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The Roles of Infltrution Trench and Area Enclosure on Grazing Land Biomass Productivity and Soil Properties at Diga, Eastern Wollega Zone, Ethiopia

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Research Article

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ABSTRACT

Land degradation is a pervasive problem that negatively affects agricultural productivity and livelihoods of farmers in the Blue Nile basin of Ethiopia. It resulted depletion of soil organic matter and available water. Therefore, implementation of soil and water conservation is believed to mitigate the impacts of soil erosion and enhance agricultural production. An on-farm study was conducted during 2016 in Arjo Gudetu kebele, Diga District, Eastern Wollega of Oromia Regional State with the objective of evaluating the role of infltration trench on the soil physico-chemical properties grazing lands and biomass of Rhodess grass. The study involves two factors. Infiltration trenches were considered as main plot factor while grass management, reseeding of *Chloris gayana* and keeping the native pasture was considered as the subplot factor. The treatments were replicated (T_1 and T_2 replicated 4 times and T_3 and T_4 replicated 5 times) randomized complete block design in a split plot arrangement. The data was analyzed using general linear model procedures and to separate difference between mean LSD (5%) was used. Infiltration trench increased the mean value of soil moisture content at(0-30 cm, 30-60 cm) soil depth while mean value of tiller per plant and plant height increased by 3.4% and 4.6% respectively. The use of Infiltration trench not significantly affects biomass of Rhodes grass (*Chloris gayana*). As the wall, it is concluded that soil and water conservation measures improves soil fertility, soil moisture status, and increases the fodder biomass productivity. However, further research is needed in the area to identify the time span available for Rhodes grass to regrowth on the same site.

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INTRODUCTION

Background and Justification

Land degradation is a severe problem throughout the world. It has negative consequences on agricultural production as about 40-75% of the world's agricultural land's productivity is reduced due to land degradation [1]. Human induced land degradation is a serious global threat that increases vulnerability to climate change, especially in marginal agro-ecosystems with low and variable rainfall, steep slopes and depleted soil fertility with resultant low agricultural productivity [2].

In Ethiopia, the severity of land degradation process makes large areas unsuitable for agricultural production, because the top soil and even part of the sub-soil in some areas has been removed and stones or bare rocks are exposed at the surface. The problem is manifested mainly in the form of soil erosion, gully formation, soil fertility loss, and crop yield reduction. Land degradation in the form of soil erosion has hampered agricultural productivity and economic growth of the nation [3].

Ethiopia is predominantly an agricultural country, which dominated by rain fed farming of low productivity. Agriculture plays a major role in the country's economy. However, the annual grain production, which is on average 7 million tons, is too low to support national food demands [4]. Growth in agricultural productivity, which influenced by anthropogenic and natural factors, could not match that of the demand. Yirga reports over the last decades, agricultural production and income growth in the country have lagged behind population growth consequently; per capita food production, income and savings have dropped.

Soil and water conservation is activities at the local level which maintain or enhance the productive capacity of the soil in erosion prone areas through prevention or reduction of erosion, conservation of soil moisture, and maintenance or improvement of soil fertility [5]. It is the only mitigation measure to reverse the threat of soil erosion and protect the land globally [6]. The structures are designed to intercept and reduce runoff velocity ,store runoff water , trap sediment and nutrients, protect the land from erosion, improve water quality, prevent flooding of neighboring lands, improve land productivity and provide diverse ecosystem services [7].

Soil conservation activities can change the physical conditions of the soil like soil structure, water holding capacity, soil bulk density, soil porosity and its workability. However, lack of evaluating the effects of soil and water conservation on the crop and grassing land down the process of adoption and replicating such structures. This study was conducted to establish empirical evidence regarding the productivity impact of infiltration trench and area enclouser on the productivity impacts of the grazing land by providing reliable evidence.

Statement of the problem

In the study area soil erosion is a serious problem due to deforestation, continues cultivation of crops, over grazing, limitations of SWC practice, inadequate land cover by grass due to termite, poor soil infiltration capacity and high volumes of runoff. This leads to low crop and fodder biomass productivity that cause food insecurity in the area. Recently there is an ongoing attempt by the agricultural extension system to introduce soil and water conservation measures like level soil bund, in filtration trench and area enclose to increase crop and fodder biomass productivity in the area. Thus, it is important to conduct a research to assess how grazing land productivity improved through application of SWC practices like infiltration trenches and Rhodes grass re-seedling on grasslands at the study area.

