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*Much of the world is losing forests but adding plantations. While India is no different, the relative area under plantations and natural forests has been obscured. Visuals: Riddhi Tandon*

**BIG STORY COP30 FORESTS**

# AS COP30 ROLLS OUT A TROPICAL FOREST FUND, HOW ARE INDIA'S NATURAL FORESTS DOING?

By [M Rajshekhar](#) / November 14, 2025

*Part 4 of CarbonCopy's forest series finds that even as the Forest Survey of India pegs India's forest cover at 21.76%, satellite images show functional forest ecosystems cover just 1-10% of India's land mass.*

A conflict of interest has dominated India's forest cover estimates for a long time. While the Union Ministry for Environment, Forests and Climate Change (MoEFCC) oversees the country's forests, Dehradun-based Forest Survey of India (FSI) monitors their extent and condition. The FSI, however, is not an independent watchdog. It reports to the MoEFCC.

This arrangement is responsible for a puzzle in India's forest numbers that has now lasted 38 years. Going by the FSI's reports, India's forest cover has grown from 642,401 square kilometres in 1987 to 715,342.61 square kilometres in 2023, a jump of 73,301 square kilometres. "India features in the list of top ten countries in terms of forest area," adds the FSI's 2023 report. "India also figures at 3rd rank in the list of top 10 countries with positive net change in forest area."

These numbers and claims, though, feel counter-intuitive. Over the past 40 years, India's population has almost doubled. Its people's aspirations have risen. In areas abutting forests, both processes have translated into rising pressure on forests. A large question lies here.

Much of the world is losing forests but adding plantations. While India is no different, the relative area under plantations and natural forests has been obscured.

The costs of this veil are starting to become apparent.

At COP30, Brazil has proposed the Tropical Forest Forever Facility (TFFF), a \$125 billion trust fund comprising \$25 billion from countries and the rest mobilised

from the private sector, which will then be invested to generate \$4 billion or so annually. This sum, nearly thrice as much as the money currently flowing into the protection of tropical forests, will flow to 74 countries with tropical forests. As this report gets written, TFFF has already received pledges for \$5.5 billion from countries and India has joined the fund as an observer.

With climate change gathering pace, one waits to see if the fund will grow in size – and the quantum of money it will direct to these 74 countries. The amount of money countries can accrue, however, hinges on the quantum of their tropical forests.

That said, TFFF is not the only reason why India should care about its forests. Forests make India habitable. Not only is the country seeing a rise in human-wildlife conflict and a drop in elephant numbers, it also has previously perennial rivers drying up even in their upper reaches, all suggesting forest loss – and a looming crisis of human survival.

In all, a question needs to be asked. Keeping plantations out of forest cover calculations, what percentage of India is now under functional or old-growth or natural forest ecosystems?

### **Forest cover-up?**

The paradox of India's forest cover numbers has been out in the open for a while now.

As the second and third reports in this series have shown, India's forest department is also wilfully failing to curb timber trafficking. With that, a clutch of commercially attractive trees like Khair (Acacia catechu) are vanishing from India's forests, with attendant impacts on forest quality.

The MoEFCC has also been allegedly diluting India's forest protection laws, making it easier for infrastructure and industrial projects to clear forests and site themselves in forestland. Between 2017 and 2020 alone, as environmental lawyer Ritwick Dutta's Legal Initiative for Life and Environment claimed to have found, it denotified 726 square kilometres of forest. Close to half of this land was dense and moderately dense forests.

A clutch of researchers, too, have flagged contradictions between FSI assessments and local developments. Take Sonitpur, Assam. Between 1994 and 2001, as wildlife biologist MD Madhusudan has written, no less than 232.19 square kilometres of moist deciduous and other forest areas in this district close to the state's border with Arunachal Pradesh were felled for cultivation. FSI's reports, however, show a jump in its forest cover – up from 732 square

kilometres (245, dense forests; 487, open forests) in 1999 to 1,054 square kilometres (471, dense forests; 683, open forests) in 2001.

Each of these counter-arguments could be dismissed as a local aberration — while stressing that FSI’s reports capture the larger picture. Pan-India assessments from a sister state-owned agency, the National Remote Sensing Centre (NRSC), also say India’s forests are shrinking. “Over the past 20 years, while FSI data shows a 80,000 square kilometre increase in India’s forests, NRSC data shows a 15,000 square kilometre fall in Indian forests,” said Madhusudan.

