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Assessment of rate of deforestation and change of forest cover for the implication of REDD+ in Chhattisgarh over the two decades

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ABSTRACT

Development, in developing countries, has been attained at the cost of land and forest degradation. Increasing population, poverty along with development activities exerts pressure on forest resources causing deforestation and degradation. Deforestation can be measured as there are several agencies monitoring the change in forest cover by using optical remote sensing. Reducing emissions from deforestation and degradation (REDD) has been projected as a low cost and effective strategy to mitigate deforestation and degradation process through financial incentive to depended communities. The present study is an effort to assess the rate of deforestation at district level in the state of Chhattisgarh, India between 1989 and 2015 using biannual forest cover data produce by Forest Survey of India. Over the two decades, considered in the present study, the forest of Chhattisgarh state faced various levels of

Deforestation and Forest degradation due to various anthropogenic pressure build up by land diversion for industrialization and mining. However managing approximately 33,190 sq. km. of forest area were managed through village committees, which could be vital for effective implementation for REDD+ and further revise the degradation process.

Key word: Deforestation, Rate of Change, Forest Monitoring, REDD+, Chhattisgarh

1. INTRODUCTION

India has around 0.173 million villages located in and around forests, and there are approximately 300 million forests dependent people's including around 87 million tribal's population living in these villages, critically depended in to forest ecosystem for generate subsentential part of their livelihoods (MoEF, 2015). Though there is no official census figures available on, actual forest dependent population of the country, moreover, a significant percentage of the country's underprivileged population happened to be living in its forested regions (Shah and Guru, 2003), apparently most forested land of central India is also witnessing the high number of forests depended population living in the fringe village. The poverty and limited sources of income generating opportunities often make forest dependent underprivileged population to exploit forest resources for additional income. Collection of firewood, open grazing, illicit harvesting of valuable timber and NTFPs had been adversely affected on growing stock as well as the regeneration capacity of forests. The pressure of these illegal activities on India's forest can explain the state of degradation of forests in forest fringe villages of the country. According to several estimates, India has traditionally been characterized as a low forest cover - low deforestation (LFLD) country exposed to significant direct-human induced deforestation and degradation in past few decades (ISFR, 2011; Ravindranath *et al.,* 2012).

Forests Ecosystem plays a vital role in the carbon cycle. When forests ecosystem is being disturbed, not only does carbon absorption cease, but also the carbon stored in the ecosystem is release into the atmosphere (FAO, 2000, Koop and Tole, 2001). During the deforestation process CO^2 is release by burning and rotting of wood and slash or even from the desertification. Forests ecosystem are depleting at an alarming rate, while forest degradation is a great issue of global concern since many decades, despite it the remaining forested land of world are still surviving under constant threat of being degradation and deforestation (Allen and Barnes 1985; Chakraborty 1994; Ravindranath *et al.,* 2012). According to the FAO - Global Forest Resources Assessments (FRA), 2010 and 2015 the world's forest cover (permanent tree estate) was approximately 3,999 Mha, i.e. 30.6% of the total land area of the world and out of that about 47% of the forest area is reported from tropical countries. Further the FRA report reported that the total area of all virgin forests of the world is decreasing with an estimated rate of 4 Mha per year during the period 2000-2010 and 3.3 Mha per year during the period 2010-2015. The reasons given are mainly due to conversion to agricultural land, now it shows signs of decreasing in several countries but continues at an alarmingly high rate in other parts of the world (FAO, 2010). Forest degradation is a phenomenon of temporary or permanent deterioration in the density or structure of vegetation cover or its species composition (Koop and Tole, 2001; Simula, 2009). It is alterations of forest attributes that lowers the productive capacity of forest and is caused by an increase in human induce disturbances. This is a time-scale process, and takes a few years to a few decades for showing the sign of degradation and lowering the benefits and services from forest, which includes wood, biodiversity and any other product or ecological service (Contreras-Hermosilla, 2000; Simula, 2009). Generally rate of forest degradation is faster than its improvement (Grainger, 1995; Grainger, 1999; Simula, 2009; Skutsch *et al*, 2009). Perceptions of forest degradation may vary, depending on the purpose of utilization and the goods or services received by forest dwellers and users. For example, replacing a natural forest with a plantation for the increased supply of desired wood products is rarely considered as forest degradation in regard to wood stock by natural conversationalists (Contreras-Hermosilla, 2000; Monfreda *et al.,* 2004; Simula, 2009). At the same time forest dwellers or other users may consider plantation to be less capable of providing ecosystem services that a fully functioning virgin natural forest would provide (Chakraborty 1994; Davidar *et al.,* 2010; Nayak *et al.,* 2012; Saigal *et al.,* 2005).

