Impact of Human Activities on Landscape of Mylliem Granite Area, Meghalaya

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Abstract— Human beings are not only controlled by the environment but they in turn also alter the environment; their intensity depending on the level of technological progress. In this process, they create major long-term problems both for the natural and man-made environment. This paper aims at studying the geomorphology of Mylliem granite area of Meghalaya and the impact of human activities on its landscape. It is found from the study that human activities have brought about significant changes in landscapes of the study area resulting in various geo-environmental problems.

Key words: Impact of Human Activities, Meghalaya

I. Introduction

Man- environment relation is a complex one. Human beings are not only subject to control by the environment but they also act as a major force in changing the face of the earth. Ever since its appearance, even before the beginning of recorded history, human society has been involved in the system of geomorphic processes. The intensity of involvement has been proportional to the size of the human population, to its demands upon the environment and to the level of technological progress achieved to satisfy growing demands [5]. Although human beings alter their environment with a view to improve their living conditions, in some cases they create major long-term problems, and in still others they have been catastrophic, both for the natural and human environment. This paper focusses on the geomorphology of the Mylliem granite area of Meghalaya Plateau in north-east India with emphasis on the impact of human activities on its landscape. The region has its unique geology, geomorphic features and economic activities which is undergoing significant changes due to increased human activities such as agriculture, quarrying, etc. which in turn influences the geo-environment of the region.

II. Database and Methodology

The present study is based on both primary and secondary data. Primary data has been collected through the field work. Field work has been carried out to acquire first-hand information about geomorphological characteristics of the study area. Soil samples were collected from different sites in the study area to determine the soil type of the area. Photographs relevant to the study were also taken. Secondary data on geology, climate, vegetation, and land use/land cover have been culled from secondary sources like the Survey of India toposheets (scale of 1: 50,000); published and unpublished literature, and web sites.

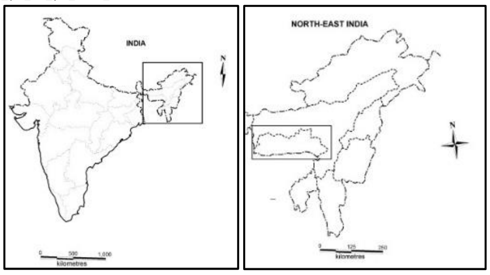
III. Location and Environment

Mylliem granite area is situated south of Shillong Peak (1961m), i.e., the kernel of the Meghalaya Plateau which is the highest point of the Plateau. The study area falls within 91° 46’ E and 91°54’ E longitudes and 25°32’ N and 25°28’ N latitudes. It covers an area of approximately 98 sq km. Some of the important villages in the study area are Ladmawreng, Mawreng, Mawsawa, Mawpynthih, Mawkohngoh, Laitjem, Mawblah, Nongbet, Umthlong, etc. The area is characterized by granite topography and wide structural valleys. The area is drained by the rivers Umlieng, Wah Umtongsyiem, Um Banium, Um Shawshaw, Umlew, Umiam and their tributaries. The drainage system is greatly controlled by its geological structure and physiographic features. The climate of the study area is sub-tropical monsoonal, with the warm rainy season spanning from June to October and the dry cool season from November to May. Mylliem area experiences maximum temperature of 24.1°C in July and a minimum temperature of 3.6°C in January [3]. Annual rainfall is 3500mm near Mylliem of which 80% rainfalls occurs between June and August.

The vegetation of the study area includes tropical, sub-tropical and temperate forests. Open pine and fairly dense mixed jungle are found at higher elevations. The pine forests found in the study area are not a climax type but represent a late secondary succession community. There are rolling grasslands covering large areas which have developed as a result of removal of their natural forest cover. Bamboo grasslands are commonly found here. A few scattered trees can also be seen within these grasslands. The soil colour of the study area ranges from very pale brown to dark brown, reddish yellow, grayish brown, dark yellowish brown. These soils are sandy loam in texture and at some places silty loam and sandy loam are also found.

IV. Regional Geology

The study area lies in the central part of the Meghalaya Plateau which in fact is a detached part of the peninsular shield of India. The western and eastern sides of the Meghalaya Plateau are bordered by the North-South trending Jamuna fault system and the North-West to South-East trending Kopili fracture zone, respectively, the latter separats the Meghalaya Plateau from the Mikir Hills [7], [6], [1], [11], [9], [12].



