

Status, Trends and Valuation Methodologies of Forestry Sector in India

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Authors' contributions

This work was carried out in collaboration between both authors. Author SG designed the study and wrote the first draft of the manuscript. Author AM wrote the sections containing status and trends of Indian forests. Author SG wrote the sections containing the valuation methodologies. Both of the authors managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

One of the crucial links of ecosystem is forest and its resources. Apart from producing direct use values, it provides several environmental benefits like pollution control, carbon sequestration, nutrient cycling, micro climate regulations etc. Forests are still an almost neglected sector and are consistently undervalued in economic and social terms. Though the area under forest cover has increased, India is still far from its target. Due to different peculiar characteristics, we are not able to value forest resources by traditional method of valuation. There is a need to proper insight into forest cover and its valuation methodologies. Through this article, we have tried to estimate the growth pattern, status and trends in India's forest cover along with its method of valuation.

Keywords: Carbon stock; forest cover; forest economics; forestry trends; forest valuation.

1. INTRODUCTION

1.1 Status of Indian Forests

Forest trees constitute about 82 per cent of the continental biomass and harbour more than 50

per cent of the terrestrial biodiversity [1]. Forests are the source of raw material for mitigating several essential needs of humans, including building materials, paper products, firewood and ecological services such as preservation of

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biodiversity, carbon sink, climate regulation and preservation of water quality and represent our cultural and patrimonial heritage [2]. India ranks 10th in the list of most forest rich nations in the world [3]. India boasts of diverse forest types ranging from tropical wet evergreen forests in the northeast and the southwest, to tropical dry thorn forests in central and western India. The Indian forests are divided into 16 major types comprising 221 sub-types. Most of these forests are located in the Western Himalayas, East Deccan, North Eastern region including Himalayas and the Western Ghats [4]. As per recent assessment total forest cover is 7,12,249 sq.km. which is 21.67% of the total geographic area of the country [5]. The total forest and tree cover of the country is estimated to have 24.56% of the total geographic area of the country. The per capita forest area in the country is 0.08 ha as compared to the world average of 0.64 ha [6]. Forests are still an almost neglected sector and are consistently undervalued in economic and social terms.

Forest cover and Recorded Forest Area (RFA) are two terms generally used by Forest Survey of India (FSI) to depict the status of forests in India. Forest cover on one hand gives information about the forest canopy area covered on the ground irrespective of legal status of land,

whereas RFA gives extent of forests in legal status or definition of land as 'forest' irrespective of actual forest canopy cover on the ground [5]. FSI divides the total forest cover of India in three major sections i.e., Very Dense Forests (VDF), Moderately Dense Forests (MDF) and Open Forests (OF). Scrubs areas, although not calculated in the actual forest cover of India, is also mapped by FSI. As per recent data, India constitutes 99,278 sq.km. of VDF (3.02% of total geographic area); 3,08,472 sq.km. of MDF (9.39% of total geographic area); and 3,04,499 sq.km. of (9.26% of total geographic area) [5]. The relative composition of forest cover in different classes is presented in the following pie chart (Fig. 1).

It is estimated by FSI that the total growing stock of wood in the country is 5,915.76 million cubic meters comprising 4,273.47 million cubic meters inside forest areas and 1,642.29 million cubic meters outside recorded forest areas (TOF). The total carbon stock of Indian forests for 2019 has been estimated 7,124.6 million tonnes in which soil organic carbon is the largest pool of forest carbon accounting for 56.19% followed by above ground biomass (AGB) consisting 31.67%, below ground biomass (BGB) consisting 9.84%, Litter consisting 1.80% and dead wood consisting 0.50% of total carbon pool [5].