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Objective of the study

General objective

- To evaluate the effects of Infltrution trench and area enclouser on grazing land biomass productivity and selected soil physico-chemical properties.

The specific objectives

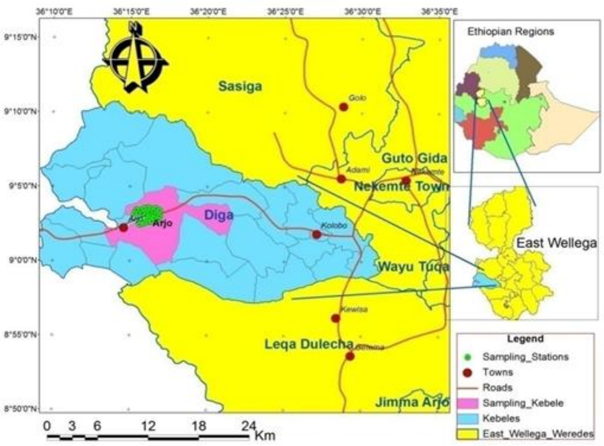
- To access the effects of infiltration trenches on selected soil physico-chemical properties and biomass productivity
- To evaluate the role area enclouser on the biomass productivity of grazing land and soil properties
- To evaluate the interaction effects of area enclosure and physical treatments

DESCRIPTION OF THE STUDY SITE

Location

Arjo Gudetu rural kebele is one of the Diga district kebele that located close to Didessa River in Southwestern part of the Abbay River. The geographical location of the study area is between 09⁰10' N and 0 9⁰00' N latitude and 36⁰10' E and 36⁰30' E, longitude. The study area is located at 346 km and 40 km west of Addis Ababa and Nekemte, cities, respectively. The area shares boundaries with West Wollega Zone in the West, Guto Gida District in the East, Sasiga in the North and Leka Dulecha in the South (Figure 1).

Figure 1. Map of the study area and sampling plots.



Topography, Geology and Soils

The altitude of Diga district ranges from 1100 to 2300 m asl and comprises two agro-ecological zones: the lowland (51%) and middle altitude agro ecology (49%) [8]. The dominant soil color of the area is red in the middle altitude, and black in the low land and generally classified as Cresols and Anisole, with some occurrence of Verticals and Nitosols. Once the productivity declines too far, farmers simply move on clearing yet more forest, this increases the desperate marginalization of the rural poor, which in turn aggravate degradation of natural resources in the area.

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Climate and water availability

The mean annual rainfall varies from 1,200 to 2,000 mm and the minimum and maximum mean Temperatures are 18^{0}C and 32^{0}C respectively. The area received the unimodal rainfall pattern, the main rainy season (June to September) and the heavy rain observed from July to the end of August. The study area is generally located at low altitude where water shortage (rain fed and irrigated) limit crop and fodder biomass productivity. Recently it is under severe stress, due to land degradation, steep slope cultivation, deforestation for expansion of agriculture and expansion of Eucalyptus plantation along river and stream banks [9].

Land use and farming system

The area of land in the district estimated to be 59,550 ha, of which 49% and 51% are located in mid-altitude and lowland agro-ecological zones, respectively. The major crop growths are maize followed by sorghum, sesame and finger millet in the low altitude agro-ecologies while teff and Niger seed are major crops of the mid altitude agro-ecology [10].

Socio-economic features and farming system

The main crops grown are; Teff (*Eragrostis tef*), Finger millet, Maize (*Zea mays*), Noug (*Guizotia abyssinica*), Faba bean (Vicia faba) and Barely (*Hordeumvulgare*) in the middle altitude and Maize, Sorghum, Seasam (*Sesamum indicum L*) and Haricot bean (*Phaseolus vulgaris*) are grown in the low land areas and coffee (*Coffea arabica*) are also widely grown. Population pressure, land degradation, inefficient use of water (rainfed and irrigated) and inappropriate land use and land and water management practices, are among the common challenges to the sustainability of the agricultural systems.