Deforestation describes the total removal of forest cover to less than 10% and land is put to non forest land use practice (FAO, 2000; Mayaux *et al.,* 2005). The underlying causes for forest area reduction, determined by various authors are, diversion of forest land e.g. for mining, dam construction, industries and urban infrastructure development, rural biomass energy requirement, grazing and illicit felling (Allen and Barnes, 1985; Chakraborty, 1994; Kummer and Turner, 1994; Lele *et al.,* 1998; Heltberg *et al.,* 2000; Reddy *et al.,* 2001; Reddy 2003; Davidar *et al.,* 2010). The general direction of deforestation tends to be consistently either positive or negative (Grainger, 1995; Grainger, 1999), depending on location, but negative values in forest area, locally, (of specific location) does not necessarily mean that national values are negative too. Periodic short-term changes in forest growing stock are part of a management plan, but a situation where harvesting becomes unsustainable should be avoided (Simula, 2009). Although, the sustaining and assimilating capacity of the ecosystem is tremendous, it is not infinite (Rees, 1992; Monfreda *et al.,* 2004). Thus it is high time for the forest ecosystem of any part of the world to opt for sustainable management of the natural resources which will result into the country's sustainable development (Kneeshaw *et al.,* 2000; Shyam S Salim and Athira P Ratnakaran, 2017; Mangala De Zoysa and Makoto Inoue, 2017).

A key component of Reducing Emissions from Deforestation and Forest Degradation (REDD+) is a credible system for measuring, reporting and verifying (MRV) changes in forest cover and carbon stock (Herold and Skutsch, 2008). REDD+ is a financial instrument developed under UNFCCC framework, for incentivize communities in favour of conservation and sustainable management of forest and thereby use carbon sequestration potential of the forests to manage climate change within accepted limits of tolerance. REDD+ is developed with an aims of compensating the forest owners and depended communities from developing countries for develop and use sustainable conservation practices for enhance the carbon stocks of forest (Stern, 2007; Ram Asheshwar Mandal *et al*., 2017). India has significant scope for improving quality of forest cover by addressing drivers of degradation as a significant part of the country's forest cover falls in the open to medium categories owning to various drivers of degradation. As per 14th assessment report of FSI's ISFR there is a 300,395 sq. km. open forest along with 41,362 sq. km. of scrubs forest, which is constituted approx 46 % of total forest cover of India (ISFR, 2015). Despite of considerable area of degraded forest, there has been little progress on the ground for effective implementation of REDD+ (Sunderlin and Atmadija 2009; Sunderlin *et al.,* 2009; Sharma and Chaudhry, 2013).

Remote sensing technique can be employed for monitoring change in forest extent, along with systematic forest inventories. Remote sensing Methods have long been developed to classify forest cover change between forest and non forest at a large scale. Monitoring and detection of Deforestation is easy by remote sensing, particularly when it occurs on a large scale, however it is much more difficult to detect forest degradation. Forest degradation (i.e. the change from intact forest to disturbed forest) by remote sensing is much more challenging than monitoring deforestation, for example, the removal of a few trees (selective logging) or loss of undergrowth (by fire) or disappearance of branches and small trees (for fuelwood) are quantify as degradation and significantly affect the forest growing stock and biomass, however these kind of activities have little effect on overall change of canopy cover. In the optical remote sensing as well as aerial photography fundamentally use reflections from canopy to study changes on canopy cover, thus does not detectible or under estimate, changes occurred due to selective logging (Lambin 1999; Peres *et al.,* 2006; DeFries *et al.,* 2007; Afunmilayo, 2016; Ale *et al.,* 2016).

Space born satellite (optical) data and change detection technique is a powerful tool for monitoring rate and direction of tropical forest change (Iverson *et al.,* 1989; Hansen *et al.,* 2000). Remote sensing provides spatial data to the managers of protected area, generates information on change in forest cover, forest degradation, alteration in species diversity and distribution, trend in pressure and threat (Nagendra *et al.,* 2012). In depth study and understanding the pattern of forest degradation over a large area and over the decades, through remote sensing application, requires the measurement of a set of indicators of the biophysical attributes of the surface, the seasonality of these attributes, and their fine-scale spatial pattern (Lambin, 1999; Chowdhury, 2006). In India, various studies has been conducted for mapping the extent of deforestation and degradation with the help of optical remote sensing technique, which are mainly region specific (Singh 1989; Menon and Bawa 1997; Gubbi, 2006; Reddy *et al.*, 2007; Lele & Joshi 2009; Davidar *et al.,* 2010), however in case of national level assessment, still needs to refer biannual assessment reports (India State Forest Report) of Forest Survey of India (FSI). In the present study we have used the India State Forest Report for assessing the forest cover change over two decades and the rate of deforestation in different administrative districts of Chhattisgarh State, India.

