WETLANDS

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25/01/2020

Overview

- Definition
- Ramsar Convention & India
- Legal provisions
- Policies and Programmes on wetlands
- Wetlands Atlas of India
- IFSR report -2019
- Notifying wetlands and Integrated wetland Management plan
- Courts directions
- Case study of chilika
- Suggested readings

Definition

WETLANDS:

" areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters "

Article 1.1 of Ramsar convention

In addition ,to protect coherent sites, **Article 2.1 of the convention** provides that ' wetlands may include riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands'

Other definitions

- *A wetland is an ecosystem that arises when inundation by water produces soils dominated by anerobic processes and forces the biota, particularly rooted plants, to exhibit adaptations to tolerate flooding.* (Paul A. Keddy)

- Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have one or more of the following three attributes: 1) at least periodically, the land supports predominantly hydrophytes: 2) the substrate is predominantly undrained hydric soil; and 3) the substrate is non soil and is saturated with water or covered by shallow water or covered by shallow water at some time during the growing season of each year (Cowardin et.al (1979))

Contd…..

- ***Rule 2 (1) g of Wetlands (Conservation and Management) Rules, 2017 defines*** *"wetland" means an area of marsh, fen, peatland or water; whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters,* ***but does not include river channels, paddy fields, human-made water bodies/tanks specifically constructed for drinking water purposes and structures specifically constructed for aquaculture, salt production, recreation and irrigation purposes;***

- **Human-made wetlands** are defined as wetlands that are planned, designed and operated to meet a specific purpose (such as providing water for irrigation, producing fish through culture operations, producing salt, recreation, preventing salinity intrusion, flood control etc.)

  Para 5 of Guidelines for *Wetlands (Conservation and Management) Rules, 2017* issued in 2020 by MOEFCC

- **Ramsar Convention**, is a global inter-governmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

- Only global treaty to focus on one single ecosystem.

- The Convention was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975

- In India-**42 Ramsar Sites** covering **1,081,438 ha**
- The **Montreux record**, established in 1990, is the"record of Ramsar sites where *changes in ecological character have occurred, are occurring or are likely to occur as a result of technological developments, pollution or other human interference"* and is inventory and assessment of maintained by the Ramsar bureau in consultation with the contracting parties concerned. Chilika lake designated in 1981, montreux record in 1993 and removed in 2002.

- Presently 2 sites Keoladeo National Park (designated 01/10/81, Montreux record 04/07/90) Loktak Lake (designated 23/03/90,Montreux record 16/06/93)

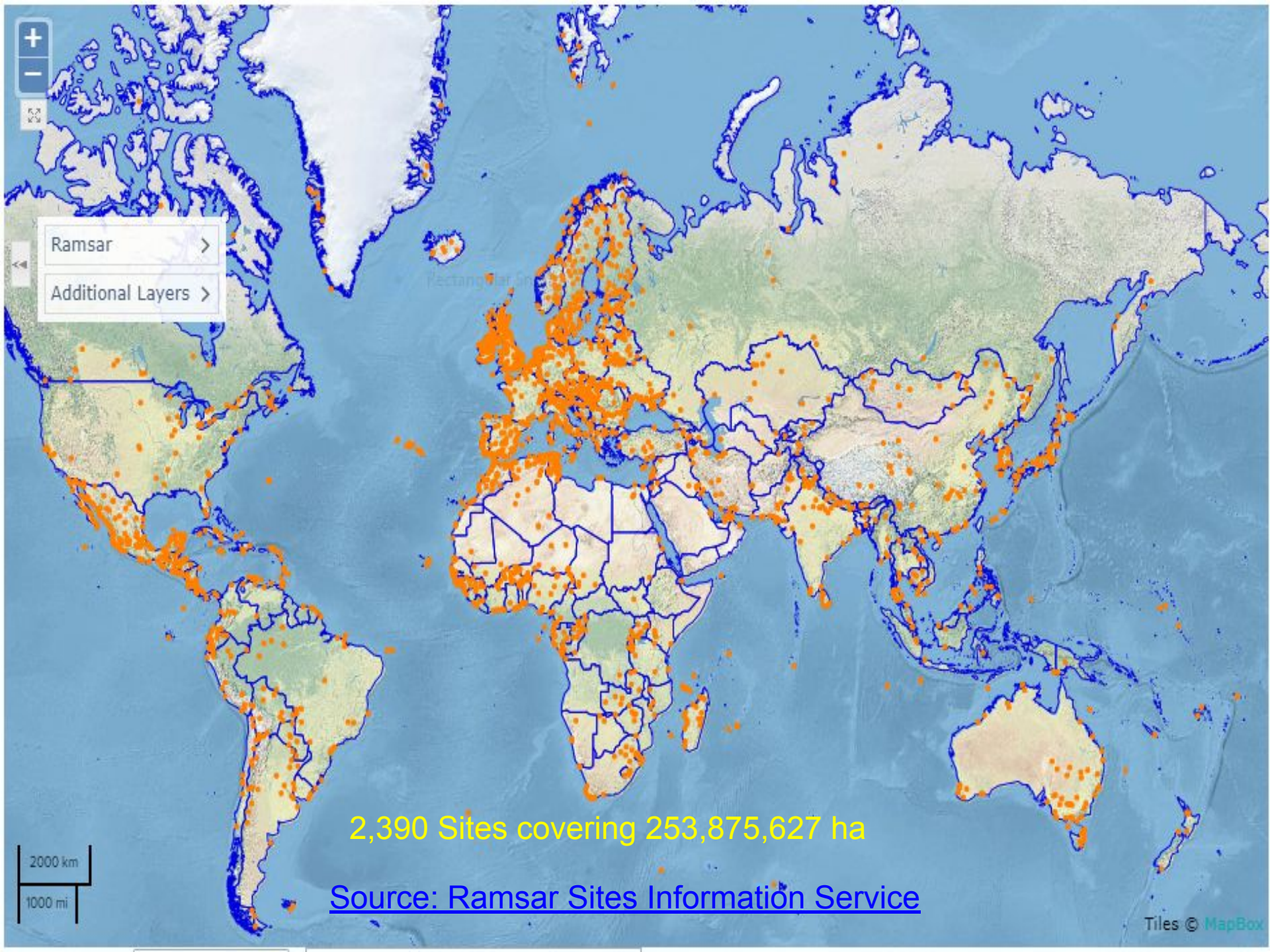

Ramsar
Additional Layers
2,390 Sites covering 253,875,627 ha
Source: Ramsar Sites Information Service
2000 km
1000 mi
Tiles © MapBox