MATERIALS AND METHODS

Experimental Design and Treatments

For experimental work, nine farmer's plots selected. Whereas four farmer's plots with infiltration trench and five farmers plots were area enclouser and each plot were sub divided into two equal parts, one for Rhodes and another for native grasses. The study involves two factors IT (with and without) were main plot factor and grass managements were subplot factors. The treatments were randomized complete block design in a split plot arrangement. The design of infiltration trenches in this study was to allow 0.6 m depth and 0.6 m width while the length was dictated by the dimension of the plot, but tied at 3 m interval to avoid concentration of runoff to a part of the field, which otherwise may result in overflowing and hence erosion (Figure 2).

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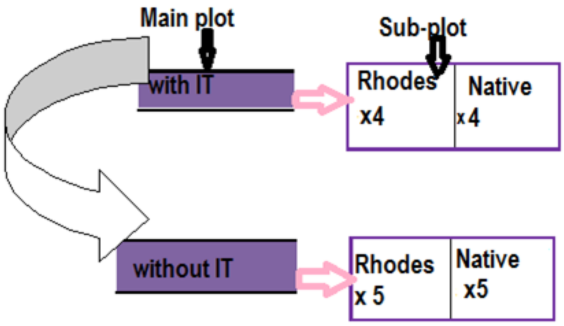
Figure 2. Experimental design for grassing land.



Soil sampling and analysis

Soil physical analysis

Monitoring soil moisture: Soil samples were collected using a spiral auger at two depths (0-30, 30-60 cm) for gravimetric moisture content determination. The samples were labeled and put into 22 mm plastic bags and transferred to Oromia Agricultural Research Institute Nekemte soil Laboratory. The soil moisture content was determined by drying the soil to constant weight and measuring the soil sample mass after and before drying. The water mass was calculated as the difference between the wet and oven dry samples. This was done as follows: initially weighing the field samples (10 g) using sensitive balance and drying the field samples at 105^{0}c for 48 hours in the oven and weighing them again. The percentage of water held in the soil was calculated as (Equation 1).

$$\% \text{ Mc} = \frac{\textit{weightof sample before oven dry} - \textit{Oven dry}}{\textit{weight of ovendry soils}} \text{x100} --- \textbf{Equation 1}$$

Where

Mc = Moister content

Analysis of soil chemical properties

Soil samples were collected at harvesting stage for all plots at 0-30 cm using spiral Auger and then the selected chemical properties determined as follows: organic carbon using Walkely and Black method (Neilsan and Sommers,), total nitrogen using Kjeldahl digestion and distillation method, available phosphorous Bray II Method, Soil pH was determined at soil: water suspension ratio of 1:2 using a conventional glass electrode pH meter and CEC was determined by Ammonium acetate Method at Ethiopian agricultural research institute of Debre Zeit agricultural research center.

Agronomic data collection

Agronomic data such as average plant population was estimated by counting the number of plants from three randomly taken quarter of the quadrant (*i.e.,* 50 cm by 50 cm). Physiological maturity data such as the number of days, from reseeding to the harvesting date, Plant height (cm), number of tillers per plant was recorded by conducting follow up on the grass and fresh biomass of the grass was collected and dries biomass weight were determined.

Determination of dry biomass Rhodes and native grass: At maturity date (end of October and beginning of November 2016), the whole plant parts, including leaves and stems was harvested from three 0.5 m* 0.5 m (quadrant) at ground level from each plot. The quadrants were randomly put over the plots without considering the area occupied by infiltration

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trenches. The fresh weight of the biomass from the quadrant was taken immediately in field using spring balance Then, about 1 kg fresh biomass from each quadrant is mixed to make 1 kg per plot sample was taken to laboratory for moisture content determination. The Moisture straw was calculated by taking about 30 grams of grass and oven dried at 65^{o}c for 48 hours at Nekemte research center and oven-dried biomass recorded again. Then the weight difference of fresh and oven dried biomass was divided by the weight of fresh sample alone multiplied by 100 was gave the percentage of moisture straw (Equation 2) [11].

