

# Chapter IX

VULNERABILITY AND  
MITIGATION





# VULNERABILITY AND MITIGATION

Forests, one of the most vulnerable resources, are affected by various development activities like road construction, mining, electric power projects, and a host of other activities. Exposed to encroachment and fires, they are also prone to various offences like poaching of wildlife, theft of material, illegal removal of wood, etc. Mitigation measures are undertaken to minimize the destruction and degradation of forests.

## 9.1 FOREST FIRES

Forest fires are one of the major causes of forest degradation in India. It is reported that almost 90% of the fires are caused by manmade factors. In the hill states, particularly Uttarakhand and Himachal Pradesh, some patches of forests are set on fire by the people to get a good harvest of fodder after monsoons for the livestock, to facilitate collection of fuel-wood and NTFPs and to practice shifting cultivation. Fires are also set to the forests as retaliation against the restrictive policies of the government and due to accident and carelessness. The forests of sal, teak and chir pine are worse affected by the forest fires. In pine forests, the problem is further aggravated due to the presence of highly inflammable pine litter. These fires, sometimes, go out of control and result in destruction of vast area of forests and loss of flora as well as fauna. Sometimes, the heat is so intense and can be felt from distance. The most common form of fire, 'ground forest fire' is also dangerous as it not only destroys herbs, shrubs and lower vegetation but also reduces the organic matter in dry and moist deciduous forests. The fire season in India begins in January and lasts till mid-June depending upon the place of occurrence. Forests are most vulnerable to fires during the summer season which immediately precedes the monsoons. The peak of forest fire occurrence happens in March and April. Several measures are usually taken up for fire control and local people are also involved in it. FSI maintains a remote-sensing database of fire incidences and also helps the forest departments in identifying the places where fire has occurred to facilitate its management.

High quality data on all aspects of forest fires, including number of forest fire incidents, area and losses in terms of goods and services and wildlife are difficult to obtain. Owing to advances in technology, the number of forest fire incidents is now regularly captured. As far as area affected and losses are concerned, there is a tendency of underreporting and SFDs are not able to accurately assess the losses occurred or area burnt. As a general rule, followed by FSI, the crew for National Forest Inventory notices the incidences of forest fires in a 2 ha area. If more than 50% of the area is affected, the fire is termed as heavy; between 10 to 50%, it is classified as moderate and mild, if area affected is less than 10%.

The number of fire incidences from 2010-11 to 2018-19 recorded by FSI is given in Table 9.1.1. During this period, out of 194,466 incidences, the maximum number of forest fires occurred in Odisha (20,308) followed by Chhattisgarh (18,854), Madhya Pradesh (18,493), Maharashtra (16,347), Mizoram (16,069), Andhra Pradesh (14,715) in that order. No incidences were reported from Daman and Diu and



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Lakshadweep and, therefore, excluded from the Table 9.1.1. Forest fires in Meghalaya, Manipur, Mizoram, Nagaland and Odisha are mainly due to practice of shifting cultivation, locally called *jhum kheti*.

**Table 9.1.1. Number of forest fires alert**

S. no	State/UT	Year								Total
		2010-2011	2011-2012	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	
1	Andaman and Nicobar Islands	0	12	9	96	1	24	8	3	153
2	Andhra Pradesh	1,119	2,559	2,143	2,458	1,075	1,699	1,877	1,785	14,715
3	Arunachal Pradesh	485	560	501	535	358	293	733	491	3,956
4	Assam	1,321	2,172	1,608	2,536	1,656	1,766	1,887	1,660	14,606
5	Bihar	81	196	273	140	45	321	272	223	1,551
6	Chandigarh	0	0	0	0	0	0	1	0	1
7	Chhattisgarh	1,074	3,448	1,530	1,018	1,272	2,808	4,373	3,331	18,854
8	Dadra and Nagar Haveli	0	1	3	1	0	0	0	0	5
9	Delhi	1	0	0	0	0	2	5	4	12
10	Goa	3	0	4	3	0	10	32	9	61
11	Gujarat	101	146	179	74	117	262	574	572	2,025
12	Haryana	5	42	5	5	6	43	185	43	334
13	Himachal Pradesh	6	249	34	32	22	199	170	748	1,460
14	Jammu and Kashmir	7	127	23	74	13	217	113	742	1,316
15	Jharkhand	192	307	554	202	457	740	1,133	666	4,251
16	Karnataka	370	724	606	424	295	831	1,333	1,068	5,651
17	Kerala	10	223	98	114	91	165	456	128	1,285
18	Madhya Pradesh	1,451	3,076	753	534	294	2,675	4,781	4,929	18,493
19	Maharashtra	882	3,329	1,433	702	721	1,874	3,487	3,919	16,347

