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Effect of Different Grass Species on Soil and Water Conservation at Assosa, Benishangul Gumuz, Ethiopia

Obsa Adugna*

Ethiopian Institute of Agricultural Research, Assosa Agricutural Research center, Ethiopia

**Corresponding author*

Abstract

Land degradation is a severe environmental problem across sub-Saharan Africa, and Ethiopia is among the most affected countries. This study was aimed to know the potential of different grasses on soil and water conservation. Three different grasses were used to evaluate their potential on conserving the soil and water on the farm land with three replications each for two consecutive years. Vetiver, Desho and Elephant grass had deposited 10 and 7 ton/ha of soil in relative to a plot without any grass control. Also, they had increased the soil water by 22.6% as compared to a plot without any grass. Thus the study revealed the best potential of Vetiver and desho grass to conserve both the soil and water. Therefore the study revealed the best and promising potential of treating degraded land by biological measures.

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Keywords

Grasses, soil deposition, soil moisture.

Introduction

Land degradation is a severe environmental problem across sub-Saharan Africa, and Ethiopia is among the most affected countries (Abiy, 2008). The productive land in Ethiopia has been exposed to degradation and menace both economic and survival of the people (Genene and Abiy, 2014). Soil erosion is a major part of land degradation that affects the physical, chemical and biological properties of soils and results in on-site nutrient loss and off-site sedimentation of water resources in Ethiopia (Hurni, 1993).

In Ethiopian highlands, high population pressure, continuous and steep slope cultivation, low vegetation cover, deforestation and inadequate soil conservation practices cause annual soil about 1.5 billion metric ton (Girma, 2001). The ever-increasing land use change is aggravating the rates of soil erosion, soil fertility reduction, crop yield decline, and food insecurity (Haregeweyn *et al.*, 2005; Tsegaye *et al.*, 2012).

To combat land degradation at a national level, environmental conservation and land rehabilitation effort was started in 1970s, with a particular focus on the construction of physical structures (bunds, terraces etc.) in the fast deteriorating highland areas of Ethiopia (Abinet, 2011). The intention of these efforts is to reduce soil erosion, restore soil fertility, rehabilitate lands, improve microclimate, and boost agricultural production and productivity (Woldeamlak, 2007; Mekuria *et al.*, 2007). Consequently, positive results are recorded in some areas of northern Ethiopia e.g., Tigray (Tefera, 2001, Mitiku & Kindeya, 2011). Beside the physical structures, implementation of biological soil conservation practices (e.g., vegetative barriers,

agronomic, alley cropping, grass strip establishment), and application of farmyard and green manures in degraded lands become immerse practices across the country (MoARD, 2005).

However, a few or no study has been done yet in Ethiopia, on the specific effects of biological measures on soil loss, in-situ moisture conservation, and crop production enhancement. Thus, this study was aimed to know the potential of different grasses on soil properties, crop production and soil and water conservation.

Materials and Methods

Description of the Study Area

The study was conducted at Asossa Woreda in Assosa zone of Benishangul-Gumuz Regional State (BGRS) (Fig.1). The Assosa District is characterized by hot to warm moist lowland plain with uni-modal rainfall pattern. The rainy season starts at the early May and lasts at the end of October with maximum rainfall in the months of June, July, and August. The total annual average (2000-2007) rainfall is 1316 mm. The annual mean minimum and mean maximum temperatures of the District for the periods from 2000 to 2008 were 16.75 and 27.92 ^{O}C, respectively.

Experimental Methodology

The study was carried out with the aim of evaluating the potential of grass species on soil and water conservation, and production. Three grass species with one control (without any grass) was replicated on three farm lands. The lengths of each hedge were 10m and their spacing depends on the Vertical increase of the slope. Each grass species had three hedges on each farm lands. The slope of the selected site for the study ranges from 6% to 10%.