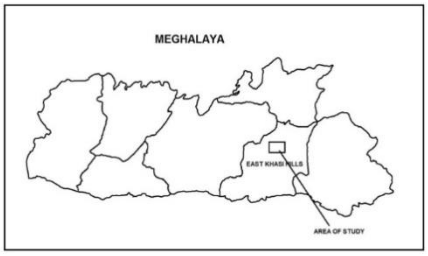


Fig. 1: Location of the Study Area

The bulk of the Meghalaya plateau is formed by Archaean (Dharwarian) quartzites, slates, schists, with granitic intrusions and some basic sills and dykes, but in the south these are overlain by horizontal Cretaceous and Eocene sandstones.

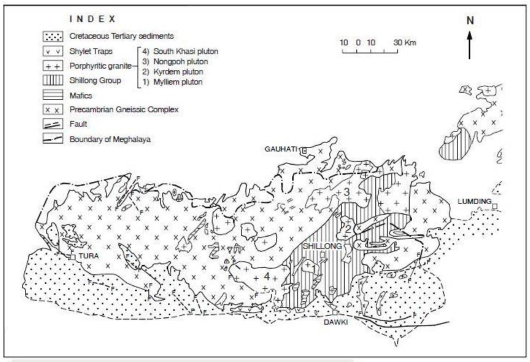


Fig. 2: Geology of Meghalaya Plateau (after Mazumder, 1976; Ghosh, 1991)

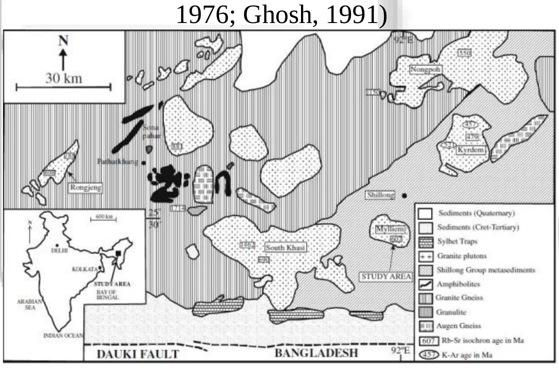


Fig. 3: Granitoid Plutons of Meghalaya with Isotopic Ages (after Ghosh et al., 2005).

Lithology of the study area includes Shillong Group of rocks along with intrusions of granitic plutons like the famous Mylliem granite. The Archaean basement gneissic complex consists of two different units, viz., gneissic complex proper and the non-porphyritic migmatitic granitoid rocks [10], [12]. The granite plutons near Mylliem intrude the quartzite of Shillong Group (Fig. 4). It occupies an area of about 40 sq km and is broadly elliptical in outline with the longer axis trending nearly E-W being oblique to the NE-SW trend of the enveloping meta-sedimentary rocks. The contact between the Mylliem granite and the enclosing Shillong Group is sharp and discordant. The main structural trend in the Shillong Group is NE-SW, which is persistent all over the area and variation of this trend is discernible at places near the contact of intruded granite plutons. Folds in the Shillong series are not frequent and those that occur are in general open, asymmetrical folds with steep axial planes and ently plunging axes.

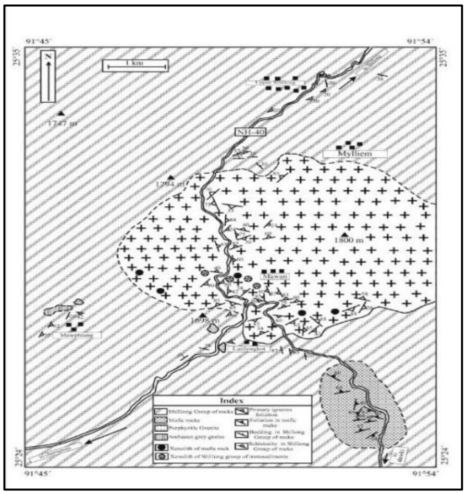


Fig. 4: Geological Set Up of the Study Area (after Ray and Saha, 2011)

The folds that occur in the rocks of the Shillong series surrounding the granite pluton, commonly known as Mylliem granite, have their axes as nearly as possible, towards the pluton. The trend of the rocks also veers round the pluton, becoming sub- parallel and often parallel to the margins of the pluton. These structural relations between the rocks of the Shillong series and the Mylliem granite are seen on the Shillong- Cherapunjee road on both the northern and southern margins of the pluton about 12 km and 24 km away from Shillong and Umtynger, respectively [4]. The study area is characterized by porphyritic coarse granite, pegmatite, aplite (quartz vein traversed by epidiorite, dolerite and basal dykes of the granite plutons and quartzite, phyllite, quartzericite schist, conglomerate of the Shillong Group. As far as seismicity is concerned, the region is tectonically very active. It falls under zone V as per the seismic zoning map of India (Indian Meteorological Department).