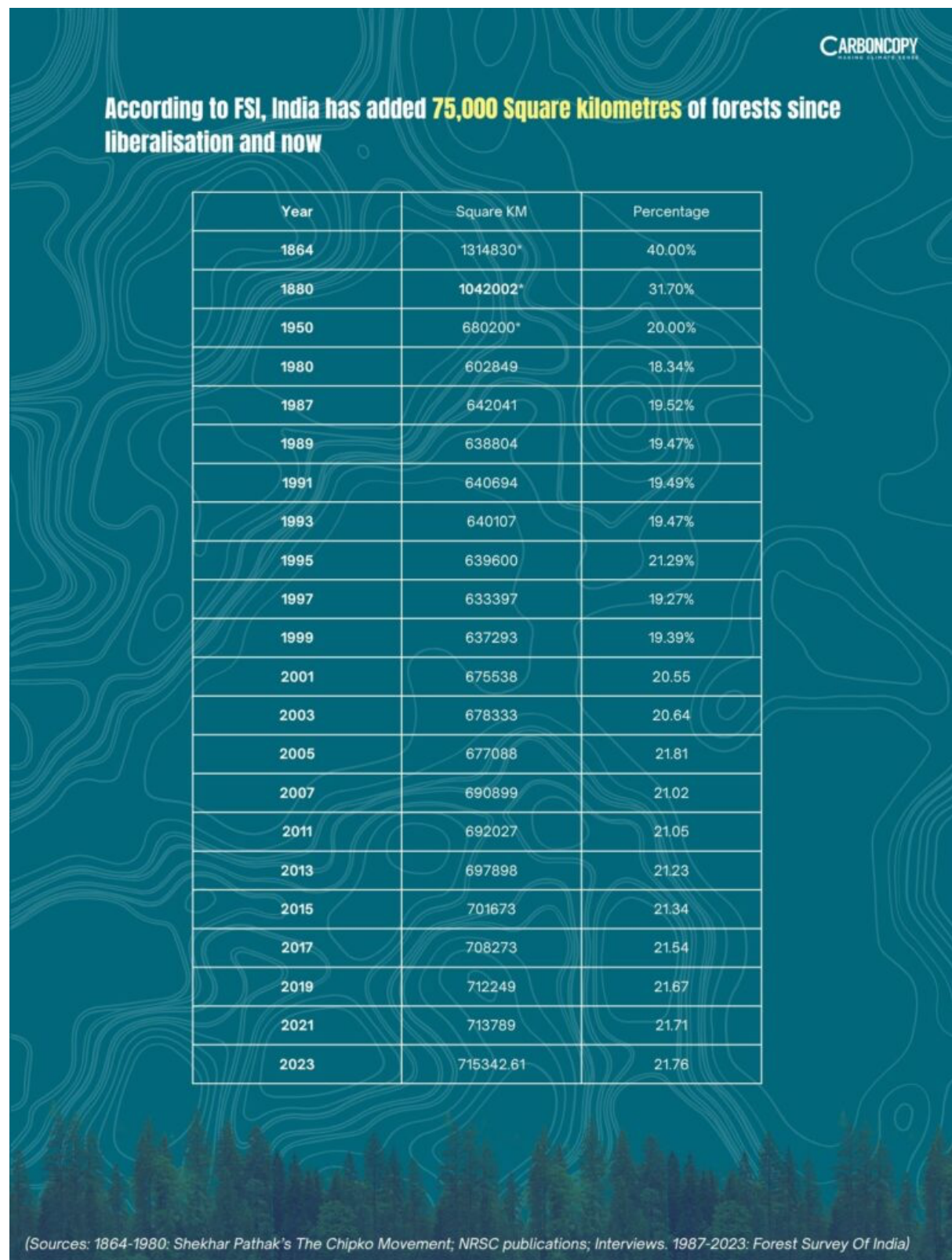
Two questions — one procedural; the other ecological — lie here. The first, on the contradiction between FSI and NRSC numbers, is easily explained. FSI defines forests so expansively that plantations and public gardens get pulled into its forest cover calculations. With that, as scientists like Priya Davidar have written, even as India has cut forests, the country’s accretion of plantations has kept forest cover growing.

