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Assessment of the Effectiveness Biophysical Soil and Water Conservation Structures: A Case Study of Kiramuworeda, East Wollega Zone, Ethiopia

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Abstract: Soil erosion is one of the most serious global environmental issues affecting agriculture and soil fertility. On a global scale, water erosion is the most common type of soil erosion in agricultural areas, reducing the soil's ability to support productive agriculture. The efficiency of biophysical soil and water conservation systems must be evaluated before solutions for limiting soil losses may be considered. To promote sustainable land use in the study area, it is critical to understand farmers' knowledge of soil and water conservation structures, as well as the factors that influence their land management practices. Farmers in the study region are well-informed about soil and water conservation structures in general, as well as their causes, indications, and the amount of their plot of land that is susceptible to soil erosion in particular. Furthermore, they feature both traditional and modern soil conservation structures that are successful. However, several impediments to implementing the Soil and Water Conservation structures were found, including a lack of finance, the small area of their land, and other socio-economic and physical aspects. Furthermore, farmers had a highly positive attitude regarding the importance of contemporary Soil and Water Conservation structures. Their awareness, on the other hand, appears to be incorrect. Because they believe that the present SWC Structure is a government-led initiative to rehabilitate highly degraded areas rather than a mechanism of soil and water conservation on agricultural land. They believe that the structures take up a huge portion of a relatively small plot of land, preventing them from properly utilizing it. As a result, it is suggested that the government's policies and strategies, as well as corrective intervention from non-governmental organizations aimed at this issue and community participation in encouraging farmers to participate in soil and water conservation practices, are critical to resolving current poverty, food insecurity, and environmental degradation in the study area.

Keywords: Biophysical; Conservation structure; Soil erosion; Soil and water conservation.

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INTRODUCTION

Due to many socio-economic and demographic variables, as well as limited resources, soil erosion has intensified in most parts of the world, particularly in developing countries (Baskanet et al., 2003). According to a survey of soil degradation conducted by the World Resource Institute for the United Nations Environment Programme, nine million hectares of land have been severely degraded, with their original biotic functions completely lost, and 1.2 billion hectares, or 10% of the earth's vegetative surface, have been moderately degraded, with about 1/4th of these degraded land found in Africa and Asia and the remaining 3/4th in North America (Wriet et al., 1996). Soil deterioration affects about 16 percent of the world's agricultural land (UNEP, 2002). It makes up 56 percent of the world's total degraded land surface. Each year, land degradation is predicted to harm 5 to 6 million hectares of productive land in Africa alone (Stocking & Niamh, 2000).

The average yearly rate of soil loss in Ethiopia is estimated to be 12 tons/hectare/year, with rates as high as 300 tons/hectare/year or roughly 250 mm/year on steep slopes where vegetation cover is sparse (USAID, 2000). Soil erosion by water is the main cause of rapid degradation of the country's highlands (areas over 1500 m a.s.l.), which affects agricultural production and stymies economic progress. For soil and water conservation, several participatory initiatives were not implemented (Addisu, 2011)..

Despite the fact that various research on soil and water conservation have been undertaken in Ethiopia, a significant portion of the country's soil and water conservation challenges remain unexplored. The researchers focused primarily on the nature of soil and water conservation, farmers' perceptions of soil and water conservation, and farmers' perceptions of soil fertility and the causes of soil erosion (Shibru, 2010). They discovered that soil erosion is widespread throughout Ethiopia, particularly in the highlands. The East wollega zones, including certain selected kebeles from Kiramuworeda, are one of the country's most eroded locations, with the investigator failing to examine farmers' awareness of soil and water conservation (SWC) measures.

This demonstrates that the effectiveness of SWC is still in question; thus, the purpose of this proposal is to evaluate the effectiveness of SWC in a few selected kebeles of Kiramuworeda in order to determine the true impact of SWC on the community level of biophysical practices of soil and water conservation techniques, and to draw conclusions for future improvements in soil and water conservation implementation in improving soil for better land productivity, erosion control, and land conservation. In Kiramuworeda, these activities have been done for at least the sixth round. However, no research has been conducted to determine whether the procedures are effective. Although there is a gap on the issue of social, economic, and institutional factors that determine the effectiveness of biophysical soil and water conservation practices, there is a gap on the issue of social, economic, and institutional factors that determine the effectiveness of biophysical soil and water conservation practices. This study examined the effectiveness of biophysical SWC methods in Kiramuworeda of Oromia Regional State's East Wollega zones in order to close the gap mentioned.

METHOD

Description of study area

Kiramuworedas is part of the East Wollega Zone, western Oromia regional state, Ethiopia. It is situated at 9º16’North latitude, 36º 34’ East longitude bounded by Abe Dongoro in the north, Amhara Region in the south, Amuru Woreda in the east and Gida Ayana Woreda in the west .The capital of the Woreda is Kiramu Town which is located at 471 km distance in the west of Finfinne and 140 km from Nekemte City. In 2007 the projected population was estimated to be for this woreda of 94,231 and 10.58% of its population are urban dwellers and 89.42% are Rural. The area characterized by annual rain fall from 1500-1800 mm per year. The mean annual temperature is 15-19 degree Celsius and maximum temperature of 28 degree Celsius and Farming system is predominantly mixed with livestock keeping

