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# AN ASSESSMENT OF FOREST COVER CHANGES IN THE INDIAN HIMALAYAN REGION

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## ABSTRACT

The Indian Himalayan Region is very rich in forest and forest-diversity. Forest covers about 62.1% of its geographical area. This paper assesses various aspects of forest cover changes from 1987 to 2013 (26 years) in the Indian Himalayan Region. Data were gathered from the reports of Forest Survey of India. We observed an increase of 15.7% in overall forest area. In terms of proportion of state forest area to the country's geographical area, the increase was 14.7%. An increase of 6.4% was noted in its share to country's forest area. I assessed proportion of tree cover to the state's geographical area using data between 2001 and 2011 and observed about 146% increase in its area although tree cover area is less than 2%. Area and change in forest cover varies from the states, lie in the eastern extension of Himalaya to the central and western Himalayan states. People's participation in forest management in the Indian Himalayan States is substantially high however, over the years, the participation decreased to a certain extend. I also observed that 'Forest Act of India 1982' has resulted in an increase in forest area.

**Keywords:** Forests cover change, State forest, Tree cover, Indian Himalayan Region.

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## INTRODUCTION

Forests cover about 30% of the Earth's land area (FAO 2012) while it varies from equatorial rain forests to deserts and from mountains to polar region. A large part of equatorial and temperate regions of the world have dense forest cover while, mountains, plateaus and deserts have sparse distribution of forests. India has 21.17% forest cover 2013 and its proportion varies from the Indian Himalayan Region (IHR) to other parts of country. India's 75.52% forest area is covered by the states of Indian Himalayan Region while, in terms of India's geographical area, it is only 15.7%. National Forest Policy of India 1988 aimed at maintaining 66% of the geographical area in the hills under forest (Negi 2009) however; this figure stands for 62.1% as of now.

Increasing world population has led to shortage of forest products by which the world is suffering (FAO 1948). In India, forest resources are decreasing however; they are one amongst the main sources of livelihoods. Sustainable management of forests and trees is also the strategic objectives of the FAO strategy for forests and forestry (FAO 2010). Global forest cover has changed substantially over

the past decades. As population continue to grow and demand for food and land increases, the rate of forest loss has been cut down by over 50%. In 1990, the world had 4,128 million ha of forest whereas by 2015, this area has decreased to 3,999 million ha (30.6% change). There was a loss of some 129 million ha of forest from 1990 to 2015 representing the annual rate of -0.13%. Average per capita forest area globally declined from 0.8 ha to 0.6 ha per person during the given time. Natural forest has decreased while planted forest has increased by over 110 million ha since 1990 and it accounts for 7% of the world's forest area (FAO 2015). India's Forest Report of 2017 showed an increase in forest cover by 1.14% through plantation. Meanwhile, a substantial increase i.e. 15.7% in forest area was noticed between 1987 and 2013 in IHR. It has 0.005 km<sup>2</sup> per capita forestland in comparison to 0.0006 km<sup>2</sup> of India average.

IHR is rich in forest diversity. Economic viability of forests across the Himalayan region is high. Further, the Himalayan forests are very important in terms of capturing essential atmospheric moisture mainly in the form of snow, to regulate river flow, and to reduce erosion and sedimentation downstream (Negi *et al.*, 2006). They can be

divided into two categories. First category represents to the western and central Himalayas including Jammu & Kashmir, Himachal Pradesh and Uttarakhand and the second is the eastern Himalaya including Sikkim and Arunachal Pradesh represented by sub-tropical and temperate forests. The major forest types are pine, oak, coniferous and alpine pastures (Sati 2006). Meanwhile, the five states of northeast India, which is called the eastern extension of the Himalaya, have domination in tropical and subtropical forests along with bamboo forests. Here, forest diversity is high and it is one amongst the global biodiversity hotspots (Sati 2014; Myers *et al.*, 2000). Floral diversity changes from the Western to Central and Eastern Himalaya (Champion *et al.*, 1968; Dhar *et al.*, 1997; Negi 1990; Singh 2004; Samal *et al.*, 2002; Samal *et al.*, 2004; Maikhuri *et al.*, 1998; Dhyani 2000). A wide variety of flora forms a gradient from tropical vegetation to alpine meadows (Singh 1971).

