

11.4

BIHAR

11.4.1 Introduction

Bihar, a State in the eastern part of the country is the 13th largest in terms of geographical area and 3rd largest by population. The State has a geographical area of 94,163 sq km which is 2.86% of the total geographical area of the country. The State lies between 24°16' N to 27°45' N latitude and 83°16' E to 88°30' E longitude. The neighboring States are Uttar Pradesh in the west, Jharkhand in the south and West Bengal in the east. On the northern side, the State has international border with Nepal. There are 38 districts in the State none of which fall in the category of Hill or Tribal district. Ganga is the main river which flows from west to east through the State. The main tributaries of Ganga are Son, Gandak and Phalgu. The annual rainfall ranges between 1,000 to 2,000 mm and the average annual temperature from 20°C to 28°C. The rural and urban population constitutes 88.71% and 11.29% respectively. The Tribal population is 1.28%. As per 2011 census, Bihar has a population of 104.10 million and population density 1,106 per sq km which is much higher than the national average of 382 persons per sq km. The 19th Livestock census 2012 has reported a total livestock population of 32.93 million.

TABLE 11.4.1 Land Use Pattern

Land Use Types	Area (in 000' ha)	Percentage
Geographical Area	9,416	
Reporting area for land utilization	9,360	100.00
Forests	622	6.64
Not available for land cultivation	2,144	22.91
Permanent pastures and other grazing lands	15	0.16
Land under misc. tree crops and groves	248	2.65
Culturable wasteland	45	0.48
Fallow land other than current fallows	119	1.28
Current fallows	889	9.49
Net area sown	5,278	56.39

Source: Land Use Statistics, Ministry of Agriculture, GOI, (2014-15)



11.4.1.1 A Brief Overview of Forestry Scenario

Bihar is a forest deficient State and natural forests are found in limited areas. Sal (*Shorea robusta*) forests are found in the West Champaran district in the Terai region in the north and in Kaimur, Rohtas, Aurangabad, Gaya, Jamui, Munger and Banka districts in southern Bihar. The West Champaran district has moist deciduous Sal forest while South Bihar has dry deciduous Sal Forests. Most of the natural forests are notified as Protected Forests. As per the Champion & Seth Classification of Forest Types (1968), the forests of Bihar belong to four Forest Type Groups further divided into 13 different Forest Types.

The improvement of the quality of forests is high in the priority and regeneration activities are carried out regularly. The other thrust area is to increase tree cover in the State and for this purpose, tree plantations and agro forestry are carried out. The State Government has included Forest Department in “Krishi Road Map” and a separate “Hariyali Mission Directorate” has been established to manage these programs. The SFD is also concentrating on massive soil and moisture conservation works in the forest areas which are successful in retaining the soil and moisture and supporting the biodiversity.

Recorded Forest Area (RFA) in the State is 6,877 sq km of which 693 sq km is Reserved Forest, 6,183 sq km is Protected Forest and 1 sq km is Unclassed Forest. In Bihar, during the period 1st January 2015 to 5th February 2019, a total of 1,131.60 hectares of forest land was diverted for non-forestry purposes under the Forest Conservation Act, 1980 (MoEF&CC, 2019). As per the information received from the State during the last two years, a total of 56,560 ha of plantations have been raised.

One National Park and 12 Wildlife Sanctuaries constitute the Protected Area network of the State covering 3.44% of its geographical area.

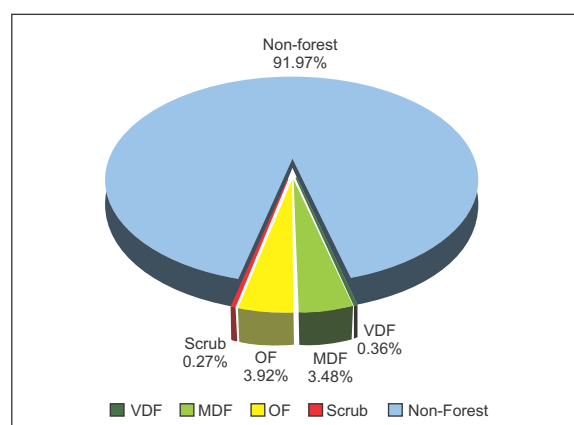
11.4.2 Forest Cover

Based on the interpretation of IRS Resourcesat-2 LISS III satellite data of the period Oct 2017 to Dec 2018, the Forest Cover in the State is 7,305.99 sq km which is 7.76 % of the State's geographical area. In terms of forest canopy density classes, the State has 333.13 sq km under Very Dense Forest (VDF), 3,280.32 sq km under Moderately Dense Forest (MDF) and 3,692.54 sq km under Open Forest (OF). Forest Cover in the State has increased by 6.99 sq km as compared to the previous assessment reported in ISFR 2017.

