

# The Dynamics of Mangrove Cover in India

Based on Assessment done by  
Forest Survey of India  
from 1987 to 2017

*The paper represents an analytical overview of decadal changes of mangrove cover in India with special emphasis on Gujarat state since 1987 based on published reports of Forest Survey of India. During last three decades in India, the mangrove cover has shown an increase of 21.6%. However, the mangrove cover increased from 0.12% to 0.15% of the total geographical area of the country. Among all the states and UTs, Gujarat has shown the maximum increase (about 167%) in mangrove cover during the same period. In Gujarat, as compared to mangrove cover in 1987 (427 km<sup>2</sup>) it increased by 2.66 times to 1140km<sup>2</sup> in 2017 during the last three decades.*

**Key words:** Mangrove cover, India, Gujarat, Decadal changes

## Introduction

A Mangrove forest is defined as a salt-tolerant forest ecosystem of the intertidal region on sheltered coastlines and normally occurs above mean sea level. "If there are no mangrove forests, then the sea will have no meaning. It is like having a tree with no roots, for the mangroves are the roots of the sea" (MAP, 1999). The mangroves are adapted to wet and loose soils and periodic submergence in the saline water. They survive in harsh conditions of low oxygen and nutrient availability and high salinity in the soil, wind and wave action and substrate instability. Mangrove forests are distributed in the intertidal region between the sea and the land in the tropical and subtropical regions of the world, between approximately 30° N and 30° S latitude (Giri *et al.*, 2011).

Mangrove ecosystem is one of the most productive natural ecosystems on the earth with great ecological, biodiversity and socio-economic importance. They provide habitat to many diverse species of birds, mammals, crustacean, fish etc. Many ecological services are also regulated by mangroves such as preservation of water quality and pollution reduction by filtering suspended material and assimilating dissolved nutrients. Other ecological functions include biogeochemical cycling, purification and detoxification, nutrient flows, carbon assimilation etc. Furthermore, the mangrove forests play a major role in reducing the severity of tsunami wave, cyclones, sea currents and wind erosion (Mazda *et al.*, 1997a, 1997b; Kathiresan and Rajendran, 2005). It is also reported that, the mangroves of Bhitarkanika in Orissa, India have greatly reduced the impact of the 'super cyclone' that had struck in October 1999 (Kathiresan and Rajendran, 2005). There were little human causality and less economic damage in the dense mangrove cover areas of Parangipettai, Tamil Nadu, India during 2004 tsunami and during the same time, the dense mangrove cover of Sundarbans saved West Bengal (India) and Bangladesh from the killer impact of tsunami (Kathiresan and Rajendran, 2005; Patel *et al.*, 2014)

Mangroves are one of the most valuable coastal habitats from socio-economic point of view as they provide enormous benefits (both

*Distribution and decadal changes of Mangrove cover in India with special emphasis on Gujarat state since 1987.*

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tangible and non-tangible) to the local communities as well as the ecology and environment surrounding them. Local communities that live near mangrove areas derive a number of natural resources such as firewood, fodder, honey, timber; fish etc. from the mangrove forests.

In the world, the total mangrove cover is 150,000 Km<sup>2</sup> (World Atlas of Mangroves, 2010). Mangroves are mostly distributed over 123 countries and territories in tropical and sub-tropical regions of the world. Asia has the largest mangrove cover in the world. The most extensive area of mangrove is found in South East Asia (33.50%) followed by South America (15.60%), North Central America (14.70%) and West and Central Africa (13.20%). The mangrove cover of South Asia is 10,344 km<sup>2</sup> which constitute 6.8% of the world's mangrove cover. In south Asia, India's contribution is 45.8% of the total mangrove cover (FSI, 2017).

Forest survey of India published the first report in 1987 and so far a total of 15 independent assessment reports report have been published. From 1987 to 1999 the mangrove cover was not classified density wise. Thereafter from 2001 the mangrove cover was also classified according to canopy density classes. In the present paper an attempt has been made to assess the changes in Mangrove cover in India as well as at Gujarat state level, over last three decades.