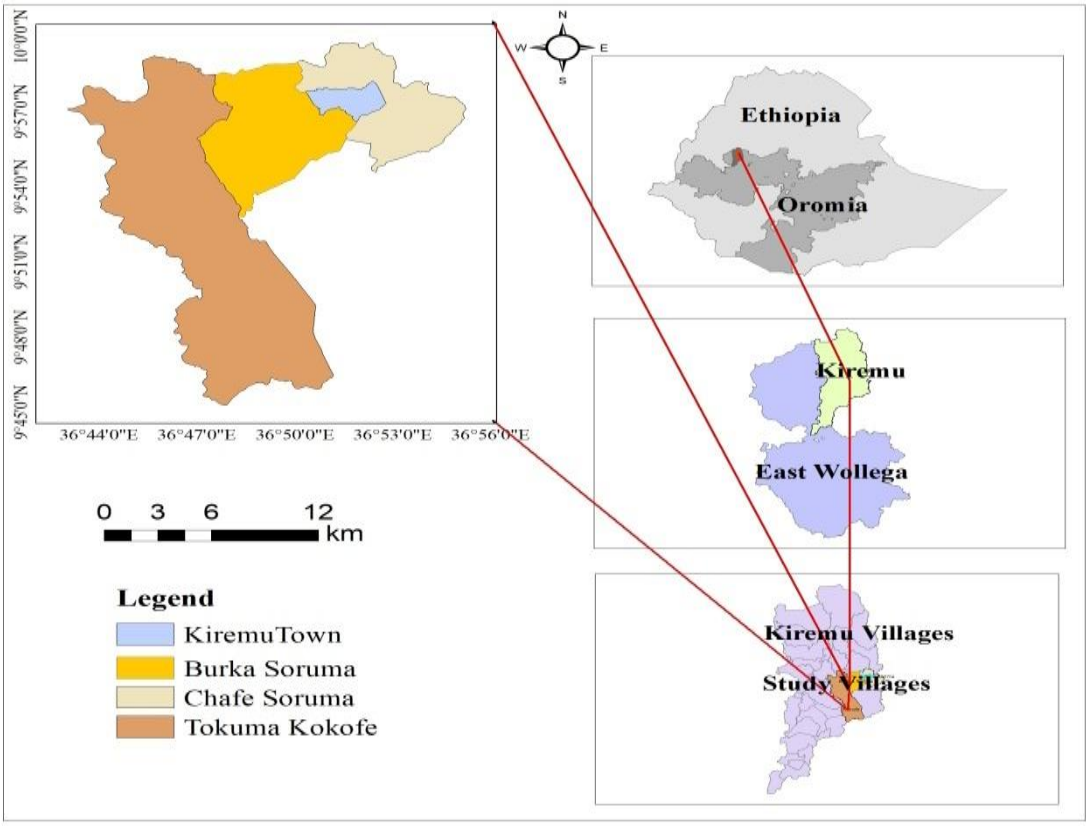

Figure.1 Map of study area

Data sources and sampling

The study employed a descriptive survey research approach. This strategy was chosen because it can assist researchers in gathering as much current and detailed information as possible on the topic at hand, as well as dealing with a big number of respondents at one time. Data was collected using two sources: primary and secondary. Questionnaire was used to collect data from farmers, agriculture and NRM office of woreda and kebeles manager and using interview information was obtained from agricultural principals, das supervisors, zone and woreda agriculture and NRM office heads for the primary data. In addition, personal observation of the researchers also was serving as supplement to primary data. Besides these, different relevant documents were used as secondary sources including annual and field reports from agricultural office.

Sample Kebeles was drawn from the Woreda using random sampling technique depending on land degradation severity, SWC practices adoption and difficulty in nature of topography. Respondents (farmers, kebeles managers, DAs) were selected from each kebeles proportionally using simple random sampling technique. Moreover, purposeful sampling technique was used to DAs supervisors, principals, Zone and Woredas agricultural office heads with the assumptions that relevant information was obtained from them. Sampling technique was used to select the representative sample from the total population under the study and from the total household heads of the three kebeles of the woreda. The Woreda has 19 kebeles; from these purposively the three kebeleswere selected. The kebeles were namely, TokummaKofcafe, BurqaSoruma and Cafe Soruma. They consists 323, 433 and 939 household heads respectively. The total household heads living in these three kebeles were 1695 The sample of household's heads from each kebeles has been taken by applying the Kothari (2004), with 95% confidence level, with the assumption of 5% standard error. In addition to this seven key informants and six Focus group discussion participants were selected purposively due to the fact that to provide adequate data on the issue under the study.

Formula of the Sample Size

Where,
N=size of household heads of KiramuWoreda
n = sample size
e = acceptable error (the precision error 0.08)
p = standard deviation of population (0.5)
Z = standard variant at a given confidence level (1.96)
q=1-p

Accordingly, 138 household heads respondents from the three sample kebeles were used in this study (Table 1)

Table 1. Sample size of household heads

Kebeles	Number of households Kebeles	Number of household selected
Café soruma	939	76
Burka Soruma	433	36
T. Kofcafe	323	26
	1695	138

Source: Primary data, 2020

Table 2. Sample size of the key informant interview and focused group discussion

Group	No of Key Informant Interviewee	No of Focused Group Participant	Sampling Technique
Development Agent	1	-	Purposive
Elderly Farmers	2	2	Purposive
Religious Leader	3	2	Purposive
WoredaNaRM Head	1	-	Purposive
Village Leader	-	1	Purposive
Total	7	5	Purposive

Source: Primary data, 2020

Methods of data Analysis

Both qualitative and quantitative data analysis methodologies were used in this investigation. The qualitative approaches of description, narrative, and interpretation of facts are utilized to examine responses acquired from surveys and semi-structured interviews using a quantitative technique. Using information gathered through field observation and Focus Group Discussion, a qualitative method was utilized to describe the farmers' attitudes regarding soil and water conservation structures in relation to physical and socio-economic conditions in the research area. Finally, tables were used to support the analyses.

RESULTS AND DISCUSSION

3.1 Farmers' family profiles, land holding and occupations

Table 3. Total household, average family size and age structure

S.N	Kebeles	Total No. HH Heads			Average Family size of sampled HH		Age Structure of the family		
		Male (%)	Female (%)	<20(%)		<20(%)	21-30 %	41-60 %	>60 %
1	Burka Soruma	35(97.2%)	1(2.8%)	36(100%)	9	1(2.8%)	19(52.8%)	8(22.2%)	8(22.2%)
2	Cafe Soruma	64(84.2%)	12(15.8%)	76(100%)	19	17(22.4%)	43(56.6%)	4(5.3%)	12(15.8%)
3	T/Kofcafe	25(96.2%)	1(3.8%)	26(100%)	6.5	0(0%)	13(50%)	11(42.3%)	2(7.7%)
Over all Total		124 (89.9%)	14 (10.1%)	138(100%)	11.5	18(13%)	75(54.3%)	23 (16.7%)	22(15.9%)

Source: Field Survey, 2020

There were 138 household heads living in the KiramuWoreda from which the sample was taken, with 124 (89.9%) being males and 14 (10.1%) being females. The sampled households had a total population of 150 people (including seven key informant interviews and five focus group sessions). 54.3 percent of the household heads were under the age of 30 and 16.7% were above the age of 41. These findings suggest that the research area is characterized by a high reliance ratio, primarily among people under the age of 30 (Table 3).

According to a study by Shibiru (2010), the large number of children compared to adults indicates that there will be increasing demand for land in the future, and given the limited arable land and lack of employment opportunities in other sectors, the pressure on land resources may become much more severe. According to the farmers interviewed, the huge growth in population in the study area produced a slew of issues. However, population growth can be beneficial, as scholars Aklilu and Graaff (2004) found in their study that increased the value of land relative to labor, causing farmers to make labor-intensive investments in land improvement and soil management, such as planting trees, constructing terraces, composting, and mulching. Over half of the respondents (47.1%) had no formal education, while 13 percent could read and write, 23.9 percent had completed primary school, and 13 percent had completed secondary school, with only 2.9 percent of the respondents having a higher education level (Table 4).

