



TAMIL NADU WETLANDS MISSION



Mission Document on Wetlands and Livelihood
Department of Environment, Climate Change and Forests



“ Wetlands are natural sponges and kidneys of landscape, recharges ground water, improves biodiversity and provides livelihood to millions of people. I am extremely glad to note that under the Tamil Nadu Wetlands Mission, 13 new wetlands have been internationally recognised and added to the list of Ramsar sites. As a result the state of Tamil Nadu have become No.1 state with 14 Ramsar sites out of 75 Ramsar Sites in the country. ”

Thiru M.K.STALIN
Honourable Chief Minister of Tamil Nadu

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An aerial photograph of a lush green mangrove forest. A narrow, winding river flows through the dense canopy of trees. The water is a murky, brownish-green color. In the lower right portion of the river, a small wooden boat is visible, carrying several people. The boat is moving towards the bottom right of the frame, leaving a small wake behind it. The trees are a vibrant green, and the overall scene is one of a healthy, natural environment.

1

Introduction



1.1

Overview of Wetlands in India and Tamil Nadu

India has variety of wetland ecosystems distributed in different geographical regions. Diversity of wetlands in India ranges from the floodplains of rivers like Ganga and Brahmaputra to the high-altitude wetlands of the Himalayas, lagoons and mangrove marshes on the coastline and reefs in marine environments. As part of the National Wetland Inventory Atlas (NWIA) of 2011 of the Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India (GOI) spatial estimates of various wetland categories had been carried out using GIS layers of wetland boundary, water-spread and aquatic vegetation. As per the said inventory, India has about 757.06 thousand wetlands with a total wetland area of 15.3 m ha, accounting for nearly 4.7% of the total geographical area of the Country.

Wetlands are lifelines of the society. They provide vital support to human well-being through their wide-ranging ecosystem services and biodiversity values. As these ecosystems degrade or are adversely altered, the water cycle, and the interlinked carbon and nutrient cycles are also adversely altered, leading to water, food and climate insecurity, and loss of biodiversity. Some of the major ecosystem services provided by wetlands are:

1. Water storage;
2. Support livelihoods by providing food, water and fiber;
3. Regulation of water regimes and stream flows;
4. Ground water recharge;
5. Water purification;
6. Nutrient recycling;
7. Buffer shorelines from erosion;
8. Buffer communities against floods, droughts, cyclones and wave surges;
9. Support a variety of life forms through extensive food webs;
10. Habitat to diverse flora and fauna, including resident and migratory species;
11. Habitat for migratory species such as waterbirds and fish;
12. Provide recreational opportunities;
13. Integral part of cultural identities;
14. Enhance landscape aesthetics; and,
15. Stabilize local climate.

• Pichavaram mangroves



• Greater Flamingo

1.2

Major Threats and Impacts

Wetlands are subject to a number of threats emanating from anthropogenic and non-anthropogenic drivers and pressures. Some of the major threats to these ecosystems are:

1. Fragmentation of hydrological regime
2. Siltation
3. Pollution
4. Encroachment and land reclamation
5. Species invasion including alien species
6. Unregulated recreation and tourism
7. Over-harvesting of resources
8. Climate change

1.3

Management Gaps and Challenges

Following gaps and challenges have limited effectiveness of interventions made for conservation and management of wetlands:

1.3.1 Sectoral Approaches

Wetlands are not recognized as a unique land use category and these are often clubbed with 'dumping ground' meant to be used for alternate developmental purposes.

1.3.2 Partial Approach to Implementation of Management Plans

The management plans for wetlands are mostly formulated, financed and implemented on annual cycles, and in several cases, these are not based on comprehensive landscape scale management plans

1.3.3 Weak cross – Sectoral Governance

Integrated management plan of wetlands requires cross - sectoral institutional arrangements for developing management plans, site monitoring and evaluation and implementation through line departments.

1.3.4 Insufficient Capacity for Integrated Management

Lack of knowledge and experience in the formulation of management plans addressing the full range of drivers of ecosystem degradation and lack of training and capacity building opportunities for the site managers.

1.3.5 Limited Research Management Interface

Management of wetlands calls for continuous research inputs to address the drivers of change. However, research has not been given due importance in case of most of the wetlands

1.3.6 Impact of Climate Change

The sea level rise is expected to adversely affect the coastal wetlands; some of them might disappear; several others would experience changes to their morphology, water balance, salinity levels and biodiversity. The mudflats and coral reefs could be considerably affected by sea level rise. The variation in precipitation pattern would have its impact on wetland ecosystems and their wise use.

According to the National Wetland Inventory Atlas 2011, the geographical area in the State under wetlands accounts for 6.92% of the total geographic area which is 9,02,534 hectares. The type of wetlands and its distribution as given under the National Wetlands Inventory Atlas report, the Ministry of Environment, Forest and Climate Change, Government of India is as follows



• Deposition of fly ash in Ennore Creek

Wetlands Classification System

Wettcode	Level I	Level II	Level III
	Inland Wetlands		
1100		Natural	
1101			Lakes
1102			Ox-Bow Lakes/Cut-Off Meanders
1103			High altitude Wetlands
1104			Riverine Wetlands
1105			Waterlogged
1106			River/Stream
		Man-made	
1201			Reservoirs/Barrages
1202			Tanks/Ponds
1203			Waterlogged
1204			Salt pans
1205			Aquaculture ponds
2100	Coastal Wetlands		
2101		Natural	
2102			Lagoons
2103			Creeks
2104			Sand/Beach
2105			Intertidal mud flats
2106			Salt Marsh
2107			Mangroves
			Coral Reefs
		Man-Made	
2201			Salt pans
2202			Aquaculture ponds

1.4 Hydro-Geological Inputs On Tamil Nadu With Special Reference to Wetlands

1.4.1 Climate and Rainfall Pattern
Generally, a sub-tropical climate prevails throughout the State, and the maximum temperature ranges from 37 °C to 43 °C and the minimum temperature ranges from 12 °C to 17 °C. Tamil Nadu is a State with limited water resources and the rainfall in the State is seasonal. The annual average rainfall in the State is 843 mm for the period from 2013 to 2022 and the pattern of rainfall distribution is shown below. The status of annual average rainfall in the State is 985 mm for the period 1991 to 2021 and the pattern of rainfall distribution is presented as follows: -

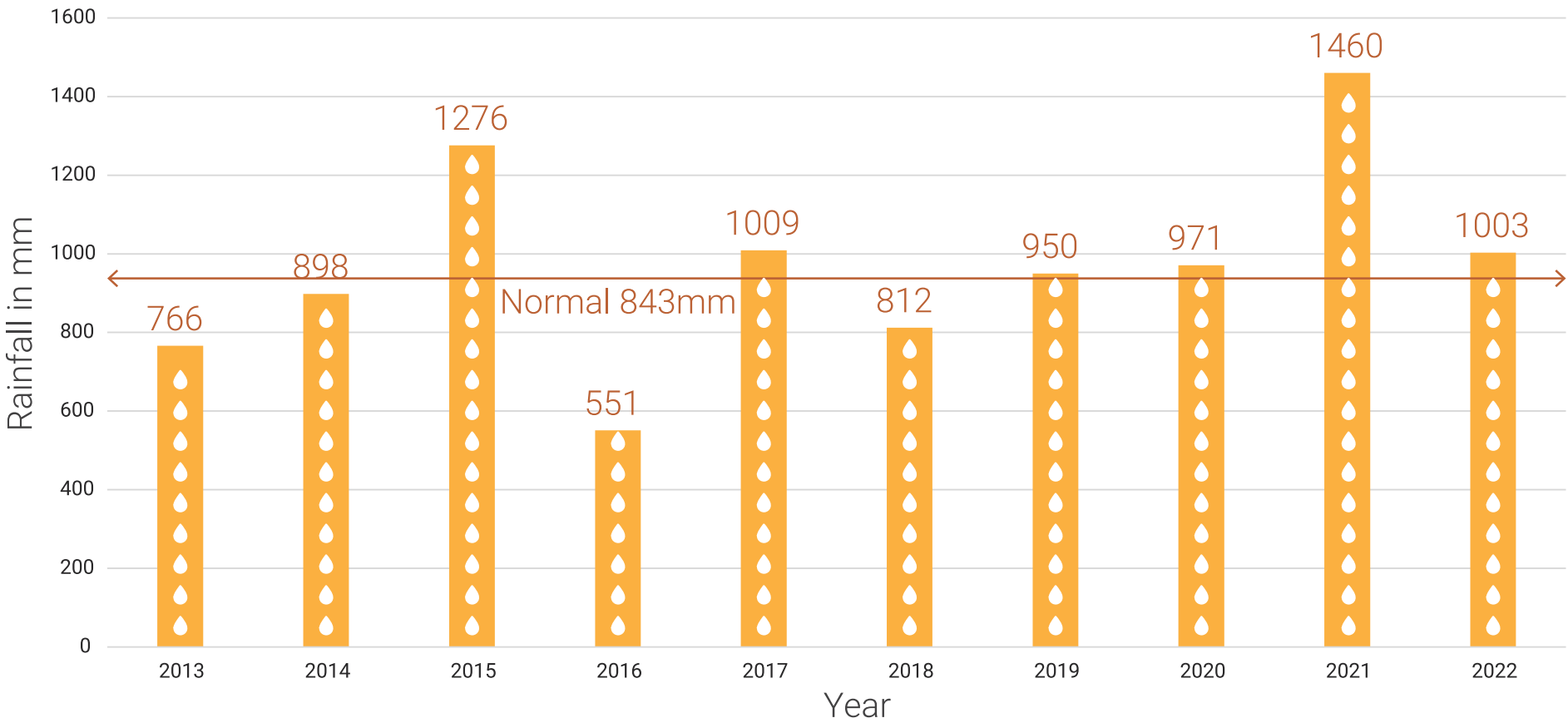


Status of Annual Average Rainfall Pattern in Tamil Nadu from the year of 1991-2021



Season	Month	Average rainfall mm	Percentage
Winter rains	Jan – Feb	27	2.74 %
Summer rains	March-May	121	12.28%
Southwest monsoon	Jun – Sept	349	35.43 %
Northeast monsoon	Oct – Dec	488	49.4 %
Total		985	99.85%

Average rainfall pattern of Tamil Nadu (2013-2022)





• Red-wattled Lapwing

1.4.2 Physiography

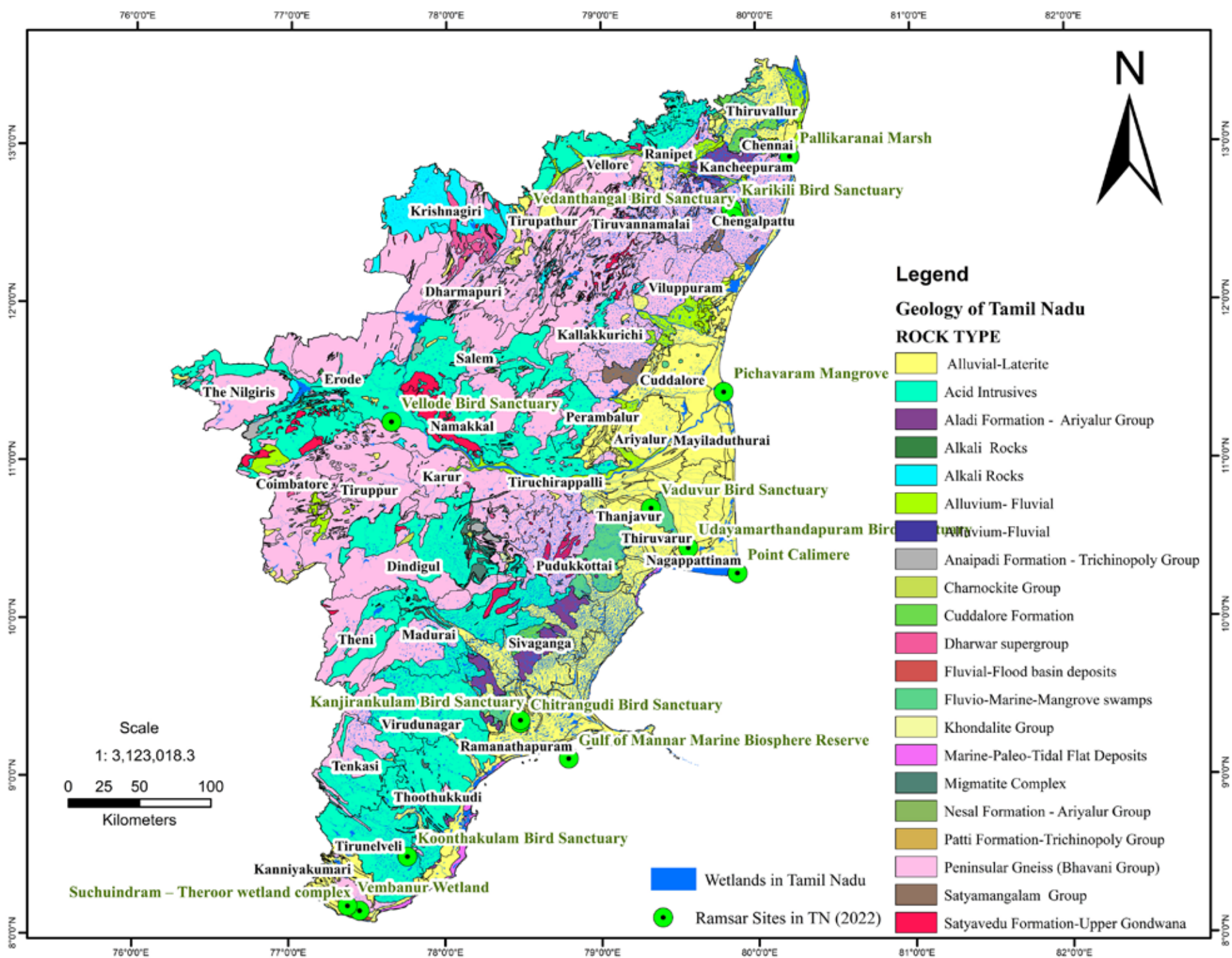
- Geomorphologically, three major units are recognised from west to east. The western part comprises the Western Ghats roughly trending N-S and marked by a continuous range of Hills, extending from Nagercoil in the south upto Nilgiri -Bilgiriangan Hills in the north and further northwards through Karnataka. The elevation of these Hills ranges between 1275m and 2637m. The prominent Hills are Mahendragiri, Agasthiarmalai, Anaimalai, Palani and Nilgiris. Doddabetta with an elevation of 2637m is the highest peak in the Nilgiri Hills. The east-west trending Palghat Gap is a prominent physiographic break in the Western Ghats.
- The central part of the State is a vast track of dissected pediments and pediplains. Residual Hills in this part viz., Shevaroy, Kalrayan, Chitteri, Kollimalai, Pachchaimalai and Javadi demarcate the extensions of Eastern Ghats, while Karandamalai, Sirumalai and Kodaikanal Hills form another set of residual Hills, further south.
- The eastern part of Tamil Nadu and Pondicherry and Karaikkal are marked by a coastal plain with associated landforms like vast tidal flats, continuous beach ridges, estuaries and lagoons and a narrow but fairly continuous beach. The area is drained by a number of Rivers such as Palar, Cheyyar, Ponnaiyar, Cauvery, Moyar, Bhavani, Amaravathi, Vaigai, Tambraparani etc. flowing ESE from the Western Ghats. Pondicherry and its surrounding lie in the drainage basin of the Gingee River. Karaikkal is located in the fertile Cauvery Delta and is fed by the waters of Arasalar, Nattar, Vanjiyar and Nandalar.

- The coastline of Tamil Nadu and Pondicherry comprises a number of cusps, spits and wave cut platforms and several palaeo-shorelines. Some of the palaeo-shorelines extend inland suggesting periods of transgression and regression. The ongoing geodynamic process is generally progradation along the coast, which is modified at several places by erosion and deposition by aeolian and fluvial agents. The eastern areas of the central part of the State are marked by the depositional regime of many Rivers manifested by typical fluvial features like levees, channel bars and palaeochannels, back swamps and vast flood plains.