### Methodology

The data from published reports of Forest Survey of India were used to calculate change in mangrove cover (km<sup>2</sup>) and mangrove cover as percent of geographical area from 1987 to 2017 by applying Mathematical equations in Micro Soft Office, 2010.

### Overviews of Mangrove cover in India from 1987 to 2017

The status of mangrove cover in India assessed from

**Table 1:** The status of mangrove cover in India from 1987-2017.

Year of report	Mangrove cover (km <sup>2</sup> )				Change in mangrove cover (Km <sup>2</sup> )	Mangrove cover as % of geographical area
	Very dense	Dense	Open	Total		
1987				4046	0	0.12
1989				4255	209	0.13
1991	Not classified according to density classes			4242	-13	0.13
1993				4256	14	0.13
1995				4533	277	0.14
1997				4827	294	0.15
1999				4871	130	0.15
2001		2859	1623	4482	-389	0.14
2003	1162	1657	1642	4461	-21	0.14
2005	1147	1629	1669	4445	-16	0.14
2009	1405	1659	1575	4639	194	0.14
2011	1403	1658.12	1601.44	4662.56	23.56	0.14
2013	1351	1457.1	1819	4628	-34.56	0.14
2015	1472	1391	1877	4740	112	0.14
2017	1481	1480	1960	4921	181	0.15
<b>Change since 1987</b>					<b>875</b>	

(Source FSI reports -1987, 1989, 1991, 1993, 1995, 1999, 2001, 2003, 2005, 2011, 2013, 2015 & 2017)

1987 to 2017 is presented in Table 1. The 1<sup>st</sup> assessment of FSI (1987) reveals mangrove cover area to be 4046 Km<sup>2</sup> in India. Thereafter, the 2<sup>nd</sup> cycle (1989) recorded an increase of 209 Km<sup>2</sup> (4255 Km<sup>2</sup>) in mangrove cover in India which constituted 0.13% of the total country's geographical area. Mangrove cover showed decline by 13 Km<sup>2</sup> during the 3<sup>rd</sup> assessment cycle (1991). Afterwards from 4<sup>th</sup> to 7<sup>th</sup> assessment cycle the mangrove cover of India increased from 4256 Km<sup>2</sup> to 4871 Km<sup>2</sup> indicating an average increase of 14.4%.

The mangrove cover declined by 8.7% from 1999 to 2005 (4871 Km<sup>2</sup> to 4445 Km<sup>2</sup>). According to FSI report (2001) the main reason for this decline was change in methodology (digital interpretation) and scale of interpretation (1:50,000) due to which small water bodies (creeks, straits etc.) and non-mangrove areas which earlier could not be delineated, had been detected and extracted out from areas under mangrove cover. The next two cycles (2009 and 2011) reported an increase of 194 km<sup>2</sup> and 23.56 km<sup>2</sup> in mangrove cover, respectively. The 2013 assessment recorded decline in mangrove area by 34.56 km<sup>2</sup> followed by an increase in mangrove area, *i.e.*, 112 Km<sup>2</sup> in 2015.

The current assessment by FSI, 2017 shows that mangrove cover in India is 4921 Km<sup>2</sup>, which is 0.15% of the total country's geographical area (32,87,469 Km<sup>2</sup>, Census of India- 2011). As per this assessment, the very dense mangroves comprise of 1481 Km<sup>2</sup> (30.10%), moderately dense mangrove is 1480 Km<sup>2</sup> (30.07%) and open mangroves constitute an area of 1960 Km<sup>2</sup> (39.03%). Thus the mangrove cover in India during last three decades has shown increase of 21.6%. However, the mangrove cover increased from 0.12% to 0.15% of the total geographical area of the country.

In India, mangroves are spread over an area of 4921 Km<sup>2</sup> which is 3.3% of the world's mangrove cover (FSI, 2017). West Bengal exhibits the maximum mangrove cover (2,114 Km<sup>2</sup>) followed by Gujarat state (1,140 Km<sup>2</sup>) and Andaman and Nicobar Islands (617 Km<sup>2</sup>) (Table 2). Among the states and UT's, all except Andhra Pradesh and Andaman & Nicobar have recorded increase in mangrove cover during last three decades. However, Gujarat has shown the maximum increase (about 167%) in mangrove cover during the same period. As compared to mangrove cover in 1987 (427 km<sup>2</sup>) it increased by 2.66 times to 1140 km<sup>2</sup> in 2017 during the last three decades.

