increase the availability of wood and tree products and improve land and soil quality. This makes farming more productive and helps with income, food security, and being able to handle extreme weather (Rinaudo T, et al. 2019).

Large-scale deforestation and soil erosion caused by inappropriate farming techniques, destructive forest exploitation, wildfires, and unregulated grazing practices have resulted in major ecological imbalances in Ethiopia over the last couple of decades. As a result, agricultural production has declined, water resources have been depleted, hydrological conditions have been disrupted, and there has been an increase in poverty and food insecurity (Daniel, 2002). The National potential and priority maps for tree-based landscape restoration technical report (MEFCC, 2018), says that Ethiopia has more than 54 million hectares of land that could be restored with tree-based landscape restoration. From this, more than 20 million ha of land were found in the Oromia region. Given Ethiopia's promise to restore 15 million hectares of degraded land using various methods and techniques to attain carbon neutrality by 2025 as part of a climate change and renewable energy plan (UNDP 2011). Moreover, Ethiopia's senior policy and decision-makers, along with governmental and civil society organizations, must recognize the potential of rehabilitating degraded farmland as an essential ecological restoration instrument.

The study area is experiencing deterioration driven by decades of uncontrolled farmland use, exacerbated by widespread poverty and population growth. Historically known for dense acacia tree cover, the district now suffers from farmland degradation, influenced by soil characteristics, slope angle, and land management practices. The reduction in acacia trees, primarily for charcoal production, has further impacted farmland productivity, threatening community livelihoods and ecological processes (Melaku, T., 2013). This district faces significant challenges, including recurrent drought, flooding, and erratic rainfall, which have led to moisture stress and the loss of agricultural land. Crop production, the main income source for farmers, has been inadequate due to insufficient rainfall and poor farmland management, resulting in decreased farmland productivity (MoARD, 2010).

This paper aims to assess the issues of degraded farmland and suggests that landscape-level interventions are necessary to enhance farmland productivity and improve farmers' livelihoods. In this regard, Temesgen et al. (2014) did research related to my issue, which is to give an overview of the causes and impacts of farmland degradation in Ethiopia and present rehabilitative measures to restore degraded farmlands, but they did not address the issue of land degradation concerning agricultural aspects, which this research tries to address. Similarly, Feyera Deresa and Tsetadirgachew Legesse (2015) did research on the cause of farmland degradation and its impacts on the livelihoods of the population in Toke Kutaye district, Ethiopia. But they did not address the restoration aspects of the degraded farmlands. So, such problems need solutions, and this research paper tried to address the above gaps.

This study primarily aimed to evaluate the status of farmland degradation, its causes and effects, the challenges and opportunities for restoration, and the feasibility of rehabilitation options within the context of the study area. The specific objectives of this paper were, therefore, (i) to assess the major causes and consequences of farmland degradation, (ii) to assess major challenges and opportunities in undertaking farmland rehabilitation and restoration practices, and (iii) to show the potential of the area for implementing restoration and rehabilitation programs.

II. DESCRIPTION OF THE STUDY AREA

2.1 Geographical Location

The research was conducted in the Sire district of the Arsi zone, Oromia Region, Ethiopia, where soil erosion, including flooding, land degradation, decreasing crop productivity, and other issues, are prevalent problems. The district is one of the 26 districts found in the Arsi zone. It was part of the former Dodota Sire district. The administrative center of the district is Sire town. Geographically, the district is located between 80°10’30’’N to 80°27’0’’N latitude and 39°21’30’’E to 39°38’0’’E longitude. The

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district covers a total area of 52,816 ha. Currently, the Sire district has 18 kebeles (lower administrative bodies): 1 urban and 17 rural kebeles. The district is located 145 km and 75 km from Addis Ababa and Asela, respectively.

2.2 Population

The population of the district was 73,970 in 2007, according to the National Census Report. The rural population accounts for about 65,597 (88.68%) of the population, and 11.32% of its population were urban dwellers. Sire town, the district's administrative center of Sire district, with an altitude of 1793 meters above sea level. Sire District in the West, Dodota District in the North, Adama Zuria and Boset districts in the East, Jeju District in the South, and Southeast Deksis district define the district's boundaries. The district is known to be found in the Rift Valley.

2.3 Rainfall and Temperature

In the Sire district, agricultural production is mainly rain-fed. The district is known for moisture stress and the potential for wheat production. It has erratic rainfall with a mean annual rainfall of 700 mm and average maximum and minimum monthly temperatures of 28°C and 20°C, respectively (NMA, 2007). The main rainy season is from June to August. Farmers produce crops using the main 'Meher' (April–June) season. Sire District lies between 1100 and 2600 m above sea level, and 42% of the district is kola agroecology, and 30% and 28% of the district is dry Weyna Dega and moist Weyna Dega agroecology, respectively (District Agricultural Office, 2022).