1.4.3 Geology and Stratigraphy

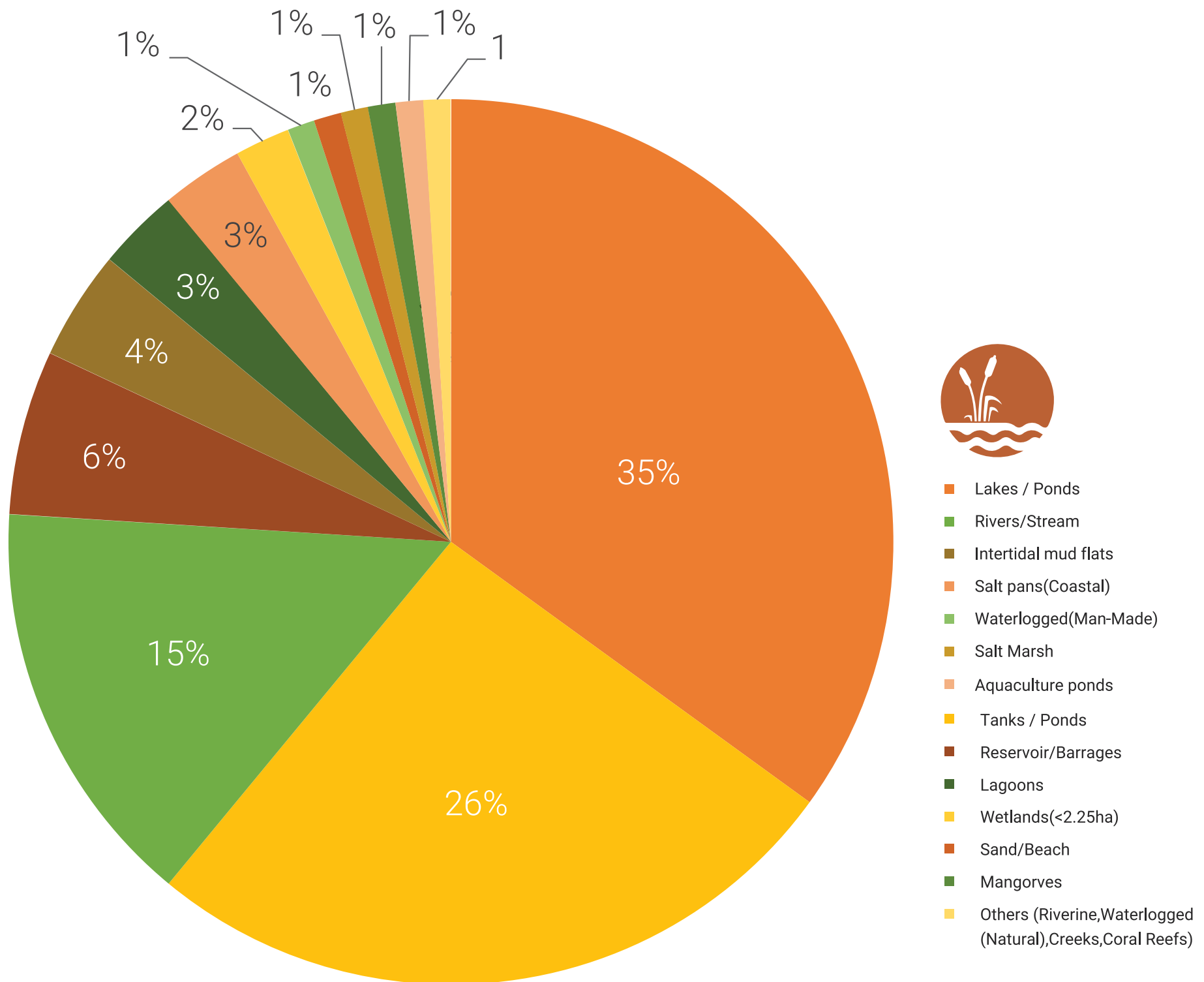
- Crystalline rocks of Archaean to late Proterozoic age occupy over 73% of the area of the State, while the rest of 27% covered by Phanerozoic sedimentary rocks mainly along the coastal belt and in a few inland River valleys.
- The hard rock terrain comprises predominantly of Charnockite and Khondalite groups and their migmatitic derivatives, supracrustal sequences of Sathyamangalam and Kolar groups and Peninsular Gneissic Complex (Bhavani Group), intruded by ultramafic-mafic complexes, basic dykes, granites and syenites.
- The sedimentary rocks of the coastal belt include fluvial, fluvio-marine and marine sequences, such as Gondwana Supergroup (Carboniferous to Permian and Upper Jurassic to Lower Cretaceous), marine sediments of Cauvery basin (Lower Cretaceous to Paleogene), Cuddalore / Panambarai Formation (Mio-Pliocene) and sediments of Quaternary and Recent age.

Geology of Tamil Nadu



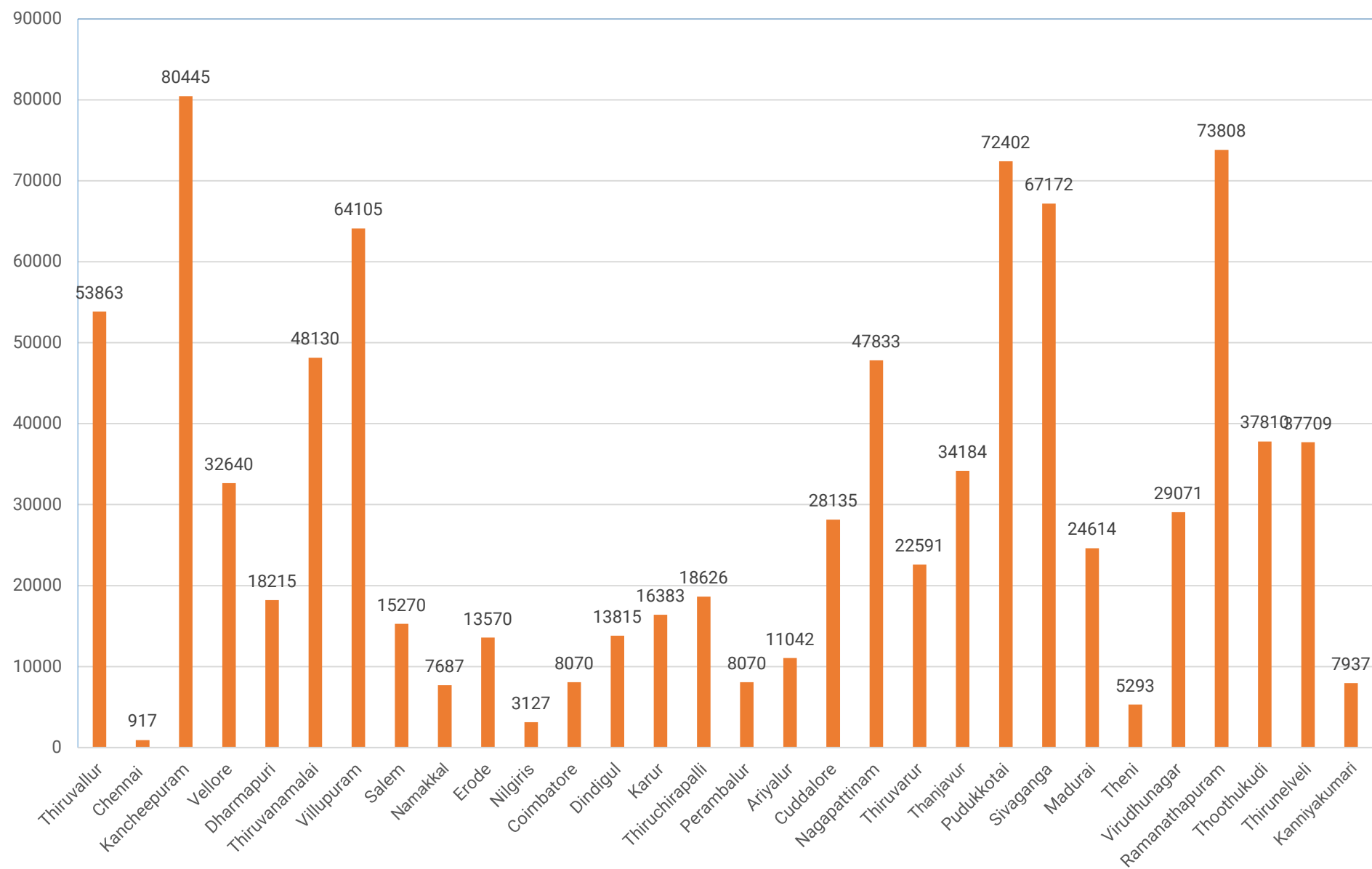
1.5

Wetlands Distribution in Tamil Nadu



Distribution of various wetlands types in Tamil Nadu
(Source: National Wetland Atlas, 2011).

District-wise Wetland Distribution in Tamil Nadu.



1.6 International Conventions on Wetlands (Ramsar Sites)

India is a signatory to the Ramsar Convention on Wetlands. The Convention has a broad approach for defining wetlands 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 metres.

Article 2.1 of the Ramsar Convention provides that wetlands 'may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands. The definition thus covers a large number of inland wetlands (such as swamps, marshes, lakes and peatlands); coastal and near shore marine wetlands (such as coral reefs, mangroves, seagrass beds and estuaries) and man-made wetlands (such as reservoirs, salt pans, irrigation channels and fish ponds).

The Space Application Centre of Indian Space Research Organization, under the National Wetland Inventory and Assessment Project supported by the Central Government has prepared State wise Atlas of wetlands at 1: 50,000 scale using remote sensing imageries of 2006-07. Wetland inventories have also been published by Wetlands International and WWF-India.

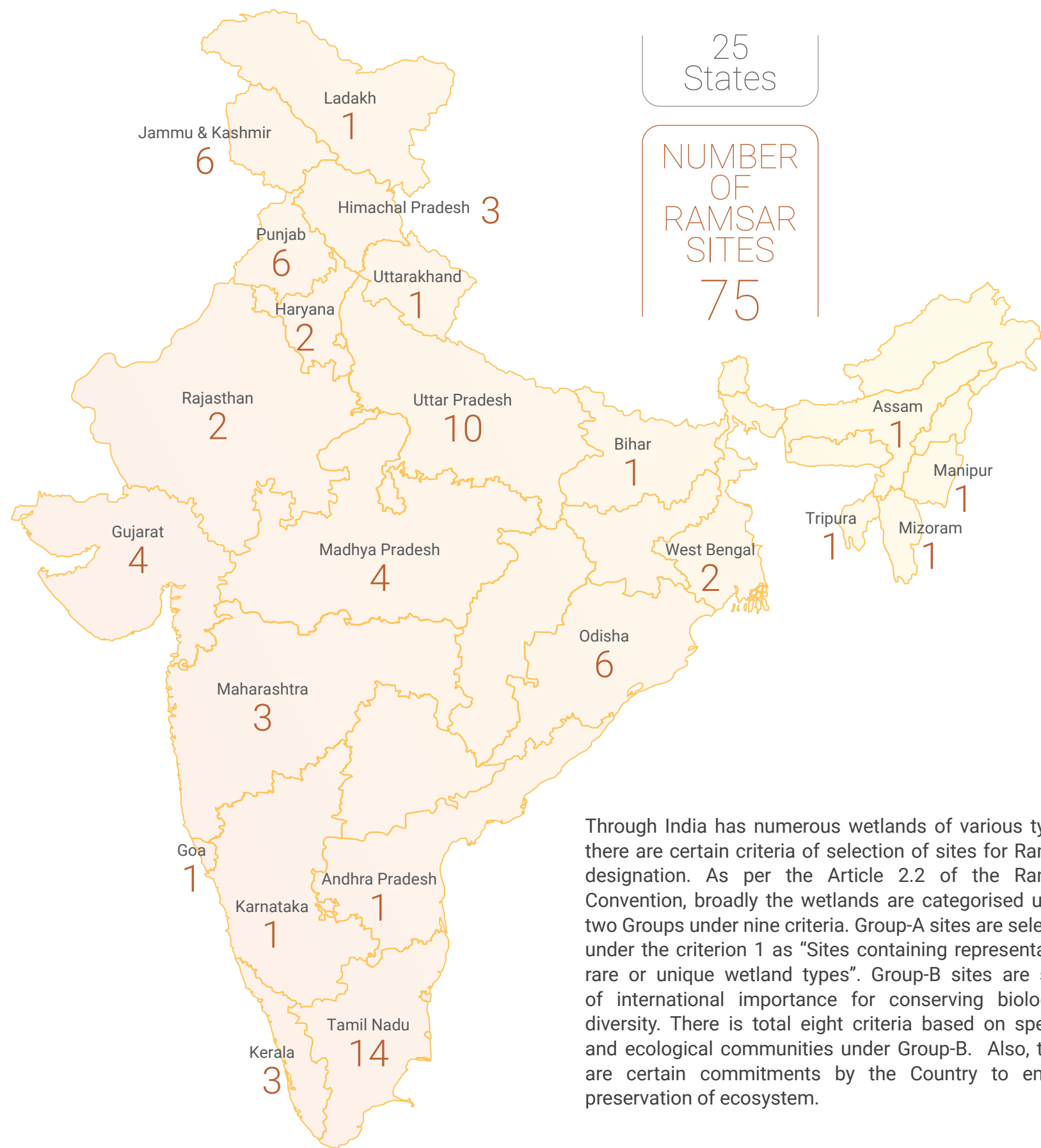
Currently, 170 countries have become a signatory to the Ramsar Convention on Wetlands, and around 2300 sites globally have been earmarked as Ramsar sites. India became the contracting party of the Ramsar Convention on 1st February 1982. There are 75 wetlands of India that are declared as Wetlands of International Importance. The State of Tamil Nadu has 14 wetlands of international significance and tops the list of Ramsar sites in the Country consequent to the declaration of 13 Ramsar sites in the year 2022 i.e., after a long gap of 20 years. The signing of the Convention only imposes the duty to wisely use the wetlands and to conserve them.





• Karikili Bird Sanctuary

Number of Ramsar site in various States of India



Through India has numerous wetlands of various types, there are certain criteria of selection of sites for Ramsar designation. As per the Article 2.2 of the Ramsar Convention, broadly the wetlands are categorised under two Groups under nine criteria. Group-A sites are selected under the criterion 1 as “Sites containing representative, rare or unique wetland types”. Group-B sites are sites of international importance for conserving biological diversity. There is total eight criteria based on species and ecological communities under Group-B. Also, there are certain commitments by the Country to ensure preservation of ecosystem.

A brief of these criteria is given below:

GROUP
A

Sites containing representative,
rare or unique wetland types

Criteria 1

A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

GROUP
B

Sites of international importance for conserving biological diversity.
This group Criteria based on species and ecological communities

Criteria 2

A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

Criteria 3

A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular bio geographic region.

Criteria 4

A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

Criteria 5

Specific criteria on water birds

A wetland should be considered internationally important if it regularly supports 20,000 or more water birds

Criteria 6

A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of water bird

Criteria 7

Specific criteria based on fish

A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity

Criteria 8

A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

Criteria 9

Specific criteria based on other taxa

A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.

1.7

The National Environmental Policy 2006

The National Environmental Policy 2006, for the first time categorically mentioned about a need for the protection and conservation of wetlands both natural and man-made, fresh water or brackish for the benefit of aquatic flora and fauna besides the role of wetlands in agriculture, fishing, tourism and ground water recharge. The National Environmental Policy 2006, specifically mentioned about the anthropogenic threats to the wetlands on account of drainage, pollution, encroachment and waste dump. Therefore, the policy recommended for taking a holistic view of wetlands in terms of its casual linkages with other natural entities, human needs and its own attributes.

The Wetlands (Conservation and Management) Rule 2017 came into force after the supersession of the Wetlands (Conservation and Management) Rule 2010 for Conservation and Management of Wetlands. The Rule (4) of the Wetlands (Conservation and Management) Rule 2017 envisaged that the wetlands shall be conserved and managed in accordance with the principle of “Wise Use” and following activities shall be prohibited within the wetlands:

- i. Conversion for non-wetland uses including encroachment of any kind;
- ii. Setting up of any industry and expansion of existing industries;
- 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.