#### Overview of Mangrove cover in Gujarat from 1987 to 2017

Gujarat is the northernmost maritime state of India. The state has a long coastline of 1,650 km, constituting over 21% of the Indian coastline and the longest among all states. There are two major indentations in Gujarat's coast – the Gulf of Kachchh (GoK) and the Gulf of Khambhat. Of the total wetland area of 27,175 km<sup>2</sup> in the state, coastal wetlands

comprise as much as 92.3% (SAC 1998). Based on the evaporation rate and hydrological inflow, Gujarat is categorized as an arid or semiarid zone. These coastal stretches are rich in biodiversity and the GoK have the Marine National Park and sanctuaries located along it.

Regular mapping of mangrove cover in the country has been conducted by the Forest Survey of India (FSI). According to FSI data, the trend of mangrove cover from 1987 to 2017 for Gujarat is shown in Table 3. However, due to natural calamities there was a significant loss of mangrove cover during the late 1990s and in 2001 along the Gujarat coast. The mangrove cover in Gujarat gradually increased from 1991 to 1999 and from 2009 to 2017. The positive change in the mangrove cover of Gujarat is mainly due to conservational efforts such as plantation and regeneration particularly in Jamnagar, Bhavnagar, Kachchh and Junagadh districts.

Under different plantation schemes, the Gujarat Forest Department (GFD) planted about 50,000 ha and 49,385ha of mangroves from 1983-84 to 2007-2008

**Table 2:** The status of mangrove cover (area in km<sup>2</sup>) in States and UT's of India from 1987-2017.

State/UT	1987	1989	1991	1993	1995	1997	1999	2001	2003	2005	2009	2011	2013	2015	2017
Andhra Pradesh	495	405	399	378	383	383	397	333	329	329	353	352	352	367	404
Goa	0	3	3	3	3	5	5	5	10	16	17	22	22	26	26
Gujarat	427	412	397	419	689	901	1031	911	960	936	1046	1058	1103	1107	1140
Karnataka	0	0	0	0	2	3	3	2	3	3	3	3	3	3	10
Kerala	0	0	0	0	0	0	0	0	8	8	5	6	6	9	9
Maharashtra	140	114	113	155	155	124	108	118	116	158	186	186	186	222	304
Orissa	199	192	195	195	195	211	215	219	207	203	221	222	213	231	243
Tamil Nadu	23	47	47	21	21	21	21	23	35	35	39	39	39	47	49
West Bengal	2076	2109	2119	2119	2119	2123	2125	2081	2120	2118	2152	2155	2097	2106	2114
Andaman & Nicobar	686	973	971	966	966	966	966	789	671	637	615	617	604	617	617
Daman & Diu	0	0	0	0	0	0	0	0	1	1	1	1.56	1	3	3
Pondicherry	0	0	0	0	0	0	0	1	1	1	1	1	0.63	2	2
<b>Total</b>	<b>4046</b>	<b>4255</b>	<b>4244</b>	<b>4256</b>	<b>4533</b>	<b>4737</b>	<b>4871</b>	<b>4482</b>	<b>4461</b>	<b>4445</b>	<b>4639</b>	<b>4663</b>	<b>4628</b>	<b>4740</b>	<b>4921</b>

(Source FSI reports -1987, 1989, 1991, 1993, 1995, 1999, 2001, 2003, 2005, 2011, 2013, 2015 & 2017)

**Table 3:** The status of mangrove cover in Gujarat from 1987-2017.

Year of report	Mangrove cover (km <sup>2</sup> )				Change in mangrove cover (Km <sup>2</sup> )	Mangrove cover as % of geographical area
	Very dense	Dense	Open	Total		
1987				427	0	0.22
1989				412	-15	0.21
1991	Not classified according to density classes			397	-15	0.20
1993				419	22	0.21
1995				689	270	0.35
1997				901	212	0.46
1999				1031	130	0.53
2001	0	184	827	911	-120	0.46
2003	0	198	762	960	49	0.49
2005	0	195	741	936	-24	0.48
2009	0	188	858	1046	55	0.53
2011	0	182	876	1058	12	0.54
2013	0	175	928	1103	45	0.56
2015	0	174	933	1107	4	0.56
2017	0	172	968	1140	33	0.58
<b>Change since 1987</b>					<b>713</b>	

