

Conversion of forest land in Garo Hills, Meghalaya for construction of roads: A threat to the environment and biodiversity

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Tropical forests have a special role in the conservation of biodiversity. They are home to 70% of the world's vascular plants and animals. In tree species alone, tropical rainforests are extremely diverse, often having more than 200 species per hectare. The forest types can be grouped as mixed deciduous sal forest and open bamboo forests in and around the study areas. The percentage of Government-owned reserve forests in Meghalaya is only 3–3.2 of the total of 36.5. The forests have been over exploited due to road and other infrastructural development. As a result, natural forest stands are becoming less in arial extent day by day. This article deals with the number, length and nature of constructed roads; total encroachment area of about 456 ha of major forest ranges in Meghalaya has been assessed.

Keywords: Biodiversity, Garo Hills, forest land, Meghalaya, road construction.

FORESTS influence the local as well as global climate and moderate the diurnal range of air temperatures and maintain atmospheric humidity levels. Forests absorb atmospheric carbon and replenish oxygen in the air we breathe. Conservation of forest resources in the watersheds that supply water for irrigation, sanitation and human consumption is an important component of water-supply strategies. When tropical watersheds have balanced land use, their forests absorb excessive rainfall that is gradually released later. Forests also regulate stream flows by intercepting rainfall, absorbing the water into the underlying soil, and gradually releasing it into the streams and rivers of the watersheds. This minimizes both downstream flooding and drought conditions. Tree cover conserves moisture in the soil by providing shade that reduces evaporative loss from radiant energy exchange with the atmosphere.

The growing population, human greed and lack of knowledge about ecological balance of nature, have destroyed the environment in such a manner that there is already a vast degradation of soil, water, air, biodiversity and even light/temperature¹. Forest cover removal is traced to early Palaeolithic period; the trend accelerated during Neolithic and subsequent ages especially in the last 100 years there has been greater destruction of the green mantle². In recent times it has been noted that the amount of sediments eroded away from sites of road construction is ten times

greater than that derived from agricultural land, about 200 times greater than that from grassland and 2000 times greater than that from forest land³. Construction of roads disturbs the stability of the hillside, causes serious damage to the hydrologic system and removes the protective cover from the vulnerable slopes⁴.

The Geological Survey of India has systematically studied the Garo Hills, during the last decade^{5–10}. The Gneissic group is the oldest rock group in the state, which is Achaean in age. The next younger group of rocks belonging to the Shillong group is argillaceous sediment of Pre-Cambrian age. Rocks of both groups are affected by intrusive like amphibolites, metadolerite and granite, which have undergone varying degree of metamorphism. The amphibolites intrusive are Pre-Shillong group in age, while the meteorite and granite are later intrusive. The Meghalaya–Karbi plateau represent a part of Gondwanaland. The low hill ranges with hot and humid climate along with heavy rainfall, concentrated to few months of the year, experience solifluction, sheet erosion and land slides¹¹. Over a long geological period through which the Garo Hill plateau has been raising, the area is being simultaneously subjected to natural processes of denudation, deriving thereby its present-day geomorphologic characters comprising elongated hill ranges. High peaks, deep gorges and narrow valleys have been carved out by a network of young rivers and streams like Ranra, Dudhnai, Krishnai and Someswari and their tributaries¹².

Variation of road density in different ranges of the Garo Hills is high and parameters like road density, seasonal condition of road service and different means of transport

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tation system are taken into account. The Garo Hills is one of the western-most regions of Meghalaya, which is situated between lat. 25°9'–26°1'N and long. 89°49' to 91°2'E, and is 545 m asl level. The climate of Garo Hills as the whole is hot and sultry during summer and sober during winter. The average maximum temperatures 31.2°C in May, the lowest is 9°C in February, and relative humidity is highest (90%) in June and lowest (30%) in February. The actual rainy season continues up to October. Frost occurs every year during winter in interior reserves of Rongrengiri in particular, but damage due to frost is insignificant. Based on these parameters, database for four ranges of the study region has been formulated and processed by adopting simple quantitative methods and techniques. Both primary and secondary data have been used to study this problem.

Results and discussion

The Garo Hills region comprises several of flat lands and valleys. Reserved forests are located in different pockets

all over the district. Four categories of these reserves can be distinguished on the basis of location. Ildek, Rajasimla, Dhima, Dilma, Chimabangshi and Dalu hill reserves are situated on the northern foothill belt of the main Garo Hill range and belong to the first category. A greater portion of the reserves lies in the plain area along the Assam–Meghalaya border. Dambu, Darugiri, Rongrengiri and Songsak reserve forests belong to the second category. These four reserves are situated in the interior ranges of the Garo Hills and form the important catchment areas of most rivers. Siju, Rewak and Emangiri reserves belong to the third category which is located in the most difficult terrains on the southeastern part of Garo Hills, forming the catchment of the Someshwari river. Angratoli and Baghmara belong to the fourth category, situated in the southern belt of Garo Hills in close proximity to the plain district of Mymensingh in Bangladesh. The soil is sandy loam in the hills, while in the plain it is alluvial. However, soil in the interior reserves is deep red clay, whereas quartzite and limestone pebbles are found in the soil around Siju and Rewak reserves.