S. no	State/UT	Year								Total
		2010-2011	2011-2012	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	
20	Manipur	1,275	1,507	1,303	1,774	1,286	1,105	1,094	1,606	10,950
21	Meghalaya	879	911	804	1,123	1,373	966	1,454	1,664	9,174
22	Mizoram	1,691	2,218	2,259	2,189	2,468	1,318	1,587	2,339	16,069
23	Nagaland	919	927	846	886	722	678	930	935	6,843
24	Odisha	780	3,022	2,221	1,904	1,467	2,763	4,416	3,735	20,308
25	Puducherry	0	0	0	0	0	0	9	4	13
26	Punjab	10	83	36	20	7	45	320	487	1,008
27	Rajasthan	87	83	75	53	90	66	260	292	1,006
28	Sikkim	1	3	0	0	3	0	8	1	16
29	Tamil Nadu	34	262	89	284	95	113	301	221	1,399
30	Telangana	-	-	-	-	1,052	1,154	1,748	1,918	5,872
31	Tripura	634	1,233	588	1,160	476	346	431	861	5,729
32	Uttar Pradesh	198	560	237	218	130	691	1,170	1,165	4,369
33	Uttarakhand	85	1,265	119	379	207	1,501	376	1,385	5,317
34	West Bengal	197	117	118	116	138	142	364	125	1,317
<b>Total</b>		<b>13,898</b>	<b>29,362</b>	<b>18,451</b>	<b>19,054</b>	<b>15,937</b>	<b>24,817</b>	<b>35,888</b>	<b>37,059</b>	<b>1,94,466</b>

Source: Forest Survey of India, Dehradun.

Year wise trend of forest fire incidences is presented in Fig. 9.1.1. After witnessing a dip in the number of forest fire incidences in 2015-16, they again rose sharply in the following years.

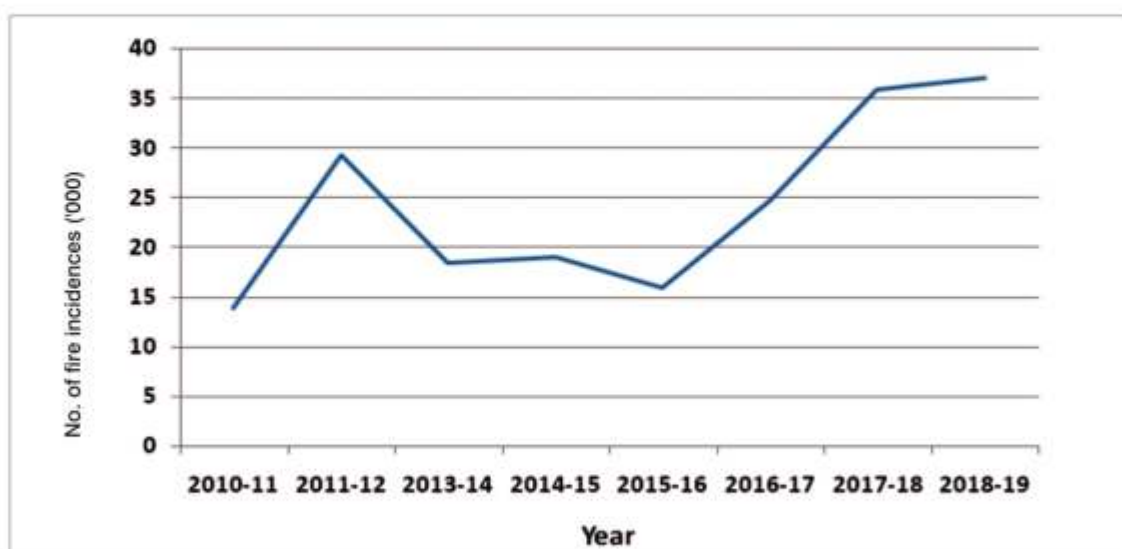


Fig. 9.1.1. Trends in incidences of forest fires ('000 numbers)

Of late, the losses due to forest fires have been immense and states like Uttarakhand and Himachal Pradesh are worst affected. The hill states also find it difficult to manage forest fires due to the unfriendly terrain. Although the area burnt is not readily available, statistics from some selected states are given in the Table 9.1.2.

