*Applied Ecology and Environmental Sciences, 2020, Vol. 8, No. 6, 367-372*
Available online at http://pubs.sciepub.com/aees/8/6/6
Published by Science and Education Publishing
DOI:10.12691/aees-8-6-6

# Assessment of Forest Cover and Forest Loss in the Senapati District of Manipur, India

**Tumtin Sonmang Koren*, B.S. Mipun**

Department of Geography, North Eastern Hill University, Shillong, India
*Corresponding author: corenhemilton14@gmail.com

*Received July 23, 2020; Revised August 25, 2020; Accepted September 03, 2020*

**Abstract** Forest degradation is a worldwide phenomenon affecting directly or indirectly to the existent of mankind. An area of 3,952 million hectares is reported to be the total global forest cover, occupying 30 percent of land area, but the annual gross deforestation (between 2000 and 2005) took place at a pace of 12.9 million hectares which is considered as a serious concern [1]. Population and economic development lead to trade-offs between different land-use causing the disappearance of habitat to the thousands of animals. The forests are being diverted to non-forestry land uses so the forests today are more threatened than in the past. The Senapati being a hill district located in the northern part of the Manipur is bestowed with rich natural resources particularly its forest. Nevertheless, the rapid shrinking of forest cover has been observed during the past two decades. From the ecological points of view, such changes have brought significant transformation in the set-up of the local forest ecosystem and community well being. This paper intended to analyse the trend of forest cover as well as forest depletion in the district during the last 10 years (between 2005 and 2015) as the need for protection and conservation of forest is identified in the district. Further, this study also tries to outline the major factors responsible for the quick forest cover loss or degradation in the district.

***Keywords:*** *degradation, deforestation, habitat, shrinking, ecosystem, depletion*

**Cite This Article:** Tumtin Sonmang Koren, and B.S. Mipun, "Assessment of Forest Cover and Forest Loss in the Senapati District of Manipur, India." *Applied Ecology and Environmental Sciences*, vol. 8, no. 6 (2020): 367-372. doi: 10.12691/aees-8-6-6.

## 1. Introduction

A forest can be defined as: Land with a canopy that covers more than 10 percent, straddling an area greater than 0.5 hectares including the trees with a height taller than 5 m or *in situ*. [2]. According to FSI booklet 2011, the term 'forest area' (or recorded forest area) generally refers to all the geographic areas recorded as forests in the revenue records under any State Act or Local Laws. On the other hand, the term 'forest cover' refers to all lands more than one hectare in area, having a tree canopy density of more than 10 percent that may not be statutorily notified as revenue area. The former denotes the legal status of the land, whereas, latter indicates the presence of trees over any land.

Land, water, and vegetation are the three basic resources of the life support system. These resources are under extreme pressure due to natural and human-induced factors [3]. The village forests have lost their intrinsic qualities and have ceased to provide their normal services like control soil erosion, enhance water regime, etc [4]. As in the hills of Manipur, the forest is governed by customary laws and traditional practices and is under the control of the community. Illegal logging and forest conversion are more rampant where land tenure right over forests is weak or unclear. This uncertainty is often linked to an absence of forest mapping or registration, as well as aggravated by laws and policies that are conflicting or ambiguous and constantly being challenged by private sector interests, government agencies, and even from within the communities themselves. Forests constitute a vital segment of the terrestrial ecosystem at various levels and have been substantially influenced by human intervention for at least several thousand years. Clearing of forest and vegetation areas due to the expansion of agricultural land and human habitation has induced a threat to ecology [5]. The belief in protecting nature and conserving forest becomes no longer feasible as the dependency on forest resources is amplified. The problem can look at as the higher rate of forest degradation in the North Eastern States of India, which may be due to the practice of traditional *Jhum* (shifting) cultivation [6]. Indiscriminate cutting of trees and vegetation for *Jhum* causes loss of forest cover and eco-degradation in Manipur [7]. On the other hand, the National Forest Policy (1988) aims at having a minimum of one-third of a geographical area of the country under forest or tree cover in the plains and maintaining two-third in the hills. It is, therefore; compelled me to investigate and assess the spatial loss of forest cover in Senapati District during the last 10 years. The results of this study are expected to help improve in the management of forests and benefit the

community by ensuring the enhanced sustainability of the forests.

