

Depletion of Forest and its impact on rural house pattern: A study on few forest villages of Assam-Nagaland border region

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Abstract—World Wildlife Fund (WFF) used the word “depletion” or “deforestation” to describe the destruction of forest ecosystems to facilitate human activities, primarily emphasizing the total loss of native biodiversity and ecosystem capacity. IPCC & UNFCCC defines it as the direct human-induced conversion of forested land to non-forested land. Forest depletion has a long-term impact on environment, livelihood and day to activities of rural mass. Further it adversely effects the whole ecosystem.

House exposes traditional attitudes representing their response to factors - such as ecological, economic and cultural. The dwelling thus, house type reflects the interrelationship between man and his immediate environment and obviously it tells of man’s struggle for shelter through time and space. A house or a dwelling in the traditional society is a manifestation of the intimate relation between man and his immediate environment. A house, in true sense, is an important ingredient of a society that disposes the changing interactions those continued in an area between human activity and environmental set up.

The changing forest cover scenario with the time passes imposed pressure on the dwellers to look for alternatives other than forest as the source of housing material. The Assam-Nagaland border region, a tribal dominated area witnessed a considerable change in the house pattern under compulsion of changing forest cover in the area. Presence of plenty of forest resources not only provided the materials for the construction of houses but also accommodated the tribal livelihood practices with all sorts of comfort. The onset of colonial rule in 1826 formulated a series of forest rules, regulations and act to establish their suzerainty over vast forest resources to extract revenue as much as possible. The post independent government also over ruled any significant change in the forest policies and put interest to generate more revenue at the cost of forest destruction. It, in consequence, brought a sea change in the house pattern of the forest dwellers tribe living in the forested Assam-Nagaland border region. The primary attempt of this paper is to examine the changing house pattern of the villages of Assam-Nagaland border region.

Index Terms—Forest Depletion, house pattern, environment, human activity, house materials etc

I. Introduction

The study area encompasses the parts of the state of Assam and Nagaland and hence delimitation criteria are taken into consideration to specify it. Extending NE-SW the area is approximately 310 km in length and only 20 km in width. Presence of quite a large number of reserved forest along the border areas namely - Abhaypur, Singphan, Geleki, Tiru Hills, Desoi, Desoi valley, Dayang, Diphu, Rengma, Rangapahar reasonably suggests its richness in forest cover. Referring Bluntschli’s (2005) works on Amazon lowland Hartshorne emphasized more on the aspect of climate and relief in the process of

delimitation of a natural region. He noted that “Areas where perhaps two natural elements are fairly uniform throughout and one is of such an extreme character as to dominate most other elements, the area may appear to have such a degree of interlocking and indivisible harmony that we are led to think of it as a unit, indeed as an organic unit.” This essence of areal zoning is well reflected in the dense forested patch of the foothills. Thus, in the process of delimitation of the study area the following considerations are taken into account: (i) terrain characteristics, (ii) forest cover, (iii) vegetation type, (iv) climate and (v) human aspects.

The study area, the Assam-Nagaland border, lies between 25°17'53.57"N to 27°03'46"N latitude and 93°20'32"E to 95°18'03"E longitude. Predominated by transitory nature of both hills and plains the region exhibits tortuousness where the rivers are there. Diverse topographic forms and a humid meso-thermal climate provide favourable environment for rich floral diversity with a dense canopy cover in the region. Facing old crystalline Karbi Plateau and the Brahmaputra Valley of Tertiary sediments on its west and north-western margin, the scarp line of the Naga Hills with spectacular ups and downs exhibits a rich green cover.

The region as a whole is dominated by tribal population which accounts nearly 58% of the total as per 2001 census report of India. Among the various tribal races Ao, Angami, Konyak, Lotha, Sema, Zeliang, Sonowal Kachari, Thengal Kachari, Mishing, Tai Turung, Tai Khamyang, Karbi, Bodo Kachari etc are prominent. Forests for the tribal are the life line. It provides everything of their available needs to run their life. Besides collecting fruits, plant leaf and roots, herbs and medicinal plants, fuel wood the tribal people primarily depends on forest for their house building materials. Diminishing forest resources caused by rampant deforestation all throughout the region badly impacted upon the house type of the inhabitants. The changing house type through ages reflects the state of steadily decreasing forest resources in the region and also narrates an account of change in house building materials. It is observed that the changes in house type almost coincide with the changes in forest cover in the region. It is virtually an uninterrupted march from ashoka leaves, thatch, bamboo house to modern R.C.C. type of house. The basic theme of the paper is to search the relationship between the changing house type and the episode of deforestation or forest depletion in the tribal dominated belt, the Assam-Nagaland border region.