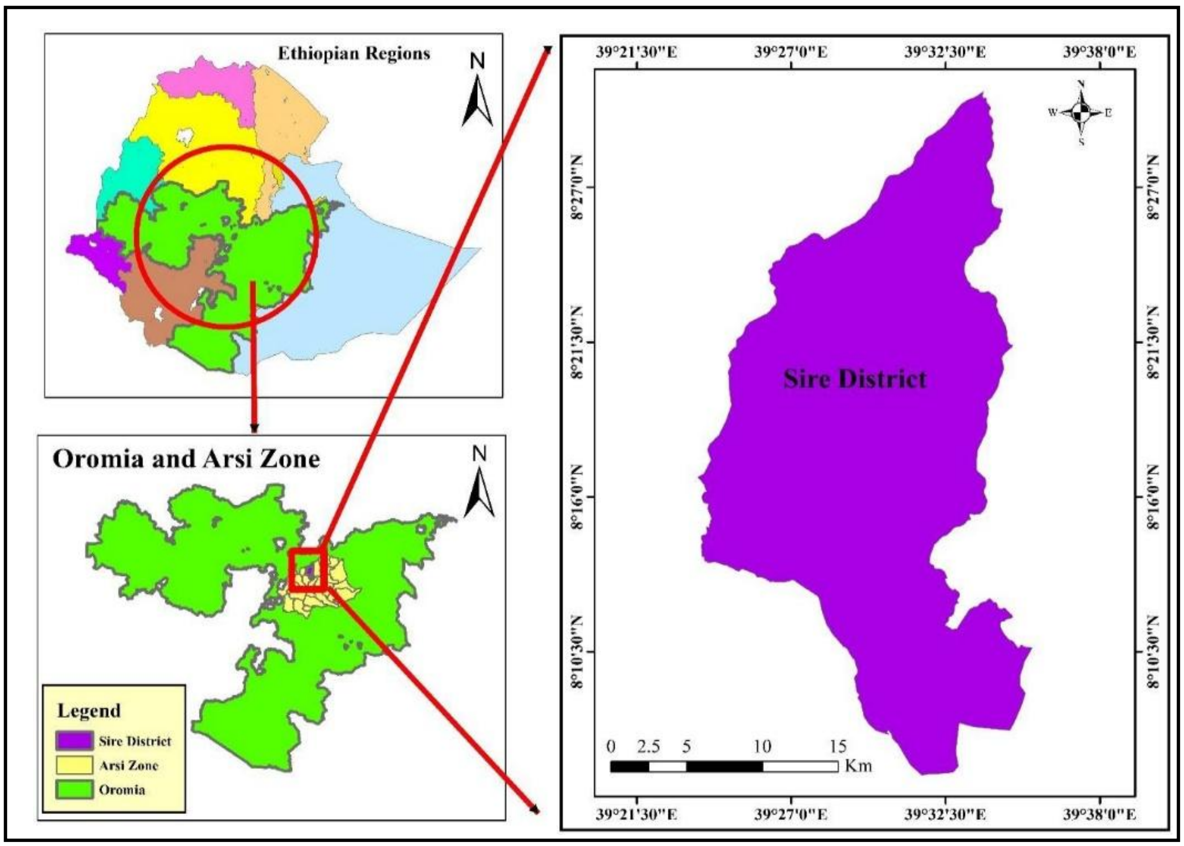

Figure 2.1: Geographical location of the study area

2.4 Land Use and Vegetation

According to the district agricultural office data (2022), 41,282 ha of the district land is covered by cropland, 8,917.25 ha of land is covered by forestland, 4,790.5 ha of land is covered by pasture land, and 17,363.12 ha of land is covered by grassland, non-cultivated land (mountainous area), and bare land. The area is characterized by dispersed acacia woodland and is classified as a tropical savannah. Acacia trees are a prominent and essential source of income for the locals. Vegetation and open woodland consist of diverse Acacia species such as Balanitis aegyptica and other species that generally characterize the vegetation cover of the area. Acacia species provide essential browse mainly to goats and other animals. The density of acacia has been remarkably reduced. The people have been cutting acacia trees mostly for the production of charcoal (District Agricultural Office, 2022).

III. MATERIALS AND METHODS

3.1 Data Collection

Primary data was predominantly collected through household surveys utilizing modern digital tools such as the Open Data Kit (ODK) smartphone application. This approach enhanced the accuracy, efficiency, and speed of real-time data collection. The survey incorporated both open and semi-structured questionnaires, striking a balance between standardized responses and the flexibility to delve into emerging topics. Additionally, qualitative data were gathered through key informant interviews and focus group discussions (FGDs), which provided valuable insights into community perceptions and local knowledge regarding land rehabilitation efforts. Alongside the primary data, secondary data were sourced from regional bureaus, zone offices, and district agricultural offices. These datasets included crucial biophysical factors like vegetation cover and soil quality, which are vital for assessing the potential for farmland rehabilitation. By integrating secondary data, the study achieved a more comprehensive understanding of the environmental context while also supporting data triangulation to enhance the reliability of the findings.

Before the main phase of data collection, a reconnaissance survey was conducted to gain an overall understanding of the farmland conditions. This preliminary step informed the design of more detailed biophysical and community perception surveys. The follow-up surveys concentrated on gathering specific information regarding vegetation, soil characteristics, and community attitudes toward rehabilitation efforts, ensuring that the data collected was both focused and relevant.

The study used a statistically robust sampling method based on Yamane's (2001) formula, assuming a 95% confidence level and a ±5% margin of error. This approach determined a sample size of 323 household heads, who were randomly selected to ensure the sample was representative. The households were proportionally distributed across the selected kebeles (lower administrative bodies), with respondents chosen through a proportionate sampling method from each kebele's list, ensuring that the sample accurately reflected the population's structure.

3.2 Method of Data Analysis

The collected data was reviewed, cleaned, and entered into a computer for analysis to derive meaningful insights. Both qualitative and quantitative data analysis methods were employed. Qualitative data, gathered through key informant interviews, focus group discussions (FGDs), and direct observation, were analyzed using thematic content analysis. Quantitative data, collected through a formal survey, were analyzed using descriptive statistics, such as percentages and frequencies, which were presented in tables, charts, and frequency distributions. These analyses helped describe the demographic and socio-economic characteristics of households, as well as the farmers' views on farmland rehabilitation and restoration practices in the study area. For logistic regression analysis to assess the impact of independent variables on crop production, SPSS version 25 was used.

IV. RESULTS AND DISCUSSION

The data have been presented in sequential order, in accordance with the objectives outlined in Chapter One of this research paper. The data provided in the tables and charts served as the basis for the analysis. The demonstration is followed by a thorough analysis of the data. The study presentation briefly addressed the demographic characteristics of the sample populations.

4.1 Demographic and Socio-Economic Characteristics

In this section, gender, age, family size, educational background, and size of farmlands of the respondents were analyzed by using frequency and cross-tabulation techniques of analysis.

As shown in Figure 4.1, 88.5% of the respondents were male, while 11.5% were female, indicating a higher proportion of males in the sample compared to females. The age distribution of respondents, as depicted in the same figure, reveals that the youngest age group (20–30 years) accounted for 16.72% of the respondents, while the oldest age group (above 60 years) made up 9.29%. This data suggests that the majority of respondents were within the productive age range and were likely aware of the issue of farmland degradation and its impacts on livelihoods. The prevalence of working-age respondents contributed to the collection of reliable and comprehensive data on agricultural degradation and its consequences.

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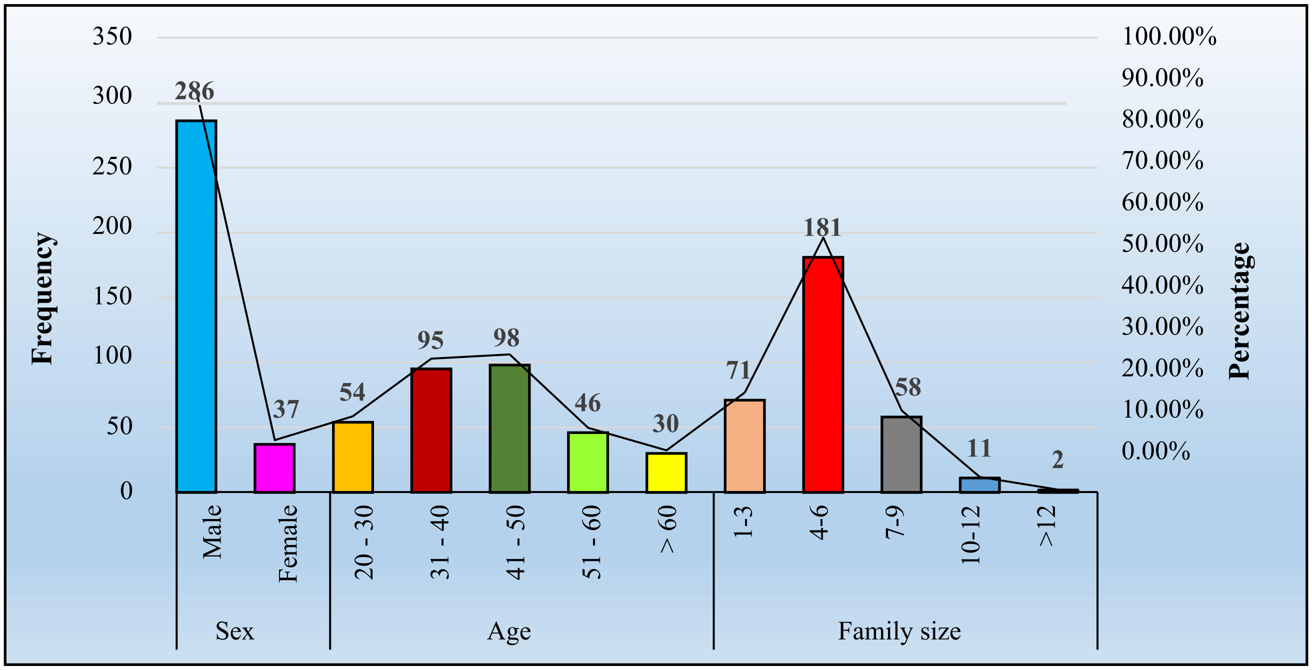

