

Review Paper

# Deforestation in Nagaland, North-East India: Causes, Effects and Subsequent Environmental Degradation-A Preliminary Review

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**Abstract**

In recent years, there is an environmental consciousness on the degradation of forests and environment resulting in depletion of ecological services and life supporting systems in the Indian state of Nagaland where forest resources play an essential part in the lives of the people. The Forest covers an area of 13,318 km<sup>2</sup>, which is 80% of the total geographical area of the state. More than 70 percent of the people of Nagaland live in the rural areas and hence are directly dependent on the natural environment for their livelihood. With increase in population the pressure on the natural resources has increased, which has led to vast destruction of forests thus destroying the rich bio-reserves of the state. It has been identified that demographic factor is one of the most important causes of deforestation. Various activities of man such as shifting cultivation (Jhum), urbanization and other developmental activities are threatening the forest resource of the state. Jhum cultivation is taking a heavy toll on the forest resources of the region, depleting the dense forest cover. The people have continuously exploited the forest and its resources without thinking of the consequences. Proper management and sustainable use of the forest resources will be an environmental and social challenge for the people. The forest cover assessment data were available with Forest Survey India (FSI) of the previous years have been used. The approach involved the comparison of the current and previous satellite data with the forest cover map and analyzed the discernible changes. There is a net decline of 628 km<sup>2</sup> in forest cover as compared to previous assessment in the year 2013. This paper discusses the causes and consequences of forest degradation proposes strategy for the conservation of forest as well as the environment in the North East India in general and Nagaland in particular.

**Key Words:** Deforestation, Environmental degradation, Shifting cultivation, Conservation, Nagaland, North East India.

**Introduction**

The North East region of India is one of the 34 "Biodiversity Hotspots" of the world (CI, 2005). In recent years, there is an environmental consciousness on the degradation of forests resulting in depletion of ecological services and life supporting systems in the region. Deforestation has primarily attributed to the process of conversion of forest land to other uses, mostly agricultural purpose. Accelerated conversion of forest land due to intensive agricultural activities, rapid urbanization and other human activities have resulted changes in land use and land cover pattern (Rawat, 2014a). Significant land use / land cover changes have been reported during the last 20-30 years both on spatial and temporal scale, mainly due to economic development and population growth (Sharma, et al, 2011). Due to rapid population growth, fresh forest areas were felled and cleared for shifting agriculture, timber and firewood etc. in the state of Nagaland. The rate of deforestation is alarmingly high in private forests due to logging, shifting cultivation, jhum and heavy consumption of firewood. Jhum cultivation alone is taking a toll on the forest resources of Nagaland, depleting the dense forest cover essential for the ecological stability of the region (Rawat, 2014b). The State of the forest Report (2003) shows that a total of 5476 km<sup>2</sup> has been eroded in the region owing to jhum cultivation. Nagaland is the worst affected, with 1332 km<sup>2</sup> (24.3%) of forest destroyed, while Assam and Manipur lost 925 (16.8%) and 855 km<sup>2</sup> (15.6%) of forest land, respectively. According to an estimate about 82 km<sup>2</sup> of forest is lost in Nagaland for jhum cultivation per annum (Rawat, 2014c). Forests have been traditionally looked as a great source of economy by the Nagas as they greatly depend on forest for their livelihood. Nagaland has been endowed with a wide variety of forest on account of its unique geographic location and wide range of physiographic terrain. Sustainable development of forests has assumed immense priority in the international policy agenda particularly after UNO Conference on Environment and Development (UNCED) in 1992. Degradation of forest resources is often associated with shifting cultivation which is the most prominent farming system, providing a way of life for a large number of ethnic communities. There are nearly 600000 families of shifting cultivators in India, and more than 90% are in the North East region of India. In fact, this region can be appropriately termed as 'land of shifting cultivators' in the Agro-Kingdom (Keitzar, 2009). Shifting cultivation has received a great deal of attention due to

their observed or hypothesized role in tropical deforestation, biodiversity loss, accelerated soil erosion, increasing flood and landslide hazards, downstream sedimentation, decreased runoff and soil fertility and diminishing water resources and global warming. During monsoon rains, this is disrupting the hydrological cycle, producing much heavier runoff and sediment transport, leading to devastating floods as well as reduced dry season flow. These environmental impacts have far reaching implications for sustainable development of this region in general and Nagaland in particular. The present paper attempts to describe briefly the degradation of forest resources and environment in the study area and proposes strategy for the protection, conservation and sustainability of the forest and environment in the North East India in general and Nagaland in particular.