## 2. Database and Methodology

The data used in the study are collected mainly from secondary sources and also personal observation and interviews. In assessing the forest coverage status and the extent of depletion, data of Forest Survey of India (FSI) five biennial reports for the years 2005, 2009, 2011, 2013 and 2015; Manipur State Forest Department statistical data are incorporated. Statistical Year Book of Manipur (2015) published by the Directorate of Economic & Statistic is used for available data on various forestry-related information. Concrete databases on forest loss and gain are evaluated by simple statistical calculation to document the extent of forest loss in the district for the past 10 years.

For effective interviews, Participatory Rural Appraisal (PRA) was engaged to support the database. The key informants were the traditional village tribal chiefs, community heads, older people who provide holistic histories of land-use and youths who provide insights into how land-use may change in the future. Two years (2005: Dec. 2014 and 2015: Dec. 2014) district's USGS satellite images are NDVI (Normalised Digital Vegetative Index) to prepared presentable maps based on the forest canopy density classes.

## 3. Study Area

Senapati district of North Eastern State of Manipur (India) is chosen for the study. It is located between 93°29' and 94°15' East Longitude and 24°37' and 25°37' North Latitude. It has a total geographical area of 3,271 km$^2$ lies at an altitude between 1,061 m to 2,994 m above MSL. The district is under a humid subtropical climate. Nearly 66.55 percent of its geographical area is under forest covered [8] that constitutes three major forest systems: the natural forests; the plantation forests; and shrubs. The district is remote, highly forested and mountainous being part of the Indo-Myanmar ranges. It has a population of 4, 79,148 persons and a density of 146 persons per km$^2$ (2011 Census). Many ethnic tribal communities lived in the district, where, the *Kukis* and the *Nagas* are dominant.