Figure 4.1: Sex, Age, and Family Size Distribution of the Respondents

As illustrated in Figure 4.1, there was considerable variation in the family sizes among respondents. A total of 21.98% of participants stated having 1 to 3 children in their household, while the majority, 56.04%, had families with 4 to 6 children. A smaller proportion, 17.96%, had 7 to 9 children, and only 3.41% of respondents indicated that their families included 10 to 12 children. The smallest group, comprising 0.62%, had more than 12 children. This distribution shows that most respondents tended to have families of moderate size, with the largest group falling within the 4 to 6 children range. There was a noticeable decline in the number of respondents with larger families. These trends could potentially influence agricultural practices and livelihoods in the study area, as family size may affect labour availability, resource allocation, and household decision-making, which are all crucial factors in agricultural productivity and sustainability.

Table 4.1: Educational status and income source of the respondent

Factors	Classification	Frequency	Percent
Educational Status	BSc degree	2	0.60%
	Diploma	2	0.60%
	Secondary school	84	26%
	Primary school	207	64.10%
	Basic education	28	8.67%
	Total	**323**	**100.00%**
Income Sources	Crop production	300	92.90%
	Livestock production	65	20.10%
	Mixed farming	32	9.90%
	Trade	32	9.90%
	Government employment	7	2.20%
	Total	**436**	**135.00%**

Source: - Survey Result, 2022

According to Table 4.1, the distribution of respondents based on their level of education shows that of all the respondents, the people who learned in primary school exceeded others by 64.1%. According to the above table, most of the respondents in the study area are literate (91.33%) and thus would be good to mitigate farmland degradation and restore the degraded farmland. In addition, as shown in the above table, 92.9% of the respondents' income source was crop production, 20.1% from livestock production, 9.9% from mixed farming, 9.9% from trade, and 2.2% from government employment, respectively.

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As presented in Table 4.1, the educational distribution of respondents reveals that a significant majority, 64.1%, had attended primary school, surpassing other educational levels. The table further shows that a high proportion of respondents, 91.33%, were literate, suggesting that the population is well-equipped to engage in initiatives aimed at mitigating farmland degradation and restoring degraded land. Regarding sources of income, the table indicates that the predominant source for most respondents, 92.9%, was crop production. Other sources included livestock production (20.1%), mixed farming (9.9%), trade (9.9%), and government employment (2.2%). This distribution of income sources highlights the central role of agriculture in the livelihoods of respondents, emphasizing the importance of sustainable agricultural practices for the community's economic stability and the potential for addressing environmental challenges.

Table 4.2: Farmland Holding Size for Respondents

Landholding size (ha)	Landowner		Rented inland		Rented out land	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0.25 - 1.0	167	51.70%	103	31.89%	15	4.64%
1.1 - 2.0	96	29.72%	29	8.98%	1	0.31%
2.1 - 3.0	30	9.29%	1	0.31%	1	0.31%
3.1 - 4.0	5	1.55%	2	0.62%	0	0.00%
4.1 - 5.0	2	0.62%	0	0.00%	0	0.00%
> 5	4	1.24%	0	0.00%	0	0.00%
None	19	5.88%	0	0.00%	0	0.00%
Total	**323**	**100.00%**	**135**	**41.80%**	**17**	**5.26%**

Source: - Survey Result, 2022

As Table 4.2 shows, the majority of landholding farmers possess between 0.25 and 1.0 hectares, accounting for 51.7% of the respondents, while 29.72% have between 1.1 and 2.0 hectares of land; additionally, 9.29%, 1.55%, 0.62%, and 1.24% of respondents own land in the ranges of 2.1–3.0 hectares, 3.1–4.0 hectares, 4.1–5.0 hectares, and more than 5.1 hectares, respectively; furthermore, 5.88% of surveyed households said that they had never owned land. However, 5.26 percent of land-owning respondents rented out their farmland to other farmers, while 41.8 percent rented land from other farmers for cultivation purposes.

4.2 Farming practice

The survey results indicate that respondents cultivate a range of crops, including teff, wheat, maize, barley, beans, and haricot beans. As shown in Table 4.3, wheat and teff are the primary crops grown by the majority of respondents. A significant portion of respondents across the district also grow maize and barley, alongside the primary crops of wheat and teff. In contrast, the cultivation of beans, haricot beans, and sorghum is less common, although these crops are typically grown in the district's highland agroecological zones. Additionally, farmers in the Weyna Dega agro-ecology were said to cultivate chickpeas, as noted in key informant interviews and focus group discussions.

Table 4.3: Major food crops produced in the study area

Major food crops in the area	Percentage
Maize	16.50%
Teff	34.90%
Wheat	35.30%
Sorghum	0.80%
Bean	3.40%
Barley	6.00%
Haricot Bean	3.10%
Total	100.00%

Source: - Survey Result, 2022

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According to the household survey, a substantial majority of respondents, 92.7%, reported using oxen for land cultivation, reflecting the traditional and widely practiced method of farming in the area. In contrast, only 7.3% of respondents utilized tractor machines for cultivation, indicating a relatively low level of mechanization in the region's agricultural practices. This indicates that while some farmers have adopted modern farming equipment, the majority continue to use oxen, which is likely due to factors such as cost, accessibility, and tradition.

Regarding the trend in crop yields over the past five to ten years (Table 4.4), a large proportion of respondents, 77.09%, reported a decline in crop yields per hectare. This suggests that most farmers perceive a decrease in agricultural productivity, which could be attributed to several factors, including soil degradation, changing climate conditions, or other environmental stressors that impact crop performance. A smaller proportion of respondents (16.10%) indicated that their crop yields had increased, which may be linked to improvements in farming practices, better access to inputs, or more favourable climatic conditions during the period. Only 6.81% of respondents indicated no significant change in their yields, implying that a small group of farmers have experienced stability in their production levels. These findings underline the challenges facing local agriculture, particularly in terms of maintaining productivity over time. The declining yields reported by the majority highlight the need for targeted interventions to improve soil health, adapt to climate change, and enhance farming practices to support sustainable agricultural development in the area.

Table 4.4: Trend of crop production in the study area

The trend of crop production	Frequency	Percent
Increased	52	16.10%
Decreased	249	77.09%
No significant change	22	6.81%
Total	**323**	**100.00%**

Source: - Survey Result, 2022

As presented in Tables 4.5 and 4.6, which reflect 13 years of data from the district agricultural office, there has been a significant decline in both gross crop yield per hectare and crop yield per quintal over the last four years. These trends are consistent with the findings from the household survey, further reinforcing the observed decline in agricultural productivity. Additionally, information gathered from focus group discussions with local representatives and key informants corroborates these findings, aligning closely with the data from our analysis. This evidence suggests that the depletion of farmlands in the area will likely have substantial consequences for the local community, both in the short term and in the long term, impacting food security, livelihoods, and overall agricultural sustainability.

