



**Wetland**

**Protecting Water and Life**

## Chapter 4

### Wetlands – Protecting Water and Life

#### Introduction

1. It is increasingly being realised that the planet Earth is facing grave environmental problems, with fast depleting natural resources threatening the very existence of many ecosystems. One of the important ecosystem under consideration is Wetlands. Wetlands are areas of land that are either seasonally or permanently covered by water, or nearly saturated by water. This means that a wetland is neither truly aquatic nor terrestrial; although in some cases, wetlands can switch between being aquatic or terrestrial for periods of time depending on seasonal variability. Thus, wetlands exhibit enormous diversity according to their genesis, geographical location, water regime and chemistry, dominant plants and soil or sediment characteristics. Because of their transitional nature, the boundaries of wetlands are often difficult to define. Wetlands do, however, share a few attributes common to all forms. Of these, hydrological structure (the dynamics of water supply, throughput, storage and loss) is most fundamental to the nature of a wetland system. The presence of water for a significant period of time is principally responsible for the development of a wetland.

2. One of the first widely used classifications systems, devised by Cowardin et al (1979), associated the wetlands with their hydrological, ecological and geological aspects, such as: marine (coastal wetlands including rock shores and coral reefs, estuarine (including deltas, tidal marshes, and mangrove swamps), lacustrine (lakes), riverine (along rivers and streams), palustrine ('marshy'- marshes, swamps and bogs). Given these characteristics, wetlands support a large variety of plant and animal species adapted to fluctuating water levels, making the wetlands of critical ecological significance. Utility wise, wetlands directly and indirectly support millions of people in providing services such as food, fibre and raw materials, storm and flood control, clean water supply, scenic beauty and educational and recreational benefits. Although there are many classification systems for wetlands in the world, the Ramsar classification system is the most preferred one.

3. The 1971 Ramsar Convention on Wetlands of International Importance is the oldest conservation convention. It owes its name to its place of adoption in Iran. It came into being due to serious decline in populations of waterfowl (mainly ducks) and conservation of habitats of migratory waterfowl. This Convention provides a framework for the conservation and 'wise use' of wetland biomes. The Ramsar Convention is the first modern global intergovernmental treaty on conservation and wise use of natural resources ([www.ramsar.org](http://www.ramsar.org)). The Ramsar Convention entered into force in 1975. Under the text of the Convention (Article 1.1) wetlands are defined as:

*“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”.*

4. In addition, the Convention (Article 2.1) provides that wetlands:  
*“may incorporate 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”.*

5. The Millennium Ecosystem Assessment estimates conservatively that wetlands cover 7% of the earth’s surface and deliver 45% of the world’s natural productivity and ecosystem services of which the benefits are estimated at \$20 trillion a year<sup>1</sup>.

### **Wetlands in India**

6. India’s vast geographical extent supports a large and diverse number of wetland classes, some of which are unique. Wetlands in India, estimated to occupy less than 5 per cent of geographical area of the country, support about a fifth of the known biodiversity. Like any other place in the world, there is a looming threat to the aquatic biodiversity of the Indian wetlands as they are under a regime of increasing human pressures. To offset the pressure, the Government of India has initiated several steps in terms of policies, programmes and plans for the preservation and conservation of these ecosystems. India is a signatory to the Ramsar Convention for management of wetlands, thus, extending the scope of conserving the biodiversity and wise use to a wide variety of habitats, including rivers and lakes, coastal lagoons, mangroves, peatlands, coral reefs, as well as numerous human-made wetlands. The government has identified a number of wetlands for conservation and management under the National Wetland Conservation Programme and helps the local governments implement the Management Action Plan for these wetlands.