II. Principal objectives

- i) Analyse the nature of forest resources and forest depletion of the region.
- ii) Analyse the settlement pattern and racial composition of the region.
- iii) Find out the building materials usually procured from forest and used mostly by the inhabitants of the region.

III. Database and Methodology

Data pertaining to the study characteristically are both primary and secondary. The principal sources of secondary data are census of India (series 14 and 15), District gazetteers of border districts of Assam and Nagaland, relevant books and journals, News paper and Periodicals and interview with the elders of the border districts of Assam and Nagaland. Topographical maps prepared by Survey of India, 1974 and landsat imageries (LISS-III, 2025) are used to measure the extent of deforestation along the Assam-Nagaland border region. For primary data a rigorous village survey has been conducted carefully selecting samples from the border areas of Assam and Nagaland so that maximum of the samples incorporate villages from forest and forest fringe areas. The schedule prepared for the survey primarily focused: i) house type, ii) materials used for construction, iii) sources of housing materials, iv) type of houses of their forefathers, v) causes of shift of house type, and vi) advantages of changing house type.

Data so collected and accumulated from both primary and secondary sources are summarised, synthesised and classified for a rational interpretation and explanation in order to arrived on a mere generalised note of the problem. Statistical and cartographic techniques are also applied in necessary areas to make a judicious analysis of the problem.

IV. ANALYSIS

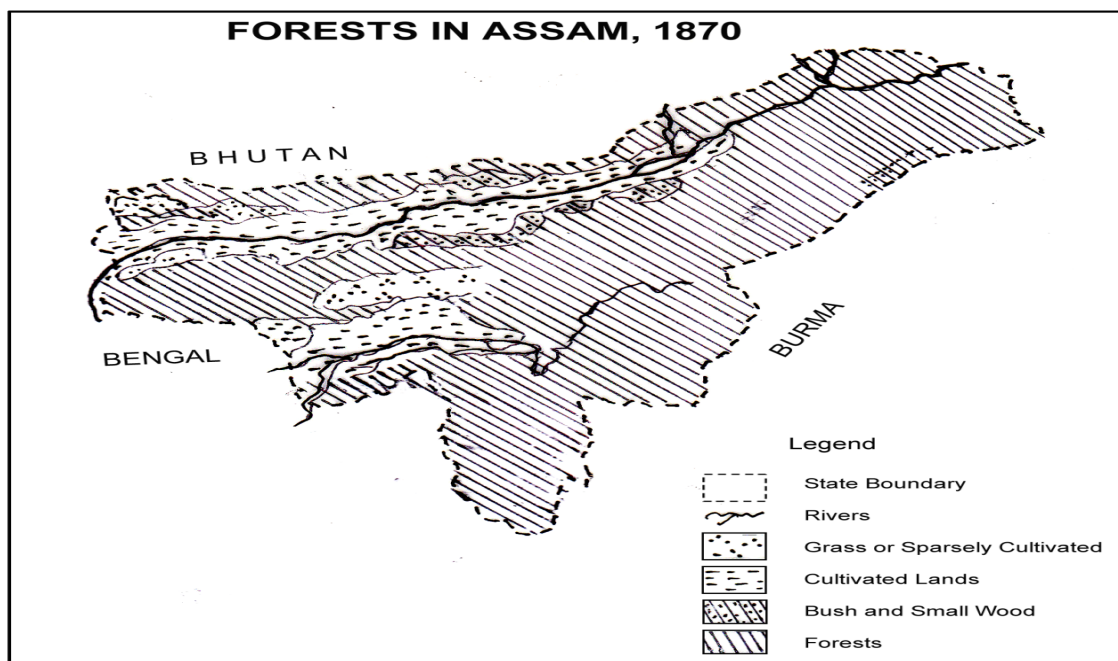
Plant Cover and Wildlife Diversity

The latitudinal extension, climate, soil, topography, species diversity and the ecosystem of the area are invariably same with that of tropical forest. However, several types of forests ranging from deciduous to evergreen type are seen in the region because of altitudinal, climatic and edaphic variations. In 1936, Champion forwarded a classification of Indian vegetation type. He along with Seth (1968) conducted a survey of Indian forestry. On the basis of the classification, the forests of Assam-Nagaland border can be grouped primarily into four types: (i) tropical wet evergreen forest, (ii) semi-evergreen forest, (iii) tropical moist deciduous forest and (iv) bamboo forest.