Table 4.5: Actual trend of crop yield/ha

Types of Main Crop Produced	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Crop yield/ha	Crop yield/ha	Crop yield/ha	Crop yield/ha	Crop yield/ha	Crop yield/ha	Crop yield/ha	Crop yield/ha	Crop yield/ha	Crop yield/ha	Crop yield/ha	Crop yield/ha	Crop yield/ha
Wheat	17.97	11.99	22.12	31.29	29.99	**33.35**	**31.47**	**12.89**	23.15	**38.35**	**29.92**	**28.53**	**23.48**
Teff	9.06	11.04	13.69	9.49	12.62	15.15	18.81	7	12.89	**17.16**	**13**	**12.26**	**11.50**
Barley	19.73	11.32	21.99	16.21	26	35.37	21.92	29.26	32.94	**39.73**	**33.07**	**32.03**	**20.00**
F. Bean	10.7	17.4	21.75	24.96	13.7	18.56	7.78	25	27.62	**26.07**	**24.72**	**16.00**	**7.00**
Maize	17.78	8.45	32.37	15.61	18.18	38.14	5.64	9.99	**58.43**	**39.64**	**34.21**	**30.00**	**25.00**

Source: - District Agricultural Office, 2022 [shaded box] - Shows the decreasing trend of crop yield/ha

Table 4.6: Actual trend of crop yield in quintals

Types of Main Crop Produced	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Crop yield (Qt)	Crop yield (Qt)	Crop yield (Qt)	Crop yield (Qt)	Crop yield (Qt)	Crop yield (Qt)	Crop yield (Qt)	Crop yield (Qt)	Crop yield (Qt)	Crop yield (Qt)	Crop yield (Qt)	Crop yield (Qt)	Crop yield (Qt)
Wheat	155,514	100,213	220,776	317,938	281,002	346,857	307,745	151,389	303,584	**411,732**	**307,572**	**275,816**	**221,136**
Teff	52,634	55,568	69,875	62,334	72,935	99,856	100,125	39,865	71,320	**92,253**	**63,816**	**71,876**	**77,439**
Barley	56,203	25,568	56,083	34,520	52,009	209,728	46,420	151,812	231,558	**285,098**	**241,020**	**209,051**	**143,945**
F. Bean	14,383	18,613	35,892	38,646	36,097	38,466	17,440	48,125	57,784	**34,105**	**63,477**	**31,088**	**12,754**
Maize	29,987	14,962	41,858	23,795	40,115	78,952	12,208	17,373	**131,477**	**73,374**	**67,220**	**55,223**	**42,525**
Sum Total	**308,721**	**214,924**	**424,484**	**477,233**	**482,158**	**773,859**	**483,938**	**408,564**	**795,723**	**896,562**	**743,105**	**643,054**	**497,799**

Source: - District Agricultural Office, 2022; [shaded box] - Trends of crop production in quintal

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As presented in Tables 4.5 and 4.6, which reflect 13 years of data from the district agricultural office, there has been a significant decline in both gross crop yield per hectare and crop yield per quintal over the last four years. These trends are consistent with the findings from the household survey, further reinforcing the observed decline in agricultural productivity. Additionally, information gathered from focus group discussions with local representatives and key informants corroborates these findings, aligning closely with the data from our analysis. This evidence suggests that the depletion of farmlands in the area will likely have substantial consequences for the local community, both in the short term and in the long term, impacting food security, livelihoods, and overall agricultural sustainability. According to the data from Tables 4.5 and 4.6, covering 13 years of records, there has been a significant decline in both gross crop yield per hectare and crop yield per quintal over the past four years. This trend aligns with findings from household surveys and focus group discussions, where local representatives expressed concerns over decreasing yields attributed to soil degradation, changing rainfall patterns, and resource depletion. The implications are serious; reduced crop yields threaten household incomes, food security, and economic stability. Over time, continued land depletion could exacerbate these issues, leading to increased poverty, migration, and social unrest as farming viability diminishes. To combat these challenges, sustainable agricultural practices and effective land management strategies are essential for the community's long-term resilience.

Figure 4.2 shows the factors respondents identified as contributing to declining crop yields. The most frequently cited causes were declining soil fertility (22.8%) and increased erosion (18.62%). Other contributing factors included the rising cost of chemical fertilizers (16.10%), reduced rainfall (12.61%), limited access to quality seed (12.03%), over-cultivation (9.70%), pests and diseases (4.85%), and increasing soil salinity (3.3%) (see Appendix 2). These issues were also emphasized in focus group discussions. Key informants noted that removing crop residues for animal feed reduces the organic material returned to the soil, weakening soil fertility over time. They explained that clearing residues entirely diminishes the nutrient base and contributes to long-term soil degradation. In contrast, some respondents observed higher crop yields in areas with better water access, largely due to increased fertilizer use.

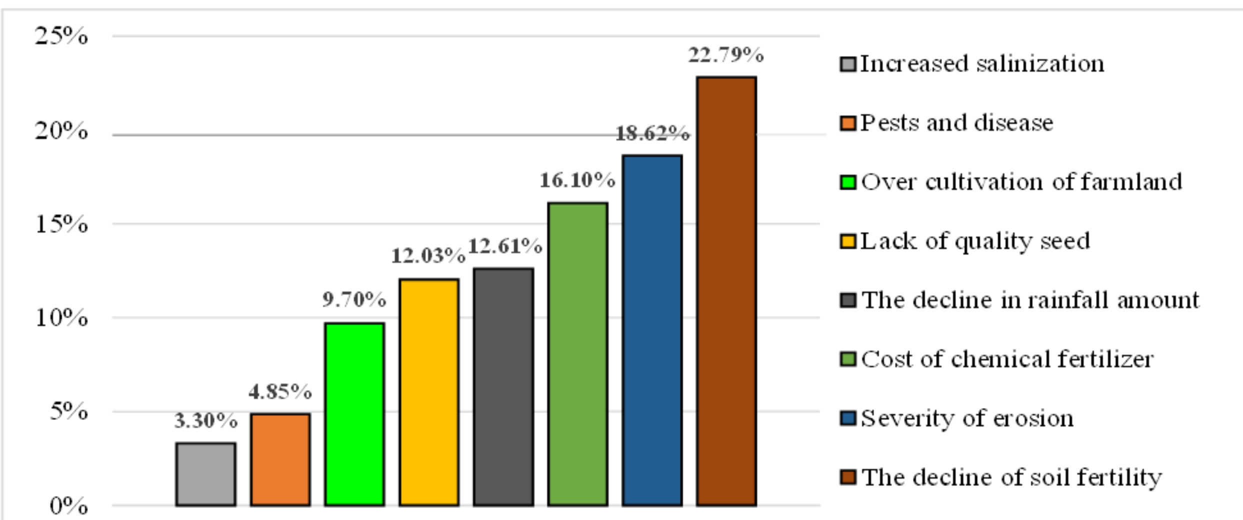

Figure 4.2: Reasons for crop yield decline

Key informants noted that grazing land, once the primary livestock feed source, has diminished due to expanded crop production. As a result, farmers rely heavily on crop residues, which they fear may reduce soil fertility over time by depleting organic matter and nutrients. Access to extension services is crucial for enhancing farmers' knowledge and farmland management; however, many extension agents only visit sporadically, leading to limited guidance. Farmers expressed concerns that the infrequent support hampers agricultural performance and does not meet their advisory needs effectively.