2. DEFORESTATION, FOREST DEGRADATION AND ITS MONITORING INITIATIVE: INDIAN CONTEXT

Indian forests are facing degradation since colonial period, due to overexploitation of forest for timber; population pressure and faulty implementation of forest conservation policies on predominately state owned forest (Guha, 1983; Chakraborty, 1994). The other reasons for depletion of forest wealth are over-exploitation for fuel-wood, illicit felling, overgrazing, encroachments, unsustainable practices, forest fires, and an indiscriminate approval of development projects in the forest areas (Kummer and Turner, 1994; Hazra, 2002; Basu, 2010). Chakraborty, (1994) has analyse the causes of deforestation of Indian forest and discussed about econometric of deforestation with historical data analysis. He has summarized extent of forest area under different forest type and class category during the period of 1950 -80 which is taken from different sources.

Table 1 Classification of area under Forest (Thousand Hectares)

	1950-91	1960-61	1970-71	1979-80	1985-86
Total Forest Area	71803	69135	74961	73669	75227
I Forest Type					
a) Merchantable	58460	52701	47654	56493	49246
b) Inaccessible	13343	15289	19426	16042	25981
II Legal Status					
a) Reserved	34405	31631	31798	37252	40612
b) Protected	11793	20355	20444	22537	21509
c) Unclassified	25570	15069	12946	10558	13107
III Composition					
a) Coniferous	3630	4435	4312	4767	
b) Broadleaved					71164
i) Sal	10554	11365	8072	12013	
ii) Teak	4347	9309	7100	8351	
iii) Miscellaneous	53272	43152	44011	46672	

Source: *Agarwal 1989, Department of The Environment, 1987 cited in Chakraborty, (1994)*

National Remote Sensing Centre (NRSC) Hyderabad prepared forest vegetation map of India in 1983 with the help of satellite remote sensing (Landsat MSS) data for the first time, using visual interpretation technique and 1:1 million scales (NRSA, 1983). Subsequently Forest Survey of India (FSI) mapped forest cover using Landsat MSS images of 1985-87 and figure out actual forest cover 64.20 million ha against the official forest cover of 75.1 million ha. Since 1986, FSI has a mandate to prepare forest cover map of entire country in two year cycle using remote sensing technology. With the advancement of optical remote sensing and mapping technique, FSI are now preparing forest cover map at 1:50000 scale with one hectare as minimum mapping unit, which are further classified as Very Dense Forests (VDF), Moderately Dense Forests (MDF), and Open Forest (OF) with canopy density more than 70%, 40-70% and 10-40% respectively, which also includes Tree Resources outside the Recorded Forest Area. FSI defines the forest area as "all lands, more than one hectare in area, with a tree canopy density of more than 10%" (FSI 2009).

Table 2 Comparison of Rate of Deforestation and Forest Cover Change between India and Chhattisgarh state Over the Two Decades ***(Source:*** *Forest Survey of India – ISFR reports)*

Total Forest Cover (in Sq. km)				**Between 1987-89 to 2000**		**Between 2000 to 2013-14**		**Between 1987-89 to 2013-14**	
				Rate of Deforestation	**Cumulative Change in Forest Cover**	**Rate of Deforestation**	**Cumulative Change in Forest Cover**	**Rate of Deforestation**	**Cumulative Change in Forest Cover**
Year	1987	2000	2013-14						
India	640819	668806	701673	0.143	27,987	0.149	32,867	0.146	60,854
Chhattisgarh	57589	56448	55586	-0.067	-1,141	-0.048	-862	-0.057	-2,003

As per the table - 2, trend of India's forest cover change is positive since 1st assessment cycle of State Forest Report in year 1989, totalling 60,854 sq. km. forest cover was increased with the rate of 0.146 sq. km. per year, on the other hand the Chhattisgarh state depleted a total of -2003 sq. km. of forest cover with the rate of -0.057 sq. km. per year, which was approx 3.60 % of the State total forest cover. On the other hand availability of per capita of forest area in the country has also shown a sharp decline since 1950s, despite the increase in forest cover, the accelerated population growth and demand for rural energy has negatively affected the forest productivity (Basu, 2010; Davidar *et al.,* 2010).