Table 1. Encroachment of forest land for construction of roads (Garo Hills Forest Division, Working Plan 2001)

Range	Locality	Road	Length		Nature of road
			km	ha	
Baghmara	Lat. 25°12'00"N Long. 90°35'00"E	Baghmara Panda–Border road	10.50	78.43	BT
		Khandak Halwal road	2.00	14.74	G
		Angratoli–Tolikhali road	3.00	22.41	G
		Angratoli–Khandal link road	2.50	18.70	G
		Total	18.00	134.28	
Holloidanga	Lat. 25°35'00"N Long. 90°45'00"E	Holloidanga–Sabang forest road	2.00	14.94	G
		Holloidanga–Gabtoli forest road	2.60	19.42	G
		Holloidanga–forest village road	1.00	7.47	G
		Forest Tilla road	0.50	3.73	G
		Total	6.10	45.56	G
Dainadubi	Lat. 25°36'00"N Long. 90°47'00"E	Dudhnai–Chibuk road no.1	4.02	30.03	BT
		Damra–Badmadang road no. 2	1.42	10.61	BT
		Damra–Badmadang road no. 3	1.21	9.04	BT
		Chimabangshi Reserved Forest road no. 1	4.02	30.03	G
		Chimabangshi Reserved Forest road no. 2	2.51	18.75	G
		Chimabangshi Reserved Forest road no. 3	1.54	11.50	G
		Adokgiri–Athiabari road	1.23	9.19	BT
		Kharkuta–Adokgiri road	1.50	11.20	BT
		Total	17.47	130.35	
Darugiri	Lat. 25°35'00"N Long. 90°45'00"E	Old Dambu forest road	6.04	45.12	G
Songsak	Lat. 25°28'00"N Long. 90°42'00"E	Songsak forest road	3.86	28.89	G
		Ildek Reserved Forest road	3.22	24.05	K
Total			7.08	52.94	
Rongrengiri	Lat. 25°30'00"N Long. 90°30'00"E	Rongrengiri–Kharra road	6.40	47.81	BT
Grand total			61.09	456.06	

G, Gravel; K, Kacha; BT, Black top.

Table 2. Different agents and their link to deforestation

Agent	Links to deforestation
Commercial farmers	Clear forests to plant commercial cash crops; sometimes displace slash-and-burn farmers who then move to the forests.
Slash-and-burn farmers	Clear forests to grow subsistence and cash crops.
Cattle ranchers	Clear forests to plant pasture; sometimes displace slash-and-burn farmers who then move to the forests.
Livestock herders	Intensification of herding activities can lead to deforestation.
Loggers	Removal of commercial timber logging roads provides access to other land-users.
Commercial tree planters	Clear fallow or previously logged forests to establish plantations for the supply of fibres to the pulp and paper industry.
Firewood collectors	Intensification of firewood collection can lead to deforestation.
Mining and petroleum industrialists	Roads and seismic lines provide access to other land-users; localized deforestation related to their operations.
Land-settlement planners	Relocation of people into forested areas as well as settlement projects displacing local people who then move to the forests.
Infrastructure developers	New access for other land-users from road and highway construction through forested areas.

Since 1971, there has been shrinkage of reserved forests of about 456.06 ha, mainly due to construction of roads (Table 1). The six ranges under Garo Hills forest division include Baghmara, Holloidanga, Dainadubi, Darugiri, Songsak and Rongrengiri under three districts, i.e. West, East and South Garo Hills, where *Shorea robusta* (Sal) dominates. Analysis of encroached forest areas for construction of roads in Garo Hills is made range-wise from 1971 to 1991 in the following lines.

Total encroachment in Baghmara range was about 134.28 ha of reserved forests for the construction of roads: Baghmara Panda–Border road, 78.43 ha; Khandak–Halwal road, 14.74 ha; Angratoli–Tolikhali road, 22.41 ha, and Angratoli–Khandal link road, 18.70 ha. In the Holloidanga range total encroachment in reserved forest was 45.56 ha Holloidanga–Sabang forest road, 14.94 ha; Holloidanga–Gabtoli forest road, 19.42 ha; Holloidanga–forest village road, 7.47 ha, and Forest Tilla road, 3.73 ha. In the Dainadubi range total encroachment of reserve forest was 130.35 ha; Dudhnai–Chibuk road, 30.03 ha; Damra–Badmadang road, 10.61 ha; Damra–Badmadang (no. 3), 9.04 ha; Chimabangshi Reserved Forest road (no. 1), 30.03 ha; Chimabangshi Reserve Forest road (no. 2), 18.75 ha; Chimabangshi Reserve Forest road (no. 3), 11.50 ha; Adokgiri–Athiabari road, 9.19 ha, and Kharkuta–Adokgiri road, 11.20 ha (Table 1). In the Darugiri range: Old Dambu forest road, 45.12 ha and in the Songsak range total encroachment was 52.94 ha; Songsak forest road, 28.83 ha and Ildek Reserve Forest road, 24.05 ha. In the Rongrengiri range: Rongrengiri–Kharra road, 47.81 ha.