V. LANDFORMS

Origin and development of a landform is a very complex process and is the resultant product of many factors viz., rock types, structure, slope, drainage system, altitude, vegetation, climatic factors and spatial arrangement of some of the physiographic and geomorphic elements. As has been mentioned earlier, the study area is characterized by granitic intrusions within the quartzites of the Shillong Group. The timing of emplacement of Mylliem granite is 607 Ma which is in age similar to other granite plutons of Meghalaya (881-479 Ma) and the Indian Peninsular Shield (740-395 Ma) [8]. The beds of the Shillong Group standing nearly vertical and are highly metamorphosed near the contact with granite. These granites have been considerably weathered. The agents of denudation like rain, surface water, and change of temperature have played a dominant role in the rock types in moulding the landscape of the area. The tropical monsoon humid climate exerts significant influence on the evolution of the topography.

Mylliem granite area is a flat structural valley formed due to widening of gap between the ranges of the Meghalaya Plateau. Of course, The Mylliem granite area is characterized by typical granite topography with broad flat valleys surrounded by rounded hills. It is a structural valley filled by the sediments brought from the nearby hills. Flat valleys are typical structural landforms drained by rivers [2]. Such flat valleys develop when the space between two hill ranges is quite wider than the normal river valleys. The rivers in the flat valleys are not powerful enough to carve out such wide valleys The granite hills rise to a general height of 1750-1850 m above mean sea level. These hills are weathered throughout. Residual landforms such as granitic boulders and corestones of various shape and size are also found in abundance.

VI. LANDUSE IN MYLLIEM AREA

Agriculture: Mylliem and its surrounding area have been put to different land use. The study area has summit, side-slopes and valleys under various land use including forest and cultivation. The soils on the side-slopes are eroded and shallow with little pedogenic development. The soils in the valleys are deep and course textured with high water table. The area is dominated by pine (pinus insularis) along with rhododendron, Mongolia and other temperate forest trees. As has been mentioned earlier, agriculture is the mainstay of the economy (Plate 1). So a large part of the area is under agriculture. The transect of Mylliem covers summits with pine vegetation (slopes of <8 percent). The side-slopes (8-15 percent) are presently under the cultivation of potato, radish, and other vegetables whereas the valleys are cultivated with paddy in the rainy season and peas in winter [3].The natural forest cover has been depleted due to deforestation. A generalised land use pattern of Mylliem has been shown in Fig. 5.

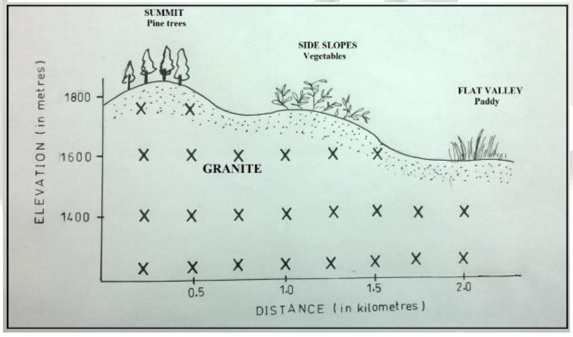


Fig. 5: Land Use in Mylliem(modified from Bhaskar, et al)

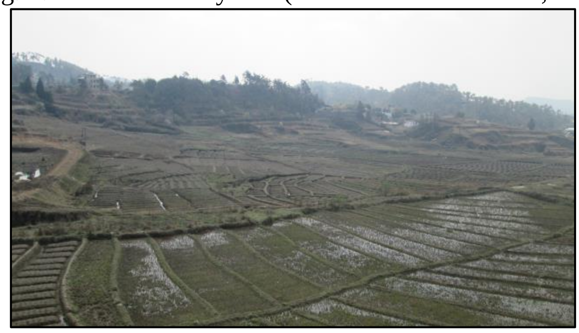


Plate 1: Agriculture in the flat valley

Quarrying: Stone quarrying and sand mining is an important economic activity in the area under study. Quarrying involves the excavation of rock, gravel and sand from the ground. Sand and gravel are used along with stone in construction work. Due to the proximity of Mylliem to Shillong City, there is a huge demand for stone, sand and gravel for building purposes. It is a practice that is becoming an environmental issue as the demand for sand and stone increases in industry and construction activities (Plate 2 and 3). To meet these demands, a number of quarries are opening up. The extraction, processing and transport of stone are a complex issue. On the one hand, it supplies materials to meet many of societies needs and creates employment, but on the other hand it can have significant impact upon the environment and local communities. Quarrying can generate a number of environmental effects through the blasting, excavation, crushing, screening, stockpiling and transport of aggregate. Uncontrolled and inefficient stone quarrying techniques produces a degradation of both land and stone reserves. Stone quarries are sited haphazardly without professional assistance or guidance which is responsible for various environmental problems. Sand mining has led to dumping of the unwanted sand matters into the rivers that flows next to the quarries. The residues of the sand quarries are washed away by rain water and carried to the agricultural fields and natural water bodies (Plate 6 and Plate7). Besides rain water, the unwanted refuse is dumped by people into the rivers which have affected the condition of these rivers in this region.

