

11.8

GUJARAT

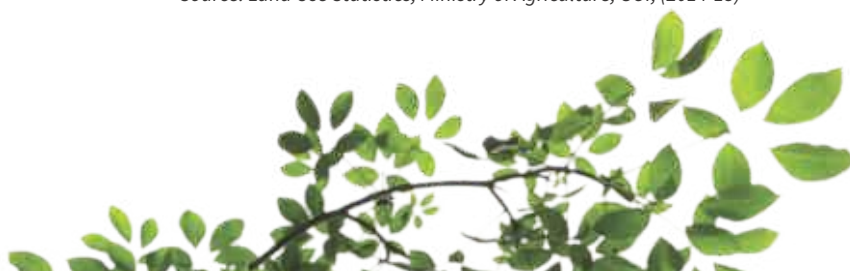
11.8.1 Introduction

Gujarat is the western most State of the country having the longest coastline among the Indian States. The geographical area of the State is 1,96,244 sq km, which is 5.97% of the geographical area of the country. The State lies between 20°07'N to 24°43'N latitude and 68°10'E to 74°29'E longitude and has international border with Pakistan in the North. It shares border with Rajasthan in the north and the northeast, Madhya Pradesh in the east and Maharashtra and Dadra & Nagar Haveli in the south. Physiographically the State can be divided into three distinct regions viz the peninsula, traditionally known as Saurashtra which is a hilly tract with low hills, Kachchh on the north-west which is barren and contains the famous Rann of Kachchh and the mainland, extending from the Rann of Kuchchh and the Aravalli hills to the river Damanganga and consists of plains with alluvial soil. Climate of the State is moderate with mean temperature ranging from 25°C to 28°C and the average annual rainfall from 800 mm to 1,000 mm. The State has 26 districts out of which 8 districts are tribal. As per the 2011 census Gujarat has a population of 60.44 million accounting to 4.99% of India's population. The rural and urban population constitutes 42.60% and 57.40% respectively. Tribal population is 14.75% of the State's population. The population density of the State is 308 per sq km which is lower than the national average. The 19th Livestock census 2012 has reported a total livestock population of 27.12 million in the State.

TABLE 11.8.1 Land Use Pattern

Land Use Types	Area (in 000' ha)	Percentage
Geographical Area	19,602	
Reporting area for land utilization	19,069	100.00
Forests	1,834	9.62
Not available for land cultivation	3,723	19.52
Permanent pastures and other grazing lands	851	4.46
Land under misc. tree crops and groves	4	0.02
Culturable wasteland	1,960	10.28
Fallow land other than current fallows	16	0.08
Current fallows	379	1.99
Net area sown	10,302	54.03

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



11.8.1.1 A Brief Overview of Forestry Scenario

The unique features of the State of Gujarat are the climatic and geomorphologic conditions such as the largest coastline in the country, the saline deserts of Rann, grasslands, wetlands etc. These factors have bestowed the State with rich floral and faunal diversity. The Asiatic lion and Wild Ass have their last reserve in the forests of Gir and the Little Rann of Kachchh respectively in Gujarat. As per Champion & Seth Classification of Forest Types (1968), the forests in Gujarat belongs to four Type Groups which are further divided into 25 Forest Types.

Recorded Forest Area (RFA) in the state is 21,647 sq km of which 14,373 sq km is Reserved Forest, 2,886 sq km of Protected Forest and 4,388 sq km of Unclassed Forests. In Gujarat, during the period 1st January 2015 to 5th February 2019, a total of 2,009.30 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 75,672 ha of plantations were raised in the State.

Four National Parks, 23 Wildlife Sanctuaries and one Conservation Reserve constitute the Protected Area network of the State covering 8.83% of its geographical area.