$$\% \mathbf{MS} = \frac{FB-OD}{FB} X100 --- \text{Equation 2}$$

Where, MS=Moisture Straw, FB=Fresh Biomass, OD=Oven Dried biomass then, percent of dry biomass at harvest was obtained by multiplying 100 by the ratio of the dry weight to the fresh weight (Equation 3).

$$\%\text{dry matter} = \frac{\text{Final dry weight (g)}}{\text{Initial wet weight(g)}} x\ 100 --- \text{Equation 3}$$

Plant height was measured as the height from the soil surface of three randomly taken plants from each plot at maturity using graduated stick. The number of tillers per plant was counted at maturity from three randomly selected plants. The tillers number of plants was counted and their averages were taken as the number of tillers per plant.

Data analysis

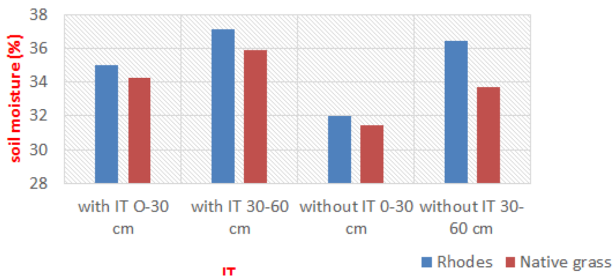
The collected data was subjected to Analysis of Variance (ANOVA) using General Linear Model (GLM) procedures in SAS version 9.2.3 (SAS Institute, 2002). Means that were significantly affected by the treatments were separated using the Least Significant Difference (LSD) test at 5% level of significance.

RESULTS AND DISCUSSION

Effects of infiltration trench on soil properties

Soil moisture contents: Soil moisture is one of the sources of water available to grass growth. Excessive volumes of water in a soil retards plant growth and make drainage essential. The critical perusal data in (Figure 1) revealed that the use of IT significantly influenced the soil moisture content. The improved soil moistures content by the use of infiltration trench in the study area positively affects tiller per plant and plant height of native and Rhodes grass while Rhodes biomass was insignificantly affected. The previous reports of Brown and Schueler similar with the present study that infiltration trench is used in agriculture to collect surface run-off, increase water infiltration and prevent soil erosion. The higher soil moisture content under infiltration trenches than the control plot throughout the growing period observed in current study concurs with earlier reports where soil and water conservation structures were reported to reduce loss of water, soil and valuable nutrients [12].

Figure 3. Graph of soil moisture contents on the grazing lands.



As the data presented by (Figure 3) the infiltration trench did significantly influence on the moisture conservation at 0-30 cm and 30-60 cm soil depth. The mean values of soil moisture content 35.04% obtained in the of plots IT at 0-30 cm while 37.18% from non-conserved at 30-60 cm soil depth. The maximum soil moisture content recorded in plots with IT were 35.4% and 37.18 % at 0-30 cm and 30-60 cm depths respectively, while 32 % at 30-60 cm and 36.45% at 0-30 cm depth were maximum soil moisture recorded for the control plots on grazing lands respectively. The results was similar with the findings of Stroosnijder and Hoogmoed that reported as the mean soil moisture content under closed area with SWC was higher than under closed area without SWC and open grazing land. Soil moister content is a factor that can be affected by SWC practices, because the structure captures moisture, enhance infiltration and reduce surface runoff and evaporation [13].

Soil chemical properties

Organic carbon: Organic carbon was significantly ($P \leq 0.05$) affected by the use of IT (Table 1) on grazing land. The higher mean values of organic carbon 4.85 % obtained in the plots of IT while the lower mean value 4.21 % scored in the plots without IT. The present result was similar with the findings of Kebede, et al. Who reports construction of soil and water conservation structures reduces surface runoff and soil loss thereby retaining water, which enhances plat growth.

Area enclosure also positively affects the mean value of OC and used as supplementary for the use of IT, as enclosure age also plays a role in conditioning the rehabilitation impact on soil properties [14]. The previous works of Singh and Lal (2005) was similar with this result. According to their reports, adoption of technologies for restoration of degraded soils by establishing ecological based vegetation cover, using appropriate soil and water conservation measures, adopting water harvesting measures, enhancing nutrient recycling mechanisms, and controlling stocking rate increases the SOC stock through creating conducive medium for increasing above ground biomass and enhancing its humification. Also the enclosure have great impacts on the mean value of OC as organic matter accumulation in the enclosure site could be the higher vegetation coverage which resulted in higher litter input and thus higher accumulation of organic matter in the soil [15].