(Source FSI reports -1987, 1989, 1991, 1993, 1995, 1999, 2001, 2003, 2005, 2011, 2013, 2015 & 2017)

and 2008-09 to 2016-2017, respectively in various coastal areas and islands of Gujarat (Pandey and Pandey, 2009; Gujarat Forest statistics, 2008-2017). Apart from Gujarat Forest Department, Gujarat Ecology Commission has also raised plantation of mangroves in an area of 5546 ha during 2001 to 2007 by involving local communities (Pandey and Pandey, 2009).

Gujarat mangrove forest covers an area of 1140 km<sup>2</sup>; of which 172 km<sup>2</sup> are moderately dense and 968 km<sup>2</sup> are open mangrove forests (FSI, 2017). Broadly, in Gujarat's coast, mangrove forest is distributed in five major regions that include the Gulf of Kachchh, the Gulf of Khambhat, the Saurashtra Coast, the South Gujarat Coast and the Kachchh region. Region wise distribution of mangrove cover in Gujarat is given in Table 4.

### The Kachchh Region

The Kachchh region falls in the northern arid coastal part of the Gujarat state. The whole region is represented by a single district, Kachchh which has long coastline of 337.9 km. Among different coastal regions of Gujarat, Kachchh region exhibits the maximum (70%) of the total mangrove cover of the state. The region has 798 km<sup>2</sup> of mangrove cover, which comprised of 118 km<sup>2</sup> of moderately dense forests and 680 km<sup>2</sup> of sparse forests. The mangrove area of this zone has a very low precipitation-evapotranspiration ratio. The average rainfall of this zone is less than 400 mm annually, which is the lowest among all the five mangrove regions of Gujarat and these forests are characterized by semiarid and arid climatic conditions. This region has a very high salinity level. The mangrove forests of this zone predominantly comprise (99.9%) of *Avicennia marina* (Forsk.) Vierh. which is known to be the hardiest mangrove species in terms of salinity and aridity tolerance. The region also has a very sporadic presence of a few other mangrove species such as *Rhizophora mucronata* Lam. and *Ceriops tagal* Arnold.

### The Gulf of Kachchh and Saurashtra region

The mangrove areas of Gulf of Kachchh are found in Devbhoomi Dwarka, Jamnagar and Morbi Districts. The majority of the mangrove forests of the Gulf of Kachchh occur in its various islands. In the Gulf of Kachchh, out of 42 islands, about 20 islands are represented with mangrove forests. The Gulf of

Kachchh has 188 km<sup>2</sup> of mangrove cover which is 16.49% of the total mangrove cover of the state. This region comprises of 29 km<sup>2</sup> of moderately dense mangrove forests and 159 km<sup>2</sup> of sparse mangrove forests. At present, four species of mangrove generally found in this region are *Avicennia marina* (Forsk.) Vierh., *Ceriops tagal* Arnold, *Rhizophora mucronata* Lam., and *Aegiceras corniculatum* (L.) Blanco. In this area the fresh water inflow is much less than that in South Gujarat with no perennial rivers draining into the sea. The combination of good tidal inundation but less fresh water inflow has caused good mangrove cover with relatively less growth and less mangrove species diversity as compared to those in South Gujarat.

One of the first Marine National Park and Sanctuary (MNP&S) located along the Southern part of the Gulf of Kachchh, in Morbi, Jamnagar and Devbhoomi Dwarka districts between 20°15' N to 23°40' N latitudes and 68°20' to 70°40' E longitudes, is endowed with ecologically sensitive habitats such as mangroves, mudflats, coral reefs, seagrasses and sand dune (IRADe, 2017). Marine Sanctuary (MS) covers an area of 457.92 km<sup>2</sup> whereas the Marine National Park (MNP) is established in an area of 162.89 km<sup>2</sup>. (Jain, 2007-08 to 2016-17). The coastline of Jamnagar had luxuriant mangrove cover before independence and most of the coastal mudflats from Okha to Maliya were with dense mangrove cover (Singh, 2000). In the year, 1972, in MNP&S, the total mangrove cover estimated was 175.36 km<sup>2</sup> (IRADe, 2017).