7. Wetlands of India have been classified into 19 classes. River/stream reservoir/barrage, inter-tidal mud-flat and natural lake/pond are some of the major wetland types of India. Lagoon, mangrove, coral, riverine wetland and high altitude lake (>3,000 m elevation) are some of the unique wetland types of the country. Each wetland type also exhibits a wide diversity in terms of shape, size, water quality, aquatic vegetation etc. The classes of wetlands are listed below:

- |                                  |                            |
|----------------------------------|----------------------------|
| i. Lake/ pond                    | vi. River/ Stream          |
| ii. Ox-bow lake/ Cut-off meander | vii. Reservoir/ Barrage    |
| iii. High altitude wetland       | viii. Tank/ Pond           |
| iv. Riverine wetland             | ix. Waterlogged (Man-made) |
| v. Waterlogged (Natural)         | x. Salt pan                |

<sup>1</sup> <https://www.millenniumassessment.org/en/index.html>

- |                          |                       |
|--------------------------|-----------------------|
| xi. Lagoon               | xvi. Mangrove         |
| xii. Creek               | xvii. Coral Reef      |
| xiii. Sand/ Beach        | xviii. Salt pan       |
| xiv. Intertidal mud flat | xix. Aquaculture pond |
| xv. Salt Marsh           |                       |

### Extent of Wetlands in India

8. Recognizing the fact that an updated geospatial data base of these natural resources is the pre-requisite for management and conservation planning, National Wetland Inventory and Assessment (NWIA) project was formulated as a joint programme of Ministry of Environment & Forests, Government of India, and Space Applications Centre, ISRO, Ahmedabad.

9. Under the NWIA Project, the entire country, including the island territories, was considered for inventory and assessment of wetlands. Mapping was carried out on 1:50,000 scale. Area estimates of various wetland categories for India were compiled using GIS layers of wetland boundary, water-spread, aquatic vegetation and turbidity. A total of 2,01,503 wetlands have been mapped at 1:50,000 scale in the country. In addition, 5,55,557 wetlands of less than 2.25 hectares have also been identified. The total wetland area is estimated to be 15.26 million hectares (Mha), which is around 4.63 percent of the geographic area of the country.

10. Wetlands were categorised in to 2 major categories, 4 sub-categories and 19 classes. The area of inland wetlands was estimated as 10.56 Mha and the area of coastal wetlands as 4.14 Mha. Category-wise distribution of wetlands in the country are shown in **Table 1**. An analysis of wetland status in terms of open water shows that out of the total wetland area, the extent of open water is 58.5 per cent in post-monsoon and 39.4 per cent in pre-monsoon. There is a significant reduction in the extent of open water (about 32.5%) from post-monsoon to pre-monsoon conditions (8.60 Mha to 5.80 Mha). It is reflected in all the inland wetland types. The aquatic vegetation in India accounts for about 9 and 14 per cent of total wetland area in post-monsoon (1.32 Mha) and pre-monsoon (2.06 Mha) respectively.



**Table 1: Area of Wetlands in India, 2006-07**

(Area in Hectare)

S. No.	Wetland Category	Number of Wetlands	Total wetland Area	% of Wetland Area	Open Water	
					Post-monsoon Area	Pre-monsoon Area
1a	Inland Wetlands - Natural	45,658	6,62,3067	43.4	41,00,766	31,15,701
1b	Inland Wetlands - Man-made	1,42,812	39,41,832	25.83	32,67,602	16,54,170
1	<b>Total - Inland</b>	<b>1,88,470</b>	<b>1,05,64,899</b>	<b>69.23</b>	<b>73,68,368</b>	<b>47,69,871</b>
2a	Coastal Wetlands - Natural	10,204	37,03,971	24.27	9,30,663	7,50,339
2b	Coastal Wetlands - Man-made	2,829	4,36,145	2.86	3,01,767	2,81,010
2	<b>Total - Coastal</b>	<b>13,033</b>	<b>41,40,116</b>	<b>27.13</b>	<b>12,32,430</b>	<b>10,31,349</b>
	<b>Sub-Total</b>	<b>2,01,503</b>	<b>1,47,05,015</b>	<b>96.36</b>	<b>86,00,798</b>	<b>58,01,220</b>
3	Wetlands (<2.25 ha)	5,55,557	5,55,557	3.64	-	-
	<b>Total</b>	<b>7,57,060</b>	<b>1,52,60,572</b>	<b>100</b>	<b>86,00,798</b>	<b>58,01,220</b>