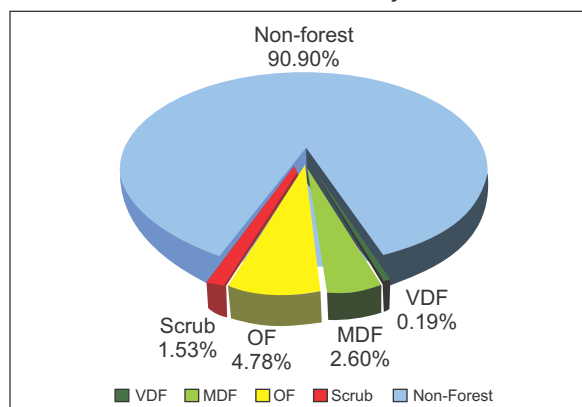
11.8.2 Forest Cover

Based on the interpretation of IRS Resourcesat-2 LISS III satellite data of the period Oct 2017 to Dec 2017, the Forest Cover in the State is 14,857.33 sq km which is 7.57% of the State's geographical area. In terms of forest canopy density classes, the State has 377.90 sq km under Very Dense Forest (VDF), 5,092 sq km under Moderately Dense Forest (MDF) and 9,387.43 sq km under Open Forest (OF). Forest Cover in the State has increased by 100.33 sq km as compared to the previous assessment reported in ISFR 2017.

TABLE 11.8.2 Forest Cover of Gujarat
(in sq km)

Class	Area	% of GA
VDF	377.90	0.19
MDF	5,092.00	2.60
OF	9,387.43	4.78
Total	14,857.33	7.57
Scrub	2,994.11	1.53

FIGURE 11.8.1 Forest Cover of Gujarat



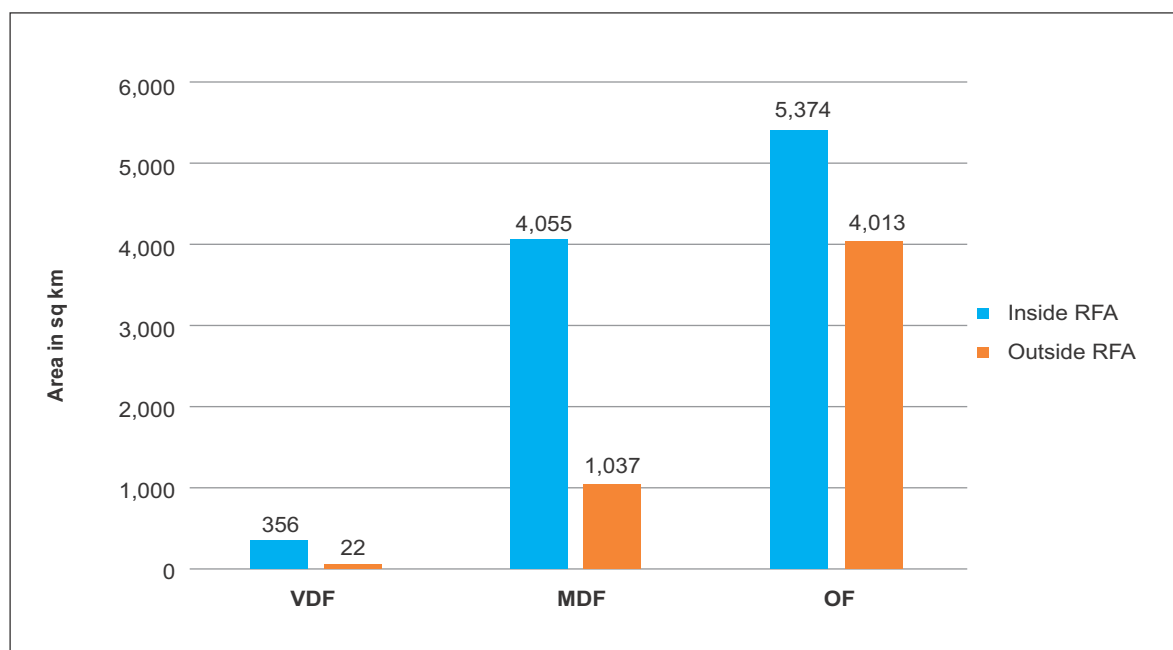
11.8.2.1 Forest Cover inside and outside Recorded Forest Area (or Green Wash)

The State has reported extent of recorded forest area (RFA) 21,647 sq km which is 11.03% of its geographical area. The reserved, protected and unclassified forests are 66.39%, 13.33% and 20.28% of the recorded forest area in the State respectively. However, as the digitized boundary of recorded forest area from the State covers 30,354.44 sq km, the analysis of forest cover inside and outside this area is given below.