4.3 Characteristics of farmland and nature of farmland degradation

Farmland characteristics play an important role in shaping land-use decisions and patterns of land degradation. For this reason, the analysis considered the slope of the plots managed by surveyed households. As shown in Table 4.7, about one-third of respondents (31.3%) reported farming on flat land, more than half (56.3%) cultivated gently sloping land, while 11.1% worked on moderately sloping plots. Only a small share, about 1.2%, farmed on steeply sloping land.

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Table 4.7: Slope of Farmland

		Frequency	Percent
Respondent farmland slope	Flat Land (<2%)	101	31.3%
	Gentle Slope Land (2% - 9%)	182	56.3%
	Moderate Slope Land (9% - 15%)	36	11.1%
	Strong Slope Land (15% - 30%)	4	1.2%
	Total	**323**	**100.0%**
Farmland level of degradation	Serious	109	33.7%
	Moderate	209	64.7%
	Minor	5	1.5%
	Total	**323**	**100%**

Source: - Survey Result, 2022

Key informants and focus group discussions indicate that over fifty percent of farmers cultivate areas susceptible to erosion. It was concluded that certain marginal lands should remain uncultivated due to their inherent characteristics, yet they are currently being farmed due to population pressures and rising demands. This is a big issue that looks to be aggravating farmland degradation. As indicated in Table 4.7, the extent of farmland degradation in the study area includes 64.7% categorized as moderate, 33.7% as serious, and 1.5% as minor. Sheet and rill erosion are common issues affecting these farmlands. Focus group discussions indicated that they are aware of the difficulties associated with farmland degradation in their kebeles. They found that some agriculture had fallen out of use, owing primarily to soil erosion.

4.4 Causes of Farmland Degradation

Farmland degradation in the study area is driven by multiple, interacting factors similar to those observed elsewhere in the country. Table 4.8 shows the primary causes identified by respondents: soil erosion was the most frequently mentioned cause, 24.6%, followed by over-cultivation, 20.0% and poor farming systems, 14.1%. Heavy rainfall events were reported by 13.3%, while deforestation accounted for 12.8%. Other contributors included over-grazing 6.0%, cultivation on steep slopes 5.3%, strong winds 3.7%, and mineral and mine extraction 0.2%. These results indicate that mechanical (erosion, slope cultivation), management (over-cultivation, poor farming systems), and land-use change (deforestation, mining) processes together drive degradation, underscoring the need for integrated soil-conservation and land-management interventions.

Table 4.8: Causes of farmland degradation

		Percentage
Causes of Farmland Degradation	Deforestation	12.8%
	Overcultivation	20.0%
	Overgrazing	6.0%
	Soil Erosion	24.6%
	Cultivation of steep areas	5.3%
	Poor farming system	14.1%
	Occurrence of heavy rainfall	13.3%
	Occurrence of high wind	3.7%
	Mineral and mine extraction	0.2%
	Total	**100.0%**
Main agents of farmland degradation	Rainfall	55.70%
	Topography	28.40%
	Wind speed	13.70%
	Fire	0.50%
	Poor land-use system	1.60%
	Total	**100.00%**

Source: - Survey Result, 2022

Population growth and rising household needs continue to put pressure on available farmland. A small share of farmers (5.3%) has responded by expanding cultivation into steep and marginal areas instead of adopting productivity-enhancing practices. This strategy

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reflects limited land availability and barriers to using improved inputs, but it also exposes fragile soils to erosion and reduces long-term productivity. Table 4.8 shows that rainfall is the leading driver of farmland degradation, cited by 55.7% of respondents. Topography follows at 28.4%, reflecting the influence of sloping terrain. Wind contributes 13.7%, while poor land-use systems and fire account for 1.6% and 0.5%, respectively. These results indicate that both environmental conditions and management choices shape the patterns of degradation in the area.

Farmland tree cover has steadily declined due to ongoing tree cutting, deforestation, and poor land management. The main pressures include unsustainable farming practices, soil erosion, intensive rainfall, over-cultivation, overgrazing, cultivation on steep slopes, and strong winds. These factors accelerate land degradation and the depletion of natural resources in the area. Population growth, weak law enforcement, limited energy alternatives, charcoal production, and wildfires further worsen the situation. Restoring degraded farmland and ensuring community benefits are essential for reducing these pressures. Previous studies support these observations. Merkineh Mesene (2017) identified unsustainable farming practices, overgrazing, and deforestation as major drivers of farmland degradation. Assemu Tesfa and Shigdaf Mekuriaw (2014) reported that inappropriate land use degrades soil, water, and vegetation, reducing biodiversity and impairing ecosystem function. Hurni H. (1993) also noted that even marginal lands on steep, erosion-prone slopes have been cultivated due to land scarcity.

4.5 Effect of Farmland Degradation on Crop Production

Agriculture continues to be the predominant livelihood in the study area, evident in the strong reliance households have on crop production as their primary source of income. Most respondents indicated that farmland degradation has significantly diminished crop yields. They observed that fertile topsoil is being lost from exposed and degraded fields, resulting in lowered productivity and contributing to seasonal shortages that impact household food security. As soil fertility declines, the yield from each plot of land also decreases, which directly influences household welfare and overall economic stability. Farmers in the region are profoundly affected by farmland degradation, often incurring substantial annual expenses on fertilizers to maintain crop production levels. During focus group discussions, community representatives highlighted the challenges of achieving adequate yields to meet household needs amid declining soil fertility. To tackle this issue, both short- and long-term interventions are essential for restoring and sustaining productive farmland. In response, participants in the household survey identified various strategies they implement to preserve soil fertility and sustain crop yields, which are summarized in Table 4.26.

4.6 Multiple Linear Regression Analysis

It is a statistical tool used to estimate the strength and direction of the relationship between an outcome variable and a set of explanatory variables. In the context of farmland degradation, regression analysis helps identify which factors have the strongest influence, which play a minor role, and how these factors interact. By examining these relationships, it becomes possible to determine the key drivers of degradation and to focus attention on the variables that have the greatest explanatory power. As shown in Table 4.9, the regression model includes one dependent variable, crop yield (Y), measured in quintals, and nine independent variables. These explanatory variables are deforestation (X1), over-cultivation (X2), over-grazing (X3), soil erosion (X4), cultivation of steeply sloped land (X5), poor farming systems (X6), occurrence of heavy rainfall (X7), occurrence of high wind (X8), and mineral or mine extraction (X9). All nine variables were incorporated to assess their influence on crop yield and to identify the most important drivers of yield reduction in the study area.

Table 4.9: Compete Variables

	Variables	
Y	Dependent	Crop yield in quintal
X1	Independent	Deforestation
X2	Independent	Over Cultivation
X3	Independent	Overgrazing
X4	Independent	Soil Erosion
X5	Independent	Cultivation of steep lands
X6	Independent	Poor farming system
X7	Independent	Occurrence of heavy rainfall
X8	Independent	Occurrence of high wind
X9	Independent	Mineral and mine extraction

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In this study, multiple linear regression is used to examine whether crop yield, measured in quintals, can be explained by a set of farmland degradation factors. The model assesses the combined and individual effects of deforestation, over-cultivation, over-grazing, soil erosion, cultivation of steep lands, poor farming systems, heavy rainfall, high wind, and mineral and mine extraction. This approach allows the analysis to identify which factors significantly influence crop yield and how strongly each contributes to variations in production.