Available phosphorus: Phosphorus is an essential plant nutrient and is taken up by plants in the form of inorganic ions. Available Phosphorus was considerably not significant affected by IT practices ($P \leq 0.05$). The results showed that, available phosphorus in plots of IT (4.41 ppm) was higher than that of without plots of IT (4.02 ppm). The result was similar with the findings of that reported as highest amount of phosphorus was recorded in IT a plot which was significantly different from the controlled plot. The AvP in most soils of Ethiopia decline by the impacts of fixation, abundant crop harvest and erosion [16]. The relatively higher amount of available phosphorus in the IT stabilized by vegetation than in other plots may probably be due to its high mean organic carbon content.

Soil pH: The results of pH value analyzed were not significantly affected by the soil and water conservation practice on the study area. The higher soil mean pH value (6.02) obtained in the plots of with IT and the lower means pH values (5.23) was observed in the plots of without IT as presented in Table 1. This observation agrees with that reported by Bobe and Gachene and Belay that reported as a the value of soil pH was lower with increasing soil loss on the unprotected land and the soil pH value increase with the reduction of soil loss through application of soil and water conservation methods.

Total Nitrogen: Total nitrogen was significantly affected by use of IT in study area at ($p<0.05$). Numerically the plots of IT have higher mean value than that of without IT as presented in Table 1. The mean total nitrogen in the plots of with IT was 0.26 while the mean value of TN on the plots of without IT was 0.22 which is difference in between. This finding was similar with the findings of the articulated, as the overall TN was higher under closed area with SWC than in soil under closed area without SWC. Also reported that the land with physical SWC measures have high total nitrogen as compared to the non-conserved land.

Cation exchange capacity: Cation Exchange Capacity (CEC) was not significantly affected by the use of infiltration trench in the present study. But higher mean value was observed on the plots of soil and water conservation (Table 1). The results was similar with the finding of Lemma (2015) that reported as stone faced soil bund with mean value has significantly higher Cation Exchange Capacity (CEC) than non-treated plots with mean value .The CEC of a soil can be reduced by soil erosion through the loss of soil organic matter and clay particles [17].

Table 1. Mean value of selected soil chemical properties on grazing land.

Treatment	TN (%)	AvP (ppm)	PH (1:2H_2O)	OC (%)	CEC (meq/100 g)
With IT	0.26^a	4.41	6.02	4.85^a	24.79
Without IT	0.22^b	4.02	5.23	4.21^b	24.68
LSD (5%)	0.13	1.05	1.08	0.57	4.47
CV (%)	16.74	25.56	20.54	19.14	17.47

Effects of Infiltration trench on growth Rhodes and native grass

Effects number of tiller per plant, plant height and dry biomass

Number of tillers: Statistical analyses of variance showed that there were not significant differences between plots of IT and controlled on the number of tillers per plants. Mean tiller number was increased on the plots of with IT ($p \leq 0.05$) as shown in (Table 2) [18]. The higher mean value of tiller numbers per plants observed on the plots of with IT (6.125) than without IT (5.9). When compared with the results of 2014 (5.57) in the plots of soil and water conservation the tiller per plants was increase by 9% as the results of IT. On the anther hand, average number of tillers from plots with Rhodes grass (5.667) was less than that of native grasses (6.3) (Table 2). The reduction of tillers per plant in the plots of Rhodes might be related to nutrient availability and lack of proper management as the Rhodes grass need more management and fallow up than native grass. Tillers increase the chance of survival and the available forage resource of grasses and tiller numbers are an indicator of resource use efficiency by different grass species. A Grass plant has the ability to produce tillers [19].

Plant height: The plant height was not significant ($p<0.05$) affected by the use of infiltration trenches. However, the plots of soil and water conservation gives higher mean value than the controlled plots as presented in Table 2 [20]. The higher mean height and lower mean value (151 cm) and (144 cm) were obtained in the plots with and without IT respectively.

