# STATE OF SOIL CONSERVATION PRACTICES IN SILTI WOREDA, SOUTHERN ETHIOPIA

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***Abstract***

**State of soil conservation practices in Silti Woreda, Southern Ethiopia**

Soil erosion is the major problem of Ethiopian highland areas where an average soil loss of 42tons/ha/year, with rate soil depth loss of more than 2 cm/year, corresponding to 1 to 2 billion US$/year (an amount comparable to the country's annual budget). The higher soil loss has been estimated at Southern Ethiopia where densely settled on highlands. A vast majority of the population derives its livelihood from forest, livestock herding and agriculture. The economic conditions force the rural poor to exploit the environment for their survival. Keeping the importance, the work was conducted in Silti Woreda, Southern Ethiopia, with the objectives; to identify the current status and trend of soil conservation practices, to assess the socio-cultural, economic, biophysical and institutional/policy/support system constraints for the implementation and maintenance of conservation practices. The study reveals, indigenous soil conservation technologies are considered as effective methods of conservation. But, population poverty and unawareness are major constraints.

***Keywords***

Soil conservation, agriculture, backwardness, indigenous method, topography

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## 1. Introduction

Soil is the basic natural resource that directly or indirectly sustains lives of every living creature. The output gained from the soil is the source for economic development of a country. According to FAO (1993) soil of Sub-Saharan areas moderately to agriculture are for the most part, already in use, and efficient use is becoming a matter of life or death for increasing millions of mankind. In satisfying the limitless needs of human beings soil has been started continuously. Some areas are degraded and cannot be productive unless appropriate rehabilitation measures are taken (Tamirie 1995).

The biggest aspiration for the people is to have an adequate diet and livelihood. The resources particularly, soil needed to fulfill these hopes is rapidly shrinking and its productivity is decreasing, inevitably resulting in social disintegration and a climate of conflict and unrest. Unless the livelihood of the rural community increases, it is difficult to reduce degradation of the environment for sustainable utilization (Biswas, 1990). In countries with limited cultivable land and high population growth rates due to soil degradation crop yields have fallen. Nowhere is the lethal interaction of poverty and environment degradation more evident in Ethiopia (Cesen 1986; World Bank 1984). Consequently, about 72% of the total land area of the country falls within the UNEP's definition of desertification.

The problem is extensive in the highlands (above 1500m masl) which comprise 44% of the total land mass, and account for 95% of the crop soil (Heweg and Ludi, 1999). Accommodating about 88% and two-third of the livestock the highlands belong to the areas in Africa with the highest population densities (Kruger et al 1996). It was estimated that soil erosion eroded nearly half of the country's highland areas resulting in soil loss of 1.5 to 2 billion tons/year which is equivalent to 35 tons/ha (Dejene 2003). This corresponds to 1 to 2 billion US$ per annum (an amount comparable to the country's annual budget). Hurni (1993) and Heweg and Stillhardt (1999) estimated that the loss of soil on the highlands might reach annual rates of 200-300 tons/ha/year. Despite the disparities of the estimates, all suggest that the rate of soil degradation in the country is difficult to accept it.

If the trend continues, some 38,000 sq km or about 18% of the highlands of Ethiopia may be eroded down to bare rock by the coming 25 years and further 60,000 sq km will have a soil depth of 10 cm below which the soil would be too shallow to support cropping. About 2 million ha of farmlands are already estimated to be beyond recovery.

Soil loss control measures are needed so that soil can be conserved to be used indefinitely (Larson et al 1987). Soil conservation measures according to Morgan (1979) are related to "changes that man can make to the soil, plant cover and slope of the land, and the effects these have on the mechanics of erosion". To conserve soils, change is needed on the land use, ground cover, land management, soil property, slope length and slope gradient (Hurni 1988).

The practice of soil in study area seems to suffer from a wide range of problems which might be attributed to socio-cultural, economic, and institutional and other related factors. Rather than conserving the soil and water resources in their vicinity to improve the fertility and productivity of their lands, most people prefer to do some other work or to go remote areas or nearby town searching for labor work.

This situation puts under threat the environmental protection of the area in general and the soil practices in particular. Therefore, this study is aimed at investigating the major factors that under mines the sustainable implementation and maintenance of soil practices in Silti woreda[1], Southern Ethiopia.

## 2. Objectives of the study

The main objective of the research is to investigate the major factors that influence the construction and maintenance of soil conservation practices in Silti Woreda, Southern Ethiopia.
The study tries to address the following specific objectives:

1. To identify the current status and trend of soil conservation practices in the study area.
2. To assess the socio-cultural, economic, biophysical and institutional/policy/ support system constraints for the implementation and maintenance of conservation practices
3. To evaluate the performance and identify problems and opportunities in the application of soil and water conservation practices in the study area
4. To draw lessons that might help in the design and implementation of future conservation programs and policy implication.

## 3. Hypotheses

Dominant factors hypothesized to influence the implementation of conservation structures.

1. Age of farmers has a positive or negative effect on the implementation and retention of conservation structures.
2. Education is hypothesized to increase probability that a farmer will construct and maintain soil and water conservation structures.
3. The effect of family size on the conservation practices may be either positive or negative
4. Farm size often related to the wealth of a farmer and is expected to be positively associated with implementation of conservation practices.
5. The slope of a plot is also hypothesized to affect conservation practices.
   Severity of erosion: the higher the severity of erosion on the farmers plots, the higher will be their awareness then they are forced to implement conservation structures. Thus it is hypothesized to have positive relation.

## 4. Research design and methodology

The type of research used in this study was descriptive. Survey method or design of research was utilized in the research. Both quantitative and qualitative approaches of data acquisitions were used to generate data in quantitative and in non-quantitative forms respectively. The study was conducted in Siliti woreda, in Southern Nation, Nationalities and People Regional State (SNNPRS). The woreda was purposely selected due to the fact that the woreda is one of the highly eroded areas in the country. The procedure used for selection of sample kebeles[2] involved purposive sampling method. Agro-ecology, time, cost, accessibility and representativeness of samples were considered in the selection.

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[1] Woreda means District
[2] Kebele is an administrative unit made up of many households and villages like a block

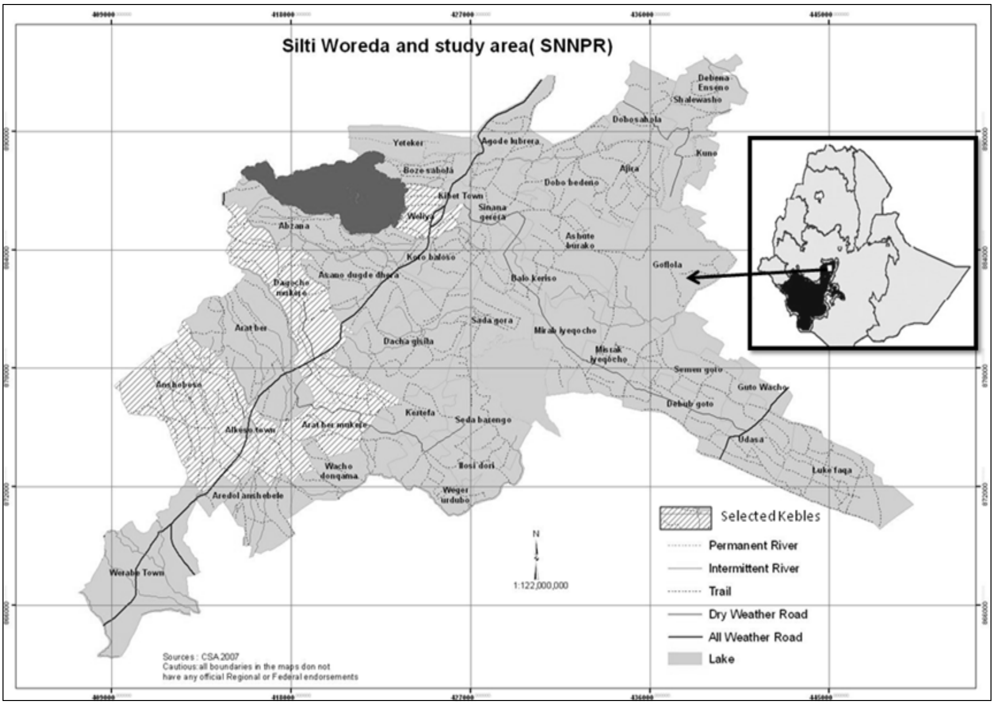


Fig. 1: Location of study area.