TABLE 11.8.3 Forest Cover inside and outside Recorded Forest Area or (Green Wash) in Gujarat (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
356	4,055	5,374	9,785	22	1,037	4,013	5,072
3.64%	41.44%	54.92%		0.43%	20.44%	79.13%	

*in case of Gujarat RFA boundaries have been used.

FIGURE 11.8.2 Forest Cover inside and outside RFA in Gujarat**TABLE 11.8.4** District-wise Forest Cover in Gujarat

(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			
Ahmedabad	8,107	0.00	12.75	118.46	131.21	1.62	2.21	40.53
Amreli	7,397	0.00	63.01	197.39	260.40	3.52	9.40	90.69
Anand	3,204	0.00	9.32	41.16	50.48	1.58	-12.52	16.51
Banas Kantha ^T	10,743	0.00	367.74	454.76	822.50	7.66	-25.50	153.64
Bharuch ^T	6,509	0.00	58.12	219.40	277.52	4.26	-36.48	14.48
Bhavnagar	10,034	0.00	47.85	245.36	293.21	2.92	16.21	84.70
Dohod	3,642	1.00	115.64	413.18	529.82	14.55	-8.18	30.17
Gandhinagar	2,140	0.00	10.14	81.91	92.05	4.30	0.05	51.77
Jamnagar	14,184	0.00	53.75	417.36	471.11	3.32	36.11	157.86
Junagadh	8,831	15.00	938.08	740.23	1,693.31	19.17	59.31	95.43
Kachchh	45,674	0.00	284.89	2,060.40	2,345.29	5.13	33.29	1,520.19
Kheda	3,953	0.00	17.64	76.80	94.44	2.39	0.44	36.01
Mahesana	4,401	0.00	9.91	148.71	158.62	3.60	-0.38	45.59
Narmada	2,817	20.00	460.24	467.76	948.00	33.65	-15.00	25.50
Navsari	2,246	18.00	122.61	221.82	362.43	16.14	60.43	10.14
Panch Mahals ^T	5,231	0.00	203.13	506.93	710.06	13.57	-26.94	48.75
Patan	5,792	0.00	1.00	101.51	102.51	1.77	0.51	115.60
Porbandar	2,316	0.00	16.15	110.53	126.68	5.47	2.68	40.17
Rajkot	11,198	0.00	2.64	151.68	154.32	1.38	13.32	95.12
Sabarkantha ^T	7,394	29.00	302.30	483.97	815.27	11.03	8.27	111.77
Surat ^T	4,549	5.00	288.85	206.21	500.06	10.99	-14.94	81.94

Contd.

District	Geographical Area (GA)	2019 Assessment				% of GA	Change wrt 2017 assessment	Scrub
		Very Dense Forest	Mod. Dense Forest	Open Forest	Total			
Surendranagar	10,423	0.00	6.00	167.99	173.99	1.67	-1.01	48.30
Tapi ^T	3,139	79.90	475.66	236.85	792.41	25.24	-17.59	7.00
The Dangs ^T	1,766	210.00	740.36	412.26	1,362.62	77.16	-5.38	3.00
Vadodara ^T	7,546	0.00	140.83	462.38	603.21	7.99	-25.79	42.53
Valsad ^T	3,008	0.00	343.39	642.42	985.81	32.77	47.81	26.72
Grand Total	1,96,244	377.90	5,092.00	9,387.43	14,857.33	7.57	100.33	2,994.11

TABLE 11.8.5 Forest Cover Change Matrix for Gujarat

(in sq km)

Class	2019 Assessment					Total ISFR 2017
	VDF	MDF	OF	Scrub	NF	
Very Dense Forest	378	0	0	0	0	378
Moderately Dense Forest	0	5,078	40	4	78	5,200
Open Forest	0	9	8,287	206	677	9,179
Scrub	0	0	222	1,759	213	2,194
Non Forest	0	5	838	1,025	1,77,425	1,79,293
Total ISFR 2019	378	5,092	9,387	2,994	1,78,393	1,96,244
Net Change	0	-108	208	800	-900	

Main reasons for the increase in forest cover in the State are plantation and conservation activities.