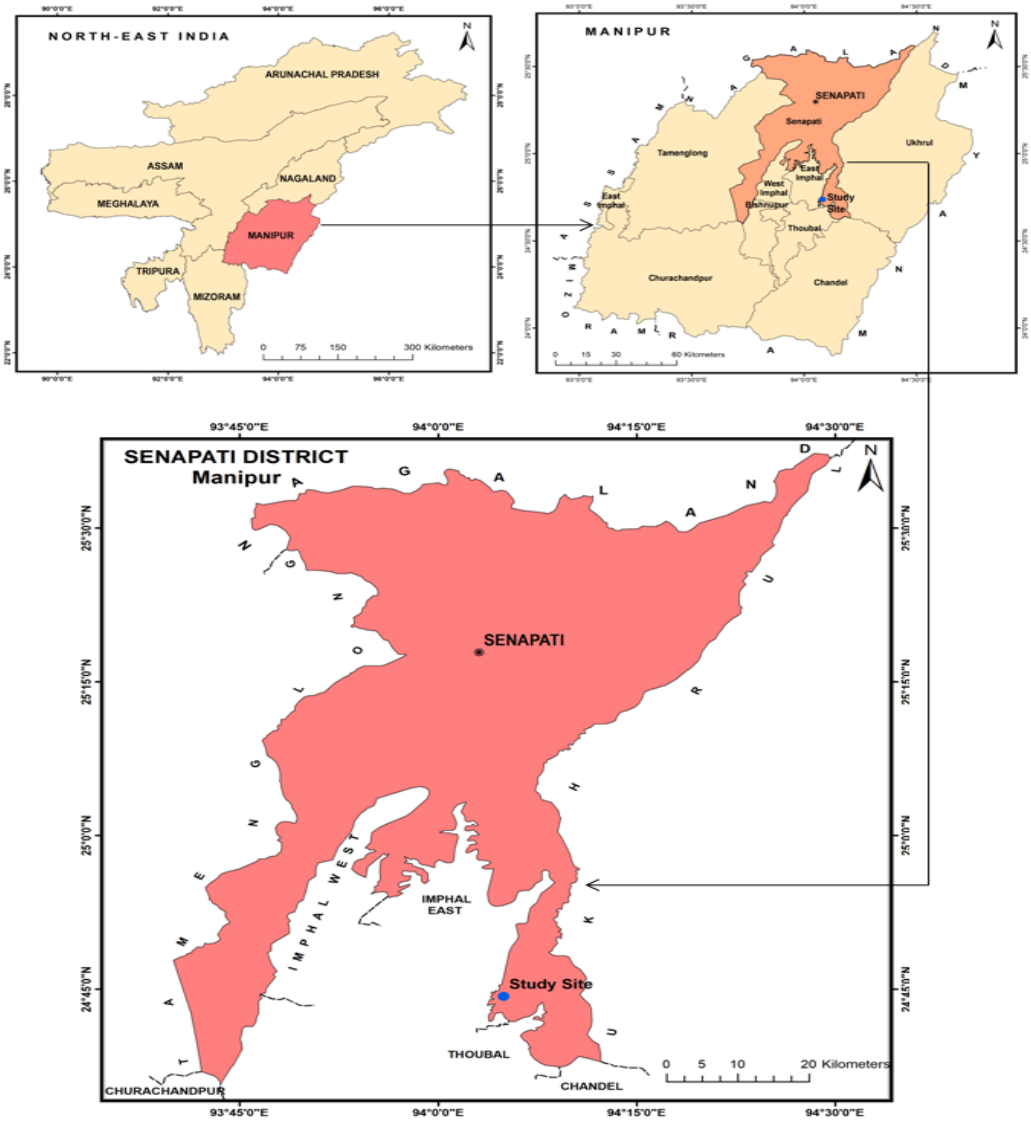


**Figure 1.** Location map of Senapati, Manipur

Agriculture is the main occupation and many practices shifting cultivation. Peoples depend on the forest for their daily requirements like fuel-wood, foods, water and varieties of forest products.

## 4. Background and Evaluation

The uncertain tenure system in the hill of Manipur encourages people to act promptly into a large scale clearing of forest areas for personal gains. Population pressure, poverty and human greed make persons away from the principles of sustainability. One of the major driving forces of forest and biodiversity loss in Manipur is the rapid population growth. The growth rate is significantly higher in the hill districts [9]. Since the early human civilizations, people used to occupy their immediate surroundings for more space and foods leading to a micro-level of ecological disturbances. However, such impacts were imperceptible due to the low population density and low technological interventions [10]. But as times change, demographic changes and new technologies result in visibility of their impacts on socio-economy and environment. Therefore, pressure on natural resources like forests increases immensely.

**Table 1. Trend in Forests Cover of Senapati District, Manipur**

| Parameter (s) (Area in km$^2$) | Year (s) | | | | |
|---|---|---|---|---|---|
| | 2005 | 2009 | 2011 | 2013 | 2015 |
| Total Geographical Area | 3,271 | 3,271 | 3,271 | 3,271 | 3,271 |
| Area under Actual Forest cover | 2,483 | 2,303 | 2,183 | 2,173 | 2,177 |
| Percent of actual forest cover to GA | 75.91 | 70.41 | 66.74 | 66.43 | 66.55 |
| Area under Dense Forest cover | 296 | 233 | 233 | 232 | 229 |
| Area under Moderately Dense Forest | 936 | 940 | 870 | 861 | 822 |
| Area under Open Forest cover | 1,251 | 1,130 | 1,080 | 1,080 | 1,126 |
| Area under scrublands | 7 | 0 | 0 | 0 | 308 |

Source: FSI, India State of Forest Report, 2005-2015.

Table 1 shows the trend in forest cover status of Senapati district between 2005 and 2015. The area under actual forest cover is reduced to 2,177 km$^2$ from 2,483 km$^2$ indicating a loss of 306 km$^2$ (12.3 percent). The percentage of total forest area to the total district's geographical area declined from 75.91 percent during 2005 to 66.55 percent in 2015. Most interestingly in 2005, the district had only 7 km$^2$ land areas under scrubs whereas the area increased to 308 km$^2$ in 2015. Increased scrubs land reflects the degradation or loss of actual forest cover in the district. Gradual shrinkage of forest areas is noticed during the first three years though there is also an increase of 0.12 percent between 2013 and 2015.

