Soil organic carbon stock and erodibility indices under different land uses of Nagaland, India

Gaurav Mishra[1,*], Abhishek Jangir[2] and Benukantha Dash[3]

[1]Centre of Excellence on Sustainable Land Management, Indian Council of Forestry Research and Education, Dehradun 248 006, India
[2]ICAR-National Bureau of Soil Survey and Land Use Planning, RC, Udaipur 313 001, India
[3]Division of Remote Sensing Applications, ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur 440 033, India

Soil erosion is one of the major environmental concerns, causing a reduction in soil carbon stock and soil fertility. It is generally difficult to estimate soil erosion in hilly terrains. To overcome this, different types of erodibility indices are developed and used to describe the intensity of soil erosion. The present study was conducted in Nagaland state of northeast India, where clay ratio (CR), modified clay ratio (MCR), critical level of organic matter (CLOM) and erodibility factor (K) were used to assess the severity of soil erosion under different land uses. To study these, soil samples from forest, *jhum*, fallow *jhum* and tea gardens were collected from 0 to 30 cm soil depth. The results showed that sand and clay content were significantly different under different land uses, while soil organic carbon (SOC) and stocks followed the same trend, with maximum and minimum values under tea (60.55 t C ha^{-1}) and *jhum* lands (40.74 t C ha^{-1}) respectively. Among the different erodibility indices, only CR and MCR values were found to be significantly different from each other. Higher values of CR and MCR under *jhum* and fallow *jhum* lands indicate that these land uses are more prone to erosion. The present study provides a picture of severity of soil erosion under different land uses in Nagaland and recommends that CR and MCR can be used to evaluate soil erosion in hilly terrain areas.

Keywords: Forest, shifting cultivation, soil erosion, soil organic carbon, tea garden.

estimated at around 5.3 billion tonnes per year[4]. In the northeastern (NE) region of India, traditional agricultural practices like shifting cultivation without conservation measures have aggravated the problems of soil erosion, landslides and siltation of rivers. NE region of India is a biodiversity hotspot, rich in flora and fauna with favourable climate and healthy soils[5]. In this region, forestry is the major land use pattern covering around 65% of the area, followed by agricultural land use (16%)[6]. Most of the cultivated area in hilly regions of NE India is under shifting cultivation, locally called *jhum*[7]. *Jhum* also aggravates the issue of land degradation due to continuous changes in land use, which leads to depletion of soil organic carbon (SOC) and loss of soil due to erosion[8].

SOC is considered one of the best indicators of soil quality, which is associated with many physico-chemical properties and different ecosystem services such as climate and water regulation, water purification, nutrient cycling, soil biodiversity, etc.[9]. The top 1 m of soil, across the globe, can store about 1408 Pg (1 Pg = 10^{15} g) organic carbon (C)[10], and transfer of 1 Pg of C into the soil could decrease the concentration of atmospheric CO_2 by 0.47 ppm (ref. 11). The atmospheric C can be sequestrated using appropriate land use management practices and thus can improve the resilience of soils and the associated agroecosystems[12]. However, SOC pools are dynamic and sensitive to anthropogenic, environmental and climatic variations[13]. Moreover, conversion of natural vegetation to other land uses can reduce the SOC content by 20–50% (ref. 14). Land