The ecosystem of the Assam-Nagaland border is invariably dominated by forest ecosystem with occasional presence of aquatic ecosystem of both lotic and lentic type. On the other hand, no specific grassland ecosystem can be strike out for zonation since bamboos of different varieties are wide spread all along the forest area of the region. Works on forest and vegetation of North-East India done by Griffith (1847), Hooker (1849), Clarke (1889), Fisher (1938), Kingdom and Ward (1960), Naik and Panigrahi (1961), Rao and Joseph (1965), Baishya and Rao (1982), Rao and Hazara (1986), Handique (1992), Chaudhury (2005) etc. are important. On the basis of these works and the existing pattern of the ecosystem of the region, the wildlife diversity of the Assam-Nagaland border region can best be illustrated under two main categories. These are (i) forest ecosystem and (ii) aquatic ecosystem. The wildlife sanctuaries, reserved forests,

unclassified state forest etc. are the legitimate constituent part of forest ecosystem of the region. Several reserved forests, in fact, constitute the backbone of the forest ecosystem which is endowed with diverse flora and fauna. The floristic diversity is conspicuous having numerous species ranging from evergreen type to wet savannah type of vegetation. The outstanding features especially of tropical wet evergreen forest are their high species diversity, complex stratification and large standing biomass. The following species are representative and typical to the region.

The tree species usually found include *Kaya assamica* (sia-nahar), *Shorea assamica* (Makai), *Dipterocarpus* (Hollong), *D. turbinatus* (Gurjan), *Mesoa farrea* (Nahar), *Guruga pinata* (Kahimala), *Palaquium polyanthum* (Kurta), *Hibiscus macrophyllus* (Chemia), *Carallia bracheata*, (Lateku), *Sapium baccatum* (Chelleng), *Dysoxylum binectariferum* (Bandardima), *Michelia champaca* Linn (Titachapa), *Artocarpus chaphasha* (Cham), *Eugenia jambolana* (Jamu), along with several other tree species. The shrub layer is quite prominent and often merges with the tree layer of smaller variety. Innumerable species of tree ferns, angiopteris, other ferns and fern allies, many lianas are common in these forests. Multiple species of bamboo and cane are found in the wet foothills and valleys. The region is also endowed with a dense network of rivers, streams, streamlets, along with a number of beels, swamps and marshy lands. Aquatic ecosystem of both lotic and lentic types are there that harbour diverse forms of life. By virtue of the quality and behaviour the aquatic community has been maintaining their presence in the beels and marshy lands of this region. The lotic system constituted by numerous rivers and streams possesses periphytons which include attached clumped and filamentous green and blue green algae and various sessile invertebrates. Farther downstream floating and emergent vegetation along with sessile invertebrates and a number of snails, crabs and fishes are abundant.

Fig. 1 Extent of deforestation

Source : Political and Ecological History of Assam, 1826-2000

Map showing distribution of forest in Assam based on H.Schlich's description on Assam during 1870, Courtesy Prasanta Bhattacharjya.

With a congenial environment for the growth of diverse plants and animals the Assam-Nagaland border region in particular and the entire North East India in general represent as one of the very rich forested areas of the country. The history of peopling in the area also indicates its richness in forest cover. W. Shakespeare (1929), a British official, forwarded a lively description on the nature of forest cover in Assam. He wrote – “From the Brahmaputra for 20 or 30 miles when the border is reached, the level country is covered with the thick jungle everywhere and much intersected streams. Near to and beyond the border the forest occurs, enormous trees with dense undergrowth flourishing up to 8000 feet.” All the British officers and travellers, who visited this area during the colonial rule, overwhelmingly appreciated the natural beauty and grandeur of the area. British officials like Allen (1905), McCosh (1834), Butler (1841), Hunter (1869) and Mills (1848) mentioned about the unique forest cover that the area manifested all throughout. As per records, during the period 1879-1880 the extent of the reserved forests in Sibsagar district and Naga Hills was 857.33 km² (Table 3.2). Noticeably, the area of reserved forests as shown in the table was much lower than the today's reserved forest area since there had been areas left back unexplored due to inaccessibility and inhospitable conditions. Moreover, excluding the areas which had already been declared reserved or protected or village forest, these were areas covered by forest of either low density or degraded nature not taken into account of forested areas.

Table 1: Area under reserved forests in Assam-Nagaland border region, 1879-80

Name of the reserved forest	District	Total area (sq.km.)
Abhoypur	Sibsagar	24.15
Hahchora	Sibsagar	2.42
Kakadonga	Sibsagar	48.30
Nambor	Naga Hills	626.29
Mikir Hills	Naga Hills	130.41
Daigrung	Naga Hills	25.76
Total	06	857.33

Source: D. Brandis, Suggestions Regarding Forest Administration in Assam, 1879

To study the nature and extent of forest cover of the study area imageries of IRS P6 LISS -III, 53, Jan, 2010 with 23.5 meter resolution are exclusively used. To acquire a total coverage, imagery sheets are selected from row 52 and 53 and column 112,113,114 and 115 imaged by the sensor LISS-III in 2010. These imageries are converted into geocoded form to identify the