TABLE 11.8.6 Altitude-wise Forest Cover in Gujarat

(in sq km)

Altitude Zone (m)	Geographical Area	VDF	MDF	OF	Total	Scrub
0-500	1,95,407	329	4,748	9,172	14,249 (95.91%)	2,990
500-1000	830	49	343	214	606 (4.08%)	3
1000-2000	7	0	1	1	2 (0.01%)	1
Total	1,96,244	378	5,092	9,387	14,857	2,994

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

TABLE 11.8.7 Forest Cover in different slope classes in Gujarat

(in sq km)

Slope (in degrees)	Geographical Area	VDF	MDF	OF	Total	Scrub
0-5	1,85,312	121	2,306	6,359	8,786 (59.14%)	2,566
5-10	6,265	73	1,067	1,384	2,524 (16.99%)	267
10-15	2,322	67	740	791	1,598 (10.76%)	92
15-20	1,257	56	491	461	1,008 (6.78%)	42
20-25	659	37	285	243	565 (3.80%)	18
25-30	291	17	135	105	257 (1.73%)	6
>30	138	7	68	44	119 (0.80%)	3
Total	1,96,244	378	5,092	9,387	14,857	2,994

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

FIGURE 11.8.3 Forest Cover Map of Gujarat

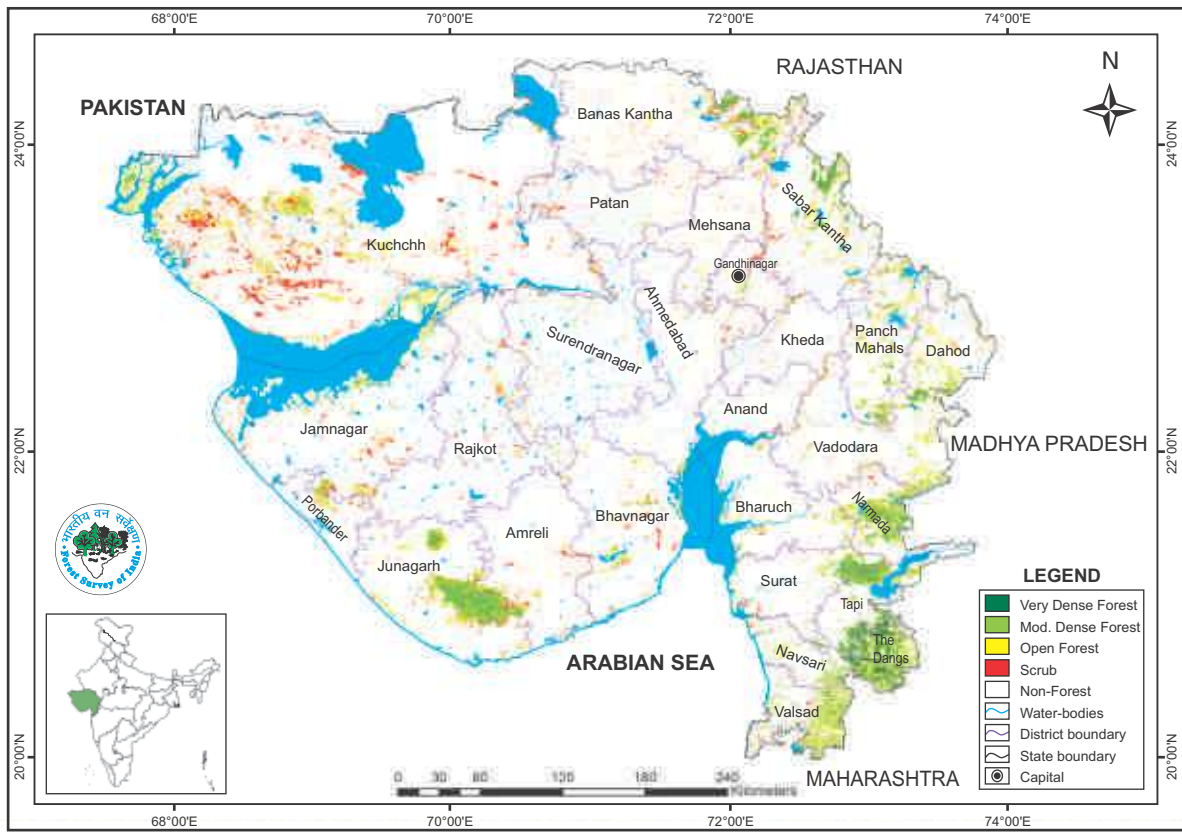


TABLE 11.8.8 Wetlands inside the Recorded Forest Area (or Green Wash) in Gujarat (in ha)