Nayak et al. (1989) used satellite images to map mangroves area of a stretch of MNP&S between Rozi and Vadinar, and reported the mangrove cover in 1975 to be 138.5 km<sup>2</sup> Mangrove cover in this stretch declined to 50 km<sup>2</sup> in 1982 and 33 km<sup>2</sup> in 1985 (Nayak et al., 1989). However, some improvement was reported in 1988 as the mangrove area in this stretch increased to 47 km<sup>2</sup> in this year (Nayak et al., 1989). In 1998, the mangrove area of Jamnagar coast was estimated as 141.44 km<sup>2</sup> and this includes 58.21 km<sup>2</sup> of mangrove cover on various islands (Singh, 2000).

The mangroves around Jindra Island suffered severe degradation due to recurring oil spill incidences in 1998-99 and an estimated 14.7 km<sup>2</sup> of mangrove cover in south-east of Jindra bet was considerably affected (Navalgund and Bahuguna, 1999; IRADe, 2017).

**Table 4:** Region wise distribution of mangrove cover in Gujarat in 2017.

S.N.	Region	Mangrove Cover (km <sup>2</sup> )	Percentage of State's mangrove cover
1	South Gujarat	17	1.49
2	Gulf of Khambhat	31	11.49
3	Gulf of Kachchh	188	16.49
4	Saurashtra region	6	0.53
5	Kachchh Region (including Kori Creek )	798	70.00
	<b>Total</b>	<b>1140</b>	<b>100</b>

(Source: FSI, 2017)

In 2006 mangrove cover increased substantially, the increase was more in case of sparse mangroves (7.05 km<sup>2</sup>) than in case of dense mangroves (1.97 km<sup>2</sup>) (Kumar *et al.*, 2013). The area impacted by oil spill at southeast of Jindra bet was recorded with sparse mangrove cover in 2006 (Kumar *et al.*, 2013). The mangrove cover in Jamnagar was calculated as 149.62 km<sup>2</sup> using satellite data of 2005-07 periods (SAC, 2012). The mangrove cover in Marine National Park and Sanctuary-Jamnagar has increased and estimated as 182.10 km<sup>2</sup> and 237.25 km<sup>2</sup> during 2009 and 2012, respectively (GEER, 2019).

In 1983 Mangrove plantation was initiated by the MNP authorities to increase the mangrove cover, and by 2015 an area of 472.44 km<sup>2</sup> of mangroves was planted at various locations within MNP&S (IRADe, 2017). Mangrove area mapped by Forest Survey of India (FSI) for Jamnagar district for different years from 2001 to 2017 showed consistent increase in mangrove cover (Table 5). This progressive increase in mangrove cover attributed to mangrove plantation initiatives carried out by MNP authorities every year.

The mangrove areas of Saurashtra region occur in 3 districts, *viz.*, Amreli, Junagadh and Porbandar. This region possesses only 6 km<sup>2</sup> of mangrove cover which is 0.53% of the total mangrove cover of the state and mostly comprises of sparse mangrove forests.

#### **The Gulf of Khambhat and South Gujarat Region**

The Gulf of Khambhat and South Gujarat region includes a total of 8 coastal districts *viz.* Ahmedabad, Vadodara, Anand, Bharuch, Surat, Bhavnagar, Navsari and Valsad. South Gujarat region has 148 km<sup>2</sup> of mangrove cover which is 12.98 % of the total mangrove cover of the state. The region comprises of 123 km<sup>2</sup> of sparse mangrove cover and 25 km<sup>2</sup> of open mangrove cover. Most of the mangrove species which are rare in the state have been reported from these estuarine mangrove forest areas. Many perennial