### Materials and methods

The forest cover assessment data of the previous cycle were available with Forest Survey of India and used as important information for successive forest cover classification. The approach followed in the current assessment also involves comparison of the current satellite data with the previous forest cover map and analyzed the discernible changes occurring due to improvement or degradation in the forest cover. LISS III data having spatial resolution of 23.5 meter has been used. The mapping was carried at a scale of 1:50000 with digital mode of interpretation. Data on the forest cover and land use etc. were also obtained through the detailed studies of Survey of India Topographical Sheets. The estimate of growing stock or wood volume of forest has always been of working plan of the government forest departments. Therefore, Annual Reports and monographs of the forest department, Govt. of Nagaland as well as other departments / non-government agencies were consulted and analyzed. Interviews were also conducted with various officials of Forest and other Departments of the State Government. Meetings and interviews with the local communities at the grass root level and civil societies were conducted to understand the utilization and management of the forest and its resources. Data were also collected on environmental degradation included geographical, hydrological and agricultural and socio-economic supported by regularly field surveys to assess the impacts followed by Rawat, (2017; 2014a).

### Study area

The state of Nagaland lies between 25°06' N to 27° 04' N latitudes and 93° 20'E to 95° 15' E longitudes with Myanmar in the east, Manipur in the South, Assam in the North and West and Arunachal Pradesh in the North. Nagaland has a total geographical area of 16,579 km<sup>2</sup> and is divided into eleven districts (Fig. 1). About 96 percent of its area is mountainous. The altitude varies between 190 m to 3048 m above msl and climatic conditions that varies from sub-temperate to sub-tropical. The geographical location and varied climatic conditions have contributed to the state's unique environment and ecosystems that are home to numerous endemic and endangered species of flora and fauna. Physiographically, the study area can be divided into three NE-SW trending mountain ranges (Fig. 2). These are (1) Eastern mountain ranges or High Hill ranges in the east. (2) Middle hilly ranges or Medium high hill ranges in the intermediate zone and (3) Western low ranges. Nagaland is situated almost at the tri-junction of the three major river systems of the region viz., Brahmaputra River System in the West and north, Meghna River System in the south and Chindwin River System in the east (Fig. 4). Nagaland has a total population of 1980602 out of which 1025707 (52%) are male and 954895 (48%) are female (Census, 2011).. The rural population comprises 82% of the total population. Presently, there are 11 districts in Nagaland each district is headed by Deputy Commissioner. All together there are 1428 villages (Census, 2011) each headed by Gaon Buras (GB's) or the traditional headman who look after the administrative functioning of the village. All these villages have strong set up of independent democratic governance in the form of "Village Councils" Each village has a Village Development Board headed by the VDB Secretary and this Board serves as a decision making as well as implementing agency for all development work at the village level.



Fig. 1. Study area

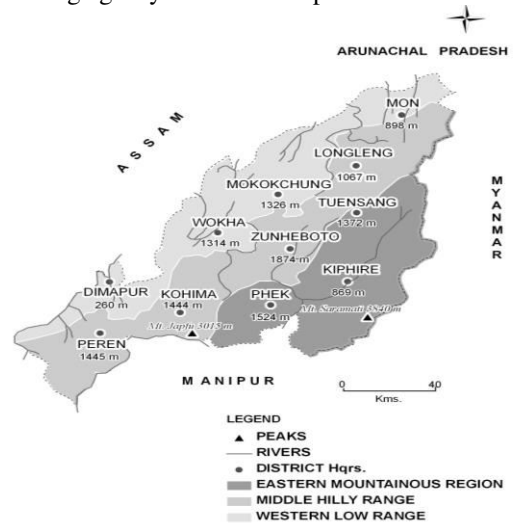


Fig 2. Physiographic Map

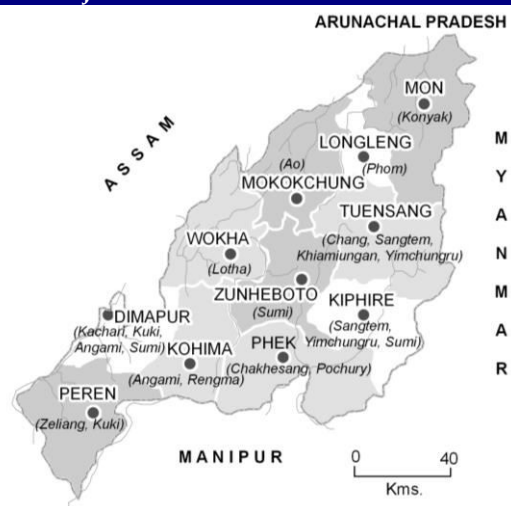


Fig. 3. Spatial distribution of different tribes.