Wetland Category	No. of Wetlands	Total Wetland Area
Inland Wetlands - Natural		
Lake/Pond	18	12,613
Waterlogged	66	3,476
River/Stream	476	21,869
Sub - Total	560	37,958
Inland Wetlands -Man-made		
Reservoir/Barrage	342	32,928
Tank/Pond	1,329	8,456
Waterlogged	3	2,801
Salt Pan	3	269
Sub - Total	1,677	44,454
Coastal Wetlands – Natural		
Lagoon	14	7,010
Creek	53	14,991
Sand/Beach	36	2,054
Intertidal mud flat	249	104,9483
Salt Marsh	106	21,166
Mangrove	150	19,634
Coral Reef	73	13,314
Sub -Total	681	11,27,652
Wetlands (<2.25 ha)	611	611
Total	3,529	12,10,675
Total Recorded Forest (or Green Wash) Area (in ha)		30,35,444
% of Wetland area inside Recorded Forest (or Green Wash) Area		39.88%

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

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

TABLE 11.8.9 Percentage area under different forest types of Gujarat

Sl.No.	Forest Type	% of Forest cover
1.	3B/C1b Moist Teak Forest	4.50
2.	3B/C1c Slightly Moist Teak Forest	3.83
3.	3B/C2 Southern Moist Mixed Deciduous Forest	6.79
4.	4B/TS1 Mangrove Scrub	3.86
5.	4B/TS2 Mangrove Forest	3.37
6.	5A/C1a Very Dry Teak Forest	4.60
7.	5A/C1b Dry Teak Forest	11.77
8.	5A/C3 Southern Dry Mixed Deciduous Forest	12.75
9.	5B/DS1 Dry Deciduous Scrub	5.00
10.	5B/DS4 (Dry Grassland)	1.93

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Sl.No.	Forest Type	% of Forest cover
11.	5/E1 Anogeissus Pendula Forest	0.35
12.	5/E2 Boswellia Forest	0.01
13.	5/E3 Babul Forest	0.81
14.	5/E5 Butea Forest	0.52
15.	5/E8c Salvadora - Tamarix Scrub	0.99
16.	5/E9 Dry Bamboo Brake	0.66
17.	5/1S1 Dry Tropical Riverain Forest	0.01
18.	5/2S1 Secondary Dry Deciduous Forest	0.28
19.	5B/C2 Northern Dry Mixed Deciduous Forest	5.28
20.	6A/C1 Southern Thorn Forest	0.38
21.	6B/C1 Desert Thorn Forest	9.22
22.	6/DS2 Tropical Euphorbia Scrub	4.82
23.	6/E2 Acacia Senegal Forest	5.20
24.	6/E3 Rann Saline Thorn Forest	4.76
25.	6/E4 Salvadora Scrub	0.10
26.	Plantation/TOF	8.21
	Total	100.00

11.8.3.1 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 11.8.10 and table 11.8.11 in respect of Gujarat.

TABLE 11.8.10 No. of species observed during the rapid assessment

Plant Type	Number of Species
Tree	102
Shrub	37
Herb	73

TABLE 11.8.11 Shannon-Wiener Index of Tree, Shrub and Herb species in different Type Groups of Gujarat.

Sl.No.	Forest Type Group	Shannon-Wiener Index		
		Tree	Shrub	Herb
1	Group 3- Tropical Moist Deciduous Forests	2.80	2.40	2.02
2	Group 4- Littoral and Swamp Forests	*	0.86	1.80
3	Group 5- Tropical Dry Deciduous Forests	3.09	2.14	3.30
4	Group 6- Tropical Thorn Forests	1.93	1.44	2.58