Table 4. Farmer's educational level of household

S.N	kebele	Educational Levels of HH Heads				
		I (in %)	II (in %)	III (in %)	IV (in %)	VI(in %)
1	Burka Soruma	16(44.4%)	4(11.1%)	8(22.2%)	7(19.4%)	1(2.8%)
2	Cafe Soruma	36(47.4%)	13(17.1%)	22(28.9%)	4(5.3%)	1(1.3%)
3	T/ Kofcafe	13(50%)	1(3.8%)	3(11.5%)	7(26.9%)	2(7.7%)
Over all Total		65(47.1%)	18(13%)	33(23.9%)	18(13%)	4(2.9%)

Source: Field Survey, 2020

Key: HH=House Hold I=can't read and write II=Read and Write III=Elementary School I V=Secondary School VI=Tertiary and above

Almost all of the farmers interviewed (97.2%) owned land, with only 2.8 percent relying on contract land and non-agricultural businesses (mostly natural resource-based industries such as charcoal manufacture from wild forests) as their sole source of income. The average size of a land holding was roughly 1.1 hectare (Table 5). Using the average household size and average land holdings of the sample households, the per capita holding was 0.2 hectare, agreeing with Benjamin et al. (2007), who found that average land holdings in Ethiopia decreased from 0.5 hectare per person in 1960 to 0.11 hectare per person in 1999. The size of land holdings among householders varies significantly. The majority of the studied households (47.1%) had less than one hectare of land. In table 5, only 2.9 percent have more than four hectares, whereas 13 percent had 1-2 hectares.

Table 5. Landholding size of the households

S.N	kebele	Land holding size of HH Heads				
		< 1 ha	1-2 ha	2-3 ha	3-4 ha	>4 ha
1	Burka Soruma	16(44.4%)	4(11.1%)	8(22.2%)	7(19.4%)	1(2.8%)
2	Cafe Soruma	36(47.4%)	13(17.1%)	22(28.9%)	4(5.3%)	1(1.3%)
3	T/Kofcafe	13(50%)	1(3.8%)	3(11.5%)	7(26.9%)	2(7.7%)
Over all Total		65(47.1%)	18(13%)	33(23.9%)	18(13%)	4(2.9%)

Source: Field Survey, 2020

In the research area, the majority of farmers practiced mixed farming (90.6%), with only 8.7% relying only on crop production and 0.7 percent relying solely on livestock production (Table 6). According to the report of interviewed respondents, livestock are the most important element for the life of the people in the research region, as in all other parts of the Ethiopian highlands, to play a complex function in smallholder mixed systems, which is similar to the finding of Assefa (2009). According to the reports of the interviewed households, livestock are not only used to cultivate land (oxen for ploughing), but also to produce meat and milk, manure for fertility, and as a store of wealth, as a saving method that serves as an economic buffer in times of crop failure and economic crisis, and as a supportive enterprise for crop production used during emergency times, where the farmer can sell his or her livestock at local markets whenever he or she wants.

Table 6. Economic activities of the household heads

S.N	Economic Activities		Burka Soruma	Cafe Soruma	T/Kofcafe	Over all Total
1	Agricultural Activities	Cropping only	4(11.1%)	1(1.3%)	7(26.9%)	12(8.7%)
		Live stock only	1(2.8%)	0 0	0 0	1(0.7%)
		Both	31(86.1%)	75(98.7%)	19(73.1%)	125(90.6%)
		Total	36(100%)	76(100%)	25(100%)	138(100%)
2	Non-agricultural Activities	Off-farm Activities	8(22.2%)	3(3.9%)	2(7.7%)	13(33.8%)

Source: Field Survey, 2020

Off-farm employment is a significant source of income for some farmers in the study area, accounting for 33.8 percent of total income (Table 6). Off-farm work in the kiramuWoreda mostly consisted of exploiting natural resources (charcoal production for market and selling firewood) as well as other occupations such as butchering, guarding, and small-scale trading for those living closer to kiramu town. As a result, they are unconcerned with soil and water conservation because their livelihood is derived in part from non-agricultural activities, according to a study by Bekele and Drake (2003). Furthermore, dual-income farmers do not participate in community-based soil conservation initiatives. These people, according to the respondents, are unaware of agricultural activities in general, and soil and water conservation in particular. However, because of factors such as the small amount of their agricultural property, poor level of productivity, and severity of soil erosion, a small fraction of those who practice off-farm economy supported off-farm activities.

3.2 Assessment of soil and water conservation structures

3.2.1. Situation of soil and water conservation practices of the study area

Traditional approaches are commonly seen conserving constructions. Modern conservation structures are primarily built on vulnerable soils outside of cultivated and grazing grounds (i.e., locally known as 'daagaa' (modern soil conservation structure), which was implemented through a government campaign). Farmers were also opposed to adopting SWC structures, according to a report from the woreda's Agriculture and Rural Development Department, since they believed the structures would consume their fields.

3.2.2. Assessment of farmers' participation on soil and water conservation practices

The majority of farmers in the research area (77.5%) feel erosion can be controlled, while only 22.5 percent say it is impossible. The same number of people were asked how they protect their land from soil erosion catastrophe, and just 70.3 percent responded that they use conservation strategies. These findings revealed that a large percentage of farmers (27.7%) are not conserving their land. Figure 2 depicted the causes for the farmers' incapacity to conserve their land. However, the strategies described are used by 70.3 percent of the total interviewed peoples who are saving their land (Table 7).

Table 7. Farmer's responses on the effectiveness of traditional practices of SWC

S. N	Structures	Kebeles							
		Burka Soruma		Cafe Soruma		T/ Kofcafe		Over all Total	
		Effective	Not Effective	Effective	Not Effective	Effective	Not Effective	Effective	Not Effective
1	Mixed Cropping	31(86.1%)	5(13.9%)	2(2.6%)	74(97.4%)	17(65.4%)	17(65.4%)	2(1.5%)	136(98.5%)
2	Crop Rotation	35(97.2%)	1(2.8%)	71(93.4%)	5(6.6%)	6(23.1%)	6(23.1%)	126(91.3%)	12(8.7%)
3	Afforestation	4(11.1%)	32(88.9%)	5(6.6%)	71(93.4%)	9(34.6%)	9(34.6%)	26(8.8%)	112(81.2%)
4	Fallowing	15(41.7%)	21(58.3%)	1(1.3%)	75(98.7%)	7(26.9%)	7(26.9%)	35(25.4%)	103(74.6%)
5	Contour Plowing	27(75%)	9(25%)	75(98.7%)	1(1.3%)	9(34.6%)	9(34.6%)	119(86.2%)	19(13.8%)
6	Terracing	4(11.1%)	32(88.9%)	2(2.6%)	74(97.4%)	21(80.8%)	21(80.8%)	11(8%)	127(92%)
7	Agro forestry	1(2.8%)	35(97.2%)	2(2.6%)	74(97.4%)	24(92.3%)	24(92.3%)	5(3.7%)	133(96.3%)

