Soil and Water Conservation

Quantifying the Impacts of Livestock Trampling on Runoff, Soil Loss and Crop Yield under Traditional Teff Cultivation System

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Abstract

Tef is one of Ethiopian stable food crops and is widely cultivated in many areas of the country. It needs fine seed bed preparations and is planted lately compared to other main season crops. Under the traditional farming system of tef, farmers use livestock trampling to compact the soil. There were two different hypotheses concerning the effects of trampling upon water and soil conservations. The first hypothesis was trampling reduces infiltration of water into the soil thereby increases runoff, soil loss, nutrient loss and finally grain yield would be reduced. The second hypothesis was in favor of trampling that trampling increases adhesion of soil particles thereby reduces soil loss and accompanying nutrient losses and hence increases yield. To justify the effects of trampling on run-off, soil loss and crop yield, a research was undertaken at Adet and Debre Tabor (on station) for four years with treatments trampled, leveled, and control. A runoff plot technique with a run-off and sediment trap at the bottom of each treatment was used for collection of water and soil loss. There was no significant difference between treatments for grain yield, plant height and root depth in general. However, there was very high significant difference between treatments for runoff and soil loss. The highest runoff (898.05m^3 water/ha) and soil loss (3549 kg /ha) was registered from trampled treatment while the lowest from the control (447.4 m^3/ha water and 1518 kg soil /ha). Except the demand of livestock and other inputs for trampling, no reward or positive response was found from trampling; rather the loss of water and soil was very higher. The result generally showed that trampling is unjustified cultural practice.

Key words: farming system, infiltration and runoff, soil lose, Trampling,

Introduction

The livelihood of Ethiopians and the country's gross domestic product mainly depend upon agriculture. Agriculture in Ethiopia is characterized by low mechanization, low chemical inputs (fertilizer, herbicides, insecticides) local crop varieties and local livestock breeds. In short, the country exercises extensive farming system. However, the carrying capacity of the land to support both livestock and crop is approaching reached to its maximum and extensive farming is always on the expense of natural resources (soil, forest and water). This is especially true in the highlands of Ethiopia where the number of livestock and human population is very high and land degradation reached to intolerable level (FAO, 1986). The effect of natural resources degradation was clearly observed on the occurrence of 1974 Ethiopia drought and famine (FAO, 1986). Degree of natural resource degradation varies within our country and the highest being in northern parts of the country where there are places that are rocked out and wasted. Amhara Regional State is one of the states seriously threatened by natural resources degradation (Lakew etal, 2000). Current degradation is more sever in the so called high potential areas for

agriculture in the region. There are different factors contributing for soil degradations in the region such as crop types and their cultural practices (sowing date, plowing frequency, crop cover etc). The region is dominated by annual crops that have positive relation with soil erosion (FAO, 1986, Lakew etal 2000). Among annual crops, tef is one of the major crops grown by farmers in the country as early as 1000 and 400 BC (Hailu and Seifu, 2000). Tef is a stable food for the country and different kinds of food staff are made of tef. According to CSA data of 1999, the area coverage of tef in Amhara region was 42.6 % from the total production area. Tef is planted very lately as compared to other cereal crops, needs fine seed bed preparation and trampling with livestock (Hailu and Seifu, 2000, Seifu, 1997). Because tef is planted very lately, the land is not covered during peak time of soil erosion and erosion from tef field is very high (FAO, 1986, Lakew etal., 2000). The importance of fine bed preparation for tef production is well justified by Hailu and Seifu (2000) and also by Sifu (1997). However making the bed too fine with frequent plowing is exposing the soil for erosion. As far as herbicides are used, there is no significant importance for plowing frequencies (Seifu, 1997) for tef production. Trampling is another cultural practice with tef production system. Trampling is exercised by farmers to promote germination and establishment, to make the seed bed firm, to prevent the soil surface from drying and to free the seed bed from weeds (Seifu, 1997). He also added that in areas with sufficient rainfall, trampling is not needed for promoting germination and establishment. But others argue that trampling has a negative impact on water infiltrations and hence moisture conservation (Connolly etal., 1998, G. Tadesse etal., 2002, G. Fierer and J. Gabet, 2002, and Van vuren etal, 2001). They all justified that trampling reduces infiltration by closing the porous system and therefore increases runoff. Increasing runoff is reducing the moisture of the soil and runoff is accompanied with soil loss. Moreover, the need to livestock for trampling makes the practice more costly from both individual farmers and community levels perispective. Regardless of all the arguments listed, there is limitation of research results showing full-fledged data on the effect of trampling on grain yield, runoff, soil loss etc. Therefore, data based information generation remains vital to reach into conclusions either to accept or reject trampling. The research was, therefore, carried out with the objective of investigating andquantifying impacts of livestock trampling on runoff, soil loss, yield and weed infestation.