The district Open Forest remained occupying the major forests area of the district. In 2015, the district Dense Forest cover was recorded 229 km$^2$ from 296 km$^2$ during the year 2005. Similarly, the district had 822 km$^2$ Moderately Dense Forest in 2015 from 936 km$^2$ in 2005. From the ecology points of view, the district forest percentage is said to be excellent compared to the national percentage of 21.23 percent (2015). Of the district's total geographical area, 66.55 percent is found to be under forest cover; 7 percent Dense Forest, 25 percent Moderately Dense Forest and 34 percent open Forest. The district's Open Forest covered two-thirds of the total geographical area and was found dominantly at an altitude between 1000 to 2000 m above MSL. These forests are the most important constituents of the natural resources of Senapati district even if in present they are under high pressure for economic exploitation. The important trees widely found in the district are oak, chestnut, *Grulinaar borea*, toon, *Salix tetrasperma*, *Schima wallichii* etc. In the recent decade, for socio-economic purposes, selective logging and mass felling are witnessed leading to quick changes in forest health.

## 5. Forest Loss in Senapati District

Traditional *Jhum* or Shifting cultivation became the single most potent force of forest area loss in the district. A weak economy and lack of livelihood opportunity among the ethnic tribal in the rural Senapati enhance the wide-spread destruction of the forests. As Cooper *et.al* [11] stated, the rural population is supposed to be the main group that lives and depends on forest resources, but they are unaware of the importance of conservation and utilisation.

This section of the paper highlights the nature of forest cover change and aim to unravel the mechanisms underlying for such change in the study area.

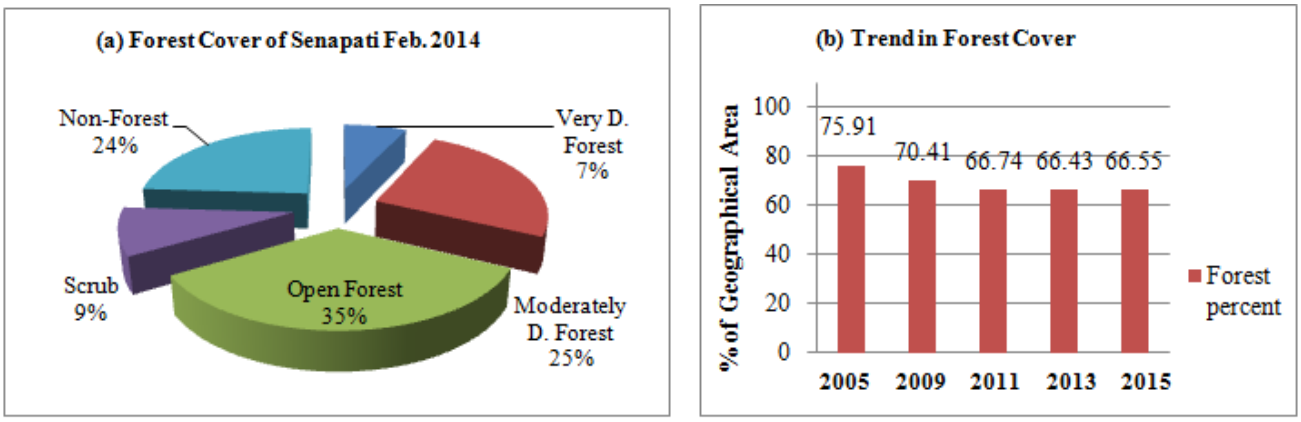


**Figure 2.** Change in the Geographical Area under Forest Cover

**Table 2. Forest Cover Change Matrix of Senapati District**

| Year(s) | Total GA ($Km^2$) | VDF (%) | MDF (%) | O.F. (%) | Total ($Km^2$) | % of total GA | Net Change (%) |
|---|---|---|---|---|---|---|---|
| 2005 | 3,271 | 9.04 | 28.61 | 38.24 | 2,483 | 75.91 | |
| 2009 | 3,271 | 7.12 | 28.73 | 34.54 | 2,303 | 70.41 | -5.50 |
| 2011 | 3,271 | 7.12 | 26.59 | 33.01 | 2,183 | 66.74 | -3.66 |
| 2013 | 3,271 | 7.09 | 26.32 | 33.01 | 2,173 | 66.43 | -0.30 |
| 2015 | 3,271 | 7.01 | 26.32 | 34.42 | 2,177 | 66.55 | 0.12 |
| Total | | -2.03 | -2.29 | -3.82 | -306 | | -9.34 |

Source: FSI, India State of Forest Report, 2005-2015.
GA-Geographical Area, VDF-Very Dense Forest, MDF-Moderately Dense Forest, OF-Open Forest.