3. FOREST COVER OF CHHATTISGARH STATE

Chhattisgarh state was carved out of erstwhile Madhya Pradesh state in the year 2000. Total geographic area of the Chhattisgarh is 1,35,197 sq. km. (4.1 percent of the countries geographic area) and extended between latitude 17° 47' and 24° 06' North and longitude 80° 15' and 84° 24' East divided in to 27 administrative districts. As per the national Agriculture Research Project classification (IGAU-Agromet, 2015), the state comes under three agro-climatic zones viz, the central plain (51.0%), northern hills (21.0%) and Bastar plateau (28.0%). Total recorded forest area of the State is 59,772 Sq. Km., constituted 44.21 percent of the total geographic area of the state. The forests of the state are ecologically significant, as main Rivers of central India originate from the hills of Chhattisgarh. There are 11185 forest fringe villages (within 5 km of forest boundary), which are directly dependent on forests for their livelihood and utilizing the forests resources such as various NTFPs and medicinal plants for their living from decades.

The forests in the state are further categorized in reserved, protected and unclassified forest with percentage 43.13, 44.21 and 16.65 respectively. As per the forest cover mapping carried out by FSI in the year 2013-14, 41.11 % (55,586 sq km) of the state geographical area is under forest and tree canopy density classes. Further the state has 4,152 sq. km. very dense forests, 34,846 sq. km.; moderately dense forests 16,588 sq. km.; open forest and 117 sq.km scrubs. As per the Champion and Seth forest type classification 1968, forest of the state is divided into two major forest type i.e. tropical moist deciduous forests and tropical dry deciduous forest with percentage distribution 44.03% and 55.56% respectively along with 0.41% is plantation/ other tree groves. The state had a growing stock of 362.88 million cu. m. during the 2013-14 assessment and Per capita available Forest & Tree Cover is 0.232 ha (ISFR, 2015). As per the latest census report (2011), there were 19720 villages in the state and out of which 11185 are forest and fringe villages (i.e. within 5 km from the forest boundary) and total population of the state is 25,545,198, out of this around 76.76 percent live in the villages of rural areas.

4. METHODOLOGY FOR CALCULATION OF RATE OF DEFORESTATION IN CHHATTISGARH

For studying the extent of forest cover and rate of deforestation of Chhattisgarh state, FSI's biannual Forest Cover statistics for year 1987-89, 2000 and 2013-2014 were used (ISFR 1991, 2001 and 2015). The visual interpretation technique at the scale of 1:250,000 was applied during the assessment period 1987-89 for mapping of forest cover, however with the advancement of mapping techniques, subsequent forest cover mapping was carried out using digital interpretation technique at the scale of 1:50,000 form the assessment period 2000, which bring down minimum mappabe unit to 1 ha, from 25 ha during assessment period 1987-89. The total time period was divided in two assessments time period, 1st time period was 1989 to 2000 and 2nd time period was 2000 to 2015. Deforestation rate for successive years of forest cover mapping was evaluated using methodology of Armenteras *et al.,* (2006) as described by Joshi and Lele, 2008. In order to calculate the average annual deforestation rate, following formula was employed:

$$\textbf{Rate of Deforestation} = \frac{(\log Ft2 - \log Ft1) \times 100}{t2 - t1}$$

Where, F indicates the area under forest in square kilometres and 't1' and 't2' indicates time -1 and time -2. We assume that annual deforestation rate may not remain constant and varies from year to year.