Table 2: Reserved forests in Assam-Nagaland border, 2006-07

State	District	Name of reserved forest	Area (sq. km)
Assam	Golaghat	Dayang	246.36
		Rengma	139.21
		Diphu	183.63
	Jorhat	Desso	27.97
		Desso valley	163.81
		Tiru hills	58.58
	Sibsagar	Abhaypur	67.38
		Deroi	48.34
		Geleki	59.27
		Sapekhati	7.36
		Panidihing	20.22
	Karbi	Dhansiri	770.58
		Daldali	123.33
		S. Namabor	272.40
Nagaland	Dimapur	Rnagaphahar	62.26
	Mon	Singphan	23.57

Source: Office of the Chief Conservator of Forest, Assam

reflection co-efficient of plant cover during rainy summer months creates problem in identification of exact nature of forest cover. It requires imageries of winter months which may usually help in differentiating actual character of the forest cover over the region; (ii) existence of plantation crops and *basti* land depicts a misleading image of forest cover, and (iii) the *jhum* regrowth cannot be separated from other forests as leaf area expands to maximum during rainy months.

The topographic sheets corresponding to the study area are: 83 J/13, J/3.J/9, J/2, J/7, J/6, J/5, G/9, N/1, I/16, F/15 and M/18, which are surveyed in 1974.

Maps are prepared accordingly representing the study area with special emphasis on forest cover and topographic characteristics from both Landsat imageries (2025) and respective topographic sheets (1974). Forest areas are then delineated according to the density. Forest areas on the topographic sheets are classified as (i) dense forest, (ii) moderate forest and (iii) low or degraded forest. As such forest areas are also identified as per density from the map prepared from Landsat imageries. The two maps are superimposed and areas deforested are identified and measured. ARC-GIS & Q GIS software are used in the entire process of identification, classification and to develop necessary data base. The results are presented in following tables:

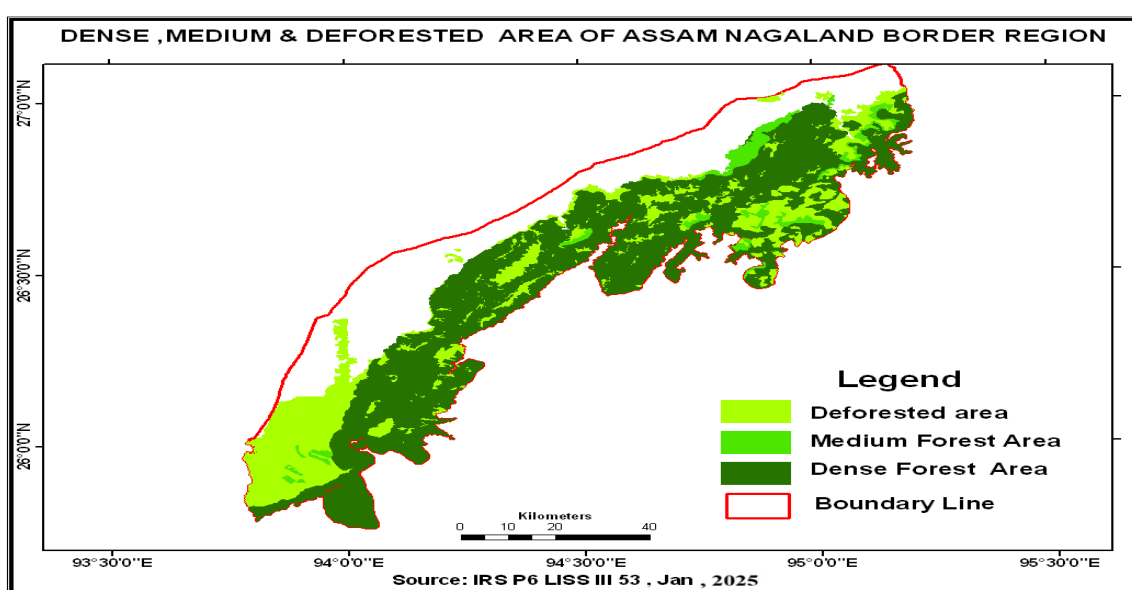


Fig. 2

Table 3.: Area and percentage of forest cover, 1974

Types of forest	Area (km ²)	% of forest area
Dense forest	2741.15	58.54
Medium forest	468.78	10.02
Low Forest	1472.61	31.44
Total forest area	4632.54	75.36
Total geographical area	6213.35	-

Source: Topographical sheets, Survey of India, 1974

Table 4: Analytical charts on change of forest cover (1974-2025)

Year of assessment	Total forest area (km ²)	% of total area
1974	4682.54	75.36
2025	2741.15	44.12
Total loss of forest	1941.39	31.24

Source: Survey of India, Topographical Sheets, 1974; Landsat-LISS-III Imagery, 2025