All wetlands, irrespective of their location, size, ownership, biodiversity, or ecosystem services values, can be notified under the Wetlands Rules, except:

- i. River channels;
- ii. Paddy fields;
- iii. Human-made waterbodies specifically constructed for drinking water purposes;
- iv. Human-made waterbodies specifically constructed for aquaculture purposes;
- v. Human-made waterbodies specifically constructed for salt production purposes;
- vi. Human-made waterbodies specifically constructed for recreation purposes;
- vii. Human-made waterbodies specifically constructed for irrigation purposes;
- viii. Wetlands falling within areas covered under the Indian Forest Act, 1927; Forest (Conservation) Act, 1980; State Forest Acts and amendments thereof;
- ix. Wetlands falling within areas covered under the Wildlife (Protection) Act, 1972 and amendments thereof;
- x. Wetlands falling within areas covered under the Coastal Regulation Zone Notification, 2011 and amendments thereof.

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.). Only those human-made wetlands that have been built for purposes, mentioned at paras 4(iii) – 4(vii) above, are excluded from notification under these Rules.

However, it is made clear that the natural wetlands partly or wholly used for the purposes as mentioned at 4 (iii) and 4(vii) attract the provisions of the Wetlands Rules. Wetlands designated as Ramsar Sites may also be notified under the Rules as per the process mentioned in paragraphs 57-65, even when partly or wholly overlapping with areas covered under the Indian Forest Act, 1927; Forest (Conservation) Act, 1980; State Forest Acts and amendments thereof; Wildlife (Protection) Act, 1972 and amendments thereof; Coastal Regulation Zone Notification, 2011 and amendments thereof. Regulations for parts of wetlands overlapping with 4(viii)-4(x) (supra) will, however, be as per the corresponding regulatory framework. Ramsar site areas, not covered under any of the overlapping laws and rules, attracts the provisions of the Wetlands Rules

1.8

National Plan for Conservation of Aquatic Ecosystems

The National Plan for Conservation of Aquatic Ecosystems was enacted in the year 2015 after the amalgamation of the National Lake Conservation Plan and the National Wetlands Conservation Programme. This plan works for the protection of both wetlands and lakes.

The main objectives of the National Plan for Conservation of Aquatic Ecosystems are as follows:

- i) The holistic conservation of the wetlands.
- ii) Focuses on other related aspects like ameliorating water quality, biodiversity, etc

1.9

Penal provisions under Environmental Protection Act 1986

The first contravention of the provisions of the Wetlands Rules is an offence under section 15 of the Environment (Protection) Act and it is punishable with imprisonment (up to five years) or with fine (up to Rs.one lakh), or with both. A continuing contravention, after conviction for the first contravention, will attract additional fine (up to Rs 5,000) per day. An offender who continues to contravene the Rules beyond a period of one year after the date of conviction shall be punishable with imprisonment (up to seven years).

1.10

Wetland Protection Laws and Government Initiatives

As on today, Wetlands are not delineated under any specific administrative jurisdiction. Some wetlands are protected after the formulation of the Wildlife Protection Act. However, it is ineffective and most are in grave danger of extinction. Effective coordination between the different ministries like energy, industry, fisheries, revenue, agriculture, transport and water resources, is essential for the protection of these ecosystems.

Prevailing laws are ineffective as far as the protection or conservation of aquatic ecosystems are concerned as most of them indirectly touch wetland protection (fragmented approach):

- I. The Indian Fisheries Act - 1857
- II. The Indian Forest Act - 1927
- III. Wildlife (Protection) Act - 1972
- IV. Water (Prevention and Control of Pollution) Act - 1974
- V. Territorial Water, Continental Shelf, Exclusive Economic Zone and other Marine Zones Act - 1976
- VI. Water (Prevention and Control of Pollution) Act – 1977
- VII. Maritime Zone of India (Regulation and fishing by foreign vessels) Act - 1980
- VIII. Environmental (Protection) Act - 1986
- IX. Forest (Conservation) Act - 1980
- X. Coastal Zone Regulation Notification - 1991
- XI. Wildlife (Protection) Amendment Act - 1991



2

Tamil Nadu Wetlands Mission



• Mudhumalai Tiger Reserve

The Government of Tamil Nadu stands committed to protect its wetlands through a comprehensive conservation and management plan. During the Budget speech for the year 2021-22, the Hon'ble Minister for Finance and Human Resources Management made the following announcement among others:

“Under the leadership of Hon'ble Chief Minister, this Government will launch the ‘Tamil Nadu Wetlands Mission’ with the objective of ecological restoration of wetlands in Tamil Nadu. The Mission will identify and map 100 wetlands in 5 years and restore the ecological balance with focus on livelihood options”

Thus, the State of Tamil Nadu becomes the first State in the Country to initiate a unique Mission for the protection and conservation of wetlands in the State with focus on livelihood improvement of the local communities.

Accordingly, the Government issued the orders vide G.O (Ms.) No. 59, Environmental Climate Change and Forest (FR.9) Department dated 25.03.2022 with the following goals and objectives.

- i. Identify, map and inventories wetlands in the State of Tamil Nadu.
- ii. Prepare extensive documentation viz., Integrated Wetland Management Plan for Notification of identified wetlands under the Wetlands (Conservation and Management) Rules, 2017.
- iii. Notification of identified wetlands under the Environment (Protection) Act, 1986 and Rules framed there under for their protection and conservation.
- iv. Undertake comprehensive eco-restoration of wetlands in accordance with proven scientific strategies and evidence-based methodologies.
- v. Raise awareness on wetland conservation through public awareness campaign.
- vi. Promote research, inventory and monitoring of wetland resources for effective management.
- vii. Promote and support sustainable livelihood options in order to ensure productivity while protecting wetland resources.
- viii. Promote stakeholder participation for effective management of wetlands.
- ix. Conserve wetland biodiversity through community-based approaches.

The National Inventory Wetland Atlas (NWI) 2011 was put up in the public domain in the year 2011. As per the said inventory report, there were 42978 wetlands in the State of Tamil Nadu (Inland Wetlands – Natural (4609), Inland Wetlands - Man-made (19480), Coastal Wetlands – Natural (404), Coastal Wetlands - Man-made (891) , Wetlands < 2.25ha (18294)) which is 6.92% of the total geographical area of the State, is above the national figure of 4.62 % of the total geographical area of the Country. In these lakes, ponds everything has been classified however the shape files were only made available to the State of Tamil Nadu like all other States. The ground truthing was not carried that time leading to a situation that many natural wetlands got converted in to man-made structures due to lack of ecosystem-based approach. Therefore, under the Tamil Nadu Wetlands Mission, the shapefiles of wetlands of few districts like Tiruvallur, Pudukkottai, Kancheepuram, Ramanathapuram etc., shall be verified on ground by the District Level Wetland Management Committees and based on the report of the committees, the list of wetlands shall be revisited for avoiding the inter-departmental conflicts in the best interest of wetlands conservation and protection for inter-generational equity.

2.1 Wetlands and Ecosystem Services

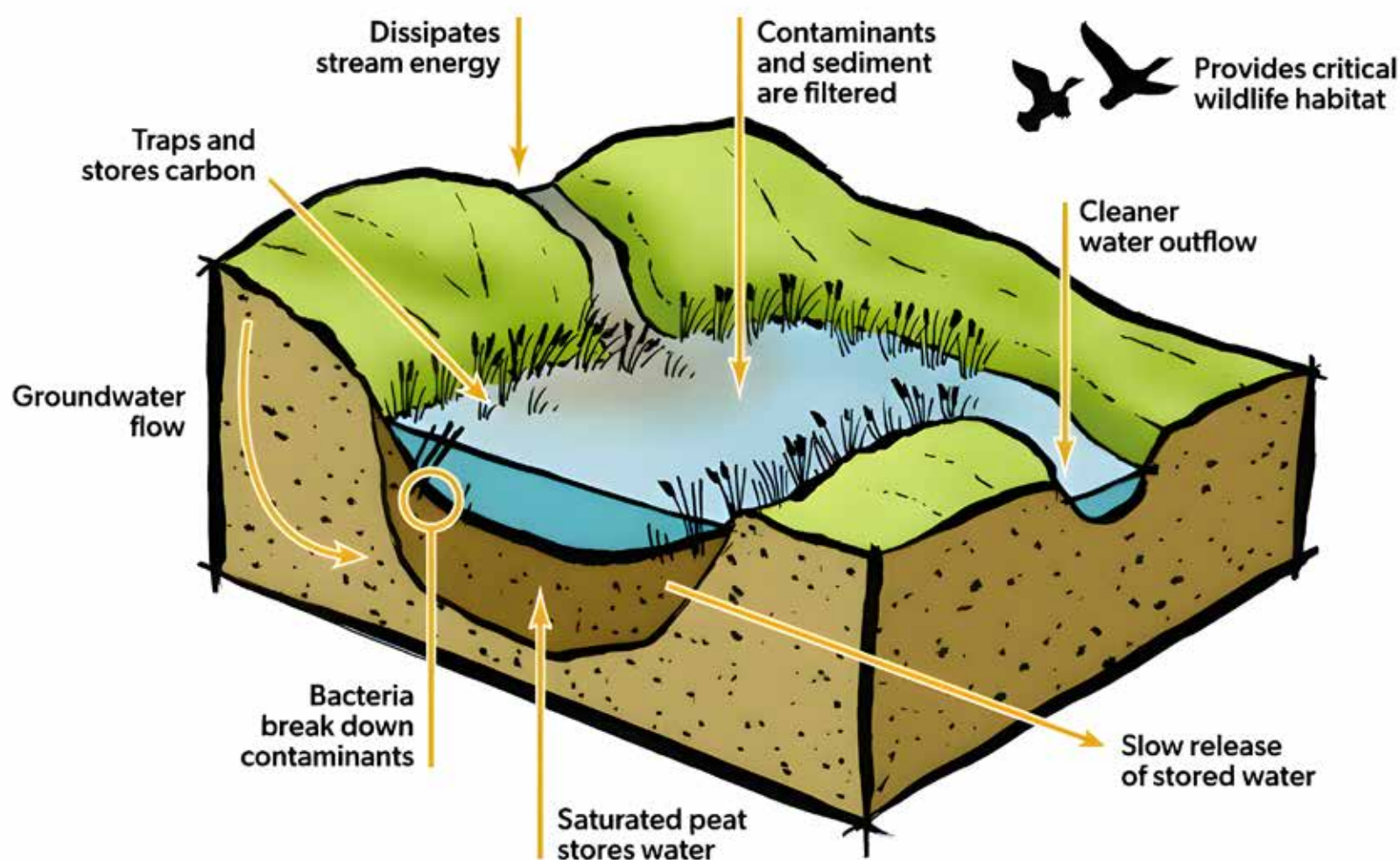
The Wetlands are considered the “kidneys of the landscape” that regulate water and filter waste from the landscape. Wetlands are areas that are inundated with water permanently or seasonally. They are unique, highly productive ecosystems where terrestrial and aquatic habitats meet. Wetlands include mangroves, peatlands and marshes, rivers and lakes, deltas, floodplains and flooded forests, rice-fields, and even coral reefs. (www.forests.tn.gov.in)

Wetlands act as a buffer during the time of high rainfall events and the wetlands catch and slow down the flow of surface water, which significantly reduces the amount of flooding downstream. Since the water is slowed down, there is an opportunity for the wetlands to be a source of ground water recharge. Moreover, it improves water quality because sediments fall out of the water column and nutrients are taken up by aquatic plants. Wetlands

act as bioremediation sites as these nature-based solutions have the ability to remove pollutants from surface water and they also provide excellent habitat for harbouring flora and fauna.

A variety of key features and benefits could be accrued by conserving the wetlands of the State through Wetlands Mission. The multiple co-benefits of substantial social and economic values could be derived by conserving wetlands in the State and help address a wide range of needs and objectives, contributing benefits to people, society and the economy at large. These include:

- (i) Multiple Ecosystem Services related to water and wetlands through
 - a) water provisioning, regulation (for example, water-related disaster risk reduction), purification and groundwater replenishment,
 - b) addressing objectives of water security and water for food security
 - c) important roles in relation to nutrient cycling, climate mitigation and adaptation
 - d) livelihood promotion and job security



e) range of cultural benefits, including knowledge (scientific and traditional), recreation and tourism, and formation of cultural values, including identity and spiritual values (www.cbd.int)

- (ii) In so far as wetland and mitigation of natural disasters are concerned it has been widely researched that wetlands have been known for maintaining the unique balance among the ecological processes because of the vegetation, soil characteristics and hydrological regimes. Any changes in the ecological processes in the wetlands can either mitigate or worsen the natural disaster risks like floods, droughts, tidal waves, sea erosion etc., The soil characterisation of

the wetlands determine the water holding capacity of the wetlands which are considered peculiar natural sponges because of their soil characteristics. This feature of the wetlands facilitates ground water storage and reduce intensity of the water velocity. The sediment and soil characterisation shall be studied in depth under the Tamil Nadu Wetlands Mission so as to find out the soil and sediment’s enrichment in the wetland’s soil which normally takes place because of runoff and wherein the deposition of heavy toxic metals within the sediments shall be explored through the research studies and accordingly the interventions shall be planned for ecological restoration of wetlands.

Non-Exhaustive examples of how regulating ecosystems services reduce hazards and exposure

Hazard	Ecosystem	Regulating Service for Disaster Risk Reduction
Landslides	Forested Slopes	Erosion control
River Erosion	River Vegetation	Erosion control
Flooding	Watershed forests, wetlands	Water storage capacity/ water flows
Drought	Watershed forests, wetlands	Water storage capacity/ water flows
Storm surges /tsunami	Mangroves, sand dunes, coral reefs, coastal wetlands	Physical buffer
Avalanches	Forested Slopes	Physical buffer
Cyclones	Forests, Mangroves	Physical buffer
Heat Waves	Trees, Parks, wetlands	Local climate regulation



• Thamirabarani

2.2

Wetlands and Livelihood

Healthy wetlands are natural assets that support innumerable livelihoods directly and indirectly. More than one billion of world's population depend on wetlands for their living. Throughout the State of Tamil Nadu, lakhs of people derive income from wetlands to sustain their families, through practising agriculture, fisheries, tourism and recreational activities. With regards to agriculture, paddy cultivation thrives mostly on wetlands. Rice is the staple diet in Tamil Nadu. About 7265.2 kt of rice is produced per year in 1907.41 kha of land, providing income to lakhs of people involved in different stages of rice production from sowing to selling in the market.

The State consists of 12.83 lakhs of fisherfolk population with inland fisheries alone producing 174428.32 tonnes per year valuing 332432.79 lakhs of rupees. Moreover, State exports fish and fish products worth 6210.53Cr per year. The quality of water in the wetlands shall be a vital factor in fish protection, since the Fish gut analysis have indicated contamination in the form of Chromium, Cadmium, Mercury etc.

The cultural heritage and natural features of the State makes it one of the major hubs for tourism. Most of the tourists prefer wetlands and coastal regions because of the recreational and aesthetic benefits. About 50.2 Crores of tourists visit Tamil Nadu in a year with Tamil Nadu having 21.9% share of foreign tourists to India. Under the Tamil Nadu Wetlands Mission all the Ramsar sites shall be made a tourist hub in partnership with the Department of Tourism and the concept of responsible tourism shall be introduced in all the Ramsar sites for the people to appreciate and learn about the wetlands ecosystems in toto. (Source: Department of Economics and Statistics, Government of Tamil Nadu).