4.1 Research type

The type of research used in this study was descriptive. Survey method or design of research was utilized in the research. Both quantitative and qualitative approaches of data acquisitions were used to generate data in quantitative and in non-quantitative forms respectively. All the necessary data required for the study were collected through a sample farm household survey conducted by using questionnaire method from January to February, 2011.

4.2 Sampling techniques

The study was conducted in Siliti Woreda, in Southern Nation, Nationalities and People Regional State (SNNPRS). The woreda was purposely selected due to the fact that the Woreda is one of the highly eroded areas in the country. The procedure used for selection of sample kebeles involved purposive sampling method. Agro-ecology, time, cost, accessibility and representativeness of samples were considered in the selection. Because in the woreda most eroded areas are the highlands, the study focused on those kebeles that lie at elevation above 2000 m (Tab. 1).

From the total 38 rural kebeles of the woreda four highland kebeles were randomly selected as a sample for the study. Following the selection of sample, 120 farm households were purposive selected using list of all farm households available in the selected sample kebeles.

Tab. 1: Sample kebeles and their characteristics.

| No | Kebele | Altitude (m) | Household head population | Total population | Area (ha) | Density /ha |
|---|---|---|---|---|---|---|
| 1 | Aratber Mukere | 2090 | 566 | 5203 | 888 | 5.86 |
| 2 | Danecho Mukere | 2418-3023 | 981 | 9307 | 1477 | 6.30 |
| 3 | Weliya | 2110 | 401 | 3800 | 600 | 6.33 |
| 4 | Anshebeso | 2266 | 864 | 8211 | 1285 | 6.40 |

Source: Woreda Agricultural and Rural Development Office, 2010.

The selection of sample household was proportional to the total number of households of each kebele. Accordingly 24 households from Arat-ber Mukere kebele, 42 from Dancecho Mukere, 17 from Welia and 37 from Anshebeso were selected. Out of the total sample household heads, 99 were males and the remaining 21 were females (Tab. 2).

The total members of the household heads of four kebeles, 2812 farmers were the sampling frame of the study and sampled 120 farmers drawn randomly from the registry of the kebeles, were the sampling units of the study (Tab. 2).

Tab. 2: Share of the sample population.

| Kebele | Total members | | | share of samples | | |
|---|---|---|---|---|---|---|
| | M | F | T | M | F | T |
| Aratber mukere | 384 | 182 | 566 | 19 | 5 | 24 |
| Danecho mukere | 808 | 173 | 981 | 35 | 7 | 42 |
| Welia | 355 | 46 | 401 | 13 | 4 | 17 |
| Anshebeso | 628 | 236 | 864 | 32 | 5 | 37 |
| Total | 2175 | 637 | 2812 | 99 | 21 | 120 |

Source: Woreda Agricultural and Rural Development Office, 2010.

### 4.3 Sources and methods of data collection

Data collection for this study involved both primary and secondary sources. The primary data sources used in this study include questionnaires, focus group discussions, field observation and intensive interviews with sample farmers, and other key informants including zonal and local government officials, development agents and elders. All the necessary data required for the study were collected through a sample farm household survey conducted from January to February, 2011. At the first stage of the survey informal meetings were undertaken with a sampled kebeles' representatives, in order to know the general social, cultural, and economic situations of the population of the study area. In addition informal meetings with key informant (farmers, elder people researchers, experts, women, and development agents) were held to get in depth knowledge and to pretest the questionnaire.

Transect walks across the sample kebeles were conducted in order to obtain all the necessary biophysical and major terrain features such as, topography, erosion status, characteristics of implemented soil and water conservation structures, land uses soil types, slope status and soil depth of the areas and to determine the questions that need to be included in the survey.

The survey questionnaire included both open and close ended questions which were pre-tested by administering it to selected respondents. Subsequently on the basis of the results obtained from the pretest necessary adjustments were made on the questionnaire which was ultimately translated from English in to local language, Siltigna. Information through surveying was gathered on farm family characteristics, farm situation implementation and maintenance of various indigenous and improved soil conservation practices, trend of soil and water conservation practices, participation of the society, especially the young generation and family level assistance for the practice. Basic information on crop and livestock production, off-farm activities and income was also collected. Besides questionnaire to conduct field survey instruments were used:

- a Global Positioning System (GPS) to register elevation and location
- clinometers to measure slope gradient
- measuring tape to measure slope length
- camera to take pictures in the field
- soil sample of uplands, middle and bottom lands from different land use types such as cultivated, open grassland and eroded lands during transect walk were taken from 20- 60 cm depth.

Secondary were collected from concerned offices and related to books, journals, official documents. At the end of the formal survey discussions were held with four focus groups having 6- 8 members in each four sample kebeles and with key informants including community leaders, women, elders and development agents these qualitative data were used to verify and supplement the quantitative results from the survey questionnaires.

## 5. Data analysis

Finally a descriptive statistical procedure of the statistical package for the social sciences (SPSS) was used in analyzing and summarizing the acquired data in this study. The quantitative data were analyzed using descriptive and inferential statistics. The Chi-square test, independent t-test and reliability analyses were used to know the relationship between the dependent and independent variables. The qualitative description was used to describe data acquired through focus group discussions and field observations. Collected data have been represented with the help of series of tables, figures and maps.

To identify the need for soil and water conservation measures in the study area Hurni's (1985), the Universal Soil Loss Equation (USLE) model was applied. The study was briefly introduced this model to predict the extent of soil erosion. The collection of data for this model has been carried out during the field work.

Prior to laboratory analysis, soil samples were first air dried and grounded a 2 mm sieve, except for the determination of total organic carbon, where samples were further grounded to fineness. Texture was determined by modified Bouyoucos hydrometer method. PH and EC (electrical conductivity) were determined 1:2.5 soil to water ratio. Soil organic carbon was determined by Walkley and Black method. Available phosphorus was extracted by Olsen Method and determined calorimetrically. The percentage of soil organic matter was calculated by multiplying the percent organic carbon by a fraction of 1.724 following the standard procedure that organic matter is composed of 58% of carbon (Wolkite Soil Laboratory Institute 2010).

## 6. Soil erosion status and conservation

In Silti Woreda, soil erosion is widespread, but there is considerable variation in the degree of erosion from place to place. Erosion is most serious in the highlands and middle lands such that most areas are covered with gullies and bare surfaces. These features are good indicators of severe soil erosion in the woreda (Fig.2).

Fig. 2: Formation of active gullies in A/Mukere.
Source: Field survey, Jan. 2011.

According to the Woreda Agricultural and Rural Development Office (WARDO) annual report, the major causes for soil erosion are the steepness of the land surface, improper land use systems (poor farming practice and expansion of agriculture to sensitive forest and grasslands), poor soil and water conservation practices on farming and eroded lands. So as to predict the extent of soil erosion in the area, this study introduces briefly the Universal Soil Loss Equation (USLE), especially, has been modified for the peculiar conditions of the Ethiopian highlands by Hurni (1985). This model has been applied to emphasize the general need of soil conservation measures in the area. The USLE considers several variables affecting the process of soil erosion, like factors of climate, groundcover, land use type and erodibility of soils (Morgan 1995, cited in Steuernagel 2006).

The Universal Soil Loss Equation (USLE) is given as: $A = RKLSCP$
Where, A = the computed or predicted mean annual soil loss (t/ha/yr), R = the rainfall erosivity factor, K= the soil erodibility factors, L= the slope length factor, S= the slop gradient factor, C= the cropping or ground cover management factor and P= the erosion control practice factor. A detailed description of the variables of this model is attached in the appendix 4.