Figure 1.1

Ecosystem services from wetlands

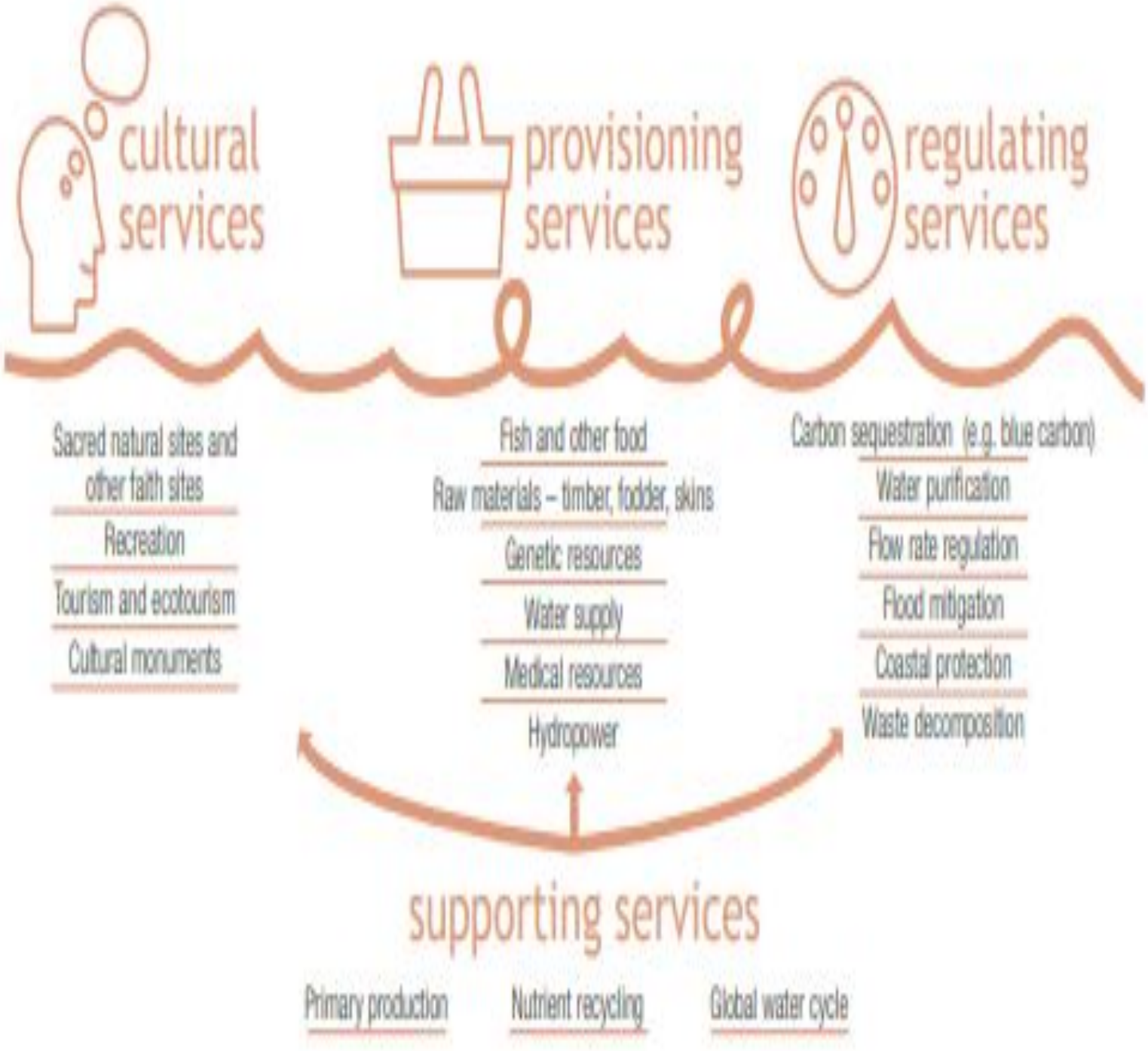
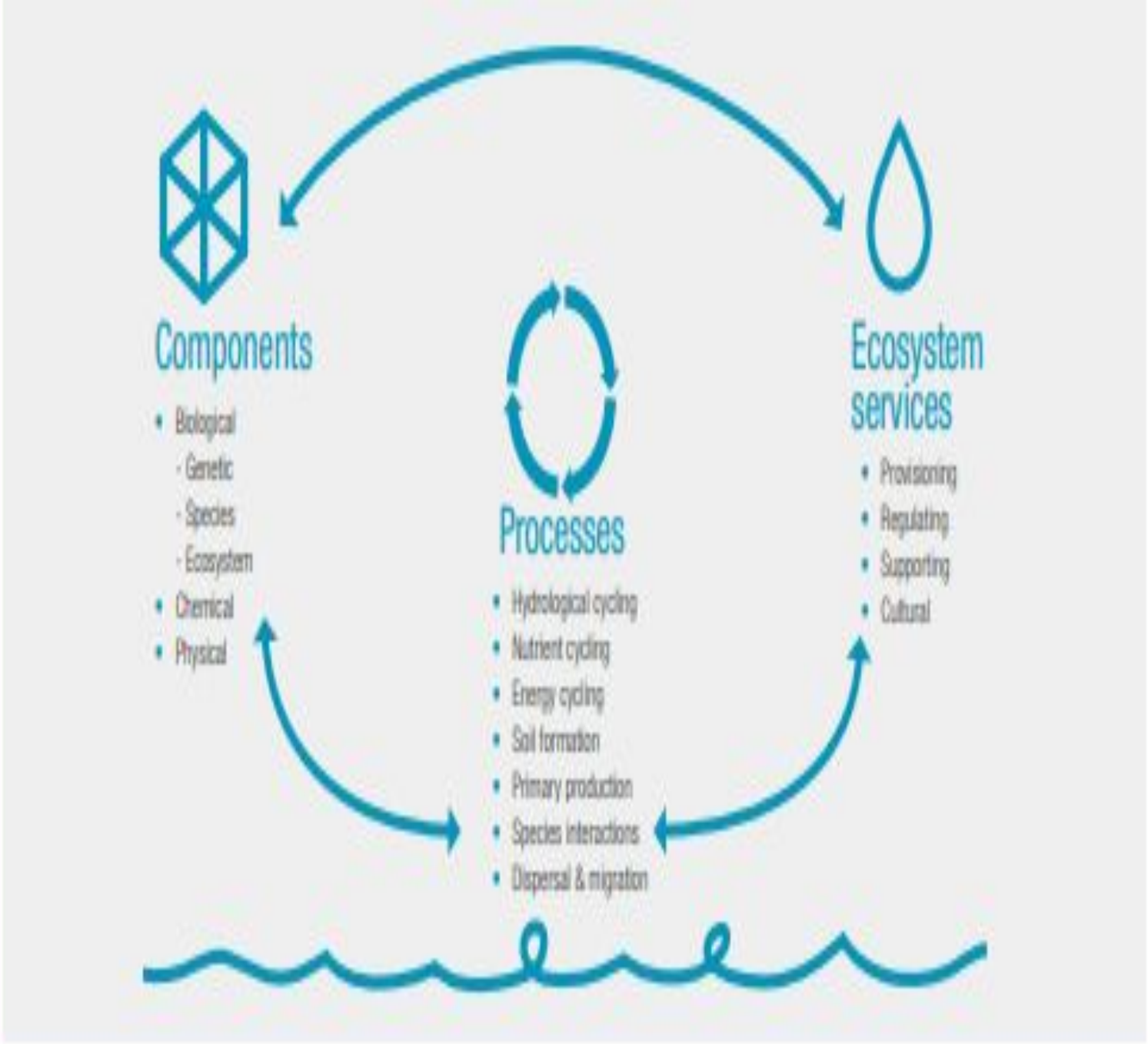


Figure 2.1

Conceptualization of ecological character as the components, processes and ecosystem services that characterize a wetland (from Finlayson et al. 2016)