<b>Area under Aquatic Vegetation</b>	13,22,837	20,65,096
<b>Area under turbidity levels</b>		
Low	32,06,003	18,88,493
Moderate	41,68,401	29,67,523
High	12,26,394	9,45,204

*State-wise details on extent of Wetlands is given in Statement 4.1.*

*State-wise and Class-wise details on extent of Wetlands are given in Annexure-4.1.*

### **Assessment of Condition of Select Wetlands in India**

11. The Ministry of Environment, Forest and Climate Change (MoEFCC) aims to conserve a network of healthy wetlands which sustain rich biodiversity and provide wide ranging ecosystem services for societal well-being. 'Wetlands rejuvenation' is a transformative idea of the Government of India, under which systematic rejuvenation is being initiated of selected wetlands on the basis of well-defined and targeted management plans and with active stakeholder collaboration. The State Wetlands Authorities and wetlands managers are at the forefront of implementation of this programme, with the Ministry providing an enabling environment in the form of programmatic framework, capacity development, and financing (on convergence basis).

12. The programme is structured around a four pronged approach:
  - i. Developing baseline information
  - ii. Rapid assessment of wetlands condition
  - iii. Enabling stakeholder platforms
  - iv. Management planning
  
13. Technical handholding for the programme is done by six knowledge partners:
  - i. Wetlands International South Asia
  - ii. Salim Ali Center for Ornithology and Natural History
  - iii. World Wide Fund for Nature India
  - iv. Chilika Development Authority
  - v. The Environmental Planning and Coordination Organization
  - vi. Gujarat Ecological Education and Research Foundation
  
14. In the first cycle of the programme, during 2019-20, 130 wetlands were selected in consultation with State Governments. MoEFCC rolled out an ecosystem health report card system for these selected wetlands to enrich management planning processes for ecological rehabilitation. The entire process was implemented under the guidance of MoEFCC by the State Governments in collaboration with knowledge partners. The report card is designed as a scoring tool for assessing ecosystem health in terms of a set of indicators with reference to their desired values. The purpose of the tool is to communicate complex and large amount of ecosystem information to a broad audience in a simple manner.

### **The Scoring method**

15. The scoring method follows a three stage approach for Ecosystem Health and Ecosystem Threats. Additionally, information was also collected on Ecosystem Services and Rights and Privileges. For Ecosystem Health and Ecosystem Threats, scores provided to each of the categories were then aggregated to provide a score for the wetland. The selection of indicators & approach for assessment of health of wetlands, seems to borrow (although not strictly) from the discussion papers on the compilation of ecosystem condition accounts proposed for the revised SEEA-EEA<sup>2</sup>.

### **Ecosystem Health**

16. For ecosystem health assessment, a set of nine indicators (**Table 2**) under four categories were selected, primarily on the basis of their relevance to management and ease of reporting.

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<sup>2</sup>[https://seea.un.org/sites/seea.un.org/files/documents/EEA/ec\\_discussionpaper\\_23\\_typology-v22-clean.pdf](https://seea.un.org/sites/seea.un.org/files/documents/EEA/ec_discussionpaper_23_typology-v22-clean.pdf)

**Table 2: Ecosystem Health Indicators**

Category	Indicator	Desired Value
Conversion to non-wetlands use	% wetland area converted to non-wetland use since the year 2000	No conversion to non-wetland use
Hydrological regimes	Ratio of natural inlets choked and diverted to total number of natural inlets	<0.2
	Ratio of natural outlets choked & diverted to total number of natural outlets	<0.2
	% of water quality samples conforming to desired Biological Oxygen Demand / Dissolved Oxygen levels*	Dissolved Oxygen $\geq$ 6 mg/l Biological Oxygen Demand: Between 3 - 6 mg/l *For urban wetlands: Chemical Oxygen Demand: < 50 mg/l
Biodiversity	% wetland area covered by invasive macrophytes	< 10%
	Annual January water bird count as a proportion to maximum count observed count in last 10 years (only for protected areas of high ornithological value)	0.7 and above
Governance	Status of wetland mapping	Wetlands map prepared and approved by State Wetlands Authority
	Status of wetland management action plan	Management Action Plan prepared and approved by State Wetlands Authority
	Status of notification	Wetland notified under extant regulation