The results of the application of the Hurni's modified USLE revealed that in the study area an annual soil loss of about 114.59 tons/ha/year on the steep slopes lying between high and middle altitudes indicate the necessity of soil and water conservation measures implementation as well (Tab. 3).

Tab. 3: Hurni's (1985) USLE application factors in the study area.

| Elements | Description (value) | Factors | Factor value |
|---|---|---|---|
| Rainfall(mm) | 1435.6 | R | 789.6 |
| Soil color | Red | K | 0.25 |
| Slope length(m) | 160 | L | 2.7 |
| Slope gradient | 42% | S | 4.30 |
| Land cover | Degraded land | C | 0.05 |
| Management | No tillage | P | 1.00 |
| A= R X K X L X S X C X P | | = 114.59 | |

The main components of soil and water conservation measures implemented in the woreda were dominantly physical and to some extent agronomic structures (Fig. 3). These measures implemented mainly on farm lands, degraded hillsides, gully treatments, watershed development and grazing lands exposed for erosion.

Fig. 3: Enclosed area for regeneration.
Source: Field survey, 2011.

Soil/stone bunds are embankments or ridges made of soil or stones built across a slope, along contours. These structures prevent water from flowing down the slope, and so also prevent soil erosion. There are different types of bunds constructed in the woreda, depending on the availability of the materials. Stone bunds are used mostly in hilly uncultivable eroded lands, and soil bunds are used mainly on farm lands. In the woreda about 6,218.5 km of construction of bunds, 1,884.8 km of maintenance of bunds, 449.7 $m^3$ waterways, 9,854 $m^3$ compost, 29,767 trenches, $1,095^2$ micro basins, 5,359 ha degraded land enclosure, 18,216,267 preparation of seedlings and 16,516,163 planting of seedlings, 28,156 farm water reservoir and 7,514 spring and channel diversion construction activities were carried out in the woreda from 2004 to 2009 (Tab. 4).

Tab. 4: Performance of improved soil conservation structures-2004 to 2009.

| Activities | Unit | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | Total |
|---|---|---|---|---|---|---|---|---|
| Stone/soil bunds construction | km | 1123 | 1280 | 712 | 1127 | 1099.5 | 881 | 6222.5 |
| Maintenance of bunds | km | 34.3 | 348 | 548 | 346 | 498 | 110.5 | 1884.8 |
| Check dam construction | $m^3$ | 63.9 | 50.7 | 97 | 63.8 | 45.2 | 129.1 | 449.7 |
| Check dam maintenance | $m^3$ | 38 | 20 | 52.4 | 38.8 | 20.9 | 21.5 | 191.6 |
| Water ways | $m^3$ | 51.2 | 17.3 | 14 | 8.8 | 58.6 | 116.4 | 266.3 |
| Compost | $m^3$ | 3030 | na | 169 | 18 | 1278 | 4259 | 8754 |
| Trenches | No. | na | na | na | Na | 6205 | 23562 | 29767 |
| Micro-basin | No. | na | na | na | Na | 1750 | 9292 | 10952 |
| Degraded land enclosure | ha | 847 | 1891 | 503 | 847 | 935 | 336 | 5359 |
| - Afforestation<br>- Preparation of seedlings | No. | na<br>na | 948953<br>843200 | 5850000<br>5733000 | 4397000<br>3270000 | 3726300<br>3539985 | 3294014<br>3129978 | 18216267<br>16516163 |
| Farm pond (water reservoir) | No | 3932 | 4400 | 4559 | 8019 | 3038 | 4208 | 28156 |
| Spring and channel diversion | No. | 1400 | 2000 | 2100 | 1900 | 69 | 45 | 7514 |

Source: Woreda Agricultural and Rural Development Office, 2010 (na – not available).

## 7. Results and Discussions

Interpretation of the analytical findings of the study shows about subsequent to the household, farm, economic characteristics, soil conservation practices and undermining factors.

7.1 Household characteristics by size, age and sex

Household size and characteristics are directly related to the supply and demand conditions for basic human needs, such as food, shelter, health and educational facilities which in turn directly or indirectly influence the continued use of soil and water conservation practices. The household size ranges from 2 to 11 persons with a mean of 6.5 persons, and standard deviation of 1.95. From the total sample households about 48.3% have family size of 6 persons and above per household (Tab. 5).

The family size of those who applied soil conservation practices was larger than those who were not implemented. The Pearson chi-square test (6.8) between household size and farmers implementation of soil conservation practices is not statistically significant (P=0.05, d.f=3). Thus, the hypothesis that states household size is negatively or positively affect the continued use of the practices is rejected. This implies that households with larger or smaller household size are not less likely implement and maintain conservation structures than their counterparts.

With respect to the age structure of the sample households, average age of 46.9 years ranges from 26 to 74 with a standard deviation of 10.66. Most of the respondents (> 80.8%) belong to the young and the middle-age groups which is an indication that there is a sufficiently large labor force (Tab. 4). These farmers have better understanding of soil erosion problems due to more access to information in the area and as a result more interested in soil and water conservation practices.

Tab. 5: Distribution of sample households by family size.

| Household size | Soil conservation measures | | | | Total sample (120) | |
|---|---|---|---|---|---|---|
| | Implemented (n = 74) | | Not implemented (n = 46) | | | |
| | Count | % | Count | % | Count | % |
| Less than 3 | 4 | 5.4 | 3 | 6.5 | 7 | 5.8 |
| 3 -6 | 28 | 37.8 | 27 | 58.7 | 55 | 45.8 |
| 7-9 | 34 | 46 | 15 | 32.6 | 49 | 40.8 |
| above 9 | 8 | 10.8 | 1 | 2.2 | 9 | 7.6 |

Source: Field survey, 2011.

From the total respondents 61.7% implemented the soil conservation practices. The remaining 46% or 38.8% didn't construct any type of conservation measures. From the total implemented farmers more than 66% of them were found within the age group 36-56 years. The remaining age group account 21.6% for age groups of 56-76 and 12.2% for age group 26-36. However, the Chi-square results showed that there is no significant association between age and conservation practices ($X^2$ = 6.4, at $P < 0.05$).

Tab. 6: Farmers' implementation of soil conservation structures by age groups.

| Household head age | Soil conservation | | | | Total sample (N=120) | |
|---|---|---|---|---|---|---|
| | Implemented (74) | | Not implemented (46) | | | |
| | Count | % | Count | % | Count | % |
| 26-36 | 9 | 12.2 | 12 | 26.1 | 21 | 17.5 |
| 37-46 | 21 | 28.4 | 15 | 32.6 | 36 | 30 |
| 47-56 | 28 | 37.8 | 12 | 26.1 | 40 | 33.3 |
| 57-66 | 13 | 17.6 | 7 | 15.2 | 20 | 16.7 |
| 67-76 | 3 | 4.0 | - | - | 3 | 2.5 |
| Total | 74 | 100 | 46 | 100 | 120 | 100 |

Source: Field survey, 2011.

Among household heads 80.8% were male and 19.2% were female. The marital status of the total household heads, revealed that 80.8%, and 19.2% of them were married and widowed, respectively. From those who were implemented soil conservation practices, 16.2% was females (Tab. 7).

Tab. 7: Household heads by sex and marital status.

| Household head characteristics (years) | Soil conservation practices | | | | Total sample (120) | |
|---|---|---|---|---|---|---|
| | Implemented farmers (74) | | Not implemented farmers (46) | | | |
| | Count | % | Count | % | Count | % |
| Sex: | | | | | | |
| Male | 62 | 83.8 | 35 | 76.1 | 97 | 80.8 |
| Female | 12 | 16.2 | 11 | 23.9 | 23 | 19.2 |
| Marital status | | | | | | |
| Married | 62 | 83.8 | 35 | 76.1 | 97 | 80.8 |
| Widowed | 12 | 16.2 | 11 | 23.9 | 23 | 19.2 |

Source: Field survey, 2011.

