Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.8, No.5, 2018

Implementation and Effect of Vetiver Grass (Vetiveria zizanioides) on Soil Erosion in Somodo Watershed, South-Western Ethiopia

Gizaw Tesfaye* Yalemtsehay Debebe Tesfaye Yakob
Ethiopian Institute of Agricultural research, Jimma, Ethiopia, P. O. Box 192

Abstract
Soil conservation is one of management strategies to prevent the soil being eroded from earth's surface. The aim of this study was to assess implementation and effect of Vetiver grass on soil erosion in Somodo watershed. Community mobilization was used to implement Vetiver grass on farm lands as bund stabilization and grass strip. Accordingly, more than 45km (20%) of the watershed was covered by Vetiver grass on soil bund. The hedge was fully established within two years and formed averagely 36 cm raised terrace. The result of the study showed that within two years period about 36 cm soils was accumulated above the hedgerow. In addition, field slope was reduced on average by 2.5% due to soil accumulated above Vetiver hedgerow. And phosphorus availability was found higher on the above hedgerow than below the hedge row while, exchangeable acidity was found less above the hedgerow than below the Vetiver hedgerow in the watershed. The study recommends Vetiver hedgerow as an immediate measure for soil erosion on hill slopes and farm lands which can be implemented through community mobilization. Further study on how the Vetiver hedgerow improves phosphorus availability and decreases exchangeable acidity is also highly recommended.
Keywords: Vetiver grass, Hedge row, Soil erosion

1. INTRODUCTION

Soil erosion is one of the major threats among others, to the conservation of the soil and water resources. Ever if soil erosion can be caused by geo-morphological processes, anthropological or accelerated erosion, which is mainly favored by human activities (Ni and Li, 2003). Therefore, it is the major trigger factor for soil loss and water resources. Soil erosion is the most serious issue in the world, especially in developing countries due to different socio-economic and demographic factors as well as limited resources (Ni and Li, 2003). According to De Roo (1996), increasing population, deforestation, land degradation, over grazing and higher demand for firewood often causes of soil erosion.

Soil conservation strategy is one of the most prevention methods of soil being eroded from land surface. These mechanisms reduce soil acidity, salinization, chemically altered by over use and other chemical soil contamination to retain the fertility of soil. In Ethiopia, the agricultural sector creates employment for about 84% of the population and it accounts for 45-50% of the GDP of the country and makes the largest input to raw materials for agro-industries and food security (Amdissa, 2006).

Smallholder farms are pre-dominant and account for more than 90% of agricultural production and cover over 95% of the total area under cultivation (Tiruneh *et al.,* 2001; MoFED, 2010). However, most of their products go for their own use as they retain about 80% of their produce for their own consumption (Stefan, 1990). Cognizant of these problems, soil and water conservation technologies were implemented in many parts of the country for the last 30 years. These conservation mechanisms were introduced mainly in some degraded and food deficit part of the country. Thus, fanyaju and level soil bund are mainly practiced in the area (Belay, 1992). However, biological conservation measures are ignored for a long period of time in the country. But, in most parts of the world biological conservation measures have been practicing (Evette *et al*., 2009). In Ethiopia, these biological conservation measures was started during 1980's when revising the soil and water conservation strategies, it included both physical and biological conservation methods.

Runoff is made to move more gently down the slope over the soil surface and as it does, it is intercepted and spread out by the Vetiver strip. In using the Vetiver as a green structure, the farmer does not need any mathematical formulae or engineering designs for its establishment in the field. Even in situations where steep slope limits the use of engineering structures and erosion continues uncontrolled, the green structure can be used without any constraint. To the farmer, this means food crops can be effectively grown on very steep slopes with a reasonable level of erosion control. Studies on the use of Vetiver grass buffer strips for soil and water conservation are still in their infancy in Nigeria (Babalola *et al*., 2007).

2. MATERIALS AND METHODS

2.1. Description of the Study Area

The study was conducted at Somodo watershed, which is found at the upper part of Abay river basin, Oromia regional state in the South West part of Ethiopia. It is located about 20 km from Jimma town and about 369 kilometers to the South West of Addis Ababa, Capital City of the country. The watershed covers about 400 ha with a total of 300 households and found in between $7^0$46'00"-$7^0$47'00"N latitude and $36^0$47'00"-$36^0$48'00"E

longitude. The altitude of the watershed varies in the ranges of 1900 to 2075m.a.s.l. The average annual rainfall of the area is about 1523 mm with the mean temperature of 18.9^{O}C ranging from 13.0^{O}C and 24.8^{O}C.