Source: Field Survey, 2020

Crop rotation (91.3%), cultivating following the contour (86.2%), fallowing (25.4%), afforestation (8.8%), terracing (8%), and agroforestry (8%) are the most important methods of soil and water conservation in the research region, according to Table 7. (3.7 percent). The method used by the farmers in the research area is only 1.5

percent mixed cropping. This indicates that the expected soil and water conservation strategies in Ethiopia's highlands are being implemented in the research region with varying levels of farmer acceptability, i.e. Crop rotation is the most prevalent strategy, while mixed cropping is used by the least percentage of people; and they are aware of soil erosion management measures on their farm lands to some level. According to a study conducted on farmers in the Amhara region by UNECA in 1996, which was quoted by Assefa (2009), roughly 30% of the families did nothing to tackle erosion problems, while 40% did terracing, 24% planted trees, and 10% erected check dams to control soil erosion.

It is likely that the majority of farmers (91.3 percent) utilize crop rationing because it does not demand additional resources or time in addition to farming land (Table7). However, due to a lack of land, only 25.4 percent of respondents are able to put ideas into effect. Due to a lack of understanding, agroforestry, which allows the cultivation of multiple crops on a plot of land with trees and grassland, is not considered a soil conservation strategy.

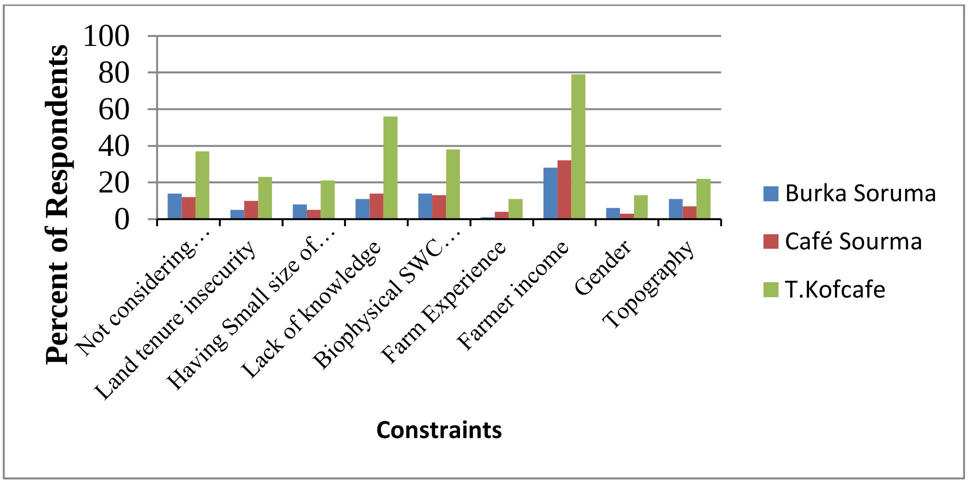

Figure 2. Factors affecting farmer's acceptance and adaptations of biophysical SWC structure (Source: Field Survey, 2020)

As shown in Figure 2, the majority of farmers in the research area (79 percent) believed that a lack of capital is the primary reason for their failure to protect their land, followed by a lack of knowledge (56 percent). Similarly, 38% of respondents stated Biophysical SWC demands too much labor, while only 37% said Erosion is not a problem, 13% said gender was a factor, and 11% said farm experience was a factor. According to the respondents, garnering community participation in soil and water conservation measures was difficult because most farmers in the area are striving to make ends meet on a daily basis. Farmers are sometimes aware that some of their actions are harming the land, but the immediate benefits of these actions appear to be more important than long-term degradation, which is similar to the perception of Tigray farmers by WoldeMekuriaet al. (2009), who believe that they have a good understanding of the causes for their inability to protect their land from soil erosion devastations.

4.3. Biophysical and Socio-economic Factors of Soil and Water Conservation Structures

Almost all of the farmers polled (98.5 percent) saw soil erosion as a problem that hampered crop output on their field. To determine how people perceive each factor, causes of soil erosion are presented to them in the form of physical and socioeconomic elements (Table 8 and 9 respectively). Farmers' perceptions may differ due to differences in soil cultivation methods, plot gradient, land ownership structure, and land size, as well as other socio-economic differences between households in the same kebele and different kebeles.

Farmer perceptions of biophysical elements impacting soil erosion differ among questioned households, as seen in Table 8. Most farmers in Burka Soruma Kebele believe that lack of vegetation cover and their land are the most determinant physical causes of soil erosion (66.7 percent), while expansion of overgrazing land and more rain fall are the least determinant physical causes (2.8 percent) and (2.8 percent), respectively. Runoff (8.3%) and steep slopes contribute 19.4 percent, according to the perceptions of the respondents in this kebele. This is most likely due to the area's relief structure, which is steeper than the slopes of CaffeSoruma and T.Cofcafe.

Table 8. Farmer's perception of Biophysical factors affecting soil erosion

S.N	Causes	Kebele			
		Burka Soruma	Cafe Soruma	T/ Kofcafe	Percentage of farmers
1	Lack of vegetation covers	24(66.7%)	12(15.8%)	11(42.3%)	47(34.1%)
2	Runoff/Flood	3(8.3%)	47(61.8%)	5(19.3%)	55(39.9%)
3	Expansion of Grazing land	1(2.8%)	13(17.1%)	5(19.3%)	19(13.8%)
4	More Rain/Heavy Rain	1(2.8%)	4(5.3%)	4(15.4%)	9(6.5%)
5	Steep Slopes	7(19.4%)	0	1(3.8%)	8(5.8%)
Over all Total		36(100%)	76(100%)	26(100%)	138(100%)

Source: Field Survey, 2020

Sheet and splash erosion are more common on steep slopes than on gentler slopes. During a field survey in this location, this problem was discovered. Farmers in CaffeSoruma, on the other hand, saw flood (61.8 percent) as the primary source of soil erosion, followed by grazing land (17.1%), vegetation cover (15.8%), more rain (5.3 percent), and no more steep slope. This is supported by field observations, which show that erosion features such as rills and gullies are more abundant in Burka Soruma than in Cafe Soruma and T.Kofcafe. Farmers in Sierra Leone have linked deforestation, heavy rainfall, steep slopes, overcultivation, and overgrazing to the erosion problem on their land (Shibru, 2010,Azene, 1997 and Assefa, 2009).