### 7.2 Educational Status of Sample Household Heads

Low level of education and high illiteracy rate is typical in developing countries like Ethiopia. Four education level groups were identified which include, illiterate, literate primary, and above primary. Among household heads 47.5% were illiterate, 10.8% can read and write, 27.5% attended primary and 14.2% attended above primary level. About 21.6% of those who were used conservation measures and 89.1% of those who were not implemented the practice categorized under the illiterate group of farmers (Tab. 8). Almost half of the respondents in the area are not educated and thus have little access to information about soil conservation practices. Generally, better-educated households have a more realistic perception about soil erosion problems, have more knowledge related to soil conservation practices and hence can more easily be involved in conservation activities. The Pearson Chi-square analysis for educational status of sample households between the continuously implemented groups and those who were not used the practice was found to be positively significant ($X^2$ = 53.6 at $P < 0.05$, d.f =3). Therefore, the hypothesis that states education status of household heads is positively associated with their continued use of soil conservation practices is accepted. This result is in line with findings of Ervin and Ervin (1982). They found that education was significantly related with conservation efforts. According to them, farmers are more educated, are more likely to use contouring, minimum tillage, and hay or pasture rotation to control soil loss. Krishna et al, (2008), Okoye, (1998), and Gould et al, (1989) also found a positive relationship.

Tab. 8: Educational status of household heads and soil conservation.

| Household head educational level | Soil conservation practices | | | | Total sample size (N = 120) | |
|---|---|---|---|---|---|---|
| | Implemented farmers (74) | | Not implemented farmers (46) | | | |
| | Count | % | Count | % | Count | % |
| Illiterate | 16 | 21.6 | 41 | 89.1 | 57 | 47.5 |
| Read & Write | 10 | 13.5 | 3 | 6.5 | 13 | 10.8 |
| Primary (1-8) | 31 | 41.9 | 2 | 4.4 | 33 | 27.5 |
| Above primary | 17 | 23 | 0 | - | 17 | 14.2 |

Source: Field survey, 2011.

### 7.3 Land holding and farm characteristics - farm size and number of farm plots

Land resource is one of the most important production factors for agricultural production. In rural households, in developing countries land and labor account for the largest share of agricultural inputs. Hence, the quality and quantity of land available for farm size of farm plots in the study area varies with density of population, which in turn follows farmers' local knowledge of soil fertility and topsoil depth. The survey result shows that the size of land holding varies from 0.25 to 4 ha with a mean size of 1.46 ha. As depicted from Tab. 9 about 65% of household heads owned less than 1 ha and about 29.2 % of the respondents possessed from 1 to 2 ha. Those farmers who implemented soil conservation measures owned farm size greater than 1ha. The Chi-square test for those who were implemented and not implemented with regard to farm size was found to assure the existence of significant association between the two variables ($X^2$ = 8.71 at $P < 0.05$, d.f=2). Thus, the hypothesis that states farm size is positively associated with the use and maintenance of soil conservation structures is accepted.

This suggests that farmers who possess small farms or less than 1 ha are less likely to invest in soil conservation practices. This may be due to the fact that conservation structures occupy part of the scarce farming lands, therefore farmers with smaller farm size cannot construct and maintain conservation structures compared to those with relatively larger farm size. In different studies conducted in Ethiopia it was reported that conservation structures takes 10-20% cultivation land through embankment and ditches (Cambell 1991, cited in Zelalem 2010) and land taken out of cultivation increases rapidly with increasing slope. This makes the benefit that may be obtained from conserving soil in small farms to be less likely to compensate for the decline in production due to physical conservation measures (Wegayehu and Lar 2003). Studies made in different parts of Ethiopia also supported the above findings. Bekele and Darke (1998) reported that existence of soil conservation measure is positively related to land holding size. Belay (1992) observed that all farmers that rejected soil conservation structures were those that had farm size in the lowest categories (cultivating less than 0.33 ha).

Tab. 9: Household heads and their farm size.

| Farm size (ha) | Implementation of soil conservation | | | | Total sample (n = 120) | |
|---|---|---|---|---|---|---|
| | Yes (n = 74) | | No (n = 46) | | | |
| | Count | % | Count | % | Count | % |
| Less than 1 | 41 | 55.4 | 37 | 80.4 | 78 | 65.0 |
| 1.0 -2.0 | 27 | 36.5 | 8 | 17.4 | 35 | 29.2 |
| 2.1 -3.0 | 6 | 8.1 | 1 | 2.2 | 7 | 5.8 |

Source: Field survey, 2011.

7.4 Farming system in the study area

Shortage of farm land is acute in Danecho Mukere and Welia kebeles where farm size dropped to 0.13 ha. In the study area there is no more scope of expanding farm lands since the tillable lands are already intensively cultivated. Land use competition is very obvious in the denser gentler slopes, where farm sizes are smaller. Home stead farm plots are shared by various perennial and annual crops, pasture land and for the planting of trees. The farming system practices in the study area are traditional, small farming involving a subsistent production of crops and livestock. Perennial and annual crops are grown in the study area. The perennial crops include enset, coffee and chat. The annual crops include barely, wheat, maize, beans, teff, and cabbages. The main food crops include, enset, barely, wheat, maize, cabbage. The main cash crops include chat, eucalyptus tree, and other food crops. The land allotted to cash crops is increasing rapidly. Altitude, farm size and top soil depth govern the variation of crops. While the ‘Nekala’ Shallower eroded upland soils grow a smaller variety of crops, especially enset. The ‘Rebeka’, low land fertile soils grow various types of food and cash crops Male household heads engage themselves in the preparation of the farm, in the planting, ploughing, sowing and weeding and harvesting of crops (Tab. 10).

Tab. 10: Cropping seasons for the four main annual crops grown.

| Crop type | Land preparation | Sowing | Weeding | Harvesting |
|---|---|---|---|---|
| Maize | Jan - Mar | Mar - Apr | Jun-Aug | Nov - Dec. |
| Wheat | Feb - Apr | May - Jul | Jul-Aug | Nov - Dec |
| Barely | Mar - Apr | Jun - Jul | Aug | Nov - Dec |
| Teff | Feb - Apr | Jun - Jul | Jul-Aug | Nov - Dec. |

Source: Field survey, 2011.

The farm plots were prepared mainly by using a hoe for enset, chat or "kofero" with a two pointed tips and ox-drawn plough. There was a high shortage of oxen in Danecho Mukere kebele. Enset plant is very important food crops and harvested for food after 6 to 8 years. By products of crops, enset leaf, maize stalks, and hay are used mainly for the purpose of forage and house construction.

### 7.5 Number of parcels of plots

Due to high population pressure in the study area a land fragmentation is very high. Accordingly, the survey result shows that the mean number of parcels of land is 3.45. The number of parcels of lands as a whole varies from 1 to 8 for the sample respondents. When respondents asked about the contiguity of their land holding, 96.7% of them, answered, their landholding was not contagious.

### 7.6 Distance of the farm plot

It was found that distance between the farm land and a homestead is an important factor in the use and maintenance of soil and water conservation structures. The survey result shows that the average walking time from the homestead to the farm land is 23 minutes for the total sample households. There were also farm plots that took more than an hour. The total numbers of farm plots that take such a time were found to be only two (Tab. 11).

Tab. 11: Average time required by farmers to travel for their farm plot.

| Time required in minutes | Soil conservation practices | | | | Total sample (120) | |
|---|---|---|---|---|---|---|
| | Implemented farmers (74) | | Not implemented farmers (46) | | | |
| | Count | % | Count | % | Count | % |
| Less than 20 | 37 | 50.0 | 23 | 50.0 | 60 | 50.0 |
| 20-40 | 28 | 37.8 | 18 | 39.1 | 46 | 38.3 |
| 41-60 | 8 | 10.8 | 4 | 8.7 | 12 | 10.0 |
| Above 60 | 1 | 1.4 | 1 | 2.2 | 2 | 1.7 |

Source: Field survey, 2011.

### 7.7 Economic characteristics - work status

During the field survey household heads were asked to state their work status. According, 60.9% of them were depend on on-farm activities as their means of living. Other respondents were based on off-farm and other remittent income (Tab. 12).