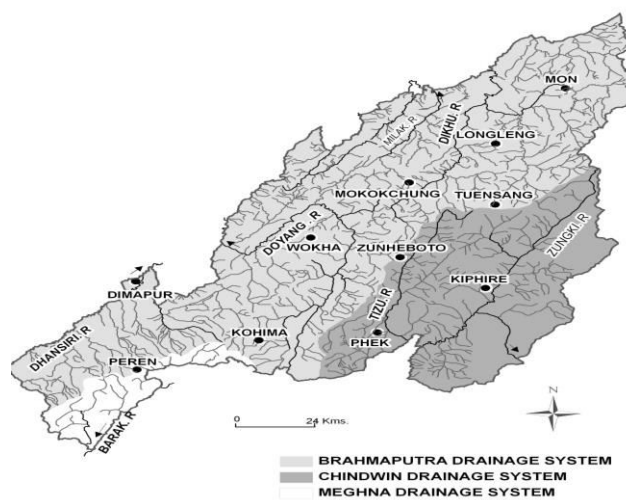


Fig. 4. River systems of Nagaland.

**Results and Discussion**

Though small in area the state is rich in natural resources and a wide variety of forests are found in Nagaland. The five different types of forest in Nagaland classified as per Champion and Seth are - Northern Tropical Wet Evergreen forests, Northern Tropical Semi Evergreen forests, Northern Sub-Tropical Broad Leaved Wet Hill Forests, Northern Sub-Tropical Pine Forests and Northern Montane Wet-temperate Forests. According to the 2009-10 report of the Forest Department of Nagaland the forest covers 81.21% of the total geographical area of the state and 88.3% of the total forest area is private/community owned while the state owns only 11.7%. In the State of Forest Report 2011, of the Forest Survey of India, it is seen that the forest cover in the state has decreased from 88.3% to 80.33% of the total geographical area. A comparatively low population, high regeneration rate of plant resources, community based natural resources management initiatives and most importantly shifting cultivation activities are the major controlling factors of ecological and environmental health of the study area. The hilly nature, rugged terrain and lofty ranges have a great bearing on the population distribution and the cultural landscape of Nagaland. The Naga community itself playing the vital role in the participatory mode to biodiversity conservation and natural resources management and forest conservation.

*The Present Status of Forest Cover*

Forests are complex ecosystems that comprises mainly of trees that support all kinds of life. Forest covers about one-third of the earth’s land cover. India has 23% of its land under forest cover according to the Global forest resource assessment 2010 by the FAO while in the Northeastern states of India, forest constitute 66.1% of the total geographical area (Table 1) which accounts for one fourth of the national forest cover. The forest cover is 80.3% in Nagaland which is 7.84% of the total forest cover of the Northeast. Forest plays an important role in the lives of the people as they are directly dependent on the forest and its resources and also indirectly it benefits the people by protecting the land/soil from erosion and facilitating the recharge of ground water. Forest also plays an important role in regulating the earth’s climate, the cycling of different elements such as carbon, water, nitrogen etc. The land to forest ratio in the northeast is seen to be the highest in Mizoram with the forest occupying 90.7% of the state’s geographical area while it is the lowest in Assam with just 35.3% (Table 1).

**Table- 1:** The Forest Cover of Northeast Region of India (Source: State of Forest Report of FSI, 2011).

State	Total Forest cover (in km <sup>2</sup> )	% of total area
Arunachal Pradesh	67,410	80.5
Assam	27,673	35.3
Manipur	17,090	76.5
Meghalaya	17,275	47.0
Mizoram	19,117	90.7
Nagaland	13,318	80.3
Tripura	7,977	76.0
<b>N.E. India</b>	<b>1,69,860</b>	<b>66.1</b>
<b>India</b>	<b>6,92,072</b>	<b>21.0</b>

On studying the change in forest area in the northeast in twenty four years it is seen that there is an overall increase in the forest area in the northeast. In the first twelve years (1987-1999) increase in the forest area is observed only in the states of Arunachal Pradesh and Tripura, but in the next twelve years (1999-2011) increase in forest area is noticed in the states of Assam, Meghalaya, Mizoram and Tripura with Assam having an increase of more than 3900 sq.km. In Nagaland there has been a decrease in the forest area with the maximum decrease i.e., more than 800 sq.km, noticed in the last twelve years (Table 2). Forests in Nagaland and the northeast are mostly controlled by the community and private sectors. 88.3 % of the forests in Nagaland are under the community control which is

attributed to the traditional law and practices dominant in the state. The forest cover of Nagaland has been continuously decreasing except for a slight increase (300 sq.km) in the 2003 assessment (Table 4). The forest cover within twenty two years (1987-2011) has seen a decrease of 1033 sq.km i.e., from 14,351 sq.km in 1987 to 13,318 sq.km in 2011 (Table 2). In Nagaland, Kohima district has the largest percentage of area under forest which is more than 89 % while Dimapur district has the least percentage of forested area i.e. 51% (Table 3).