According to farmer remarks, soil erosion is most problematic during the start of the rainy season, when ploughed fields are devoid of vegetation cover. Cropping grains, particularly teff, exacerbates the problem because cropland requires repeated ploughing (severe pulverization) before sowing and is bare when the rains arrive. This is comparable to what Sterk (2002) discovered in the Chemoga watershed.

Rapid population growth is the most perceived socio-economic driver of soil erosion in all examined areas, as shown in Table 9. It came in first with 29% of the vote, followed by a shortage of fertilizers (23.2 percent). Population growth, according to the majority of respondents, increases land demand and adds to farming on steep and fragile soils, while land fragmentation causes erosion difficulties. Other socio-economic issues ranked by farmers in the study area include land tenure system (14.5%), lack of knowledge (awareness) (22.5%), and distance from farm land (10.9%), which is similar to an FAO study from 2003 (Shibru, 2010).

Table 9. Farmer's rank on socio-economic causes of soil erosion

S. N	Expected Socio-economic causes of soil erosion	Farmers' rank in Percentage				
		Burka Soruma	CaffeSoruma	T/ Kofcafe	Percentage of farmers	Rank
1	proximity to farm land	1(2.8%)	12(15.8%)	1(2.8%)	15(10.9%)	5th
2	land tenure system	9(25%)	11(14.5%)	0	20(14.5%)	4th
3	lack of fertilizers	2(5.6%)	22(29.8	8(30.8%)	32(23.2%)	2nd
4	lack of awareness/education	12(33.3%)	10(13.2%)	9(43.6%)	31(22.5%)	3rd
5	increased cultivated area due to population growth	12(33.3%)	21(27.6%)	7(26.9%)	40(29%)	1st
Over all Total		36(100%)	76(100%)	26(100%)	138(100%)	

Source: Field Survey, 2020

The main reason for deforestation in this study area is dependency on charcoal production for the markets as the source of their livelihood and as the off-farm employment according to the respondents. Furthermore, forests are used as the source of domestic energy used during night, since electrification and other social services were highly limited. Social grazing land along mountain sides are used by the people without any care and conservation since it is considered as common property. The best example for this is the steep sides of Cafe Soruma Kebele where the people of the surrounding areas have been using as common grazing land.

4.3.1. Assessment of Indicators and Severity of Soil Erosion on the Farm Land

Even if all farmers recognize the problem of soil erosion on their land, their perceptions of its severity vary greatly among the kebeles assessed. This could be owing to the variety of causes impacting soil erosion, as well as their intensity. The socio-economic state of the farmers in all examined areas is more or less similar, but there are some physical feature variances, as revealed in the information regarding Farmers' Household profiles, land holdings, and vocations. As a result, the investigator opted to look at the farmers' perceptions of the severity of soil erosion on their farmland based on their various kebeles.

As shown in Figure 3, T.Kofcafekebele was the most severely damaged area of the Woreda, with the majority of farmers reporting severe soil erosion (26.9%), moderate soil erosion (61.5%), mild soil erosion (11.5%), and no respondents being uncertain. In Caffesoruma, 13.2% said severe, 82.9 percent said moderate, and 3.9 percent said low, with no one saying they were undecided. Only 11.1 percent of respondents in Burka Soruma, where the land slope is somewhat gentler, reported severe, while more than half of the respondents (86.1 percent) described the severity as moderate, and 2.8 percent said low. It is feasible to determine how the steepness of the terrain influences farmers' perceptions of the severity of soil erosion using this data. Regardless of their gentle slope of land, Study kebeles' farmers have a good awareness of the severity of soil erosion. Because no one indicated the severity was still up in the air. The differences in farmer perceptions observed in the study area have a close link with other researchers' findings (Benjamin et al., 2007, Akliluet al., 2007).

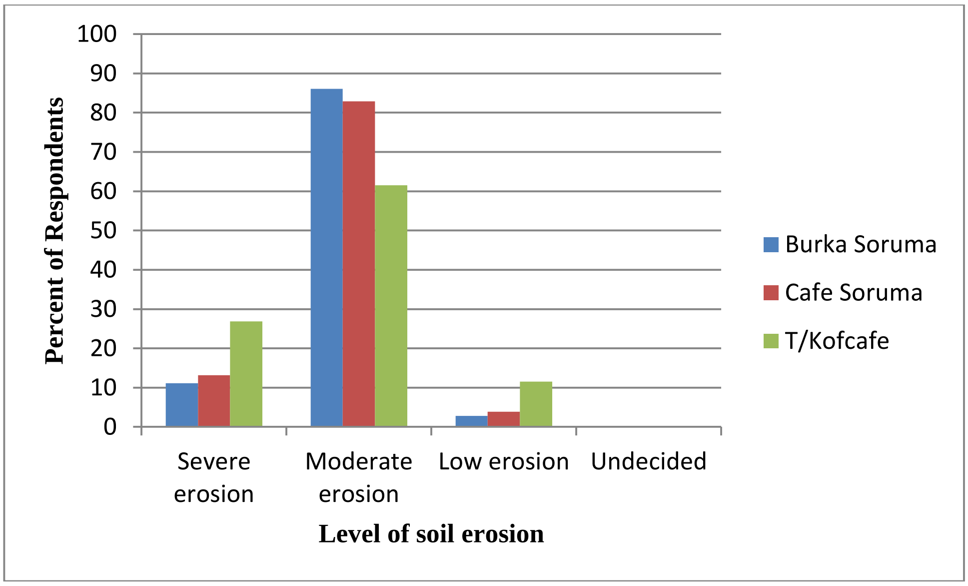

Figure3 Farmer's perception on the severity of soil erosion on the farm land
Source: Field survey, 2020

Table 12 shows the results of the assessment of indicators of soil erosion on agriculture. As a result, 81.2 percent of respondents strongly agreed that a decrease in crop output indicates the presence of soil erosion on their farmland, whereas 1.4 percent were undecided. The influence of soil erosion on agricultural yield output was disputed by 1.4 percent and highly disputed by 0.7 percent of respondents, respectively. Farmers realized that the pace of soil loss and the level of soil fertility were related, according to Shibiru (2010), which determined the crop production potential in every landscape position. 44.2 percent of respondents highly agreed that soil color change as an indicator of soil erosion, whereas 46.4 percent agreed, 4.3 percent uncertain, 2.2 percent disagreed, and 2.9 strongly disagreed with soil color change as an indicator of soil erosion from black to red hue. The majority of farmers strongly agreed that the formation of small depressions (rills) as an indicator of soil erosion (33.3 percent) and 50.7 percent disagreed, respectively, while only 12.3 percent and 3.6 percent were undecided and disagreed. Surprisingly, most farmers regard gully formation as a signal, with 33.3 percent very agreeing, 39.9% agreeing, 11.6 percent unsure, 10.9% disagreeing, and 4.3 percent strongly disagreeing that gully formation is an indicator of the presence of soil erosion on their holdings. It can be deduced from these comments that farmers have a positive impression of soil erosion indicators as a problem that restricts soil productivity. Surprisingly, most farmers saw weed presence or absence as a signal, with 52.2 percent very agreeing, 32.6 percent agreeing, 3.6 percent unsure, 5.8% disagreeing, and 5.8% strongly disagreeing that gully development is an indicator of soil erosion on their properties. This finding was in line with Bekele and Drake's 2003 investigation.