Other Wetland Products like Medicinal plants, raw materials for handicrafts, herbs, edible fruits and fodder are obtained from wetlands that support local livelihoods, and empower them socially and economically. It shall be ensured under the Mission that the principle of wise use of wetlands is adopted and the over exploitation of the wetland resources are kept under check. The improvement of livelihoods for the local communities emanating from the wetland ecosystem services shall be given impetus under the Mission like provisioning services (fisheries, aquatic vegetation for economic purpose within the carrying capacity, wetland agricultural



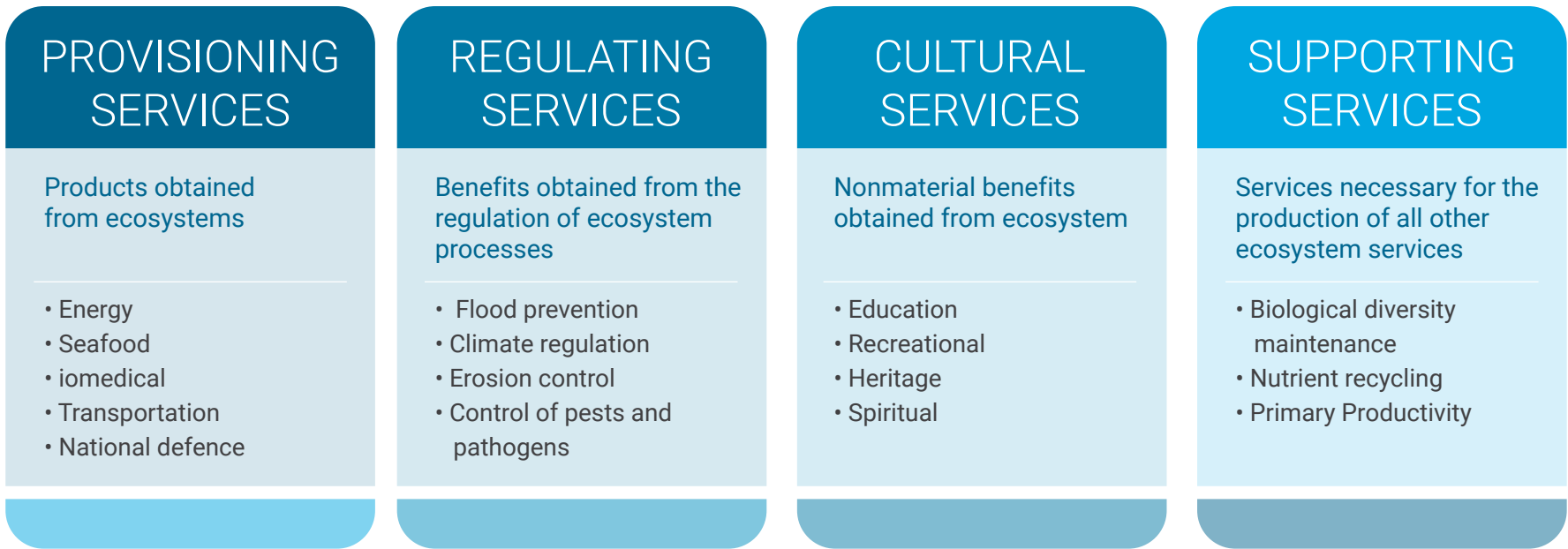
• Point Calimere Wildlife and Bird Sanctuary

emphasizing organic farming, biochemical products etc.), regulating services (maintenance of hydrological regime to mitigate drought and flood), cultural services (recreation, tourism, spiritual, scientific and educational) and supporting services (more ecosystem services which are included within the ecosystem processes).

Further it shall be ensured under the Mission with help and support from the line Departments viz., Water Resources Department (WRD), Department of Municipal Administration and Water Supply (DMAWS), Department of Rural Development and Panchayat Raj (RD and PR), Department of Agricultural and Farmer's Welfare (DAFW), Department of Tourism, Department of Fisheries, Department of Animal Husbandry etc., that the livelihood of the local communities dependent on the wetlands do not lead to adverse changes in the various ecosystem characteristics and processes such as

- i. Reduction in water flowing into the wetlands
- ii. Reduction in the area under inundation, or changes in inundation regime
- iii. Reduction and alteration of natural shoreline
- iv. Fragmentation of wetlands into small patches of water
- v. Reduction in water holding capacity
- vi. Degradation of water quality
- vii. Reduction in diversity of native species
- viii. Introduction or emergence of invasive species
- ix. Decline in wetlands resources, such as fish, aquatic plants, and water

Type of ecosystem services provided by wetlands



Few illustrative examples that may not be ‘wise-use’ shall be discouraged under the Mission: -

Type of wetland	Intervention	Ecosystem services likely to be enhanced	Ecosystem services likely to be diminished
Lagoon	Prawn aquaculture by creating enclosures within the lagoon area	• Food provision • Livelihoods for wetlands dependent communities	• Water regime Moderation • Flood buffering
Lake	Impounding water by regulating outflows	Increased water availability for human use	• Ability to moderate floods
Marsh	Construction of road connecting settlements located on the periphery	Transport	• Hydrological regime moderation • Flood buffering • Aesthetics
Urban lake	Concretization of shoreline for beatification	• Aesthetic value • Tourism and recreational benefits	• Ability to accommodate monsoon flows • Habitat values

2.3

Wetlands & Climate Change

Wetlands are construed as high-carbon ecosystems. Although they occupy only between 5% and 8% of the earth's total land surface, their soils hold 35% or more of the estimated 1,500 gigatons (Gt, or billion metric tons) of organic carbon that is stored in soils (Mitsch & Gosselink, 2015). Thus, the wetlands serve both as important Carbon and Methane sources and sinks. Under the Tamil Nadu Wetlands Mission, the appropriate interventions shall be made to ensure that the wetland soils become a net sink of the Greenhouse Gases.

Carbon sequestration potential of the inundated wetlands and marshes have been widely studied and documented. The wetlands are natural climate solutions and therefore there is a need for understanding the drivers of the carbon sequestration of the wetlands and marshes. Under the Tamil Nadu Wetlands Mission, the role of wetlands particularly the marshes, coastal wetlands and inland natural wetlands shall be taken up for estimating the sink or source potential of a particular wetland. The expert institutions and the private sectors on Community Public Private Partnership (CPPP) shall be involved in the Wetlands Mission to identify and manage 100 wetlands for making them net Green House Gas emissions sink, keeping in view the fact that the net carbon uptake by the wetlands do offsets the CH₄ emission with the adjustment of the water and vegetation status of the particular wetland. As the wetland restoration particularly the mangroves and seagrasses have the potential to become a negative emission technology by remaining a net carbon sink for centuries, the State would take every possible effort to work towards the ecological restoration of the 100 wetlands in such a way that the wetlands and marshes including mangroves, seagrasses become a carbon offsetting mechanism with minimum leakages.

It is also widely known fact globally that the wetlands particularly the mangroves and seagrasses act as blue carbon sinks. These natural climate change mitigation solutions have not been accounted for under the Green House Gas inventory in the Country. Under the Tamil Nadu Wetlands Mission, the baseline studies of the blue carbon sinks shall be undertaken and the blue carbon inventories shall be attempted with the support of the Institutions which are working in the field of wetlands and climate change. The broad objective of the study shall be to monitor the source or sink nature of the inland and coastal wetlands and ensure that all the 100 wetlands undertaken as a part of the Mission become a net sink of the Green House Gases and contribute substantially in achieving

net zero emission scenario by the State of Tamil Nadu by the year 2070. The carbon credits generated in the voluntary carbon markets and of the blue carbon initiatives shall be distributed to the local communities and other stakeholders (private or public) as agreed to by the State Government for long term protection, conservation and management of the wetlands for the sustainable livelihood and climate change solutions.



Wetland Ecosystem Services in Climate Change Mitigation and Adaptation



As IPCC research has shown that CH₄ is responsible for at least 25% of today's global warming. An assessment by the UNEP and the Climate and Clean Air coalition in 2021 found that cutting human and farming related CH₄ emission by 45% by this decade i.e., by the year 2030 shall be the key in the global battle against the climate change. Wetland being a source of CH₄ emission, steps shall be taken under the Mission to study the CH₄ emission patterns and appropriate interventions shall be planned to ensure that the CH₄ offsetting is undertaken by making the wetland net CH₄ sink.

2.4

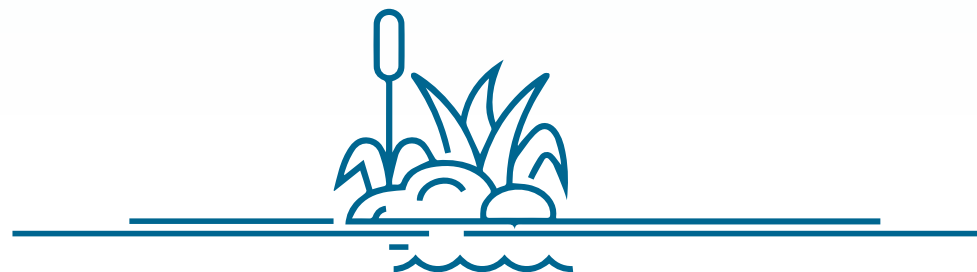
Wetlands & Health

Water borne diseases have a significant impact on wildlife populations and are of special concern for species that have small populations and/or are highly localised at some stages of their life cycle. Highly pathogenic avian influenza H5N1 of Asian lineage (HPAI H5N1) is a viral zoonotic disease that emerged in poultry in southeast Asia between 1997 and 2003 and the said disease has had major impacts on rural livelihoods dependent on domestic birds i.e., chickens, turkeys etc., including mortality of water birds and negative public attitude towards water birds and their habitats as a result of lack of understanding of the role of wild birds in the epidemiology of the disease.

This shall be one of the important case of interventions under the Mission since wildlife disease is increasingly being recognized as a central issue for conservation managers. As the situation at each site shall be different, specific risk reduction measures shall be undertaken at each site so that local efforts remain focused on controlling the most significant risk factors. A series of measures that should effectively reduce the risks of HPAI transmission between domestic birds, wild birds, people at their sites, and other natural disasters shall be undertaken through the site managers. However, site managers of individual sites and wetland systems shall also put in place systematic measures which shall be facilitate reduction of the overall risks of HPAI transmission across the wetlands. The general principles of these measures which may be adopted by the site managers is advised on following lines:

- i) Physically separate wild birds and domestic/captive birds (including poultry), their food and water sources, and their waste wherever found necessary;
- ii) Improve biosecurity arrangements for domestic/captive birds;
- iii) Control environmental transmission routes for the virus on the site and, where appropriate, when leaving the site, e.g., via wild, captive or domestic birds and fomites (inanimate contaminated objects such as footwear or vehicle wheels);
- iv) Improve surveillance and reporting of the health of domestic/captive birds and wild birds;
- v) Improve the knowledge base on the use of the site by wild birds and potential bridge species
- vi) Be fully prepared with a response plan in the event of an outbreak.

The wetlands, human health and their livelihood being intricately linked, therefore the ways in which wetlands can and do maintain or enhance human health and wellbeing through provision of livelihoods shall be given priority and the relationships between wetlands and human sanitation shall be studied and wherever the correction would be required shall be undertaken with the help of the veterinarian experts, Municipalities / Panchayats



2.5

Economic Evaluation of Wetlands

The United Nations Millennium Ecosystem assessment (MEA 2005, IPSES 2016) has demonstrated the intricate links between the ecosystem functioning and the economic value of the ecosystem services. The Ramsar convention has also specifically emphasized on the economic valuation of the wetlands in order to improve the awareness of the people on economic value of the ecosystem goods and services derived from the wetlands by the communities, so that the degradation of the wetland may be arrested. Under the Tamil Nadu Wetlands Mission, the economic valuation of 80 prioritised wetlands were done by Madras Institute Development Studies, Chennai.

Altogether there are 52 sub-components of ecosystem services originating from the 80 wetlands prioritised by Madras Institute of Development Study. These include 27 services under the provisioning services, 6 under the regulating services, 15 under the cultural services and 5 under the habitat services. The estimated monetary value of all ecosystem services delivered by 80 prioritised wetlands of the State comes to Rs. 4386.65 crores per annum. Based on the global benefit transfer value, the potential values of ecosystem services from all the 80 wetlands stands at Rs. 17, 467.9 crores per annum. Deducting the current value from the potential value yields a 'net losses of ecosystem services worth of Rs. 13, 081.00 crores per annum. In 58 wetlands, the current ecosystem values indeed exceed the potential values indicating that they are over-used while among the 22 wetlands, there is a loss of ecosystem values worth of Rs. 15, 203.14 crore at present. This net loss is seven-and-half times greater than the gains from the 58 wetlands with surplus value. Thus, economic valuation has facilitated in quantifying benefits from and changes in wetland ecosystems. Moreover, by including sediment analysis and the benefits accruing from carbon sequestration, the total values of ecosystem services of wetlands shall further increase, which shall be tried under the Tamil Nadu Wetlands Mission.

Wetland ecosystem services are highly valuable and are used in innumerable production and consumption activities in the economy. However, most of the services are not traded in the market and therefore, there is no proper mechanism that captures their true economic values. As a result, policies tend to ignore the importance of the wetlands making them more vulnerable to depletion and degradation. The ecosystem matrix reveals that even under the current situation where the quality of many wetlands is poorer, the wetlands are delivering considerable number of ecosystem services to the community.

Therefore, there is a need to:

- (i) Sensitize different stakeholders about the economic importance of the wetlands in the State;
- (ii) Highlight the interlinkage between wetland ecosystem and the livelihoods of the people in the State; and
- (iii) Generate relevant information for formulating 'evidence-based' policies to protect and manage the wetlands of the State on a long-term basis.

An economic valuation study is expected to answer questions such as how much benefits are generated by the wetlands at present, how much benefits are foregone due to not protecting them and how much potential benefits can be generated due to improvement or restoration of them in future.

The specific objectives of the economic valuation shall be as follows:

- (i) To estimate the economic value of ecosystem benefits and their losses in monetary terms in order to design appropriate policy instruments for efficient, equitable and sustainable management of wetlands in the State.
- (ii) To assist the decision-making committees in the State- to periodically assess the quantum of ecosystem benefits/ costs due to changes in the wetland's ecosystem.
- (iii) To analyse how enhanced ecosystem services impact the livelihoods of the people dependent on the wetland ecosystem services and for designing appropriate evidence-based policy measures to make use of the wetlands in a wise manner
- (iv) To explore the possibility of introducing innovative institutional approach, especially 'market-based economic instruments' such as payment for ecosystem services (PES), for sustainable management of State's wetlands.
- (v) To estimate the amount of carbon, nitrous oxide and methane in the wetland soils and residuals to establish the linkages between the wetlands and the climate change mitigation and adaptation.



• Suchindram

2.6

Wetlands and Biodiversity

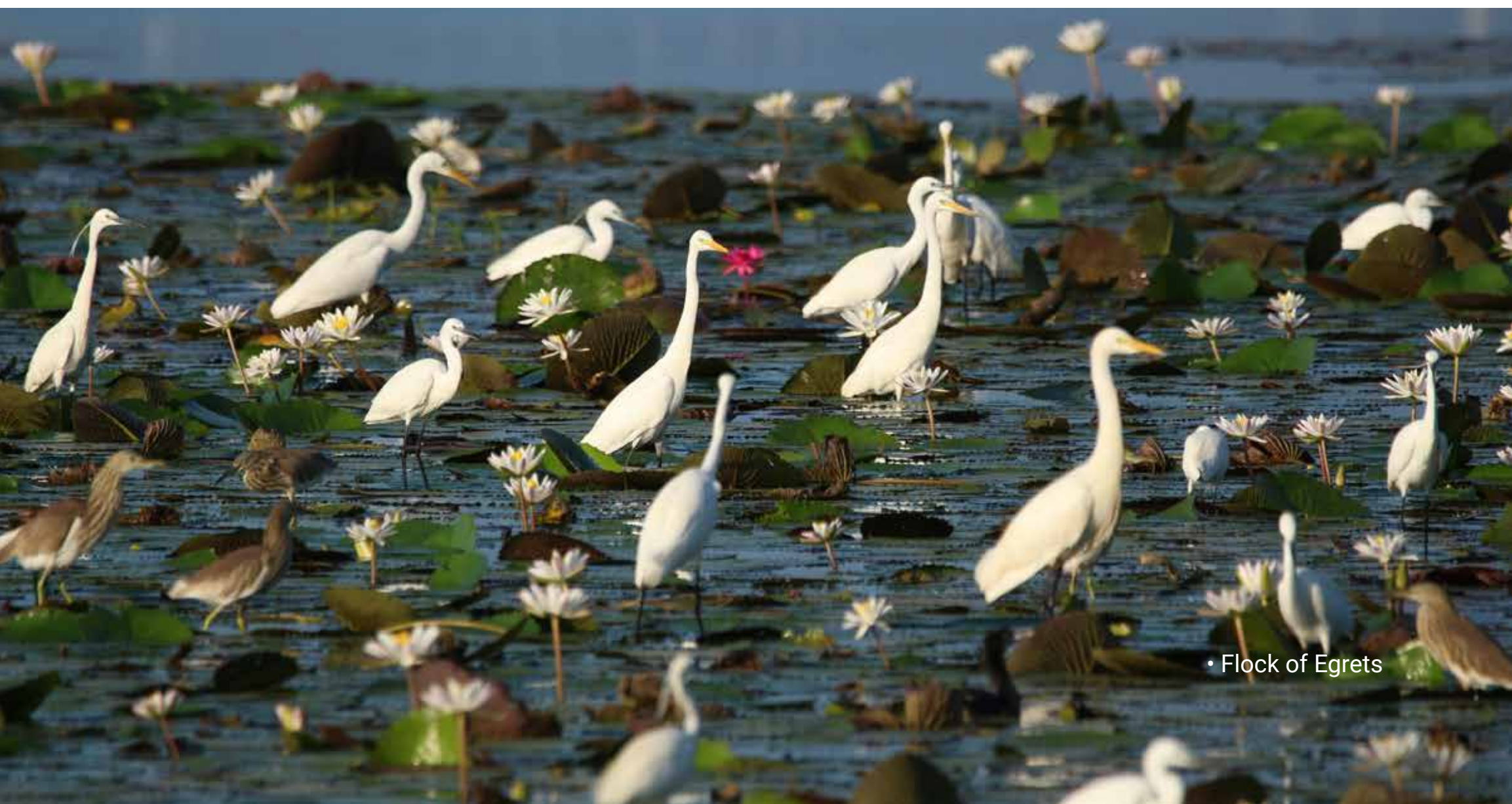
2.6.1.1 Introduction – General

The State of Tamil Nadu has a wealth of wetland ecosystems distributed in different geographical regions with varied climatic conditions. The Diverse habitats such as high-altitude wetlands, swamps, marshes, rivers, lakes, coastal wetlands and marine ecosystems serves as habitat for rich diversity of flora and fauna with high numbers of endemic and endangered species which are adapted to these unique habitats. These habitats also attract the attention of foreign visitors such migratory birds, fishes, turtles, mammals, insects etc., which visits during favourable conditions.