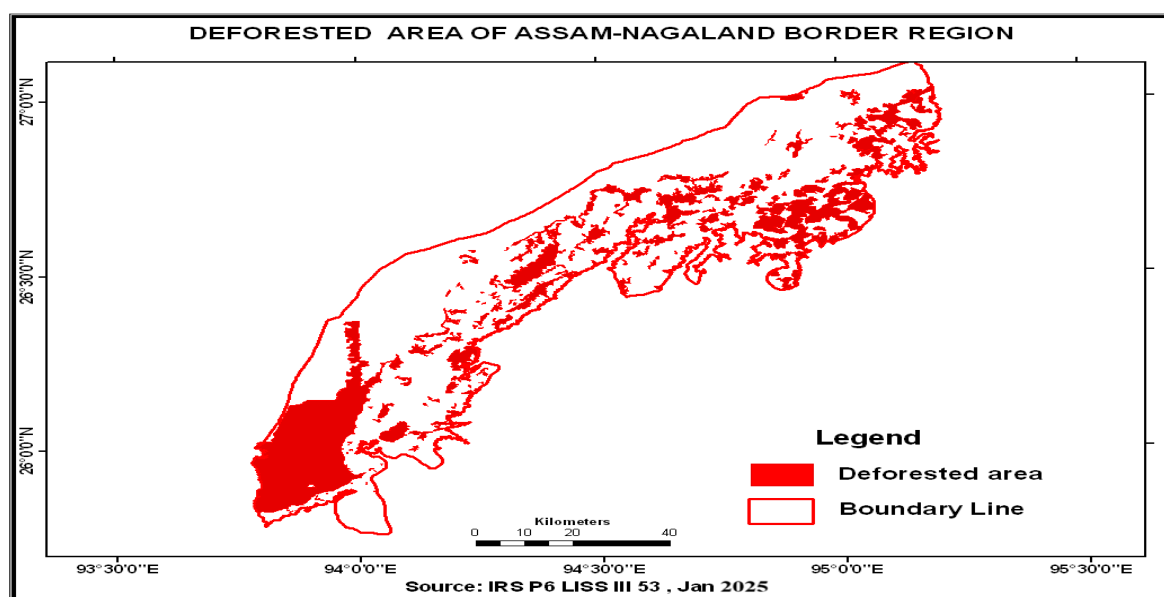
**Fig. 3**

Table 3.49 reveals that in 1974, the total area under forest was 4682.54 km² which was 75.36% of the total geographical area (6213.35 km²). The area under dense forest was 2741.15 km² (58.54% of total forest area), and 468.78 sq. km. of medium forest accounted only for 10.02% of the total forest area. Area under degraded or low forest was 1472.61 km². The comparison made with the RS data, 2025 shows that the total area under forest came down to 2741.15 km², which confirmed a loss of 1941.39 km² of forest area. At present the area under forest measures only 2741.15 km² including all types of forest and plantation areas (table 3.47).

On the basis of the above analysis and data, the annual loss of forest can be computed. Ecologist usually prefers the formulae of compound interest to compute the annual loss of forest. Accordingly the formulae is

$$P = \frac{100}{t_2 - t_1} \times \frac{a_1}{a_2}$$

Where, P is the annual loss of forest, t_1 is the time of base year and t_2 is the time of current year, a_1 is the total forest area during t_1 and a_2 is the forest area during t_2 time.

Computation shows that the rate of annual loss of forest for the Assam-Nagaland border is 4.745 km² area per year. On the other hand, on an average the annual loss of forest is 53.93 km². The overall scenario of forest loss approves that deforestation process has still been continuing at an accelerating pace in this part of Assam-Nagaland border.

The chief causes of deforestation so far identified are (i) incapability of the Department of Forest and Environment to implement the forest conservation Act, 1988, (ii) increasing encroachment of forest land by the peasantry of both the states, (iii) lack of co-ordination between the Department of Land Revenue and the Department of Forest and Environment, (iv) poor and incompetent planning and management system, (v) unresolved issues like border dispute between the two concerned states, (vi) absence of effective state forest policy, (vii) illegal timber felling and timber trade, (viii) illegal coal mining and quarrying, (ix) increasing population and (x) expansion of *jhum* land and reduction in *jhum* cycle.

Spatial Distribution of population

Distribution of population in a rural region with topographic diversity and ethnicity is always found to be heterogeneous. On the other hand, a region largely inhabited by people of varying ethnic groups in combination of multifarious cultural landscapes reflects diverse attributes of population distribution (Grover, 2004). On the other hand, ecology as a revolutionary force of life (Marcuse, 1972) is seen as one strong determinant of distribution of population with distinctive social and cultural imprints. The prevalence of tribal people in this belt of Assam-Nagaland border therefore, acts as a critical element in the distribution of population. Eastward and north-eastward, from the Assam Bengal railway line up to the Naga Hill range, three culturally distinct settlement zones can be identified on the basis of racial, ethnic and cultural attributes. These are: (i) the non-tribal settlement zone, (ii) the plain tribes settlement zone and (iii) the hill tribes settlement zone (table-1).