**Table 2:** Change in Forest Cover (in km<sup>2</sup>) in the Northeast region of India (Source: State of Forest Report of Forest Survey of India - 1987; 1999 and 2011).

State	Area in 1987	Area in 1999	Change in area (1987-1999)	Area in 2011	Change in area (1999-2011)
Arunachal Pradesh	60500	68,847	+8347	67,410	-1437
Assam	26386	23,688	-2698	27,673	+3985
Manipur	17679	17,384	-295	17,090	-294
Meghalaya	16511	15,633	-878	17,275	+1642
Mizoram	19092	18,338	-754	19,117	+779
Nagaland	14351	14,164	-187	13,318	-846
Tripura	5743	5,745	+2	7,977	+2232
<b>N.E. India</b>	<b>160262</b>	<b>1,63,799</b>	<b>+3537</b>	<b>1,69,860</b>	<b>+6061</b>

**Table 3:** District-wise Forest Cover (in km<sup>2</sup>) in Nagaland during the year 2011 (Source: State of Forest Report of Forest Survey of India - 1987; 1999 and 2011).

Districts	Geographical area	Very dense forest	Mod. dense forest	Open forest	Total	Percentage of Geographical area	Change	Scrub
Dimapur	758	0	75	317	392	51.72	-9	0
Kohima	3283	288	1146	1489	2923	89.03	58	0
Mokokchung	1615	3	521	825	1349	83.53	-46	0
Mon	1786	33	482	724	1239	69.37	-55	1
Phek	2026	279	675	813	1767	87.22	56	0
Tuensang	4228	603	1112	1517	3232	76.44	-108	2
Wokha	1628	1	504	873	1378	84.64	-36	0
Zunheboto	1255	86	416	536	1038	82.71	-6	0
Total	16579	1,293	4,931	7,094	13,318	80.33	-146	3

**Table 4.** Trends in area under different types of forest in Nagaland (in km<sup>2</sup>) Source: State of Forest Report of Forest Survey of India - 1987; 1999 and 2011).

Forest type	2001 Assessment	2003 assessment	2005 assessment	2007 assessment	2009 Assessment	2011 Assessment
Dense forest	5,393	5,707	5,838	6,171	6171	6224
Open forest	7,952	7,902	7,881	7,293	7293	7094
Scrub forest	47	231	13	2	2	3
Total	13,392	13,840	13,732	13,466	13,466	13,321

### The Causes of Deforestation

Shifting cultivation has been identified as one of the principal causes of deforestation in most of the tropical regions of the globe, accounting for 70%, 50% and 35% respectively in Africa, Asia and tropical America. In the developing countries, where most of the tropical forests are located, the major transition in forest is a rapid reduction in forest area. This is primarily attributed to the process of conversion of forest land to other uses, mostly agricultural purpose. Some causes of deforestation are agriculture, shifting cultivation, demand of firewood for domestic, industrial and commercial purposes, urbanization and developmental activities. The main cause of loss of forest in Nagaland and most states of the Northeast India according to the Forest Survey of India is attributed to shortening of shifting cultivation cycle and biotic pressure. The major causes of deforestation in Nagaland are:

*Population Growth:-* The population of Nagaland has been increasing rapidly and this has led to increase in the demand on the natural resources. This has put pressure on the forests leading to an unsustainable harvest and degradation of community forests. The greater the number of people, the higher is the demand on the natural resources, and this demand has put a great toll on the forest resources of the state like any other place in the world.

*Jhum Cultivation:-* Jhum cultivation is a slash and burn type of agricultural practice where forest areas are cleared, burned and tilled for cultivation. Multiple intercropping of up to 60 food crops is done in a single field. After cultivating for a year or two the land is left

fallow for some years so that the land would regain its fertility. In India shifting/jhum cultivation is predominant in the states of Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Andaman and Nicobar Islands. Shifting cultivation accounts for 85% of the total cultivation in Northeast India. Jhum cultivation is practiced by almost all the tribes of Nagaland and is intricately linked to the socio-economic life of the people. About 70% of the people depend on agricultural sector for their livelihood. More than 45 % of forest is under Jhum cultivation. The area under jhum in Nagaland was 192 sq. km., in the year 1975, with a fallow period of 4-9 years. It has been currently reported that an approximate area of 937 sq. km is cleared annually for jhum cultivation. Traditionally the cycle for jhumming was 15 to 20 years but in recent years the cycle has been reduced to as short as 2 to 3 years. This has led to large scale deforestation, poor forest re-generation, reduction in indigenous biodiversity, exhaustion of nutrients and decrease in the crop yield. Shifting cultivation is most complex and multifaceted form of agriculture or agro-forestry practices in the world (Darlong, 2004). Forest areas are being converted to agriculture through its practices thus diminishing the area under primary forest (DPC, 2011). A virgin forest land is cleared by burning and the land is put to cultivation. When production declines, the land is abandoned and another virgin forest site is selected for cultivation (Sema et al., 2010).