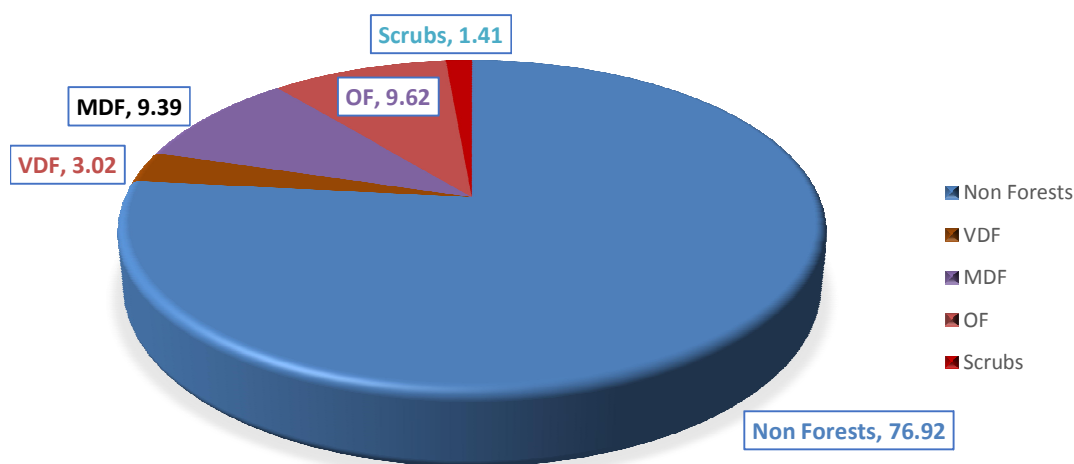


Fig. 1. Percentage cover of total geographic area by different classes of forests in India (After, ISFR, 2019)

1.2 Trends of Indian Forests

Forest Survey of India (FSI) regularly assess the status and trends of forests of India and publishes the updates in various State of Forest Reports (SFRs) since 1987 in a biennial manner. Till date all total sixteen (16) cycles of assessment have been completed by FSI and the latest data was published in India State of Forest Report (ISFR) [5]. Change in forest resources between two successive assessments is an important indicator of gain or loss of forests in the country as a whole. Due to innovative measures in conservation and protection of forests and a strong policy framework, the deforestation rate is almost negligible in India [7]. The National Forestry Action Programme of 1999 had the central aim of raising forest cover to 25 per cent by 2007 and 33 per cent by 2012 [8]. Forest cover in India has seen increase of 0.5 per cent per annum over the past decade [9]. India is ranked third among all the countries over the world, in terms of gaining forest cover in the last decade [10]. However, the quality of existing forest stock is still deteriorating due to a number of factors. India's forests are facing biotic pressure resulting in deterioration in quality of forest cover as well as their productivity. The unsustainable exploitation of forest resources has resulted in their degradation which has been estimated as 41 per cent by the National Forest Commission [11]. It is estimated that the Indian forests have an average productivity of 1.97 m³/ha/year which is far lower than the world average which is estimated at around 3.175 m³/ha/year [12].

With the data cumulated from the sixteen ISFRs (1987-2019), we have calculated the trend and hereby representing graphically (Fig. 2). It is evident that all the components of forest cover have recorded an increase from 1987 to 2019. It is to be notified that only marginal changes are observed during the initial period from 1989 to 1999. On the other hand, during the period of 21st century, from 2001 to 2019, significant increasing trends were recorded in different components of forest cover at all India level. This gain in forest cover or improvement in forest canopy density may be attributed to the better conservation measures, protection, afforestation activities, tree plantation drives and agroforestry along with research and technological advancement in forestry sector.

The recent changes in the forests can be seen as an achievement for the country. Indian forests have seen a gain of 3,976 sq.km. of forest cover in the country according to the 2019 assessment as compared to the previous assessment in 2017 [5]. If we calculate the percentage values, as compared to ISFR 2017 enumerations, there is an increase of 0.65% of forest and tree cover; 0.56% of only forest cover and 1.29% of only tree cover at national level. There is a total increase of 93.38 million cubic meters in the total growing stock of the country which depicts an increase of 1.6 per cent from the previous calculations in ISFR 2017. Also, the change in forest carbon stock is noticeable as there is a net gain of 42.6 million tonnes of carbon pool in Indian forests as compared to the previous assessment in 2017. Currently, India's forests act as a major sink of CO₂ and help with Green House Gas (GHG) mitigation. Although according to FSI, this gain is very much unevenly distributed all over the country as severe loss in forest cover is seen in North-East India which can be due to shifting cultivations, forest fires, felling of trees (legally or illegally), natural calamities, anthropogenic pressure and other developmental activities surging in the areas.