Based on the interpretation of the above Table 2 & Figure 2 (b) data, gradual shrinkage of forest area is noticed from 2005 to 2013 whereas in 2015, increased by 4 $km^2$ compared to the previous assessment reported in 2013. The total forest cover loss in the district is 306 $km^2$ which is 9.34 percent of the district's geographical area. In 2005, 75.91 percent of the district's land was under forest cover which was reduced to 66.55 percent in the year 2015. The district lost its forest area at an alarming rate. It is calculated that the district lost it forest cover at a tune of 30.6 $km^2$ per year.

According to the study, the highest percentage of loss was recorded between 2005 and 2009 in which 5 percent of the forest area was lost in five years. Open Forest areas degraded the most that the district lost 3.83 percent of its OP in one decade. Similarly, 2.29 percent of MDF and 2.03 percent DF is observed loss during the same period of time. From the above information destruction on the district's forest area is said to be continuous and active. Beside, *Jhum* related activities mass rotational felling for commercial purposes, forest fire, and *Annual Household Firewood Cutting* are considered to be important factors for forest degradation in the district.

For further inquiry, two years (2005 and 2015) USGS district satellite image were NDVI to generate forest loss data.

**Table 3. NDVI data on Depletion of Forest Cover in Senapati**

| Variables (%) | Year (s) | | Change (in %) |
|---|---|---|---|
| | 2005 | 2015 | |
| Non-Forest Area | 24.09 | 33.41 | +9.32 |
| Total Forest | 76.39 | 66.89 | -9.5 |
| Open Forest | 50.3 | 51.6 | +1.3 |
| Moderately Dense Forest | 37.7 | 37.7 | -2.1 |
| Very Dense Forest | 11.9 | 10.6 | -1.2 |

Source: Analysing Figure 3 and Figure 4.