**Table 9.1.2. Estimated burnt area (ha) in selected states/UTs**

State/UT	Year						
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Andhra Pradesh	NA	836.78	1106.09	NA	NA	NA	NA
Andaman and Nicobar Islands	310.42	34.27	2,061.06	2,369.25	NA	NA	NA
Arunachal Pradesh	30	1,850	2,485	85	NA	NA	NA
Chandigarh	NA	8.00	NA	15	1	NA	80.00
Dadra and Nagar Haveli	169.95	77.62	51.11	60.50	NA	NA	NA
Daman and Diu	NA	NA	NA	845.00	NA	NA	NA
Goa	NA	12.00	28.00	3.05	NA	NA	NA
Gujarat	NA	NA	NA	33,130.00	NA	NA	NA
Haryana	NA	9.91	447.82	20.38	23.64	19.30	NA
Himachal Pradesh	7,837.00	1,758.00	20,774.00	3,237.00	6,726.49	5,749.95	1,953.76
Jammu and Kashmir	664.63	410.70	1,260.15	398.87	NA	NA	NA
Jharkhand	666.00	400.00	4,607.00	20,808.00	285.06	843.69	NA
Karnataka	NA	NA	NA	NA	168.67	279.00	6,976.85
Kerala	2,364.41	5,640.26	2,359.68	2,633.15	1,694.42	1,975.37	NA
Lakshadweep	NA	NA	NA	6,505.40	NA	NA	NA
Madhya Pradesh	19,322.00	15,090.00	5,045.00	3,425.00	NA	NA	NA
Maharashtra	38,467.00	72,247.00	34,148.00	16,504.00	26,560.00	25,553.00	33,067.00
Meghalaya	NA	NA	21.31	274.6	202	161	520
Mizoram	1,431.50	1,845.50	1,056.71	5,563.10	1,036.45	398.36	238.73
Nagaland	1,188.00	NA	500.00	25.00	NA	NA	NA
Puducherry	0.10	0.10	NA	0.20	NA	NA	NA
Punjab	3,200.00	1,717.33	2,616.00	1,598.40	628.00	NA	NA
Rajasthan	1,379.01	535.16	NA	NA	NA	NA	NA
Sikkim	523.60	21.00	272.30	881.00	502.00	NA	NA
Tamil Nadu	1,510.47	NA	NA	NA	NA	NA	NA
Uttarakhand	231.80	2,826.30	384.05	930.33	701.36	4,433.75	NA
West Bengal	1,827.14	1,420.36	792.12	646.28	3,166.26	3,673.43	NA

Source: SFDs; NA: Data not available.

Ten major states in terms of maximum average burnt area year<sup>-1</sup> is shown in Fig. 9.1.2. From the available data, the maximum average burnt area is for Maharashtra (35,220.86 ha year<sup>-1</sup>) followed by Gujarat (33,133 ha year<sup>-1</sup>).

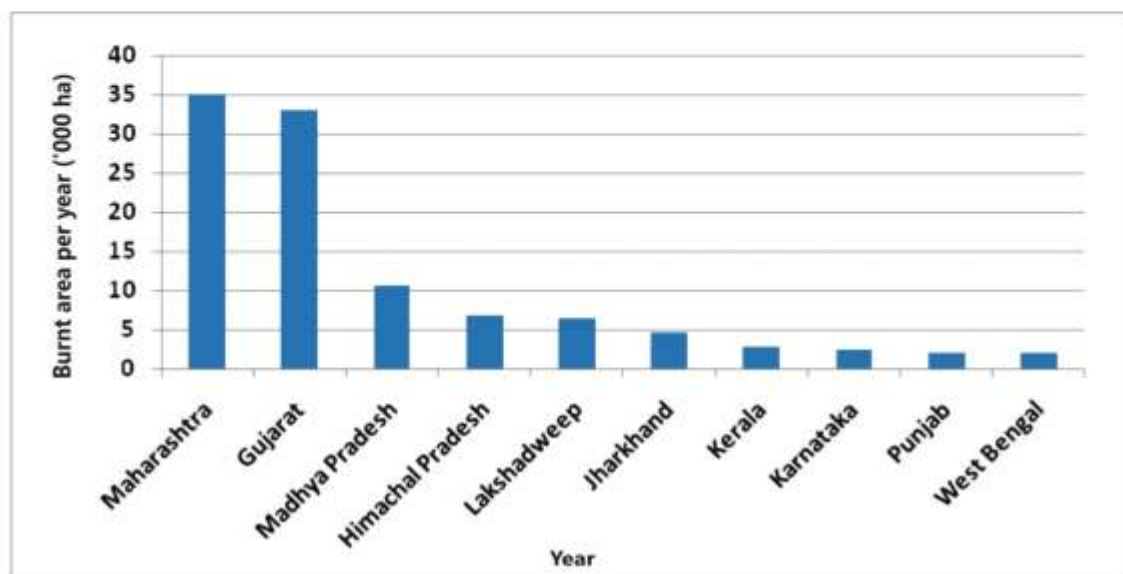


Fig. 9.1.2. Ten major states having maximum burnt area ('000 ha) per year during 2010-2017.