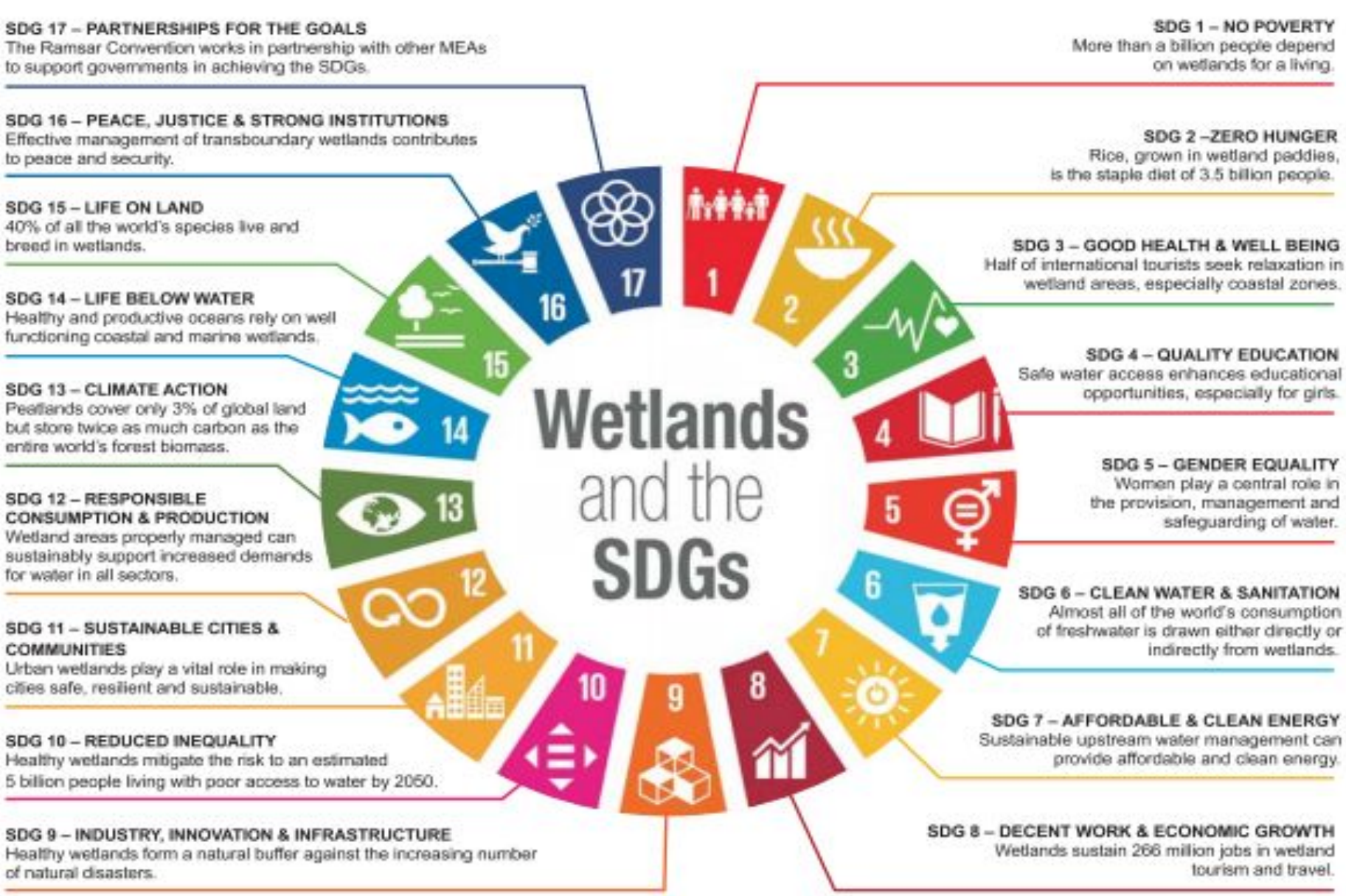


Figure 1: Wetlands and Sustainable Development Goals

(Source: Scaling up wetland conservation, wise use and restoration to achieve the Sustainable Development Goals, July 2018, www.ramsar.org)

Wetland ecosystem services

Table 2.7
Consolidated list of wetland ecosystem services

Relative importance of ecosystem services derived from different types of wetland ecosystems (based on expert opinion and from the Millennium Ecosystem Assessment 2005). The information represents a global average; there will be local and regional differences in importance, and further services could be added as considered important and where adequate information is available.

H High
M Medium
L Low
? Not known
na Not applicable

Wetland types / Services	Inland wetlands					Coastal / marine wetlands							Human-made wetlands					
	River Stream	Lake	Peatland	Marsh Swamp	Underground	Salt Marsh	Mangrove	Seagrass	Coral Reef	Shellfish Reef	Lagoon	Kelp	Reservoir	Rice Paddy	Wet Grass	Waste Ponds	Salinas	Aqua Ponds
Provisioning services																		
Food	H	H	H	H	na	H	H	M	M	M	M	L	M	H	H	L	H	H
Fresh water	H	H	L	M	H	L	na	na	na	na	L	na	M	na	na	L	na	Na
Fibre & fuel	M	M	H	H	na	L	H	na	na	na	M	na	L	na	na	L	na	L
Biochemical products	L	?	?	L	?	L	L	?	L	?	?	L	?	na	?	?	L	?
Genetic materials	L	L	?	?	?	L	L	?	L	?	?	?	L	L	?	?	L	L
Regulating services																		
Climate	L	H	H	H	L	H	H	H	M	L	L	na	M	L	L	na	L	na
Hydrological	H	H	M	M	L	M	H	na	na	na	M	na	H	M	L	na	na	na
Pollution control	H	M	M	H	M	H	H	L	L	na	M	?	L	L	L		na	na
Erosion protection	M	M	M	M	H	M	H	L	M	M	L	L	L	M	M		M	na
Natural hazards	M	H	M	H	na	H	H	M	H	M	M	L	L	L	L	na	M	na
Cultural services																		
Spiritual & inspirational	M	H	M	M	L	?	L	?	H	na	M	na	M	L	L	na	M	na
Recreational	H	H	L	M	L	?	?	?	H	na	M		H	L	L	na	L	na
Aesthetic	M	M	L	M	L	M	M	na	H	na	M	na	H	M	M	na	M	na
Educational	H	H	M	M	L	L	L	L	L	L	L	L	H	L	L	L	M	L
Supporting services																		
Biodiversity	H	H	H	H	H	M	M	L	H	M	M	L	M	M	M	L	M	L
Soil formation	H	L	H	H	na	M	M	na	Na	na	na	na	L	M	L	L	L	na
Nutrient cycling	H	L	H	H	L	M	M	L	M	na	M	L	L	M	L	H	L	L
Pollination	L	L	L	L	na	L	M	M	Na	na	?	?	L	L	M	L	L	na

Legal provisions

- **Article 48A of the Constitution of India**, which provides thus:"The State shall endeavour to protect and improve the environment and to safeguard the forests and wild life of the country.