*adequate number of sample plots were not available



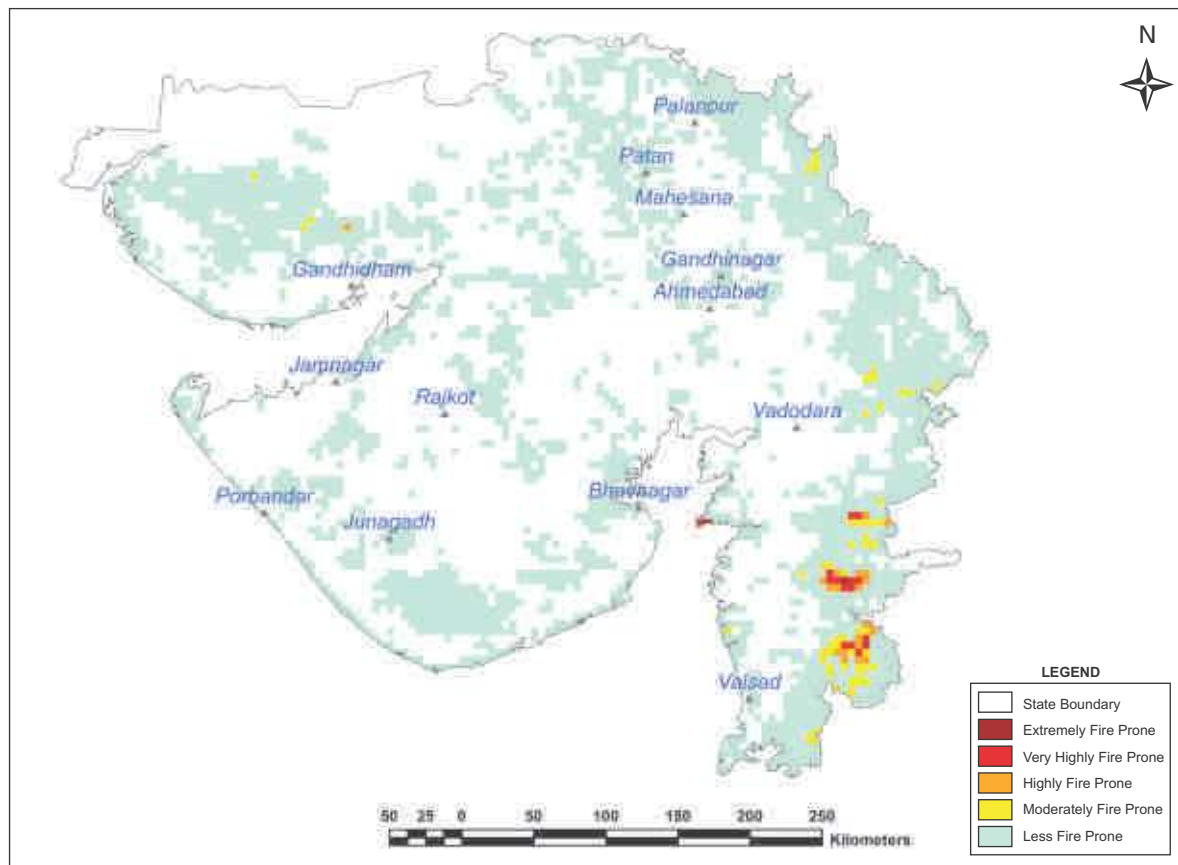
11.8.4 Fire Prone Forest Areas

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

TABLE 11.8.12 Forest Fire Prone Classes (in sq km)

Sl. No.	Forest Fire Prone Classes	Geographical Area	% of Total forest cover
1.	Extremely fire prone	68.41	0.25
2.	Very highly fire prone	390.01	2.69
3.	Highly fire prone	521.59	3.45
4.	Moderately fire prone	1,443.32	8.43
5.	Less fire prone	68,028.78	85.18
	Total	70,452.11	100.00

FIGURE 11.8.4 Fire prone forest areas under different fire prone classes



11.8.5 Tree Cover

Forest cover presented in the section 11.8.2 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 Gujarat has been estimated as given in table 11.8.13.

TABLE 11.8.13 Tree Cover in Gujarat (in sq km)

Tree Cover	Area
	6,912

Tree cover of Gujarat has decreased by 1,112 sq km as compared to the previous assessment reported in ISFR 2017.