**Satellite Image Showing Trend in Forest Cover**

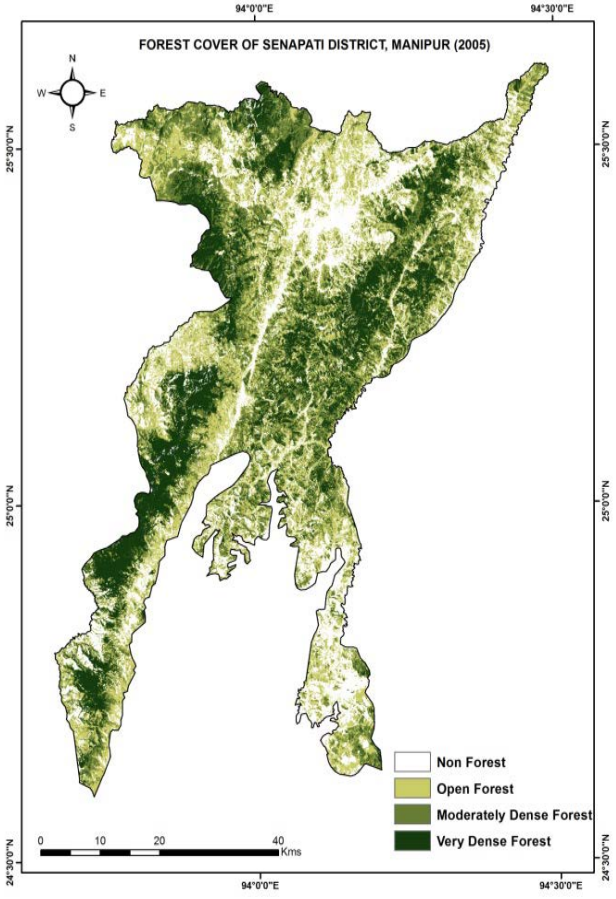


**Figure 3.** 2005 NDVI Map of Senapati District, Manipur

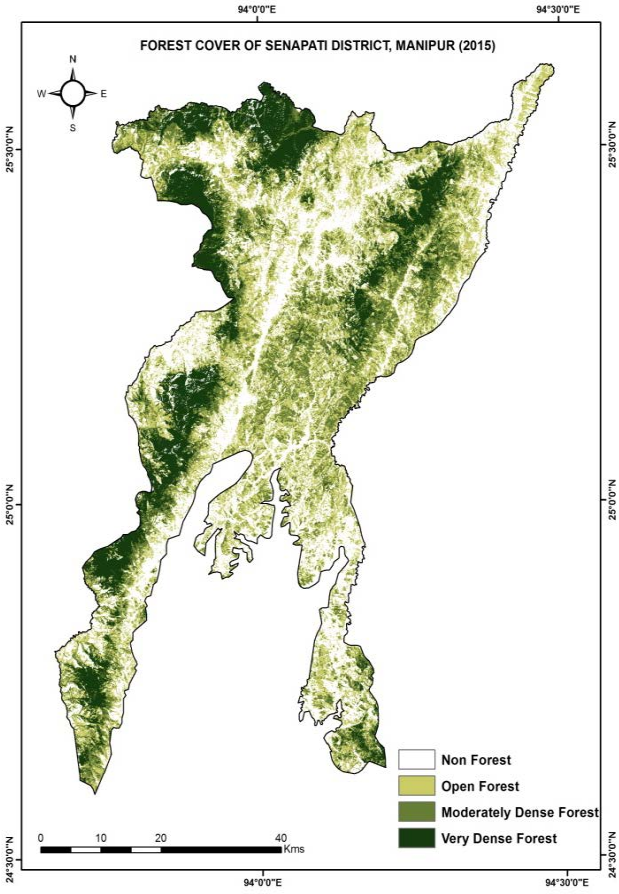


**Figure 4.** 2015 NDVI Map of Senapati District, Manipur

Similar to that of FSI data output, NDVI data provide more or less a similar depiction of forest loss. The district forest area declined from 76.39 percent to 66.89 percent indicating the loss of 9.5 percent between 2005 and 2015. The district Non-Forest Area and Open Forest area increased substantially. The study reveals that, from 2005 to 2015, the district losses 2.1 percent MDF and 1.2 percent VDF respectively. A gradual decline in forest area is noticed from the generated database. Hence, overall, the district lost 9.5 percent (311km$^2$) of its forest area at a pace of 0.9 percent (31km$^2$) per year.

## 6. Finding

The district forest cover is found to be excellent though a gradual decline in forest area is recorded in the given period. Based on the interpretation of FSI reports (2005 and 2015), forest cover in the district is 75.91 percent and 66.55 percent of the total district's geographical area (3,271 km$^2$). In the year 2005, the district had 296 km$^2$ under Very Dense Forest (VDF), 936 km$^2$ under Moderately Dense Forest (MDF) and 1,251 km$^2$ under Open Forest. In 2015, a substantial decline was witnessed in these forest classes. Of the district's total geographical area (3,271 km$^2$) 66.55 percent land area is found to be under forest cover.

The district lost 9.34 percent (306 km$^2$) of its forest cover in the period between 2005 and 2015. The shrinking of forest area is said to be alarming in which the district loses at a pace of 30.6 km$^2$ per year. The highest loss percentage (3.82 percent) happens in the Open Forest. Similarly, Very Dense forest and Moderately Dense Forest recorded a loss of 2.03 percent and 2.29 percent respectively. It is observed that forest cover in the district has decreased by 306 km$^2$ as compared to the 2015 assessment report.

Based on the interpretation of USGS NDVI district's satellite images, the district forest cover status and forest loss scenario are parallel to that of FSI data.