TABLE 11.4.2 Forest Cover of Bihar
(in sq. km)

Class	Area	% of GA
VDF	333.13	0.36
MDF	3,280.32	3.48
OF	3,692.54	3.92
Total	7,305.99	7.76
Scrub	249.88	0.27

FIGURE 11.4.1 Forest Cover of Bihar



11.4.2.1 Forest Cover inside and outside Recorded Forest Area (or Green Wash)

The State has reported extent of recorded forest area (RFA) 6,877 sq km which is 7.30% of its geographical area. The reserved, protected and unclassified forests are 10.08%, 89.91% and 0.01% of the recorded forest area in the State respectively. However, as the digitized boundary of RFA from the State covers only an area 6,301.97 sq km, the analysis of forest cover inside and outside this area is given below.

TABLE 11.4.3 Forest Cover inside and outside Recorded Forest Area or (Green Wash) in Bihar (in sq km)

Forest Cover inside the Recorded Forest Area (or Green Wash)				Forest Cover outside the Recorded Forest Area (or Green Wash)			
VDF	MDF	OF	Total	VDF	MDF	OF	Total
314	2,451	2,004	4,769	19	829	1,689	2,537
6.59%	51.40%	42.01%		0.75%	32.69%	66.56%	

*in case of Bihar RFA boundaries have been used.

FIGURE 11.4.2 Forest Cover inside and outside RFA in Bihar

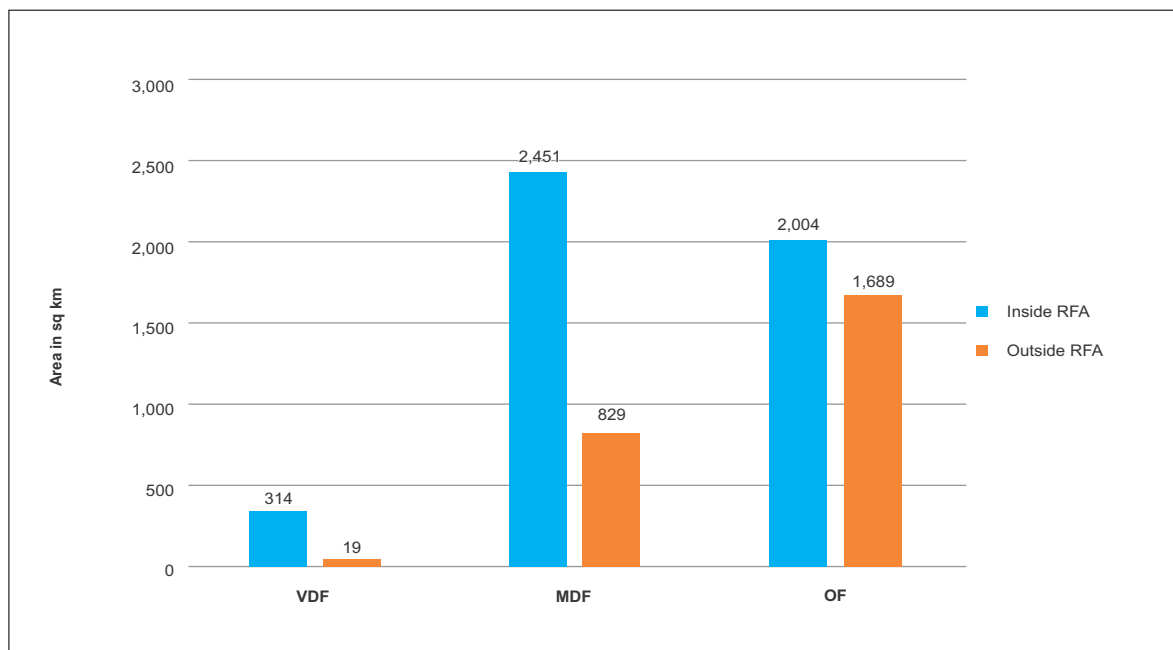


TABLE 11.4.4 District-wise Forest Cover in Bihar

(in sq km)