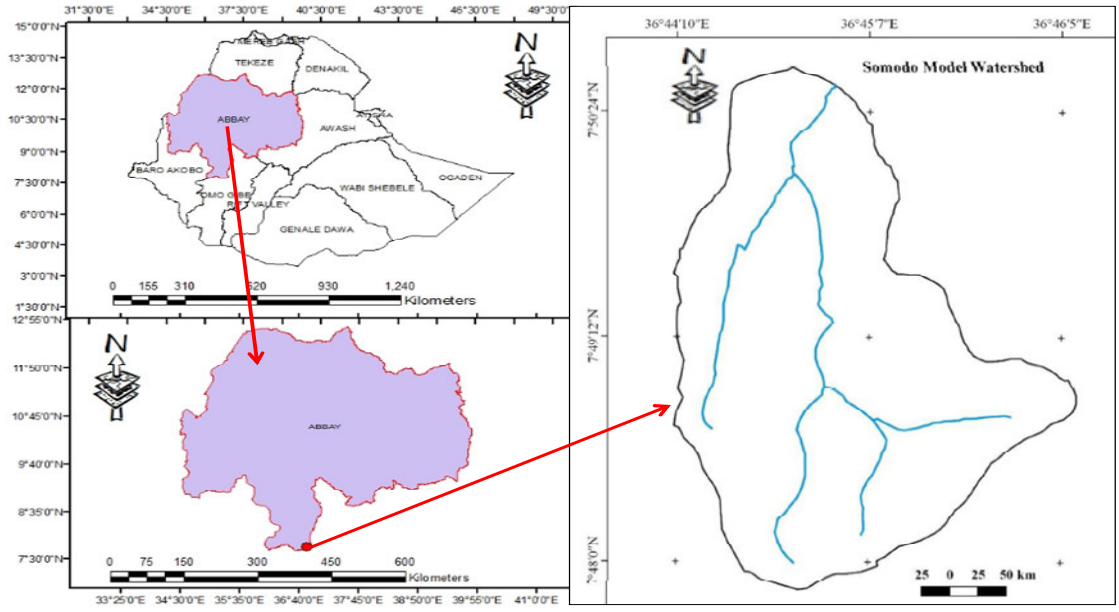

Figure 1: Map of the study site

2.2. Method of Data Collection

Awareness and training for stakeholders, local farmers, woreda/district experts and development agents were given in different time on the use of Vetiver grass and how to plant it for soil erosion before intervention. Vetiver grass nursery site was established at Jimma Agricultural research center and distributed for the farmers in the watershed to be planted as a grass strip on gentle slope farm lands and grazing lands, and as stabilizing agent for physical soil and water conservation structures, soil bund, implemented by community mobilization. During the study about 45km Vetiver hedgerow was planted as a grass strip and 95km was planted on soil bunds to stabilize the structure. This Vetiver was planted as a single hedgerow and double hedgerows. Above and below hedgerow pins were planted to measure the amount of soil deposited or removed at both above and below the hedgerows.
To evaluate its effect on some soil properties and nutrient contents soil samples were taken from four locations in the watershed above the hedgerow and below the hedgerow; and these samples were analyzed in Jimma agricultural research center soil and plant tissue laboratory for phosphorus availability and exchangeable acidity separately before and after Vetiver intervention. Furthermore, the slope or gradient changes of farm lands at four locations were also measured by the help of clinometers before and after intervention.

3. RESULTS AND DISCUSSIONS

3.1. Effect of Vetiver Hedge on Soil Erosion

The mean soil deposited from all, four, locations above the Vetiver hedgerow within two years was 36cm. The maximum soil deposition was observed at location 2 and 3, at the middle of the watershed, and minimum at 1 and 4 locations, which were found at the upper and lower part of the watershed respectively. This result implies that in the absence of Vetiver hedgerows on average about 36 cm soils is removed or eroded within two years period of time in the watershed.

Table 1. **Effect of Vetiver Hedge on Soil Erosion**

Location	Depth of soil accumulated above the hedge (cm)
1	33
2	45
3	35
4	33
Mean	36

Soil moisture content on the vetiver plots was higher than the control by a mean of 25.6% at 40cm depth and 50.1% at 20cm depth (Babalola *et al*, 2003). The higher moisture content under vetiver strip management is

the result of reduced run-off velocity and enhanced water infiltration during the rains.

