Status of Soil and Water Conservation Practices in Tigray Region, Ethiopia: A Case Study

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Abstract-**Northern Ethiopian has been severely eroded where a vast majority of the population derives the livelihood from agriculture, soil erosion created challenges for farming. The present work attempts importance soil erosion and conservation practices for improving productivity. The study was conducted in Ahferom district of Tigray region with objectives; to identify the causes of soil erosion, to assess type of indigenous practices for soil and water conversation and to ascertain contemporary practices widely used for soil and water conservation. On the basis of purposive sampling total 90 households of farmers were selected randomly from each category poor, small and big farmers. Torrential rain, unscientific cultivation, and steepness of the topography, population pressure and improper farming were main causes of soil erosion. The most important conservation strategies were carried to recover the degraded and eroded lands include both indigenous and contemporary soil and water conservation practices**

Keywords- **Soil erosion, topography, productivity, indigenous knowledge and society**

I. INTRODUCTION

In Northern Ethiopia, growing human pressure on agricultural land and forests over the last 50 years has accelerated the degradation processes along hill slopes, leading to higher sediment loads delivered to streams [1]. Despite its mountainous and rugged topography, the Tigray region has been used for traditional agriculture for millennia. The mountains and riverbanks alike are exhaustively cultivated in the traditional agriculture. Estimates showed that about 1.5 billion tons of soil is lost from the highlands annually [2]. Between 1985 and 2010, soil erosion was estimated to cost the country 1.9 billion US$ [3]. Measures must be taken immediately to save soil and water resources of the country. Hurni et al. measured the impact of ground cover and land use change on river flow using test plots, catchment studies, and modeling, which highlight the relationships between land use and land cover changes and runoff dynamics. Surface runoff was 5-30% higher than the original forest land. This is largely attributed to population growth, intensive deforestation and cultivation practices in the highlands of Ethiopia [4].

The term soil conservation should be de-emphasized or dropped al-together. It holds to many negative connotations in developing countries. In a material term such as land husbandry is more acceptable and bring out the integrated farm approach to conservation [5]. Soil conservation to as a term may not be the most appropriate name alternative is conservation to farming which changes the emphasis from conservation to farming [6].

An important step was taken in 1980 with the publication of the world conservation strategy [7]. This document defined conservation as "management of human use of the biosphere so that it is the greatest suitable benefit it to present generation while maintaining its potential to meet the needs and aspiration of future generation," living resource conservation under this definition have three specific broad objective to maintain essential ecological process and life support system, to preserve genetic diversities and to ensure that utilization of species and ecosystem are suitable. Conservation therefore expected to make an important contribution to social, cultural and exploitations [8].

To overcome unwise utilization natural resources and to maintain environmental equilibrium by different strategies have been designed among various measure of soil conservation biological and mechanical measure are highly favored by farmers because of their suitability to farmers day to day activities Conservation has two roots, one in resource management and the other in natural. Conservation and renewable resources had to be managed with care to prevent them extinct. The other root of conservation is natural and land scope and the species [9].

In this study area the main problem is the adoption of introduced soil conservation for soil and water as well as conservation of the natural resources [10]. Consequently, losses of fertile soil, damaging soil structure, have been appeared on farm lands, grazing lands those lead to decrease agricultural production.

II. OBJECTIVES OF THE STUDY

Keeping the view of importance soil erosion and conservation practices and improving productivity the study was conducted in Ahferom district of Tigray region with following objectives.

- To identify the causes of soil erosion.
- To assess type of indigenous practices for soil and water conversation, and
- To ascertain contemporary practices widely used for soil and water conservation

Data and Methodology

The work is based on primary sources those were collected through schedule/questionnaire by personal interviewing and informal discussion with farmers about their opinion and

involvement on soil conservation measure and activities. On the basis of purposive sampling total 90 households of farmers were selected randomly from each category poor, small and big farmers, 30 household heads were interviewed. The collected data were processed with tabular farm to using of the data simple statistical techniques, i.e., percentage method and frequently curve results were analyzed.