## 7. Discussion

To begin with, the forest lands in the Senapati district are not under the purview of the Manipur Land Records and Land Revenue Act, 1960. Besides, Reserved or Protected Forests, the entire forest resource is owned and managed by individuals or community leaders according to their customary laws and practices. Ancestrally, every community in the district has a distinct social system of governing and cultural beliefs. The typical example that can be cited is the prevalence of ownership rights over the village-based resources. It can be broadly divided into two; the village/community that governed by traditional tribal Chiefs, and local bodies like committees or councils. The latter system has greater advantages in maintaining the resource (forest resource) than the former. The Sixth Schedule of the Indian Constitution under Article: 243 does not enforced in the state of Manipur. Authority on the legality or approved utilization of forest resources or lands is vested with the Autonomous District Councils (ADCs) which remains as mere spectator. Such passive nature in exercising the bestowed legal rights by the government agencies is another reason for the high rate of forest degradation in the district. In the year 2009 alone, 465.38 km$^2$ (20 percent of the total district's forest area) forest areas were encroached due to *Jhum* and related activities [12]. On the basis of ground-truthing, the main reason for the drastic increase in scrub and non-forest area is shifting cultivation which is widely practiced. Economic backwardness and lack of cultivable land trigger this system of traditional farming. To control this age-old tradition many policies and Acts were adopted at a state as well as national level. In spite of efforts to contain deforestation the existing traditional norms and customary laws inherited by peoples defer such an attempt.

## 8. Conclusion

This study proposes a new metric that accounts for changes in forest cover and allows us to investigate the forest cover position as well. The study highlights a new paradigm in the management of forest resources for environmental resilience. It is also recognised the status of forest cover and forest loss scenario in the district. If people continue to favour a change in forest land use, ecological collapse is imminent. Lack of proper institutions, legislative framework, control of territories, the definition of rights and the vague ownership rights over forest land are found to be the causes of extensive forest loss. Besides, adopting a clear-cut land tenure system providing alternative livelihood, incentive and public awareness through 'citizen science' among the hill dwellers will have a good impact on curtain forest degradation predicament to some extent.

## Acknowledgments

I express my sincere thanks to every individual who has contributed directly or indirectly in drafting this manuscript successfully. I would like to thank Prof. B.S. Mipun, Department of Geography, North Eastern Hill University, for his help and guidance while preparing this paper.

## References

[1] FAO, Global Forest Resource Assessment (FRA), *Main Report*, FAO (WHO) Forestry Publication. 2006.

[2] FAO, Global Forest Resource Assessment (FRA), *Main Report*, FAO (WHO) Forestry Publication, 2010, 479.

[3] Singh, R.K, Contour Bunding and Management for Sustainable Hill Agriculture, Prakash, N., Rajesh Kumar, Brajendra and Rajiv Kumar (eds.) *Integrated farming System for Hill Agriculture*, Director, ICAR, NER, Umiam Publication, 2007, 50-54.

[4] Goswami, D.C, Social Forestry in the Himalaya- need for a better future, Hazid Husain (ed.) *Environmental Issues of North East India*, Regency Publications, New Delhi: 2003, 189-191.

[5] Nath, G, "Human Induced Treats to Biodiversity in NE India with Special Reference to Majuli", *International Journal for Basic Sciences and Social Sciences*, (IJBSS), 1, (1). 15-24. 2012.

[6] Reddy, R.V., Behera, B, and Rao, D.M, "Forest Degradation in India: Extent and Determinants", *Indian Journal of Agricultural Economic*, 56, (4). 631-651. 2001.

[7] Yadava, P.S., Sanjay, N and Th. Bhogen, Deforestation and Shifting Cultivation in Manipur, Singh, R.P. (ed.) *Environment and Change*, Rajesh Publication, New Delhi, 2002, 34-35.
[8] FSI, *India State of Forest Report*. 2015.
[9] Statistical Year Book of Manipur (SYBM), Directorate of Economics & Statistics Publication. 2015.
[10] Koren, T.S, A Study of Forest Encroachment by Settlement in Senapati District of Manipur, India, Das, T.K and Mondal, K (eds.) *Environment Degradation and Disaster: A Vision Plan for Sustainable Development*, Arati Mitra for Avenel Press Publications, Kolkata, 2016, 230.
[11] Cooper B. Caren, Dickinson Janis, Tina Phillips and Rick Bonney, "Citizen Science as a Tool for Conservation in Residential Ecosystems", *Ecology and Society*, 12 (2). 2007. https://www.ecologyandsociety.org/vol12/iss2/art11/ Accessed dated 3 Aug. 2020.
[12] Manipur State Remote Sensing Centre (MSRSC) Report, 2009.