In spite of high economic viability of forests with high biodiversity, the Himalayan forests are largely unused, which is one amongst the factors of increase in forest cover, although, the forest products are among the major sources of livelihoods. However, the states, which possess high forestland, received a substantial decrease in forest cover. The main objective of the present study is to analyze forest cover change in the states of Indian Himalayan region. It also assesses the state's proportion of forestland with the states and country and suggests optimum use of forest resources.

## STUDY AREA

The Himalaya Mountain is located in the South Asian countries, extended between 21° 57' – 37° 5' N and 72° 40' – 97° 25' E and stretches about 250-300 km. It is the world's highest, youngest and new folded mountain system, is extending about 2,400 km, from the 'Pamir's Knot' in the northwest to the Arakan-Yoma mountain ranges of Myanmar in the southeast as an arc (Fig. 1). This study is confined to the Indian Himalayan Region (IHR), which covers ten states of the northern and northeast India that include Jammu and Kashmir State, Himachal Pradesh (Western Himalaya), Uttarakhand (Central Himalaya), Sikkim and Arunachal Pradesh (Eastern Himalaya) and Nagaland, Manipur, Mizoram, Meghalaya and Tripura (the eastern extension of the Himalaya). The parts of Assam and West Bengal Hills (WBH) also form the eastern extension of Himalaya. The total area of this region is 533,604 km<sup>2</sup>, which represents 16.2% of the total geographical area of India. In this study, I exclude Assam hills due to lack of data on forest

use and cover change. IHR possesses about 6.73% forest area of the country's geographical area and 31% of the country's forest area whereas in terms of population, it obtains only 3.86% of the total population of India. The topography of the region is rough, rugged and undulating that makes the Himalaya one amongst the most fragile ecosystems in the world.



Fig. 1. Location map of IHR

## METHODOLOGY

This study was conducted through collection of data from secondary sources mainly from the Forest Survey of India reports 1987; 1995; 2005 and 2013. I analyzed data on forest use such as proportion of state forest cover to state geographic area, proportion of state forest cover to country geographic area, proportion of state cover to IHR forest cover, proportion of state forest cover to country forest cover, tree cover estimation and progress of joint forest management in different states of IHR. I observed percentile of all the variables and further analyzed change in all the variables from 1987-2013 (26 years). Further, I analyzed descriptive statistics and observed mean value and standard deviation of state wise data of all variables (n=11). I calculated percentage share of India's geographical area, percentage share of IHR, population density, per capita land and per capita forestland of the Himalayan states, IHR and of India.

## RESULTS

### Salient features of IHR

The salient features of IHR– percentage share of India's geographical area, percentage share of IHR states; population density, per capita land (km<sup>2</sup>) and per capita

forestland (km<sup>2</sup>) were described in Table 1. IHR comprises 15.7% area of India's total geographical area. Among the states of IHR, Jammu and Kashmir has the highest share of India's geographical area i.e. 6.8%, followed by Arunachal Pradesh, which is occupying 2.5% area. Himachal Pradesh has 1.7% area and Uttarakhand possesses 1.6% area. Other states have less than 1% share. Similarly, Jammu and Kashmir State obtains the highest share of IHR area (43.1%), which is followed by Arunachal Pradesh (16.3%). Himachal Pradesh and Uttarakhand share 10.8% and 10.4%, respectively. Other states have less than 5% area share. Population density is the highest in Tripura (350 persons living/km<sup>2</sup>) followed by Uttarakhand (189), Meghalaya (132), Himachal Pradesh (123), Nagaland (119) and Manipur (115). The lowest population density was recorded in Arunachal Pradesh i.e. 17 persons living/km<sup>2</sup> followed by Mizoram (52) and Jammu and Kashmir (56). In Sikkim, population density is 86 persons living/km<sup>2</sup>. As a whole, population density in IHR was registered 85 in comparison to India's population density i.e. 382 persons/km<sup>2</sup>. In term of per capita land, it is the highest in Arunachal Pradesh (0.06 km<sup>2</sup>) and the lowest in Tripura (0.002). Sikkim, Mizoram and Jammu and Kashmir states have almost equal per capita land that varies from 0.01 to 0.02. Other states have very less per