• Common Indian Pond Frog



• Flock of Egrets

2.6.1.2 Inland Wetlands – Natural

Large mammals such as Asian Elephants, Indian Gaur, Sambar Deer, Indian Boar, Tiger, Leopard etc. depend on swamps for water during dry seasons. According to the Forest Survey of India Report 2021 the sub montane hill valley swamp forest covers an area of 2.21 Sq.km. The Tropical montane and high-altitude streams habitats are home to several endemism species of Fishes, Odonates and Amphibians which are restricted to these unique habitats.

Several streams and rivers originate from both the Eastern and Western Ghats of Tamil Nadu and they are rich treasure trove of biodiversity. The Mugger Crocodile and Otters are keystone species and help in maintaining the structure of the ecosystem. They are categorized as vulnerable by IUCN. The three major Indian carp species Catla, Rohu and Mrigal along with several other indigenous inland fishes provide livelihood option for thousands of families. These fishes are also cultivated in natural as well as manmade wetlands and are harvested seasonally.

The lakes / ponds / waterbodies are the only green abodes which are still partially wild in the urban area. The lake bund itself acts as a unique habitat which supports diverse plant and animal species. In urban area lakes act as harbours of diversity especially the butterfly

population as the lake side vegetation in terms of trees, shrubs and herbs act as host plants for butterflies. These host plants are also has medicinal values which are collected by the local community. Drying up lakes offer wading birds ideal hunting grounds and islands inside lakes offer them sanctuary from urban predators like stray dogs and also provides nesting sites. Millions of migratory birds such as Waders, Ducks, Terns, Gulls etc. visits the wetland habitats during the migratory season. The migratory population includes several endangered and threatened bird species.

The big trees found in the lakes and ponds provide nesting habitat for colonial nesting birds these birds tend to prefer undisturbed sites and they acts as a bio indicator of the quality of the wetland. The bird excreta called Guano enriches the water and when used for irrigation results in high crop yield. Large amount of Guano are produced in areas where there are nesting and roosting sites within the wetlands. According to the Atlas of colonial nesting water birds in Tamil Nadu by Wildlife Institute of India in the year 2022, 19 species of colonial nesting birds are found in the State which includes near threatened birds like Spot-billed Pelican, Painted Stork, Oriental Darter and Black-headed Ibis. 101 heronries have been identified to be active nesting sites where Vachellia nilotica trees were dominantly used by the birds for nesting.



• Blackbuck (Point Calimere Wildlife and Bird Sanctuary)



• Indian Gaur

More than 100 species of Odonates are found in the State of Tamil Nadu which includes several endemic species. They are indicators of the water quality and help in controlling vectors such as mosquitos which helps us to fight against vector borne diseases. The Odonates feed on mosquito larva when they are in their nymph stage and also feed on adult mosquitos when they become adult dragonflies or damselflies. The tadpoles and frogs also help in controlling insect and vector population.

The freshwater wetlands are rich in floral diversity, aquatic plants act as food source and provide habitat for several fauna species. These plants remove carbon dioxide and produce oxygen through photosynthesis. The dead plant debris settle at the bottom of the wetland and the carbon stored in them gets stored as sediments due to anaerobic condition. People collect plant products such as flowers and leaves of lotus, typha, tubers and medicinal plants in and around wetlands. Thus the availability of food, ornamental and medicinal plants provides plenty of livelihood options to the local community.

2.6.1.3 Interventions

The montane high-altitude wetlands will be ecologically restored to improve water holding capacity which will in turn improve the surrounding ecosystem and will help in prevention human wildlife conflicts. To protect the key habitats such as fast flowing streams and rivers interventions shall be done in close consultation with the line departments and where ever possible, prevention of flow modifications, prevention of pesticide and other agrochemical use in upper catchments, regulation of tourism in critical habitats will be taken and Workshops involving local and regional stakeholders should be carried out to identify and prioritise a set of Freshwater Key Biodiversity Areas.

The lakes/ ponds/ waterbodies shall be preserved by ecologically restoring them by undertaking proper scientific studies and hearing the opinion of the local communities, stakeholders and line departments. Novel plans such as creating eco-friendly walkways such as "Bird and Butterfly trails" with information boards on the importance of dense shrubs and wild vegetation for the wellbeing of birds and butterflies. along the bund will help in conserving the biodiversity along the bund. These walkways can be used for conducting nature walks for schools, colleges and public to create awareness about the importance of wetlands.

Framework for sustainable harvesting and cultivation of natural resources shall be created to derive maximum benefit in order to maintain the sustainable flow of ecosystem goods and services within the biocapacity of the wetlands. Traditional knowledge on the

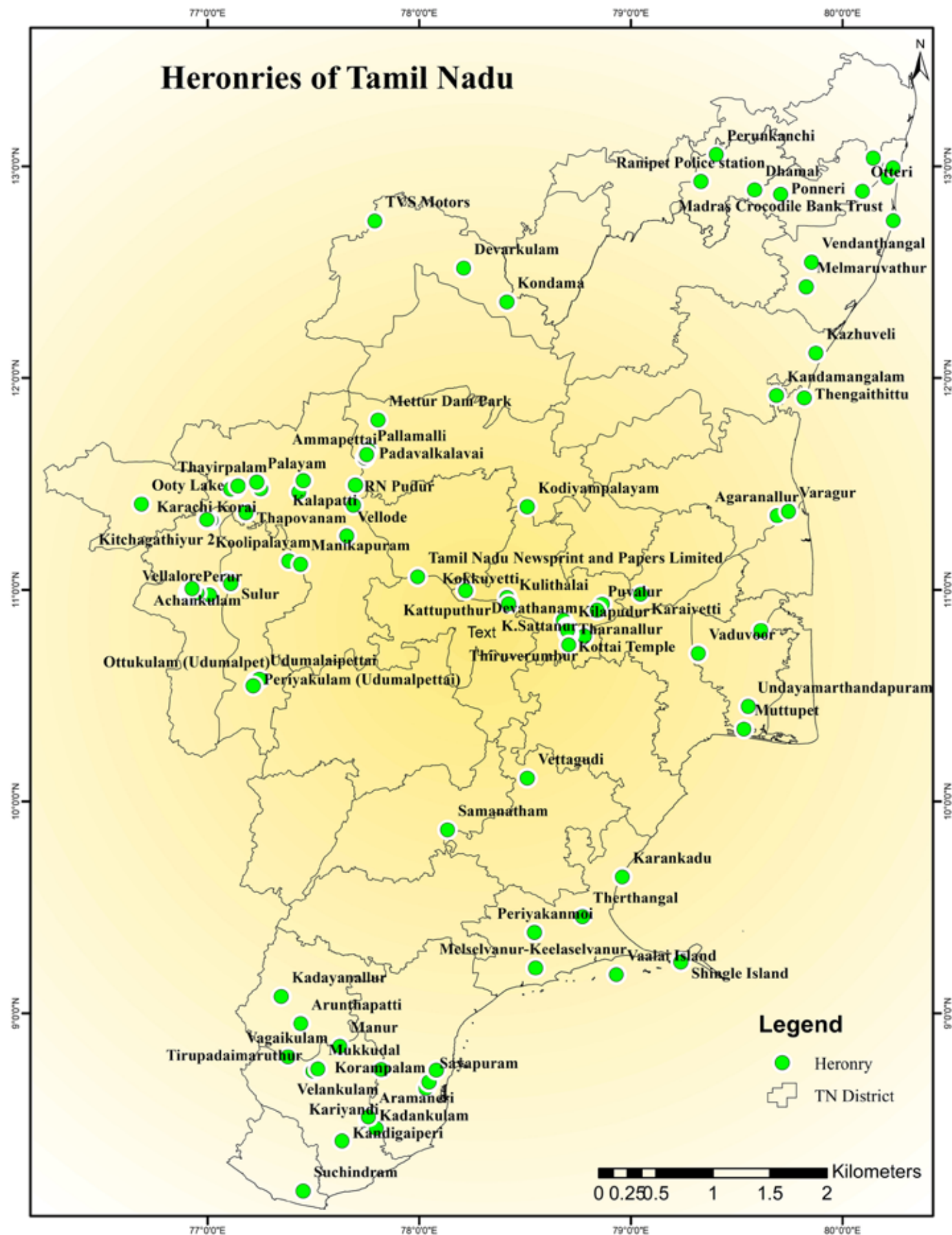
use of wetlands by the local communities shall be documented under the Mission which shall include sustainable harvesting practices such as fishing and collection of biomass having the medicinal, food and biodiversity values. It is strongly felt that the awareness generation of the communities and wetland managers based upon the traditional knowledge systems shall go a long way in the restoration and rejuvenation of degraded or disappeared wetlands besides restoration of the existing wetlands.

Exploring the value addition opportunities for promoting the sustainable use of wetland resources shall also be one of the focus areas under the Mission. Initiatives such as composting of organic waste, invasive species and utilizing wetland materials for creating pots and baskets etc., shall be promoted for improving the livelihood of the local communities by way of encouraging local craftsmanship and the sustainable harvesting of wetland resources within its biocapacity.

Furthermore, it would be crucial to establish small rural enterprise units in close proximity to wetlands to fully realize their potential. These units shall serve as hubs for economic activities and community engagements. By leveraging the advantages of being near wetlands, these enterprises shall be trained to tap various opportunities, such as eco-tourism, guided nature walks, or the production of value-added products derived from the wetland resources. This approach will not only create employment opportunities for local communities but also foster entrepreneurship and raise awareness about the ecological importance of wetland conservation on long term basis.

Bio-diversity of the wetlands shall also be documented and made a part of People's Bio-diversity Registers (PBRs). By doing this, not only the immense value of wetlands bio-diversity shall be recognised but also this will ensure mainstreaming of the wetland's biodiversity for its long-term protection, conservation and management for the benefit of the local communities.

Under the Tamil Nadu Wetlands Mission baseline data of biodiversity of the wetlands shall be created by conducting surveys which would help to formulate strategies to conserve biodiversity as several species found in the wetland ecosystem are listed as threatened by IUCN. Ecologically important wetlands/ water bodies shall be identified in each district with the help of District Level Wetland Management Committee and the surveys shall be done across seasons by involving wetland mithras, public and Non-Governmental Organizations along with the Forest Department which would help in generation of important data and at the same time create awareness among the people regarding the wetland ecosystem.

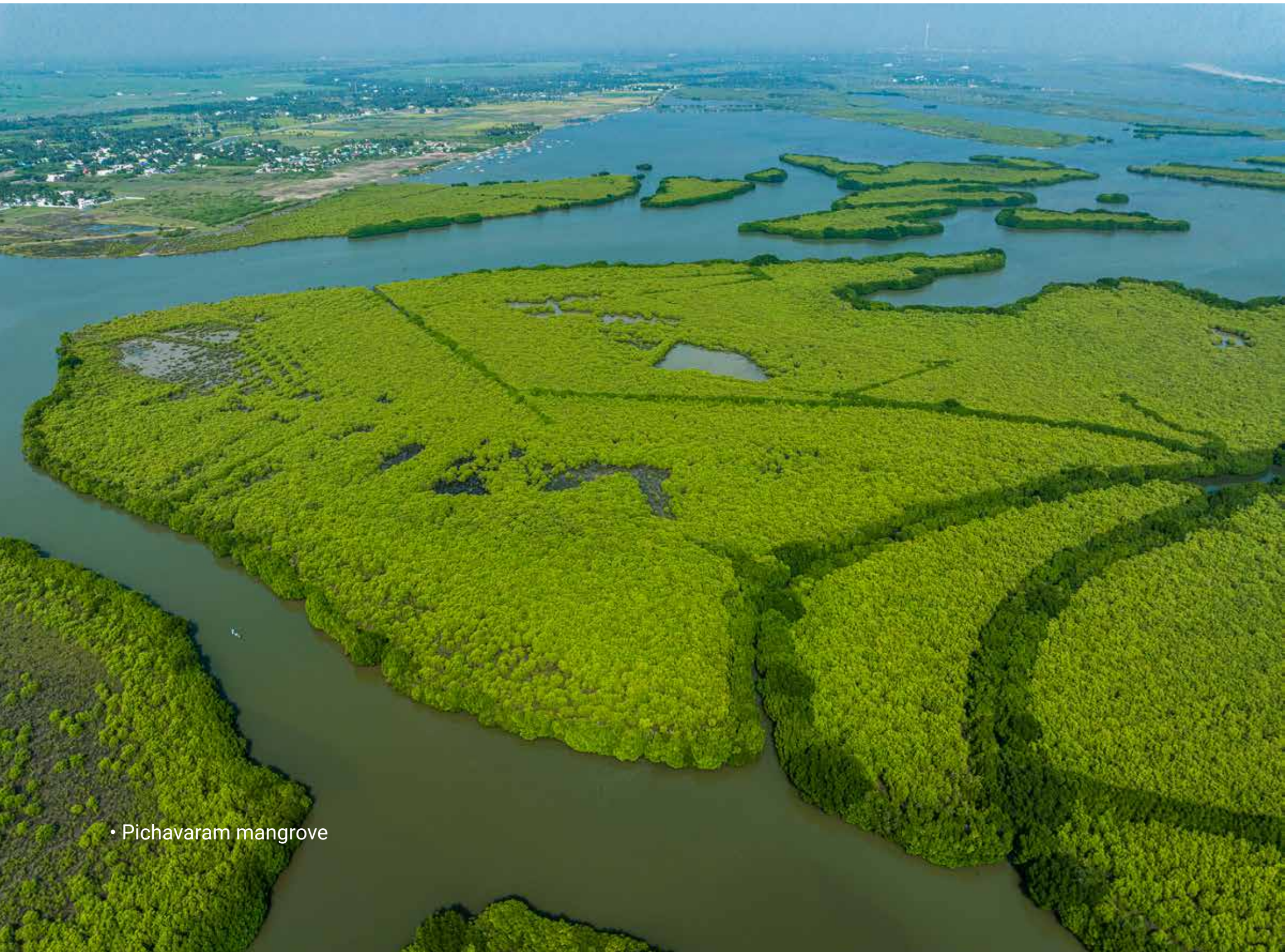


G.V.Gopi, Frank S.J.D, Pandav B (2022). Atlas of colonial nesting waterbirds in Tamil Nadu. Final Report: TR No./2022/17. Wildlife institute of India, Dehradun,200ps