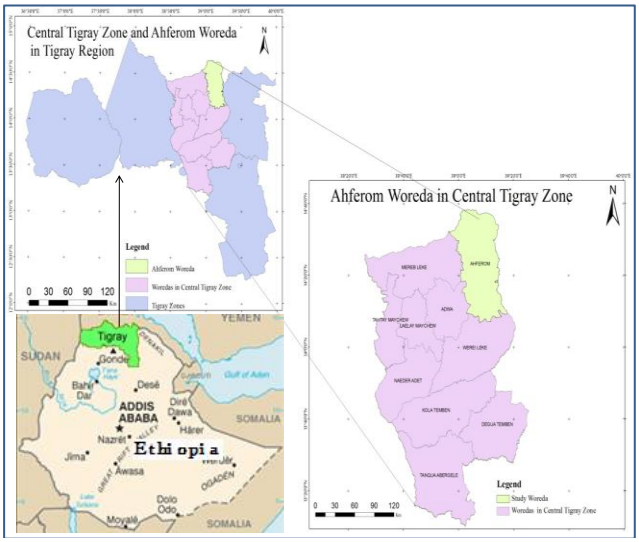


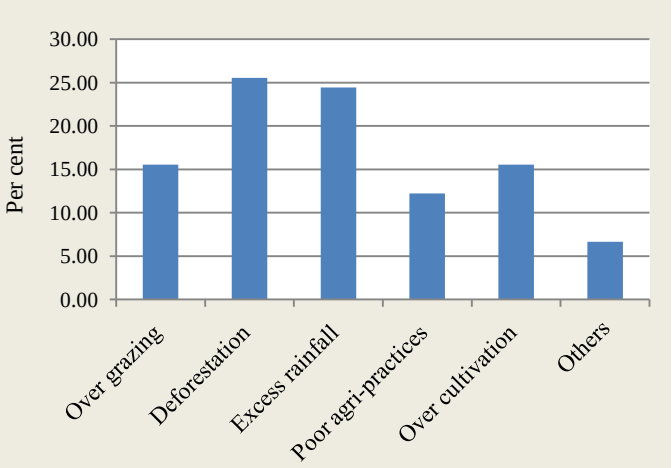
Fig 1. Location of study area in Tigray region, Ethiopia

Study Area

Ahferom woreda (district) is situated in northern part of Ethiopia in central zone of Tigray at around 1000 km from Addis Ababa and 218 km from Mekelle. It lies between latitudes $14^0$12`-$14^0$37` N and longitudes $38^0$57`-$39^0$17` E covering about 907 km^2. The topography is characterized 50% mountains, 2% hills and 48% flat land and it has altitude 2000-3000 masl. There are annual rainfall 350-550 mm and annual temperature 4^{o}C -25^{o}C. There are three types of soil distribution on the area consisting 40% sand, 30% silt and 30% clay respectively. There are six types of land use as 50% cultivated land, 5% grazing land, 34% forest land, 4% cactus, 5% households, 2% rock and hills. About 95% of the total population depends on agriculture. Those are landless and depend on off- farm activities having 5% proportion. The main crops during the high rainy season maize, wheat, *teff*, and during small rainy season barely, peas, beans, and lentil are produced in the subsistence type of agriculture by oxen. Livestock like cattle, sheep, donkey, and horse were reared and bee keeping was other source of livelihood

III. RESULTS AND DISCUSSIONS

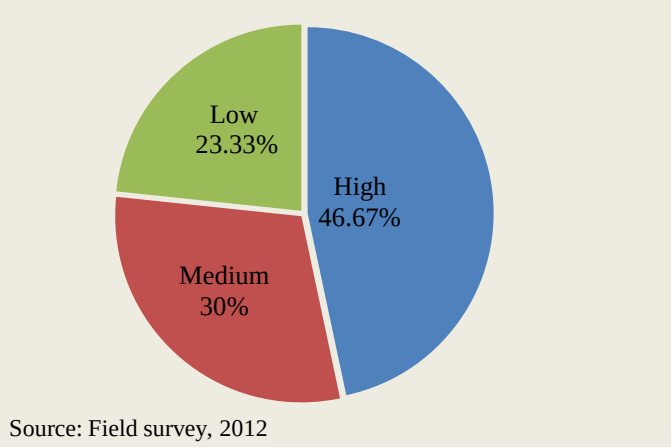
Due to the rugged terrain, the rates of soil erosion and land degradation in Ethiopia are high. Fertile soil every year and the degradation of land through soil erosion is increasing at a high rate [11]. Poor land use practices, over grazing, improper management systems and lack of appropriate soil conservation measures have played a major role for causing land degradation problems in the country [12].