Plate 2: Quarrying along hill slopes

Plate 3: Rock Slabs in stone quarries

Plate 4: Sand Mines in the Study Area

VII. HUMAN IMPACT ON LANDFORMS

The region is facing various geo-environmental problems due to human intervention in the natural environment. Geohazards are induced by unplanned, indiscriminate and unscientific land resource utilization in an area. In the study area, the impact of man on geo-environment is immensely felt. The hill slopes are deforested and overgrown by grass with scattered subtropical pines. Valley floors are occupied by paddy rice fields. Particle downwash during heavy rainfall and deposition of eroded material in the valley floors is facilitated by deforestation and crop cultivation. Quarrying, though done in a small scale, has affected the soil and water quality of the area. The major geohazards in the area are discussed as follows:

A. *Quarrying and Landscape Scarring*

The quarrying, processing and transport of minerals including hard rock aggregates and sand and gravel can have significant effects upon the environment:

B. *Damage to Biodiversity:*

Quarrying carries the potential of destroying habitats and the species they support. Even if the habitats are not directly removed by excavation, they can be indirectly affected and damaged by environmental impacts – such as changes to ground water or surface water that causes some habitats to dry out or others to become flooded.

C. *Quarry Waste:*

Quarrying involves the production of significant amounts of waste. Although the waste materials from quarries are generally inert and non-hazardous, there is still potential damage to the environment, particularly with water contamination. The quarry waste is often left over the land which gradually rolls down to the surrounding land disturbing man, material and land uses. As the dumped material is generally loose, it is highly prone to rain washing, weathering and erosion. Fine particles generated out of these get spread over the surrounding land and water bodies. Thus the turbidity of the waterbodies gets increased, siltation increases, water storage capacity decreases, gradual drying takes place, leading to land degradation. The land which receives these eroded fine materials, gets covered by these, which also damage the land's infiltration potentiality and greenery growing potentiality.

D. *Water supplies and groundwater:*

The quantity, physical and chemical quality, of surface waters and ground-waters may be affected by quarrying activities; flows can be increased or decreased and may be contaminated by runoff or dust from the quarry. The removal of topsoil, overburden and aggregates may affect the quality of water recharging of an aquifer. Siltation in surface water bodies increases (Plate 6). Sand mining also affects the underground water system. Sand layers along the riparian areas serves as a spongy layer and helps in recharge of ground water through percolation of water through different layers of sand. Sand is important for ground water recharge, on a riverbed it acts as a link between the flowing river and the water table and is part of the aquifer. When sand mining becomes intense, then the vertical and lateral movement of water is checked and affects the recharge of ground water.

Plate 6: Siltation of stream

Plate 7: Erosion of quarry wastes into agricultural fields

E. *Deforestation:*

Agriculture, logging, mining and other human activities have been responsible for fragmentation, destruction and degradation of the forests in the study area. High rainfall and undulating topography have further accentuated the impact of human activities on the forest. As a result, the forests are getting fragmented into small patches. The pine forests are most disturbed and highly fragmented and supported by successional communities of vegetation. Human activity has led to the irreversible transformation in the landscapes and caused havoc to natural fragile ecosystems.

F. *Soil erosion:*

Although soil erosion is the result of natural processes it is accelerated by human activities. In the study area, large tracts of forest cover have been cleared and put to agricultural use. This makes the soil loose and vulnerable to agents of erosion. Besides agriculture, quarrying is also another major cause of soil erosion in the area. Soil erosion has resulted in washout of upper layer of the soil, uprooting of plants due to soil cutting, loss of soil fertility, etc. in the region.

VIII. CONCLUSION

The study area is in the central part of the Meghalaya Plateau, which includes Shillong Group of rocks along with intrusions of granitic plutons like the famous Mylliem granite. It is seismically very active and experiences frequent earthquakes. It falls under sub-tropical monsoon climate. As a result of its unique geographical setting, climate, geology, etc. the study area is characterized by unique slope characteristics, landforms and drainage patterns. The area has broad flat valleys with low, residual hills and gentle, denuded slopes. The micro-landform of the study area includes boulders, core stones, river terrace, etc. It is noted that deforestation, agricultural activities, quarrying, etc. have created several geo-environmental problems such as soil erosion, siltation of rivers, land degradation and pollution. These geo-environmental problems are result of several factors like surface-runoff, undulating topography, land-use pattern, and their interaction with human activities.

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