2.6.2 Mangroves , Seagrass , Mudflats , Salt marshes and Coral Reefs

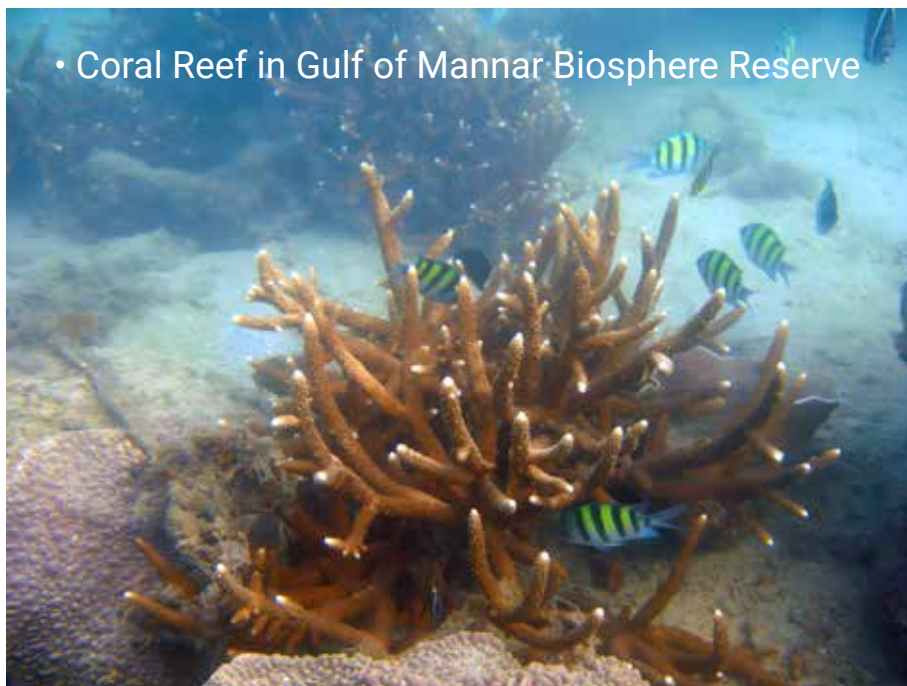
Coastal environment plays a vital role in nation's economy by virtue of the resources, productive habitats and rich biodiversity. Mangrove, sea grasses and mudflats are nature-based solutions which have the potential to address societal challenges like nature hazards (floods & droughts) food and water security and the climate security besides providing the human wellbeing and biodiversity benefits (Coher Shacham, Walters, Janzen et al 2016). Combination

of nature-based solution and the urban development in the coastal state like Tamil Nadu shall be a way forward for bringing social, economic and financial impacts on the coastal communities (Sedden, Sengupta, Garcia – Espinosa et al 2019). The state is house for five species of sea turtles namely: Olive Ridley, Green Turtle, Hawksbill Turtle, Loggerhead Turtle and Leatherback Turtle. The vast shoreline provides good nesting habitat for theses rare and endangered turtle species. Several threatened Dolphin and Whale species are found along the coast line of the state.



• Pichavaram mangrove

• Coral Reef in Gulf of Mannar Biosphere Reserve



Mudflats which are ecologically and socio-economically important ecosystems and delivers benefits to human population worldwide (Costanza et al 2014). These soft - sediment intertidal habitats with > 10% Silt and Clay (Dyer 1939) support spawning of fishes, provides feeding ground for birds (both resident and migratory), protect the coastal communities from the storm surges and cyclone. The global value of ecosystem services provided by intertidal system such as estuaries including mudflats (total area 1.8×10^6 Sq.km) is estimated to be US\$ 5.2×10^{12} 2007 \$/ha/year and a further US\$ 24.8×10^{12} 2007 \$/ha/year are provided by tidal marshes, salt marshes and mangroves (Costanza et al 2014). During migratory season thousands of waders and other migratory birds move towards the southern hemisphere in search of feeding grounds and one of the vital habitats for the survival of the migratory birds is the mudflats which provide them with nutrient rich food thus these mud flats are important for maintaining the global bird population. This unique habitat supports rare and threatened migratory bird species such as the Spoon-billed Sandpiper, Great Knot, Spotted Greenshank, Plovers etc., and thus attracts tourist and researchers from all over the world to visit these places which in turn shall improve the eco-tourism and scientific knowledge of the area.

Salt marshes are intertidal wetlands with halophytic vegetation and they have the potential to withstand the high salinity and regular or occasional immersion by the tides (Siikamaki et al 2013). The salt marshes are also the major blue carbon ecosystems with a wider latitudinal extend than mangroves. The salt marshes of Tamil Nadu comprise of 3.8% of 16000 Sq. Km under the salt marshes in India (SAC 2011; Patre et al 2013). The salt marshes shall be clearly surveyed and demarcated under the wetlands mission and shall be

• Mudflat



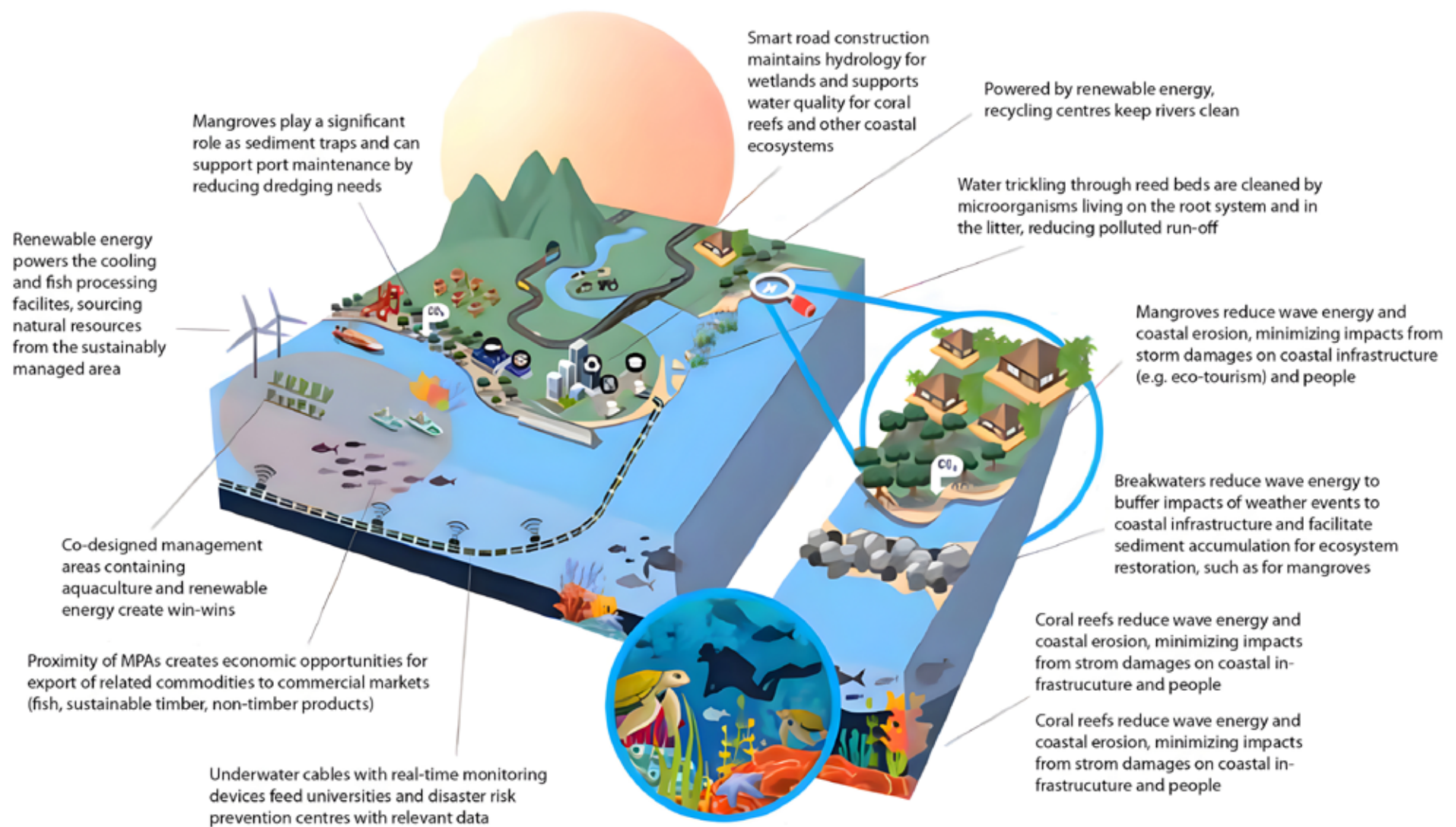
conserved and protected for reducing the impacts of storm surge duration and height through extra water uptake (Barbier et al 2011). The salt marshes being the natural filters of nutrients and pollutants also facilitate carbon sequestration and serve as an organic carbon sink by sequestering millions of tonnes of carbon annually (Mitsch and Gosselink 2008).

Mangroves in India covers an area of about 4,992 Km² contributing 3.39 % of the world's mangroves and represent one of the best swamps in the world. In Tamil Nadu, the mangroves cover 44.94 Km², which is approximately 0.034 % of the geographical area of the State as per the Indian State of Forest Report 2021. Out of which, very dense mangrove, moderately dense mangrove and open mangrove covers an area of 1.11 Km², 26.95 Km² and 16.88 Km² respectively.

• Dugong



Role of nature-based solution for coastal development



The Mangrove species found in Tamil Nadu are as follows:

Sl.no.	Family	Scientific Name	Type
1.	Avicennaceae	<i>Avicennia alba</i>	Tree
2.	Avicennaceae	<i>Avicennia marina</i>	Tree
3.	Avicennaceae	<i>Avicennia officinalis</i>	Tree
4.	Combretaceae	<i>Lumnitzera racemose</i>	Tree
5.	Euphorbiaceae	<i>Excoecaria agallocha</i>	Tree
6.	Fabaccae	<i>Dalbergia spinose</i>	Tree
7.	Myrsinaceae	<i>Aegiceras corniculatum</i>	Fern
8.	Meliaceae	<i>Xylocarpus mekongensis</i>	Tree
9.	Pteridaceae	<i>Acrostic humaureum</i>	Tree
10.	Rhizophoraceae	<i>Bruguiera cylindrica</i>	Tree
11.	Rhizophoraceae	<i>Bruguiera gymnorrhiza</i>	Tree
12.	Rhizophoraceae	<i>Cerbera odollam</i>	Tree
13.	Rhizophoraceae	<i>Ceriops decandra</i>	Tree
14.	Rhizophoraceae	<i>Ceriops tagal</i>	Tree
15.	Rhizophoraceae	<i>Rhizophora annamalayana</i>	Tree
16.	Rhizophoraceae	<i>Rhizophora apiculata</i>	Tree
17.	Rhizophoraceae	<i>Rhizophora mucronata</i>	Tree
18.	Rhizophoraceae	<i>Kandelia candel</i>	Tree
19.	Rubiaceae	<i>Scyphiphora hydrophyllacea</i>	Tree
20.	Sterculiaceae	<i>Heritiera littoralis</i>	Tree
21.	Sonneratiaceae	<i>Sonneratia apetala</i>	Tree



• Pichavaram mangrove

Mangrove forests are the world's most productive tropical ecosystems and help in improving the livelihood of the local communities especially that of the fisher folks on account of being nursing and breeding habitat for several species of fishes, molluscs and crustaceans. The mangrove forest helps in shore line stabilisation and also acts as a barrier against natural calamities such as Cyclones and tsunamis. Mangrove accounts for 3% of carbon sequestered by the tropical forest globally and the blue carbon stock stored by mangroves are vital for our fight against climate change.

Sea grasses occur in the intertidal and mid tidal zones of shallow and sheltered areas of sea, gulf, bays, backwaters and lagoons. They are submerged monocotyledonous plants and are adapted to the marine environment for the completion of their life cycle under water. They form a dense meadow on sandy and coral rubble bottom and sometimes in the crevices under water. Sea grasses are involved in cycling of nutrients. They provide food, shelter for diverse organisms and act as a nursery ground for many fishes of commercial importance and play a vital role in the fisheries production of the region. Dugong and Green Sea Turtle predominantly feed on sea grasses and are they in turn help in dispersal of sea grass seeds thus increasing the sea grass cover. Seagrasses are carbon sinks

and enablers of climate mitigation. The carbon sequestration of seagrass in Palk Bay is estimated to be 10.1 to 16.8 tCO₂e/ha per year. A recent study quantified the blue carbon of seagrass meadows in Gulf of Mannar to be 0.001782 Tg C and that of Palk Bay to be 0.043996 Tg C. Based on this the estimated value of blue carbon stored in Seagrass meadows of Gulf of Mannar and Palk Bay was valued at USD 17820 and USD 43,99,682 respectively (Kaladharan et al 2020)

Corals are productive, dynamic ecosystem providing shelter and nourishment to thousands of marine flora and fauna. The Corals prefer warm, clear, shallow coastal regions where light is abundant. The corals indirectly help to safe guard the carbon sinks of the coastal environment by buffering the shoreline, sea grass beds and mangroves from erosion and damage due to cyclone and waves. These habitats help in increasing fisheries productivity by providing nursing and feeding ground for high value fishes, crustaceans and molluscs. The coral reefs also attract tourist which creates jobs and businesses for the local community and also helps in earns foreign exchange. In Tamil Nadu, the coral reefs are distributed along the Gulf of Mannar, Palk Bay and at restricted places in Chennai and Cuddalore.

2.6.2.1 Threats

The Coastal environment are under immense pressure due rapid urbanization and increasing human population. The quality of the coastal habitats such as mudflats, salt marshes, mangroves and sea grass meadows have depleted drastically due to agricultural runoff, discharge of sewage, deposition of pollutants etc. which are carried to these habitats through rivers and canals. The change in land use for purposes such as construction of ports, sea walls, infrastructure development, shrimp culture, plantation etc. has hampered and reduced the area of the coastal wetland habitats. The habitats also face threats such as rise in sea level and reduction in flow of water due to water regulatory structures. Mangroves and other coastal vegetation are affected by pest and diseases. The Coral reefs are becoming highly disturbed and are encountering problems like pollution, sedimentation, unsustainable fishing practice such as bottom trawling and climate change, which is raising ocean temperature and are causing coral bleaching and possible death of corals. In 2016, a survey in the Gulf of Mannar by Suganthi Devadason Marine Research Institute (SDMRI) revelled that 16.2% corals had died and of the remaining 23.9% had bleached. Natural events such as cyclones, tsunamis, floods and drought also torment these coastal habitats leading to the degradation of these habitats. So there is an urgent need to take action to conserve these unique and fragile habitats which are important for improving the livelihood of the local community and also for conserving biodiversity.