17. The proposed SEEA Ecosystem Condition Typology (SECT), as framed in the discussion paper cited above, prescribes selection of indicators across several classes including the abiotic & biotic ecosystem characteristics and landscape level characteristics. The indicators selected for preparation of the wetland health card, as shown in **Table 2** above, can easily be mapped to the classes of the SECT. For example, indicators on the natural inlets or outlets and those on water quality can be mapped to abiotic ecosystem characteristics. Similarly, indicators on invasive macrophytes and

water bird count can be mapped to biotic ecosystem characteristics. Indicator on conversion of wetland may be classified under Landscape level characteristics.

18. For each indicator, a score was assigned based on the extent to which the desired values were met (A for total conformity and E for maximum deviation). An ecosystem health score was computed by using a weighted average (A=1, B=0.8, C=0.6, D=0.4 and E=0.2). These were converted into ecosystem health ranks as shown in the following **Table 3**.

**Table 3: Ecosystem Health Scores and Ranks**

Ecosystem Health Score	Ecosystem Health Rank	Health Category
Between 0.96 - 1	A+	Very good
Between 0.91 - 0.95	A-	Very good
Between 0.86 - 0.90	B+	Good
Between 0.81 - 0.85	B-	Good
Between 0.76 - 0.80	C+	Moderate
Between 0.71 - 0.75	C-	Moderate
Between 0.61 - 0.70	D	Low
0.60 and below	E	Very Low

### Ecosystem Threats

19. The data on threats for each wetland were organized into the following four categories:

- Physical regime change (adverse change in water quality and quantity, sediments and salinity)
- Extraction (water, biota, soil and minerals)
- Introduction (pollutants, invasive species)
- Structural modification of habitat (drainage, conversion into non-wetland use or encroachment)

20. Each threat was scored between 3 to 1, from high to low (no value when not applicable). The total threat score was normalized by dividing by the maximum score value across all wetlands. The scores were then converted into ranks (**Table 4**). An increase in threat score is an indicator of increasing threats.

**Table 4: Threat Scores and Rank**

Threat Score	Threat Rank	Threat Category
Between 0.91 - 1	A+	Very high
Between 0.81 - 0.9	A-	Very high



Threat Score	Threat Rank	Threat Category
Between 0.71 - 0.80	B+	High
Between 0.61 - 0.70	B-	High
Between 0.51 - 0.60	C+	Moderate
Between 0.41 - 0.50	C-	Moderate
Between 0.31 - 0.40	D	Low
0.30 and below	E	Very Low

### Ecosystem Services

21. Data on ecosystem services was reported in binary form (Yes or No) and information was obtained on following categories:

**Table 5: Ecosystem Services Categories**

Provisioning services	Source of drinking water for people living in and around Source of water for agriculture Fisheries Source food plants Source of medicinal plants Water for animals Inland transportation Source of soil and other material (such as salt)
Regulating services	Buffer from extreme events as floods and storms Groundwater recharge Water purification Sediment and nutrient sink
Cultural services	Recreation and tourism Significant religious and cultural values
Habitat services	Supports noteworthy plant species Supports noteworthy animal species Site of high congregation of migratory water birds Supports life cycle of fish and amphibians

22. For each wetland, an ecosystem services score (provisioning, regulating, cultural and habitat) has been derived by calculating the ratio of ecosystem services observed in a wetland to the total number of ecosystem services for a particular category.

### Rights and Privileges

23. Data on rights and privileges is also reported in binary form (Yes or No) and has been aggregated for each site in terms of frequencies.

