

11.23

RAJASTHAN

11.23.1 Introduction

Situated in the north-western part of the country, the largest state of the country, Rajasthan covers an area of 3,42,239 sq km, which is 10.40% of the geographical area of the country. The geographical extent of the State is bounded by 23°4'N to 30°11'N latitude and 69°29'E to 78°17' E longitude. The State has 4 distinct regions namely, Western Desert with Barren Hills, Level Rocky and Sandy Plains, the Aravalli Hills and South-Eastern Plateau. The climate of the State varies from semi-arid to arid. Western part of the State, including Thar Desert (also known as The Great Indian Desert), is relatively dry and infertile whereas in the south-western part, the land is wetter, hilly, and more fertile. The average annual temperature ranges between 0°C to 50°C and the average annual rainfall is in the range of 500 mm to about 750 mm. The State is drained by a number of rivers which include Banas, Chambal, Luni and Mahi. The State has 33 districts. As per the 2011 Census, Rajasthan has a population of 68.55 million accounting to 5.66 percent of India's population. The rural and urban population constitute 75.10% and 24.90% respectively. The population density is 200 per sq km which is much lower than the national average of 382 persons per sq km. The 19th Livestock census 2012 has reported a total livestock population of 57.73 million in the State.

TABLE 11.23.1 Land Use Pattern

Land Use Types	Area (in 000' ha)	Percentage
Geographical Area	34,224	
Reporting area for land utilization	34,267	100.00
Forests	2,740	8.00
Not available for land cultivation	4,343	12.67
Permanent pastures and other grazing lands	1,674	4.88
Land under misc. tree crops and groves	26	0.08
Culturable wasteland	4,038	11.78
Fallow land other than current fallows	2,069	6.04
Current fallows	1,856	5.42
Net area sown	17,521	51.13

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

11.23.1.1 A Brief Overview of Forestry Scenario

Rajasthan, the largest State of India according to geographical area, ranks 15th in terms of the RFA, is a forest deficient State. As per the Champion & Seth Classification of Forest Types (1968), the forests in Rajasthan belong to two Type groups i.e. Tropical Dry Deciduous and Tropical Thorn Forests which are further divided into 20 Forest Types.

The State has the examples of some of the best afforestation practices along the Indira Gandhi Canal. Under Joint Forest Management, there are 6,377 VFMCs/EDC operational in the State.

Recorded Forest Area (RFA) in the State is 32,737 sq km of which 12,475 sq km is Reserved Forest, 18,217 sq km is Protected Forest and 2,045 sq km is Unclassed Forests. In Rajasthan, during the period 1st January 2015 to 5th February 2019, a total of 2,834 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 42,633 ha of plantations were raised.

Five National Parks, 25 Wildlife Sanctuaries and 11 Conservation Reserves constitute the Protected Area network of the State covering 2.92% of its geographical area. There are 3 Project Tiger (Ranthambhore, Sariska and Mukundra Hills) and two Ramsar (Keoladeo Ghana sanctuary and Sambhar lake) sites.

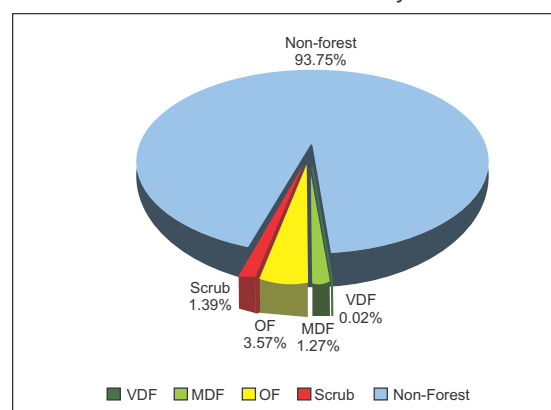
11.23.2 Forest Cover

Based on the interpretation of IRS Resourcesat-2 LISS III satellite data of the period Oct to Dec 2017, the Forest Cover in the State is 16,629.51 sq km which is 4.86 % of the State's geographical area. In terms of forest canopy density classes, the State has 77.81 sq km under Very Dense Forest (VDF), 4,341.90 sq km under Moderately Dense Forest (MDF) and 12,209.80 sq km under Open Forest (OF). Forest Cover in the State has increased by 57.51 sq km as compared to the previous assessment reported in ISFR 2017.