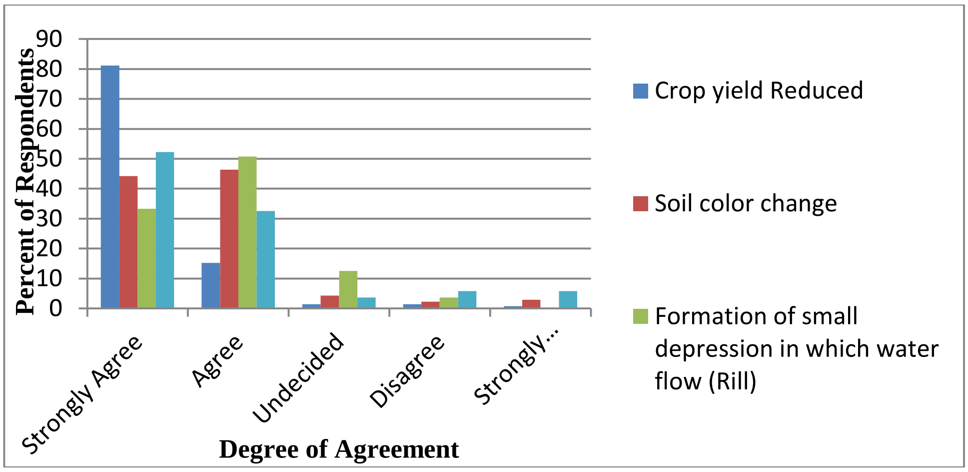

Figure 4 Farmers' perception on indicators of Soil erosion
Source: Field Survey, 2020

Figure 5 Farmers' perceptions of soil loss along different slope positions based on the Young's classification are shown in Figure 5. As a result, the majority of farmers considered steep and extremely steep slopes to be landscape segments with a significant risk of soil erosion and low soil fertility, resulting in low crop yields. Soil erosion is very high at very steep gradients, according to 76.1 percent, high at this position, 23.9 percent, and no one says moderate or low. 2.9 percent of respondents indicated the soil level is extremely high on a steep slope, while 86.2 percent said high, 10.1 percent said moderate, and 0.7 percent said low. Gentle slopes obviously graded reasonably, with very high soil loss (1.4 percent), high soil loss (5.1 percent), moderate soil loss (76.8%), and only 16.7% believing the severity of soil loss is extremely high at the moderate slope position. Surprisingly, even at a fairly steep angle, one experiences little soil loss. This could indicate that soil erosion has a significant impact on the research area's economic and environmental conditions, and that farmers are able to recognize the circumstance that signals the presence of soil erosion and its severity at various slope positions.

Farmers also have a strong understanding of how slope affects soil erosion. The farmers' account corresponded to scientific knowledge, which recognizes the impact of slope steepness on soil erosion. Farmers' knowledge is also consistent with Steiner's (1998) findings, as stated by Woldemekuriaet al., (2009), that farmers correlate slope position with soil suitability. Shallower soils prevailed on steeper slopes, but fine textured soils dominated on plateau and foot slopes, signifying high fertility soils. According to Chomba (2006), the level of soil fertility on flat ground is very high when compared to the other slope degrees. Farmers with fertile soils may not notice the short-term consequences of erosion on their plots.

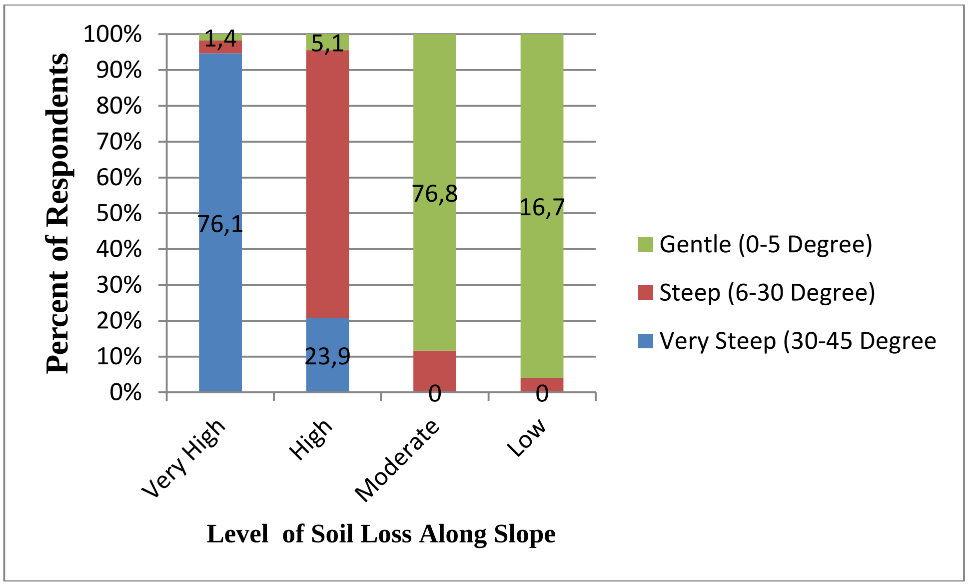

Figure 5 Levels of Soil Loss along Different Slope Position
Source: Field Survey, 2020

4.3.2. Trends of Soil Erosion and its Effects on Farmers Living Conditions

Over the previous ten years, farmers' perceptions of soil erosion and its effects on crop output have been depicted in Figure 6. Because respondents over 35 years old were asked to explain 10-year trends, respondents over 35 years old were interviewed for this reason. The goal of this interview was to learn how to analyze the state of soil erosion over time and how soil erosion has impacted crops. All farmers (100%) believe that the rate of erosion is excessively increasing with time. Figure 6 also shows an analysis of the effects of soil erosion on agricultural yield during the last ten years. Crop yield has been declining too much from time to time, according to all of the farmers (100%). No one believes that their output will increase or remain steady over the next ten years. Farmers were invited to discuss the effects of soil erosion on their living conditions and socio-economic indicators in a focused group discussion. Many of them expressed concern that their living conditions are deteriorating as a result of decreased production caused by soil erosion. Crop production, primarily teff, wheat, and barley, was previously a source of income in addition to domestic consumption. But, even without a source of income, they claim that it is no longer enough to feed their children. Furthermore, due to the complexities of the rural agricultural situation's environmental and socio-economic challenges, some of them are proposing to convert their means of livelihood to non-agricultural industries. Various scientific investigations can confirm this conclusion. Soil erosion is a major cause of poverty in rural parts of developing countries, according to Moges and Holden (2006). Farm income has decreased in several locations, affecting farming populations. Reduced crop output is the immediate result of soil degradation, followed by economic decline and social suffering.