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Consequently, the use of infiltration trench increased by the plant height by 4.6%. Native grasses were taller (153.5 cm) than Rhodes grass (148.5 cm) as the data in Table 2. Therefore, infiltration trench positively affects plant growth by conserving nutrient and moisture availability in the soil. Vishwanath acquire results that corroborate with this finding. He reports the main contributing factors for the heights of the grass was infiltration trench, an excavated depression perpendicular to the land slope and run-off, thereby promoting infiltration and increased vegetative cover in extensive grazing land [21].

Dry biomass: Statistical analysis showed that the treatments had no significant effect on dry biomass as presented in Table 2. Numerically, the plots of IT had lower (5625) biomass than that of controlled plots (5767). The consequences were related with the reduction of Rhodes grass biomass, as Rhodes grass needs more management than native grass. Rhodes grass produce lower biomass (5337.85 kg ha^{-1}) when compared with native grass (6071.56 kg ha^{-1}) as presented in Table 2. The results was similar with the previews works Bekeshe, that reported as the use of infiltration trench not significantly affects the biomass since the physical soil conservation measures does not bring change in short periods of time [22].

Table 2. Effects of IT on number of tillers, number of plants.

Treatment	Number tiller/plant	plant height (cm)	dry biomass (kg ha^{-1})
With IT	6.125^a	1 51^a	5625
Without IT	5.9^a	1 44^a	5 767
L SD (5%)	3.24	2 8.53	N s
C V (%)	34.72	1 5.24	2 5.14
Grass type			
Rhodes	5.67^a	1 44.67^a	5337.85^a
Native grass	6.3a	1 49.55^a	6071.56^a
L SD (5%)	2.88	3 2.6	2344
C V (%)	3 4.72	1 5.238	25.14
Means within the same column or row followed by the same letter are not significantly different at 95% confidence limit NS=Not Significantly			

As the present study, native grass was more effective than Rhodes grass. So that, protection and restoration of native grass is critical for long-term and sustainability of animal production. The results were contradicted with the study conducted by Bekeshe on the same plots. She reports the use of infiltration trench significantly affects the biomass of Rhodes. The contributing factors for the reduction of Rhodes may be low management practices like lack of fertilizer application and time of weeding. On the other hand, using Rhodes grass for long time on the same plots may have negative impacts on biomass of Rhodes [23,24].

Interaction effects of infiltration trench and area enclouser on Rhodes grass on number Tiller per plants: The combination effects of infiltration trench and Rhodes grass no significant ($P \leq 0.05$) effects on the height of the plants as revealed in Table 3 as the results of lower value (5.6) obtained from the interaction of IT and Rhodes grass. The higher mean value of tillers per plant obtained from native grass in the plots of IT (6.5) [25]. The results were contradicted with the finding of Bekeshe [26]. The reason may relate with lack of application of available fertilizer and reseeding on the same plots for long time.

Table 3. Interaction effects of IT and Rhodes grass on number of tillers

Main plot* subplots	Tiller per plant		
	Rhodes	controlled	mean
With IT	5.75[a]	6.50[a]	6.12
Without IT	5.75[a]	6.20[a]	5.9
LSD (5%)	5.75[a]	3.77	
CV (%)	27.52	6.313	
Means within the same column or row followed by the same letter are not significantly different at 95 % confidence limit. NS=Not Significantly			

Plant height: The combination effects of IT and Rhodes grass re-seedling was not significantly ($p \leq 0.05$) affects plant height as presented in Table 4 [27,28]. However, the height of plants was a variation between plots with and without soil and water conservation and there was also deference between grass varieties. The native grass in the IT plots had higher mean value of plant height (153.5 cm) than the interaction effects of Rhodes with IT (148.5 cm). This may be due to lack of management, application of fertilizer and using for a long period on the same plots. The findings of coincide with the present as the deficiency of major nutrients in Rhodes grass restricted growth of plants due to which plants could not attain good height [29].

Table 4. Interaction effects of IT and Rhodes grass on plant height and biomass.