5. RATE OF DEFORESTATION DURING 1987-89 TO 2000

During the 3rd forest cover assessment year 1987-89 (SFR published in 1991), those 7 districts (Bastar, Bilaspur, Durg, Raigarh, Raipur, Surguja, Rajnandgaon) that presently constitute of Chhattisgarh State, were part of erstwhile Madhya Pradesh State of central India. According to FSI these seven districts of erstwhile Madhya Pradesh State had 57,589 sq. km. geographical area under forest cover, which is constitute 42.60 % of Total Geographical Area (TGA) (i.e. 1,35,194 sq. km.), these 7 districts had been further divided in 15 administrative districts after constitution of Chhattisgarh state. During the 8th forest cover assessment in year 2000 (SFR published in 2001) 56,448 sq. km. area under forest which was comprise 41.75 of TGA (1,35,191) of Chhattisgarh state. Table - 3 summarizes the changes of forest cover between assessments periods of 1987-89 to 2000 and 2000 to 2013-14. The total loss of forest area is 1,141 sq. Km. which constitute about 0.84 of TGA with annual -0.079 deforestation rate. The decadal yearly rate of deforestation is higher in Bilaspur district at -0.595 per year. In during the 2000 assessment period Bilaspur districts was divided in three new district namely Korba, Janjgir – Champa and Bilapur, further a 1,176 sq. km. area of the erstwhile Bilaspur district was merged in to newly constituted Kawardha district, which was constituted by dividing Rajanandgaon district, in this reason there was significant negative change observed in forest cover in Bilaspur district. Raipur and Surguja are other major districts which had higher deforestation during the same period, at -0.419 and -0.294 sq. km per year respectively. On the other hand, Raigarh and Rajnandgoan districts had increase forest area during the same assessments, in the Raigarh district 172 sq. km. area and in Rajnandgoan 92 sq. km. was increased with the annual rate of 0.184 and 0.092 sq. km. respectively.

6. RATE OF DEFORESTATION DURING 2000 TO 2013-14

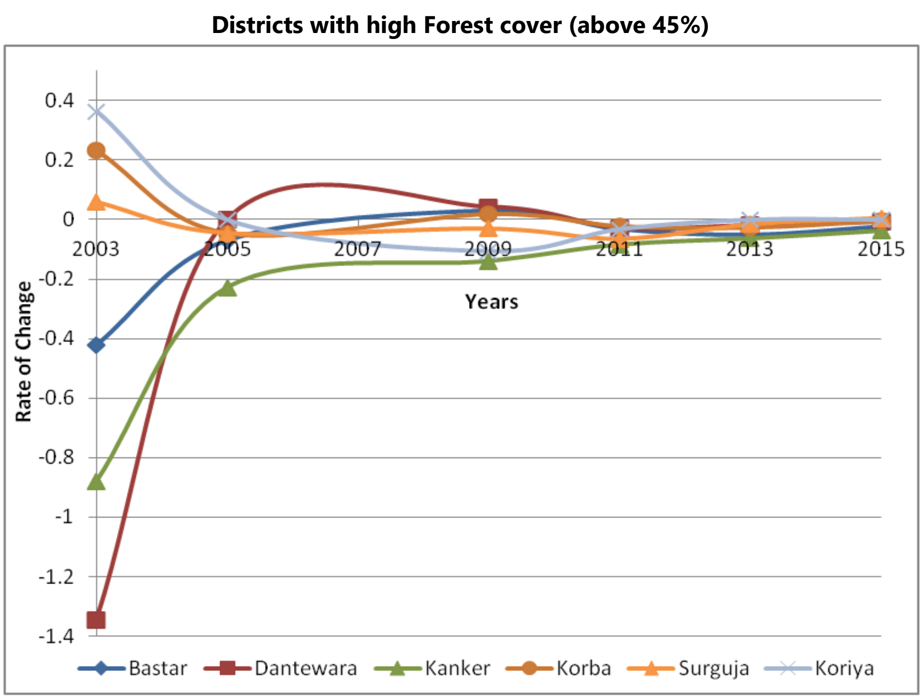
The new state was constituted in November 2000, subsequently, onward of its 8th assessment; FSI's has reported forest cover of eastern part of erstwhile Madhya Pradesh, as forest cover of Chhattisgarh state. With the advancement and standardization of FSI's image interpretation technique during the 8th assessment cycle, the forest cover of Chhattisgarh was reported 56,448 sq. km., and 55,586 sq. km. in the assessment year 2000 and 2013-14 respectively. As per analysis summarized in Table – 3, the state lost -873 sq. km. area with the deforestation rate of -0.048 annually during the same period. The Bastar plateau showed higher vulnerability to Deforestation. All three districts of Bastar plateau (i.e., Bastar, Dantewara & Kanker) has depleted totalling -1,182 sq. km. of forest area with the annual rate of deforestation of -0.168 sq. km. per year followed by Surguja District with a loss of -39 sq. km. forest area. Whereas, Raipur district have benefited from conservation measure and plantation activities taken place in the degraded forest land, hence increased an area of 251 sq. km. with the annual rate of 0.146 sq. km.; followed by Koriya and Raigarh districts, with increased of 40 and 29 sq. km. forest cover respectively.

