Catena 164 (2018) 71–78

Contents lists available at ScienceDirect

Catena

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

Prioritization and field validation of erosion risk areas for combating land degradation in North Western Himalayas

V.N. Sharda[a], Debashis Mandal[b,*]

[a] KAB-I, Pusa, New Delhi -110012, India
[b] Indian Institute of Soil and Water Conservation, 218, Kaulagarh Road, Dehradun-248 195, (Uttarakhand), India

ARTICLE INFO

Keywords:
Soil erosion
Targeted erosion rates
Priority areas
Field verification
Soil conservation strategies

ABSTRACT

Appropriate soil conservation practices are essentially required in Indian Himalayan region to prevent degradation of natural resources. Thus erosion priority risk areas need to be identified to efficiently plan and execute conservation programmes. This study envisages to develop a strategy based upon the concept of partial area treatment by classifying erosion risk areas and prioritizing them upon the basis of existing erosion rates with targeted soil loss limits (T-value). The hypothesis is that highest priority for conservation action should go to such areas where the difference between potential erosion rate and the targeted limit is maximum so that available financial resources are efficiently utilized. The analysis indicated that about 25% of the total land area (TLA) in the north-western Himalayan region falls under severe or very severe erosion risk categories, especially where steeply sloping lands are under cultivation or overgrazed for decades. Only about 13% of TLA has T-value of > 10 Mg ha^{-1} yr^{-1} while about 30% area of the area is less prone to soil erosion. Within the region, Uttarakhand state has highest erosion risk area (58%) followed by Himachal Pradesh (48.5%). The concept of prioritization of erosion risk areas and their treatment with appropriate conservation measures was validated with the field data collected from two representative watersheds in the Himalayan region. The present approach can be easily extrapolated to other agro-climatic regions of the country to develop conservation master plans for efficient utilization of limited financial resources on sustainable basis.

1. Introduction

Soil erosion is one of the most serious environmental threats affecting all natural and human-managed ecosystems (Pimentel, 2006; Kalibová et al., 2016; Galdino et al., 2016). Although soil erosion occurs throughout the world since long past, its intensity has steadily increased in recent times due to burgeoning population pressures coupled with diversified and inappropriate land use practices (Mandal and Sharda, 2013; Sharda et al., 2013a, 2013b; Nearing et al., 2005; Leh et al., 2013). The risk of soil erosion in some parts of Indian Himalayas is so serious that the land can no longer be restored for productive utilization thus leading to its abandonment (Mandal, 2014). Intensive or inappropriate land use practices very often lead to serious land degradation problems (Mandal et al., 2010). Almost all the soil threats are caused and aggravated due to anthropogenic activities. It is thus our primary responsibility to plan our activities in such a way that minimizes their impact on soil erosion, especially in mountain areas (Hu et al., 2013; Stanchi et al., 2015). Increasing tourist pressure, changing climate and intensive crop husbandry activities have further aggravated soil erosion problems in hilly regions. The irreversible degradation due to breakdown of soil aggregates, depletion of nutrients, reduction in soil water availability, and enhanced risk of flooding and landslides are the processes closely associated with soil erosion in the region.

The Agro-climatic Zone 1 (ACZ 1) of India represents North-Western Himalayan region comprising of Uttarakhand, Himachal Pradesh and Jammu and Kashmir states, where water erosion is a major factor leading to environmental degradation (Harden, 2001; Angima et al., 2003; Sharma, 2004). As per harmonized database on land degradation, water erosion alone contributes about 68% to the total land degradation problems in India (Maji, 2007; NAAS, 2010). Excessive soil erosion adversely affects soil productivity besides several off-site effects such as damages in terms of rapid siltation of multipurpose reservoirs and lakes (Sharda and Ojasvi, 2016). According to an estimates given by Sharda et al. (2010) the production loss of rainfed agricultural crops due to water erosion in the north western Himalayan states was highest in Uttarakhand (20%) followed by Himachal Pradesh (13%) and least in J &K (10%).

Soil erosion risk assessment is of paramount importance for sustainable land use systems (Zhang et al., 2010; Kheir et al., 2006; Strohmeier et al., 2016). Soil erosion is of great concern if it exceeds a

* Corresponding author.
E-mail address: dmandalcswcrti@gmail.com (D. Mandal).

https://doi.org/10.1016/j.catena.2017.12.037
Received 4 September 2017; Received in revised form 21 December 2017; Accepted 27 December 2017