**Table 5:** Administrative Classification of the Forest Cover and Area (in km<sup>2</sup>) under Shifting Cultivation in the Northeastern States in India (Source: Forest Survey of India, 2011).

State	Total Forest Area	Area Under Shifting Cultivation	Percentage of Forests Under Shifting Cultivation
Arunachal Pradesh	51,500	2600	5.0
Assam	27,000	3100	11.5
Manipur	17,400	3600	20.7
Meghalaya	9,500	2600	27.4
Mizoram	15,900	3800	23.8
Nagaland	8,600	3900	45.3
Tripura	7,000	1000	14.3

*Logging:-* Firewood has been used as a source of energy for cooking, heating etc. Wood consumption in the world is 3.2 billion m<sup>3</sup>. Developing countries of the world consume 1.8 billion m<sup>3</sup> which is 57% of the world total consumption while the developed countries consume 43% i.e., 1.4 billion m<sup>3</sup>. Almost 44% of the total global wood produced fulfils the fuel requirements of the world. Close look at the pattern of utilization of wood produced will show that the developed countries utilize 16% of their share for fuel requirements. India consumes nearly 135-170 Mt (million tonnes) of firewood annually and 10-15 ha of forest cover is being stripped off to meet the minimum fuel needs of urban and rural poor. In India 27% of the fuel-wood is derived from the forest whereas in the northeast it is more than 70% which lead to massive deforestation. Forest product, firewood is commonly used as domestic fuel by the people of Nagaland. Logging for developmental activities and for economic benefit has also led to high deforestation. Logging has destroyed nearly all the virgin forest of Nagaland within a short span of time. Consumption of firewood has increased both in rural and urban because of the population growth. There is no alternative source of energy in the villages. Fuel wood is one of the most important needs of a family's existence. In fact, it is next only to rice in importance. Next to food security, firewood is the most important resource in the life of a farming family. Demand for firewood is on the rise in the towns which is being sailing to the towns regularly. The firewood consumption in Nagaland is about 8.7 million cubic meters assuring the tree stand volume to approximately equivalent to that of jhum which is 188 m<sup>3</sup> trees from 46090 ha of wood. The rate of tree felling of late, has increased tremendously. The demand of fire wood for fuel has increased three fold as compared to the early 1970's in Nagaland. The sprawling townships have triggered the high demand. Limited scope for availability of an alternative at a lower cost than fire wood also accounts to the high demand of firewood. Since the early 1970's the demand for firewood could not meet the demands from the jhum clearance. The farmers started to penetrate primary and other forests under fallow regeneration period. This has disturbed the jhum cycle as well as the primary forest that host rich biodiversity of the region. By early 1990's Agri-link roads to the jhum fields were constructed at a very fast pace. This has resulted increased export of firewood and other timber products.

*Urbanization:-* Often urbanization and developmental activities lead to deforestation. The process of deforestation begins with building of infrastructure in the form of roads, railway lines, dams, townships, electric supply etc. Urban Development process for economic growth has led to loss of forest in the State. The effect of urban development is seen in all the major towns but is most prominent in the capital town of Kohima and the commercial hub of the state viz. Dimapur. The urban population was only 17.74 % of the total population in 2001 which increased to 28.97% in 2011 recording highest urban population growth. In 2011 census of India, Nagaland recorded highest urban population growth rate in the country.

### Environmental Degradation

Shifting cultivation, is a traditional practice and still predominant in the studied region. As a result of population expansion, demand for food and fuel has increased and land availability for agriculture has been reduced. Therefore, in recent years, the cycle of 10-15 years has decreased to 3-5 years, which allows insufficient fallowing time for the soils and vegetation to recover. Consequently, the indiscriminate felling of trees on hill slopes has brought higher erosion of soil and increasing rates of siltation, leading to unprecedented floods. This is all because of deforestation. The ecological and environmental consequence of deforestation and