Main plot* subplots	Plant height (cm)			Dry biomass (kg ha^{-1})		
	Rhodes	controlled	mean	Rhodes	controlled	mean
With IT	148.50[a]	153.50[a]	151	5138.07	6113.44	5625.76
Without IT	141.00[a]	146.40[a]	144	5497.68	6038	5767
LSD (5%)	16.97	39.24	32.6	1782.5	2205.4	
CV (%)	13.36	15.98	14.9	22.82	25.38	
Means within the same column or row followed by the same letter are not significantly different at 95 % confidence limit. NS=Not Significantly						

Biomass: The analysis results revealed that, the interaction effect of infiltration trench and Rhodes grass reseeding had no significant ($p \leq 0.05$) effect on the dry biomass while native grass produces numerically higher dry biomass (6113.44 kg/ha) [30,31]. As the results of present finding the biomass of the Rhodes grass down since Rhodes grass needs proper management. For the incremental mean value of dry biomass of the native grass, area enclosure has positive effect. This

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was similar with the result obtained by Ibrahim that reported enclosure areas have been effective in restoring plant species composition, biomass and cover of herbaceous species and the enclosure areas were in a better condition than the communal grazing areas.

CONCLUSION

The study confirms that the use of Infiltration trench increased soil moisture content at both 0-30 cm and 30-60 cm depth. The value TN and OC was significantly affected by the use of infiltration trench while AvP, Ph and increased. As the present study pant height and tiller per plant increased by 9% and 4.6% respectively as infiltration trench prevented soil erosion by trapping and storing sediments and run-off, thereby promoting infiltration and increased vegetative cover.

Reseeding Rhodes grass was not significantly affect selected soil physico-chemical properties, soil moisture content at both 0-30 cm and 30-60 cm soil depth plant, growth parameters like biomass, number of tillers and plant height

The interaction effects of infiltration trench and area enclouser significantly affects soil moisture at both soil depth 0-30 cm and 30-60 cm and total nitrogen. However, plant height and tiller per plants increased. However, the dry biomass of Rhodes was decreased.

RECOMMENDATIONS

Based on the findings the following recommendations are forwarded;

- Infiltration trench had increased growth parameters like number of tillers and plant height while biomass productivity decreased. Thus, additional research focusing on the application of fertilizer and length of year required.
- The establishments of area enclosures should be encouraged since area enclosure, no needs any labor requirement for establishments and increase the productivity of grazing land through reducing soil erosion and improving soil quality.
- By the present finding, the biomass of Rhodes grass was insignificant. So, further research is needed in the area to identify the durability of years available for Rhodes grass reseeding on the same site and the application of fertilizers on Rhodes grass.

REFERENCES

1. Araya Alemie and Stroosnijder L, et al. Effects of tied ridges and mulch on barley (Hordeum Vulgare) rain water use efficiency and production in Northern Ethiopia. Agric. Water Manag, 2010;97:841-847.
2. Balana BB, et al. Assessing the sustainability of forest management: an application of multicriteria decision analysis to com-munity forests in northern, Ethiopia. J Environ Manage, 2010;91:1294-1304
3. Baylis K, et al. Land Degradation's Implications on Agricultural Value of Production in Ethiopia: A Look inside the Bowl. Int Rev Agric Econ, 2012;18-24.
4. Blanco R, et al. (2008) Principles of soil and water conservation. Springer, New York. 285.
5. Bobe Bedadi and Gachen, et al. Effects of different soil conservation methods on soil productivity in the Harege