2.6.2.2 Interventions

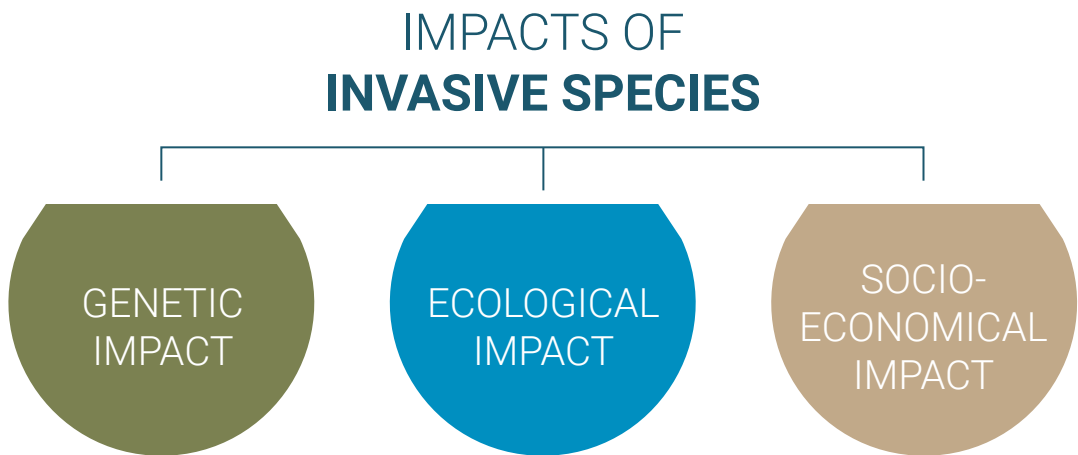
As the blue carbon has the potential to mitigate the Co2 emission for centuries, these are perceived to be natural climate solution. The State under the Tamil Nadu Wetlands Mission shall quantify and monetize the carbon stored and sequestered through the coastal ecosystems for achieving the net zero carbon emission. The State shall map the total area under sea grasses, salt marshes, mudflats and mangroves to maintain and increase the blue carbon pool and also to prevent the carbon emission from the land use change due to the anthropogenic factors. The seagrass restoration in the Gulf of Mannar Marine Biosphere Reserve shall be undertaken through the expert institutions to improve the Dugong habitat and other marine wildlife habitat as well as to improve the blue carbon sink inside the ocean as a carbon offsetting project. The Community Public Private Partnerships shall be tried for financing various blue initiatives for creating additional blue carbon sink and monetizing and earning of blue carbon credits particularly for the benefit of the local communities. Under the Mission, the ecosystem-based models shall be formulated with the inputs of the experts, scientists and Research Institutes for conservation of coastal ecosystems and mitigating the adverse impacts of the climate change. Detailed studies on the coastal ecosystem shall be encouraged to better understand the ecosystem values provided by the habitats and also to conserve them. Large scale awareness programs and educational materials regarding the ecosystems values and services provided by coastal wetlands and the wise use of these habitats shall be taken forward to enhance the awareness amongst the general public on the importance of these vital coastal wetland ecosystems.



2.7

Invasive Species

Invasive species have been posing sever threat to the wetland ecosystem and the services it provides to people. More than 200 species of flora and fauna have been reported in India and the number is on increase due to lack of awareness regarding the impact of these species.



2.7.1 Ecological Impacts of invasion

- i. Competes with native species for living space and food.
- ii. Predates native species of fish in various forms of their life cycle (egg, larva, fry, juvenile and adult.
- iii. The invasive species are hardy in nature and hence are able to survive in tough environmental condition such as contaminated water, water with low dissolved oxygen etc.
- iv. The reproduction rate is high and they possess various adaptations to alter their reproduction strategies during adverse climatic conditions.
- v. They act as vector and lead to the spread of new pathogens and parasites among the native fish population.
- vi. Invasive species generally reduce the abundance of native inland water species through altering community structure and ecosystem processes, such as nutrient cycling, energy flow or the hydrodynamic properties of a particular inland water ecosystem.

2.7.2 Socio- Economic Impact of invasion

- i. The Native fish productivity reduces due to the impact of invasive species.
- ii. The invasive species are not preferred for consumption by people.
- iii. The price of these species is always lower when compared to native fish species.
- iv. The cost of managing the invasive species is very high as they are difficult to control which leads to the increase in coast of wetland restoration projects.

- v. The water quality gets reduced which makes the water unfeasible for domestic household uses.

2.7.3 Genetic Impact of the invasion

- i. Alters the genetic pool by reducing the size of the native fish population and thus causes the exposure of undesirable characters.
- ii. Interbreeding may occur in closely related species.
- iii. Fragmentation of population may occur.

In order to combat this daunting task of eradicating invasive species from the wetlands under the Tamil Nadu Wetlands Mission, detailed inventory and study regarding the spread and impact of invasive species shall be undertaken in consultation with Experts and Research Institutions to formulate strategies in order to prevent the degradation of wetlands. Innovative ideas such as citizen science initiatives shall be taken up to monitor these invasive and awareness shall be created among the public with the help of wetland mithras, NGOs, line departments and other stakeholders, for eradicating the invasive species from the wetlands ecosystem. However, this shall be one of the most challenging and ambitious tasks where the inter-sectoral convergence with the Department of Fisheries, Animal Husbandry, Expert Institutions working in the field of the invasive species shall be the way forward.



• Removal of water hyacinth in Vaduvur bird sanctuary



• Tilapia



• African Giant Snail

Major Invasive species recorded in and around the wetlands of Tamil Nadu

Sl.no	Taxa	Family	Scientific name	Common name
1	Fish	Cichlidae	<i>Oreochromis mosambicus</i>	Tilapia
2	Fish	Poeciliidae	<i>Gambusia holbrooki</i>	Mosquito fish
3	Fish	Poeciliidae	<i>Poecilia reticulata</i>	Guppy
4	Fish	Loricariidae	<i>Pterygoplichthys sp.</i>	Sailfin Catfishes
5	Fish	Clariidae	<i>Clarias gariepinus</i>	African Catfish
6	Fish	Cyprinidae	<i>Cyprinus carpio</i>	common carp
7	Reptile	Emydidae	<i>Trachemys scripta elegance</i>	Red-eared slider
8	Snail	Achatinidae	<i>Lissachatina fulica</i>	Giant African Land Snail
9	Bivalve	Mytilidae	<i>Mytella strigata</i>	Charru Mussel
10	Tree	Fabaceae	<i>Prosopis juliflora</i>	Prosopis
11	Shrub	Verbenaceae	<i>Lantana camara</i>	Lantana
12	Bush	Convolvulaceae	<i>Ipomoea carnea</i>	Pink morning glory
13	Herb	Asteraceae	<i>Sphagneticola trilobata</i>	Trailing daisy
14	Herb	Araceae	<i>Pistia stratiotes</i>	Water lettuce
15	Herb	Pontederiaceae	<i>Pontederia crassipes</i>	Water Hyacinth
16	Herb	Asteraceae	<i>Parthenium hysterophorus</i>	Famine weed
17	Algae	Solieriaceae	<i>kappaphycus alvarezii</i>	Elkhorn sea moss

Possible steps to eradicate Invasive Species



Steps to
**ERADICATE
INVASIVE
SPECIES**

STUDY

- Identifying
invasive Species
- Distribution
- Impact Caused

PREVENTION

- Creating
Awareness
- Creating
New Laws
- Protecting the
un-invaded wetlands

ERADICATION

- Mechanical
methods
- Biological
control
- Chemical
methods

2.8

Wetlands and SDG's

SDG 17 – PARTNERSHIPS FOR THE GOALS

The Ramsar Convention works in partnership with other MEAs to support governments in achieving the SDGs.

SDG 16 – PEACE, JUSTICE & STRONG INSTITUTIONS

Effective management of transboundary wetlands contributes to peace and security.

SDG 15 – LIFE ON LAND

40% of all the world's species live and breed in wetlands.

SDG 14 – LIFE BELOW WATER

Healthy and productive oceans rely on well functioning coastal and marine wetlands.

SDG 13 – CLIMATE ACTION

Peatlands cover only 3% of global land but store twice as much carbon as the entire world's forest biomass.

SDG 12 – RESPONSIBLE CONSUMPTION & PRODUCTION

Wetland areas properly managed can sustainably support increased demands for water in all sectors.

SDG 11 – SUSTAINABLE CITIES & COMMUNITIES

Urban wetlands play a vital role in making cities safe, resilient and sustainable.

SDG 10 – REDUCED INEQUALITY

Healthy wetlands mitigate the risk to an estimated 5 billion people living with poor access to water by 2050.

SDG 9 – INDUSTRY, INNOVATION & INFRASTRUCTURE

Healthy wetlands form a natural buffer against the increasing number of natural disasters.

SDG 1 – NO POVERTY

More than a billion people depend on wetlands for a living.

SDG 2 – ZERO HUNGER

Rice, grown in wetland paddies, is the staple diet of 3.5 billion people.

SDG 3 – GOOD HEALTH & WELL BEING

Half of international tourists seek relaxation in wetland areas, especially coastal zones.

SDG 4 – QUALITY EDUCATION

Safe water access enhances educational opportunities, especially for girls.

SDG 5 – GENDER EQUALITY

Women play a central role in the provision, management and safeguarding of water.

SDG 6 – CLEAN WATER & SANITATION

Almost all of the world's consumption of freshwater is drawn either directly or indirectly from wetlands.

SDG 7 – AFFORDABLE & CLEAN ENERGY

Sustainable upstream water management can provide affordable and clean energy.

SDG 8 – DECENT WORK & ECONOMIC GROWTH

Wetlands sustain 266 million jobs in wetland tourism and travel.



2.9

Concerns and Conservation Methods

Measures taken to promote conservation and their integrated management have been effective to a very limited extent in preventing water pollution, degradation and loss of wetlands. Wetlands have been drained, reclaimed and encroached upon widely. Most of the wetlands that remain today suffer from siltation, mining, altered hydrological regime, infestation by noxious aquatic invasive species, discharge of untreated sewage and industrial effluents, dumping of solid waste, hazardous waste and excessive harvesting of living resources. The loss of wetlands endangers water, food and climate security. The issues aforementioned emphasise on the importance of intersectoral convergence in wetland management.

Efforts shall be made under the mission to efficiently address the below mentioned concerns:

Sl.no	Concerns	Solutions/ Conservation methods
1.	Poor planning (due to no definitive body tasked to manage wetlands, independent development of sectoral laws and lack of wetland management plans)	• Integrated planning process involving all stakeholders • Formulate Integrated Management plans for each wetland • Adequate inventory of wetlands to understand them and device customised and appropriate
2.	Lack of Community Empowerment (due to lack of involvement, unemployment and lack of knowledge)	• Create awareness • Train and employ more personnel form the community • Capacity building on a continuous basis • Encourage community participation in conservation
3.	Scarce resources (Due to insufficient funds allocation)	• Mobilization of the resources • Provision of resources by both the villages and Government • Efficiency in resource use • Seek donor funding through proposals
4.	Encroachment (Due to poverty, population growth, no clear demarcation of wetland areas, hotels and other recreation facilities, agriculture, felling of trees in the wetland vicinities, overgrazing, Drainage fill-in]	• Re-demarcate all wetlands • Inflow and outflow management by preventing discharge of sewage, industrial effluents, agricultural wastes, pesticides etc. • Prevention and curtailing of encroachment • Create income generating programs • Implement laws and regulations • Planting of water-friendly species e.g., bamboo • Local community involvement to protect the resources from uncontrolled human encroachment and interventions
5.	Pollution (Due to urbanization poor planning, poor disposal of waste water and solid wastes, broken sewer system etc.)	• Controlled urbanization • Creation of green and blue infrastructure • Proper waste management practices by prevention of dumping solid wastes such as plastic waste, e-waste, Construction &Demolition waste, hazardous waste, etc. into the wetland • Closure of nearby industries, carwashes along rivers and wetland etc.
6.	Extreme weather events such as floods and droughts (due to Climate Change impacts and other anthropogenic pressures)	• Disaster risk management • Flood and Drought averting plans through suitable real time monitoring systems and technologies
7.	Climate change issues causing other changes	• Carbon, Methane and Nitrous Oxide sequestration
8.	Invasive Species (IS)	• Removal of Invasive Species • Planting/ rearing of indigenous species (flora and fauna)
9.	Uncoordinated Legislation (due to conflicting policies on wetlands, and lack of political goodwill)	• Coordination of operations of laws • Development of one common law to manage all wetlands and resources such as under Notification process, or designating RAMSAR sites etc. • Engage all stakeholders and hold them accountable • Elected representatives to be more responsible • Clear Government policies on wetland protection

2.10

Wetlands and inflow / outflow management

The various scientific and research studies point out that globally 30 % of the wetlands have been lost in 3 decades and India is no exception to this phenomenon. Under the mission conserving and protecting the wetlands from anthropogenic stresses and resultant degradation with the help of the District Level Wetland Management Committees and the local communities shall be given at most priority. The baseline information on the health status of the wetlands shall be gathered, causes shall be identified and various interventions that would be required to restore the wetlands shall be designed and implemented following bottom-up approach. The interventions to improve the ecological, hydrological and biological characteristics of the wetland shall be designed appropriately following the Wetlands (Conservation and Management) Rules 2017, so that the wetlands selected for the ecological restoration attain sound ecological health, retain bio-diversity and provide the various eco-system goods and services in an efficient and effective manner. The funding for the implementation of the ecological restoration of wetlands shall be largely through public as well as private sources. The approach to planning can be more systematic by following a set of initiatives. This requires collation and synthesis of existing information on various site features so as to provide a basis for the identification of management objectives. Problem of poor planning and management of wetlands can be addressed through the following information needs and data requirements presented in the Table below.