District	Geographical Area (GA)	2019 Assessment				% of GA	Change wrt 2017 assessment	Scrub
		Very Dense Forest	Mod. Dense Forest	Open Forest	Total			
Araria	2,830	0.00	8.10	142.91	151.01	5.34	-4.99	0.38
Arwal	638	0.00	1.63	2.37	4.00	0.63	-1.00	0.00
Aurangabad	3,305	0.00	62.26	94.50	156.76	4.74	-0.24	16.70
Banka	3,020	0.00	103.34	157.39	260.73	8.63	20.73	34.55
Begusarai	1,918	0.00	28.64	53.31	81.95	4.27	-1.05	0.00
Bhagalpur	2,569	0.00	46.21	23.52	69.73	2.91	1.73	0.00
Bhojpur	2,395	0.00	19.44	12.81	32.25	1.89	-3.75	0.00
Buxar	1,703	0.00	2.94	2.95	5.89	0.26	-0.11	0.00
Darbhanga	2,279	0.00	43.54	94.12	137.66	2.77	1.66	0.00
Gaya	4,976	0.00	134.40	455.91	590.31	29.04	-14.69	62.34
Gopalganj	2,033	0.00	1.98	2.93	4.91	0.16	-0.09	0.00
Jamui	3,098	28.97	351.69	267.29	647.95	69.60	6.95	15.74
Jehanabad	931	0.00	0.00	0.00	0.00	0.00	0.00	5.00
Kaimur(Bhabua)	3,332	0.00	525.14	531.25	1,056.39	41.12	-14.61	19.43
Katihar	3,057	0.00	6.03	55.95	61.98	2.03	0.98	0.00
Khagaria	1,486	0.00	3.18	15.27	18.45	1.24	-2.55	0.00
Kishanganj	1,884	0.00	16.33	87.37	103.70	5.50	1.70	0.00
Lakhisarai	1,228	17.00	144.42	18.99	180.41	14.69	-2.59	5.49
Madhepura	1,788	0.00	0.93	51.95	52.88	2.96	1.88	0.40
Madhubani	3,501	0.00	40.34	163.73	204.07	5.83	7.07	0.00
Munger	1,419	37.97	223.67	21.96	283.60	19.99	-1.40	9.98
Muzaffarpur	3,172	0.00	52.17	109.65	161.82	5.10	19.82	0.00
Nalanda	2,355	0.00	6.86	24.99	31.85	1.35	-0.15	9.17
Nawada	2,494	0.00	200.98	312.52	513.50	20.59	1.50	20.46
Pashchim Champaran	5,228	249.19	550.24	105.23	904.66	17.30	0.66	8.10
Patna	3,202	0.00	18.78	4.76	23.54	0.74	-2.46	0.00
Purbi Champaran	3,968	0.00	65.04	98.82	163.86	4.13	8.86	0.00
Purnia	3,229	0.00	5.00	50.67	55.67	1.72	2.67	0.00
Rohtas	3,881	0.00	352.52	319.71	672.23	17.32	-33.77	42.14
Saharsa	1,687	0.00	4.17	30.45	34.62	2.05	0.62	0.00
Samastipur	2,904	0.00	105.30	48.06	153.36	5.28	-3.64	0.00
Saran	2,641	0.00	26.30	32.83	59.13	2.24	2.13	0.00
Sheikhpura	689	0.00	1.00	0.00	1.00	0.15	0.00	0.00
Sheohar	349	0.00	2.00	18.58	20.58	5.90	1.58	0.00
Sitamarhi	2,294	0.00	37.38	110.40	147.78	6.44	1.78	0.00
Siwan	2,219	0.00	1.99	5.17	7.16	0.32	0.16	0.00
Supaul	2,425	0.00	3.89	134.89	138.78	5.72	8.78	0.00
Vaishali	2,036	0.00	82.49	29.33	111.82	5.49	2.82	0.00
Grand Total	94,163	333.13	3,280.32	3,692.54	7,305.99	7.76	6.99	249.88

TABLE 11.4.5 Forest Cover Change Matrix for Bihar

(in sq km)

Class	2019 Assessment					Total ISFR 2017
	VDF	MDF	OF	Scrub	NF	
Very Dense Forest	332	0	0	0	0	332
Moderately Dense Forest	1	3,150	17	7	85	3,260
Open Forest	0	50	3,414	44	199	3,707
Scrub	0	0	22	177	29	228
Non Forest	0	80	240	22	86,294	86,636
Total ISFR 2019	333	3,280	3,693	250	86,607	94,163
Net Change	1	20	-14	22	-29	

A net positive change of 6.99 sq km observed in forest cover of the state could be attributed to plantations and conservation practices.

