Livestock Science 157 (2013) 271–279

Contents lists available at ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

Collective management on communal grazing lands: Its impact on vegetation attributes and soil erosion in the upper Blue Nile basin, northwestern Ethiopia

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ARTICLE INFO

Article history:
Received 3 May 2012
Received in revised form
19 June 2013
Accepted 19 June 2013

Keywords:
Grazing land management
Overstocking
Ground cover
Resting pasture
Land degradation

ABSTRACT

Collective action, on communal grazing land, has evolved in the highlands of northwestern Ethiopia to mitigate the problems of feed shortage and land degradation due to overgrazing. The exercise is liked by farmers for improving the availability of natural pasture during the long dry season when other feed sources get depleted. However, large portions of the communal grazing lands are still managed under free grazing throughout the year. This study was undertaken in *Maynet* village in the upper Blue Nile basin, northwestern Ethiopia, to assess the impacts of three different types of grazing land management (GLM) and two slope gradients ($<10\%$; 15–25%) on aboveground herbaceous biomass yield, ground cover, species richness, runoff, soil loss and soil bulk density of grazing lands. The GLMs include (a) freely open communal GLM, (b) restricted communal GLM – collective management of communal grazing land locally named as '*yebere sar*' and (c) private holding GLM. Stocking density was more than carrying capacity of grazing lands across all GLMs. However, the extent of overstocking problem was exceptionally severe in freely open communal GLM. The interaction between GLM and slope was significant ($P<0.05$) for runoff, soil loss and runoff coefficient. The average runoff coefficient was close to 50% in freely open communal GLM on steeper slopes (15–25%). Freely open communal GLM on steeper slopes resulted in consistently highest cumulative runoff and soil loss amounting to 491 mm and 32 t/ha per year, respectively. Polynomial regression analysis showed that quadratic relationship ($r^2=0.87$) existed between soil loss and runoff. But, soil loss was close to nil when runoff did not exceed 2 mm per rainfall event. As expected, restricted communal GLM appeared to reduce surface runoff by more than 40% and curb the rate of soil erosion by more than 50% compared to freely open communal GLM. Its vegetation cover persisted above 70% throughout the year, meeting the threshold level recommended to keep surface runoff and soil loss to minimum. Reducing the problem of overstocking and pasture resting in August–November are important components to improve ground cover and aboveground herbaceous biomass yield, which in turn reduce land degradation on grazing lands.

1. Introduction

Throughout the world today, natural resource depletion is among the major problems faced by human beings

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http://dx.doi.org/10.1016/j.livsci.2013.06.024

(UNEP, 2011; WWF, 2010). However, there are great differences in the abilities of countries to cope with the problem of sustained use of natural resources (Hurni, 1997). Of all the regions in the world, sub-Saharan Africa (SSA) that embraces least developing countries suffers most from accelerated soil erosion (Fleitmann et al., 2007; Lal, 1990). In Ethiopia, land degradation is a core problem threatening sustainability of the traditional agricultural system (Hagos et al., 2002; Nyssen et al., 2009; Zeleke and Hurni, 2001) on which more than 80% of the population relies for its livelihood (EPCC, 2008). Its negative impact has contributed to the country's overarching problem of protracted impoverishment and increasing social stress (Demelash and Stahr, 2010; Hurni, 1993). In assessing the cost of land degradation in Ethiopia, the annual loss due to erosion and soil nutrient reaches 80 million USD which amounts to 3% of the agricultural gross domestic product (Böjo and Cassells, 1995).