Table 3 Forest Cover Change and Deforestation rates for during 1987 to 2013-14 in the Chhattisgarh, India

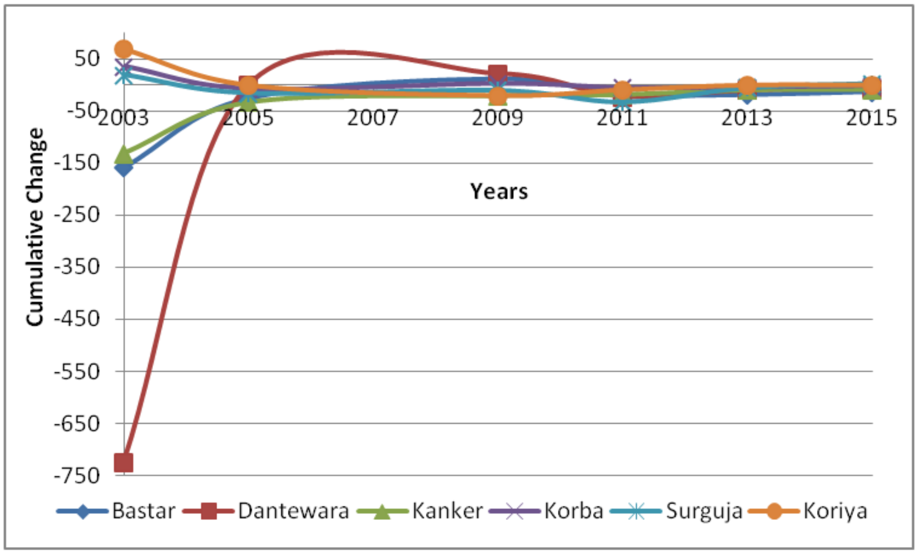
Cumulative Change in Forest Cover	Rate of Deforestation	Forest cover in Assessment Year 1987-89	Assessment Year 2000	Geographical Area	Districts (during 1987 - 2000)	Districts (during 2000 – 2014)	Geographical Area	Assessment Year 2000	Assessment Year 2013-14	Rate of Deforestation	Cumulative Change in Forest Cover
1,156	0.199	22,394	23,550	39,114	Bastar	Bastar	14,974	8,202	7,979	-0.086	-223
						Dantewara	17,634	12052	11,312	-0.197	-740
						Kanker	6,506	3296	3,077	-0.213	-219
-971	-0.595	6,939	5,968	19,897	Bilaspur	Bilaspur	8,270	2,502	2,489	-0.016	-13
						Janjgir-Champa	3,852	144	155	0.228	11
						Korba	6,599	3,322	3,344	0.020	22
-30	-0.148	816	786	8,537	Durg	Durg	8,549	786	778	-0.032	-8
172	0.148	4,495	4,667	12,924	Raigarh	Raigarh	7,086	2,514	2,543	0.036	29
						Jashpur	5,838	2,153	2,163	0.014	10
-691	-0.419	6,859	6,168	21,258	Raipur	Raipur & Dhamtari	16,468	5,208	5,459	0.146	251
						Mahasamud	4,789	960	952	-0.026	-8
-869	-0.294	12,106	11,237	22,337	Surguja	Surguja	15,731	7,170	7,131	-0.017	-39
						Koriya	6,604	4067	4,107	0.030	40
92	0.090	3980	4072	11,127	Rajnandgoan	Rajnandgaon	8,068	2499	2,519	0.025	20
						Kawardha	4,223	1573	1,578	0.010	5
-1,141	**-0.079**	**57,589**	**56,448**	**1,35,194**	**Total**	**Total**	**1,35,191**	**56,448**	**55,586**	**-0.048**	**-862**
-2561	**-1.456**	**Total Loss & Rate of Loss**								**-0.586**	**-1250**
1420	**0.437**	**Total Gain & Rate of Gain**								**0.510**	**388**