shifting cultivation have been the subject of scientific interest in the recent years and is also a subject which has important ramifications for future of the sustainable development of this region. These consequences have far reaching implications for both the natural resources and environment. Presently, there is an environmental consciousness on the degradation of forests resulting in depletion of ecological services and life supporting systems in Nagaland. Environment is holocoenotic in nature and therefore any change in one component is bound to change the states of all other components (Singh, 1998), for example, deforestation leads to increased runoff (hence flood problems), increased soil erosion (hence siltation of water bodies), disappearance of species (hence gene erosion) and atmospheric loading of carbon dioxide (hence global warming). Shifting cultivation involves a rigorous method of clearing huge forest area, slashing and burning huge chunk of trees. This amounts to loss of top fertile soil and biodiversity within the area and if left unchecked leads to low productivity in the subsequent cycle that returns approximately in about 5-10 years fallow. The hills and mountains are given mandate to achieve 66% forest cover for its ecological significance. The forest has vital importance for sound environment. It also protects the landscape from exogenous destabilizing forces. The vegetation not only decreases flood peaks, but also increases the water yield during dry periods. Peak discharge rates are reduced because of increase infiltration in the presence of a forest cover. The consequences of deforestation can not only be immediately felt in an area but its effect can be carried on to harm the future generations and their environment. Some outstanding environmental degradation has been presented below.

*Loss of top soil:-* Without the roots of trees the top soil can be easily lost, which can lead to soil erosion and flash floods. The Indian Council for Agricultural Research (ICAR) estimates that up to 40 metric tons of top soil per hectare per year is eroded in a Naga Jhum field. The indiscriminate felling of trees on hill slopes has brought higher erosion of soil and increasing rates of the siltation of streams and water reservoirs, leading to unprecedented floods. The amount of soil erosion mainly due to the shifting cultivation is estimated as 88.3 million tonnes annually (Singh and Singh, 1981). Table 6 describes the annual cropping cycle of a typical jhum system and highlights those points where the soil is most vulnerable in this local shifting cultivation system.

**Table 6:** Soil erosion calendar of shifting cultivation system in the North East Hill region of India (after Yadav et al, 2001).

Month	Agricultural operation	Erosion problem	Soil erosion (t/ha)	
			Minimum	Maximum
January to April	Selection of plot, forest cutting, burning and cleaning of hill slopes and sowing begins	Displacement of loose soil materials to down hills and rolling down of earthworm casting, soil erosion as above and wash due to rains	0.0	22.4
May	Sowing / weeding	Heavy soil wash, faint drilling at foot hills on silt deposits	0.2	61.9
June	Weeding	Heavy wash of soil aggregates	0.2	45.4
July	Weeding/harvesting begins	Heavy wash of soil aggregates, crop root exposed, farm soil visible	1.8	21.9
August	Harvesting and occasional weeding	Soil wash continues	1.0	29.6
September	Harvesting	Moss appears, soil erosion slows down	0.1	13.8
October	Harvesting	Soil erosion appreciably reduced	0.0	2.7
November	Harvesting	No erosion, moss turns blackish	0.0	0.0
December	Harvesting/threshing/carry harvest back to home	No erosion	0.0	0.0
Year	Cropping with zero tillage on steep slope	Heavy soil wash	3.3	201.4

*Decline of natural forest:-* With more than 80% of the forest falling under the control of the community and the private sectors it is an undeniable reality that a large number of natural forest are being cleared for economic profits. Natural forests are also being cleared to make way for monoculture plantation of profitable species.

*Loss of Habitat/biodiversity:-* Biodiversity is the very basis of human survival and economic well-being as it provides food, medicine and offers a potential for providing many more yet unknown benefit to future generations. Species and their population contain precious 'genetic library' maintained by natural ecosystem (Singh, 1998). The state supports approximately 2,431 species of angiosperms, 9 species of Gymnosperms. The faunal diversity in the state is also rich with rare birds and animals. There are about 32 species of mammals, 65 species of birds, 42 fish species and 9 species of reptiles. Forests, being home of wildlife are important assets of aesthetic, touristic and cultural value to the society. There are some parts of the state that are still pristine and harbor a wide variety of endemic species of plants, animals and micro-organisms. However, in recent times, due to increasing population, pressure on agriculture to bring more areas under cultivation and other developmental activities the biodiversity of the state is facing serious threats. As per the India State of Forest Report (FSI, 2015), 55.62% area of the total geographical area in the state, is covered by forest which constitutes for 1.21% of India's forest area. In Nagaland state owned forest cover is just 11.7% as compared to private owned forest cover which is 88.3%. The habitat is about 2431 species of plants and a large number from the animal kingdom with recorded 42 species of fishes and 55 species of birds of which some are endemic to Nagaland. Forests are not safe in the hands of

government. It is the village that owns forest. Therefore, a pertinent question is the forest safe in the hands of the owner? The owner is the best protector of his property, therefore in the case of Nagaland the government may work out a system of conserving the forest in collaboration with the village. According to an estimate about 82 km<sup>2</sup> of forest is lost by the state for jhum cultivation per annum. The extent of area under shifting cultivation is also maximum in Nagaland compared to other states of North East region.