capita land. Average per capita land of IHR is 0.01 whereas India has 0.003 per capita lands. Per capita forestland is the highest in Arunachal Pradesh (0.05 km<sup>2</sup>) while the lowest per capita forestland was noted in Himachal Pradesh, Jammu and Kashmir, Tripura and Uttarakhand which is 0.002 km<sup>2</sup> in each state. In IHR, this figure stands for 0.005 while it is 0.0006 km<sup>2</sup> in India.

## FOREST COVER CHANGE

### Proportion of state forest cover to state's geographic area and change

I gathered time series data of all 11 states of the Himalaya from 1987 to 2013. The Himalayan region had 62.1% forest area (2013), it was 55.6% in 1987. Mizoram obtained the highest area under forest i.e. 90.38%, it is followed by Arunachal Pradesh (80.39%), Nagaland (78.68%), Meghalaya (77.08%), Manipur (76.10) and Tripura and WBH (about 75% each). The lowest area under forest is obtained by Jammu and Kashmir (10.14%) followed by Himachal Pradesh (26.37%), Uttarakhand (45.82%) and Sikkim (47.32%).

Forest cover change from 1987 to 2013 was analyzed. In the Indian Himalayan region, 15.7% forestland increased

**Table 1.** Salient features of IHR

States	% share of India's geographical area	% share of IHR	Population density*	Forest cover (%) **	Per capita land (Km <sup>2</sup> )	Per capita forestland (Km <sup>2</sup> )
Arunachal Pradesh	2.5	16.3	17	80.39	0.06	0.05
Himachal Pradesh	1.7	10.8	123	26.37	0.008	0.002
Jammu and Kashmir	6.8	43.1	56	10.14	0.018	0.002
Manipur	0.7	4.3	115	76.10	0.009	0.007
Meghalaya	0.7	4.4	132	77.08	0.007	0.006
Mizoram	0.6	4.1	52	90.38	0.019	0.017
Nagaland	0.5	3.1	119	78.68	0.008	0.007
Sikkim	0.2	1.4	86	47.32	0.01	0.005
Tripura	0.3	2.1	350	75.01	0.002	0.002
Uttarakhand	1.6	10.4	189	45.82	0.005	0.002
IHR	15.7	100	85	75.52	0.01	0.005
India	100	-	382	21.23	0.003	0.0006

Source: Data were gathered and analyzed from various secondary sources

Note: WBH and Assam hills are excluded \* Census of India 2011; \*\*2013

**Table 2.** Proportion of state forest cover to state's geographic area and change (in %)

States	1987	1995	2005	2013	Change (%) 1987-2013
Arunachal Pradesh	72.39	81.94	80.93	80.39	11
Himachal Pradesh	23.14	22.45	25.81	26.37	14
Jammu & Kashmir	9.40	9.19	9.57	10.14	7.8
Manipur	79.07	78.64	76.53	76.10	-3.8
Meghalaya	73.41	70.06	75.74	77.08	5
Mizoram	90.53	88.12	88.63	90.38	-0.2
Nagaland	86.82	86.20	82.75	78.68	-9.4
Sikkim	38.89	44.07	45.97	47.32	21.7
Tripura	54.80	52.81	77.77	75.01	36.9
Uttarakhand	41.14	44.32	45.70	45.82	11.4
WBH	42.30	45.98	70.53	75.52	78.5
Mean	55.6	56.7	61.8	62.1	15.7
Std. Deviation	26.8	26.5	26.1	25.8	24.3

Source: *State of Forest Report (1987, 1995, 2005 and 2013)*

during the period 1987-2013. In terms of state wise change in forest cover, the highest increase was recorded in WBH which was 78.5% followed by Tripura where this increase is 36.9% although, forestland in these two states is less. Sikkim recorded 21.7% increase in forest area while 14% increase in forestland was observed in Himachal Pradesh. Uttarakhand and Arunachal Pradesh received 11% increase in each. An increase of 7.8% in forestland was noticed in Jammu and Kashmir and similarly 5% increase was registered in Meghalaya. Three states Nagaland, Manipur and Mizoram observed a decrease in forestland representing 9.4, 3.8 and 0.2%, respectively in Table 2.