## Description of sample

24. For the first cycle of assessments of wetlands under the “Wetland Health Scheme”, data on 116 wetlands was received from 30 States and Union Territories (Table 6). The wetlands covered nine of the ten biogeographic zones (only islands were missed) and ranged in area from 0.4 ha (Khajjiar, Himachal Pradesh) to 0.75 Mha (Great Rann of Kutch, Gujarat). The assessment covered 22 of the wetlands declared as Ramsar Sites.

**Table 6: Distribution of wetlands included under different biogeographic zones (BGZ) and area categories**

BGZ	<= 10 ha	10- 100 ha	100- 1,000 ha	1,000 - 5,000 ha	5,000 - 10,000 ha	10,000- 50,000 ha	50000- 1,00,000 ha	>1,00,000 ha	Grand Total
Arid	1	1	8		1	2		2	15
Coastal			10	2	1	3			16
Deccan Peninsula	4	11	8	2	2	2	1		30
Himalayas	1	3	3	2		3			12
North East	1	1	2	3		1	1	1	10
Northern plains		2	5	6	1	1		1	16
Semi-Arid	3	2	6	1		1			13
Trans Himalayas	1		1						2
Western Ghats			1					1	2
<b>Grand Total</b>	<b>11</b>	<b>20</b>	<b>44</b>	<b>16</b>	<b>5</b>	<b>13</b>	<b>2</b>	<b>5</b>	<b>116</b>

## Results

25. The ecosystem health assessment undertaken by MoEFCC is significant in terms of pan-India efforts to understand the status of wetland condition, drivers of change and management. Despite including a small subset of extensive wetland regime in the country (116 out of 0.77 million) and a narrow range of ecosystem health indicators, the assessment throws up several insights into management needs of wetlands. The distribution of wetlands, in terms of the aggregate scores for ecosystem health and the threat status, can be seen in Table 7. Further, the detailed assessment may be seen at Annexure 4.2.

**Table 7: Distribution of wetlands in terms of the aggregate scores for ecosystem health and the threat status**

Category	Very High (A+ & A-)	High (B+ & B-)	Moderate (C+ & C-)	Low D	Very Low E	Total
Ecosystem health	21	33	26	23	8	111
Threat status	11	17	25	15	43	111

Note: Five wetlands have not been classified because of unavailability of requisite data.

26. Table 8 shows the state-wise distribution of the selected wetlands in the different aggregate score classes in respect of Ecosystem Health.

**Table 8: Number of wetlands in different 'Ecosystem Health' score classes**

State / UT	Very High (A+ & A-)	High (B+ & B-)	Moderate (C+ & C-)	Low D	Very Low E	Total
Andhra Pradesh	2	0	1	1		4
Arunachal Pradesh	0	0	2			2
Assam	0	0	0	1	1	2
Bihar	0	2	1			3
Chhattisgarh	0	1	0		2	3
Delhi	0	0	0	5		5
Gujarat	8	0	1			9
Gujarat	0	0	0			0
Haryana	0	0	1			1
Himachal	3	2	0			5
INTERSTATE	0	0	0		1	1
Jammu	0	1	0			1
Jharkhand	0	0	0	5		5
Karnataka	0	5	3	1	2	11
Kashmir	0	2	0			2
Kerala	2	1	0		1	4
Ladakh	0	0	0			0
Madhya Pradesh	0	2	0			2
Maharashtra	1	2	3	1		7
Manipur	0	0	1	1		2
Meghalaya	0	0	1			1
Mizoram	0	1	0			1
Nagaland	0	1	0			1
Odisha	0	2	0	1		3
Punjab	1	0	3			4
Rajasthan	1	0	2	3		6
Sikkim	0	2	1			3
Tamil Nadu	0	2	0		1	3
Telangana	0	0	1	1		2

State / UT	Very High (A+ & A-)	High (B+ & B-)	Moderate (C+ & C-)	Low D	Very Low E	Total
Tripura	0	0	1			1
Uttar Pradesh	1	6	4	2		13
Uttarakhand	1	1	0			2
West Bengal	1	1	0			2
<b>All India</b>	<b>21</b>	<b>34</b>	<b>26</b>	<b>22</b>	<b>8</b>	<b>111</b>

Note: Five wetlands have not been classified because of unavailability of requisite data. Pulicat wetland is shown as INTERSTATE.