Tab. 12: Distribution of household heads by their work status.

| Work Status | Count | % |
|---|---|---|
| On-farm | 73 | 60.8 |
| Off-farm | 39 | 32.5 |
| Other | 8 | 6.7 |
| Total | 120 | 100 |

Source: Field survey, 2011.

### 7.8 Income

Respondents in the study area were asked to state their annual income. Accordingly, as the survey revealed that the mean annual income of respondents was 4657 and the minimum and maximum incomes were about 600 and 24,000 birr respectively. Respondents who have annual income of greater than 10,000 birr were only 6.7% from the total. The majority of respondents were getting annual income less than 10,000 birr (Tab. 13).

Tab. 13: Respondents by annual income.

| Annual Income (birr*) | Count | % |
|---|---|---|
| Less than 10,000 | 112 | 93.3 |
| 10,000-20,000 | 6 | 5.0 |
| 20,000-30,000 | 2 | 1.7 |
| Total | 120 | 100 |

Source: Field survey, 2011 (* 1USD = 17.5 Birr, at February, 2011).

### 7.9 Off-farm economic activities

In general, the relationship between off-farm income and continued use of soil and water conservation is poorly understood (Kessler 2006, cited in Fikru 2009). Off farm activities may have a negative effect on the implementation and maintenance of conservation practices due to reduced labor availability. More environments of the farmer and family members may lead to off-farm activities and may limit the time spent on their farm land; the family is discouraged from being involved in construction and maintenance of soil conservation structures. On the other hand, off farm activities can be a source of income and might encourage investment in farming and soil conservation practices.

As shown in Tab. 12, from the total sample households, about 32.5% involved in off-farm activities and nearly 23% of the implemented farmers were engaged in off farm activities. This shows that better access to off-farm activities reduces or encourages farmer's interest to invest on soil conservation structures. However, the t - test for equality of means between off- farm incomes of those who apply (N=17) was not significantly different from those who didn't apply (N=21, d.f= 36, P=0.57). However, the amount of income generated from off farm activities is not significantly associated with the use of conservation practices. Tenge et al (2004) found out that the involvement in off-farm activities negatively influenced the implementation of soil conservation measures. Pali et al, (2002) found different results in Uganda, where farmers with off farm activities were used better, implying that the off- farm income was used as a source of cash to invest in soil conservation practices.

Socio-economic variables such as income assumed to affect the continued implementation and maintenance of soil and water conservation practices. The data have presented in Tab. 14 shows that most of the respondents who were implemented and not implemented, earned annual income below 10,000 birr. However, as the survey result showed the Chi-square test for the relationship between the use of conservation structures and income variables of respondents ($x^2$=2.8, at P > 0.05, d.f =2) shows no statistical significance, as far as annual income of respondents is concerned.

Tab. 14: Income of respondents by implementation of soil conservation practices.

| Annual income in birr | Soil conservation | | | | Total sample (120) | |
|---|---|---|---|---|---|---|
| | Implemented farmers (74) | | Not implemented farmers (46) | | | |
| | Count | % | Count | % | Count | % |
| Less than 10,000 | 68 | 92.0 | 44 | 95.7 | 112 | 93.3 |
| 10,000 -20,000 | 5 | 6.8 | 1 | 2.2 | 6 | 5.0 |
| 20,001-30,000 | 1 | 1.2 | 1 | 2.1 | 2 | 1.7 |

Source: Field survey, 2011.

7.10 Soil conservation practices in the study area

Farmers' willingness to use soil conservation practices is largely determined by their knowledge of the problem of soil erosion. The results of the field survey show that about 70% of the farmers recognized soil erosion problems, and were of the opinion that conservation was necessary. Rill and gully erosion were the dominant forms mentioned by 76% of the respondents.

To prevent the problems of soil erosion in the area farmers applied various traditional and improved soil and water conservation measures. Before the intervention of the Productive Safety Net Program (PSNP) farmers in the area were practicing the indigenous methods. Improved soil conservation methods are brought to the area very recently by the funded partners with Woreda Agricultural and Rural Development Office in collaboration.

Until recently, indigenous soil and water conservation practices have often been ignored or underestimated by DAs, researcher's conservationists and government staff (IFAD 1992). Whereas, surveying both methods help us to understand farmers' way of thinking about the intervention of the practices (Hudson 1992) Various erosion control methods used in the area include, plantation of trees, application of manure, cut off drains, soil (stone) bunds, fallowing, contour ploughing drainage ditche and leaving crop residues on the field. The most important conservation structures widely used in the area include, fallowing, distribution of manure and soil (stone) bunds.

Fallow land is a traditional practice of leaving the crop land uncultivated for one or more years for the purpose of recovering soil fertility and minimizing soil loss. About 24.2% of the respondents have applied fallowing as a soil conservation measure. This method is used mainly Aratber Mukere and Anshebeso kebeles, where land is plentiful. However, its application is becoming lesser in densely populated than that of other kebeles, because farmers need the land to grow crops every year.

Application of manure in the study area is used by many farmers (21.7%) in order to improve the fertility of the soil. Manure consisting of animal dung and urine, is the best form of organic fertilizer. Farmers used manure mainly near the homestead. During the focus group discussions with key informant and Das, farmers (especially, those who were poor) have increased the use of manure applied because of the high current price of inorganic fertilizers.

Soil (stone) bund is an embankment or ridge built across a slope along the contour. Soil bunds are made of soil or mud. On moderately sloping areas the farmers construct the soil bunds for erosion control. On steep eroded bare lands stone terraces are most used structures in study area. As it is stated by key informants during focus group discussion the stone terraces are considered effective in erosion control in steeply areas (Fig.4).

In the study area about 10.8% of the respondents have constructed soil and stone bunds (Tab. 15), in the common eroded lands especially around the mountainous area, farmers were constructing bunds because of the cash they would earn from a safety net program.

Fig. 4: Stone bunds are common on steep slopes, Anshebeso.
Source: Photo by author, Jan. 2011.

Contour ploughing is a practice of tilling the land along the contours of the slope in order to reduce the runoff on a steep sloping land. It is used separately or in combination with other conservation structures such as plantation trees and cut- off drains. In the study area from the sample farmers about 13.3% applied the structure in combination with cut off drain (Tab. 15); it is carried out using the ox-drawn plough. Hence, it is part of the normal farming activity; it needs no extra labor and time for construction.

Tab. 15: Indigenous and improved soil conservation structure applied by respondents.

| Types of soil conservation structures | Indigenous soil conservation structure | Improved soil conservation structure | Total | |
|---|---|---|---|---|
| | | | Count | % |
| Contour plowing and cut off-drain | + | - | 16 | 13.3 |
| Soil /stone bunds | + | + | 13 | 10.8 |
| Fanya juu | - | + | 5 | 4.2 |
| Cutoff drains | + | + | 6 | 5.0 |
| Planting of trees | + | + | 9 | 7.5 |
| Fallowing | + | - | 29 | 24.2 |
| Leaving crop residues | + | - | 6 | 5.0 |
| Application of manure | + | - | 26 | 21.7 |
| Drainage ditches | + | - | 10 | 8.3 |

Source: Field survey, 2011.

Trees and other non–crop plants such as sisal euphorbia and eucalyptus are planted along the contour sometimes together with other conservation practices (Fig. 5). This type of conservation method is applied by 7.5% of the respondents in order to reduce runoff and conserve the soil and water round the root of the plants. Indigenous and newly introduced trees and shrubs are planted on over used eroded lands to make the land fully productive again. In certain areas, common highly degraded lands are closed off to livestock to protect it from grazing and planted with trees for regeneration.

Drainage ditches are one of the widely used soil conservation practices in the study area and also known as traditional ditches. These are micro-channels constructed on cultivated farms to drain off excess water and control soil erosion. Out of total respondents, 8.3% applied indigenous drainage ditches. These are low cost measures in which construction is part of the normal ploughing activity. However, unlike the plough furrows, the ditches are made wider and deeper in dimension and usually run diagonally across the field (Fig. 6). Locally farmers in study area, call the drainage ditches “Boye”.

Fig. 5: Plantation of Sisal and Euphorbia, D/Mukere.
Source: Photo by author, Jan. 2011.