Donjadee S. *et al*., (2009) came out with the result vetiver grass *(Vetiveria nemoralis)* has great potential for reducing runoff and soil loss by about 38·7–68·6. The vetiver strips delayed incipient runoff and reduced peak runoff rate and steady erosion rate. The land slope affected soil loss but did not have a significant effect on runoff. A narrow vetiver hedge interval slightly reduced runoff and soil loss more than a wider one. The soil loss equation obtained in this study revealed that runoff has a higher effect on soil loss.

3.2. Effect of Vetiver Hedge on Slope

The hedge was planted on a field with a slope of 13%, 17% and 18%; and after two years of intervention the slope of these fields were reduced to 11%, 14% and 16% due to the accumulated soil above the hedge. These hedges were currently growing to terrace and field slope length was also reduced. The field length is divided into different segments with the Vetiver hedgerows and as a result field slope was reduced from 16.25% to 13.75% on average, which is about 2.5% slope change due to Vetiver hedge intervention.

Due to the reduction of slope gradient and slope length soil erosion problem in the watershed was also reduced as some farmers stated. This is because the hedgerows reduce the velocity of running water detaching and transporting soil particles.

Table 2. **Effect of Vetiver Hedge on Slope**

	Slope change (%)	
Location	Before intervention	After intervention
1	17	14
2	17	14
3	13	11
4	18	16
Mean	16.25	13.75

3.3. Effect of Vetiver Hedge on Soil Nutrient

According to local farmer discussants, soil fertility and productivity around the area is being increased. nutrient availability of the above hedge row is higher than below the hedge row. This indicates that, mineral contents in the soil increasing after this Vetiver grass planted in the model watershed. Therefore, the production and productivity of the area is increasing.

The other is the exchangeable acidity above the hedgerow was less than below the Vetiver hedgerow in all locations across the watershed. The reason is that, nutrients that should be eroded by water erosion were protecting above the Vetiver hedgerow.

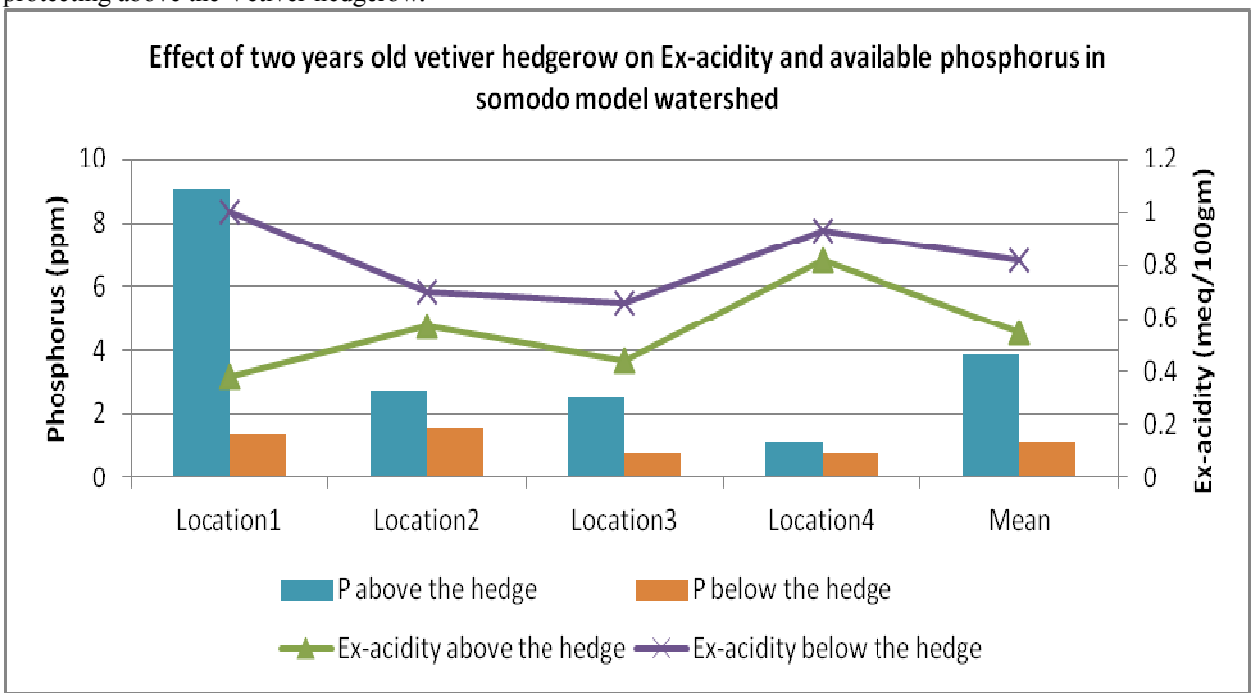

Figure 1: Effect of two years vetiver hedgerow on ex-acidity and available phosphorus in Somodo watershed