Source: Field Survey, 2012

Fig 2. Responsible factors for soil erosion

Fig 2 shows that the causes responsible for soil erosion those were recorded during field surveys. Deforestation and excess rainfall were major reasons (50%) for soil erosion followed by overgrazing (15.5%), over cultivation, (15.5%), poor agricultural practices and others (6.67%) respectively. Highlands, slopes, thin layer of fertile soils are common characteristics of the study area where about 95% people were engaged traditionally in agriculture and livestock rearing; due to increasing population pressure, the people had started to occupied new lands on high altitude and slope for cultivation. As a result the soil lost the natural compactness with vegetation and at the time of rainfall that occurs rapidly, soil erosion easily happened. Moreover, lack of proper contour, bunds and checking dams for soil erosion at the time of rainfall that occurs in rapid nature.



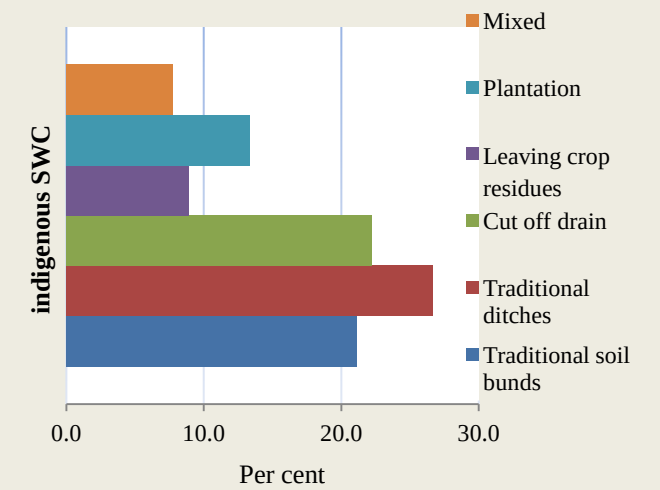
Source: Field survey, 2012

Fig 3. Level of decline soil depth fertility on the plot

It was recorded during field survey that soil erosion problem was common in the agricultural plots of respondents. But the level of soil erosion problem varied according to slope, economic condition as well as awareness of farmers regarding the soil conversation. The decline of soil depth fertility on the plot was the highest proportion reported by respondent which

accounted 46.67% followed by medium (30%) and low (23.33%). Declining fertility affects economic well being of the households and farming activities by low yield production.

The indigenous soil water conversations were common in the study area. However, SWC (Soil and Water Conservation) practices have often been ignored or underestimated by researcher's conservationists and government. Whereas during field survey it was noted that both activities were in the practices [13]. 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 *ditches* 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.



Source: Field survey, 2012

Fig 4. Indigenous methods for soil and water conservation

Fig 4 shows the most popular indigenous method for SWC practices is traditional *diches* in the study area. They are micro-channels constructed on cultivated farms to drain off excess water and control soil erosion. Out of total respondents, 26.7% applied traditional *diches* because they can construct at low lobour cost, time and money which are constructed during 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.

Traditional soil bunds

They are embankments or ridges 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 are considered effective in erosion control in steeply areas. In the study area about 21.1% of the respondents constructed soil and stone bunds, in the common eroded lands especially around the highlands or mountainous area.

Cut off drains

There is the physical structure constructed by digging the soil deep in order to divert the runoff before reaching the farmland. Fig 4 shows that 22.2% respondents used cut off drains and another 7.8% 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.