TABLE 11.4.6 Altitude-wise Forest Cover in Bihar

(in sq km)

Altitude Zone (m)	Geographical Area	VDF	MDF	OF	Total	Scrub
0-500	93,821	330	3,138	3,564	7,032 (96.25%)	245
500-1000	342	3	142	129	274 (3.75%)	5
Total	94,163	333	3,280	3,693	7,306	250

(based on SRTM, Digital Elevation Model, 30 m, 2016)

TABLE 11.4.7 Forest Cover in different slope classes in Bihar

(in sq km)

Slope (in degrees)	Geographical Area	VDF	MDF	OF	Total	Scrub
0-5	91,177	177	2,131	2,894	5,202 (71.20%)	157
5-10	1,576	72	484	363	919 (12.58%)	34
10-15	594	38	275	171	484 (6.62%)	20
15-20	363	23	175	119	317 (4.34%)	15
20-25	222	14	105	68	187 (2.56%)	11
25-30	122	6	58	39	103 (1.41%)	7
>30	109	3	52	39	94 (1.29%)	6
Total	94,163	333	3,280	3,693	7,306	250

(based on SRTM, Digital Elevation Model, 30 m, 2016)



FIGURE 11.4.3 Forest Cover Map of Bihar

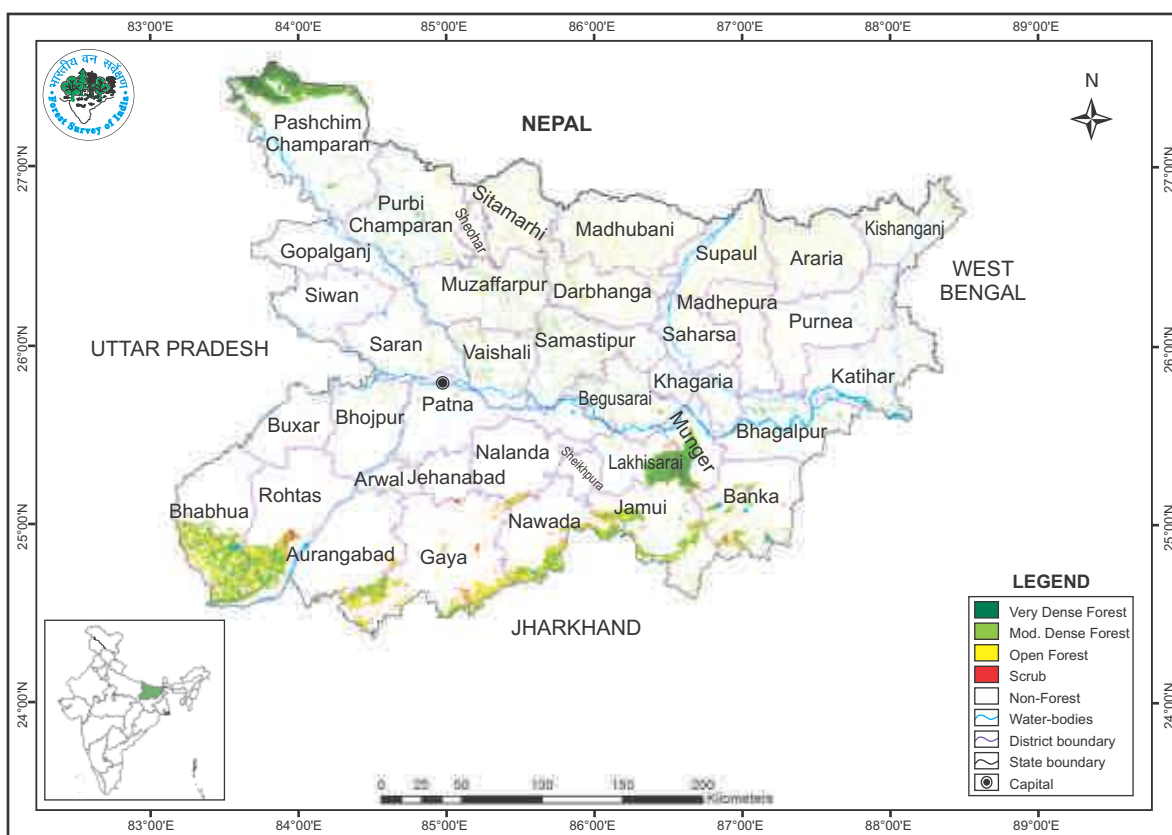


TABLE 11.4.8 Wetlands inside the Recorded Forest Area (or Green wash) in Bihar (in ha)