TABLE 11.23.2 Forest Cover of Rajasthan
(in sq km)

Class	Area	% of GA
VDF	77.81	0.02
MDF	4,341.90	1.27
OF	12,209.80	3.57
Total	16,629.51	4.86
Scrub	4,760.04	1.39

FIGURE 11.23.1 Forest Cover of Rajasthan



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

The State has reported extent of recorded forest area (RFA) 32,737 sq km which is 9.57% of its geographical area. The reserved, protected and unclassified forests are 38.11%, 55.64% and 6.25% of the recorded forest area in the State respectively. However, as the digitized boundary of recorded forest area from the State covers 33,072.12 sq km, the analysis of forest cover inside and outside this area is given below.

TABLE 11.23.3 Forest Cover inside and outside Recorded Forest Area or (Green Wash) in Rajasthan (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
72	3,931	8,279	12,282	6	411	3,931	4,348
0.59%	32.00%	67.41%		0.13%	9.45%	90.42%	

*in case of Rajasthan RFA boundaries have been used.

FIGURE 11.23.2 Forest Cover inside and outside RFA in Rajasthan

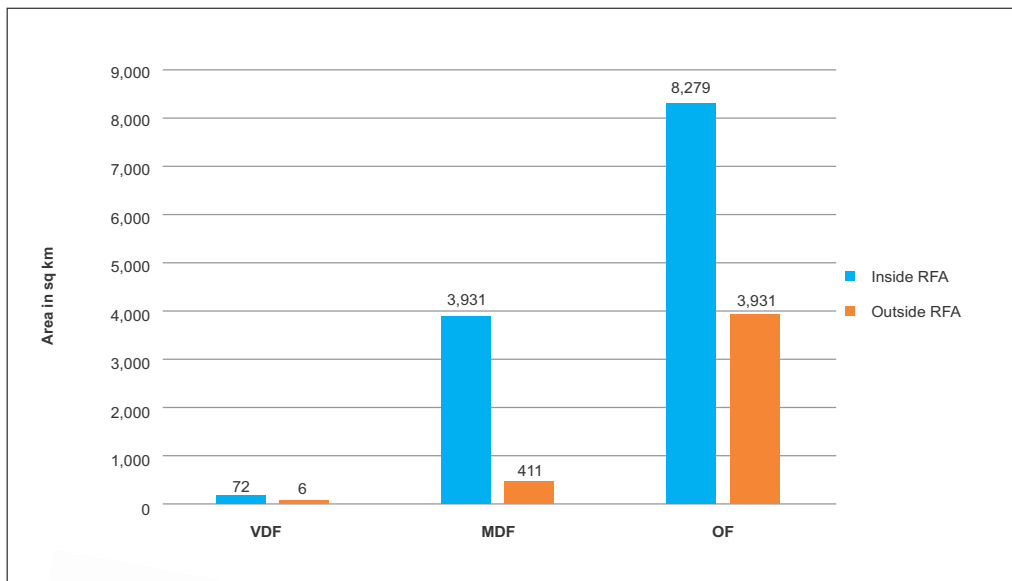


TABLE 11.23.4 District-wise Forest Cover in Rajasthan

(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			
Ajmer	8,481	0.00	43.00	262.11	305.11	3.60	6.11	204.64
Alwar	8,380	59.00	334.96	802.70	1,196.66	14.28	-0.34	245.66
Banswara ^T	4,522	0.00	38.57	229.85	268.42	5.94	7.42	63.45
Baran	6,992	0.00	154.89	856.10	1,010.99	14.46	-2.01	106.56
Barmer	28,387	0.00	3.85	285.94	289.79	1.02	16.79	234.23
Bharatpur	5,066	0.00	22.00	208.27	230.27	4.55	1.27	77.93
Bhilwara	10,455	0.00	31.00	193.19	224.19	2.14	3.19	176.39
Bikaner	30,239	0.88	27.23	227.50	255.61	0.85	8.61	51.85
Bundi	5,776	1.00	137.93	418.25	557.18	9.65	-0.82	151.62
Chittaurgarh	7,822	0.00	220.55	768.25	988.80	12.64	-0.20	100.09
Churu	13,835	0.00	3.00	79.00	82.00	0.59	0.00	22.00
Dausa	3,432	0.00	12.00	105.00	117.00	3.41	0.00	99.00