Plantation

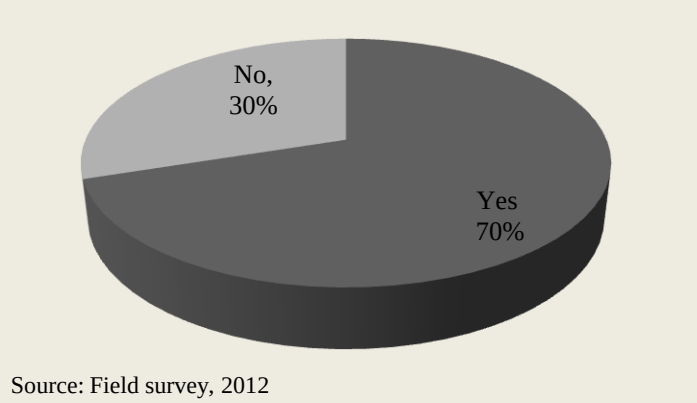
Sisal euphorbia and eucalyptus are planted along the contour sometimes together with other conservation practices. This type of conservation method was adapted 13.3% to reduce runoff and conserve the soil and water round the root of the plants. Indigenous and newly introduced trees and shrubs were planted on over used to check degradation of lands and to protect from animal grazing.

Leaving crop residues

On the field after harvest farmers are left crops residues not to disturb natural compactness and enhance the nutrient level of the soil by traditional practice. It was recorded that 8.9% farmers applied such type of measure to improve fertility of the soil and there by protect soil from erosion. However during the discussion, it was noted that because of shortage of animal feed, roof cover for hut and quick cash from traders, this method was not adopted by every farmer.

Contemporary soil and water conservation practices

The field survey results (Fig 5) reflect that the participation 70% households was in the community conservation activities for soil and water; those has been run by the regional government at *kebele* (local) level to train the farmers. The concerned agricultural trainers organized the meeting, demonstration and investigations in different parts of the region, described by Mr. Memhur, SWC trainer, Agriculture Ministry, Tigary region.



Source: Field survey, 2012

Fig 5. Participation in Community Conservation activities

Table 1 shows that indigenous soil and water conservation, respondents adopted the prevailing widely contemporary practices as mechanical soil conservation (70%) and biological conservation (30%). Stone bund and soil bund and wide spread, for such construction suitable stone was available on or near the field to compare soil. Stone bunds are considered better than soil bund because soil is susceptible to wash in heavy rainfall. Some farmers even enhance the permanent bund by adding stone in the top.

Table 1 Mechanical and biological contemporary SWC

Access types of mechanical SWCM	%
Soil bunds	30
Stone bunds	40
Tree plantations	18
Grass strips	12

Source: Field survey, 2012

The purple of combined stone and soil bund which is a field is to increase proportion of available. The biological soil conservation measures were adopted in 30% cases through tree planting, grass strip but lack of water for irrigation.

IV. CONCLUSIONS AND SUGGESTIONS

Ethiopia highlands experience high rates of land degradation in the form of soil erosion and nutrient depletion have been constrained for agricultural development. The current SWC practices in northern Ethiopia and to assess the major constraints and opportunities for better conservation intervention. Over grazing, deforestation, over cultivation, steepness of the topography, land fragmentation, population pressure and poor farming practices were identified primary causes of soil erosion in the study area. 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. But lack of vision, poverty and awareness, the majority of farmers did not put the methods in to practice [14].

The findings of study reveals, that indigenous soil conservation practices 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. Most of the farmers were benefits and practicing of structures such as, soil, stone bunds, and biological conservation practices [15]. Now-a-days the role as played by the traditional practices and involvement of the community in the SWC practices. 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 specific activities can be included to improve the conservation activities:

1. To organize the self supporting organization so that they can have more opportunities to discuss on their conditions and share experience.
2. Administrative leaders and farmers should draw rules and regulations to protect soil erosion and to use land resources wisely for integrating soil conservation practices with the currently working farming system.
3. Finally, need of further research to strengthen the institutional support for related factors that impede the continued use of soil and water conservation practices in the study area.

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