Table 5: Population in the ecological zones of Assam-Nagaland border region, 2001

Ecological Zone	Area (sq.km)	Total Population	Density
1. Non-tribal zone	1425.07	5,01,625	352
2. Plain tribal zone	2,448.81	6,04,739	220
3. Hill tribal zone	3,041.06	4,40,953	145

Source: (i) Area delimited from topographical sheet of 1:50,000 scale, (ii) Population compiled from Village Directory Census of India 2001,

House Type

An areas dominated by ethnic groups usually expose traditional attitudes representing their response to ecological, economic and cultural factors. The traditional dwelling is not simply an isolated element within the existing culture but is an integral component of a system which normally bears immense importance from ecological point of view. The dwellings thus appear as a major ingredient of ethnographic and ecological study. A house or a dwelling in the traditional society is manifestation of the intimate relation between man and his immediate environment. A house, in true sense, is an important ingredient of a society that presents the changing nature of interaction between human and environment in an area. At the same time, it also tells the story of man's struggle for shelter through time and space.

Enriched by ethnic diversity, the Assam-Nagaland border region harbors three distinct types of traditional dwellings representing three major ethnic groups, namely Naga, Karbi and the Assamese. In presence of intra ethnic diversity, this generalization is somewhat an abrupt coincidence but in a wider sense this categorization on the basis of some characteristics such as outdoor decoration, structural configuration and use of the dwellings stands to exhibit the commonness and thus provide the base of the generalization. It, however, appears that during the last few decades the house type has been changing at a faster rate and apparently it is due to the fast disappearing housing materials from the forest. At present, nearly 60 to 65% houses are of modified type. The causes of change in house type can be summarised as:

- The construction of traditional house is complicated and it needs a large amount of bamboos and woods which are now costly and not available as per requirements.
- With the disappearance of forest cover the housing materials have become locally scarce to meet the growing demands.
- Change in the mode of living from shifting to permanent and shifting of sites from hills to plains or foothills, more precisely from forest to the open areas, have rendered the platform houses increasingly clumsy and avoidable.

Table 6: House types by dominant roof materials, 1980

Sample village	Assam type thatch/bamboo cottage		Assam type building GI/asbestos/metal sheet roof	
	Number of house-hold	% of total	Number of house-hold	% of total
Aochendung	58	93.55	4	6.45
Akatitto	46	97.87	1	2.13
Than Pathar	179	90.86	18	9.14

Nagaadi	109	94.78	6	5.22
Golakpar	145	94.77	8	5.23
Gamariguri	102	90.27	11	9.73
Betbari	87	89.69	10	10.31

Source: Gaonburah or Village Head of the Respective Villages and Sample Survey, 2011

The Assam type buildings are primarily the results of the initiatives taken by the British with some elements of European architectural design. These houses were designed so as to suit the local environmental condition by tuning a little change in the setting of the roofs. The rural areas of the region is mostly characterised by Assam type houses of varying size and style. The housing scenario of the rural Assam is fast changing where the ratio between Assam type thatched cottage and Assam type building has been increasing almost by three times within a span of just ten years. Data collected from the sample villages indicate that the ratio has changed from 1:20 to 1:6 during the period 1980-2011 (Figs.-2, 3). However, multi storied building (maximum two storied) has emerged here and there within the rural landscape of the area, but in number these are quite insignificant (Table 2).

Table 7: Number and percentage of house type by dominant roof materials, 2024

Sample village	Assam type thatch/ bamboo cottage		Assam type building GI/ asbestos/ metal sheet roof	
	Number of house-hold	% of total	Number of house-hold	% of total
Aochendung	32	44.44	40	55.56
Akatitto	40	57.97	29	42.03
Than Pathar	160	66.67	80	33.33
Nagaadi	97	48.99	101	51.10
Golakpur	109	47.60	120	52.40
Gamariguri	70	34.83	131	65.17
Betbari	35	33.33	70	66.67

Source: Personal Survey, 2024

An analysis of the house type of the region would provide an interesting instance of human response to the physical environment. A house is an element of cultural landscape which expresses the physical condition of the region and cultural heritage of the people. The type of roofs, the walls, frames etc. show a remarkable adjustment of man to nature (Bhattacharya, 2010). The second important aspect which is exclusively conspicuous is the people's dependency on the immediate environment. As the dwelling houses are considered as the vital basic needs of man, any change in it is in fact a genuine product of the ecological changes.