Abdisa Gesesse *et al*., (2013) reported soil bulk density, CEC, Organic Matter, Total Nitrogen, Available Phosphorous, and Potassium contents, were significantly higher for soil with Vetiver than for without Vetiver

grass soil at Anno agro industry farm, Gobu Sayo District, Oromiya region, Ethiopia. They concluded that the use of Vetiver grass as a soil conservation practice improved soil fertility and productivity.

4. CONCLUSION AND RECCOMMENDATIONS

This study revealed that, the implementation of physical and biological soil and water conservation practices in Somodo model watershed. The result shows that, vetiver grass plantation and soil bund construction in the area is significantly affected the soil properties as well as the production and productivity at large. In addition to this, vetiver grass plantation with and without bund is determined the soil deposition above the hedge and below the hedge row.

To sum up, soil bund construction and vetiver grass plantation in the area is drastically essential to increasing the soil fertility, production and productivity and also reduce the slope of the area and reduce sever erosion in the watershed.

REFERENCES

Abdisa Gesesse, Tesfaye Balemi, P. Natarajan and Yosef Amha 2013. Effect of Vetiver Grass Headges in Maintaining Soil Fertility and Productivity at Anno Agro Industry Farm, Gobu Sayo District, Oromiya Region, Ethiopia. Journal of Science and Sustainable Development (JSSD) , 1(1), 37-49.

Babalola, O., S.O. Oshunsanya and K. Are. 2007. Effects of vetiver grass (Vetivera nigritana) strips, vetiver grass mulch and an organomineral fertilizer on soil, water and nutrient losses and maize (Zea mays, L) yields. Soil and Tillage Res. 96: 1–2, 6–18.

Babalola O.S.O. Oshunsaya and Are K. 2003: Continuous cultivation of maize under vetiver grass (Vetiveria nigritana) strip management: Runoff, Soil Loss, Nutrient Loss and Crop yields. Journal of Sustainable Agriculture (In Press).

Belay T. 1992. Farmers' Perception of Erosion Hazards and Attitudes towards SoilConservation in Gunono, Wolayita, Southern Ethiopia. *Journal of Ethiopian Development Research* 14 (2): 31-58..

Clemente R. S., Tingsanchali T., Chinnarasri C. (2009) .Effects of vertical hedge interval of vetiver grass on erosion on steep agricultural lands

Evette, A., S, Labonne, F. Rey, F. Liebault, O. Jancke and J. Girel. 2009. History of Green Structure Technique for Erosion Control in Rivers in Western Europe. Enviro. Manage. 43(6): 972–984.

FAO. 2003. Smallholder Agriculture in East Africa: Trends, Constraints and Opportunities.

MoFED. 2010. The Federal Democratic Republic of Ethiopia, Growth and Transformation Plan (GTP) 2010/11-2014/15, Draft. 2010 September, Addis Ababa.

Schluter, U. 1984. Zur Geschichte Ingenieurbiologie. Landschaft + Stadt: 16: 2–9.

Stiles, R. 1991. Re-inventing the wheel? Landscape Design 203: 11–111.

Teshome Atnafie. 2006. Irrigation Policies, Strategies and Institutional Support Conditions in Ethiopia. Proceedings of Symposium on Best Practices and Technologies for Agricultural Water Management in Ethiopia, March 7-9, 2006, Addis Ababa, Ethiopia.

Tiruneh, A., Tesfaye,T., Wilfred, M. and Hugo, V. 2001. Gender Differentials in Agricultural Production and Decision-Making Among Smallholders in Ada'a, Lume and Gimbichu Woredas of the Central Highlands of Ethiopia. International Maize and Wheat Improvement Center (CIMMYT) and Ethiopian Agricultural Research Organization (EARO). 62p.

Woldeamlak B. 2003. Land Degradation and Farmer's Acceptance and Adoption of Conservation Technologies in the Digil watershed, Northern Highlands of Ethiopia, Social Science Reaserch report Series No.29. Addis Ababa.