The social forestry projects and community forest plantation are one of main accelerant to the plantation boom occurred in Indian forestry. Several afforestation projects were carried out with the assistance of external donors [7]. The annual rate of plantation forestry since 1990 has ranged between 1,400,000 and 1,600,000 ha [13]. Hence, the assessment of forest cover by FSI using satellite imagery is often criticized by several authors like Puyravaud et al. [14] as it fails to distinguish native forests from tree plantations, which are often monocultures of exotic species that have limited value for endangered biodiversity. Several authors in their study have claimed that the increase in forest cover between 1997 to 2007 were actually made up of exotic tree plantations such as *Eucalyptus* and *Acacia* having absolutely no value to conserve the native forest ecosystems. T.V. Ramachandra of the Centre for Ecological Sciences, Indian Institute of Science (IISc), Bengaluru, had made some serious allegations like the FSI report "*masks ground realities*" of forest status by including commercial plantations etc. in several interviews. He also pointed out that, in case of decline in forest cover of native species in the catchment areas of the streams increases water conflicts to a severe state and native forests are converted into

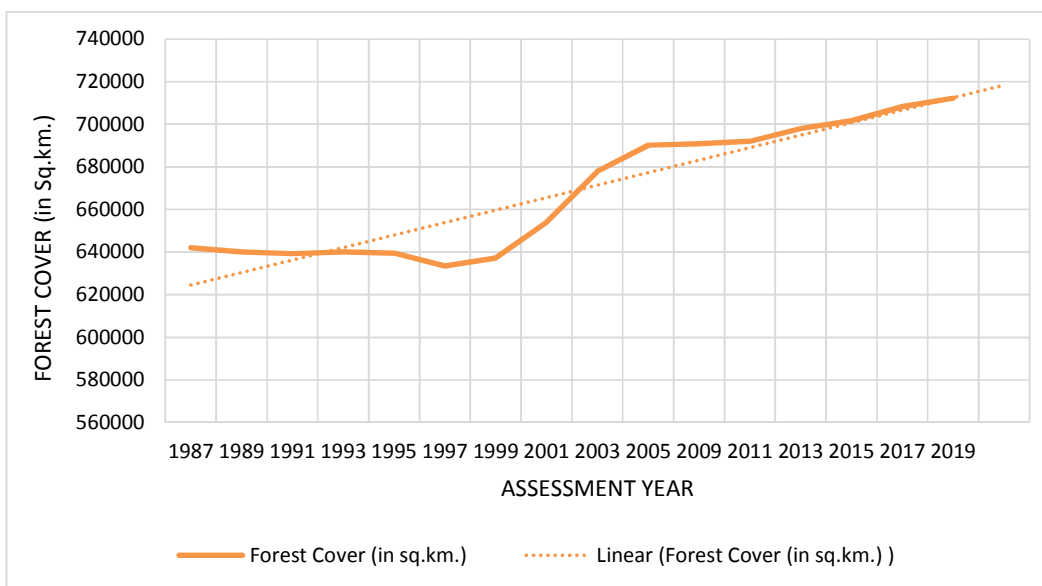


Fig. 2. Trend in Indian forest cover (After, ISFR, 1987-2019)

monoculture plantation under the disguise of forest development it can make the plantation area lose the water supply for even up to six months in a year. He pointed out that a vast area of Western Ghat forest cover calculated by FSI is actually plantation patches of Rubber, *Eucalyptus* and *Acacia* [15].