- **Article 51A clause (g) of the Constitution** stipulates that it shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures

- **Environment (Protection) Act, 1986** is a comprehensive legislation to provide protection and improvement of the environment, including inter-alia, wetlands, and for matters connected therewith

Legal provisions contd…

- **National Environment Policy, 2006** recognises the ecosystem services provided by wetlands and emphasizes the need to set up a regulatory mechanism for all wetlands so as to maintain their ecological character, and ultimately support their integrated management

- Signatory to the **Ramsar Convention on Wetlands** and is committed to conservation and wise use of all wetlands within its territory

- Central Government considered it necessary to supersede the **Wetlands (Conservation and Management) Rules, 2010** for effective conservation and management of wetlands in the country and notified the **Wetlands (Conservation and Management) Rules, 2017** and the rules have come into force on the date of publication in the official gazette on 26th Sept,2017.
- **MOEFCC Guidelines for implementing wetlands(Conservation and Management)Rules,2017** drafted to support the State governments/UT Administration issued in 2020

Policies/Programmes

- The **National Biodiversity Action Plan** identifies wetlands as key components of biodiversity and thereby seeks their integrated management as one of the key pathways for achieving national biodiversity conservation objectives.

- **CBD Strategic Plan 2011-2020**,

  Aspects of wetlands conservation and wise use are covered under *Target 3* (Strategies for reducing rate of degradation, fragmentation and loss of natural habitats are finalized and actions put in place by 2020)

  Target 6 (ecologically representative areas on land and in inland waters, as well as coastal and marine zones, especially those of particular importance for species, biodiversity and ecosystem services, are conserved effectively and equitably)

  Target 8 (by 2020, ecosystem services, especially those related to water, human health and livelihoods and well-being are enumerated and measures to safeguard them are identified)

SOURCE: National Report to Ramsar COP13

Programmes

- The **National Climate Action Plan** identifies ***Conservation of Wetlands*** as a component of the **National Water Mission** response strategy to climate change mitigation and adaptation.

- Merger of Centrally Sponsored Schemes (CSS) of the Ministry of Environment, Forest and Climate Change for conservation of water bodies, namely the National Wetlands Conservation Programme (NWCP) implemented since 1986 and the National Lake Conservation Plan (NLCP), implemented since 2001 was integrated as scheme of **National Plan for Conservation of Aquatic Ecosystems (NPCA**) in Feb 2013.

- In April 2019 the "Guidelines for National Plan for Conservation of Aquatic Ecosystems“ were published and are intended to streamline the details required for development of institutional mechanism at National as well as State levels and optimize the project reports and proposals submitted under the NPCA.

Wetlands (Conservation and Management) Rules, 2017

"ecological character" means the sum of ecosystem components, processes and services that characterise the wetlands; { Rule 2(1)(d)}

"wise use of wetlands" means maintenance of their ecological character, achieved through implementation of ecosystem approach within the context of sustainable development{ Rule 2(1)(i)}

"zone of influence" means that part of the catchment area of the wetland or wetland complex, developmental activities in which induce adverse changes in ecosystem structure, and ecosystem services. {Rule 2(1)(j)}

4. Restrictions of activities in wetlands.—

(1) The wetlands shall be conserved and managed in accordance with the principle of 'wise use' as determined by the Wetlands Authority.

(2) The following activities shall be prohibited within the wetlands, namely,-

(i) conversion for non-wetland uses including encroachment of any kind;

(ii) setting up of any industry and expansion of existing industries;

Rules 2017 contd…..

(iii) manufacture or handling or storage or disposal of construction and demolition waste covered under the Construction and Demolition Waste Management Rules, 2016; hazardous substances covered under the Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 or the Rules for Manufacture, Use, Import, Export and Storage of Hazardous Micro-organisms Genetically engineered organisms or cells, 1989 or the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008; electronic waste covered under the E-Waste (Management) Rules, 2016;

(iv) solid waste dumping;

(v) discharge of untreated wastes and effluents from industries, cities, towns, villages and other human settlements;

(vi) any construction of a permanent nature except for boat jetties within fifty metres from the mean high flood level observed in the past ten years calculated from the date of commencement of these rules; and,

(vii) poaching

National Wetland Atlas

- 1st scientific National Inventory of wetlands of India carried out at 1:250,000 scale by Space Applications Centre (ISRO), Ahmedabad ,using IRS satellite data (1992-93 timeframe) put the total wetland extent at about 8.26 million ha.

- 'National Wetland Inventory and Assessment' project, executed by Space Application Centre, Ahmedabad to map wetlands of the country at 1: 50,000 scale.(published in March 2011)

- Using a 19 wetland type classification, State and Union territory wise wetland maps have been prepared.

- Main objectives of the project were:

A) Wetland mapping and inventory at 1: 50 000 scale by analysis of digital IRS LISS III data of post and premonsoon seasons.

B) Creation of digital database in GIS environment.

C) Preparation of State-wise wetland atlases

http://moef.gov.in/division/environment-divisions/wetland/national-wetlands-inventory-assessment/

wetlands\National Wetland Inventory Assessment.pdf

wetlands\NWIA_National_atlas.pdf

Inland wetlands types in India

Coastal wetlands types in India

NWIA Findings

Entire country including the main land and islands territories has been considered for inventory and assessment of wetlands. Total wetland area estimated is **15.260 Mha**, which is around **4.63 per cent** of the geographic area of the country. Total 201503 wetlands have been mapped at 1:50,000 scale. In addition, 555557 small wetlands (<2.25 ha) have also been identified. Excluding rivers/streams, the total wetland area estimated to be 10 Mha.

Category-wise wetland distribution in the country

Sr. No.	Wetland category	Total wetland area(ha)	% of wetland area
1	Inland Wetlands -Natural	6623067	43.40
2	Inland Wetlands -Man-made	3941832	25.83
	Total - Inland	**10564899**	**69.22**
3	Coastal Wetlands -Natural	3703971	24.27
4	Coastal Wetlands -Man-made	436145	2.86
	Total - Coastal	**4140116**	**27.13**
	Sub-Total	**14705015**	**96.36**
5	Wetlands (<2.25 ha)	555557	3.64
	Total	**15260572**	**100**

Inland-Natural wetlands accounted for around 43.4 per cent of the total area, while Coastal - Natural wetlands account for 24.3 per cent. As far as wetland units are concerned tanks are maximum in number (122370) as mappable units. However, 555557 small wetlands (< 2.25 ha) are mapped as point features (3.64 %).