Wetland Category	No. of Wetlands	Total Wetland Area
Inland Wetlands - Natural		
Lake/Pond	6	62
Ox-bow lake/Cut-off meander	1	222
Riverine wetland	4	13
Waterlogged	26	139
River/Stream	35	2,137
Sub - Total	72	2,573
Inland Wetlands -Man-made		
Reservoir/Barrage	34	1,224
Tank/Pond	16	32
Sub - Total	50	1,256
Wetlands (<2.25 ha)	163	163
Total	285	3,992
Total Recorded Forest (or Green Wash) Area (in ha)		6,30,197
% of Wetland area inside Recorded Forest (or Green Wash) Area		0.63%

(analysis based on the National Wetland Atlas: India, 2011)

11.4.3 Forest Types & Biodiversity

Forest Type Maps of 2011 have been refined in the recently completed exercise by FSI. Percentage area under different forest types of Bihar as per the Champion & Seth classification (1968), according to the latest exercise are presented in the following table.

TABLE 11.4.9 Percentage area under different forest types of Bihar

Sl.No.	Forest Type	% of Forest cover
1.	2/E1 (Cane Brakes)	0.03
2.	3B/C1b Moist Teak Forest	0.06
3.	3C/C2b(l) Bhabar-Dun Sal Forest	3.66
4.	3C/C3a West Gangatic Moist Mixed Deciduous Forest	2.30
5.	4D/2S2 Eastern Wet Alluvial Grassland	0.22
6.	4D/SS2 <i>Barringtonia</i> Swamp Forest	0.03
7.	5/1S2 <i>Khair-Sissu</i> Forest	0.06
8.	5/DS1 Dry Deciduous Scrub	2.48
9.	5/E2 <i>Boswellia</i> Forest	4.52
10.	5/E9 Dry Bamboo Brake	0.97
11.	5B/C1a Dry Siwalik Sal Forest	5.14
12.	5B/C1c Dry Peninsular Sal Forest	21.13
13.	5B/C2 Northern Dry Mixed Deciduous Forest	30.70
14.	Plantation/TOF	28.70
	Total	100.00

11.4.3.1 Assessment of Biodiversity

Findings of the rapid assessment of Biodiversity carried out at the national level for natural forests during September 2018 to May 2019 as part of the forest type mapping exercise is summarized below in table 11.4.10 and table 11.4.11 in respect of Bihar.

TABLE 11.4.10 No. of species observed during the rapid assessment

Plant Type	Number of Species
Tree	113
Shrub	42
Herb	52

TABLE 11.4.11 Shannon-Wiener Index of Tree, Shrub and Herb species in different Type Groups of Bihar

Sl.No.	Forest Type Group	Shannon-Wiener Index		
		Tree	Shrub	Herb
1.	Group 2- Tropical Semi Evergreen Forests	*	2.22	2.85
2.	Group 3- Tropical Moist Deciduous Forests	3.10	2.65	2.02
3.	Group 4- Littoral and Swamp Forests	*	1.58	2.72
4.	Group 5- Tropical Dry Deciduous Forests	3.42	2.25	1.21