*Climate Change:*-The North East India, which boasts of world's wettest place, has witnessed the highest rainfall deficit in the last 30 years and meteorologists say there is a clue to global warming in the phenomenon. Meteorological records till July, 2009 reveal that Manipur has been worst affected recording 67% deficient rainfall followed by Nagaland (-62), Meghalaya (-55), Sikkim (-44), Assam (-34), Mizoram (-31), Tripura (-30) and Arunachal Pradesh (-29). As a fall-out, summer temperatures have shot up by almost 5° C on an average over the last two decades in North East India, a region nestled in hills and surrounded by rivers. On 19 July 2009 the maximum and minimum temperature was recorded as 37.5° C and 27.5° C in Guwahati of Assam, respectively which was above normal by 5° C and 1° C, respectively. The mean July temperature for the city during 1951-1980 had been 31.8° C as per the analysis of Indian Meteorological Department (IMD). Similarly, Imphal recorded 32.4° C (5° C above normal) and minimum 23.6° C (1° C above normal), with mean temperature for the same month being 28.8° C between 1951-1980. Shillong registered the maximum of 27.3° C (3° C above normal) and Agartala maximum 35° C (4° C above normal) and minimum 27° C (2° C above normal). The mean temperature for Shillong and Agartala for the month of July between 1951-1980 had been 24.1° C and 31.3° C, respectively. Manipur and several districts of Assam have already been declared as affected by drought like situation. Nagaland enjoys diverse climate ranging from sub tropical to sub montane temperate and even micro climatic conditions within a short distance. In this state rainfall is showing a declining trend during the last 15-20 years. Forests have profound effect on the climate as it balances carbon dioxide and oxygen in the atmosphere. They also play a vital role in the regulation of the water cycle and regulation of climate and atmospheric humidity. Destruction of the forests has altered rainfall pattern. Forests enhance local precipitation and improve water holding capacity of soil, regulate water cycle, maintain soil fertility by returning the nutrients to the soil through leaf fall and decomposition of litter, checks soil-erosion, landslides and reduce intensity of flood and droughts. The green house effect which is build-up of heat in the atmosphere is partly the result of deforestation. The analysis of temperature records for Nagaland shows a steady warming trend in both the minimum and maximum temperatures.

### Conservation of Forest Resources and the Environment

Recently there is a renewed interest on forestry development among most communities in the form of "tree farming" and "tree plantation". Community conservation efforts in the villages of Khonoma, Sendenyu and Changtongya are some of the success gained in conservation of the biodiversity. Ban on hunting of wild animals and birds for specific period of time is declared by a number of village councils. Joint conservation through the initiative of Nagaland Environmental Protection and Economic Development (NEPED) is done on a cluster of villages (more than 40 villages) for conservation and management of the bio-reserves of the villages. The forest resources of Nagaland are protected by a number of legislations. These are – 1) The Nagaland Forest Act, 1968, 2) The Nagaland Jhum land Act 1970 (Nagaland Act no.3 of 1974) 3) Forest Conservation Act, 1980 (No. 69 of 1980), 4) Joint Forest Management (JFM), 5) Nagaland Tree felling Regulation 2002 and 6) The biodiversity Act, 2012.

For protection, conservation and sustainability of forests in Nagaland various strategies must be developed. The strategies should be based on the involvement of the community for success as maximum forest area belongs to the community and private sector in Nagaland. Some strategies which can be taken for sustainability and proper management of the forest and its resources are highlighted below:

1. Participation of local government and community should be encouraged for better management of forest.
2. Protection of the indigenous institutions and traditional management systems that have protected forests for generations from dying.
3. Afforestation and tree farming in the degraded forests and jhum lands.
4. Maintain long fallow periods in the *jhum* areas.
5. Generate other livelihood opportunities in order to take the pressure off the forest and save it for posterity.
6. To improve income and the quality of life of forest dependent communities there should be proper and effective management of community forests.
7. Plantation of trees, creation and maintenance of natural parks and greenery should be made a priority in urban areas.