And yet, a collection of trees is not a forest. Evolving over millions of years, forests are complex ecosystems. Each comes with an unique assemblage of species — trees, ferns, animals, birds, insects, fungi and microbes — living off each other such that, as Barbara Kingsolver wrote in *The Poisonwood Bible*, the “forest eats itself and lives forever”. Apart from keeping the forest steady, as the box below shows, this latticework of species also stabilises global climate.



Visual: Riddhi Tandon

Plantations, in contrast, have a fraction of this diversity and so, perform a fraction of a forest's ecological functions.



Visual: Riddhi Tandon

## How to boost a forest

On the face of things, counting India's forest cover should be easy.

All trees and plant species, given their biochemical and physiological nature, carry subtle differences in pigments like chlorophyll (which absorbs light in the blue and red parts of the spectrum, but reflects green). When studied from a satellite, these differences show up as unique signatures from each species and forest type per the spectrum each absorbs and reflects.

With precautions, like ground verification of satellite images; and not taking satellite scans only during rains, satellites can gauge the extent of crops, trees and forest types. Not only does India have access to such satellite data and imaging knowhow, the country's forest department physically inspects forests — be it while preparing working plans or patrolling. It should be easy, ergo, for the FSI to club ground information with satellite images to produce its biennial snapshots of India's forest health. And yet, looking for disaggregated data on forests and plantations in its reports is a fruitless exercise.

The reasons run deep. FSI, for one, interprets the Food and Agriculture Organisation (FAO)'s forest definition so expansively that plantations and public gardens qualify as forests.

Defining forests as “Land spanning more than 0.5 hectares with trees higher than 5 metres and a canopy cover of more than 10 percent”, FAO excludes “tree stands in agricultural production systems, such as fruit tree plantations, oil palm plantations, olive orchards and agroforestry systems” from its definition of forest cover. FSI, however, says: “All tree stands with canopy density over 10% and having an extent of more than one hectare, including tree orchards, bamboo, palms etc within recorded forests, on other government lands, private, community or institutional lands are included in the assessment of forest cover.”

Thereafter, it has leveraged this (re)definition by not classifying forests by type (say, tropical evergreens or semi-evergreens) but by density (very dense, moderately dense and open). The fallouts are consequential. Even when the natural forest is cut and replaced by plantations, the focus on density lets FSI continue counting the land as a forest, alluding, at the most, to a change in forest density. See the chart below.

## FSI trends in Very Dense, Moderately Dense and Open Forests

Years	Dense forests (canopy density over 40%)	Very dense forests (canopy density over 70%)	Moderately dense forests (40-70%)	Open forests (10-40%)
1991	385008			249930
1993	385566			250275
1995	386756			249311
1997	367260			261310
1999	377358			255064
2001	416089			258729
2003	390564	51285	339279	287769
2005	387216	54569	332647	289872
2007	402522	<b>83510</b>	319012	288377
2011	404207	83471	320736	287820
2013	402247	83502	318745	295651
2015	401278	85904	315374	300395
2017	406476	<b>98158</b>	308318	301797
2019	407750	99278	308472	304499
2021	406669	99779	306890	307120
2023	409090	103244	305846	303365.89

(Source: Forest Survey Of India)

Visual: Riddhi Tandon

Going by the FSI's numbers, very dense forests jumped discontinuously twice. First in 2007, mainly due to a change in mapping scale from 1:250,000 (25ha) to 1:50,000 (1ha), which permitted "the inclusion of smaller patches of forest cover up to 1 ha". Then comes the jump in 2017 when land under dense forests spikes

by nearly-13,000 square kilometres. While explaining that, FSI’s report lists plantations.

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### Understanding the 12,254 square kilometre spike in dense forests

Area	State	Reasons
2141	Andhra.	Plantations, conservation activities, better interpretation of data.
567	Assam	Mainly due to plantations outside forest areas.
393	Himachal Pradesh.	Plantations, conservation activities, better interpretation of data.
1101	Karnataka	Karnataka. Plantations, conservation activities, better interpretation of data.
253	J&K	Plantations, conservation activities, better interpretation of data.
1043	Kerala	Commercial plantations outside forest areas, better interpretation of data.
263	Manipur	]Plantations, conservation activities and regrowth in shifting cultivation areas.
885	Odisha	Plantations, conservation activities, better interpretation of data.
466	Rajasthan	Plantations, conservation activities, regeneration of fast-growing species.
565	Telangana	Telangana. Expansion of tree cover outside recorded forest areas

*FSI's State of India Forests report for 2017.*

Visual: Riddhi Tandon

Apart from conflating natural forests and plantations, FSI has also muddied waters by tweaking its methodology. Its decision to change the minimum mappable area from 1:250,000 to 1:50,000 helped it count smaller forest patches, but also made it harder to compare newer reports with earlier ones. Compounding matters, as Madhusudan wrote, FSI reports “don’t just report forest cover for a new assessment year, but often go back and tweak forest cover values of previous years”.