Dhaulpur	3,033	0.00	80.00	339.00	419.00	13.81	0.00	75.40
Dungarpur ^T	3,770	0.00	42.71	259.59	302.30	8.02	11.30	75.35
Ganganagar	10,978	0.00	10.00	102.92	112.92	1.03	-0.08	13.00
Hanumangarh	9,656	1.00	7.00	81.96	89.96	0.93	-0.04	1.00
Jaipur	11,143	12.00	97.11	443.65	552.76	4.96	0.76	285.39
Jaisalmer	38,401	3.93	51.13	270.71	325.77	0.85	12.77	213.27
Jalor	10,640	0.00	18.91	249.16	268.07	2.52	-6.93	250.89
Jhalawar	6,219	0.00	83.02	352.56	435.58	7.00	-3.42	102.34
Jhunjhun	5,928	0.00	21.00	179.77	200.77	3.39	4.77	186.72
Jodhpur	22,850	0.00	4.55	103.23	107.78	0.47	2.78	172.71
Karauli	5,524	0.00	95.00	775.00	870.00	15.75	0.00	273.00
Kota	5,217	0.00	153.62	393.11	546.73	10.48	-3.27	135.17
Nagaur	17,718	0.00	15.00	132.04	147.04	0.83	4.04	102.32
Pali	12,387	0.00	209.94	464.91	674.85	5.45	0.85	323.64
Pratapgarh ^T	4,449	0.00	562.54	475.37	1,037.91	23.33	-6.09	58.73
Rajsamand	4,655	0.00	134.91	386.88	521.79	11.21	10.79	124.23
Sawai Madhopur	4,498	0.00	153.92	308.77	462.69	10.29	-3.31	119.67
Sikar	7,732	0.00	31.00	162.06	193.06	2.50	1.06	202.34
Sirohi ^T	5,136	0.00	300.74	611.17	911.91	17.76	-2.09	229.36
Tonk	7,194	0.00	26.94	138.12	165.06	2.29	0.06	57.73
Udaipur ^T	11,724	0.00	1,213.88	1,543.66	2,757.54	23.51	-6.46	224.36
Grand Total	3,42,239	77.81	4,341.90	12,209.80	16,629.51	4.86	57.51	4,760.04

TABLE 11.23.5 Forest Cover Change Matrix for Rajasthan

(in sq km)

Class	2019 Assessment					Total ISFR 2017
	VDF	MDF	OF	Scrub	NF	
Very Dense Forest	78	0	0	0	0	78
Moderately Dense Forest	0	4,309	13	2	16	4,340
Open Forest	0	28	11,708	88	330	12,154
Scrub	0	0	107	4,143	329	4,579
Non Forest	0	5	382	527	3,20,174	3,21,088
Total ISFR 2019	78	4,342	12,210	4,760	3,20,849	3,42,239
Net Change	0	2	56	181	-239	

Main reasons for the increase in forest cover in the State are plantation and conservation activities as well as improvement in interpretation.