In 2024 there were 3, 09,456 households in the region and of these 2, 39,176 were rural and 70,280 urban. The houses of each family are used for different purposes. Tribal people, in general, construct one or two houses with the provision of their bare necessities of space to perform various household functions. On the other hand, the hill tribes usually possess a single house, with provisions for conducting their day to day household works. A family having a higher income and with joint family system builds more than two or three houses to make room for all the family members and all their household works.

Replacement of Traditional House-building Materials

Mode of living is an active expression of the adaptations of the human groups to their natural settings (Sorre, 1962). Being a product of culture – environment interaction, house type reflects the cultural heritage, changing fashion, functional needs and consequent positive and negative aspects of non-cultural elements (Kniffen, 1965). The Assam-Nagaland border region, originally a forested patch with sizeable tribal inhabitants, has experienced a significant change in the form, function and structure of house type during the post-deforestation period. It is a vital question to enquire that what kind of changes have taken place in the house type and to what extent the socio-economic and ecological conditions in the area are experiencing change.

The house types in the Assam-Nagaland border region can be distinguished on the basis of the building materials used. In all rural landscapes, the tendency in making houses is to use materials available in the locality and to maintain the cultural attributes evolved through generations. Before the onset of large scale deforestation the inhabitants of the region collected all their building materials from the nearby forests. Thatch, bamboo, *ashoka* leaves (*takau pat*), wood, cane, etc. were plenty in the forests which were used as primary building materials by the forest dwellers of this region. The highland forest dwellers mostly used *ashoka* leaves as roofing materials against the extensive use of thatch by the plain dwellers of as thatches were found extensively in the river valleys. However, *ashoka* leaves, bamboo, wood and cane continued to remain as main building materials until 1960. Big thatch houses were the status symbols of the people and were mostly owned by the well-to-do families. Assam type cottage with *ashoka* leaf roofs are found still in many parts of the foothill areas of the border region.

Removal of maximum of the forest cover, establishment of tea estates and expansion of settlements encroaching forest land brought significant change in the house type of the region. The process of large scale forest destruction also reduced the availability of building materials like timber, cane, *ashoka* leaves, reeds and bamboo. Settlers of the plain districts of the border region, however, replaced their *ashoka* leaf roofs by thatches which they used to cultivate in the highlands to supplement the growing demand for roofing materials. On the other hand, houses in the foothill areas as well as the hilly parts remained almost

unchanged as plenty of ashoka trees were still there to meet the requirement. Two types of Assam type cottage in the rural- scape of the border belt can be identified – (i) *ashoka* leaf roofed cottage of foothills and hill areas and (ii) thatch roofed cottage of plain areas beyond the hills. During this period the region perhaps for the first time witnessed the growth of Assam type semi-pucca and pucca houses. The British and the European tea planters introduced this type of building in the administrative centers and in the tea estates of the region.

The second phase of impact of deforestation on house type of the region started during 70^s of 20th century as most of the forests, especially of the plain part, were wiped out. Scarcity of local building materials was mounting resulting from continuous deforestation and encroachment by the land hungry peasants of the surrounding areas. Conversion of vast grassland and the grazing reserves into productive crop land caused shortage of thatch, reeds, cane, bamboo etc. It is reported that cost of one bundle of thatch (containing 100 fistful thatches) was Rs. 400/- during 80^s in parts of South Nambor area (Tengani area) which was quite high for any lower middle class peasant. A well stitched thatched house usually lasted for 8 to 9 years depending upon the quality of thatch (Borah, 2011). As an alternative the middle class peasants started using corrugated iron sheets and asbestos sheets for roofing. Durability and effectiveness of these materials against all meteorological hazards attracted more and more people to use it and thus a new wave of using iron sheets (tin) and asbestos sheets which brought about a significant change in the house type. Within a period 15 years, from 1990 to 2005, C.I. sheets and asbestos got top priority as roofing materials in the villages of plain tribes and then among the hill tribe villages.

Apart from these, the implementation of “Pradhan Mantri Gram Sarak Yojana” (PMGSY) to connect rural areas by easy means of transport and communication also enhanced the pace of accessibility which contributed towards improving the marketing facilities in the remote rural areas. The third phase of change saw the growth of Assam type semi-pucca and Assam type pucca house. Change in the house type associated with the process of deforestation can be put in chronological order on the basis of building materials used. Table - 3 is derived on the basis of intensive field work done and interview carried with the experienced elderly people of the study area.