A 2-3 tillers of the each type of grass species has been planted along the contours in double rows with staggered pattern. The inter and intra spacing used for each grass was 10 cm and 15 cm respectively along the contour for Vetiver and Desho grass where 20cm inter and 75cm intra spacing was used for Elephant grass. A total of 108 pins were installed on a single farm land to monitor soil erosion and deposition. The pin height was measured by two week interval during the cropping season. The total height of the pin was 50cm of which 15cm was inserted into the ground and 35cm left above the ground to collect the data of soil erosion/deposition. Pins, plastic string, meters, Machete, and Reck were used for measurement.

Soil moisture data were collected before and after the cropping season for each treatment. Gravimetric method was used to determine the moisture content.

MC% = (W2-W3) / (W3-W1) (1)

Where; W1 = Weight of tin (g), W2 = Weight of moist soil + tin (g), and W3 = Weight of dried soil + tin (g).

Results and Discussion

Effect of grass hedges on soil and water conservation

Effects of grass hedges on pin height

Different parameters were collected to evaluate the potential of grass hedges on soil and water conservation. Pin height, soil deposition/erosion and soil moisture were of some parameters collected to determine the potential of each grasses on conserving soil and water. Analysis of variance showed significant difference at ($p<0.01$) for pin height. The highest pin height reduction was observed under Vetiver and desho hedges whereas the lowest pin height for the plot without any grass hedge (Table 1).

The study revealed that, Vetiver, Desho and Elephant grass had reduced pin height by 26.71%, 24.47%, and 7.5% respectively as compared with the plot without any grass hedges within two research years (Table 1).This implies the better potential Vetiver and desho grass for pin height reduction and in turn determines their potential to conserve the soil and water.

Similarly,

Effects of grass hedges on Soil deposition/Erosion

Analysis of variance showed significant difference at ($p<0.01$) for soil erosion/deposition. The highest soil deposition was observed under Vetiver and Desho hedges whereas the lowest for the plot without any grass hedge (Table1). Vetiver, Desho and Elephanth edges had reduced the soil erosion by 26.71%, 24.47%, and 7.5% respectively as compared with the plot without any grass hedges within two research years (Table 1).

This reveals the critical importance of grass strips for soil and water conservation especially the best potential of vetiver and desho grasses for soil and water conservation. Werner (1977); Chikowo *et al.*, (2004); Deschemaeker *et al.*, (2005) and Abinet (2011) has also

reported land treatment with vegetation lowers the erosion rates and removal of fine particles with surface runoff.

Effects of grass hedges on Soil moisture

Soil moisture was significantly affected by each hedges at ($p<0.01$). Vetiver and Desho hedges showed the highest potential of conserving soil moisture where, the plot not treated with grass hedges showed the lowest soil water (Table 1). They had increased the soil moisture by 22.6%, whereas, Elephant grass reduced the soil water by 12.1% respectively as compared with the plot without any grass hedges within two research years (Table 1). The highest soil water content of Vetiver and desho grass is due to their massive root system which anchors the soil in turn the soil water (Fig.2).

Babalola *et al.*, 2003 has also reported the soil moisture conservation of potential of vetiver grass as 25.76% at 40cm and 40.1% at 20cm than the plot without grass strip.

Table.1 Effects of grass hedges on soil and water conservation (2020-2021)

Grass types	Pin height(mm)	SD/SE(ton/ha)	Mo
Vetiver	3.37[a]	38.72[a]	14[a]
Desho	3.27[a]	35.57[a]	14[a]
Elephant	2.67[b]	30.67[b]	12.33[b]
Control	2.47[b]	28.37[b]	10.83[c]
LSd	0.48	5.26	1.47
Cv (%)	7.79	7.79	5.79

P = Average pin height, SD = Soil deposition, SE= Soil erosion, Mo = Moisture, a, b and c letters shows the mean separation of the treatments

