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EXECUTIVE SUMMARY

India is amongst one of the few countries having a robust scientific system for periodic assessment of Forest Cover, Forest Inventory and inventory of Trees Outside Forest. Forest Survey of India (FSI), an organization of Ministry of Environment, Forest & Climate Change carries out these assessments and publishes the findings in its biennial report as 'India State of Forest Report (ISFR)'. The first State of the Forest Report was published in 1987 and the current report (ISFR 2021) is 17th in the series. The ISFR provides valuable inputs for planning, policy formulation and evidence based decision making both at National and State level.

The ISFR 2021, having information on different parameters of the forest resources, is based on the regular nation-wide mapping of Forest Cover, National Forest Inventory and other studies conducted at the national level. The methodology adopted for Forest Cover and Forest Inventory has undergone regular improvements over time.

The Forest Cover as reported in ISFR includes all patches of land with a tree canopy density of more than 10% and with area having more than 1 ha, irrespective of land use, ownership and species of trees. It is assessed by a wall-to-wall mapping exercise using remote sensing followed by extensive ground truthing. Results of the nation-wide Forest Cover Mapping exercise are presented on 1:50,000 scale in three canopy density classes viz Very Dense Forest (canopy density > 70%), Moderately Dense Forest (canopy density 40-70%) and Open Forest (canopy density 10-40%). The tree cover is assessed following a methodology involving remote sensing based stratification and observations on sample plots laid in the strata as part of the National Forest Inventory. Tree cover includes all patches of trees less than 1 ha.

In the current assessment, ortho-rectified LISS III data of IRS Resourcesat-2 with a spatial resolution of 23.5 m for the period October to December 2019 have been used for Forest Cover Mapping. In order to ensure uniformity, consistency and accuracy in the mapping exercise, the procedure has been codified into a manual for Forest Cover Mapping. For the current assessment, ground truthing has been carried out at 3,414 locations across the country. Change matrix showing a quantitative account of class wise change and also the flux of changes among the classes between the current and previous assessment has been presented for all the States & UTs and country as a whole.

National Forest Inventory assesses the growing stock in forests and TOF, bamboo resource, carbon stock and several other parameters. Field data for the same is collected from approximately 30,000 sample plots laid in a 2 years period as per the standardized design. The growing stock and other assessments presented in ISFR 2021 are on the basis of a new grid based forest inventory design adopted by FSI in 2016. This ensures higher sampling intensity with uniformly spread sample plots across the country, leading to higher precision.

In the current ISFR, a new Chapter about 'Above Ground Biomass Estimation using SAR



Data' has been included containing information about spatial distribution of the forest biomass categories which are important for proper management of the forest resources. For this purpose, FSI has collaborated with Space Application Centre (SAC), ISRO, Ahmedabad. The result of this exercise represents that MLR model can be used for AGB estimation at country level. The use of ancillary data in combination with SAR data have been effective in improving coefficient of correlation (r) using MLR model.

Another new chapter on, 'Mapping of Climate Change Hotspots in Indian Forests' has also been included in this ISFR. Forest plants play a significant role in relation to climate change by reducing emission of Green House Gases (GHGs), through expanding the mitigation and adaptation actions with low cost interventions. Therefore, a collaborative study was carried out by FSI with BITS PILANI, Goa Campus to map the climatic hotspots over Indian forest cover using temperature and rainfall data, for the three future time periods i.e. year 2030, 2050 & 2085. To identify climatic hotspots in Indian forests two computer based models were used i.e. RCP 4.5 and RCP 8.5, where RCP 4.5 represents moderate emission scenarios and RCP 8.5 represents the highest emission scenario or worst case scenario.