The state of the forest of Nagaland if seen globally is still in a good condition, but for its sustainability, measures for conservation and proper management of the available forest should be taken up before it is too late. All activities of man having an impact on the forest and its resources should be carefully and continuously monitored so that actions can be taken as and when discrepancies are observed. The decrease in the forest cover of the state can be checked by educating the people of the consequences of deforestation in the long run. Since maximum area of the state's forest is under the community and public ownership, community involvement in management and conservation of the available forest is a must for sustainability of this precious resource. One of the issues of the ecology and environment is the role of shifting cultivation activities and the threat they pose to sustainability, especially of environment and forest in the North East India in general and Nagaland in particular. In recent years, integrated watershed management has been identified as a key to sustainable development in the mountain ecosystems. It provides an ecologically sound economic base for the watersheds and its people. In any developmental activity, the watershed approach is more scientific because the inherent potential of soil, water and

forest resources in a particular area is controlled by various factors such as physiography, geological base, soil characteristics, climate, land use and socio-economic aspects etc.

### Conclusion

The main reasons for decrease in forest cover are shifting cultivation, high rate of fire wood consumption and other biotic pressure on forest lands. This study shows how recent shifting cultivation activities, which have caused drastic decline in both the environment and forest resources of Nagaland, may be tackled. The problem is that the environment has been degraded by shifting cultivation, the slash and burn system on steep slopes and the deforestation. These phenomena have accelerated soil erosion, landslides, and the deterioration of natural resources and the consequent loss of the well being of inhabitants. About 70% of all agricultural activities are carried out in the jhum fields which are considered as destructive to environment and ecology. Action is urgently needed to halt the further deforestation and environmental degradation. This jhum cultivation system of subsistence agriculture is now facing many challenges and there is urgent need to identify suitable alternatives. However, the indigenous community has become habituated to practice shifting cultivation for the past many generations. It is integrated into their culture and their entire life revolves around the jhum cycles. It is difficult for them to think beyond jhum. Forest and Environment Department along with the active participation and cooperation of the community have the common programmes which are presently under going in the state as follows-

1. Maintenance of environmental stability, ecological balance, conservation of biodiversity and genetic resources.
2. Increasing the forest cover in the state by encouraging involvement and participation of people in protection, development of forests through various programmes.
3. Increasing the productivity of forest through appropriate practices and technologies.
4. Protecting, developing and managing the forest resources on sustainable basis and utilization of the same to meet local domestic needs for forest products and to achieve economic growth, creating employment opportunities and promoting industrial development.
5. Need based strengthening of forest organizations with facilities, equipments and personnel with emphasis on human resource development.
6. It is recognized that a rational and balanced combination of different forest functions, production, protection, conservation and provision of environmental amenities are essential for sustainability of the forests. It is necessary to rehabilitate the degraded forests and enhance the area under effective tree cover.

### Recommendations

Traditionally, tribals have been an inseparable part of forest ecosystem. Forests are fulfilling the social, economic, cultural, religious and medicinal needs of the tribes. Therefore, it becomes very important to study the forest status of the area time to time. Forest resources continue to acquire importance for their role in meeting the human material needs and also for their ecological and environmental services. Therefore, sustainable use of forests with strong conservation approaches to the key elements for current forestry management in the state. Nagaland has strong Traditional Village Institutions at the local level. Most of the Village Councils have adopted measures to check deforestation through the setting up of forest committees whose responsibility is to protect the forest. Among the tribal societies, there are various value systems attached to the forest. However, the rapid socio-cultural changes and the market forces have little care for the traditional values that has preserved the resources till today. One of the answers for the effectiveness of management system, the preservation of forest and sustainable livelihood is the decentralization of power and providing legal rights and power to the communities. The following recommendations have been made in the course of the present study.

1. Cultivation and management of bamboo forests should be encouraged. Because bamboo is a poor's man timber. 5% of the total bamboo available in the country found in the state. It has multiple utility and versatile in nature. Development of bamboo resources for feeding the enterprises should be encouraged with effective financial, technical and marketing support to the farmers.
2. It is recommend to promote sustainable alternatives to shifting cultivation where it is no longer ecologically viable, ensuring that the culture and social organizations of the local people are not disrupted.
3. Fuel wood continues to be the predominant source of energy in rural areas. To meet the requirement, afforestation programmes should be intensified with special emphasis on plantation in degraded areas so as to decrease pressure on natural forests.
4. Non-timber forest produce including medicinal plants provides sustenance to rural population. So their production should be encouraged to generate employment opportunities and income of the people.
5. A need based and time bound programme of regeneration, afforestation and tree planting, with particular emphasis on fuel wood, timber and bamboo, on the degraded forest land may be introduced in the state at the earliest.
6. Human activities, programmes and projects which adversely affects forests that covers steep slopes, catchment areas of rivers, lakes and reservoirs, geologically unstable terrain and such other ecologically sensitive areas should be restricted.

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