In the past, as Parth Sarathi Roy, the now-retired director of Indian Institute of Remote Sensing told CarbonCopy, it has also added recorded forest area (land recorded as forestlands on departmental maps even if no forest stands there) to satellite images and included *Prosopis juliflora*, an invasive species, in its scrub forest estimates. Working on this report, CarbonCopy wrote to FSI asking it to explain these decisions. This article will be updated when it responds.

In the meantime, though, forests cannot be reimagined to suit administrative requirements. “In Assam, Hoolock Gibbons sitting in forest trees look out at tea plantations,” Madhusudan had said. “Even if the FSI calls them forests, the Gibbons cannot live there.”

### **What percentage of India is covered by natural forests?**

India’s history of forest mapping through satellites is a tale of two organisations starting together, but then taking their own paths. It’s a tale that starts in 1980, a time when India was seeing protests against the proposed dam at Silent Valley. The Chipko movement against tree-felling was underway in the Garhwal and Kumaon Himalayas as well. Against this backdrop, then-Prime Minister Indira Gandhi asked for an estimate of India’s forest cover. That first assessment was jointly produced by FSI and the Indian Space Research Organisation (ISRO).

In the years that followed, the two organisations struck out on their own. FSI began producing forest assessments for the MoEFCC. Through centres like Hyderabad-based National Remote Sensing Centre (NRSC), ISRO, too, continued with its own land and forest mapping, providing its information to other government departments.

Working on this report, CarbonCopy started with NRSC’s [Bhuvan](#) database. We took the 250m database, which presents pan-India numbers. In this database, there are five categories of forests — deciduous woodlands; littoral/swamp/mangroves; shifting cultivation; evergreen/semi-evergreen; and degraded woodland.

Since our question is about the current expanse of natural forests, this report brought deciduous woodlands, littoral/swamp/mangroves and evergreen/semi-evergreen forests into its calculations.

When placed alongside FSI numbers, one sees a rising divergence as FSI’s estimates rise while those of Bhuvan drop. This contradiction has to be taken seriously. “Unlike the FSI, which is accountable only to the MoEFCC, NRSC is accountable to many more government departments,” Madhusudan had said. For this reason, it is less likely to bias its numbers towards a particular client, he added.

Other studies have yielded yet lower numbers for India's forest cover. In 2015, NRSC scientists Sudhakar Reddy, CS Jha, PG Diwakar and VK Dadhwal published a paper titled *Nationwide classification of forest types of India using remote sensing and GIS*. It categorised India's forests into five types (tropical moist forests; tropical dry forests; subtropical forests; temperate forests; and subalpine forests) and pegged India's forest cover at 625,565 square kilometres in 2015. And then, there is Global Forest Watch. By 2020, it says, natural forests covered no more than 440,000 square kilometres — or 15% of India's landmass.

## Four satellite counts, four answers: mismatches between forest cover calculations between FSI, Bhuvan, NRSC and Global Forest Watch

	FSI	Bhuvan	NRSC	Global Forest Watch
1864	1314830*			
1880	1042002*			
1930			869012	
1950	680200*			
1975			653220	
1980	602849			
1985			638460	
1987	642041			
1989	638804			
1991	640694			
1993	640107			
1995	639600		630795	
1997	633397			
1999	637293			
2001	675538			
2003	678333			
2005	677088		627233	
2007	690899	648660		
2011	692027	648330		
2013	697898	647890		
2015	701673	649870	625656	
2017	708273	647420		
2019	712249	646110		
2020				440000
2021	713789	640820		
2023	715342.61	631880		

(Source: Source: FSI; Bhuvan; Academic publications by NRSC scientists)

Visual: Riddhi Tandon

CarbonCopy has written to the FSI asking it to comment on the contradiction between its numbers and those of NRSC and Global Forest Watch. This article will be updated when they respond. For now, though, even the Bhuvan and

Global Forest Watch numbers constitute an upper range on what India's natural forest cover might be.