## 9.2 FOREST OFFENCES

Offences like illegal felling and smuggling of timber, poaching of wildlife, trespassing forest boundaries that are prohibited, etc. regularly take place in the forest areas. Owing to the vast tracts of uninhabited and virtually impossible to erect a fence or a wall around the boundaries, the forest and its wealth are prone to the illegal activities. There are provisions under Indian forest Act 1927, Wildlife Protection Act 1972, and various state forest Acts, etc. against which cases are reported and booked.

Table 9.2.1. No. of offences committed against various forest Acts in selected states

State	Year						
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Assam	NA	NA	55	50	48	39	37
Chhattisgarh	NA	NA	NA	22,243	26,091	11,698*	NA
Goa	235	286	332	298	NA	NA	NA
Gujarat	9,216	8,992	10,204	9,662	10,056	8,590	9,209
Haryana	10,936	9,225	7,947	8,424	7,748	8,371	NA
Jammu and Kashmir	NA	1,41,650	NA	NA	NA	NA	NA
Jharkhand	NA	NA	NA	NA	1,592	NA	NA
Karnataka	54,290	59,274	80,084	76,352	97,244	79,180	81,090
Meghalaya	6,063	NA	NA	NA	NA	NA	NA

State	Year						
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Odisha	NA	62,777	64,942	60,072	60,299	59,920	66,225
Punjab	NA	2,187	3,325	4,850	4,825	NA	NA
Tripura	NA	NA	257	512	503	400	536
Uttar Pradesh	NA	NA	NA	NA	NA	29,994	NA

Source: SFDs; NA: Data not available; \*: data is upto June 2016.

Table 9.2.2. No. of cases booked against forest offences in selected states/UTs

State/UT	Year						
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Andhra Pradesh	NA	42,458	40,376	NA	NA	NA	NA
Chhattisgarh	19,487	23,650	NA	22,243	28,657	17,892	NA
Haryana	NA	8,769	7,459	8,026	7,323	7,993	NA
Himachal Pradesh	NA	NA	14,820	NA	NA	NA	NA
Jammu and Kashmir	3,874	3,518	3,499	3,540	NA	NA	NA
Karnataka	8,278	14,282	12,239	8,768	9,931	10,428	8,224
Kerala	NA	415	304	1,218	21	924	NA
Madhya Pradesh	63,792	66,514	64,910	62,293	60,411	56,174	NA
Maharashtra	NA	34,779	34,065	30,075	30,616	30,524	27,634
Rajasthan	NA	NA	21,322	19,063	5,604	NA	NA
Tripura	NA	NA	248	486	491	402	482
Uttarakhand	NA	NA	NA	932	1,009	1,084	1,166
West Bengal	NA	NA	NA	NA	NA	11,849	NA
Andaman and Nicobar islands	NA	NA	698	564	322	417	451
Dadra and Nagar Haveli	73	58	80	NA	NA	NA	NA

Source: SFDs; NA: Data not available.

### 9.3 DIVERSION OF FORESTRY LAND FOR NON-FORESTRY PURPOSE

Forest land is diverted for non-forestry purposes mainly for developmental needs. The detail of land diversion and the purpose for which it was diverted is given in Table 9.3.1. From April 2010 to March 2019, 7,362 proposals were approved and 1,48,359.42 ha of forest land was diverted for non-forestry purposes. Maximum land was diverted for the purpose of mining (50,612.16 ha, 34.11%) followed by irrigation (24,134.96 ha, 16.27%). Minimum area was diverted for canal followed by the approach access (3.04 ha).



