

Changing dimensions of forests in India: impact of climate change and deforestation

Introduction

India is endowed with varied ecological donation ranging from temperate forests, alpine desert to tropical dry desert areas to tropical evergreen forests existing in 16 agro-climatic zones of the county. It is truly remarkable that an excellent range of bio-diversity exist here considering its geographic area of 328 Million hectares with more than 1.3 billion people. The forests have been the source of water, health and food security for a country of more than 1.3 billion people and still growing. More than 450 rivers and rivulet's catchments are situated in these forests. According to latest estimate of 'State of Forest Report 2017' published by Forest Survey of India (FSI) the total forest cover of the country, is 70.8 million hectares which is 21.54 % of the geographic area of the country. The tree cover outside the recorded forest is 9.38 million ha. The total forest and tree cover is 80.2 million ha. There has been a net increase of 1243 sq km in the forest cover compared to last assessment of 2015.

Experimental methodology

The Champion et al.¹ Forest Types of India classification were opted as base line. The Forest Survey of India's maps of 1:50,000 were available for each forest types. More than 1700 sample point locations (geo-coordinates) were obtained from Forest Survey of India from the digitized forest type maps using stratified random sampling scheme with proportional allocation across the 178 forest sub group types found during the survey.² The vegetation data collected during the survey of sample plots were quantitatively analyzed for abundance, density and frequency.³ Relative frequency, relative density and relative dominance were determined following Phillips⁴ while importance value index (IVI) was calculated following Mishra.⁵ Species diversity was determined following Shannon and Wiener information function⁶ and species similarity index.⁷ The study was to see the present state of vegetation in each forest type and a change matrix was prepared to compare the present status of the forests with the original vegetation as described by Champion et al.^{1,8}

Quality of forest cover

The forest cover is being monitored in India since 1985 when the first State of Forest Report was published by the FSI. Though the forest and tree cover has been increasing marginally after every assessment report which is due apart from steps taken for afforestation and expansion of tree cover on private and common lands is also the result of changes in technology of assessment over the year. Nevertheless, it is credible for the country of such a huge population that the forest cover is increasing as also its flagship wild life species like Lions and Tigers. There is a total of 7082 million tonnes of carbon in India's forests indicating an increase of 38 million tonnes over the last assessments of 2015.

The question from the point of view of ecological stability and sustainability of forests wealth, however, is whether the forests of the country are in good shape quality wise and able to meet the ecological needs of the country. The answer is a firm no despite some remarkable but fragmentary achievements. The degraded forests of less than 40% crown density as per the latest estimation is 30 million ha which has increased from 24 million ha as estimated in 1985 report of the FSI.

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The moderately dense forests with crown density of more than 40% now stand to 39 million ha which is an addition of around 2 million ha over the 37 million ha reported previously in 1985. This also includes around 9 million ha area of dense forests of more than 70 % crown density. It is these areas which also have most of the wild life National Parks and Sanctuaries covering around 15 million ha of the forests. This meagre addition of 2 million ha seems more to be the result of technology rather than improvements in the forest stands. There are 170,000 villages in the country in and around 32 million ha of forests. It is the pressure exerted by the people y these villages for fuel wood, fodder and Non Timber Forest Products (NTFPs) living in and around forest areas that the degradation of the forest resources is continuing. The increase in carbon stock is primarily due to plantations and the quality of plantations from the ecological point of view cannot match the composition of a natural forests. The other cause of the degradation and poor quality of forests is the raging annual forest fires. Though the involvement of communities in forest management through India's famous Joint Forest Management definitely prevented rapid degradation of forests, it however, failed to elicit the cooperation of villagers in controlling the forest fires as more than 90% fires are manmade and lit by villagers. Though this author was responsible for setting up of the national fire fighting and monitoring mechanism during 2001–2002 in the country due to policy deficiencies administrative commitments and also due to extreme heat caused by climatic changes the forest fires are causing huge damages to the forest and bio-diversity. This year alone in the Himalayan State of Uttarakhand 35,000 ha areas are affected by fires with 3000 ha completely destroyed by raging fires due to intense heat waves. Thus the regeneration of the dominant species in natural forests is deficient in many forest types leading to heavy loss of bio-diversity. The government of India in the year 2006 in the midst of political heat had enacted Forest Rights Act 2006⁹ under which the traditional rights of the forest dwellers mainly of tribal people were recognized. If seen purely on professional ground it was an attempt to regularise encroachments on forest lands. So far as on January 2018; around 5.7 million ha forest land has been vested with 4 million people. According to records at hand in 2004 in the government of India when this writer as Inspector General of Forests compiled the data on encroachments around 1.2 million ha forest land was under encroachments and only around 3,00,000 ha genuinely belonged to the disputed settlement category the buzz for which led to the creation of this Act. But four times more land was released for settlement of rights and the process is still on. Though the land has been vested with the people, it is a