## A question about Intact Forest Ecosystems

TFFF seeks to support functional forest ecosystems. To stay ecologically viable, India, too, needs fairly large stretches of contiguous forest ecosystems that can perform all their environmental functions. For both these reasons, the question Indians have to ask is not about aggregate forest cover, but about intact forest ecosystems.



Visual: Riddhi Tandon

The second part of this series had described Uttar Pradesh's Suhelwa Wildlife Sanctuary as an empty forest. "Close to 25 years have passed since the park last had a breeding population of tigers," CarbonCopy had written. "Moving through the forest, one sees trees but hears little birdsong."

The reasons are familiar enough. Illicit felling of timber created conditions for invasives like lantana to take root in the forest. With that, disturbed by human activity and not finding enough food, both deer and big cats have moved out. "This was supposed to be a tiger reserve," Niharika Singh, a local activist and a former member of UP's State Wildlife Board had told CarbonCopy. "But now, not even a *khargosh*(hare) is seen here."

Suhelwa is far from an outlier. About 10 years ago, travelling in the forests of southern Chhattisgarh just after Salva Judum founder Mahendra Karma was killed, this reporter had been struck by how silent those forests were. “Even in the Jarawa reserve, Garjan and Padauk are being logged,” Roy had said. Elsewhere in the country, as in the vicinity of Hasdeo Arand and Tadoba, mines have come up close to forests. “Across India, as with the world, forests are turning into isolated fragments with impaired functional ecological capabilities,” a former professor at Dehradun’s Wildlife Institute of India told CarbonCopy. “This has resulted in a reduction of the ecosystem services they provide.”

The difference is material. As Roy and his co-authors reported in a 2013 paper titled Forest Fragmentation in India, intact forests house far more biodiversity than fragmented areas. While intact forest areas had a total of 6,660 species, highly fragmented areas had no more than 1,125. Their capacity to provide the ecological services mentioned above shrinks as well. The Hoolock Gibbons near Jorhat, for instance, now have just the 20 square kilometres that comprise the Hoollongapar Gibbon Sanctuary. It is what they have to survive in — even though the small area caps their numbers.

For this reason, anyone trying to quantify the current expanse of functional forest ecosystems, those forests working as before, has to exclude fragments as well.

How large should an intact forest ecosystem be? The answer depends on the conservation goal. To house a squirrel, a one hectare patch might be enough. For an elephant, a much larger range will be needed. For other ecological services, like producing a river, the answer changes again.

In India, data on forest sizes has been hard to come by. One FSI report, the one for 2017, has some numbers. However, the ones for 2019, 2021, 2023 don’t. Even so, the 2017 report makes for an eye-opening read.

Table 2.18 National Level Forest Cover Information in different patch sizes

Sl. No.	Patch Size Range in (sq.km)		No. of Patches	Forest Cover	Percentage
1	>=0.01	<=1.0	7,27,380	54,082	7.64
2	>1.0	<=10	16,444	43,639	6.16
3	>10	<=100	2,183	58,052	8.20
4	>100	<=500	257	51,298	7.24
5	>500	<=1000	57	39,628	5.59
6	>1000	<=5000	42	85,407	12.06
7	>5000	<=10000	14	90,028	12.71
8	>10000		9	2,86,139	40.40
	<b>Total</b>		<b>7,46,386</b>	<b>7,08,273</b>	<b>100</b>



*The above table reveals that more than 40 % of the forest cover is contained in 9 patches each having area greater than 10,000 sq km. 65 patches, each having area above 1,000 sq km covers more than 65% of the forest cover of country. The largest patch lies in the North-Eastern States and covers an area of 1,58,439 sq km.*

### National Level Forest Cover Information in Different Patch Sizes

Going by these numbers, fragments less than 100 square kilometres (10 km by 10 km) accounted for 22% of India’s forest cover at the time data was collected for the 2017 report. Patches between 100-1,000 square kilometres accounted for another 12%. To put that in perspective, if a park needs 20 breeding tigers to keep the population genetically viable, it will need at least 800-1,200 square kilometres of inviolable space.