27. The assessment is not intended to create a comprehensive picture of wetlands in the country. The results are derived from a select set of wetlands only, which is *not representative of the entire wetlands* distribution. Being a pilot study, the focus was on demonstrating application of a concept and building capacity of wetlands managers in this aspect.

28. Being selective in nature, the ecosystem health indicators present a partial view of the wetlands' condition. The coverage of indicators may need to be broadened in the next iterations, particularly including aspects of wetland catchments, inundation regime, ecological productivity, status of species of high conservation value, sustainability of resource use (such as harvest of fish, aquatic vegetation), and institutional aspects (such as involvement of stakeholders in management planning process, the quality of monitoring and evaluation etc.).

29. It cannot be emphasized enough that the uniqueness of each wetland needs to be understood for the rejuvenation programme to be effective. Nevertheless, the patterns in the scores in different categories may help define sectoral convergence needs and priorities. For example, in order to secure the buffering functions of wetlands, it is pertinent that district and state disaster management plans understand the importance of the rights and privileges, as also the threats, and integrate these values of wetlands into their programmatic design so as to ensure that the proposed interventions in the disaster management sector do not adversely impact the wetlands.

### Ramsar Sites (Wetlands) in India

30. Wetland ecosystems are vital for sustenance and growth of all life forms and are of immense ecological, socio-economic as well as cultural importance. However, wetlands remain the most threatened of all natural resources and are disappearing three times faster than forests<sup>3</sup>.

<sup>3</sup> [http://moef.gov.in/wp-content/uploads/2019/09/Ramsar-Factsheets\\_2020-Final-8-May-2020.pdf](http://moef.gov.in/wp-content/uploads/2019/09/Ramsar-Factsheets_2020-Final-8-May-2020.pdf)

31. The Ramsar Convention, in line with its mission to conserve and promote wise use of all wetlands, designates suitable wetlands for the list of Wetlands of International Importance (the “Ramsar List”), so as to bring focus on their effective management. After India became a party to the Ramsar Convention on Wetlands of International Importance in 1982 as an endorsement of its resolution to conserve the wetlands of the country, it has designated 37 Ramsar sites of international importance covering an area of 1067939 hectares as on August 31, 2020. State-wise details of 37 Ramsar Sites of India, which are being managed as per the Ramsar mandate, are given in Table 9.

**Table 9: State-wise Details of Ramsar Sites (Wetlands) as on August 31, 2020**

(Area in hectares)

N o.	State/UT	Ramsar Wetland	Ramsar Area of State/UT	Wetland Area of State/UT	% Area of Ramsar Sites in State
1.	Andhra Pradesh	Kolleru Lake	90,100	14,47,133	6.23
2.	Assam	Deepor Beel	4,000	7,64,372	0.52
3.	Gujarat	Nalsarovar Bird Sanctuary	12,000	34,74,950	0.35
4.	Himachal Pradesh	Chandertal Wetland, Pong Dam Lake, Renuka Wetland	15,731	98,496	15.97
5.	Jammu and Kashmir	Hokera Wetland, Surinsar-Mansar Lakes, Wular Lake	20,625	1,77,926	11.59
6.	Kerala	Asthamudi Wetland, Sasthamkotta Lake, Vembanad Kol Wetland	1,57,763	1,60,590	98.24
7.	Ladakh	Tsomoriri Lake	12,000	2,13,575	5.62
8.	Madhya Pradesh	Bhoj Wetlands	3201	8,18,166	0.39
9.	Maharashtra	Nandur Madhameshwar	1437	10,14,522	0.14
10.	Manipur	Loktak Lake	26,600	63,616	41.81
11.	Odisha	Bhitarkanika Mangroves, Chilka Lake	1,81,500	6,90,904	26.27
12.	Punjab	Beas Conservation Reserve, Harike Lake, Kanjli Lake Keshopur - Mian Community Reserve, Nangal Wildlife Sanctuary, Ropar Lake	12,537	86,283	14.53
13.	Rajasthan	Keoladeo Ghana National Park, Sambhar Lake	26,873	7,82,314	3.44