Fig. 6: Indigenous drainage ditches, Datewezir.
Source: Photo by author, Jan. 2011.

Cut off drains are one of the physical structure constructed by digging the soil deep in order to divert the runoff before reaching the farmland. The survey results show that 5% of the respondents use cut off drains and another 13.3% used a mix of cut-off drains with contour ploughing. The farmer constructed such structures to prevent loss of seeds, fertilizer and soil due to excessive run–off coming from uplands and dispose the excess water for the field. However, according to farmers' opinion, through time most of these structures are accelerating soil erosion. During a transect walk with DAs gullies associated with the construction of these structure especially, between the boundaries of plots, were commonly observed.

Leaving crop residues on the field after harvest is another traditional practice used by the farmers in the area. The survey results show that only 5% of the farmers are implementing this type of measure to improve fertility of the soil and there by protect soil from erosion. During the transect walks with key informants, it has been observed that crop residues left on the field in Gewo high altitude areas. However during the discussion with the focus groups, it was noted that because of shortage of animal feed and roof cover for hut, most of the farmers used the crop residue for off plot purposes.

Fig. 7: Soil bunds in Danech.
Source: Photo by author, Jan. 2011.

Fanya juu terraces, an improved soil conservation structures, are made by digging a trench and throwing the soil uphill to form an embankment and over time creates sloping bench-like terraces (Fig. 7). The survey results show that 4.2% of the respondents have used these structures on their fields. Respondents applying these structures explained the advantage of the structures as follows:

- Bunds hold water and allow it to soak in to the ground reducing run off and causing gullies
- Soil gradually build up behind the bunds producing a bench terrace
- This can be built by an individual or by a group
- Bunds can be used to produce high yield and produce animal feed.

## 8. Bio-physical Factors in Relation to Soil Conservation Practices Farmers' Perception of Soil Erosion as a Problem

Farmer's awareness about the problem and causes of soil erosion as well as its consequences will help to motivate farmers to use soil conservation practices. Accordingly, as the survey result showed 70% of the interviewed farmers reported from moderate to very severe soil erosion problems on their farmland. While 30% of them responded that the problem is minor, because most of their farm land is found on gentle slopes (Tab. 16).

Tab. 16: Farmers' Response to Soil Erosion Problem by Degree of Severity.

| Degree of severity of erosion | Soil conservation practices | | | | Total sample (N = 120) | |
|---|---|---|---|---|---|---|
| | Implemented (74) | | Not implemented (46) | | | |
| | Count | % | Count | % | Count | % |
| Minor | 12 | 16.2 | 24 | 52.2 | 36 | 30.0 |
| Moderate | 27 | 36.5 | 8 | 17.4 | 35 | 29.2 |
| Severe | 21 | 28.4 | 11 | 23.9 | 32 | 26.7 |
| Very severe | 14 | 18.9 | 3 | 6.5 | 17 | 14.1 |
| Total | 74 | 100.0 | 46 | 100.0 | 120 | 100.0 |

Source: Field survey, 2011.

The chi-square result ($X^2$=19.06 at P< 0.05 d. f=3) also indicated the existence of significant association between the application of conservation measures and severity of soil erosion problems.

## 9. Causes of soil erosion and decline productivity

It can be seen that the level of soil fertility is very high on flat land as compared to the other slope degrees. It has also been observed that the steeper the slope the lower the fertility of soil, indicating the presence of higher erosion on very steep slopes. Farmers with poor soils or plot with low fertility are more involved conservation work than those who have fertile land. The farmers, who have very fertile lands, possibly do not see the negative effects of erosion on their plots in the short term. Out of the total respondents 53.3% expressed the opinion that the loss of soil from cultivated fields reduced the depth of the topsoil and led to a reduced production potential.

The slope of the farm land is highly related to the degree of involvement in conservation activities. Farmers living on steep slope are involved more in the continued use of conservation measures than those who own flat or gently sloping farm lands. About 58.4% of respondents expressed their farm land slope, moderate to steep (Tab. 17). The chi-square result of the survey ($X^2$ =17.27 at P< 0.05 d. f = 3) showed the existence of association between the slope of a farm land and implementation of soil conservation practices. Thus, the hypothesis that states slope of a farm plot affect soil conservation practices positively is accepted. A similar conclusion was also forwarded by Aklilu (2006) the effect of steep slopes on the implementation of the stone terraces is due to effectiveness of the measures for erosion control.

Farmers have been asked to indicate the productivity of their farmland overtime, 38.3% of them indicate the yield in unit area, as decreasing, 16.7% felt there was no change and 45% said it was increasing (Tab. 18).

Tab. 17: Slope of cultivated lands of respondents.

| Degree of steepness of plots | Soil conservation practices | | | | Total sample (N = 120) | |
|---|---|---|---|---|---|---|
| | Implemented (74) | | Not implemented (46) | | | |
| | Count | % | Count | % | Count | % |
| Flat /no slope/ | 6 | 8.10 | 11 | 23.9 | 17 | 14.2 |
| Gentle | 14 | 18.9 | 19 | 41.3 | 33 | 27.5 |
| Moderate | 43 | 58.1 | 13 | 28.3 | 56 | 46.7 |
| Steep | 11 | 14.9 | 3 | 6.5 | 14 | 11.6 |

Source: Field survey, 2011.

Tab. 18: Farmers' Response to the Yield, Farming and Soil Fertility Management.

| Farmers response to | Respondents (N=120 ) | |
|---|---|---|
| | Count | % |
| Yield in unit area | | |
| decreasing | 46 | 38.3 |
| unchanged | 20 | 16.7 |
| increasing | 54 | 45.0 |
| Size of agricultural land cultivated over time | | |
| decreasing | 79 | 65.8 |
| unchanged | 32 | 26.7 |
| in creasing | 9 | 7.5 |
| Current land holding to support the family | | |
| insufficient | 81 | 67.5 |
| sufficient | 36 | 32.5 |
| Measures taken to enhance the declining fertility of the farm land | | |
| crop rotation | 107 | 26.1 |
| shift to other land | 2 | 0.5 |
| using manure | 74 | 18.0 |
| expand the farm land | 6 | 1.5 |
| use fertilizer | 104 | 25.4 |
| change land use type | 11 | 2.7 |
| fallowing | 42 | 10.2 |
| others | 64 | 15.6 |

Source, Field survey, 2011.

Tab. 19: Farmers Response to Causes of Soil Erosion and Decline Productivity.

| Farmers response to | Respondents (N= 120 ) | |
|---|---|---|
| | Count | % |
| Causes of soil erosion | | |
| overgrazing | 4 | 3.3 |
| poor agricultural practice | 11 | 9.2 |
| over cultivation | 22 | 18.3 |
| excess rain | 62 | 51.7 |
| cultivation of steep slope | 21 | 17.5 |
| Cause of productivity decline | | |
| frequent cultivation | 54 | 23.2 |
| soil erosion | 81 | 34.8 |
| unreliable rainfall | 66 | 28.3 |
| high price of fertilizer | 4 | 1.7 |
| other | 28 | 12.0 |
| Reasons for the size of agricultural land decline | | |
| family (population ) increase | 56 | 57.0 |
| it was sold due to poverty | 36 | 36.7 |
| land degradation | 6 | 6.3 |

Sources: Field survey, 2011

In the study area it has been noticed that soil erosion is the main reason for decreasing productivity in the yield. Those who indicated that the productivity was decreased were mentioned soil erosion (34.8%) as a main reason. The local farmers generally believe that the major causes of soil erosion in their area include erosive rain (51.7%) over cultivation (18.3%), and cultivation of steep slopes (17.5%) (Tab. 19).

## 10. Soil fertility decline and management practices

Respondents in the study area asked about soil fertility changes on their crop land, most of the interviewed farmers in Danecho-Mukere, Welia and Anshebeso kebeles indicated that soil fertility has declined over the past decades. The major reasons mentioned by the farmers, for the decline in the ranking order were severe soil erosion, frequent cultivation, tilling of steep slopes and poor agricultural practices. In study area, farmers use several practices for soil fertility maintenance. As, it is indicated in Table 16 farmers used manure (18%), crop rotation (26.1%), fallowing (10.2%), application of chemical fertilizer (25.4%) and other erosion control related measures (15.6%). These are the most important soil fertility management practices in the area.