7. ANALYSING THE DEFORESTATION PATTERN

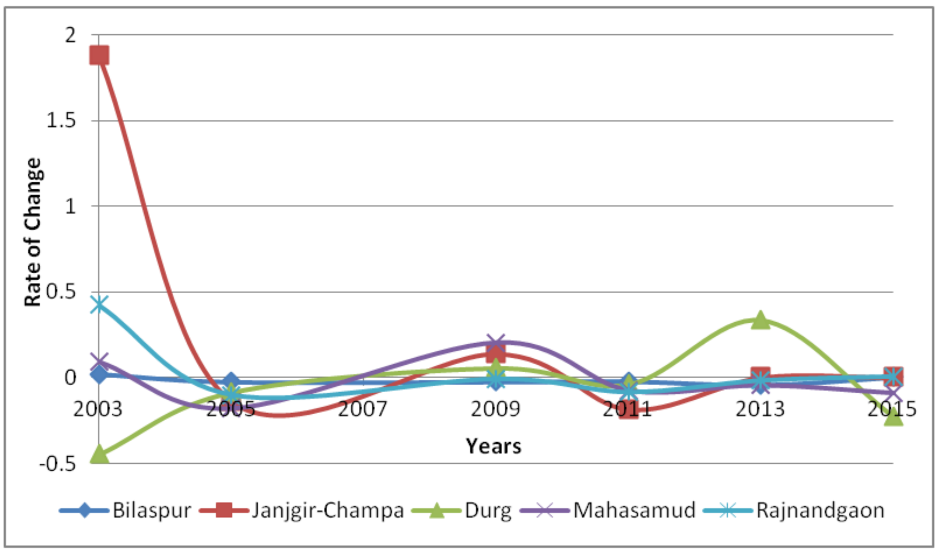
Chhattisgarh state has experienced a combination of factors, which induce land cover changes, such as deforestation, fragmentation and afforestation since past 30 years. However the climatic condition of Chhattisgarh state supports luxuriant vegetation with dense forest cover of Sal (*Shorea robusta*) forest in northern hills and Teak (*Tectona grandis*) forest in Bastar plateau (Southern districts) of the state. Lose of forest cover in the state has been attributed to the clear felling for mining, infrastructure establishment, dam construction, settlements, and other developmental projects along with commercial timber extraction. In addition to felling for developmental activities, other activities such as illegal felling, overgrazing, encroachment, etc. plays a vital role in decline in forest cover. While analyzing temporal changes in forest cover, the results showed that there is drastic reduction in the total forest cover of Southern Chhattisgarh. The total loss of forest cover is -2561 sq. km. between years 1987 to 2000 with rate of -1.456 sq. km. per year, while increase 1420 sq. km. with rate of 0.437 sq. km. per year in same period. On the other hand -1261 sq. km. of forest cover was lost during year 2000 to 2014 with rate of -0.631 and forest gain is 388 sq. km. with rate of 0.509 sq. km. per year. The forest of northern and southern district of Chhattisgarh has facing major deforestation. Over the study period an area of 214.2142 sq. km. of forest land was diverted for mining activity between 1980 to 2008 and 69.8739 sq. km. were given away for mining in over the 3 year period of 2005-2008 (Mishra & Reddy; 2009), which can consider main cause of deforestation. The southern districts of state is least develop in respect of socio-economic and industrial establishment; therefore villagers of the area in more depend on forest resources for income generation. Other hand these southern districts of state are facing civil insurgency, especially left wing extremism known as naxalism. It has affected implementation of developmental schemes in these districts (Tiwari and Sinha 2010). It has also affect effective implementation of conservation policies, even make difficult to gathering field enumeration data of forest resources. Thus the overall increase in forest cover of state by 0.70% is a resulted of extensive plantation activities carried out throughout in state, as well as advancement and improvement achieved in forest cover mapping techniques by FSI during the recent period. The central plain of the state of has gained forest cover during 2000-2014 assessment periods, mainly due to sustainable management of forest and large scale plantation under National Afforestation Programe. Approximately 1265.47 sq. km. area was planted under National Afforestation Programe (NAP: A Glance) between 2000 and 2016 in all over the state. The graphic representation of fig-1, represent districts wise trend of rate of change and cumulative change of forest covers correspondence to each districts of Chhattisgarh, indicating positive and negative variation occurred in forest cover with respect ISFR reports published during 2000 to 2015 assessment years. Abrupt variation observed in graph between two consecutive assessment years may attributed error in mapping, which needs to be carefully analyse and cross validated with the data of annual plantation, diversion of forest and illicit felling, available with state forest departments.