In Ethiopia, agricultural land degradation is associated with the unsustainable exploitation of the land resource (Bewket and Teferi, 2009; Nyssen et al., 2004) and is believed to arise partly from the existing land tenure system (Gebremedhin et al., 2002; Tenaw et al., 2009). The land tenure system of Ethiopia assigns the entire land ownership to the government while the people have a use-right of various forms (Ahmed et al., 2002). It recognizes communal ownership of grazing lands respecting customary use right (but no functional policy towards its sustainable utilization) that are mostly subjected to free grazing management. Despite the challenge of ecological degradation persisting in the country, farmers' engagement in successful land conservation practice is limited (Demelash and Stahr, 2010; Shiferaw and Holden, 1999), with the exception of Konso area in southern Ethiopia where contour terracing (stone terracing) is practiced on hill slopes (Beshah, 2003). In northern Ethiopia, community based soil and water conservation measures have also been implemented since the late 1980s and its impact evaluation demonstrated encouraging results (Descheemaeker et al., 2006; Nyssen et al., 2009). Nonetheless, the ever increasing rural population continues to negatively change the land use system (such as cultivation on steep slopes, clearing of vegetation and overgrazing) in most part of the country, provoking accelerated soil erosion (Hurni et al., 2005; Shiferaw, 2011). The expansion of crop cultivation has pushed livestock grazing to patches of marginal and steep sloping common holds (Mwendera et al., 1997; Tamene and Vlek, 2008). Yet, livestock numbers continued to increase despite the dwindling of pastureland (Mengistu, 2006). This situation has inevitably turned most pasturelands into degraded land due to overgrazing (Taddese et al., 2002).

Grazing impacts vary naturally in space and over time due to the normal variability of climate, vegetation, intensity and duration of livestock presence (Mwendera, 1996). Trends of the impacts are partly influenced by farmers' management decisions and partly by natural variations in landforms (Mwendera and Mohamed Saleem, 1997). The key to sustainability of grazing lands is thus managing vegetative cover, not only to provide feed for grazing livestock but also to hold soil in place, to filter water, and to recycle nutrients (Mwendera et al., 1997). In some villages of the upper Blue Nile basin, there is an innovative local experience of collective management on common hold natural pastureland that attempts to solve the problems of feed shortage in the dry season and grazing land degradation. On selected communal pasturelands – locally named '*yebere sar*', farmers put restricted grazing management in place using judicious by-laws developed by the community itself. However, large portions of the communal grazing lands are still in open/unrestricted grazing system. Literature on the concepts, socio-economic contexts, institutional and governance perspectives of collective action including its effectiveness in common hold resource managements have been well developed (Agrawal, 2001; Benin and Pender, 2006; Gebremedhin et al., 2004; McCarthy et al., 2004; Poteete and Ostrom, 2004). The present study intended to explore the impact of collective management on biophysical attributes of communal grazing lands. The specific objectives were (a) to assess above ground herbaceous biomass yield and ground cover of these pastures, (b) to quantify the amount of runoff and soil loss in response to different grazing managements, and (c) to learn lessons from local experiences of collective management having significance to policy implication.

2. Materials and methods

2.1. Description of study area

The study was carried out at Maynet village, from December 2006 to November 2007, in Farta district representing a typical upland ecology of the Blue Nile basin, northwestern Ethiopia. The study site is located with coordinates of 11°44′ N latitude and 38°06′ E longitude. It is situated at an elevation of 2800 m above sea level. The rainfall distribution follows a uni-modal pattern; rains fall in June–September (Fig. 1) and the average total annual precipitation is 1532 mm.

Precipitation peaks in July and August when more than half of the total annual rainfall is received. The coefficient of variation for rainfall in the study area indicates rainfall variability is lower in the wet season than in the dry season (Zewdie, 2010). The mean annual potential evapotranspiration is 1217 mm (Zewdie, 2010). It is cool upland with the mean annual minimum and maximum daily temperature of 9.6 °C

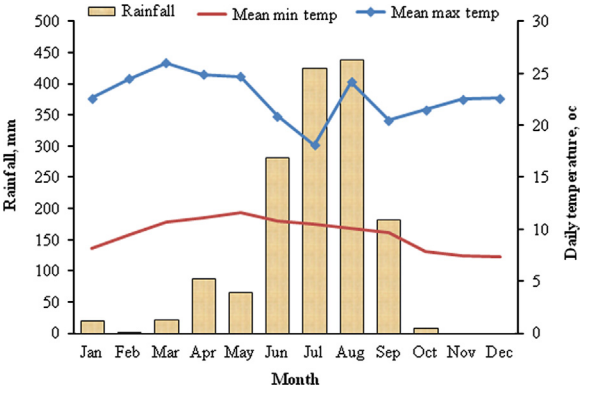

Fig. 1. Monthly rainfall and mean (minimum and maximum) daily temperature of the study area in year 2007.