The main crop rotation system is the cultivation of cereals, legumes and tuber crops alternatively, In addition practicing fallow, forms part of the rotation system.
Farmers also use chemical fertilizers to maintain soil fertility. However, there were significant differences in the use of chemical fertilizers. Most of the Arat ber Mukere, Gewo area of Danecho Mukere, and lower altitude area of Anshebeso, farmers prefer to use chemical fertilizers instead of manure.

## 11. Problems related to soil conservation measures

The major problems related to conservation structures mentioned by the respondents include, source of pests, inconveniency during ox ploughing, reduction of farmland, labour intensiveness, difficulty in implementation, and costliness. During field survey it was recorded that about 31.7% of respondents indicated soil (stone) bunds reduce farm lands, 23.3% responded inconveniency during oxen ploughing and 17.5% revealed labor intensive.

The application of cut-off drains and water-ways is very important in combination with other structures especially in highlands and heavy rainfall areas. But because of the requirement of large labor and technical difficulty for implementation, they have been applied in a limited scale in the study area when compared with soil and stone bunds.

Regarding cut-off drains, 36.7%, 28.3% and 21.7% of respondents reported problems of costly, implementation difficulty, and labour intensiveness, respectively (Tab. 20). Concerning, water-way, 39.2%, 35.8% and 11.7% of the respondents indicated that it is costly, difficult to implement and labour intensive, respectively. As to Fanya juu-32.5%, 24.2% and 22.5% of the farmers responded that it reduce farm lands, require large labor, and inconveniency during oxen ploughing (Tab. 20).

Tab. 20: Farmers' response to the problems of conservation structures.

| Identified problem | Farmer's response to selected structures (%) | | | |
|---|---|---|---|---|
| | Stone /soil bunds | Cutoff drains | Water ways | Fanya Juu |
| Costly | 4.2 | 36.7 | 39.2 | 1.7 |
| Difficult to implement | 8.3 | 28.3 | 35.8 | 10.0 |
| Labour intensive | 17.5 | 21.7 | 11.7 | 24.2 |
| Difficult to turn oxen | 23.3 | 3.3 | 5.0 | 22.5 |
| Reduce farm land | 31.7 | 9.2 | 6.7 | 32.5 |
| No problem at all | - | 0.8 | 1.7 | 1.7 |

Source: Field survey, 2011.

Farmers were also asked to compare the improved conservation practices with the traditional ones. About 70% of the respondents indicated that improved conservation practices perform better in retaining soil from being eroded than the traditional ones (Tab. 21).

The farmers were asked also what their intentions regarding using the improved soil conservation technologies in the future, 88.3% of the respondents expressed their commitment to use and continue applying these structures. Except some factors that limit their acceptance, it can be concluded that the improved soil conservation structures were widely acknowledged and accepted as effective measures against soil erosion and as effective measures against soil erosion and as having the potential to improve land productivity. Though they enthusiastically expressed the belief they could control soil erosion on their farm plots, yet the constructed conservation structures in the farm lands were not maintained and some of them totally destroyed.

Tab. 21: Farmers' response to the effectiveness of improved conservation structures.

| Responses | Sampled Respondents (N =120) | |
|---|---|---|
| | Count | % |
| Less effective than the traditional | 26 | 21.7 |
| The same as the traditional | 10 | 8.3 |
| More effective than the traditional | 84 | 70.0 |
| Interest to use and continue improved soil conservation measures | | |
| Yes | 106 | 88.3 |
| No | 14 | 11.7 |

Source: Field survey, 2011.

## 12. Institutional support related factors - contact with development agents (DAs)

Extension services are a major source of technical information for farmers and are measured by the number of contact a farmer had with development agents. So, a contact to development agents increases their adoption decision. According, those farmers who have highly potential access to DAs are more likely to use soil conservation practices than their counter parts that did not. Therefore, it was expected that sample household have an access to extension services through continuous supervision of extension personnel, attending field days demonstrating of better farming practices and training. However from the total respondents, 43.3%, and from those who were applied the measures, 17.6% of them have indicated that they have no access to extension services. Moreover 48.8% of sample farmers have been visited by DAs once per month, those areas near to the main asphalt road. But, this visit mainly focused on crop production and other agricultural activities. Whereas the DA visit on conservation activities was very limited though it was better than before (Tab. 22 and 23).

Tab. 22: Distribution of respondents by frequency of the das visit.

| Frequency of visit per month | Soil conservation practices | | | | Total samples (N = 120) | |
|---|---|---|---|---|---|---|
| | Implemented (n = 74) | | Not implemented (n= 46) | | | |
| | Count | % | Count | % | Count | % |
| Once | 38 | 51.2 | 4 | 8.7 | 42 | 35.0 |
| Twice | 9 | 12.2 | 2 | 4.3 | 11 | 9.2 |
| Three times | 9 | 12.2 | - | - | 9 | 7.5 |
| Irregular visit | 9 | 12.2 | 15 | 32.6 | 24 | 20.0 |
| No visit | 9 | 12.2 | 25 | 54.4 | 34 | 28.3 |

Source: Field survey, 2011.

As the field survey indicated, the variable considered in the extension service provision factor did not show a significant relationship /at $P < 0.05$ at d.f =1) with the continued use of soil and water conservation practices. This is possible because the extension support provided is not aimed at the promotion of conservation practice. This is in line with the study by Chomba (2004) explained that a large proportion of farmers who had contacts with agricultural support programs did not continue improved practices. This explanation also presents that it is not enough to have extension support but the aim or purpose of the extension service should also relate to the continuation of conservation work.

Tab. 23: Farmers' Response to Institutional Support Factors.

| Institutional support factors | | Responses (n = 120 for each) | |
|---|---|---|---|
| | | Count | % |
| Do you have access to extension support | Yes<br>No | 68<br>52 | 56.7<br>43.3 |
| Have you attended training related to soil conservation practices | Yes<br>No | 62<br>58 | 51.7<br>48.3 |
| Land tenure system from | Renting<br>Inheritance<br>Allocated from kebele | 13<br>101<br>6 | 10.8<br>84.2<br>5.0 |

Source: Field survey, 2011.

Training is an important part of disseminating a given agricultural technology in general and soil conservation practices in particular. In the study area there are efforts made by Woreda Agricultural and Rural Development Office to provide training to the farmers about soil and water conservation practices. It was recorded during field survey that 51.7% of the respondents received at least once in the last ten years. However, the majority of farmers/respondents/ expressed that they didn't apply to know how gained from the training (Table 23).

In the study area farmers have three major sources of land, or access to land, namely receiving from the kebele, inheritance from the parents and renting systems or share cropping system. It has also recorded during field survey, that most sample households-obtained their farm lands from their parents. From the total number of farm plots of the sample households, 84.2% were inherited, 5% received from the kebele administrators and 10.8% obtained plots through renting. During the focus group discussion with DAs and key informants, in the area it has been assured that, the case of land insecurity is not significant problem to influence soil conservation practice. They said that there is no excess land and as a result there is no problem of redistribution. This by itself settles the problem of insecurity. Rather farmers become more secured than ever after the implementation of land registration and certification program in the woreda. About 91.7% of respondents were registered and 90.8% were given their land certificate.

## 13. Conclusions

It is generally recognized that the Ethiopia highlands experience severe rates of land degradation in the form of soil erosion and nutrient depletion that this has constrained agricultural development and food security in the country.

This study was aimed at identifying the current soil conservation practices in Southern Ethiopia and to assess the major constraints and opportunities for better conservation intervention. Soil conservation activities by the local farmers are faced with several problems. Though farmers have a considerable knowledge of land degradation problems and able knowledge of land degradation problems and apply a range of various conservation practices, their activities are largely constrained by problems that exist at the different levels of decision– making.

