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RESEARCH ARTICLE

Effect of different Grass Species on Soil Loss, and Runoff at Assosa, Benishangul Gumuz, Ethiopia

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ABSTRACT

Land degradation is a severe environmental problem across sub-Saharan Africa, and Ethiopia is among the most affected countries. This study aimed to know the potential of different grasses for soil and water conservation. Three different grasses were used to evaluate their potential for conserving the soil and water on the farmland, with three replications each for 2 consecutive years. Vetiver, Desho, and elephant grass had deposited 10 and 7 ton/he of soil relative to a plot without any grass control. Furthermore, 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 most promising potential for treating degraded land with biological measures.

Key words: 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.[2] The productive land in Ethiopia has been exposed to degradation and menaces to both the economy and the survival of the people.[2,6] 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.[9]

In the Ethiopian highlands, high population pressure, continuous and steep slope cultivation, low vegetation cover, deforestation, and inadequate soil conservation practices cause annual soil of about 1.5 billion metric tons.[7] The ever-increasing land use change is aggravating the rates of soil erosion, soil fertility reduction, crop yield decline, and food insecurity.[8,14]

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To combat land degradation at a national level, an environmental conservation and land rehabilitation effort was started in the 1970s, with a particular focus on the construction of physical structures (bunds, terraces, etc.) in the fast-deteriorating highland areas of Ethiopia.[1] The intention of these efforts is to reduce soil erosion, restore soil fertility, rehabilitate lands, improve microclimate, and boost agricultural production and productivity.[10,16] Consequently, positive results are recorded in some areas of northern Ethiopia, e.g., Tigray.[11,13] Besides the physical structures, the 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.[12]

However, few or no studies have 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 aimed to know the potential of different grasses for 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 the Assosa zone of Benishangul-Gumuz Regional State [Figure 1]. The Assosa District is characterized by a hot to warm, moist lowland plain with a uni-modal rainfall pattern. The rainy season starts in early May and lasts until 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 from 2000 to 2008 were 16.75 and 27.92°C, respectively.

Experimental Methodology

The study was carried out with the aim of evaluating the potential of grass species for soil and water conservation and production. Three grass species, with one control (without any grass), were replicated on three farm lands. The lengths of each hedge were 10 m, 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 each type of grass species have been planted along the contours in double rows in a 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, while 20 cm inter- and 75 cm intra-spacing was used for Elephant grass. A total of 108 pins were installed on a single farmland to monitor soil erosion and deposition. The pin height was measured at a 2-week intervals during the cropping season. The total height of the pin was 50 cm, of which 15 cm was inserted into the ground and 35 cm were left above the ground to collect data on soil erosion and deposition. Pins, plastic string, meters, a machete, and a reck were used for measurement.

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

$$MC\% = (W2-W3)/(W3-W1) \quad (1)$$

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 for soil and water conservation. Pin height, soil deposition/erosion, and soil moisture were some of the parameters collected to determine the potential of each grass to conserve soil and water. Analysis of variance showed a significant difference ($P < 0.01$) 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 of Vetiver and Desho grass for pin height reduction, which in turn determines their potential to conserve the soil and water.

Effects of grass hedges on soil deposition/erosion

Analysis of variance showed a significant difference ($P < 0.01$) for soil erosion and deposition. The highest soil deposition was observed under Vetiver and Desho hedges, whereas the lowest for the plot without any grass hedges [Table 1]. Vetiver, Desho, and Elephant hedges had reduced the soil erosion by 26.71%, 24.47%, and 7.5%, respectively, as compared with the plot without any grass hedges within 2 research years [Table 1].

This reveals the critical importance of grass strips for soil and water conservation, especially the

Table 1: Effects of grass hedges on soil and water conservation (2020–2021)

Grass types	P in 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 P in height, SD: Soil deposition, SE: Soil erosion, Mo: Moisture, a, b and c letters shows the mean separation of the treatments

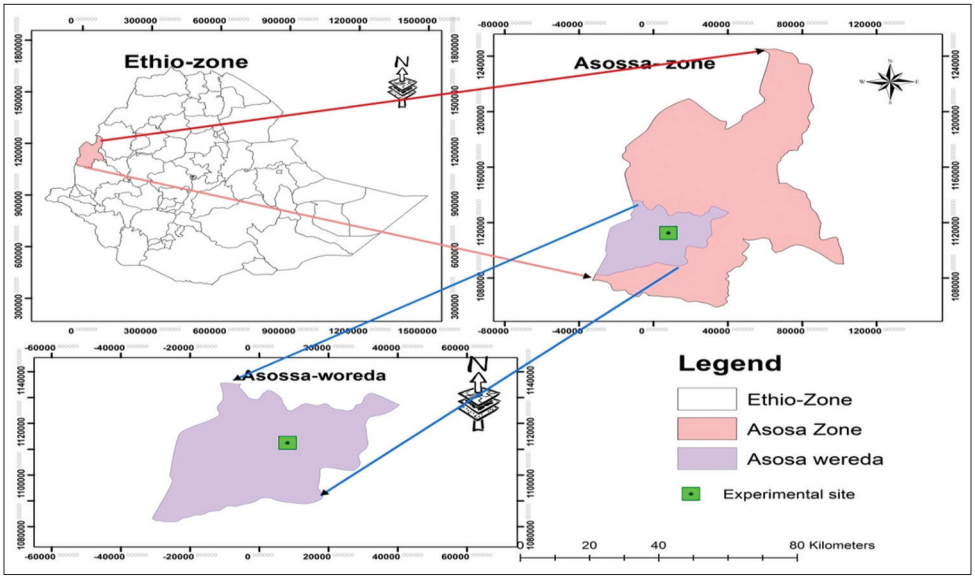

Figure 1: Location map of experimental site

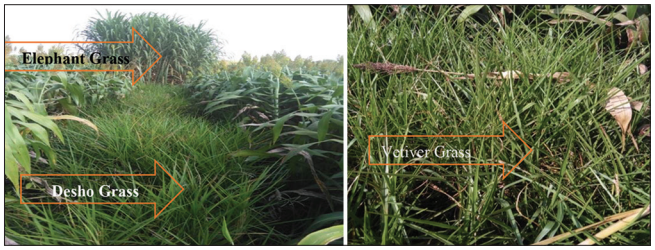

Figure 2: The status of each grass species on the field

best potential of vetiver and desho grasses for soil and water conservation.[2,4,5,15] Reported that land treatment with vegetation lowers erosion rates and removes fine particles with surface runoff.

Effects of grass hedges on soil moisture

Soil moisture was significantly affected by each hedge ($P < 0.01$). Vetiver and Desho hedges showed the highest potential for conserving soil moisture, whereas 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 2 research years [Table 1]. The highest soil water content of Vetiver and Desho grass is due to their massive root systems, which anchor the soil in turn the soil water [Figure 2].

Babalola *et al*., (2003)[3] has also reported the soil moisture conservation potential of vetiver grass as 25.76% at 40 cm and 40.1% at 20 cm than the plot without a grass strip.

CONCLUSION

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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