#### **Proportion of state forest cover to country's geographic area**

I compared proportion of state forest cover with country's geographical area (in %). The Himalayan region represents about 6.73% of the country's geographical area. State wise proportion of forest area to country's geographical area showed that it is the highest in Arunachal Pradesh, which is 2.05%. Uttarakhand followed it where this proportion is 0.75%. Jammu and Kashmir shared 0.69% and Mizoram shares 0.58% proportion. Meghalaya and Manipur shared 0.53% and 0.52% proportion, respectively. The lowest proportion was shared by WBH (0.07%), which is seconded to Sikkim (0.10%), Tripura (0.24%), Nagaland (0.40%) and

Himachal Pradesh (0.45%) states.

Changes in state forest cover in proportion to country's geographical area (in %) in the Himalayan states was analyzed and comparison period was between 1987 and 2013. The entire Himalayan region received 14.7% increase in forest cover to countries geographical area during the given period. The highest increase was noticed in WBH (75%) followed by Tripura (41.2%). Uttarakhand occupied 17.2% and Himachal Pradesh shared 15.4% increase. Sikkim and Arunachal Pradesh have about 11% increase and subsequently Jammu and Kashmir and Meghalaya received changes about 7.8% and 6%, respectively. Mizoram state did not observe any change whereas the two states Nagaland and Sikkim observed decrease in proportion of state forest cover to countries geographical area i.e. 9.1% and 3.7% (Table 3).

#### **Proportion share of state forest cover to forest cover of IHR**

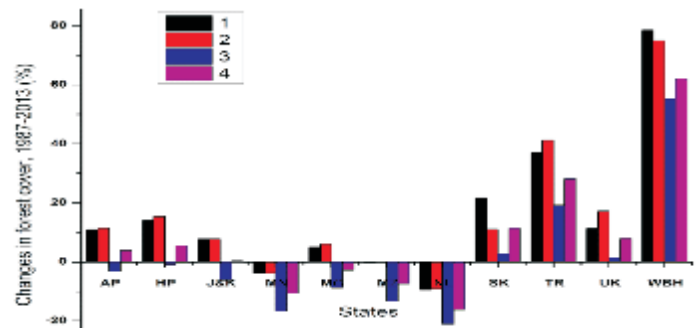
Proportion share of state forest cover to IHR's forest cover was analyzed (Table 4). In 2013, Arunachal Pradesh shared the highest proportion of state forest cover to IHR forest cover (30.36%), which was followed by Uttarakhand (11.05%) and Jammu and Kashmir (10.16%). Mizoram state

**Table 3.** Proportion of state forest cover to country's geographical area and change (in %)

States	1987	1995	2005	2013	Change (%) 1987-2013
Arunachal Pradesh	1.84	2.09	2.06	2.05	11.4
Himachal Pradesh	0.39	0.38	0.44	0.45	15.4
Jammu & Kashmir	0.64	0.62	0.65	0.69	7.8
Manipur	0.54	0.53	0.52	0.52	-3.7
Meghalaya	0.50	0.48	0.52	0.53	6
Mizoram	0.58	0.57	0.57	0.58	0
Nagaland	0.44	0.43	0.42	0.40	-9.1
Sikkim	0.09	0.10	0.10	0.10	11.1
Tripura	0.17	0.17	0.25	0.24	41.2
Uttarakhand	0.64	0.69	0.74	0.75	17.2
WBH	0.04	0.04	0.07	0.07	75
IHR	5.87	6.10	6.70	6.73	14.7
Mean	0.53	0.55	0.57	0.58	15.7
Std. deviation	0.48	0.55	0.53	0.53	23.7