highlands of Ethiopia. E Afr J Agric. 1999;65:95-100

6. Bot A, et al. (2005) The importance of soil organic matter: key to drought- resistant soil and sustainable food production. FAO soils bulletin. Rome, Italy. 80:548.
7. Brady NC, et al. Properties and nature of soils. (13th edition). Prentice- hall inc, New Jersey, USA. 2002;960.
8. Demir M, et al. Harvesting impact on herbaceous understory, forest floor and soil properties on skid road. J Environ Biol. 2007;28:427-432.
9. Desslegn Etana, et al. Effects of Level Soil Bund and Ages of Bund on Teff Productivity and Soil Properties: At, Nejo District, Oromia Region, Ethiopia. SF J Agri Crop Manag. 2020;1:1008
10. Erkossa Teklu, et al. Agricultural water productivity across landscape positions in the Ethiopian highlands. Int Water Manag Inst. 2015;5-6.
11. Erkossa Teklu, et al. Characterization and Productivity Assessment of the Farming Systems in Upper Part of Nile Basin. J Nat Resour. 2009;11:149–167.
12. Erkossa Teklu, et al. Soil fertility effect on water productivity of maize in the upper Abbay basin, Ethiopia. J Agric Sci. 2011;2:238-247.
13. Eyasu Y, et al. (2005) Development and management of irrigated lands in Tigray, Ethiopia. Wageningen University and Research ProQuest Dissertations Publisher, Netherlands.
14. Gete Zeleke, et al. (2000) Landscape dynamics and soil erosion process modeling in the north western Ethiopia highlands. African studies. University of Berne, Switzerland. 226.
15. Haile G, et al. Assessment of soil erosion hazards in Kilie catchment east Shoa, Ethiopia. Land Degrad Dev. 2015;23:293-306.
16. Haileslassie A, et al. Assessment of soil nutrient depletion and its spatial variability on smallholders' mixed farming systems in Ethiopia using partial versus full nutrient balances. Agric Ecosyst Environ. 2005;105:29–40.
17. Hengsdijk H, et al. Modeling the Effect of Soil and Water Conservation Practices In Tigray, Ethiopia. Agric Ecosyst Environ. 2005;105:29-40.
18. Imran Arshad, et al. Integrated impact of nitrogen and phosphorus on Rhodes grass under Ghotki environment. J Agric Res. 2016;54:687-695.
19. Lal R, et al. (1990) Soil erosion in the tropics: principles and management. McGraw-Hill, Department of Agriculture field libraries, US. 580.
20. Lemma Tiki, et al. Effects of integrating different soil and water conservation measures into hillside area closure on selected soil properties in Hawassa Zuria district, Ethiopia. J Soil Sci Environ. 2015;268-274.
21. Mekuria W, et al. Enclosure for restoration of the degraded communal grazing lands in northern Ethiopia. Land Degrad Dev. 24: 528–538.
22. Morgan RPC, et al. Soil Erosion and conservation. 3rd Edition. Blackwell Publishing, New York, USA. 2005.
23. Mosisa Ararso, et al. (2015) Impacts of forest degradation on rural livelihoods and food security, east wollega zone, Ethiopia. Department of Geography and Environmental Studies, East Wollega Zone, Ethiopia.
24. Mulugeta D, et al. Assessment of integrated soil and water conservation measures on key soil properties in south Gonder, north-western highlands of Ethiopia. Soil Sci Environ Manage. 2010;1:164-176.
25. Mulugeta Lemenih, et al. Effects of land use change on soil quality and native flora degradation and restoration in the highlands of Ethiopia. J Agric Chem Environ. 2004;10.
26. Stroosnijder L, et al. The contribution of soil and water conservation to carbon sequestration in semi-arid Africa.

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Bull Res Erosion. 2004;23:528-539.

27. Vancampenhout K, et al. Stone bunds for soil conservation in the northern Ethiopian highlands: impacts on soil fertility and crop yield. Soil Tillage Res. 2005;90:1-15.
28. Verdoodt A, et al. Impacts of management and enclosure age on recovery of the herbaceous rangeland vegetation in semi-arid Kenya. J Arid Environ. 2010;74:1066–1073.
29. Welle S, et al. Effectiveness of grass strips as barriers against runoff and soil loss in Jijiga area, northern part of Somalia region, Ethiopia. Agric Nat Resour. 2006;40:549-558.
30. Hanspeter L, et al. (2007) WOCAT 2007: Where the Land is Greener: Case studies and analysis of SWC worldwide cases and analysis of approaches and techniques. 1st edition. Edited by WRSC and HP Liniger: WOCAT, Berne, WOCAT, Berne, Switzerland.
31. Woldeamlak B, et al. Soil and Water conservation intervention with conventional technologies in northwestern highlands of Ethiopia: Acceptance and adoption by farmers. Land Use Policy. 2007;24:404-416.