TABLE 11.23.6 Altitude-wise Forest Cover in Rajasthan

(in sq km)

Altitude Zone (m)	Geographical Area	VDF	MDF	OF	Total	Scrub
0-500	3,24,954	27	2,538	9,383	11,948 (71.84%)	4016
500-1000	17,070	51	1,690	2,777	4,518 (27.17%)	740
1000-2000	215	0	114	50	164 (0.99%)	4
Total	3,42,239	78	4,342	12,210	16,630	4,760

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

TABLE 11.23.7 Forest Cover in different slope classes in Rajasthan

(in sq km)

Slope (in degrees)	Geographical Area	VDF	MDF	OF	Total	Scrub
0-5	3,15,978	21	1,563	7,253	8,837 (53.13%)	3,410
5-10	15,796	15	846	1,912	2,773 (16.68%)	586
10-15	4,729	12	669	1,163	1,844 (11.09%)	295
15-20	2,656	11	537	814	1,362 (8.19%)	200
20-25	1,650	9	379	560	948 (5.70%)	140
25-30	901	6	215	321	542 (3.26%)	82
>30	529	4	133	187	324 (1.95%)	47
Total	3,42,239	78	4,342	12,210	16,630	4,760

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



FIGURE 11.23.3 Forest Cover Map of Rajasthan

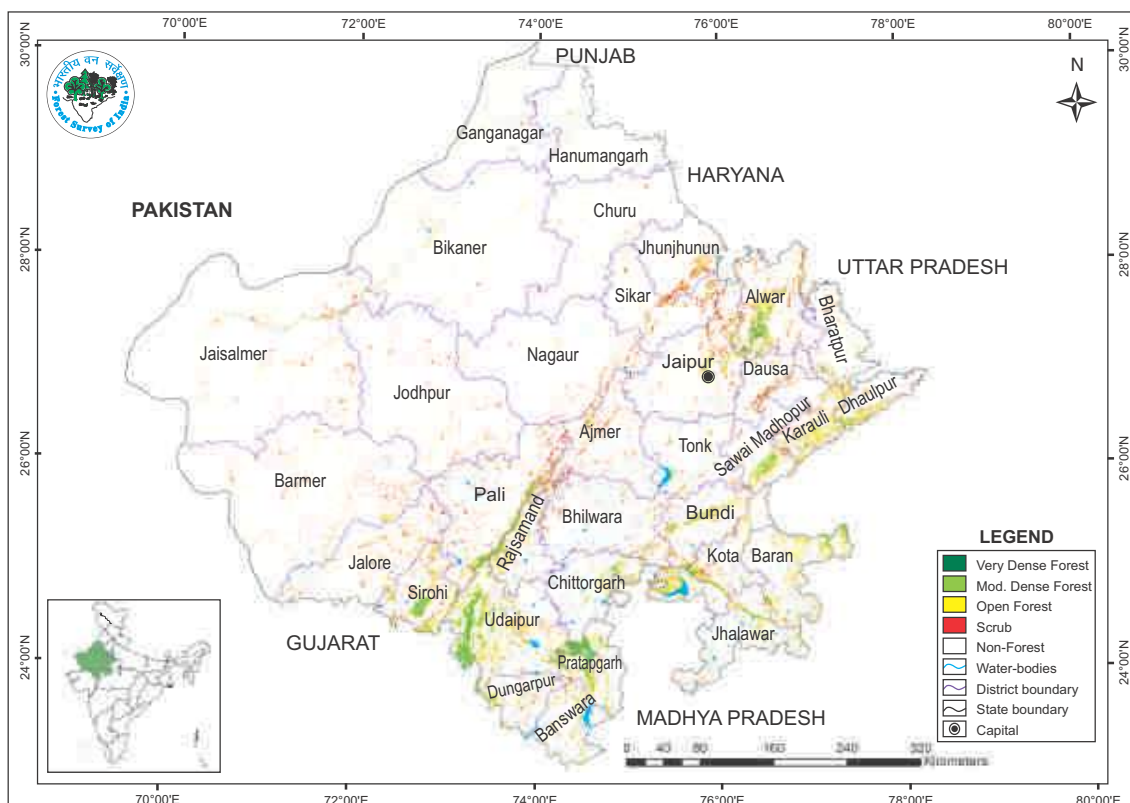


TABLE 11.23.8 Wetlands inside the Recorded Forest Area (or Green Wash) in Rajasthan (in ha)