Source: State of Forest Report (1987; 1995; 2005 and 2013)

had 8.59% share of IHR forest cover. Meghalaya and Manipur had equal share (about 7%) whereas Himachal Pradesh shared 6.62%. WBH shared the lowest i.e. 1.07% followed by Sikkim (1.51%), Tripura (3.55%) and Nagaland (5.88%). In terms of changes in proportion of state forest cover to IHR's forest cover, it is the highest in WBH (55.1%) followed by Tripura (19.2%). Other states such as Sikkim (2.7%) and Uttarakhand (1.3%) got increase in proportion of



**Fig. 2.** State wise changes in forest cover

**Table 4.** Proportion of state forest cover to IHR's forest cover and change (in %)

States	1987	1995	2005	2013	Change (%) 1987-2013
Arunachal Pradesh	31.37	34.23	30.77	30.36	-3.2
Himachal Pradesh	6.68	6.24	6.52	6.62	-0.9
Jammu & Kashmir	10.83	10.19	9.66	10.16	-6.2
Manipur	9.17	8.76	7.76	7.66	-16.5
Meghalaya	8.56	7.84	7.71	7.80	-8.8
Mizoram	9.90	9.27	8.48	8.59	-13.2
Nagaland	7.44	7.13	6.23	5.88	-21
Sikkim	1.47	1.56	1.48	1.51	2.7
Tripura	2.98	2.76	3.70	3.55	19.2
Uttarakhand	10.91	11.30	11.10	11.05	1.3
WBH	0.69	0.72	1.01	1.07	55.1
Mean	9.0	9.0	8.6	8.6	0.8
Std. deviation	8.2	9.0	8.0	7.9	21

state forest cover to IHR forest cover. There was a decrease in proportion of state forest cover to IHR forest cover in many states. Among them, the highest decrease was noticed in Nagaland (21%), followed by Manipur (16.5%), Mizoram (13.2%) and Meghalaya (8.8%). Jammu and Kashmir (6.2%), Arunachal Pradesh (3.2%) and Himachal Pradesh (0.9%) also received a substantial decrease.

- Abbr.: 1 Changes in proportion of state forest cover to state geographic area  
 2 Changes in proportion of state forest cover to country's geographical area  
 3 Changes in proportion of state forest cover to IHR forest cover  
 4 Changes in proportion of state forest cover to country's forest cover

### Proportion of state forest cover to country's forest cover

I analyzed proportion of state forest cover to country's forest cover in Table 5 and described the latest data of 2013. The IHR possesses 31.97% forest area of the country's forest cover. State wise analysis of forest cover showed that Arunachal Pradesh shared the highest proportion of country's forest cover i.e. 9.73% followed by Uttarakhand (3.54%) and Jammu and Kashmir states (3.26%). Four states – Mizoram, Meghalaya, Manipur and Himachal Pradesh have almost equal proportion of forest cover to country's forest cover, which was between 2% and 3%. Change in

proportion of state forest cover to country's forest cover from 1987 to 2013 was noted. In IHR, an increase of 6.4% forest cover to country's forest cover was observed. Among states, WBH have the highest increase (61.9%) followed by Tripura (28.1%), Sikkim (11.4%), Uttarakhand (7.9%), Himachal Pradesh (3.9%) and Arunachal Pradesh (3.9%). Jammu and Kashmir obtains 0.3% increase in forest cover. Four northeast India's states received decrease in forest cover, which varies from 16.1% in Nagaland (highest) to 2.7% (lowest) Meghalaya. Manipur registered 10.5% decrease and Mizoram received 7.4% decrease.

### Proportion of tree cover to state geographic area and change

Tree cover refers to the area, which is covered by tree canopy/crown. It is defined as an area more than 1 ha in extend and having tree canopy density of 10% and above. State wise data on proportion of tree cover to state geographic area 2001; 2005 and 2011 was calculated and change in tree cover from 2001 to 2011 was noted. In IHR, total tree cover of its geographical area is only 1.85% 2011. Proportion of tree cover in the states of IHR varies from 2.92% (highest) in Jammu and Kashmir to 0.35% (lowest) in Sikkim. The state of Meghalaya stands second in tree cover represents 2.58%, Nagaland has 1.94% tree cover and Tripura has 1.75%. Uttarakhand obtains 1.2% tree cover while Himachal Pradesh possesses 1.12% tree cover.