N o.	State/UT	Ramsar Wetland	Ramsar Area of State/UT	Wetland Area of State/UT	% Area of Ramsar Sites in State
14.	Tamil Nadu	Point Calimere	38,500	9,02,534	4.27
15.	Tripura	Rudrasagar Lake	240	17,542	1.37
16.	Uttar Pradesh	Nawabganj Bird Sanctuary, Parvati Arga Sanctuary, Saman Bird Sanctuary, Samaspur Bird Sanctuary, Sandi Bird Sanctuary, Sarsai Nawar Jheel, Upper Ganga River	29,332	12,42,530	2.36
17.	West Bengal	East Calcutta Wetlands, Sunderbans Wetland	4,35,500	11,07,907	39.31
	Total		<b>10,67,939</b>		

*Note: Area of wetlands in States derived from National Wetland Atlas 2011; For the UT of Jammu & Kashmir, area derived from state wetland area of Jammu & Kashmir minus the wetland area of Kargil and Leh districts which form the wetland area of the UT of Ladakh]*

## Conclusions

32. Wetland ecosystems are complex ecosystems which offer a wide range of services including fresh water supply, food, fibre and raw materials besides playing a role in food control, water quality improvement, groundwater recharge, recreation and climate change mitigation. Their complexity, which make them difficult to be assessed with reference to any scale or levels, along with the importance of the many ecosystem services they provide, highlights the need for development programmes to take more cognizance of these rich and invaluable ecosystems. The SEEA framework defines a coherent system to help integrate these concerns, which in turn, is envisaged to provide a tool for enhanced decision-making capabilities.

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Statement 4.1: State-wise wetland distribution in India (Area in ha)

State/UT	Wetland area	% of total wetland area	Year 2006-07									
			Open water		Aquatic Vegetation		Turbidity (Post-monsoon)			Turbidity (Pre-monsoon)		
			Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon	Low	Moderate	High	Low	Moderate	High
Andhra Pradesh	14,47,133	9.48	8,87,143	6,10,668	1,26,187	2,68,267	2,95,604	5,31,282	60,257	2,27,855	3,50,782	32,031
Arunachal Pradesh	1,55,728	1.02	66,222	57,516	6,002	5,924	56,471	7,984	1,767	45,810	9,541	2,165
Assam	7,64,372	5.01	4,23,068	3,90,152	36,817	76,036	64,137	3,58,429	502	22,834	3,66,654	664
Bihar	4,03,209	2.64	2,24,655	1,48,382	25,179	17,360	1,32,318	75,292	17,045	316	1,46,269	1,797
Chhattisgarh	3,37,966	2.21	2,43,814	1,73,678	2,123	19,600	28,985	1,83,025	31,804	79,103	85,841	8,734
Delhi	2,771	0.02	1,282	1,526	700	835	1,239	43	-	1,461	65	-
Goa	21,337	0.14	18,899	18,899	1,752	1,752	2,363	10,280	6,256	2,363	10,280	6,256
Gujarat	34,74,950	22.77	11,50,755	7,32,481	1,52,318	2,05,159	3,31,081	1,36,136	6,83,538	1,45,292	83,970	5,03,219
Haryana	42,478	0.28	14,216	18,912	2,245	1,497	6,953	3,295	3,968	6,423	9,481	3,008
Himachal Pradesh	98,496	0.65	69,107	49,245	-	5,294	46,871	22,236	-	33,949	15,296	-
Jammu & Kashmir	3,91,501	2.57	3,01,818	3,14,209	19,826	15,434	3,00,480	1,295	43	3,06,201	1,644	6,364
Jharkhand	1,70,051	1.11	1,52,879	1,03,225	3,437	7,244	21,014	88,410	43,455	12,774	64,127	26,324
Karnataka	6,43,576	4.22	4,27,921	2,62,991	80,818	1,07,259	65,547	3,26,173	36,201	60,149	1,78,414	24,428
Kerala	1,60,590	1.05	1,38,962	1,30,468	13,364	8,925	1,02,026	36,501	435	94,722	35,119	627
Madhya Pradesh	8,18,166	5.36	5,71,961	2,45,289	13,379	62,751	2,827	5,32,712	36,422	713	2,13,784	30,792
Maharashtra	10,14,522	6.65	7,96,834	3,70,357	47,551	84,702	6,33,128	1,39,816	23,890	2,02,581	1,59,856	7,920
Manipur	63,616	0.42	45,304	39,391	16,756	23,500	17,866	26,911	527	17,261	21,841	289
Meghalaya	29,987	0.20	27,912	27,420	819	852	24,919	1,928	1,065	24,692	1,168	1,560