11.8.6 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 methodology. 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 11.8.14 Extent of TOF in Gujarat (in sq km)

Forest Cover outside the RFA/GW	Tree Cover	Extent of TOF
5,072	6,912	11,984

11.8.7 Growing Stock in Forest

Growing stock in the recorded forest areas (RFA) in Gujarat is given in the table 11.8.15. Diameter class-wise distribution of top 5 species in numbers derived from the forest inventory data is presented in the table 11.8.16

TABLE 11.8.15 Growing Stock in Gujarat (in m cum)

Growing Stock (GS)		% of Country's GS
Growing Stock in Recorded Forest Area	48.31	1.13
Growing Stock in TOF	82.60	5.03

TABLE 11.8.16 Diameter class distribution of top five species inside RFA in Gujarat (in '000)

Sl.No.	Species	Dia class (cm)		
		10-30	30-60	>60
1.	<i>Tectona grandis</i>	55,834	3,429	345
2.	<i>Terminalia tomentosa</i>	12,671	1,599	0
3.	<i>Butea frondosa</i>	17,629	694	0
4.	<i>Prosopis juliflora</i>	14,925	0	0
5.	<i>Wrightia tinctoria</i>	25,809	1000	0

11.8.8 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 107.25 million tonnes (393.25 million tonnes of CO₂ equivalent) which is 1.51% of total forest carbon of the country. Pool wise forest carbon in Gujarat is given in the following table

TABLE 11.8.17 Forest Carbon in Gujarat in different pools (in '000 tonnes)

AGB	BGB	Dead wood	Litter	SOC	Total
27,737	9,636	315	1,556	68,003	1,07,247

11.8.9 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 11.8.18

TABLE 11.8.18 Growing Stock of Bamboo in Gujarat

Growing Stock (GS)		% of Country's GS of Bamboo
Bamboo bearing area inside RFA/Green Wash (in sq km)	3,393	2.12
Total number of culms (in millions)	677	1.72
Total equivalent green weight (in 000' tonnes)	8,877	3.20

11.8.10 Dominant tree species in Trees Outside Forests (TOF)

Top five species in numbers in Trees Outside Forests in Gujarat in Rural and Urban areas are given in the table 11.8.19 and table 11.8.20 respectively

TABLE 11.8.19 Top five tree species in TOF (Rural) in Gujarat

Sl. No.	Species	Relative Abundance (%)
1.	<i>Azadirachta indica</i>	25.17
2.	<i>Mangifera indica</i>	12.06
3.	<i>Acacia arabica</i>	6.11
4.	<i>Prosopis juliflora</i>	5.79
5.	<i>Tectona grandis</i>	4.62

TABLE 11.8.20 Top five tree species in TOF (Urban) in Gujarat

Sl. No.	Species	Relative Abundance (%)
1.	<i>Azadirachta indica</i>	26.91
2.	<i>Pittosporum ferrugineum</i>	8.16
3.	<i>Polyalthia species</i>	5.13
4.	<i>Mangifera indica</i>	4.12
5.	<i>Cocos nucifera</i>	3.73

11.8.11 Major NTFP and Invasive Species

Major NTFP and invasive species as assessed from forest inventory data are presented in the table 11.8.21 and table 11.8.22 respectively.

TABLE 11.8.21 Major NTFP species in the State inside the RFA/Green wash in Gujarat (in sq km)

Sl. No.	Species	Plant Type	Relative Abundance (%)
1.	<i>Rizophora mucronata</i>	Shrub	39.08
2.	<i>Desomodium gangeticum</i>	Shrub	31.03
3.	<i>Phyllanthus amarus</i>	Herb	20.69
4.	<i>Ruta graveolens</i>	Herb	4.60
5.	<i>Chlorophytum borivilliamnum</i>	Herb	2.30

TABLE 11.8.22 Major invasive species in the State inside the RFA/Green wash in Gujarat (in sq km)

Sl. No.	Species	Estimated Extent
1.	<i>Prosopis juliflora</i>	290
2.	<i>Cassia tora</i>	266
3.	<i>Ageratum conyzoides</i>	149
4.	<i>Lantana camara</i>	139
5.	<i>Senna occidentalis</i>	74

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

11.8.12 Quantified estimation of Dependence of People living in forest fringe villages on forests in Gujarat

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 Gujarat is given in the table 11.8.23

TABLE 11.8.23 Estimation of Dependence of People in Forest Fringe Villages on Forests in Gujarat

Fuelwood (tonnes)	Fodder (tonnes)	Bamboo (tonnes)	Small Timber (cum)
49,83,289	11,90,53,905	2,91,749	11,92,475