rivers such as Narmada, Sabarmati, Mahi, Kim, Dhandhar, Tapti, Ambika, Purna, Auranga and Daman Ganga drain their fresh water into the Arabian Sea through the Gulf of Khambhat and south Gujarat region. The continuous fresh water inflow brings nutrients and regulates the salinity, which facilitates the growth and development of mangroves in this area. There is a great potential of raising mangrove forests of different species in this zone. Fourteen mangrove species have been reported from this zone. They are *Aegiceras corniculatum* (L.), *Avicennia alba* Bl., *Avicennia marina* (Forsk.) Vierh., *Avicennia officinalis* L., *Ceriops decandra* (Griff.) Ding Hou., *Ceriops tagal* (Perr.) Robinson, Blanco, *Excoecaria agallocha* L., *Sonneratia apetala* Buch.- Ham., *Rhizophora mucronata* Lamk., *Bruguiera cylindrica* (L.) Bl., *Acanthus ilicifolius* L., *Bruguiera gymnorrhiza* (L.) Savigny., *Kandelia candel* (L.) Druce, *Lumnitzera racemosa* Willd (Pandey and Pandey, 2009).

#### **District-wise distributions of mangrove cover 2001 to 2017**

The district wise status of mangrove cover in Gujarat from 2001-2017 is presented in Table 5. During this assessment period (2001-2017) the highest increase in mangrove cover are observed in Kachchh district (92 Km<sup>2</sup>) followed by Jamnagar (42 Km<sup>2</sup>), Ahmedabad (30 Km<sup>2</sup>) and Bharuch district (17 Km<sup>2</sup>). The increase in mangrove cover in Navsari district is 12 Km<sup>2</sup> and for both Anand and Surat District it is 8 Km<sup>2</sup>.

The state of Gujarat has 33 districts, 15 of which are coastal district. The FSI report (2017) reveals that the mangrove cover of 1140 km<sup>2</sup> is spread over 15 districts (Table 6). Kachchh district alone represents 70% (798 km<sup>2</sup>) of the total mangrove cover of the state, which comprises of 680 km<sup>2</sup> of open mangrove forest area and 118 km<sup>2</sup> of moderately dense mangrove area. Moreover, Jamnagar, Devbhoomi Dwarka and Morbi districts exhibits 188 km<sup>2</sup> of mangrove forests, which

**Table 5:** District wise status of mangrove cover assessed from 2001 to 2017.

Sl. No.	Name of Districts	Mangrove Cover (Km <sup>2</sup> ) with respect to assessment year							
		2001	2003	2005	2009	2011	2013	2015	2017
1	Ahmedabad	2	2	6	27	30	36	33	32
2	Amreli	0	0	0	0	1	2	2	2
3	Anand	0	0	0	3	0	8	8	8
4	Bharuch	28	33	36	42	43	44	42	45
5	Bhavnagar	16	16	14	13	19	11	17	22
6	Jamnagar & Devbhoomi Dwarka	142	141	150	157	159	167	173	184
7	Junagadh	0	0	0	0	1	1	1	3
8	Kachchh	706	749	707	775	778	789	786	798
9	Navsari	2	1	1	1	1	13	13	14
10	Porbandar	1	1	1	0	0	1	1	1
11	Morbi	1	2	2	2	2	4	4	4
12	Surat	13	13	17	17	20	21	21	21
13	Vadodara	0	0	0	4	2	3	3	3
14	Valsad	0	2	2	5	2	3	3	3
	<b>Total</b>	<b>911</b>	<b>960</b>	<b>936</b>	<b>1046</b>	<b>1058</b>	<b>1103</b>	<b>1107</b>	<b>1140</b>