* adequate number of sample plots were not available

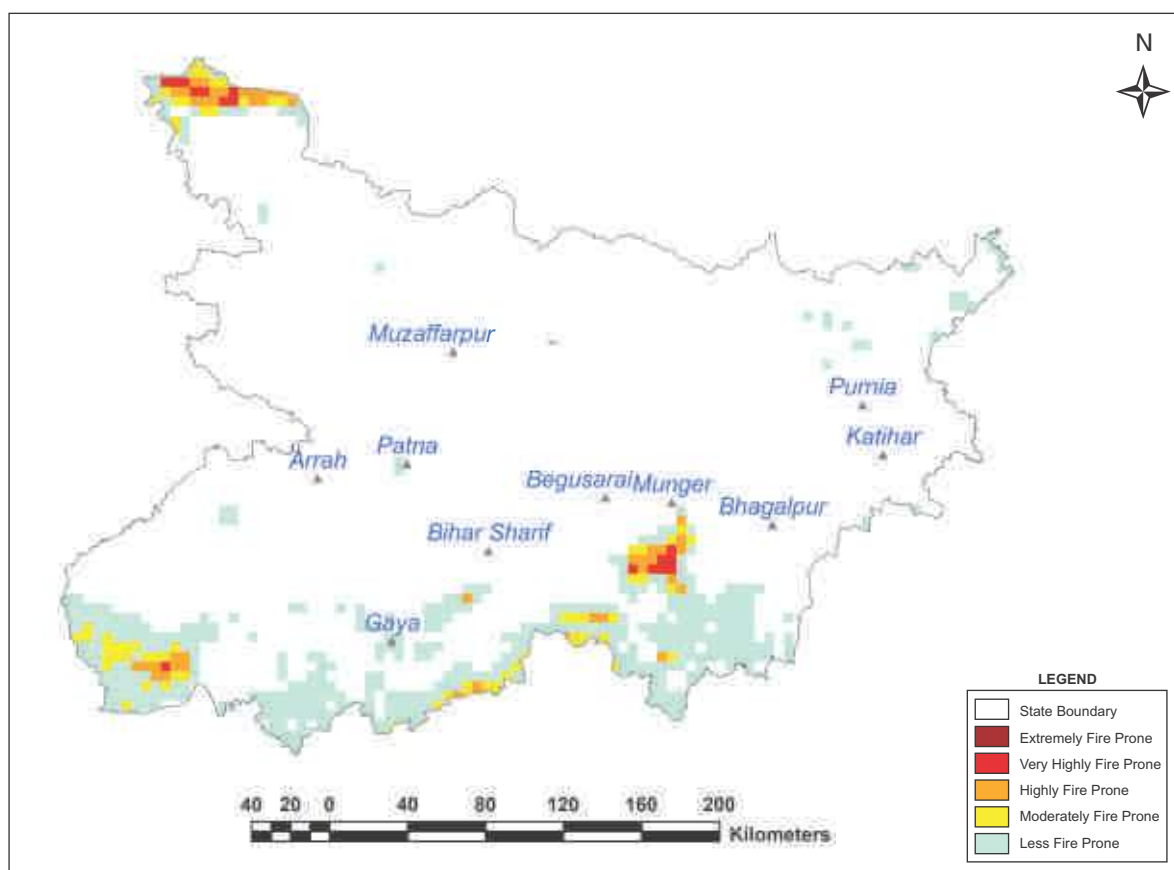
11.4.4 Fire Prone Forest Areas

Geographical area under different classes of forest fire proneness are given in the following table.

TABLE 11.4.12 Forest Fire Prone Classes (in sq km)

Sl. No.	Forest Fire Prone Classes	Geographical Area	% of Total forest cover
1.	Extremely fire prone	0.00	0.00
2.	Very highly fire prone	399.64	7.15
3.	Highly fire prone	1,059.74	17.68
4.	Moderately fire prone	1,557.06	22.74
5.	Less fire prone	10,729.41	52.43
	Total	13,745.85	100.00

FIGURE 11.4.4 Fire prone forest areas under different fire prone classes



11.4.5 Tree Cover

Forest cover presented in the section 11.4.2 accounts for tree patches of size 1 ha and more having canopy density more than 10%. However, trees occurring in patches of size less than 1 ha including scattered trees are assessed through sampling based methodology. Tree cover in Bihar has been estimated as given in table 11.4.13.

TABLE 11.4.13 Tree Cover in Bihar (in sq km)

Tree Cover	Area
	2,003

Tree cover of Bihar has decreased by 260 sq km as compared to the previous assessment reported in ISFR2017.

11.4.6 Extent of Trees Outside Forest (TOF)

Trees outside Forests (TOF) refer to tree resources found outside the forests as defined in the Government records. FSI maps forest cover using satellite data and assesses tree cover outside forests using sampling based method. Forest Cover outside the recorded forest area is derived using boundaries of RFA or Green Wash. Extent of TOF therefore may be estimated as the sum of extent of forest cover outside the recorded forest areas (RFA) and tree cover as given in the preceding section.