2. REASONS BEHIND DEPLETION OF FOREST

Over a period of time Indian forests may have achieved a significant increase in terms of total cover, but it is very much evident that the gain in forest resources is not in qualitative manner. Puyravaud et al. [14] have remarked that such '*cryptic destruction of India's native forests*' possesses a challenge for the scientists and researchers who are trying to understand the trends of Indian forests. Increasing population pressure along with poverty and poor institutional framework have been often viewed as predominant causes of depletion of forest and degradation in most of the developing countries. Forest resource depletion can be quantitative as well qualitative. However, quantitative aspects were given more priority than qualitative aspect by the researcher and policy makers [16,17]. Therefore, there is a need to maintain the harmony between development and conservation of the valuable forest resource. Primarily Indian forestry was only production oriented and that led to indiscriminate exploitation of forest resources in the name of economic development of the

country for a long time. Observing the dreadful consequences, environmentalists and conservationists raised their voice to protect forests of India. As a result, there had been a paradigm shift in the way of managing Indian forests and now the foremost importance is given to the protection and conservation of forests and its resources. Although this sustainable approach, Indian forests are facing critical loss in quality. Apart from the major reasons like anthropogenic pressure, changes in land use and illegal poaching and trade activities, such depletion can be attributed to improper valuation of the forests and forest resources in India. Hence appropriate valuation of the forest is necessary to achieve the harmony between production and conservation in forestry sectors of India. Around 1.83 trillion Indian Rupees of Agricultural Gross Value is contributed by forestry sector in the fiscal year of 2018 [18]. This production figure can further be uplifted to a greater value while conserving the forest ecosystem and biodiversity, if proper valuation of forests is done by the concerned authorities.

3. WHY TO VALUATE THE FOREST DIFFERENTLY?

Recently economic valuation of ecosystem services gained considerable interest in research and policy prescriptions after the publication of Millennium Ecosystem Assessment [19]. Natural resources (forest resource) need to evaluate

differently due to its several peculiar characteristics.

- Through demand behaviour we can value any resource. Forests products facing the problem of non-existence of markets for all products.
- Further, forest services like hydrological cycle regulation, regulation of global and local climate, watersheds protection and the 'public goods' provide by the forest have no such market place.
- Forest faced peculiarity of inter-generational use. Standard economic analysis not serve the purpose of valuing the forest resources.
- Natural (forest) resources are subjected to various property right system, from individual to private property rights.
- Positive externalities as well negative externalities are associated with forest resources. Positive externalities are various biological, ecological and aesthetics values are very less priced. Natural resources are subject to market failures, due to externalities and public goods and results in under-estimation of value of forests.

Under these peculiar characteristics of forest resources, under-valuation leads to inefficient allocation of funds to preserve and maintain forest. Therefore, to account the true benefits and costs involved for conservation and maintenance of forests, appropriation valuation methodology is very much crucial.

4. VALUATION OF FORESTS – ASSESSMENT METHODS

Ecosystem services are not adequately quantified or fully captured in compared with economic and manufactured capital goods and services. Ecosystem services are often accounted with too little weight in policy decisions [20]. Forests can be valued through several methodologies, but in practice there are three methods those are used rigorously to valuate the Indian forests.

1. **Total Economic Value (TEV):** The concept of TEV is the most complete measure and the most practiced methodology when it comes to forest valuation. TEV takes in account the both direct use and indirect use values during the valuation. It measures the ecological services provided by the forests in terms of economical values along with the

direct economical benefits generated by the forests. Forest produces like timber and non-timber products come under the tangible benefits exploited from the forests whereas mitigation of climate change and reducing green house gas emission, regulation of the hydrological cycle, conservation of soil and gene pool and carbon sequestration are some of the intangible benefits that can be received from the forests. TEV is calculated according to the following formula:

Total Economic Value = Use Values + Non-Use Values

Where, Use Values=Direct Use Values + Indirect Use Values + Option Value

And, Non-Use Values = Bequest Value + Existence Value

Direct use values consider the direct economical return from the forests mainly through consumptive use of timber or non-timber forest products and non-consumptive uses like recreation, tourism or researches. Indirect use values are enumerated from the total ecological services provided by the forests. Option value can be explained as the future benefits of conserving the forests where as the Bequest Value measures the People's willingness to pay (WTP) for the conservation of forests. The Existence Value, on the other hand, takes into account the people's willingness to pay (WTP) for the aesthetic purposes derived from the forests. Total Economic Value is the most accurate economic enumeration tool for forests as it measures all the above values together.