Wetland Category	No. of Wetlands	Total Wetland Area
Inland Wetlands - Natural		
Lake/Pond	20	1,177
Waterlogged	5	1,195
River/Stream	259	19,147
Sub - Total	284	21,519
Inland Wetlands - Man-made		
Reservoir/Barrage	219	16,401
Tank/Pond	1038	7,697
Waterlogged	16	3,037
Salt Pan	2	929
Sub - Total	1,275	28,064
Coastal Wetlands - Natural		
Intertidal mud flat	1	4,386
Salt Marsh	3	109
Sub - Total	4	4,495
Wetlands (<2.25 ha)	2,263	2,263
Total	3,826	56,341
Total Recorded Forest (or Green Wash) Area (in ha)		33,07,212
% of Wetland area inside Recorded Forest (or Green Wash) Area		1.70%

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

11.23.3 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 Rajasthan as per the Champion & Seth classification (1968), according to the latest exercise are presented in the following table.

TABLE 11.23.9 Percentage area under different forest types of Rajasthan

Sl.No.	Forest Type	% of Forest cover
1.	5A/C1a Very Dry Teak Forest	5.63
2.	5A/C1b Dry Teak Forest	0.21
3.	5B/C2 Northern Dry Mixed Deciduous Forest	40.07
4.	5/E1/DS1 Dry Deciduous Scrub	10.96
5.	5/DS2 Dry savannah Forest	0.02
6.	5/E1 <i>Anogeissus pendula</i> Forest	15.21
7.	5/E1/DS1 <i>Anogeissus pendula</i> Scrub	2.94
8.	5/E2 <i>Boswellia</i> Forest	0.79
9.	5/E5 <i>Butea</i> Forest	0.30
10.	5/E6 <i>Aegle</i> Forest	0.01
11.	5/E8a <i>Phoenix</i> Savannah Forest	0.01
12.	5/1S1 Dry Tropical Riverain Forest	0.26
13.	5/1S2 <i>Khair-Sissu</i> Forest	1.52
14.	6B/C1 Desert Thorn Forest	6.17
15.	6B/C2 Ravine Thorn Forest	1.93
16.	6B/DS1 <i>Zizyphus</i> Scrub	0.94
17.	6B/DS2 Tropical <i>Euphorbia</i> Scrub	0.19
18.	6/E1 (<i>Euphorbia</i> scrub)	0.85
19.	6/E2 <i>Acacia senegal</i> Forest	0.23
20.	6/1S1 Desert Dune Scrub	6.62
21.	Plantation/TOF	5.14
	Total	100.00

11.23.3.1 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 11.23.10 and table 11.23.11 in respect of Rajasthan.

TABLE 11.23.10 No. of species observed during the rapid assessment

Plant Type	Number of Species
Tree	65
Shrub	30
Herb	8



TABLE 11.23.11 Shannon-Wiener Index of Tree, Shrub and Herb species in different Type Groups of Rajasthan

Sl.No.	Forest Type Group	Shannon-Wiener Index		
		Tree	Shrub	Herb
1	Group 5- Tropical Dry Deciduous Forests	2.59	2.63	2.01
2	Group 6- Tropical Thorn Forests	1.86	1.69	*