The outcropping of farm lands, formation of rills and gullies, decline of fertility and productivity of soil are some of the identified indicators of soil erosion at the study area. On the contrary, some considerable numbers of respondents were not aware of the indicators like the decline of the depth of soils, soil fertility, changing and failing of crops grown as indicators of soil erosion.

Torrential rain, continuous cultivation, steepness of the topography, land fragmentation, population pressure and improper farming were identified primary causes of soil erosion in the study area. These in turn resulted in migration of the productive force of the study area to the towns and big cities.

The most important conservation proactive carried out by farmers as coping strategies to recover the degraded and eroded lands include afforestaton of both indigenous and introduced trees, terracing, construction of check dams closuring and fencing of farm plots, manuring, crop rotation and using agronomic and other structural measures. But lack of vision, poverty and awareness, carelessness, the majority of farmers did not put the methods in to practice. As the result of the study reveal, indigenous soil conservation technologies are considered as effective methods of conservation. Measures such as contour ploughing, manuring, crop rotation, crop residue, cut off drains and ditches as the paramount importance to increase soil fertility, increasing the productive capacity of soil and in arresting soil from erosion. On the contrary, a significant number of the total respondents did not perceive and aware of the effectiveness of such above mentioned indigenous soil and water conservation measure and also most of the farmers, didn’t aware of the practices of mulching, mixing and strip-cropping.

Manuring is one of the indigenous soil and water conservation practices. The trends of practicing among the individuals in different agro-climatic zones are varied. In the three middle and high altitude sample kebeles it has been used for fertility enhancement and as fuel. But in Aratber kebele, the majority of the farmers were using chemical fertilizers instead of manure which they used it as fuel. The trends of practicing the modern structures between were different in Danechomukere, Welia and Anshebeso kebeles. Most of the farmers were benefits and practicing of structures such as, soil (stone) bunds, fanya juu and some artificial water ways very well in their farming and grazing plots. These were witnessed as effective and efficient for recovering soil fertility, increasing productivity and decreasing magnitude of erosion. On the contrary, the majority of sample farmers in the Aratber Mukere and in the upland areas of Danecho Mukere kebele in Gewo sub–kebele, especially females and the poor farmers have not practicing and maintaining the structures on their plots.

Traditional administration and social institutions plays essential role in maintaining strong social linkage and cooperative labor environment. Now-a-days the role as played by the traditional administration and social institutions greatly reduced and consequently the social harmony and the degree of cooperation among the people was threatened. This in turn seriously affects the involvement of the community in the soil and water conservation practices with the improved ones and the like; a weakening trend in the overall soil and water conservation practices has been revealed by the study. This weakening trend of the practices has placed their sustainability under serious challenges.

The study has revealed very low and decreasing participation of youth in soil and water conservation practices and deterioration of social traditions which are important for the practice. As it is known, the involvement of the youth is so vital that it plays crucial role to the sustainability of certain endeavor. Nevertheless, this is not happened in the study area.

Soil and water conservation practices by nature are labour intensive. The prevailing economic situation pushes away people from participating in the practices. Thus, it can be concluded that the economic factors have played their own role to the deterioration of soil conservation practices in the study area. The roles of the institutional intervention to the problem in the study kebeles were completely different. In Gewo-sub kebele, high altitude area (elevation around 3000 m) the role of local officials and DAs to the intervention of soil erosion and land degradation was very weak and far behinds or forgotten. Local officials and DAs were witnessed that they were incapable to mobilize, convince the community and gave no attention on the immediate soil erosion problems. As a result of this, the majority of farmers did not care and gave due attention to the environmental hazards. Especially, DAs in this area didn't visit at all, as the farmers responded. The performance of DAs, and their changes and the real problems of the farmers were not studied, monitored and evaluated in deep. From this, it is possible to conclude that the institutional support system given from the Woreda Agricultural and Rural development office and DAs to the practices in the study area, especially remote areas from the Woreda headquarters in particular and the whole sample kebeles in general was very weak that it could not help to integrate the traditional practice with the modern ones.

The specific activities to be done to improve the participation of the youth in the conservation activities could include:

1. To organize the youth in to self supporting organization so that they can have more opportunities to discuss on their conditions and share experience with adults.
2. To encourage the youth to learn the necessary skills and participation in the conservation practices.

3. As it has been talked during focus group discussion, that the expansion of the use of 'chat' was also identified as another challenge to the participation of the youth in particular in the practices. This is due to the fact that with the expansion of "chat" the youth and adults spend most of their time taking in or chewing this green material. So, this habit should be controlled.
4. To promotes the voluntary effort of NGOs on indigenous knowledge system and local practices.
5. As far as possible the Woreda Agricultural and Rural Development Office should give attention to the local soil conservation practices beginning from plan formulation to budget allocation. The development agents should frequently be supervised, encouraged and motivated through workshops, in service training and monetary rewards. The Woreda Agricultural Office should also be able to show its attention to the soil conservation practices in some practical way. Considering this as an incentive the farmers could be motivated to frequently construct and maintain the structures in their plots.
6. The conservation practices in the woreda can be further promoted if they are carried out in conjunction with other developmental activities. These include education of family planning, provision of with reasonable costs. Priority of these services and delivery of items may be given to those farmers who continuously construct and maintain their conservation structures.
7. Local or any responsible administrative leaders and farmers should draw rules and regulations that govern them to protect soil erosion and to use land resources wisely. Integrating soil conservation practices with the currently working farming systems.

Finally, suggestion has been forwarded for further research to strengthen the findings of the study pertaining to the institutional support related factors that impede the continued use of soil conservation practices in the study area.

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**STATE OF SOIL CONSERVATION PRACTICES IN SILTI WOREDA, SOUTHERN ETHIOPIA**

***Summary***

Ethiopia highlands experience severe rates of land degradation in the form of soil erosion and nutrient depletion that this has constrained agricultural development and food security in the country. The study was aimed at identifying the current soil conservation practices in Southern Ethiopia and to assess the major constraints and opportunities for better conservation intervention. The most important conservation proactive carried out by farmers as coping strategies to recover the degraded and eroded lands include afforestaton of both indigenous and introduced trees, terracing, construction of check dams closuring and fencing of farm plots, manuring, crop rotation and using agronomic and other structural measures. But lack of vision, poverty and awareness, carelessness, the majority of farmers did not put the methods in to practice. As the result of the study reveal, indigenous soil conservation technologies are considered as effective methods of conservation. Measures such as contour ploughing, manuring, crop rotation, crop residue, cut off drains and ditches as the paramount importance to increase soil fertility, increasing the productive capacity of soil and in arresting soil from erosion.

Manuring is one of the indigenous soil and water conservation practices. The trends of practicing among the individuals in different agro-climatic zones are varied. The trends of practicing the modern structures between were different in Danechomukere, Welia and Anshebeso kebeles. Most of the farmers were benefits and practicing of structures such as, soil (stone) bunds, fanya juu and some artificial water ways very well in their farming and grazing plots. These were witnessed as effective and efficient for recovering soil fertility, increasing productivity and decreasing magnitude of erosion. On the contrary, the majority of sample farmers in the Aratber Mukere and in the upland areas of Danecho Mukere kebele in Gewo sub–kebele, especially females and the poor farmers have not practicing and maintaining the structures on their plots.

Traditional administration and social institutions plays essential role in maintaining strong social linkage and cooperative labor environment. Now-a-days the role as played by the traditional administration and social institutions greatly reduced and consequently the social harmony and the degree of cooperation among the people was threatened. This in turn seriously affects the involvement of the community in the soil and water conservation practices with the improved ones and the like; a weakening trend in the overall soil and water conservation practices has been revealed by the study. This weakening trend of the practices has placed their sustainability under serious challenges.

The study revealed very low and decreasing participation of youth in soil and water conservation practices and deterioration of social traditions which are important for the practice. As it is known, the involvement of the youth is so vital that it plays crucial role to the sustainability of certain endeavor. As soil and water conservation practices by nature are labour intensive. The prevailing economic situation pushes away people from participating in the practices. Thus, it can be concluded that the economic factors have played their own role to the deterioration of soil conservation practices in the study area.