2. **Carbon Sink Method:** Forest lands sequesters the highest amount of carbon in the world which acts as the most important tool to combat rapid climate change. When forests are in the verge of degradation or over exploited the carbon stored in there is released to the atmosphere increasing the carbon footprint, which in terms accelerates the climate change.

Hence, several times forests are valued as per how much carbon stock is stored in the particular forest. In this method of valuation, the amount of carbon stocks sequestered in the forests is measured through rigorous survey (using RS-GIS and ground truthing).

3. Green Accounting Method: As the major importance in forestry sector is given to the sustainability of the forests, it is of utmost importance that economic valuation method of forestry also takes the value of sustainable growth of the forest land. Green Accounting method, as the name suggests, attempts to factor environmental costs into the financial results of operations. This is a holistic approach of valuation which values not only the forest land or forest produce, but the total forest ecosystem in economic terms. This is a newer approach of valuating forests with huge future possibilities of applications. Green accounting method is carried out through mathematical modelling with low error possibilities.

Table 1. Methods of valuation of forests

Valuation Methodologies	Advantages	Limitations	Comments
Total Economic Value (TEV)	<ol style="list-style-type: none"> 1. Use to calculate Non-Use Values. 2. Probability models helps in calculating uncertainties in valuation process. 	<ol style="list-style-type: none"> 1. Evaluation of Non-Use values are subjective and uncertainty in valuation bring high degree of errors in calculation. 2. Calculation of Non-Use values are highly time intensive and site specific. 	A significant amount of research is being conducted in this area and to accept any compensation to states are based on TEV method.
Carbon Sink Method	<ol style="list-style-type: none"> 1. Based on satellite data the stored forest carbon can be easily calculated. 2. Ground work valuations are already done by Ministry of Environment, Forest and Climate Change (MoEF) in collaboration with Reducing Emissions from Deforestation and Forest Degradation (REDD) initiative. 3. Less dispute possibility among states due to one parameter for valuation. 	<ol style="list-style-type: none"> 1. States having large forest cover in base year are not able to show 'additionality'. 2. States contributing high forest cover spends huge on maintenance which is not able to account in this method. 	To mitigate the limitations, compensation package is based on three criteria a) total amount of carbon actually stored in forests by each state in the year of valuation, b) Cost of maintenance of existing forest in specific year c) Increase in the forest cover as compared with the base year.
Green Accounting Method	<ol style="list-style-type: none"> 1. True measure of sustainable growth. 2. Not only measures financial assets and manufactured assets but also measures natural capital like forests, minerals, biodiversity, freshwater resources, fisheries, cropland etc. 	<ol style="list-style-type: none"> 1. Proper accounting by this method is still in very nascent stage in government sector. 2. Methodology involves qualitative estimation in valuing the non-marketed services like pollution abatement cost, externalities etc. 	As it is the truest measures of forest values, government should move towards Green Accounting Method in long run. To implement this, government need to implement Accrual Accounting (suggested by 12 th Finance Commission & Auditor General of India).

Here, we have tried to discuss the different valuation methodologies of the forest resources in tabular form.

5. CONCLUSION

For developing countries like India, forests are sustenance and survival for a large populace and contribute towards economic development. Presently, a large section of population depends upon forests for their livelihood. The increased demand for forest products putting pressure on all resources including forests may ultimately compromise the sustainability of humans in the biosphere. Forest valuation is hence of apex importance for its sustainable uses and conservation. Among the discussed methodologies, it is evident that the Total Economic Value method is the most used one, but several methodologies of valuation are still under research and experimentation. One can use any of the methods depending upon its specific advantages, disadvantages and limitations.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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