Table 9.3.1. Sector-wise conversion of forest land (ha)

S. no.	Category	Year										Total no. of cases	Total area diverted
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019		
1.	Approach access	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.35	0.69	99	3.04
2.	Borehole prospecting	0.00	0.00	0.00	0.00	45.99	5.00	153.11	0.00	0.00	0.00	5	204.10
3.	Canal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1	0.00
4.	Defense	2,084.15	19.90	538.93	931.57	1,647.67	203.00	0.98	3,164.75	4,158.09	1.00	53	12,750.04
5.	Dispensary /Hospital	1.60	0.00	0.01	0.55	39.86	0.00	2.05	0.34	0.86	40.51	13	85.77
6.	Drinking water	19.42	19.42	14.63	5.81	2.51	69.54	26.81	16.69	15.72	3.14	130	193.68
7.	Forest village conversion	0.00	0.00	0.00	0.00	0.00	966.20	0.00	929.04	285.70	0.00	16	2,180.94
8.	Hydel	3,916.86	122.60	225.26	1,731.70	447.92	56.69	42.27	5.11	36.65	112.02	100	6,697.09
9.	Industry	9.20	0.00	0.00	5.94	1.11	66.46	1.21	37.08	153.64	28.20	82	302.86
10.	Irrigation	2,158.37	2,996.90	450.93	803.85	2,824.98	2,110.97	2,219.18	5,643.49	3,169.14	1,757.16	214	24,134.96
11.	Mining	7,007.95	6,459.90	4,004.87	5,509.47	9,762.99	3,980.49	2,131.84	3,399.40	7,105.24	1,250.01	294	50,612.16
12.	Optical fiber cable	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.80	10.61	28	14.41
13.	Others	661.64	681.42	739.30	1,711.22	306.06	802.30	1,622.51	1,631.47	519.96	106.91	3,135	8,782.80
14.	Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	10.48	8.66	10.30	0.00	9	29.44
15.	Railway	438.61	59.12	187.41	359.86	251.91	577.81	191.35	225.74	841.84	2.87	104	3,136.52
16.	Re-habilitation	0.00	1.01	200.00	11.59	242.39	0.00	300.20	0.00	0.00	0.00	7	755.20
17.	Road	4,264.92	2,276.92	2,216.71	2,807.39	1,587.38	2,007.04	1,169.49	1,991.07	1,788.98	406.75	2,186	20,516.64
18.	School	1.71	11.55	2.86	11.14	1.00	1.62	1.45	2.06	13.31	4.38	42	51.07
19.	Thermal	590.61	42.55	130.36	47.72	395.85	2,037.55	0.00	114.36	0.00	10.70	22	3,369.69
20.	Transmission Line	1,566.19	2,258.06	2,221.15	1,323.50	1,921.43	2,105.11	312.48	250.38	1,259.02	119.12	769	13,336.44

S. no.	Category	Year										Total no. of cases	Total area diverted
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019		
21.	Village Electricity	0.09	4.96	0.01	0.00	0.00	0.00	0.49	2.20	25.33	4.16	30	37.24
22.	Wind Power	493.95	113.14	83.83	127.86	147.34	4.19	154.25	10.76	12.00	18.00	23	1,165.31
<b>Total</b>		<b>23,215.27</b>	<b>15,067.44</b>	<b>11,016.26</b>	<b>15,389.15</b>	<b>19,626.38</b>	<b>14,993.97</b>	<b>8,340.15</b>	<b>17,432.59</b>	<b>19,401.94</b>	<b>3,876.25</b>	<b>7,362</b>	<b>1,48,359.40</b>

Source: FC division, MoEF&CC, GoI.

Figure 9.3.1 gives a comparative status of proportion of forest land diverted according to categories. The proportion less than 0.001 are excluded from this Figure.