The length of the roads within reserved forests of the Baghmara range is as follows: Baghmara Panda–Border road, 10.50 km; Khandak–Halwal road, 2 km; Angratoli–Tolikhali road, 3 km and Angratoli–Khandal link road,

2.50 km. In the Holloidanga range; Holloidanga–Sabang forest road, 2 km; Holloidanga–Gabtoli forest road, 2.60 km; Holloidanga–forest village road, 1 km and Forest Tilla road, 0.50 km through Holloidanga Reserved Forest. In the Dainadubi range: Dudhnai–Chibuk road (no. 1), 4.02 km; Damra–Badmadang road (no. 2), 1.42 km; Damra–Badmadang (no. 3), 1.21 km; Chimabangshi Reserved Forest road (no. 1), 4.02 km; Chimabangshi Reserved Forest road (no. 2), 2.51 km; Chimabangshi Reserved Forest road (no. 3), 1.54 km; Kharkuta–Adokgiri road, 1.50 km and Adokgiri–Athiabari road, 1.23 km. In Darugiri range: Old Dambu forest road, 6.04 km through Dambu Reserved Forest. In the Songsak range: Songsak forest road, 3.86 km and Ildek Reserved Forest road, 3.22 km through Songsak Reserve Forest. In the Rongrengiri range, Rongrengiri–Kharra road, 1.23 km through Rongrengiri Reserve Forest.

Some variations in total number, length and nature of roads in different ranges are noted, namely, in the Baghmara range, out of four there is one black top (BT) road and three gravel (G) roads having a total length of 18 km. In the Holloidanga range, all four are gravel, having total length of 6.10 km. In the Dainadubi range, out of eight roads there are three gravel and five black top roads having total length of 17.45 km. In the Darugiri range there is only one gravel road having a total length of 6.04 km. In the Songsak range, out of two roads, one is kacha and one gravel, having a total length of 7.08 km. In the Rongrengiri range there is only one black road top having a total length of 6.40 km. Encroachment of forest lands by infrastructure developers, loggers, cattle ranchers, slash-and-burn farmers (Tables 2 and 3), including anthropogenic interventions by local bodies and tribals in remote areas results in further disturbances in the existing state of equilibrium. For example, changes in land use especially in highlands,



Figure 1 a, b. Ferns and other important plants sliding down with huge forest soil due to road-cutting.

Table 3. Region-wise agent/deforestation relation

Region	Main agents of deforestation
Africa	Slash-and-burn farmers Commercial farmers Loggers Livestock herders Refugees from civil disturbances
Asia–Oceania	Commercial farmers Slash-and-burn farmers Loggers Commercial tree planters Infrastructure developers
Latin America	Slash-and-burn farmers Cattle ranchers Commercial farmers Loggers Infrastructure developers

results in soil erosion. Road and dam construction results in initiation of phases of persistent natural hazard, especially landslides that are alarm signals for mass extinction of many important vascular plant taxa including economically important bamboo (*Bambusa vulgaris*, *B. tulda* and *Calamus strictus*), cane (*Calamus guruba* and *C. tenuis*) and medicinal plants like *Costus speciosus*, *Rauvolfia serpentina*, *Curcuma aromatica*, *Holarrhena antidysenterica*, *Dioscorea alata*, *Nepenthes khasiana*, *Emblica officinalis* and *Terminalia bellerica* along with other major timber-yielding plants like *Shorea robusta*, *Gmelina arborea*, *Artocarpus chaplasha*, *Albizia lebbeck* in North-east India. Many fern taxa such as *Blechnum*, *Dryopteris*, *Lycopodium*, *Lygodium*, *Selaginella*, *Gleichenia*, *Polypodium* and *Adiantum* are found damaged due to massive erosion of soil (Figure 1 a, b). As a result of this mass destruction of forest lands, rolling grasslands have been observed at most of the study areas. There are only a few pockets of undisturbed natural vegetation still in existence, which can play havoc for mankind in future. It has also been observed that global deforestation level is higher in Asia compared to other countries like Latin America, Europe, Africa and Russia. Therefore, preserving biodiversity should be taken into consideration. Population

growth, rapid expansion of cities and other settlements, land for new agricultural farms, mining, construction of village roads, dams, etc. have resulted in large-scale destruction of natural vegetation. However, proper management action plan by Government/semi-government/local agencies is required at this juncture to protect the existing pristine global environment of Garo Hills of Meghalaya.

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