herculean task to make it productive to retain the tribal on the land and prevent further encroachments. The Energy and Resources Institute (TERI), Delhi scrutinized about 66,300 Forest Rights on 10, 7897 ha are spread across 19 Maharashtra districts. Based on this study till 2012, Maharashtra has emitted 5, 70881 tonnes of Green House Gases (GHG) on account of deforestation due to recognition of rights under the ACT. Thus carbon sequestration has been lost in 14,669 ha of forests. The wrong implementation of this ACT is encouraging encroachments and depriving the tribal population of life sustaining resource for which it was enacted. This is a serious matter for sustainable forest management in India as so far no cut off date has been finalized by the government to settle the rights. What is a matter of ecological concern is the fact that the very people who are responsible for the encroachments will be deciding their own case as members of the village council. The land vested must yield productive resources for livelihood in a planned manner.

Impact of climate change

India being a tropical country has started feeling the heat of global warming during the five years with increasing intensity every year. This author had headed the Forest Types of India task force constituted by the Indian Council of Forestry Research and Education (ICFRE) during 2011–2013 to assess the impact of management interventions, climate change and anthropogenic factors on the forests of the country. After 18 months field work by more than 2500 scientific and technical staff a change matrix was prepared on the status of vegetation to compare the present status with the last reassessment done by Champion and Seth in 1968. Impact of climate change on the vegetation was critically examined to see the species level responses to the changes in the rainfall and temperature regimes over the past years. For assessing the impact of climate change over more than 90 years (from 1931 to 2010 in three time series) meteorological data on temperature and rainfall over 83 meteorological stations in the forest type's areas was compared. The results indicated a clear climate change impact on the forests. The changes were more pronounced and discernible especially during the last 30 years from 1991 to 2010. There has been an average 0.7 degree Celsius increase in the temperature and in some localities even more up to 1 degree Celsius. As for the rainfall, it was noticed that in most part of the country's forests both the quantity and number of rainy days have decreased (rainfall reduced by 241 mm and 5 days on an average). There have been erratic rainfall (excess rainfall in few days with prolong draught for many days during the monsoon period) and intense heat waves engulfing the large part of the country. Now after publication of the report in 2013 during last five years the intensity of heat wave, moisture variations and consequent climatic disturbances storms and gusty winds with devastating effects on life from have become a routine now in India during pre-monsoon season. The study had revealed that a big change has occurred in the composition of forests and the old classification of 16 major Types and 200 types and sub-types is no longer relevant. The new classification of forest types was proposed by the task force reflecting the present ecological, climatic, bio-geographic and edaphic influences on the vegetation composition and stand formation. In the proposed new classification, 10 major groups and 44 sub-groups were identified.

There have been considerable impacts on the vegetation particularly in Alpine flora in the higher Himalayas the hot spot of Bio-diversity. The study has indicated many changes occurring at species and forest subtypes levels. The species level changes were observed largely in *Shorea robusta* (Sal), *Tectona grandis* (Teak) and Bamboo forests with regard to their distribution and species density.

The study has indicated the absence of teak from very moist and moist teak sub-type and occurrence of many moist deciduous and semi-evergreen species. In central India, the low rainfall regime has shown the decline of Sal and occurrence of dry deciduous species. The study revealed that both positive and negative changes have been witnessed in various forest types. The Tropical Rain Forests and Mountane Wet Temperate Forests have both remained as climatic climax without any disturbances, while the semi-evergreen and all types of deciduous forest have shown changes in species composition. The study had further revealed that most of the forests specially the Himalayan forests are turning xeric as the hydrology is being massively impacted by the climate and consequent vegetation changes. The mineral and forests map together with tribal population overlap each other. Further, the overlapping mineral, forests and tribal/poverty map poses serious challenges.

Conclusion

The sustainable forest management in India is in the eyes of vortex as the changing dimensions of forests are posing a great challenge for the foresters, policy makers and people at large. Any complacency and ignoring the ecological consequences of poor management of forests will deal a body blow to the India's Intended Nationally Determined Commitments (INDCs) in Paris deal and more so to its quest for water and food for the ever increasing population. The sector needs reforms and national consensus on the management of forests for achieving millennium development goals. One of the greatest challenges before the planners is to balance the needs of development with conservation especially the requirement of industry for infrastructure of minerals, water and electricity.

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Conflict of interest

The author declares there is no conflict of interest.

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