Type-wise wetland area of India

Wettcode	Wetland category	Total wetland area (ha)	% of wetland area
1101	Lake/Pond	729532	4.78
1102	Ox-bow lake/ Cut-off meander	104124	0.68
1103	High altitude wetland	124253	0.81
1104	Riverine wetland	91682	0.60
1105	Waterlogged(Natural)	315091	2.06
1106	River/Stream	5258385	34.46
1201	Reservoir/Barrage	2481987	16.26
1202	Tank/Pond	1310443	8.59
1203	Waterlogged(Man-made)	135704	0.89
1204	Salt pan(Inland)	13698	0.09
2101	Lagoon	246044	1.61
2102	Creek	206698	1.35
2103	Sand/Beach	63033	0.41
2104	Intertidal mud flat	2413642	15.82
2105	Salt Marsh	161144	1.06
2106	Mangrove	471407	3.09
2107	Coral Reef	142003	0.93
2201	Salt pan(Coastal)	148913	0.98
2202	Aquaculture pond	287232	1.88
	Sub-total	**14705015**	**96.36**
	Wetlands (<2.25 ha)	555557	3.64
	Total	**15260572**	**100.00**

wetlands\National Wetland Inventory Assessment.pdf

India State of Forest Report 2019

- There are 62,466 wetlands covering 3.83% of the area within the RFA/GW of the country.
- The total number of wetlands located within the RFA/GW is 8.13%.
- Amongst the States, Gujarat has largest area of wetlands within RFA in the country followed by West Bengal.
- Large numbers of wetlands are found in forest areas
- Information about their spatial spread, extent and numbers within the forest areas was not available so far
- FSI has undertaken a new exercise of overlaying spatial layer of wet lands obtained from Space Application Center (SAC) Ahmedabad over the boundaries of RFA or green wash where RFA boundaries were not available, to derive information about the wetlands within the forest areas.
- The wetland spatial layer used in the study is the same as presented in the Wetlands Atlas of India published by SAC in 2011.
- wetlands\ISFR2019 Vol-I.pdf
- wetlands\ISFR2019 Vol-II.pdf

TABLE 2.13 Wetlands within Recorded Forest Area/Green Wash

(area in ha)

S. No.	State/UT	Inland Wetlands Natural		Inland Wetlands man-made		Coastal Wetlands Natural		Wetlands (<2.25 ha)		Total Wetlands		Wetlands Area as % of RFA
		No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	
1.	Andhra Pradesh	99	9,802	559	19,956	213	42,297	303	303	1,174	72,358	1.91
2.	Arunachal Pradesh	507	67,096	32	122	0	0	804	804	1,343	68,022	1.07
3.	Assam	1,038	65,067	19	2,263	0	0	527	527	1,584	67,857	2.46
4.	Bihar	72	2,573	50	1,256	0	0	163	163	285	3,992	0.63
5.	Chhattisgarh	101	39,987	1,182	21,996	0	0	2,415	2,415	3,698	64,398	1.22
6.	Delhi	1	2	0	0	0	0	16	16	17	18	0.18
7.	Goa	15	527	24	226	5	245	27	27	71	1,025	0.78
8.	Gujarat	560	37,958	1,677	44,454	681	11,27,652	611	611	3,529	12,10,675	39.88
9.	Haryana	16	1,700	27	150	0	0	35	35	78	1,885	3.33
10.	Himachal Pradesh	50	6,227	14	1,945	0	0	49	49	113	8,221	0.59
11.	Jammu & Kashmir	269	35,084	4	970	0	0	208	208	481	36,262	1.31
12.	Jharkhand	249	10,100	551	5,566	0	0	862	862	1,662	16,528	0.87
13.	Karnataka	123	15,344	633	36,488	21	26	1,261	1,261	2,038	53,119	1.71

(area in ha)

S. No.	State/UT	Inland Wetlands Natural		Inland Wetlands man-made		Coastal Wetlands Natural		Wetlands (<2.25 ha)		Total Wetlands		Wetlands Area as % of RFA
		No.	Area	No.	Area	No.	Area	No.	Area	No.	Area	
14.	Kerala	143	10,073	76	12,944	0	0	140	140	359	23,157	2.03
15.	Madhya Pradesh	249	71,116	2,655	85,821	0	0	5,636	5,636	8,540	1,62,573	1.83
16.	Maharashtra	686	29,947	4,257	73,062	432	10,382	3,446	3,446	8,821	1,16,837	2.07
17.	Manipur	26	12,075	9	178	0	0	171	171	206	12,424	0.71
18.	Meghalaya	138	20,627	32	769	0	0	74	74	244	21,470	1.22
19.	Mizoram	72	12,297	2	27	0	0	132	132	206	12,456	0.60
20.	Nagaland	75	11,385	3	18	0	0	119	119	197	11,522	1.08
21.	Odisha	393	13,389	795	40,227	170	8,242	2,769	2,769	4,127	64,627	1.52
22.	Punjab	46	1,446	37	1,586	0	0	36	36	119	3,068	3.32
23.	Rajasthan	284	21,519	1,275	28,064	4	4,495	2,263	2,263	3,826	56,341	1.70
24.	Sikkim	36	2,571	0	0	0	0	38	38	74	2,609	0.95
25.	Tamil Nadu	248	8,494	743	19,432	104	16,865	428	428	1,523	45,219	2.09
26.	Telangana	59	13,086	654	14,796	0	0	357	357	1,070	28,239	1.05
27.	Tripura	167	1,683	8	1,661	0	0	535	535	710	3,879	0.66
28.	Uttar Pradesh	792	31,828	660	9,497	0	0	899	899	2,351	42,224	3.14
29.	Uttarakhand	95	39,007	10	15,006	0	0	116	116	221	54,129	2.12
30.	West Bengal	353	2,20,751	863	5,542	239	2,02,123	10,060	10,060	11,515	4,38,476	32.68
31.	Andaman & Nicobar Is.	47	1,636	7	278	2,153	87,048	60	60	2,267	89,022	13.19
32.	Chandigarh	4	60	0	0	0	0	0	0	4	60	6.09
33.	Dadra & Nagar Haveli	3	58	1	263	0	0	1	1	5	322	1.53
34.	Puducherry	1	6	0	0	7	121	0	0	8	127	41.64
Total		**7,017**	**8,14,521**	**16,859**	**4,44,563**	**4,029**	**14,99,496**	**34,561**	**34,561**	**62,466**	**27,93,141**	**3.83**

Notifying wetland and Integrated management plan

- Preparing a list of wetlands
- Delineating wetlands
- Delineating zone of influence
- Wetlands wise use and ecological character
- Permission for carrying out prohibited activity (rule 4(2))within notified wetland:

  A specific request needs to be made by the State Government based on the recommendation of Wetlands Authority specifying: a) Activity for which permission is sought; b) Justification thereof; c) The premise on which the activity is not considered detrimental to the wetland's ecological character; & d) Supporting evidence-base (such as an expert report, EIA, mitigating measures proposed to be undertaken etc.)

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Contd..

- Developing a list of activities, to be regulated in a notified wetland
- Developing a list of activities permitted in a notified wetland
- Registration of wetlands
- Notifying wetlands

A 'Brief Document' with following details is to be prepared by nodal dept and approved by wetlands Authority

a) Demarcation of wetland boundary, supported by accurate digital maps with coordinates and validated by ground truthing;

b)Demarcation of its zone of influence alongwith land use and land cover thereof indicated in a digital map;

c) Ecological character description;

d) Account of pre-existing rights and privileges;

e) List of site-specific activities, to be permitted within the wetland and its zone of influence;

f) List of site-specific activities, to be regulated within the wetland and its zone of influence; and,

g) Modalities for enforcement of regulation.