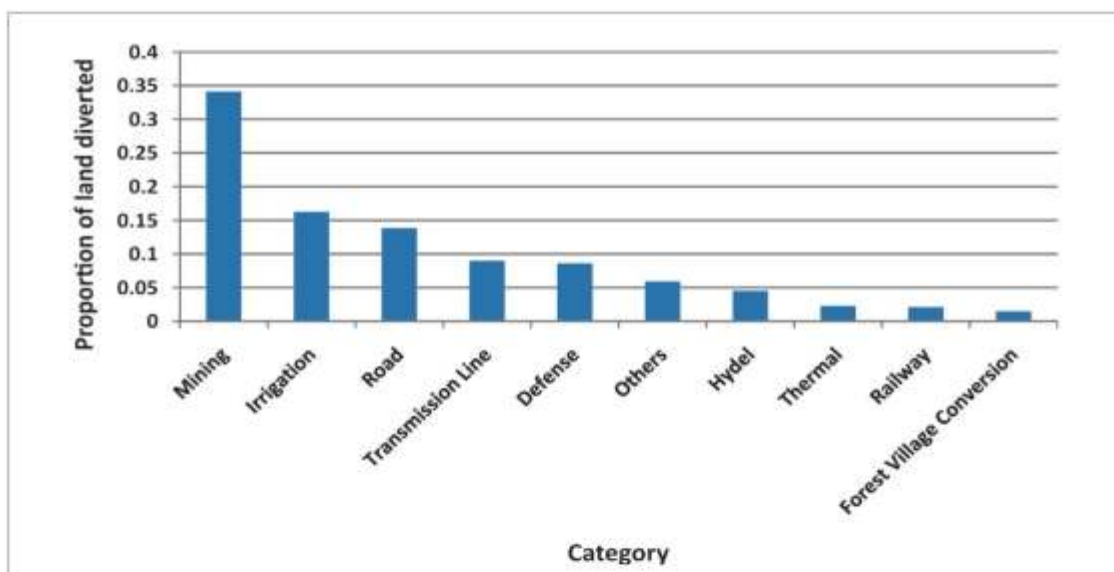


Fig. 9.3.1. Proportion of forest land diverted for the categories

The size-class wise forest land diverted during 2010-11 to 2018-19 is shown in Fig. 9.3.2. Four classes, viz., <500 ha, 500 – 2,000 ha, 2,000-10,000 ha and >10,000 ha are constructed. Maximum numbers of cases as well as forest land diverted were found in this order of the classes. There was not any case where area diverted was more than 10,000 ha.

Table 9.3.2. Size-class wise forest land diverted during 2010-11 to 2018-19

Size of area diverted (ha)	No. of cases	Forest land diverted	% of forest land diverted
<500	7,308	83,657.30	67.12
500-2,000	49	49,781.05	39.94

Size of area diverted (ha)	No. of cases	Forest land diverted	% of forest land diverted
2,000-10,000	5	14,921.05	11.97
>10,000	0	0.00	0.00
<b>Total</b>	<b>7,362</b>	<b>1,48,359.40</b>	<b>100</b>

Source: FC Division, MoEF&CC, GoI.

Fig. 9.3.2. shows the trend of area diverted under FCA from 2010 to 2019. Diversion of area fluctuated substantially over time having two peaks during 2014 and 2018 and dips in 2012, 2016 and 2019.

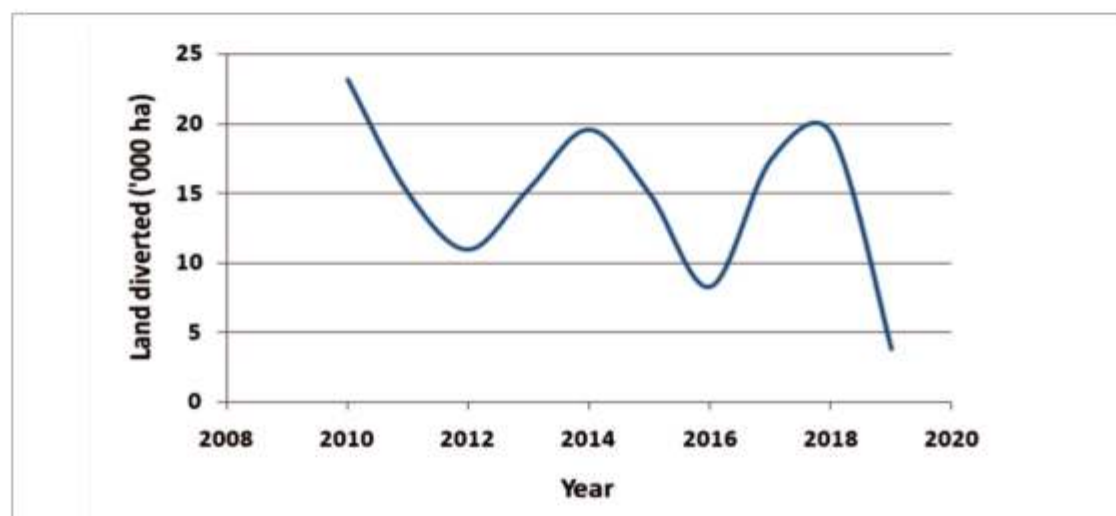


Fig 9.3.2. Trend in area diverted under FCA.

Fig. 9.3.3. shows the trend of number of cases approved for diversion of forest land from 2010-18. Maximum number of cases approved are found in the year 2010 and the trend is declining over the period in general, except the rise from 2015-17.