Contrary to the dominance of Assam type houses in the plain part of the region, the hill tribes of Nagaland and Karbi Anglong have their traditional house types. Raised platform house or *changghar* type was most common among the hill tribes like Karbi, Angami, Lotha, Ao, Konyak etc. Penetration of Christianity and increasing scarcity of locally available building materials encouraged them to construct low cost Assam type houses replacing the traditional ones. Traditionally accustomed to *changghar* culture, plain tribes like Mishing, Turung and Khamayang also have developed the habit of living in the flat floored Assam type

houses. The survey conducted in the Napam, a Sonowal dominated village of Merapani area and Mithche, a Lotha village of Wokha district reveals that most of the houses are of C.I. sheet roofed Assam type and very few *ashoka* leaf roofed houses are there. Taking help from Dambarudhar Sonowal of Napam and Auchumi Sumi of Mitche village an account on the house type was made (Table 5.14).

Table 8: Chronological order of change in house type in Assam-Nagaland border region, 1826-2005

Phase	Period	Changing house type	Predominant building materials	Status of ecology
Phase-I	Before 1826	Assam Type Cottage	Cane, bamboo, ashoka leaves, wood, reeds etc.	Scanty of population, dense forest cover, high biodiversity
Phase II	1826-1970	Assam Type Cottage	Cane, bamboo, thatch grasses, ashoka leaves, wood, reeds etc.	Population pressure rising, deforestation engraved the ecology. Heavy loss of biodiversity
Phase	Period	Changing house type	Predominant building materials	Status of ecology
Phase III	1970-2015	Assam Type Cottage and Semi-Pucca house	Bamboo, wood, C.I. Sheets, asbestos, cement etc.	Population pressure high, few isolated forest patch Remain.
Phase-IV	2015 and above	Assam Type Cottage and Semi-Pucca and Pucca house	Bamboo, wood, iron rod, Cement, bricks C.I. sheets, asbestos etc.	Man-land ratio increasing, secondary regrowth dominates forest area, poor in bio-diversity

Source: Personal field survey, 2024

Table 9: Number of households and house type in Napam and Mitche villages

Name of village	Number of Assam type cottage			Assam type semi pucca	Assam type pucca	Traditional dwelling	Total house-holds
	Palm leaves roofed	Thatch roofed	C.I. sheet roofed				
Napam	11	5	23	13	4	2	58
Mitche	3	-	15	2	-	4	24

Source: Personal Survey, 2024 with kind co-operation of locals namely Dambarudhar Sonowal and Achumi Sumi

Table-4 depicts the present status of house types in the two villages which can be logically appreciated for a generic analysis the whole region in general. C.I. sheet, wood and bamboo are the chief building materials of a tin roofed house. Bamboo is locally available since it is grown in the Basti land of every household and also in the forest of secondary growth. C.I. sheets and timbers are collected from nearby markets. The whole scenario associated with the changing house type is typically a product of ecological disorder which can be conceived from the building materials they use to construct houses. In the past, most of their needs for housing materials were fulfilled by the forests, because the environment was bounteous and there was no restriction on the use of forest resources. While enquiring about the sources of housing materials, the requirements of respondents vary greatly as they have owned more than one houses of different type.

Table-5 presents the overall pattern of sources of housing materials used by the tribes of the region to construct their houses. Growing dependence on market (percentage of respondents 41.28) is indicative of the aggravating situation of forest- based resources. Out of a total of 671 respondents, only 22.50% collect materials from the forest for construction of houses. However, dependence on market is increasing substantially, while the forests including the plantation plots of the individual family have still been playing a significant role in supplying raw materials for construction of houses.

Table 5: Sources of raw materials used for construction of houses

Materials Used	No. of respondents				Total
	Collected from forest	Purchased from market	From own plantation	Government supply	
Bamboo	52	20	58	-	130(19.37%)
Wood	18	49	31	26	124(18.48%)
Thatch	13	10	15	-	38(5.66%)
Cane	22	09	21	-	52(7.75%)

Reeds	18	12	08	-	38(5.66%)
C.I. sheets	-	78	-	26	104(15.50%)
Nuts	-	38	-	24	62 (9.24%)
Stone	10	17	-	-	27(4.02%)
Sand	18	15	-	12	45 (6.71%)
Bricks	-	29	-	22	51(7.60%)
Total	15 (22.50%)	277 (41.28%)	133 (19.82%)	110 (16.39%)	671

Source: Personal field survey, 2024

(Note: Figures in parenthesis are the percentage of total respondents)

V. Conclusion

Forest for the tribes has been acting as a staggering component to their life and livelihood since time immemorial. It, however, needs a systematic and well planned approach in order to mitigate the rising ecological crisis of the region. The two state governments in consultation with the concerned department of central government should formulate a very practical, effective and eco-friendly forest policy to repair and recover the damages caused to ecological settings of the region. It is noteworthy that the change in house pattern in the entire region almost coincides with the changes in forest cover scenario. Increasing depletion in forest cover ensures the depletion of sources for housing materials those were mostly and traditionally had been using by the tribes living there in for centuries. Type and pattern of house is solely dependent on the availability of housing materials in the locality where upon the changing house pattern of Assam-Nagaland border region is resting.

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