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Integrated management plan

A document which describes strategies and actions for achieving 'wise use' of the wetland

- includes objectives of site management;
- management actions required to achieve the objectives;
- factors that affect, or may affect, various site features;
- monitoring requirements for detecting changes in ecological character and for measuring the effectiveness of management;
- resources for management implementation.
- Helps in generating baseline information,
- communication with stakeholders
- ensuring compliance with regulatory frameworks and policy commitments.
- wetlands\final-version-and-printed-wetland-guidelines-rules-2017-03.01.20 (1).pdf
- wetlands\MoM_NWC_-26_07_2018.pdf
- wetlands\Minutes-of-2nd-NWC-meeting-held-on-05.11.2019.pdf

Hon. SC, High Court cases

- Order dated 4 th October 2017 passed by the Apex Court in Writ Petition (C) No.230/2001 (M.K.Balakrishnan and others v. Union of India) which directs that the wetlands that have been mapped by the Union of India should be continued to remain protected on the same principles as were formulated in Rule 4 of the Wetland (Conservation and Management) Rules, 2010 (for short "the Wetlands Rules of 2010").

wetlands\M.K._Balakrishnan_._vs_Union_Of_India_Ministry_Of_..._on_4_October,_2017.PDF

wetlands\Wetlands_Rules_New_Delhi_MoEF_November_2010.pdf

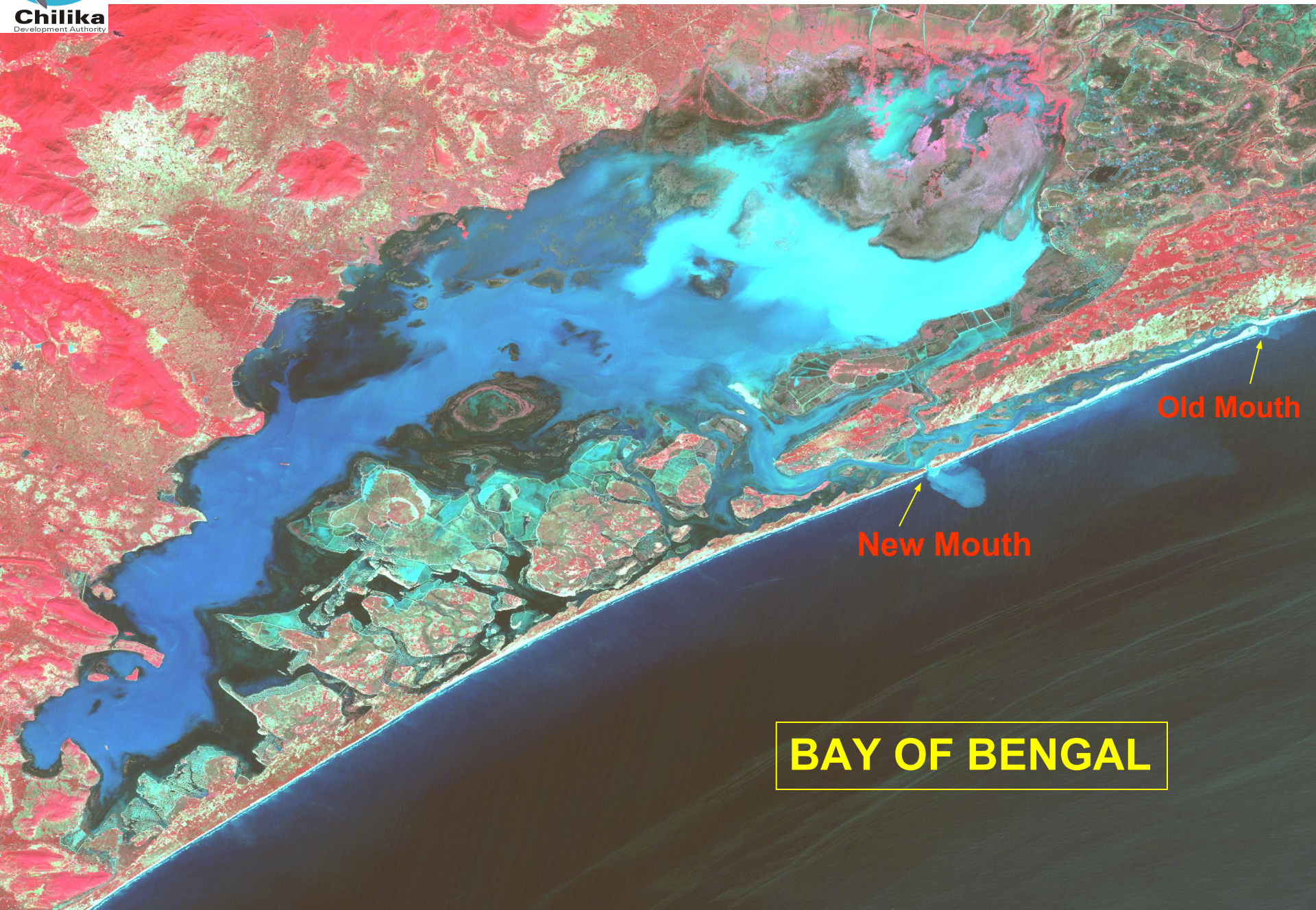
- Hon.Bombay High Court in Vanashakti Public Trust And 5 Ors vs Union Of India And 11 Ors on 15 January, 2020 ordered the following regarding submission of brief documents and for reporting there are no wetlands in Parbhani,Nandurbar and Nagpur.

"copies of all brief documents prepared for all wetlands in the State of Maharashtra shall be supplied to the Petitioner so as to enable the Petitioner to verify whether brief documents of all wetlands as already identified under the National Wetlands Atlas - Maharashtra, are being prepared and in a proper manner".

wetlands\Vanashakti_Public_Trust_And_5_Ors_vs_Union_Of_India_And_11_Ors_on_15_January,_2020.PDF

IRS 1D LISS III IMAGE OF CHILIKA LAGOON

DATE : 23rd OCTOBER 2000



Improvement after hydrological intervention

- Eight fold increase in annual fish and prawn landing

- Avg. increase in monthly family income of fishermen by Rs.5000 to 10000 during peak season, and Rs. 50 000 per annum after opening of the new mouth