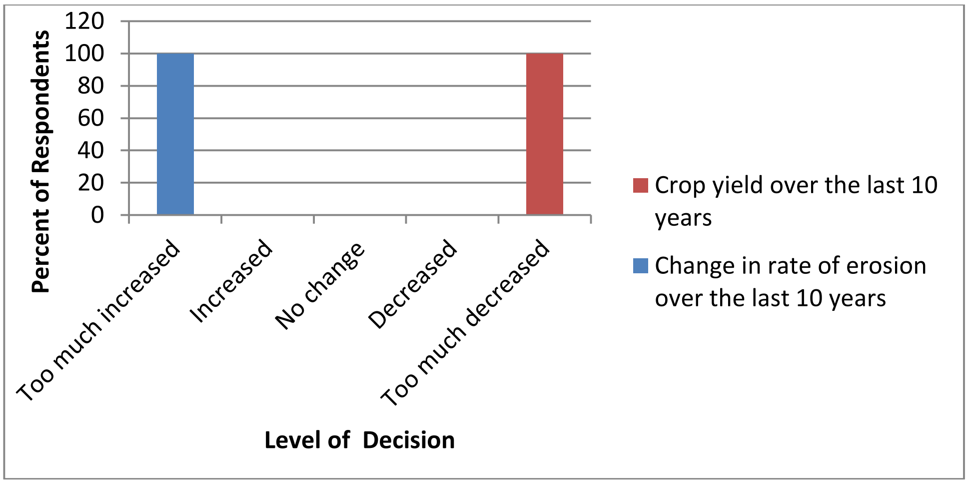

Figure 6 Farmer's perception on Trends of Soil Erosion and its Effects on Crop Production over the last 10 years

Source: Field Survey, 2020

4.4. Farmers' acceptance and adoption of biophysical soil and water conservation structures

The majority of the farmers saw the structures as crucial (93.5 percent). Only 6.5 percent of the respondents had previously attended a SWC structure demonstration, field day, or workshop. Table 10 shows that all of the respondents (100%) agreed that the structures are effective at controlling soil erosion. Similarly, over half of the respondents (98.6%) believe the newly SWC structures have the potential to increase land productivity. Nonetheless, recognition of the structures as effective soil loss control techniques with the potential to boost land productivity cannot justify their use on farms. While acceptance is more dependent on the structure's form and qualities as they relate to effectiveness, farm-level adoption is also influenced by a number of socio-economic and institutional factors. As a result, farmers who installed conservation structures in their plots were asked how they assess the efficiency of SWC structures. They stated how they saw improved crop growth and development, particularly around structures where fertile sediments were confined. They also determined that the amount of sediment caught by the structure is significant, and that this material would be removed from the area if the conservation structure were not constructed. Farmers were also questioned about their future plans for using the SWC structures that had been installed (Table 10).

Almost 80% of the respondents showed a desire in keeping the existing structures in place. Furthermore, when asked if they would like to apply the SWC structures to the rest of their agricultural fields (plots that had not been treated at the time), nearly all of the farmers (98.6%) said they planned to do so. They were asked whether they should be paid for constructing and maintaining the SWC structures on their farm to gauge their opinions toward government assistance. "No" was the overwhelming response (100 percent). This demonstrated that farmers could build conservation buildings with the help of a technical organization. As a result, perhaps, they recognized their responsibilities to safeguard their land from soil erosion by erecting SWC buildings.

Table 10. Indicators of Farmers' acceptance and adoption of Biophysical SWC structures

S.N	Indicators of acceptance and adoption	Percentage	
		Yes	No
1	Indicators of acceptance		
	a. Are the newly introduced Biophysical SWC structures effective in arresting soil erosion?	138(100%	0
	b.Do you believe that the new Biophysical SWC structures have the potential to improve land productivity?	136(98.6)	2(1.4%)
2	Indicators of Adoption		
	a. Do you have planned to maintain the constructed Biophysical structures?	105(76.1%)	33(23.9%)
	b. Do you have planned to implement the new Biophysical structures in the rest of your plots currently untreated?	136(98.6)	2(1.4)
	c. Do you believe that Biophysical SWC is farmers' responsibility?	72(52%)	66(48%)
	d. Should farmers be paid for constructing and maintaining Biophysical SWC in their farms?	0	138(100%)

Source: Field Survey, 2020

During a focused group discussion, the state of indigenous soil and water conservation technologies, as well as their effectiveness when compared to recently introduced soil and water conservation (SWC) structures, was discussed. The existence of traditional ways was agreed upon by the groups. However, they accepted both as effective in comparison, although their applications do not occur at the same time.

They claimed that traditional methods, such as contour plowing in conjunction with cut-off drain, had been quite effective on farm areas up until now. However, they are putting the newly introduced structures (terracing along steep mountainous areas) into practice through a campaign and government subsidy primarily along expertly designed areas (not on their farm land) because the structure consumes farm land and the benefits appear to be less to them. They described terracing construction as a government strategy for rehabilitating degraded land, rather than only soil and water conservation practices, which they are implementing alone through the campaign. Those who built in the remote mountainous locations knew this. This suggests that farmers misunderstood the importance of the newly introduced SWC buildings and were only willing to build on extremely degraded regions as a means of rehabilitation rather than on their farmland.

4.4.1. Factors Affecting Farmers Acceptance and Adoption of Biophysical Soil and Water

Conservation Structures

Various variables influenced farmers' acceptance and adoption of soil and water conservation structures in Kiramuworeda. Farmers identified the following factors as the most important: not considering erosion as a problem (37 percent), Biophysical SWC requires too much labor to implement (38 percent), Farmer income (79 percent), Lack of knowledge (56 percent), and Small size of crop land (21 percent), Land tenure insecurity (23 percent), and Topography (22 percent). Lack of time to execute; a focus on day-to-day survival rather than the long-term sustainability of their property; a lack of financial and material support; and frustrations with local authorities are among them. Only 13% and 11% of respondents, respectively, believe that gender and farm experiences are preventing them from implementing conservation techniques. The most important factor is farmer income, which they fear is at risk if conservation practices are not implemented. According to the findings of Assefa (2009), one household in the Debre-Wami watershed near Lake Tana possessed up to six plots of agriculture within the small total farm size. This fragmentation has its own set of problems when it comes to putting in place soil and water conservation infrastructure.