Figure.1 Location map of experimental site

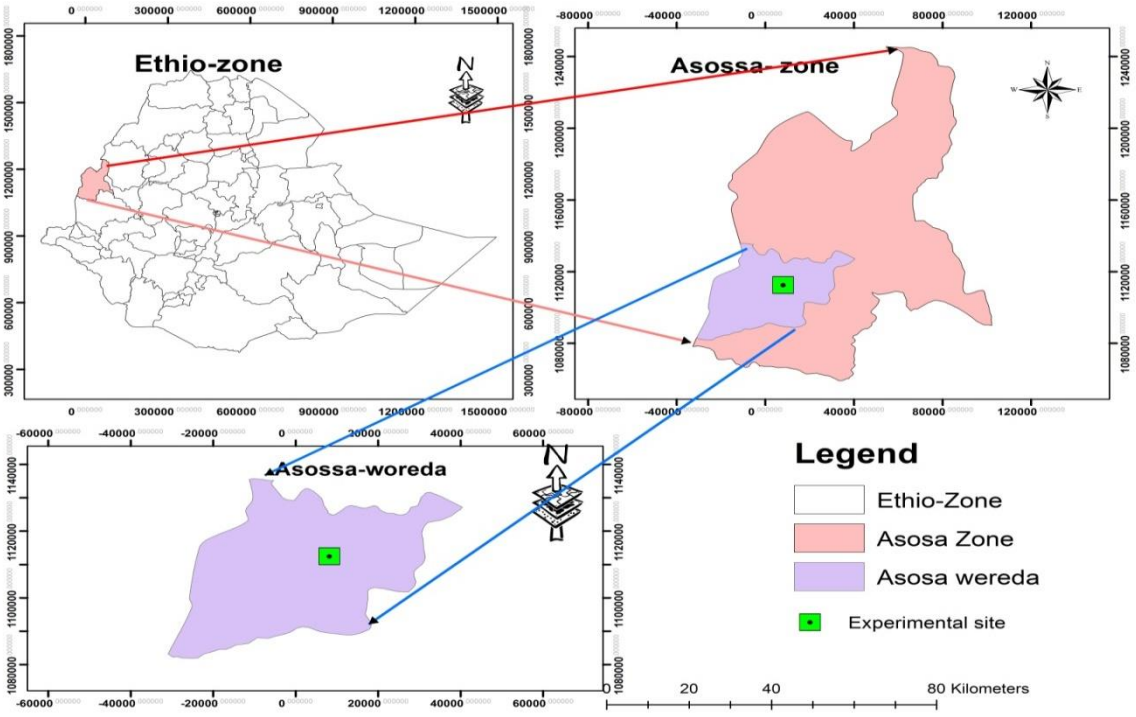
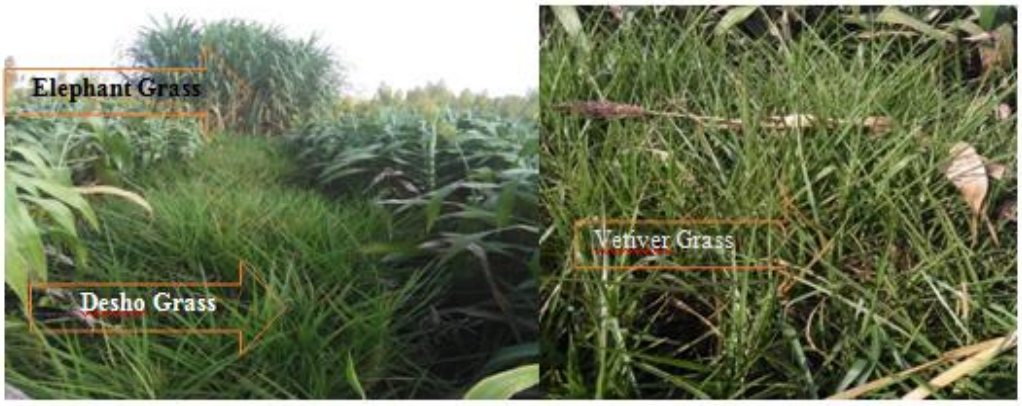


Figure.2 The status of each grass species on the field



Biological soil and water conservation practices such as vegetative barriers are effective if properly planted. Vetiver and desho grasses were effective on conserving both the soil and water in the study area. The potential of vetiver and desho on soil and water conservation was much better.

Therefore, both government and non-governmental organizations shall promote vetiver and desho to degraded areas for better conservation of soil and water. They can also increase the life span of physical soil and water conservation stabilizing the embankment of the structures.

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