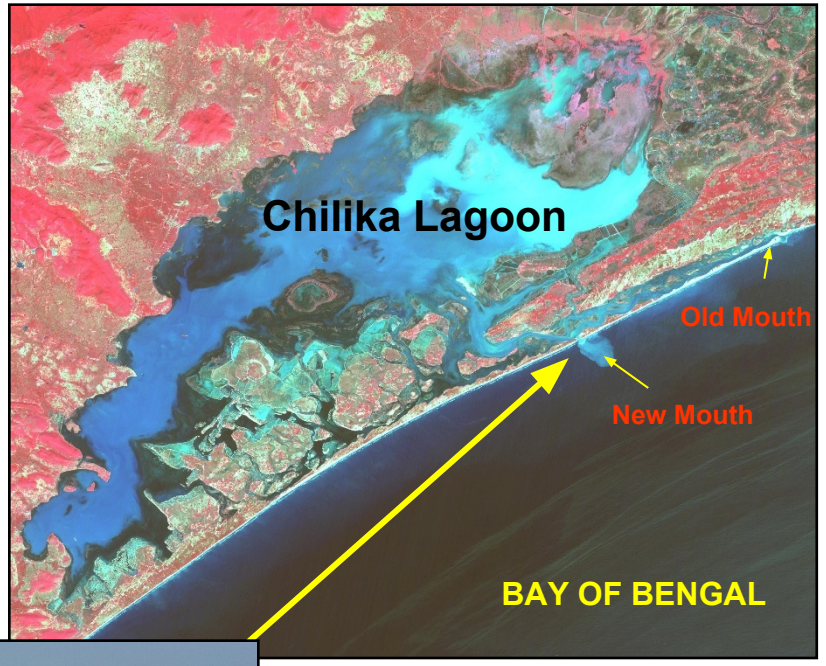
- Increase in salinity flux by 40%

- Increase in tidal flux by 45%

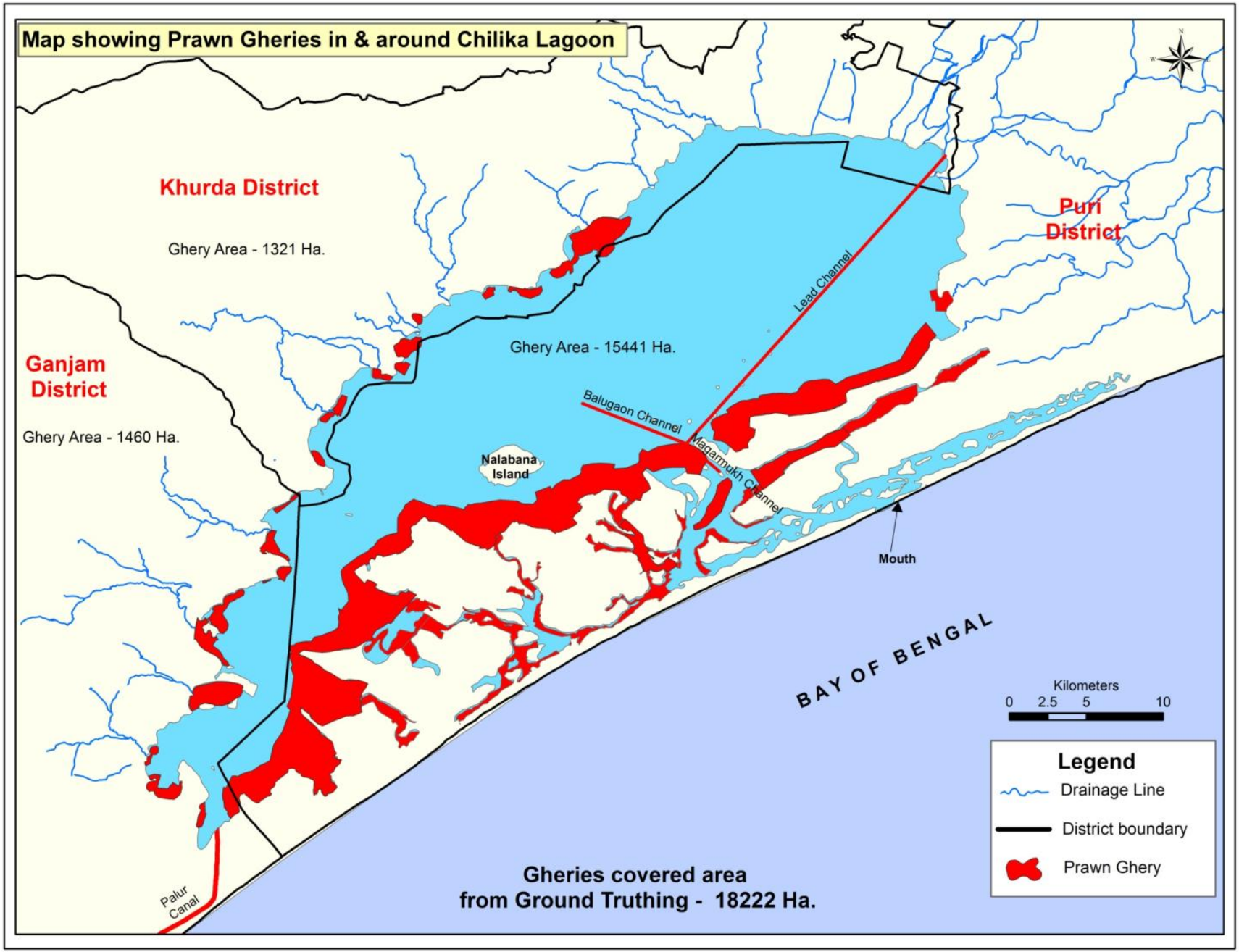
- Improvement of sediment flushing

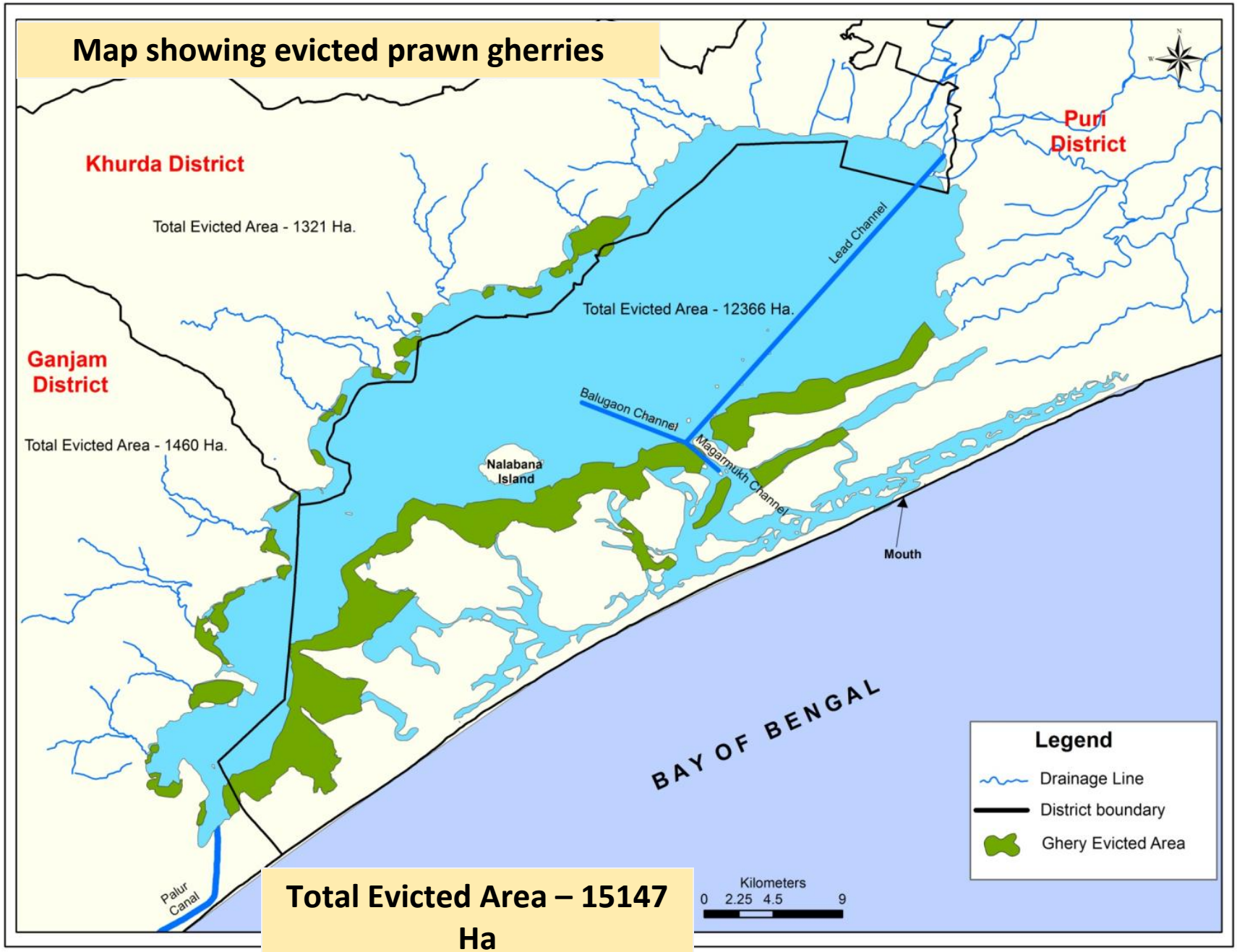
- Quick discharge of flood water

- Decrease of invasive species by 162 sq km



Opening of the New Mouth

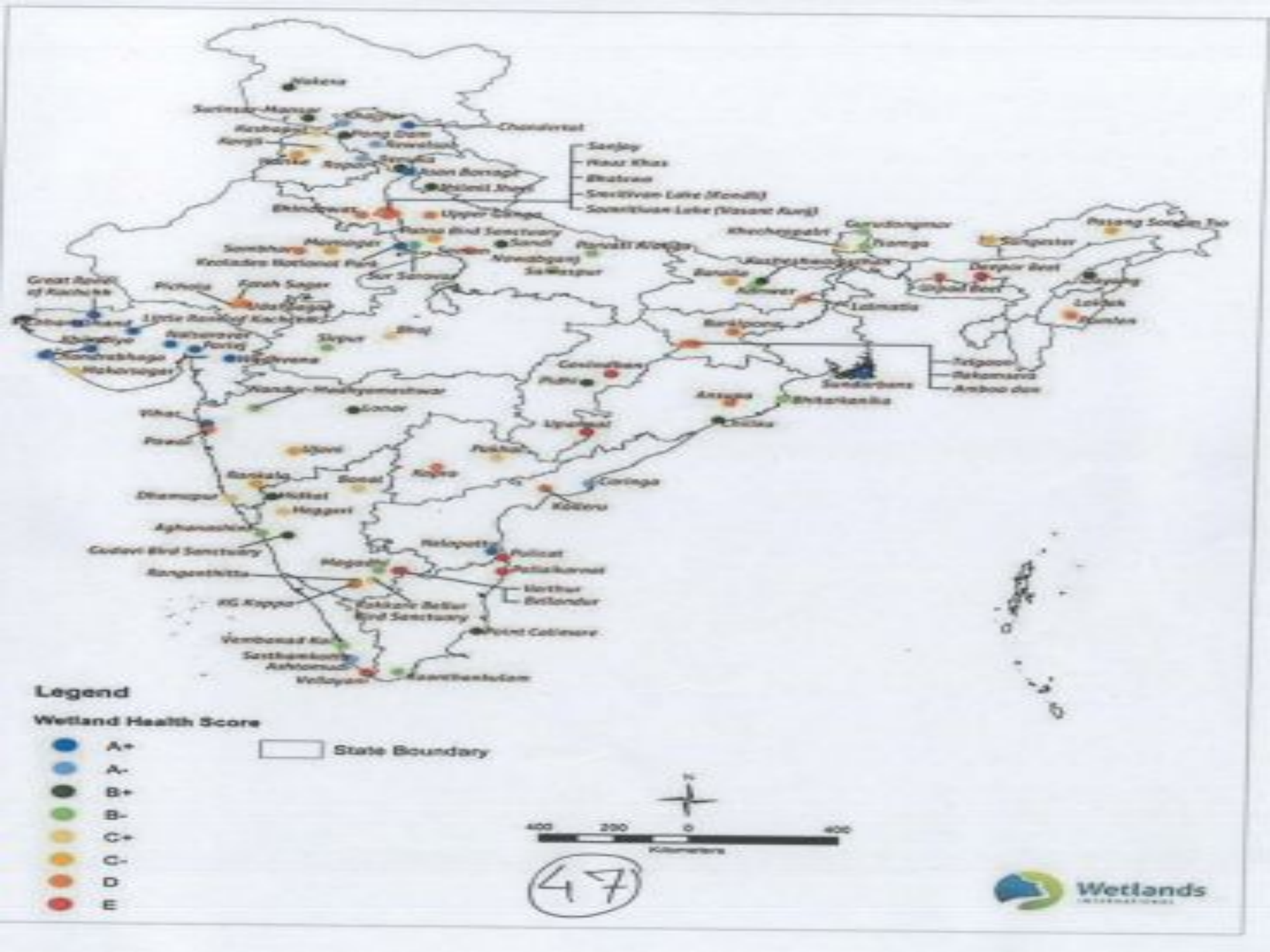

Map showing Prawn Gheries in & around Chilika Lagoon
Khurda District
Ghery Area - 1321 Ha.
Puri District
Lead Channel
Ghery Area - 15441 Ha.
Ganjam District
Ghery Area - 1460 Ha.
Balugaon Channel
Magarmukh Channel
Nalabana Island
Mouth
BAY OF BENGAL
Kilometers
0 2.5 5 10
Legend
Drainage Line
District boundary
Prawn Ghery
Palur Canal
Gheries covered area
from Ground Truthing - 18222 Ha.


Map showing evicted prawn gherries
Khurda District
Total Evicted Area - 1321 Ha.
Puri District
Lead Channel
Total Evicted Area - 12366 Ha.
Ganjam District
Total Evicted Area - 1460 Ha.
Balugaon Channel
Magamukh Channel
Nalabana Island
Mouth
BAY OF BENGAL
Palur Canal
Legend
Drainage Line
District boundary
Ghery Evicted Area
Kilometers
0 2.25 4.5 9
Total Evicted Area – 15147 Ha

Impact of eviction of gherries

1. Increase in **fish production by 20%** in last 6 months (in monetary terms this amounts to Rs100 crores) compared to the same time last year.