TABLE 11.4.14 Extent of TOF in Bihar (in sq km)

Forest Cover outside the RFA/GW	Tree Cover	Extent of TOF
2,537	2,003	4,540

11.4.7 Growing Stock in Forest

Growing stock in the recorded forest areas (RFA) in Bihar is given in the table 11.4.15. Diameter class-wise distribution of top 5 species in numbers derived from the forest inventory data is presented in the table 11.4.16

TABLE 11.4.15 Growing Stock in Bihar (in m cum)

Growing Stock (GS)		% of Country's GS
Growing Stock in Recorded Forest Area	26.73	0.63
Growing Stock in TOF	40.46	2.46

TABLE 11.4.16 Diameter class distribution of top five species inside RFA in Bihar (in '000)

Sl.No.	Species	Dia class (cm)		
		10-30	30-60	>60
1.	<i>Shorea robusta</i>	17,528	4,346	694
2.	<i>Madhuca latifolia</i>	6,308	420	67
3.	<i>Buchanania latifolia</i>	6,520	118	0
4.	<i>Lannea coromandelica</i>	8,903	201	0
5.	<i>Anogeissus latifolia</i>	5,462	302	0

11.4.7 Carbon Stock in Forest

The total Carbon stock of forests in the State including the TOF patches which are more than 1 ha in size is 55.24 million tonnes (202.55 million tonnes of CO₂ equivalent) which is 0.78% of total forest carbon of the country. Pool wise forest carbon in Bihar is given in the following table.

TABLE 11.4.17 Forest Carbon in Bihar in different pools (in '000 tonnes)

AGB	BGB	Dead wood	Litter	SOC	Total
15,007	5,428	127	746	33,931	55,239

11.4.9 Growing Stock of Bamboo

Bamboo bearing area and growing stock inside the recorded forest area (RFA)/ Green Wash in the State which include culms of 1 year age and above are given in the table 11.4.18

TABLE 11.4.18 Growing Stock of Bamboo

Growing Stock (GS)		% of Country's GS of Bamboo
Bamboo bearing area inside RFA/Green Wash (in sq km)	1,136	0.71
Total number of culms (in millions)	247	0.63
Total equivalent green weight (in 000' tonnes)	1,822	0.66

11.4.10 Dominant tree species in Trees Outside Forests (TOF)

Top five species in numbers in Trees Outside Forests in Bihar in Rural and Urban areas are given in the table 11.4.19 and table 11.4.20 respectively.

TABLE 11.4.19 Top five tree species in TOF (Rural) in Bihar

Sl. No.	Species	Relative Abundance (%)
1.	<i>Mangifera indica</i>	25.81
2.	<i>Dalbergia sissoo</i>	14.22
3.	<i>Borassus flabelliformis</i>	12.66
4.	<i>Litchi senensis</i>	3.50
5.	<i>Bombax ceiba</i>	3.42

TABLE 11.4.20 Top five tree species in TOF (Urban) in Bihar

Sl. No.	Species	Relative Abundance (%)
1.	<i>Litchi senensis</i>	17.63
2.	<i>Mangifera indica</i>	13.38
3.	<i>Bombax ceiba</i>	11.60
4.	<i>Dalbergia sissoo</i>	5.15
5.	<i>Psidium guyava</i>	3.77

11.4.11 Major Invasive Species

Major invasive species as assessed from forest inventory data are presented in the table 11.4.21

TABLE 11.4.21 Major invasive species in the State inside the RFA/Green wash in Bihar (in sq km)

Sl. No.	Species	Estimated Extent
1.	<i>Lantana camara</i>	490
2.	<i>Chromolaena odorata</i>	87
3.	<i>Argemone mexicana</i>	34
4.	<i>Cassia tora</i>	28
5.	<i>Senna occidentalis</i>	27

Major NTFP species are given in terms of relative abundance whereas invasive species are given in terms of their estimated extent.

11.4.12 Quantified estimation of Dependence of People living in forest fringe villages on forests in Bihar

Through a nation-wide study, FSI has done estimation of dependence of people living in the villages close to forest for fuel wood, fodder, small timber and bamboo in quantified terms for each State & UT of the country (Please refer to Chapter 10 in Vol. I for details). The estimated quantities of the four produce for Bihar is given in the table 11.4.22

TABLE 11.4.22 Estimation of Dependence of People in Forest Fringe Villages on Forests in Bihar

Fuel wood (tonnes)	Fodder (tonnes)	Bamboo (tonnes)	Small Timber (cum)
8,21,428	43,38,362	11,336	13,766