Material and Methods

The experiment was carried out at Adet and Debre Tabor (on stations) for four consecutive years. Sites were representative for major soils and slope ranges to each location. Plowing frequency, fertilizer rate, seed rate, time of planting and trampling were according to farmers practice. Plots with 5 meter by 22 meters were used. Treatments were: 1) leveled 2) control 3) trampled. Each treatment was randomized and replicated three times. So as to avoid treatment mixing and entering of run off from out side of the testing plot, each plot was surrounded by corrugated iron sheet. Runoff plot technique was employed to assess soil and water loses. At the bottom of each plot, there was a run-off collecting tanker. Data was collected whenever there was rainfall. Amount of water was measured with volumetric cylinder. From collected runoff, one liter uniformly mixed sample was taken and filtered with filter paper. The sample was oven dried and dry weight of soil sample was measured and the total weight from the runoff was calculated.

Weed infestations from each plot was uprooted and the fresh weight was measured. All agromic data including grain yield, plant height and root length were taken. Finally, the data were analyzed using MSTATC statistical software to test the hypothesis.

Results and Discussion

Grain yield, agronomic parameters and weed bio-mass

As could be seen in Table 1, for most of the parameters considered there was no significant difference among treatments. At very early stage of the crop stand, the trampled and leveled plots looked visually better and uniform than the control. However, at the end of its course of growing, almost all treatments become uniform. It is in agreement with conclusions of Seifu (1997) that for places with enough moisture, response of tef yield for tramping is low. There was a slight increase in yield for trampling for some of the years but it was not statistically significant.

Table 1: Effect of trampling on grain yield selected agronomic parameters of tef and weed bio-mass

Treatment	YEAR- 1

Soil loss and runoff

There was highly significant difference between treatments for both runoff and soil loss (Table 2). The highest amount of runoff and soil lose was recorded from trampled plots. This result disagrees with the hypothesis that trampling is good in moisture stress areas to maintain soil moisture and thereby increase grain yield (Seifu, 1997).

Table 2: the effect of land preparation techniques on runoff and soil loss

Treatment	Total soil loss (kg/ha)	Total runoff (m^3/ha)
Level	1968	431.072
Not trampled	1518	447.399
Trampled	3549	898.049
F- value	10.8733	25.6506
Prob.	0.0010	0.0000
c.v.	47.77	30.61

Similar to the results of this research, Connolly et al. (1998) also found that grazing of animals reduced the infiltration because of trampling and vegetation reduction. Taddese et al. (2002) evaluated the impact of trampling on the physical characteristics of Vertisols in Ethiopia and reached into conclusion that from plots of heavy grazing filds, the soil was resistant for water penetration. This resistance was due land compaction by animals that created high runoff which was in agreement with findings in this experiment. The research result of this experiment agrees with the findings of Fierer and Gabet (2002) and Van Vuren et al. (2001).

Conclusions and Recommendations

From the results of the experiment, it is possible to make the following conclusions.

- Trampling had lesser contribution in reducing weed infestation;
- Trampling didn't have positive contribution for grain yield;
- The soil loss from the trampled treatment was more than the non-trampled treatment by two folds. Therefore, trampling enhances soil loss;
- Trampling reduces infiltration and thereby increases runoff.

From the results of the experiment, it is possible to recommend that farmers can grow tef with out trampling their fields. This practice will reduce run-off, soil loss and increases profitability of tef production.

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