Table 11. The major constraints of farmers have to apply SWC Structures on their farml and

S.N	Factors Hindering	Kebele			
		Burka Soruma	Cafe Soruma	T/ Kofcafe	Percentage of farmers
1	Not considering Erosion as problem	5(14%)	9(12%)	3(11%)	17(37%)
2	Land tenure insecurity	2(5 %)	8(10%)	2(8%)	12(23%)
3	Having Small size of crop land	3(8%)	4(5%)	2(8%)	9(21%)
4	Lack of knowledge	4(11%)	11(14%)	8(31%)	23(56%)
5	Biophysical SWC requires too much labor	5(14%)	10(13%)	3(11%)	18(38%)
6	Farm Experience	1(3%)	3(4%)	1(4%)	5(11%)
7	Farmer income	10(28%)	24(32%)	5(19%)	39(79%)
8	Gender	2(6%)	2(3%)	1(4%)	5(13%)
9	Topography	4(11%)	5(7%)	1(4%)	10(22%)

Over all Total	36(100%)	76(100%)	26(100%)	138(100%)

Source: Field Survey, 2020

Construction of terraces or bunds on these small farmlands, as farmers remarked throughout the conversation, is seen as adding additional difficulty because it consumes their plot of land. Physical constructions should not be built on relative small croplands, according to farmers.

About 11% of those surveyed said they had had farm experiences. 95 percent of those surveyed said farm experiences had a negative impact on their comments. Experienced farmers, they claim, are averse to accepting and using newly proposed SWC Structures. Furthermore, they stated that farmers in areas with severe soil erosion are more willing to accept and use newly introduced SWC structures than farmers in areas with less severe soil erosion. Farm size and education have an impact on acceptance and adoption; for example, farmers with tiny plots of land are less likely to use conservation structures. As a result, the severity of soil erosion and the size of the farm impact farmers' willingness to accept and use SWC structures.

The investigator spoke with T.Kofcafekebele's DA about this matter. Of course, they verified that this topic had received little attention. They further stated that the office established technology-application strategies based on regional government strategies. Farmers are aware of the structures, but few in the kebele are willing to adopt them, according to the experts. As a result, they adopt coercive techniques to entice them to participate. They are also opposed to the development of conservation measures because they believe that the structures take up too much land.

However, some research findings go into greater detail on this. Farmers, for example, have highly specific criteria for separating different classes of farm-types for land management, according to Okoba and Graff (2004). Their criteria are based on individual land management attitudes and actions. These criteria differ significantly from those used by scientists and agricultural extension agents in rural communities during participatory assessments. Furthermore, this situation reflects a problem with the structures' suitability for farmers' needs and the farming system's circumstances, which is partly a reflection of a fault with the method taken in the structure's planning and execution. Even while it was claimed that participatory procedures were followed, the facts on the ground did not appear to back up this claim. In dealing with the soil erosion problem, for example, farmers' long-held knowledge and preferences were disregarded. As a result, persuasion rather than coercion appears to be the superior option. If progress in limiting soil erosion is to be made, cooperation and participation are required. Conservation projects in Ethiopia, according to Yohannes and Herweg (2000), reported by Gizawet al. (2009), focused on coercive tactics and worked badly.

Smallholder farmers on the hill slopes are still grappling with how to balance land management interventions with the current level of land degradation in order to satisfy both immediate economic goals and long-term environmental goals. Farmers were also asked to indicate what should be done to increase the effectiveness of SWC structures during personal interviews.

To begin with, most farmers lack the materials necessary to manufacture SWC instruments. Although farmers are aware of the problem of soil erosion, they require material assistance from the government; second, technical assistance from experts to design the SWC structures; third, continuous training and experience sharing, as well as incentives, should be provided for the community to understand and implement the new SWC structures; and fourth, the farmers, in collaboration with the government, should provide the ground rules and responsibilities for the conservation and maintenance of the SWC structures.

Following this research, we propose the following recommendations: ways to expanding SWC structures should not be top-down, forceful, and should rely on farmers' indigenous knowledge. To prevent degradation and restore the productivity of degraded land, sustainable and participatory soil and water conservation systems must be built. It's critical to raise farmers' understanding of soil erosion indicators as well as the physical state of their land. Natural vegetation and crop wastes are commonly used as fuel in rural and urban areas, posing a significant danger to soil and water conservation. It is preferable if the relevant body intervenes to raise farmers' understanding of the importance of reversing soil erosion problems and adopting alternative livelihoods. Any policy or program aimed at making sustainable use of land resources and providing farmers with training and mobilization.

Alternative fuel sources (electricity, natural gas, etc.) should be provided by the government or non-governmental organizations (NGOs) so that natural vegetation and crop residue can be saved and used for soil and water conservation. Instead of plowing fragmented pieces of land, the government should design a system to start the process of land consolidation, i.e. cultivating continuous pieces of land instead of plowing fragmented pieces of land. It is preferable if the SWC approach is implemented by a group of people rather than by a single person.

CONCLUSIONS

Farmers of the study area were characterized by poor socio-economic conditions due to severe soil erosion (> 90.6% of them depend on only agriculture). According to Farmers' perceptions,causes of soil erosions were the steep slope,Most of the farmers were the steep slope, deforestation,socio economic ,environment and run-off (ie harshness of soil erosion was 26.9% in T.Kofcafe and 11.1% in Burka Soruma kebeles). Most of the farmers argued that trends of soil erosion had direct relation ships to the slope and decrease production of agriculturalist which lead Farmers to non agricultural activities for their livelihood.77.5% of study populations were believed that erosion can be controlled and 93.5% of them were practicing conservation methods.For example, farmers of study population practicing crop rotation (91.3%) ,cultivating along contour in combination with cut-off drain(86.2%),terracing(8%),tree planting (8.8%),and Agro forestry(8%).Even though Farmers well accepted
SWC structures were well-accepted (100%) as SWC practices are valuable ways of impressive soil erosion and have potential to improve land productivity (98.6%),they percieved it as the government strategies to restore the degraded non agricultural land rather than their farm land through campaign.Thus, only 52% of the respondents were practiced on their farm land.have intention to expand the conservation structures on their farm land. The farmers of the study area believed that old methods SWC practice is effective on their farm land rather newly introduced structures due to it comsume large of their farm land,it requires extra work,needs time,lack of economic and materials,distress with local leaders.

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