**Table 5.** Proportion of state forest cover to country's forest cover (in %)

States	1987	1995	2005	2013	Change (%) 1987-2013
Arunachal Pradesh	9.42	10.73	10.01	9.73	3.9
Himachal Pradesh	2.01	1.95	2.12	2.12	5.5
Jammu & Kashmir	3.25	3.19	3.14	3.26	0.3
Manipur	2.75	2.75	2.52	2.46	-10.5
Meghalaya	2.57	2.46	2.51	2.50	-2.7
Mizoram	2.97	2.90	2.76	2.75	-7.4
Nagaland	2.24	2.23	2.03	1.88	-16.1
Sikkim	0.44	0.49	0.48	0.49	11.4
Tripura	0.89	0.87	1.20	1.14	28.1
Uttarakhand	3.28	3.54	3.61	3.54	7.9
WBH	0.21	0.23	0.33	0.34	61.9
IHR	30.04	31.34	30.71	31.97	6.4
Mean value	2.73	2.84	2.79	2.74	7.48
Standard	2.47	2.83	2.61	2.53	21.62

Source: *State of Forest Report (1987; 1995; 2005 and 2013)*

**Table 6.** Proportion of tree cover to state geographic area and change

States	2001	2005	2011	Change (%) 2001-2011
Arunachal Pradesh	0.57	0.53	0.66	15.8
Himachal Pradesh	0.71	1.27	1.12	57.7
Jammu & Kashmir	1.00	2.53	2.95	195
Manipur	0.43	0.64	0.86	100
Meghalaya	0.62	1.81	2.58	316
Mizoram	0.45	0.58	0.90	100
Nagaland	0.42	1.44	1.94	361
Sikkim	0.20	0.38	0.35	75
Tripura	0.65	1.28	1.75	169
Uttarakhand	0.84	1.23	1.20	42.9
IHR	0.75	1.60	1.85	146
Mean value	0.58	1.16	1.43	1.43
Standard Deviation	0.23	0.66	0.85	116

Source: *State of Forest Report (2001; 2005 and 2011)*

Arunachal Pradesh and Mizoram have less than 1% tree cover. A large increase (146%) in tree cover from 2001 to 2011 was observed in IHR although tree cover in all the Himalayan states is very less (Table 6). Nagaland and Meghalaya registered the highest increase i.e. 361% and 316%, respectively. Jammu and Kashmir (195%) and Tripura (169%) follow it.

### Progress of joint forest management in different states of IHR

Joint forest management (JFM) is a process in which local people participate with forest conservationists for conservation of forest. It is a popular system in the states of Indian Himalayan region. Table 7 showed the progress of joint management in different states of IHR. We analyzed two time series data of 2004 and 2010 and found out change (in %) in JFM committees (11104), area under JFM (1000358 ha) and total people (1302993) involved in JFM 2010. The highest number of JFM committees existed in Jammu and Kashmir (43.8%). Uttarakhand (16.4%) and Himachal Pradesh (10%) follow it. Other states have less than 10% committees of the total. In terms of change (in %) in number of JFM committees, a decrease of about 81% was registered in Uttarakhand followed by Sikkim (1.9%). IHR as a whole also noticed 15.3% decrease. Meanwhile, a large

increase in a number of JFM committees was noted in other states of IHR. In terms of area under JFM, it is the highest in Himachal Pradesh (42.5%) followed by Tripura (12.8%) and Uttarakhand (10.1%). In terms of changes in area under JFM from 2004 to 2010, four states— Uttarakhand (88.3%), Arunachal Pradesh (69.9%), Jammu and Kashmir (19.3%) and Manipur (2%) have observed decrease. About 61% decrease in area was noted in whole IHR. As of now, the highest number of families involved in JFM is from Nagaland (42.4%). Jammu and Kashmir (20.6%) and Mizoram (11.6%) follow it. Other states have less than 5% families, which are involved in JFM. In terms of change in involvement of families in JFM, Uttarakhand noted the highest decrease i.e. 86% followed by Himachal Pradesh (79%). As a whole, there is an increase in number of families involved in JFM in IHR (39%).