State/UT	Wetland area	% of total wetland area	Open water		Aquatic Vegetation		Turbidity (Post-monsoon)			Turbidity (Pre-monsoon)		
			Post-monsoon	Pre-monsoon	Post-monsoon	Pre-monsoon	Low	Moderate	High	Low	Moderate	High
Mizoram	13,988	0.09	13,799	13,778	37	42	13,755	44	-	13,722	56	-
Nagaland	21,544	0.14	20,938	20,650	7	604	2,243	8,071	10,624	1,065	7,926	11,659
Orissa	6,90,904	4.53	5,08,282	4,19,310	62,733	1,42,584	1,16,369	3,78,117	13,796	1,38,906	2,64,017	16,387
Punjab	86,283	0.57	36,344	24,386	15,920	17,160	30,906	5,117	321	20,504	3,573	309
Rajasthan	7,82,314	5.13	3,68,129	1,58,696	4,102	5,166	2,94,322	40,945	32,862	1,07,553	7,390	43,753
Sikkim	7,477	0.05	7,189	5,035	7	7	2,380	4,809	-	885	4,150	-
Tamil Nadu	9,02,534	5.91	6,57,861	2,96,268	1,67,273	5,31,600	3,14,273	2,47,677	95,911	70,189	1,59,206	66,873
Tripura	17,542	0.11	9,847	7,023	1,779	5,232	2,672	7,148	27	641	6,329	53
Uttar Pradesh	12,42,530	8.14	6,90,216	4,94,994	2,19,289	1,29,228	2,12,518	4,15,651	62,047	1,90,992	2,16,623	87,379
Uttarakhand	1,03,882	0.68	54,221	46,244	5,288	11,697	22,893	31,328	-	11,235	35,009	-
West Bengal	11,07,907	7.26	6,32,450	5,83,620	2,28,174	2,39,058	32,402	5,37,144	62,904	21,196	5,00,546	61,878
Andaman & Nicobar Islands*	1,52,809	1.00	8,341	8,580	68,269	68,352	965	6,749	627	1,898	6,006	676
Chandigarh*	350	0.00	242	225	10	19	65	177	-	70	155	-
Dadra & Nagar Haveli*	2,070	0.01	1,915	1,131	-	145	1,286	629	-	812	319	-
Daman & Diu*	2,068	0.01	570	262	54	58	265	299	6	137	118	7
Lakshadweep*	79,586	0.52	23,674	23,674	-	-	23,674	-	-	23,674	-	-
Puducherry*	6,335	0.04	4,028	2,535	622	1,753	1,186	2,748	94	515	1,968	52
<b>Total</b>	<b>152,60,572</b>	<b>100.00</b>	<b>86,00,798</b>	<b>58,01,220</b>	<b>13,22,837</b>	<b>20,65,096</b>	<b>32,06,003</b>	<b>41,68,401</b>	<b>12,26,394</b>	<b>18,88,493</b>	<b>29,67,523</b>	<b>9,45,204</b>

Data Source: [National Wetland Atlas](#)

\*- Union Territories