**Table 6:** District wise Mangroves cover in Gujarat (Area in Km<sup>2</sup>) (FSI, 2017).

S.N.	Districts	Very dense mangrove	Moderately dense mangrove	Open mangrove	Total	Change w.r.t. 2015 assessment	Mangrove cover as % of geographical area of respective districts
<b>A. South Gujarat</b>							
1	Navsari	0	0	14	14	1	0.634
2	Valsad	0	0	3	3	0	0.099
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>17</b>	<b>17</b>	<b>1</b>	<b>-</b>
<b>B. Gulf of Khambhat</b>							
3	Ahmedabad	0	1	31	32	-1	0.396
4	Vadodara	0	0	3	3	0	0.040
5	Anand	0	0	8	8	0	0.271
6	Bharuch	0	14	31	45	3	0.689
7	Surat	0	4	17	21	0	0.475
8	Bhavnagar	0	6	16	22	5	0.220
	<b>Total</b>	<b>0</b>	<b>25</b>	<b>106</b>	<b>131</b>	<b>7</b>	<b>-</b>
<b>C. Gulf of Kachchh</b>							
9	Devbhoomi Dwarka	0	28	156	184	11	1.328
10	Jamnagar						
11	Morbi	0	1	3	4	0	0.036
	<b>Total</b>	<b>0</b>	<b>29</b>	<b>159</b>	<b>188</b>	<b>11</b>	<b>-</b>
<b>D. Saurashtra region</b>							
12	Amreli	0	0	2	2	0	0.027
13	Junagadh	0	0	3	3	2	0.034
14	Porbandar	0	0	1	1	0	0.044
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>6</b>	<b>2</b>	<b>-</b>
<b>D. Kachchh Region</b>							
15	Kachchh	0	118	680	798	12	1.748
	<b>Total</b>	<b>0</b>	<b>118</b>	<b>680</b>	<b>798</b>	<b>12</b>	<b>-</b>
	<b>Total area for Gujarat</b>	<b>0</b>	<b>172</b>	<b>968</b>	<b>1140</b>	<b>33</b>	<b>-</b>

cover the mangroves of the Gulf of Kachchh. The remaining 13.86% (158 km<sup>2</sup>) mangrove cover is distributed in eleven districts of Gujarat.

Table 6 indicate that Kachchh district has got the highest mangrove area as per cent of its geographical area, i.e., 1.748% and the lowest mangrove cover per cent of its geographical area is 0.027% in Amreli district

### Conclusion

This paper highlighted the decadal changes in mangrove cover in India with special emphasis on Gujarat state. It has been observed that the overall mangrove cover of India increased during the 1987 to 1996 (Assessment cycle 1<sup>st</sup> to 5<sup>th</sup>) whereas in the consecutive decade i.e. 1997-2006 (Assessment cycle 6<sup>th</sup> to 10<sup>th</sup>) considerable decline was noted due to natural hazards. However, during 2007 to 2017 (Assessment cycle 11<sup>th</sup> to 15<sup>th</sup>) mangrove cover has increased again. Gujarat state has shown consistent visible increase in mangrove cover from 1987 to 2017, i.e., 713 km<sup>2</sup>.

भारतीय वन सर्वेक्षण द्वारा 1987 से 2017 तक किए गए मूल्यांकन पर आधारित भारत में कच्छ वनस्पति आवरण की गतिकी आर.डी. काम्बोज और लोपामुद्रा दास

सारांश

शोधपत्र में भारतीय वन सर्वेक्षण की प्रकाशित रिपोर्ट पर आधारित 1987 से गुजरात राज्य पर विशेष जोर देने के साथ भारत में कच्छ वनस्पति आवरण के दशकीय परिवर्तनों के विषय में विश्लेषणात्मक

वृष्टिकोण प्रस्तुत किया गया है। भारत में गत तीन दशकों के दौरान कच्छ वनस्पति आवरण ने 21.6 प्रतिशत की वृद्धि दर्शाई है। तथापि, कच्छ वनस्पति आवरण देश के कुल भौगोलिक क्षेत्र का 0.12 प्रतिशत से 0.15 प्रतिशत तक बढ़ा है। सभी राज्यों और संघ क्षेत्रों में गुजरात ने इसी अवधि में कच्छ वनस्पति आवरण में अधिकतम वृद्धि ( करीब 167 प्रतिशत ) दिखाई। गुजरात में 1987 में कच्छ वनस्पति आवरण ( 427 वर्ग कि.मी. ) की तुलना में यह गत तीन दशकों के दौरान 2017 में 1140 वर्ग कि.मी. तक 2.66 गुना तक बढ़ा।

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