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SOIL EROSION IN GARO HILLS, MEGHALAYA: CHALLENGES AND SUSTAINABLE SOLUTIONS

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Introduction

Soil erosion is one of the most serious environmental concerns and a big challenge for agriculture sustainability. Garo Hills, Meghalaya is highly susceptible to soil erosion problems due to its undulating topography, unsuitable landuse practices and high intensity rainfall. The most common form of soil loss in Garo Hills is water erosion which is primarily caused by intense rainfall and surface runoff (Fig.1). About 56.0 % of total geographical area of Meghalaya experiences moderate to severe soil erosion loss. Badavath *et al*. (2025) reported that different physiographic regions of Meghalaya showed varying erosion rates, Khasi Hills show the highest (20.94 t $ha^{-1}yr^{-1}$), trailed by Jaintia Hills (13.35) and Garo Hills (5.47). A total of 3051.68 ha of land in Meghalaya are affected by land degradation due to various factors. Among the three regions, the Garo Hills recorded the highest level of land degradation, covering 1158.88 ha (37.98% of the total degraded area), followed by the Jaintia Hills with 1111.81 ha (36.43%) and the Khasi Hills with 780.99 ha (25.59%) as shown in Fig. 2.

Fig.1. Soil loss due to intense rainfall

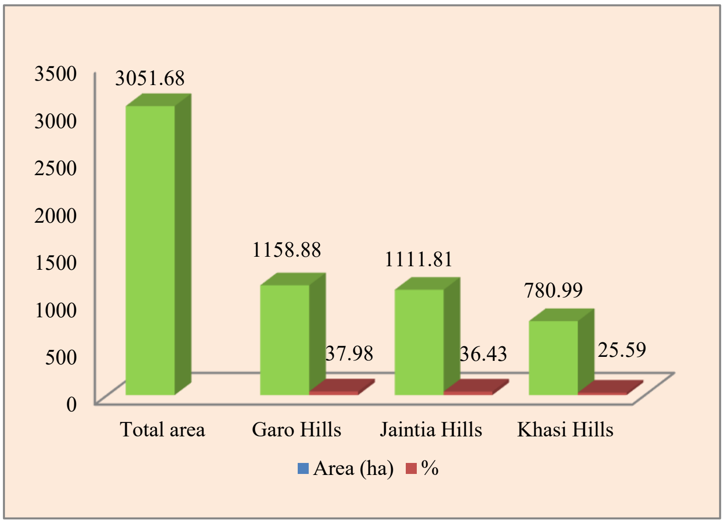

Fig.2. Land degradation level of Meghalaya (Ravindranath *et al.*, 2011)

Causes of Soil Erosion in Garo Hills

a. High intensity rainfall

Garo Hills has humid tropical climate characterized by intense high rainfall and humidity generally warm summer and moderately cold winter. The mean annual rainfall varies from 2000-4000 mm mostly concentrated from May to September month. Rainfalls with high intensity and duration, capable of causing extreme soil erosion events, occur with varying frequency. The top surface layer of soil washes away due to intense rainfall generating surface runoff, particularly from exposed slopes and cultivated lands.

b. Shifting cultivation (*Jhum* farming)

It is a traditional form of agriculture system practiced by tribal farmers in which patches of land are cleared for agricultural practice for a shorter period. It is also known as "slash and burn," which refers to the method of burning forest lands (Fig.3). The major threat to native forest biodiversity in Garo Hills is the increasing anthropogenic conversion of mature and primary forests into *jhum* cultivation areas. Its adverse effect is that it causes soil erosion that affects fertility of the soil resulting in low productivity and pressure on land. Jha and Sarma (2009) reported that the average soil loss due to shifting cultivation in Meghalaya has been found to be 40.9 t $ha^{-1}yr^{-1}$. At present with the ever-increasing population, the *jhum* farming cycle has reduced to as short as 3 to 5 years. The shortened fallow period prevents the soil from adequately restoring its fertility, leading to nutrient depletion and a consequent reduction in crop productivity.

Fig.3. Clearing and burning for *Jhum* cultivation

c. Deforestation

Without plant cover, erosion can occur and sweep the land into rivers. It has led to a dramatic increase in soil erosion, resulting in gully development and shallow landslides. Yadav (2012) reported that *jhum* as one of the drivers of deforestation in Garo Hills which increased tremendously. The graph shown in Fig. 4 illustrates a significant change in land use patterns in Garo Hills, Meghalaya from 1991 to 2010. There is a gradual loss of forest cover due to deforestation as the area under dense forest decreased from 836 km² during the year 1991 to 593 km² in 2010. It also highlights that the area occupied under open forest showed the most significant decline, reducing from 6649 km² to 4307 km² which suggests that large forest areas are degraded or converted to other land uses. It was observed that there is an increase in area of shifting cultivation practices in the last three decades. The non forest area has increase from around 614 km² in 1991 to 2846 km² in 2010 indicating vast conversion of forest land into agricultural fields, infrastructure development, roads construction or other non forest uses.