Regression line: $Y' = a + b1x1 + b2x2 + b3x3 + b4x4... + \mathcal{E}$

Where: -

- Y – Represents the outcome variable that the model is trying to predict (crop production yield in quintal)
- *a* – the intercept
- x1, x2, x3, x4, x5 … etc. – symbolize the independent variables
- b1, b2, b3, b4, b5 …etc. - These are the slope coefficients
- $\mathcal{E}$ is the error term (or residual term)

In this case, can say:

Crop production yields = B_0 *+ B1 (Deforestation) + B2 (Over cultivation) + B3 (Overgrazing) + B4 (Soil erosion) + B5 (Cultivation of steep lands) + B6 (Poor farming system) + B7 (Occurrence of heavy rainfall) + B8 (Occurrence of high wind) + B9 (Mineral and mine extraction)*

The study employs the enter method to estimate the regression model, capturing the full range of cause-and-effect relationships between farmland degradation factors and crop yield. This approach, which is the default option in SPSS, involves entering all independent variables into the model simultaneously. This forced-entry procedure enables the analysis to evaluate the effect of each variable while keeping the others constant, offering a clear understanding of which factors have the strongest influence on the dependent variable. Table 4.10 shows the relationships among the nine independent variables included in the regression model. This analysis helps assess how well the model describes the data and the strength of associations among predictors. The key statistic in this context is the R-squared value, which indicates the proportion of variance in the dependent variable (crop production yield) explained by the model. A higher R-squared value reflects a better-fitting model, demonstrating how effectively the chosen explanatory variables predict crop yield.

Table 4.10: Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.258[a]	**.066**	.040	15.076
A. Predictors: (constant), mineral and mine extraction, over-cultivation, cultivation of steep land, deforestation, poor farming system, soil erosion, occurrence of high wind, overgrazing, occurrence of heavy rainfall				

Where: -

- The multiple correlation coefficient (R) quantifies the strength of the relationship between the dependent variable, crop production yield, and all combined independent variables. In this instance, R = 0.258, indicating a relatively weak relationship. This implies that the regression model is not particularly effective in predicting crop yield based on the selected explanatory variables.
- The coefficient of determination (R^2) reveals the extent to which the variation in the dependent variable, crop production yield, can be explained by the independent variables featured in the model, these include mineral and mine extraction, over-cultivation, cultivation on steep slopes, deforestation, inadequate farming systems, soil erosion, high wind occurrences, overgrazing, and heavy rainfall events. Here, $R^2 = 0.066$, suggesting that only 6.6% of the variation in crop yield is accounted for by these predictors, with the remaining 93.4% attributable to other factors not included in the model.

The ANOVA results (Table 4.11) indicate whether the regression model, which includes mineral and mine extraction, over-cultivation, cultivation of steep slopes, deforestation, poor farming systems, soil erosion, occurrence of high wind, overgrazing, and occurrence of heavy rainfall, significantly predicts the dependent variable, crop production yield. Since the significance value (p-value)

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is less than 0.05, the model is statistically significant, meaning these predictors collectively provide a meaningful explanation of variations in crop yield.

Table 4.11: Analysis of Variance (ANOVA)

ANOVA[a]					
Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	5061.189	9	562.354	2.474	**.010[b]**
Residual	71136.607	313	227.274		
Total	76197.796	322			
a. Dependent Variable: Respondent crop production yield in quintal					
b. Predictors: (Constant), mineral and mine extraction, over-cultivation, cultivation of steep land, deforestation, poor farming system, soil erosion, occurrence of high wind, overgrazing, occurrence of heavy rainfall					

Source: - Research analysis, 2022

The key statistic in the ANOVA table is the F value, which indicates the extent to which the regression model predicts crop yield more effectively than merely using the mean. In this instance, the model demonstrates an improvement of approximately 2.47 times over the mean, signifying a modest enhancement. A larger F value, coupled with a low significance level, would suggest a more robust model with greater explanatory power. Based on the ANOVA results, it is evident that the model serves as a statistically significant predictor of the outcome variable.

The study can explain the results as:

F (*Regression df, Residual df*) = *F-Ratio*, p = Sig

In this situation, the researcher might state: The results indicated that the model serves as a significant predictor of crop production yield expressed in quintals, F (9, 313) = 2.474, p = .010.

Table 4.12: Coefficient Table

Coefficients[a]									
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	18.560	2.673		6.945	.000	13.301	23.819		
Deforestation	-.866	1.799	-.028	-.481	.631	-4.406	2.675	.897	1.115
Over Cultivation	2.708	1.916	.085	1.414	.158	-1.061	6.478	.833	1.200
Overgrazing	1.610	2.335	.041	.689	.491	-2.985	6.204	.832	1.202
Soil Erosion	6.075	2.184	.161	2.782	.006	1.778	10.372	.888	1.127
Cultivation of steep lands	-2.987	2.289	-.073	-1.305	.193	-7.491	1.517	.951	1.052
Poor farming system	-4.670	1.743	-.151	-2.679	.008	-8.099	-1.241	.933	1.072
Occurrence of heavy rainfall	2.561	1.896	.082	1.351	.178	-1.169	6.291	.802	1.247
Occurrence of high wind	-1.508	2.828	-.032	-.533	.594	-7.073	4.057	.847	1.180
Mineral & mine extraction	-3.233	10.926	-.017	-.296	.767	-24.730	18.264	.958	1.044
a. Dependent Variable: Respondent crop yield in quintal									

The study needs to look at three main sections of the coefficient table to explain the multiple regression

While the ANOVA results demonstrate that the overall model is statistically significant, the explanatory power remains relatively low. This suggests that crop production yield is affected by numerous factors beyond the identified drivers of farmland degradation. Elements such as fertilizer application, soil type, seed quality, and various management practices likely have a more substantial impact on yield outcomes. The coefficient table presented below provides clarity regarding the specific contributions of each predictor, illustrating how individual variables perform within the model.

A. Significance column

The first aspect to consider in the coefficients table is the significance level, which indicates whether each predictor has a meaningful effect on the model. This assessment helps identify the variables that statistically contribute to explaining crop yield.
The figures presented across the rows for each explanatory variable reveal that:

- Soil erosion and ineffective farming systems significantly contributed to the model, with p-values of .006 and .008, respectively.
- Conversely, the factors of mineral and mine extraction, over-cultivation, cultivation of steep lands, deforestation, high wind events, overgrazing, and heavy rainfall did not show a statistically significant contribution, with p-values of .767, .158, .193, .631, .594, .178, and .178, respectively.

B. Unstandardized beta coefficients

The unstandardized beta coefficients (B values) illustrate the impact of each independent variable on crop production yield, assuming that all other variables remain constant. In this model:
Deforestation (B1 = -0.866): Each additional hectare of deforested land leads to a reduction in crop yield by 0.866 quintals; Over-cultivation (B2 = 2.708): Interestingly, an increase in over-cultivation is associated with a rise in crop yield of 2.708 quintals; Over-grazing (B3 = 1.610): Similarly, greater levels of over-grazing correspond to a 1.610 quintal increase in yield, which may seem counterintuitive; Soil erosion (B4 = 6.075): A higher degree of soil erosion is linked to a surprising increase of 6.075 quintals, which might indicate potential issues with the model or multicollinearity; Cultivation of steep lands (B5 = -2.987): Extending cultivation into steep lands decreases yield by 2.987 quintals; Poor farming system (B6 = -4.670): Ineffective farming practices result in a yield reduction of 4.670 quintals; Heavy rainfall (B7 = 2.561): Increased rainfall correlates with a yield increase of 2.561 quintals; High wind (B8 = -1.508): Strong winds adversely affect yield, reducing it by 1.508 quintals; Mineral and mine extraction (B9 = -3.233): Mining activities are associated with a yield decrease of 3.233 quintals.