SALIENT FINDINGS

The key findings of the ISFR 2021 are as follows:

- The total forest cover of the country is 7,13,789 sq km which is 21.71% of the geographical area of the country. The tree cover of the country is estimated as 95,748 sq km which is 2.91% of the geographical area. Thus, the total Forest and Tree cover of the country is 8,09,537 sq km which is 24.62% of the geographical area of the country.
- The current assessment shows an increase of 1,540 sq km (0.22%) of forest cover, 721 sq km (0.76%) of tree cover and 2,261 sq km (0.28%) of forest and tree cover put together, at the national level as compared to the previous assessment i.e. ISFR 2019.
- Forest cover inside the RFA/GW has shown a slight increase of 31 sq km whereas there is an increase of 1,509 sq km of forest cover outside the RFA/GW as compared to previous assessment of 2019.
- The top five States in terms of increase in forest cover are Andhra Pradesh (647 sq km), Telangana (632 sq km), Odisha (537 sq km), Karnataka (155 sq km) and Jharkhand (110 sq km).
- Forest cover in the hill districts of the country is 2,83,104 sq km, which is 40.17% of the total geographical area of these districts. The current assessment shows a decrease of 902 sq km (0.32%) in 140 hill districts of the country.
- The total forest cover in the tribal districts is 4,22,296 sq km, which is 37.53% of the geographical area of these districts. The current assessment shows a decrease of 655 sq km of forest cover inside the RFA/GW in the tribal districts and an increase of 600 sq km outside.



- Total forest cover in the North Eastern region is 1,69,521 sq km, which is 64.66% of its geographical area. The current assessment shows a decrease of forest cover to the extent of 1,020 sq km (0.60%) in the region.
- Mangrove cover in the country has increased by 17 sq km (0.34%) as compared to the previous assessment.
- The total growing stock of wood in the country is estimated as 6,167.50 million cum comprising 4388.15 million cum inside forest areas and 1779.35 million cum outside recorded forest areas (TOF). The average growing stock per hectare in forest has been estimated as 56.60 cum.
- Total bamboo bearing area of the country is estimated as 1,49,443 sq km. There is a decrease of 10,594 sq km in bamboo bearing area as compared to the estimate of ISFR 2019.
- In the present assessment, total carbon stock in forest is estimated as 7,204.0 million tonnes. There is an increase of 79.4 million tonnes in the carbon stock of the country as compared to the last assessment of 2019. The annual increase is 39.7 million tonnes, which is 145.6 million tonnes CO₂ eq.
- Soil Organic Carbon (SOC) represents the largest pool of carbon stock in forests, which has been estimated as 4,010.2 million tonnes. The SOC contributes 56% to the total forest carbon stock of the country.
- Fire prone forest areas of different severity classes have been mapped in the grids of 5km x 5km based on the frequency of forest fires. The analysis reveals that 22.27% of the forest cover of the country is highly to extremely fire prone.
- The correlation analysis between the AGB and the HV, HH and HV/HH polarized backscatter reveals that the HH, HV polarized backscatter has better correlation as compared to HH/HV polarization.
- As per the Climate Hotspot projections for the studied periods i.e. 2030, 2050 and 2085, it has been observed that Ladakh, Jammu & Kashmir, Himachal Pradesh and Uttarakhand are projected to witness highest temperature increase while Andaman & Nicobar Islands, West Bengal, Goa, Tamil Nadu and Andhra Pradesh are projected to witness the least temperature rise over these periods. The North-Eastern States and Upper Malabar Coast of India are projected to experience the highest increase in rainfall; whereas, part of North-Eastern States like Arunachal Pradesh, Sikkim; North-Western parts of the country namely Ladakh, Jammu & Kashmir and Himachal Pradesh are projected to experience least increase and sometimes even decline in rainfall.

Table 1 Forest and Tree Cover of India in 2021

Class	Area (sq km)	Percentage of Geographical Area
	Forest Cover	
Very Dense Forest	99,779	3.04
Moderately Dense Forest	3,06,890	9.33
Open Forest	3,07,120	9.34
Total Forest Cover*	7,13,789	21.71
Tree Cover	95,748	2.91
Total Forest and Tree Cover	8,09,537	24.62
Scrub	46,539	1.42
Non Forest#	25,27,141	76.87
Total Geographical Area	32,87,469	-

* Includes 4,992 sq km under Mangrove Cover

Non-forest includes Tree Cover (Percentage rounded off)