In other words, between 2015 and 2017, forest patches bigger than 1,000 square kilometres covered 461,574 square kilometres of India’s geographical area (14% forest cover, in essence). Even this number, however, is an over-estimate. The FSI, as data shows, mixes up plantation and forest numbers.

In Forest Fragmentation in India, Roy et al say almost half of India’s forested areas were intact. Going by Bhuvan data, that works out to 323,945 square kilometres (about 10% of India’s geographical area) in 2013, when their paper was published. The caveat is, 12 years have passed since and India has seen both human pressure and large projects sited on forestlands rise since.

Another paper, titled Development of spatial database on intact forest landscapes of India, reaches a harsher conclusion. Defining intact forest ecosystems as those showing “no signs of forest change, settlements, roads and land clearing during the last eight decades”, it also pegged the minimum size at

10 square kilometres. Here is what they found: “Current intact forest landscapes of India (consisting) of blocks larger than 10 km<sup>2</sup> covers an area of 34,061 (square kilometres).”

### Biogeographic-zone-wise-distribution of intact-forest-landscapes-of-India

Sl.No.	Zone/Region/State/UT	Number of IFLS	Area under IFL (KM <sup>2</sup> )	%age of Area
<b>I</b>	<b>Eastern Himalayas</b>			
1	Arunachal Pradesh	49	25163.3	73.9
2	Sikkim	13	806.2	2.4
3	Part of Sikkim & West Bengal	1	78	0.2
4	Assam	2	91.1	0.3
	<b>Sub total</b>	65	26138.6	76.7
<b>II</b>	<b>Western Himalayas</b>			
1	Jammu & Kashmir	20	294.7	0.9
2	Himachal Pradesh	13	204.6	0.6
3	Uttarakhand	54	2488.7	7.3
4	Part of Himachal Pradesh & Uttarakhand	1	19.4	0.1
	<b>Sub total</b>	88	3007.3	8.8
<b>III</b>	<b>Western Ghats</b>			
1	Kerala	11	578.8	1.7
2	Part of Kerala & Karnataka	2	170.8	0.5
3	Part of Kerala & Tamil Nadu	10	1052.5	3.1
4	Tamil Nadu	5	154	0.5
	<b>Sub total</b>	28	1956.1	5.7
<b>IV</b>	<b>Andaman &amp; Nicobar Islands</b>			
1	Andaman	21	1451.1	4.3
2	Nicobar	2	668.9	2
	<b>Sub total</b>	23	2120	6.2
	<b>Coasts</b>			
1	West Bengal (Sunderbans)	33	839	2.5
	<b>Grand total</b>	237	34061	100

Source: "Development of spatial database on intact forest landscapes of India, 2017"

Visual: Riddhi Tandon

This works out to just 1% of India's total geographical area. Most of these patches, says the paper, are in the eastern Himalayas, followed by the Western Himalayas, Andaman and Nicobar Islands and then, the Western Ghats.

The rest of the country's forests, then, are relatively mixed-use landscapes straddling a continuum from slightly used to heavily degraded. This paper, too, however, was published in 2016 and its numbers are outdated now. Working on this report, CarbonCopy's efforts to meet NRSC scientists for an updated assessment were unsuccessful.

Given that regeneration is not counted while measuring intact forest ecosystems — WRI's methodology, for instance, assumes that once lost, intactness cannot be regained — India needs to ask itself a very urgent question. If, by 2016, intact forest ecosystems covered no more than 1% of the country's geographical area, what is that number today? Even taking a more expansive definition for forest cover, as inviolable areas are hard to come by in a country like India where millions depend on forest produce, forest patches (including plantations, though) bigger than 1,000 square kilometres covered just 14% of India's geographical area by 2017. How much of India do they cover now? CarbonCopy posed this question to both FSI and NRSC. This article will be updated when they respond.

Hardwired into this question is a warning about India's ecological future. Intact forest landscapes are so because of their distance from dense human populations and/or extractive industries and/or industrial development. "The highest area of IFL [Intact Forest Landscape] was found in elevation zone of 2,500-3,000m followed by 2,000-2,500m and 1,500-2,000m," says the spatial database paper. "No intact forest landscapes of larger than 10 (square kilometres) were found in arid, semi-arid, Deccan, north-east and Gangetic plains."

The final part of this series will look at the consequences that follow.

**M Rajshekhar**