Some coefficients related to over-cultivation, over-grazing, and soil erosion contradict initial expectations, suggesting possible data issues or multicollinearity. Caution is advised when interpreting these effects. In regression analysis, a positive coefficient indicates that a one-unit increase in an independent variable (X) raises the dependent variable (Y) by the coefficient's value, while a decrease in X lowers Y by the same amount. Conversely, a negative coefficient means that an increase in X leads to a decrease in Y. Using the regression coefficients, a statistical model can predict Y based on the independent variables, allowing for the estimation of crop yield from specific predictor values.

$$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 \ldots + B_9X_9$$

In this case, the researcher can say:

Crop production yields = $B_0 + B_1$ *(Deforestation) +* B_2 *(Over cultivation) +* B_3 *(Overgrazing) +* B_4 *(Soil erosion) +* B_5 *(Cultivation of Steep lands) +* B_6 *(Poor farming system) +* B_7 *(Occurrence of heavy Rainfall) +* B_8 *(Occurrence of high wind) +* B_9 *(Mineral and mine extraction)*

The completed model is shown - changing the Bs with the correct values provides the prediction model, see below:

*Crop Production Yield in quintal = 8.560 + (- 294.1955 * deforestation) + (2.708 * over cultivation) + (1.610 * overgrazing) - (6.075 * soil erosion) + (-2.987 * cultivation of Steep lands) + (-4.670 * poor farming ystem) + (2.561 * occurrence of heavy rainfall) + (-1.508 * occurrence of high wind) + -3.233 * mineral and mine extraction)*

In addition, the regression model's constant, or intercept, is 18.560, which represents the predicted crop yield in quintals when all independent variables are zero. In other words, if there were no drivers of farmland degradation, such as deforestation, over-cultivation, or soil erosion, the model predicts that crop production would be 18.560 quintals.

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C. The 95% Confidence Interval (Blue Color Column)

The 95% confidence interval represents the range within which the true coefficient of a predictor is expected to lie, with 95% certainty. If this interval includes zero, the predictor's effect on the outcome cannot be deemed statistically significant at the 5% level. For example, the coefficient for deforestation is -0.866, with a 95% confidence interval ranging from -4.406 to 2.675. Since this interval includes zero, we cannot assert with statistical confidence that deforestation has an impact on crop yield. In contrast, the coefficient for soil erosion stands at 6.075, accompanied by a 95% confidence interval of 1.778 to 10.372. Because this interval does not encompass zero, soil erosion is identified as a significant predictor of crop yield. Overall, with the exception of soil erosion and suboptimal farming systems, the 95% confidence intervals for all other predictors include zero, indicating no statistically significant effect on crop yield.

Generally, a concise and clear version of the conclusion is below:
A multiple linear regression analysis was conducted to evaluate whether the identified degradation drivers predict crop production yield. The model accounted for 6.6% of the yield variation and was statistically significant, $F(9, 313) = 2.474$, $p = .010$. Among the factors analyzed, only soil erosion and poor farming systems exhibited significant impacts on crop yield ($B = .668$, $p < .05$). The remaining variables, including mineral extraction, over-cultivation, steep-slope cultivation, deforestation, high winds, overgrazing, and heavy rainfall, did not demonstrate significant contributions.

The final model was:

*Crop production yield in quintal = 18.560 + (- 294.1955 * deforestation) + (2.708 * over cultivation) + (1.610 * over grazing) + (6.075 * soil erosion) + (-2.987 * cultivation of Steep lands) + (-4.670 * poor farming system) + (2.561 * Occurrence of heavy rainfall) + (-1.508 * Occurrence of high wind) + (-3.233 * mineral and mine extraction)*

4.7 Challenges and Opportunities of Degraded Farmland Restoration

Farmers encounter various challenges when trying to rehabilitate or restore degraded farmland. Respondents from household surveys indicated that these difficulties differ based on the type of farmland and the extent of its degradation.

Table 4.13: Challenges for farmland restoration

Farmland Restoration Challenges[a]	Responses		Percent of Cases
	N	Percent	
Shortage of labour	82	10.02%	25.39%
Lack of willingness	22	2.69%	6.81%
Lack of capital	119	14.55%	36.84%
The slope of the area	103	12.59%	31.89%
Rainfall amount	166	20.29%	51.39%
Input materials for SWC structures	158	19.32%	48.92%
Land tenure	91	11.12%	28.17%
Inadequate extension service	77	9.41%	23.84%
Total	**818**	**100.00%**	**253.30%**

a. Dichotomy group tabulated at value 1.

Source: - Survey Result, 2022

Table 4.13 shows that the main challenges to farmland restoration were rainfall variability (51.39%), limited availability of materials for physical soil and water conservation structures (48.92%), insufficient capital (36.84%), steep slope areas (31.89%), land tenure issues (28.17%), labour shortages (25.39%), inadequate extension services (23.84%), and lack of farmer willingness (6.81%).

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Table 4.14: Limiting factors in farmland rehabilitation and restoration investments

Limiting Factors[a]	Responses		Percentage of Cases
	N	Percentage	
Poor tree planting activity	110	15.11%	34.06%
Shortage of seedlings	64	8.79%	19.81%
Land ownership problems	199	27.34%	61.61%
Poor extension service support	241	33.10%	74.61%
Cost of labour	103	14.15%	31.89%
Shortage of water	11	1.51%	3.41%
Total	**728**	**100.00%**	**225.39%**

a. Dichotomy group tabulated at value 1.

Source: - Survey Result, 2022

Table 4.14 shows that household respondents identified several limiting factors for investing in farmland restoration. The most frequently described were poor extension service support (74.61%), land ownership issues (61.61%), inadequate tree-planting activities (34.06%), high labour costs (31.89%), shortage of seedlings (19.81%), and limited water availability (3.41%), respectively.

4.8 Opportunities for farmland rehabilitation and restoration

Table 4.15 indicates several opportunities for farmland rehabilitation and restoration identified by household respondents in the study area. The most frequently mentioned opportunity was the strong interest and willingness of local residents (42.7%), followed by established natural resource conservation practices (26.3%). Additional opportunities included the availability of human labour (13.9%), access to physical materials for soil and water conservation (11.8%), government policy support (4.0%), and the presence of large degraded areas suitable for intervention (1.2%). Overall, robust community engagement and ongoing conservation initiatives offer a solid foundation for effective restoration, even in the face of limited technical and institutional resources.

Table 4.15: Opportunities for farmland rehabilitation and restoration

Opportunities for farmland restoration	Frequency	Percent
Natural resource conservation practices	85	26.30%
High interest and willingness of the local people	138	42.70%
Human power availability	45	13.90%
Presence of large degraded areas	4	1.20%
Government policy direction and support	13	4.00%
Availability of physical soil and water conservation materials	38	11.80%
Total	**323**	**100.00%**

Source: - Survey Result, 2022

4.9 Potential of the area for implementing restoration and rehabilitation programs

Farmers in the study area are actively seeking to enhance soil fertility and restore degraded farmland through a range of techniques. Each year, government agencies and NGOs implement tree-planting initiatives and other rehabilitation efforts, which have yielded some success. The relatively flat terrain of the district facilitates restoration, making it more feasible compared to more rugged regions. While challenges and limitations exist in farmland rehabilitation, there are also numerous opportunities, including strong community interest, available labour and materials, and established conservation practices. Effectively minimizing obstacles and capitalizing on these opportunities is essential for developing strategies that align with both farmers' needs and broader national objectives.