2. Spectacular enhancement in the landing of **Bagada prawn**, increased by nearly 500% during the last quarter in 2017 in comparison to 2016
3. Appearance of **sponge** in certain sector of the lake for the first time after 1985
4. Distribution of **Irrawaddy dolphins** through out the lake
5. **New habitat** for migratory birds at Parikuda, Barunakuda and other places
6. Enhancement of **Seagrass**, indicating improved hydrological condition and habitat of mud crabs.

Chilika
Development Authority


Legend
Wetland Health Score
A+
A-
B+
B-
C+
C-
D
E
State Boundary
400 200 0 400
Kilometers
47
Wetlands

Suggested readings/viewings

- **Wetland ecology –Principls and Conservation Paul A.keddy**
- **WWF –INDIA's Handbook of Wetland Management**
- https://www.ramsar.org/
- http://moef.gov.in/division/environment-divisions/wetland/wetlands-publications/
- http://moef.gov.in/division/environment-divisions/wetland/global-wetland-outlook/
- https://www.chilika.com/eco-restoration.php
- wetlands\Chilika Lake Restoration and Management_Addl.CE 14112019.ppt

- Curious Case of Mangrove Resurgence | Narayan Vasudevan -Chief Conservator-Forest | TEDxGatewaySalon https://www.youtube.com/watch?v=bcTJ7oReRIg

THANK YOU