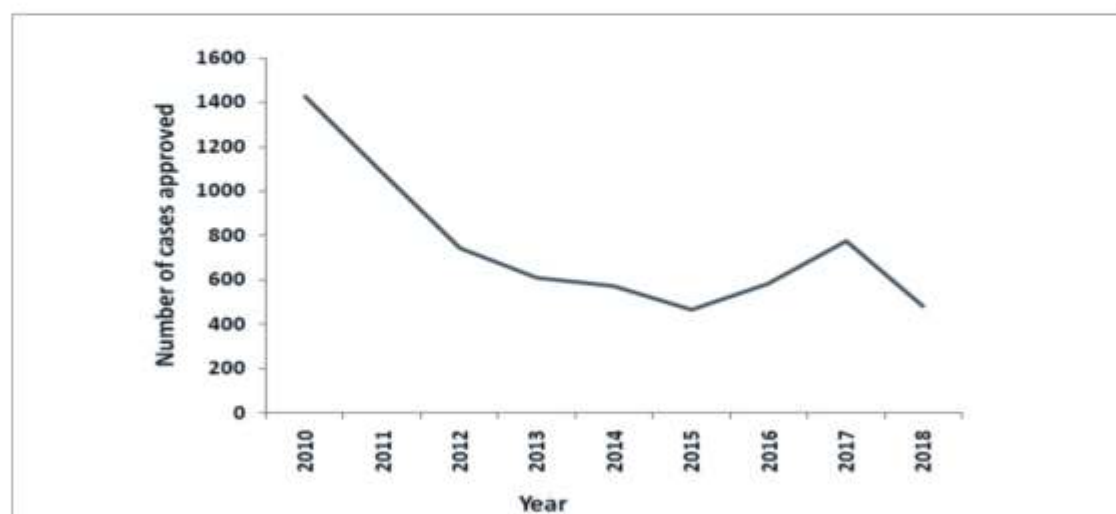


Fig. 9.3.3. Trend of number of cases approved for diversion of forest land.

State wise approved number of cases with forestry land diverted during 2010-11 to 2018-19 for non-forestry purposes under FCA 1980 is shown in Table 9.3.3. The maximum number of cases approved for diversion of forestry land was in Haryana (2,058 cases with 3,020.92 ha area) and the maximum area diverted during the entire period was in Madhya Pradesh (24,783.68 ha) for 423 cases approved. There were no cases approved for the two states Jammu and Kashmir, and Nagaland and two UTs Lakshadweep and Puducherry, and hence not included in the Table.

**Table 9.3.3. Approved number of cases and forestry land diverted during 2010-11 to 2018-19 for non-forestry purpose under FCA 1980**

S. no.	State/UT	Number of cases	Total area diverted (ha)
1.	Andaman and Nicobar Islands	16	43.35
2.	Andhra Pradesh	89	9,456.99
3.	Arunachal Pradesh	74	4,341.66
4.	Assam	14	248.58
5.	Bihar	213	4,626.13
6.	Chandigarh	11	42.08
7.	Chhattisgarh	86	15,571.87
8.	Dadra and Nagar Haveli	22	15.00
9.	Daman and Diu	1	3.95
10.	Delhi	7	19.17
11.	Goa	14	221.46
12.	Gujarat	340	4,937.33
13.	Haryana	2,058	3,020.92
14.	Himachal Pradesh	363	3,674.67
15.	Jharkhand	133	11,270.75
16.	Karnataka	120	2,173.04
17.	Kerala	22	60.17
18.	Madhya Pradesh	423	24,783.68
19.	Maharashtra	163	10,016.19
20.	Manipur	20	2,351.60
21.	Meghalaya	8	381.95
22.	Mizoram	3	458.76

S. no.	State/UT	Number of cases	Total area diverted (ha)
23.	Odisha	140	16,644.72
24.	Punjab	1,619	2,964.80
25.	Rajasthan	160	8,170.81
26.	Sikkim	118	406.64
27.	Tamil Nadu	55	685.01
28.	Telangana	62	12,861.14
29.	Tripura	60	613.91
30.	Uttar Pradesh	263	2,551.91
31.	Uttarakhand	652	5,207.21
32.	West Bengal	33	533.97
<b>Total</b>		<b>7,362</b>	<b>1,48,359.42</b>

Source: FC Division, MoEF&CC, Gol.