Focus group discussions have revealed that local residents are eager to recover and restore their farmland. Overall, field observations and interviews with key informants suggest that farmland degradation in this area is less severe than in other regions of the country, indicating that restoration efforts are feasible, less complex, and more cost-effective. Therefore, maximizing opportunities while addressing challenges is crucial for formulating strategies that satisfy both farmers' needs and broader environmental goals.

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4.10 Discussions

Farmland degradation is primarily driven by deforestation, poor farming practices, soil erosion, and over-cultivation. These factors deplete natural resources and reduce land productivity. To effectively address this issue, community involvement in reclaiming degraded land is essential for sustainable success. Population pressure increases the demand for farmland and fuelwood, while inadequate land management and weak enforcement of laws allow harmful practices to persist. Overgrazing reduces vegetative cover, and reliance on wood and charcoal accelerates deforestation. Wildfires and limited access to alternative energy sources worsen the condition, making farmland more susceptible to erosion and nutrient depletion. The situation observed in the study area aligns with previous research. Merkineh Mesene (2017) identified inappropriate land use, mainly unsustainable farming methods, overgrazing, and deforestation as major causes of land degradation, noting that these processes affect soil structure and accelerate nutrient loss through water and wind erosion, waterlogging, salinization, and soil compaction. Assemu Tesfa and Shigdaf Mekuriaw (2014) similarly reported that inappropriate land use leads to soil, water, and vegetative cover degradation, as well as a loss of both soil and vegetative biological diversity, all of which have an impact on ecosystem structure and function. In addition, this finding is in line with that of Hurni, H. (1993), the majority of agriculturally suitable lands, even marginal land on steep slopes prone to soil erosion, were occupied due to favourable conditions.

The degradation of farmland is significantly increasing farmers' vulnerability to poverty, food insecurity, and migration. Issues like soil erosion, declining productivity, deforestation, and floods threaten resources. Reduced rainfall and rising temperatures worsen these problems, undermining ecological services and contributing to climate impacts. Together, these factors create a cycle of stress that jeopardizes the resilience of farming households. This corresponds to the findings of Praol Nyol (2018), Farmland degradation significantly affects agricultural activities by reducing available land for cultivation and leading to decreased crop production. Many face challenges such as low productivity and profitability, characterized by stagnant yields, soil depletion, and loss of forest resources. Similarly, Merkineh Mesene (2017), the effects of land degradation on agricultural productivity can be seen in the average and variance of crop yields, as well as in the overall factor productivity of agricultural production.

According to the results of the household survey and statistics from the District Agriculture Office, the local crop production has been decreasing over time. The primary causes of this are declining soil fertility, over-cultivation, decreased rainfall, increased soil erosion, a lack of fertilizer, low seed quality, pests and diseases, and salinization. This finding is in line with that of Assemu Tesfa and Shigdaf Mekuriaw (2014), due to declining vegetative cover, the degree of erosion control decreases as crop productivity decreases. As a result, once crop productivity begins to decline due to soil degradation, land degradation becomes self-perpetuating. While erosion affects soil fertility and water availability, crop yields on severely degraded soils are significantly lower than on protected soils.

Farmers and stakeholders should develop strategies to rehabilitate degraded farmland based on its specific type and extent of degradation. This can help reduce crop production declines, prevent soil depletion, mitigate food shortages, address income issues, alleviate land scarcity, and protect biodiversity. Ultimately, this proactive approach will enhance farmland productivity and support the growth of local crops. This corresponds to the findings of Mark R. Wade et al. (2007), several farming activities can cause unintended or intentional degradation in the physical, chemical, and biological characteristics of farmland and its surroundings, resulting in changes to air quality, biological diversity, climate, soil condition, and the quality and quantity of water. Ecological restoration of farmland is essential for the long-term sustainability of agriculture, helping to revitalize ecosystem functions and restore degraded environments. Farmers face challenges such as inadequate extension services, land ownership issues, insufficient tree planting, high labour costs, a shortage of seedlings, and limited water availability, which hinder investment in restoration efforts. However, these challenges present an opportunity for farmers, who are eager to revitalize depleted agricultural fields and can take action to achieve this goal.

Overall, the study area reflects a pattern seen across many agricultural landscapes: multiple human and natural pressures interact to deplete soil fertility and weaken ecosystem stability. This underscores the importance of integrated restoration, improved land management, and community-centered approaches to protect farmland and sustain agricultural livelihoods.

V. CONCLUSION

This master's thesis case study was conducted in the Sire District of the Arsi Zone in Ethiopia's Oromia Regional State, focusing on the assessment of agricultural land degradation and its restoration potential. Primary data was collected through a survey of 323 respondents from their households, supplemented by focus group discussions and key informant interviews.

The assessment aimed to achieve several primary objectives: to identify and evaluate the main causes and effects of agricultural land degradation; to explore the significant challenges and opportunities related to farmland rehabilitation and restoration practices; and

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to assess the area's potential for implementing restoration and rehabilitation programs on degraded agricultural land within the district. Both qualitative and quantitative research methodologies were employed to fulfill these objectives. The study concluded each specific objective and addressed the overarching concerns raised throughout the thesis study.

Agricultural activities were initially the main income source for farmers in the study area, with most respondents aged 35 to 45, indicating their productive years. The average farmland managed was about 1.25 hectares. Key factors contributing to agricultural land degradation included deforestation, over-cultivation, overgrazing, soil erosion, poor farming systems, varying rainfall, and wind, all of which significantly affect soil productivity and agricultural output. The decline in crop yields is linked to soil depletion.

Main agents of degradation were rainfall, topography, wind speed, ineffective land-use systems, and fire. Multiple regression analysis showed that soil erosion and poor farming practices notably impacted the outcomes, although the model's predictive capacity was relatively weak. Farmers' cultivation methods, especially tractor use, further exposed soil to erosion, and 2.64 hectares of farmland remained uncultivated due to fertility issues. On average, farmers spent 3,868 birrs annually on chemical fertilizers.

Land ownership issues, the slope of the farmland, inadequate extension services, a lack of capital, insufficient input materials for soil and water conservation (SWC) structures, variable rainfall, and labour shortages were the primary challenges that impeded the rehabilitation and restoration of degraded farmland in the study area. The main barriers to investing in the restoration of degraded farmland included land ownership complications, ineffective extension service support, high labour costs, and insufficient tree-planting activities.

Conversely, the availability of natural resource conservation practices, a strong interest and willingness among local residents, accessible human resources, the presence of extensive degraded areas, supportive government policies, and the availability of physical SWC materials represented significant opportunities for the restoration of degraded farmland in the region.

Farmers in the study area employed a range of strategies to enhance soil fertility, such as crop rotation, managing crop residues, adopting agroforestry practices, composting, and increasing vegetation coverage. Additionally, they utilized contour farming along with physical and biological measures for soil and water conservation to prevent land degradation.

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