### DISCUSSION AND CONCLUSION

Population density, forest cover and per capita forestland have interrelationship. The states, which have high population density, have less per capita forestland. The second driver of less per capita forestland is less forest cover. For example, Tripura state has the highest population density while per capita forestland is 0.002 km<sup>2</sup>. It also implies with reference to Uttarakhand. On the other hand,

**Table 7.** Progress of JFM in different states of IHR

States	No. of JFM Committees (%)	Change in % (2004-2010)	Area under JFM (%)	Change in % (2004-2010)	No. of families involved in JFM (%)	Change in % (2004-2010)
Arunachal Pradesh	4	45.1	2.4	-69.9	2.3	48
Himachal Pradesh	10	32.8	42.5	80	4.2	-79
Jammu & Kashmir	43.8	419	4	-19.3	20.6	454
Manipur	5.2	181	7.8	-2.1	3.6	140
Meghalaya	3.2	0	2.9	0	2.2	0
Mizoram	4.8	112	4.6	51.2	11.6	370
Nagaland	6.9	151	4.1	78.5	42.4	862
Sikkim	1.4	-1.9	8.8	14653	4.1	1513
Tripura	4.3	0	12.8	0	3.4	0
Uttarakhand	16.4	-81	10.1	-88.3	5.6	-86
IHR	100	-15.3	100	-61	100	39

**Source:** Annual Report (2004 to 2010), Ministry of Environment and Forest, Forest protection Division, Government of India

Arunachal Pradesh has the lowest population density and it has the highest per capita forestland. Some states have the highest forest cover such as Mizoram, Nagaland and Manipur, however per capita forestland is less in these states because of less geographical area and less per capita land although population density is comparatively low. It is a positive sign that IHR obtained increase in forest cover between 1987 and 2013, which is 15.7% meanwhile the three states of northeast India, which have a largest area under forest cover, have received decrease in forest cover. We observed that Mizoram state has the highest area under forest cover, which is 90.38% but it received decrease in forest cover i.e. 0.2%, similarly the two states Nagaland and Manipur received 9.4% and 3.8% decrease, respectively. It was noted that these three states practice shifting cultivation largely and as a result, a large forest area is degraded.

I noticed that the states, which have less proportion of state forest cover to country's geographical area, have received the highest increase. For example, WBH obtained 75% increase has only 0.07% forest area to country's geographical area and Tripura obtained 41.2% increase has

<sup>1</sup>These figures are calculated out of IHR average.

0.1% forest area to country's geographical area. I also observed that the two states – Nagaland (-9.1%) and Manipur (-3.7%) lie in the eastern extension of the Himalaya have negative change in forest cover however their proportion to country's geographical area is substantial. Similarly, Mizoram covers 0.58% forest area of the country's geographical areas has no change in forest cover.

Tree cover is very less in Uttarakhand as it is only 1.85% of the total geographical area and mean value of tree cover in the states of IHR is 1.43%. In terms of change in tree cover, it is 146%. Although, biodiversity and forest cover is the highest in the states that lie in the eastern extension of Himalaya, tree cover is comparatively very less. In terms of progress in JFM, it is declining in most of the states.

IHR shares the largest proportion of forest area in India and it has the highest forest diversity. People of IHR could not use these huge and economically viable forests because of remoteness and low economic development. Further, we observed declining forestland in the states that lie in the eastern extension of the Himalaya due to shifting cultivation practices. Progress in JFM has declined in that states, where people were actively participating it earlier. I suggest



measures to optimum use of forest and its conservation. In the states such as Mizoram, Manipur and Nagaland, where shifting cultivation is largely practiced, a system of permanent cultivation should be developed. JFM can be a suitable tool to use and conserve forest sustainably, thus it should be practiced more rigorously.

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