Fig. 9.3.4. shows those states where more than 4,636.23 ha area (national average) was diverted from 2010 to 2019 for non-forestry purpose under FCA 1980. Overall ten states, namely, Madhya Pradesh, Odisha, Chhattisgarh, Telangana, Jharkhand, Maharashtra, Andhra Pradesh, Rajasthan, Uttarakhand and Gujarat fall under this category.

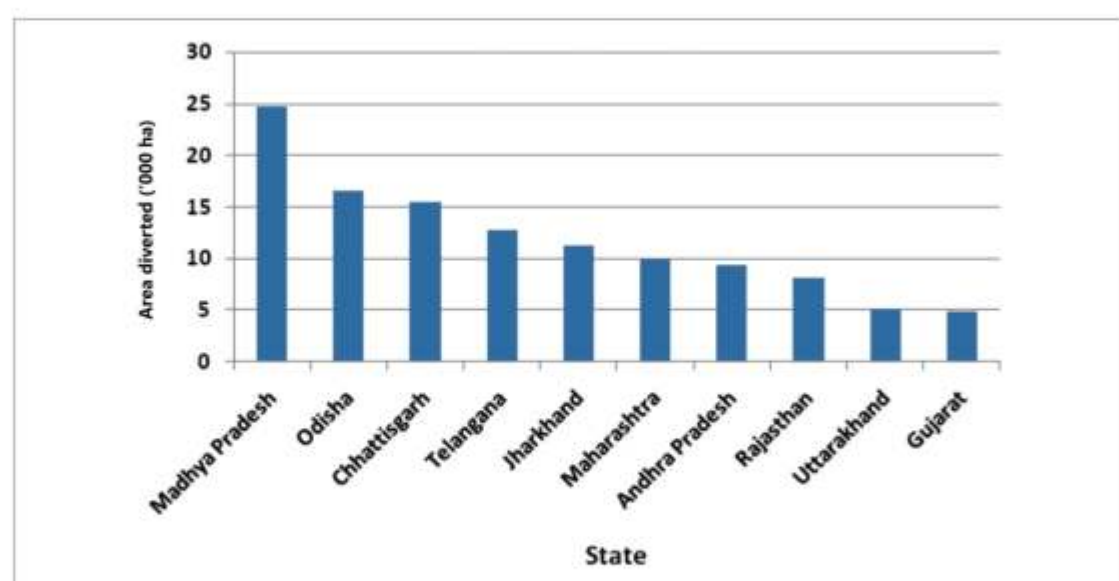


Fig. 9.3.4. Area ('000 ha) diverted of the states having more than national average from 2010 to 2019.



#### 9.4 ENCROACHMENT OF FOREST LAND

Encroachment of forest lands is another major issue that confronts the forest managers. People find it relatively easy to encroach the forest land for various purposes like practising agriculture, building hutments, etc. People living in the areas around forests, known as forest fringes, are more likely to encroach upon forest land. However, the area encroached has seen a downward trend after implementation of the Forest Rights Act. The data on encroachments are not easily available but indicative figures from selected forest departments are given in the Table 9.4.1.

Table 9.4.1. Forest area encroached (ha) in selected states

State	Year						
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Goa	NA	78.453	6.828	0.885	NA	NA	NA
Himachal Pradesh	1,587.72	1,560.64	4,311.00	3,917.00	NA	NA	NA
Jammu and Kashmir	18,376.492	13,360.10	13,312.75	NA	NA	NA	NA
Karnataka	10,28,070.14	1,01,771.63	1,00,638.51	1,02,851.33	1,00,851.34	1,02,338.54	1,02,468.17
Kerala	4,518.69	4,518.69	5,498.62	5,498.62	5,283.06	7,801.12	NA
Madhya Pradesh	NA	4,497	3,679	3,140	2,622	972	NA
Maharashtra	81,754	86,213	70,077	67,890	71,627.3	58,622.34	63,718.9
Meghalaya	NA	NA	6.496	15.389	4.51	8,088.424	2.08
Mizoram	8,705.8	NA	NA	NA	NA	NA	NA
Rajasthan	NA	NA	32,250.13	27,881.37	11,534.35	NA	NA
Sikkim	NA	NA	567.70	NA	NA	NA	NA
Uttar Pradesh	NA	NA	NA	NA	23,507.95	NA	NA
Uttarakhand	NA	9,656.73	9,656.74	9,652.57	9,646.60	9,618.38	9,524.42
West Bengal	12,506.12	12,753.8	13,495.62	NA	13,779.49	10,214.80	NA

Source: SFDs; NA: Data not available.