*adequate number of sample plots were not available

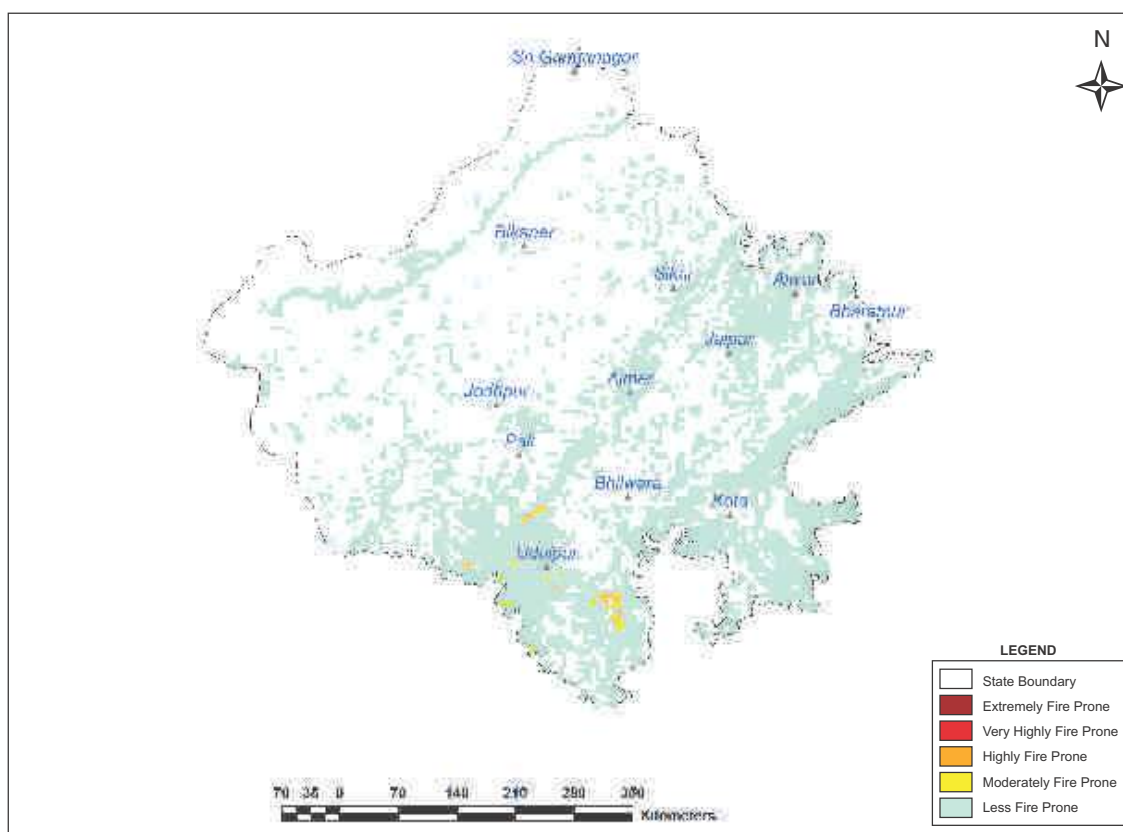
11.23.4 Fire Prone Forest Areas

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

TABLE 11.23.12 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	50.01	0.32
3.	Highly fire prone	450.08	2.48
4.	Moderately fire prone	803.51	3.62
5.	Less fire prone	1,20,580.88	93.58
	Total	1,21,884.48	100.00

FIGURE 11.23.4 Fire prone forest areas under different fire prone classes



11.23.5 Tree Cover

Forest cover presented in the section 11.23.2 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 Rajasthan has been estimated as given in table 11.23.12.

TABLE 11.23.13 Tree Cover in Rajasthan (in sq km)

Tree Cover	Area
	8,112

Tree cover of Rajasthan has decreased by 154 sq km as compared to the previous assessment reported in ISFR 2017.

11.23.6 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 11.23.14 Extent of TOF in Rajasthan (in sq km)

Forest Cover outside the RFA/GW	Tree Cover	Extent of TOF
4,348	8,112	12,460

11.23.7 Growing Stock in Forest

Growing stock in the recorded forest areas (RFA) in Rajasthan is given in the table 11.23.15. Diameter class-wise distribution of top 5 species in numbers derived from the forest inventory data is presented in the table 11.23.16

TABLE 11.23.15 Growing Stock in Rajasthan (in m cum)

Growing Stock (GS)		% of Country's GS
Growing Stock in Recorded Forest Area	24.39	0.57
Growing Stock in TOF	89.07	5.42

TABLE 11.23.16 Diameter class distribution of top five species inside RFA in Rajasthan (in '000)