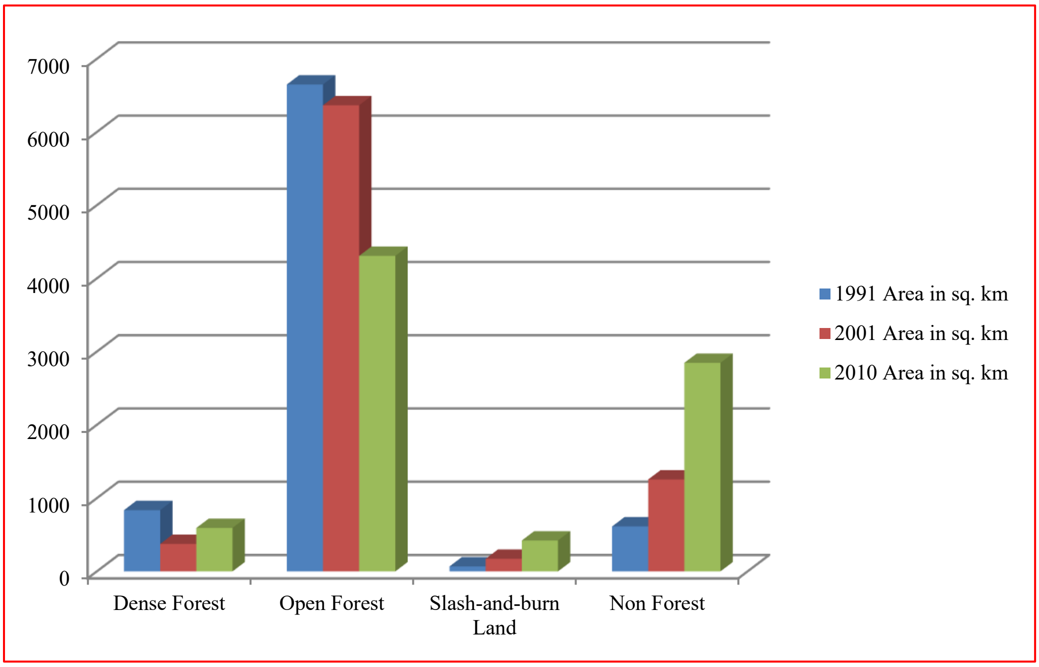

Fig.4: Area under different land use cover classes in Garo Hills

d. Cultivation on Steep Slopes

Widespread land degradation caused by inappropriate agricultural practices has a direct and adverse impact on the environment, food and livelihood security of farmers in the hill and mountain ecosystem of the North Eastern Hill Region of India (Das *et al*., 2020). The cultivation of agricultural crops on steep slopes without appropriate soil and water conservation measures accelerates topsoil loss, nutrient depletion, and surface runoff. The transfer of soil and nutrient load along with runoff due to high rainfall and steep topography has much implication for the resource base and environment in the region.

e. Road Construction and Developmental Activities

Road construction in Garo Hills has increased significantly in the last few decades. It can result in the modification of natural hill slope profiles, the construction of roadcut and fill embankments and impervious roadbeds that concentrate runoff (Jordan and Martinez Zavala, 2008). Road construction in hilly areas results in high rates of sediment production, particularly when the roads are frequently used for transporting logs.

Sustainable Solutions to Soil Erosion

Resource conservation techniques through the adoption of locally available resources encompasses practices that enhance input use efficiency and provide demonstrable economic benefits, such as, reduction in production costs, saving in water, fuel, labour requirements, and timely establishment of crops resulting in improved yields (Ghosh *et al*., 2010). The construction of terraces in hilly terrain could considerably reduce soil loss if they are properly well planned and constructed. Terracing should be complemented with other soil conservation practices like maintaining a permanent vegetative or soil cover to protect the soil from erosion. Contour farming is also an effective tillage practice for controlling soil erosion and increasing crop yield. It not only minimizes erosion but also reduces runoff by storing rainfall behind ridges. The adverse effects of shifting cultivation on soil erosion can be reduced by adopting sustainable *jhum* management practices. Increasing the fallow period, wherever feasible, allows the soil to recover its fertility and supports the regeneration of natural vegetation. Contour strip cropping is most effective measure for hilly regions and it is the growing of erosion permitting crops in strips of suitable widths across the slopes on contour, alternating with strip of soil- protecting and erosion resisting crops. Surface mulches acts as a protective layer of organic or inorganic material spread on the surface of the soil in order to reduce evaporation losses and increase the moisture holding capacity of the soil, prevent weed growth and reduce soil compaction due to heavy rains and moderate the soil temperature (Mawthaoh *et al*., 2023). Afforestation is also an effective measure for preventing soil erosion on sloping lands. Increased vegetation cover on hill slopes can intercept about 30–40% of rainfall, thereby reducing surface runoff and soil loss from bare lands.

Conclusion

Soil erosion poses a major challenge for environmental and agricultural sustainability in the Garo Hills of Meghalaya. Various factors, including high intensity rainfall, shifting cultivation, deforestation, cultivation on steep slopes, and developmental activities, are the major causes of soil and water erosion in Garo Hills. The loss of fertile topsoil not only degrades land quality but also threatens the livelihoods of local farmers that depend on agriculture by adversely affecting soil fertility and crop yields. A proper planning and implementation of soil and water conservation measures are urgently needed to protect soil resources, conserve the habitats of wild flora and fauna, and ensure sustainable agricultural production and food security. Adoption of integrated soil and water conservation measures, *viz*., terrace farming, contour cultivation, strip cropping, mulching, afforestation, agroforestry, and improved *jhum* management practices is essential for reducing soil erosion and ensuring sustainable agricultural production. Strengthening these sustainable landuse practices, along with collaborative effort from Government Agencies, Agriculture Research Institutions, and local farmers, can significantly reduce soil erosion, enhance soil health, and ensure long-term agricultural sustainability in the Garo Hills region.

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