Districts with high Forest cover (above 45%)



Districts with low Forest cover (below 32%)



Districts with low Forest cover (below 32%)

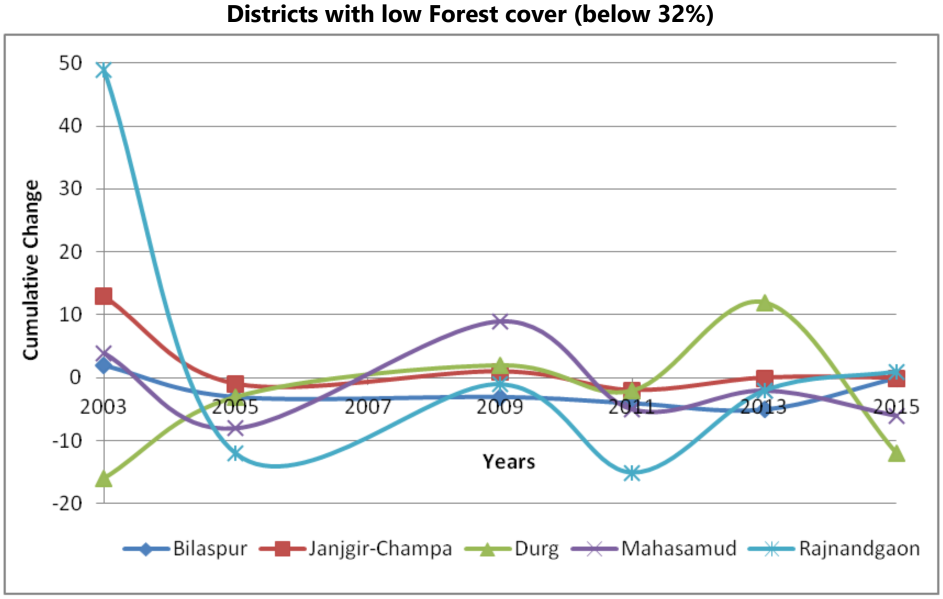


Figure 1 Districts wise trend of rate of change and cumulative change of forest covers

8. CONCLUSION

Forests of Chhattisgarh state are identified as one of the richest bio-diversity habitats of the country, the backbone of tribal (32% of total population) economy in the state. Harnessing the true potential of forests is a key imperative for development in Chhattisgarh. Though State has overall 44% of area under forest cover, many districts have less forest cover envisaged in National Forest Policy 1988. The state has 11185 are forest and fringe villages, which made enormous anthropogenic pressure on forest resources. However, there are a total 7887 Forest Protection Committees/Village Forest Committees were created in the state, which are managing approximately 33,190 sq. km. of forest area of the state and could be vital for effective implementation for REDD+. As of now much of the world's tropical forest are state owned but community participation in forest ownership and management needs to be encouraged with restrictions on extraction and conversion (Buys, 2007; Ram Asheshwar Mandal *et al.*, 2016).

In Chhattisgarh state 118.139 sq km has been diverted during 1980 to Nov 2000 and 213.034 sq km Nov 2000 to March 2016 for the various industrialization and developmental projects. The diversion of forest land is much lesser than actual deforestation over the similar period, which may be aggregated mainly due to illicit felling and encroachments. Also the diversions of large chunk of forest land are displacing people from their original land can alter the socio-economic condition of the particular region and it may decline in agricultural productivity and a polluted environment will lead increase the anthropogenic pressure on the natural resource of the region. While determining the impact of development pressure on natural resources, forest and socio-economic condition of region, the rate of forest loss cannot be left unnoticed. In order to explore the relationship between deforestation and its causes, it is necessary to identify those susceptible areas of the forest that are most seriously affected by deforestation and degradation. This require to identify and define of the process of deforestation and degradation, further needs to validate reliable criterion and indicators for measure deforestation progress at global, continental, national, and local levels.

Currently methodological approaches adopted by FSI do not permit accurate quantification of the rate of loss of biomass within degrading forests, as they provide canopy cover estimation based on interpretation made through analysis of canopy reflection captured in optical remote sensing. However at a local level, this information would not be much useful to assess current direction and causes of deforestation and degradation. Success of different REDD+ interventions for reducing emissions requires information of degradation drivers at local level for better implementation (Nayak *et al.,* 2012; Ravindranath *et al.,* 2012; Sharma and Chaudhry, 2013). Ground surveys could include information on land use history and the current use, such as numbers of cattle, unsustainable logging or estimates of fuelwood collection, which could improve knowledge of the relationship between human activities and the observed biomass in an area (Singh, 1989; Menon and Bawa 1997; Peres, 2006; Simula, 2009; Lele and Joshi 2009). In addition to quantifying carbon stocks, ground surveys have the potential to inform status of other ecosystems services that are lost when forests become degraded (Rapport *et al.,* 1998; Post *et al.,* 2009) this information will help policy makers to strengthen national policy on sustainable forests.

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