Sl.No.	Species	Dia class (cm)		
		10-30	30-60	>60
1.	<i>Butea monosperma</i>	19,371	1,795	120
2.	<i>Acacia catechu</i>	10,355	268	0
3.	<i>Boswellia serrata</i>	7,289	2,773	0
4.	<i>Anogeissus pendula</i>	55,799	780	60
5.	<i>Tectona grandis</i>	8,075	0	0

11.23.8 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 108.36 million tonnes (397.32 million tonnes of CO₂ equivalent) which is 1.52% of total forest carbon of the country. Pool wise forest carbon in Rajasthan is given in the following table

TABLE 11.23.17 Forest Carbon in Rajasthan in different pools (in '000 tonnes)

AGB	BGB	Dead wood	Litter	SOC	Total
26,155	10,865	191	928	70,224	1,08,363

11.23.9 Growing Stock of Bamboo

Bamboo bearing area and growing stock inside the recorded forest area (RFA)/ Green Wash which include culms of 1 year age and above are given in the table 11.23.18

TABLE 11.23.18 Growing Stock of Bamboo in Rajasthan

Growing Stock (GS)		% of Country's GS of Bamboo
Bamboo bearing area inside RFA/Green Wash (in sq km)	1,874	1.17
Total number of culms (in millions)	527	1.34
Total equivalent green weight (in 000' tonnes)	2,520	0.91

11.23.10 Dominant tree species in Trees Outside Forests (TOF)

Top five species in numbers in Trees Outside Forests in Rajasthan in Rural and Urban areas are given in the table 11.23.19 and table 11.23.20 respectively

TABLE 11.23.19 Top five tree species in TOF (Rural) in Rajasthan

Sl. No.	Species	Relative Abundance (%)
1.	<i>Prosopis cineraria</i>	20.25
2.	<i>Acacia arabica</i>	8.87
3.	<i>Azadirachta indica</i>	8.12
4.	<i>Prosopis juliflora</i>	7.57
5.	<i>Zizyphus jujuba</i>	6.78

TABLE 11.23.20 Top five tree species in TOF (Urban) in Rajasthan

Sl. No.	Species	Relative Abundance (%)
1.	<i>Azadirachta indica</i>	24.28
2.	<i>Prosopis juliflora</i>	15.83
3.	<i>Acacia arabica</i>	5.11
4.	<i>Acacia lenticularis</i>	4.23
5.	<i>Dalbergia sissoo</i>	3.66

11.23.11 Major NTFP and Invasive Species

Major NTFP and invasive species as assessed from forest inventory data are presented in the table 11.23.21 and table 11.23.22 respectively.

TABLE 11.23.21 Major NTFP species in the state of Rajasthan

Sl. No.	Species	Plant Type	Relative Abundance (%)
1.	<i>Butea monosperma</i>	Tree	51.03
2.	<i>Boswellia serrata</i>	Tree	22.74
3.	<i>Diospyros melanoxylon</i>	Tree	12.27
4.	<i>Aegle marmelos</i>	Tree	6.33
5.	<i>Wrigahtia arborea</i>	Tree	3.75

TABLE 11.23.22 Major invasive species in the state inside the RFA/Green Wash in Rajasthan (in sq km)

Sl. No.	Species	Estimated Extent
1.	<i>Cassia tora</i>	373
2.	<i>Lantana camara</i>	210
3.	<i>Senna occidentalis</i>	194
4.	<i>Prosopis juliflora</i>	162
5.	<i>Triumfetta rhomboidea</i>	55

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

11.23.12 Quantified estimation of Dependence of People living in forest fringe villages on forests in Rajasthan

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 Rajasthan is given in the table 11.23.23

TABLE 11.23.23 Estimation of Dependence of People in Forest Fringe Villages on Forests in Rajasthan

Fuelwood (tonnes)	Fodder (tonnes)	Bamboo (tonnes)	Small Timber (cum)
85,59,582	11,27,07,814	3,698	82,433