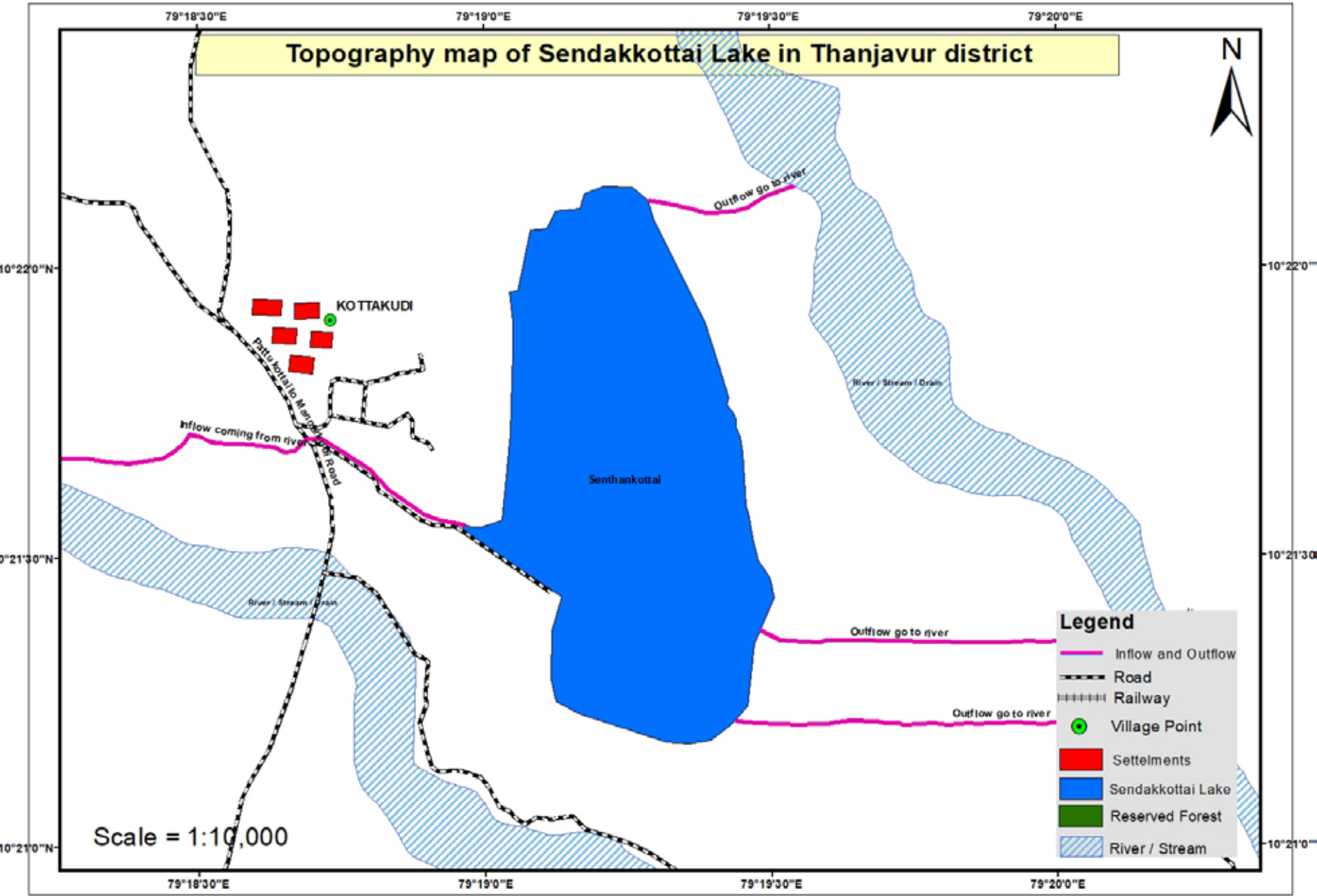
Information Needs and Data Requirement

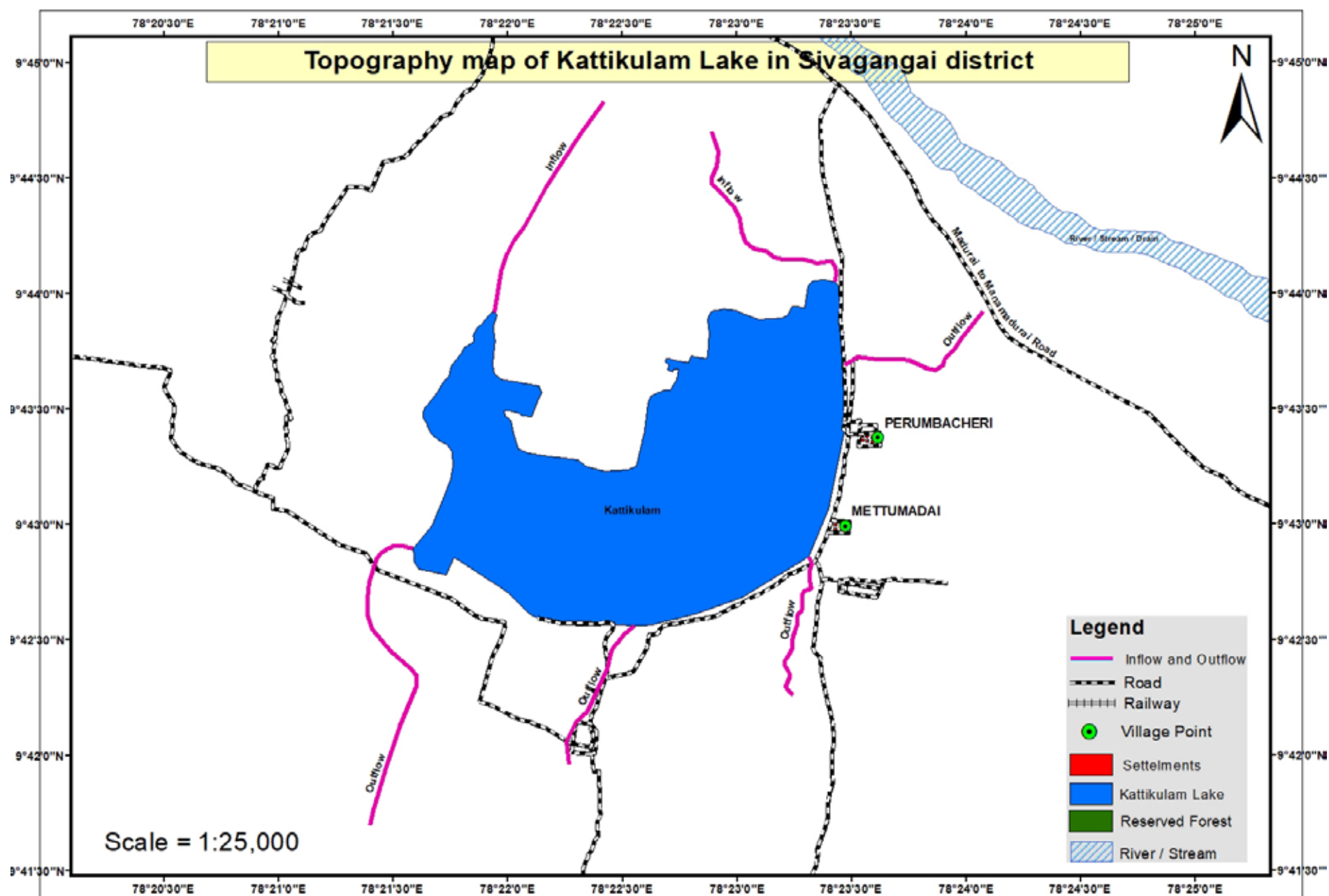
Wetland feature	Management information needs	Data requirement
Wetland type and extent	• Location • Wetland type • Wetland area • Significant inter-annual changes in the wetland • Major changes in the wetland extent in the last 20–30 years (if available)	• Geographical coordinates • Land use and land cover data for the wetland (at least for two seasons, pre- and post-monsoon) • Historical map of the wetland (can be developed from the Survey of India toposheets) (if available)
Catchment/ Drainage Basin	• Direct and indirect catchment of the wetland • Geological and geomorphological characteristics that have led to the formation of the wetland • Present land use and land cover of the catchment and their implication for wetland • Major developmental activities in the catchment and their impacts on the wetland	• Geology and geomorphology • Topography • Drainage pattern • Soil types • Climate setting • Land use and land cover change
Hydrological regimes	• Major sources of water inflow and outflow from the wetland • Major sources of sediments in to the wetland • Inundation regime • Trends in water holding capacity and factors for the decline • Water quality and pollution status • Water use pattern within the wetland catchment and implication for wetland	• Water inflow, outflow and balance • Inundation pattern • Sedimentation • Groundwater • Water quality • Water use within the basin
Biodiversity	• Species richness • Role of the wetland in the life-cycle of migratory species • Invasive species and major contributing factors • Major changes in species richness and habitat and factors thereof	• Species richness and diversity • Biological significance of habitats • Risk of species invasion
Ecosystem Services	• Key ecological and hydrological characteristics required for the sustained provision of ecosystem services • Ecosystem services trade-offs	• Provisioning services (direct wetland products, eg., food, fiber, water) • Regulating services (the ability of an ecosystem to regulate hydrological regimes, influence micro-climate, reduce disaster risk, groundwater recharge) • Cultural services (recreational values, cultural and religious norms and beliefs related to wetlands) • Supporting services (Primary production and other ecosystem functions which enable wetlands to deliver all above ecosystem services)

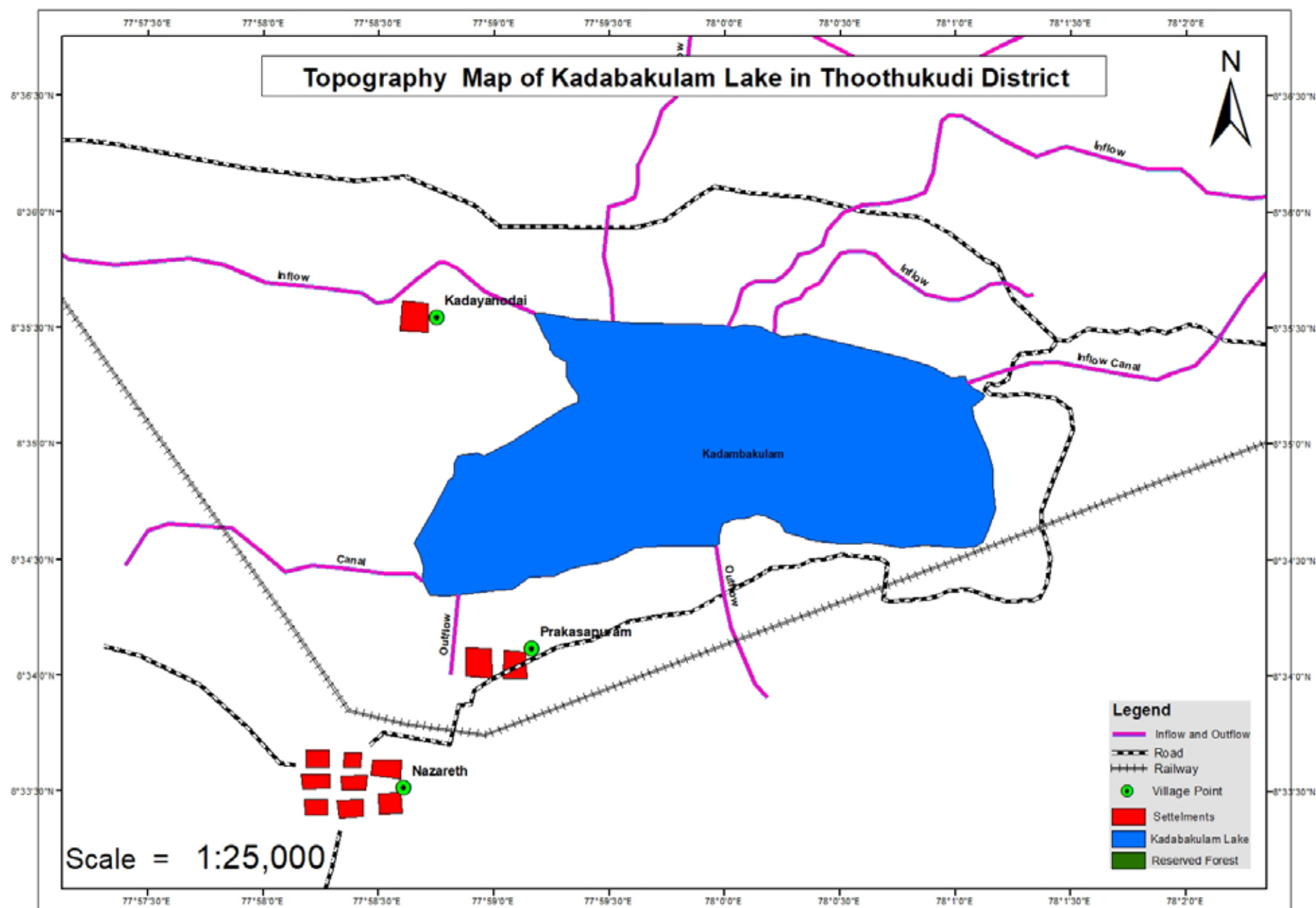
Wetland feature	Management information needs	Data requirement
Socioeconomics and livelihoods	• Extent of dependence on wetlands for livelihoods • Status of community infrastructure (such as water and sanitation) and implication for wetlands • Livelihood vulnerability and relationship with changes in wetland resources • Resource use conflicts • Major shifts in livelihoods and implications for wetlands	• Demographic features of communities living in and around • The contribution of wetland to income and employment • Community resource use and management practices

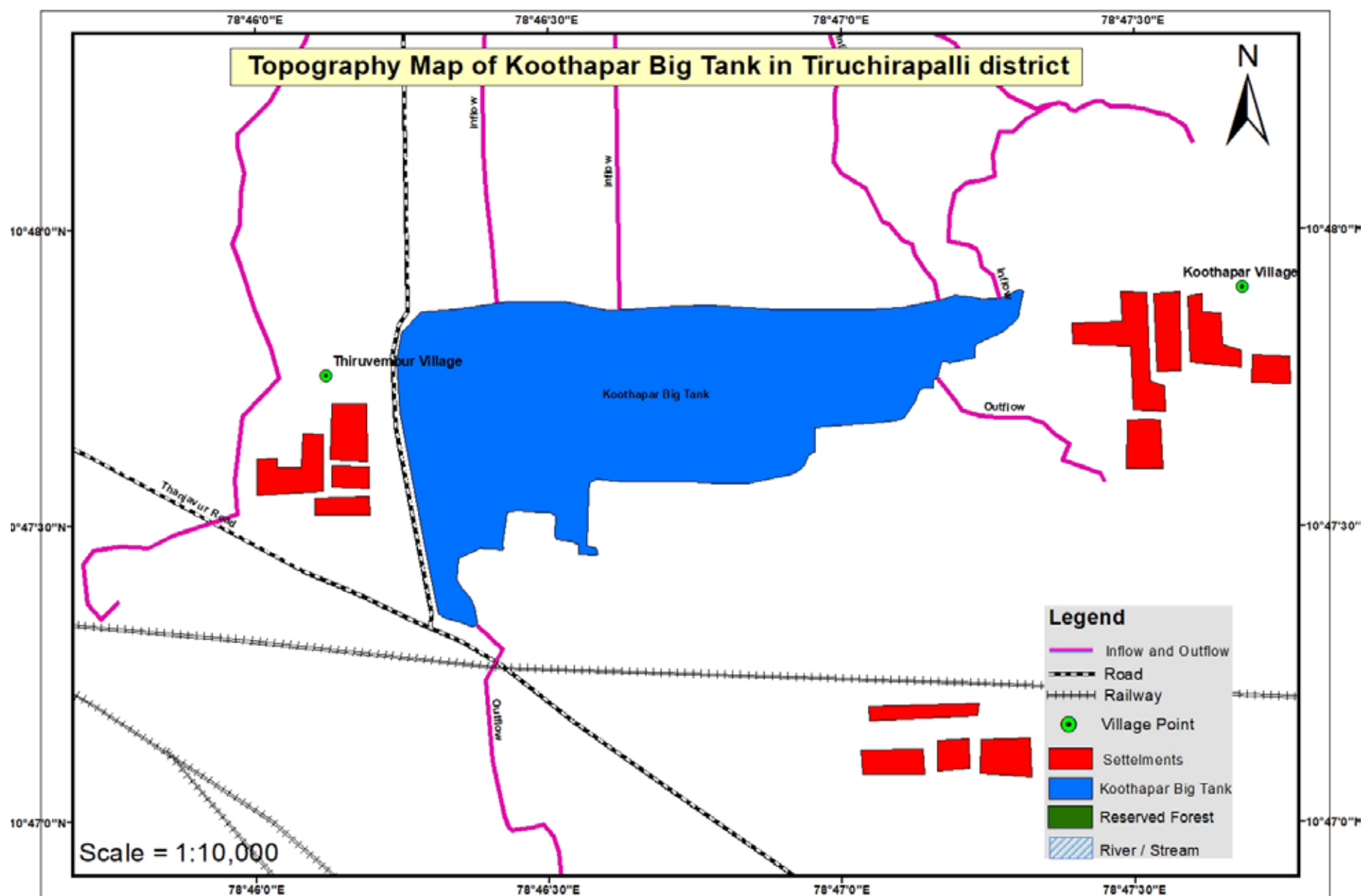
Below are some of the topographical maps prepared to plan the inflow/outflow management of wetlands in the State under the Tamil Nadu Wetlands Mission

The restoration of the wetland on the catchment area basins/ watershed basins shall be the most effective way to ensure sustainability in the restoration process in the long run. The District Level Wetland Management Committees have identified about 35 wetlands in the State which can be ecologically restored based upon the following drainage patterns. The given model of inflow and outflow management shall be followed for remaining 65 wetlands under the Tamil Nadu Wetlands Mission.









2.11 Delineating zone of influence

The Wetlands Rules recommend delineation of a zone of influence which is an area, in which developmental activities are likely to induce adverse changes in wetland ecosystem structure and functioning. It is therefore considered important under the Mission to align developmental planning (Permitted Activity, Regulated Activity and Prohibited Activity) within the zone of influence with wetland biodiversity and ecosystem services. The boundary of the zone of influence shall be defined with due consideration to local hydrology and nature of land use. For wetlands with a well-defined surface drainage system, its directly and freely draining basin shall be delineated as the zone of influence. This shall be done using a suitable digital elevation model data and validated using toposheets ensuring that the basin should encompass all direct inflow as well as outflow areas.

For wetlands with diffused drainage and where slope is too gentle, rendering large basin areas, the zone of influence shall be delineated on the basis of features that are likely to adversely influence wetland functioning. These shall be based on the outer periphery of adjoining settlements, or peripheral agricultural fields which drain directly into the wetland.

An aerial photograph showing a large flock of white birds, possibly egrets or herons, scattered across a vast, lush green field. The birds are concentrated in a diagonal line from the top left towards the bottom right, with some smaller groups elsewhere. The field is covered in dense, low-lying vegetation. In the top left corner, there is a purple circular icon containing the white number '3'.

3

Establishment of a Project
Technical Team (PTT)

The Government of Tamil Nadu for the first time has created an independent post of the Member Secretary, Tamil Nadu State Wetland Authority by upgrading the post of Chief Conservator of Forests (Wildlife) & Member Secretary Tamil Nadu State Wetlands Authority to the rank of Additional Principal Chief Conservator of Forests and Member Secretary i.e. Level 15 in the pay matrix of Indian Forest Service vide G.O.(Ms) No.38, Environment, Climate Change & Forests (FR.Spl.A), dated. 02.07.2021, in order to spearhead the wetland restoration activities in the State on a mission mode.

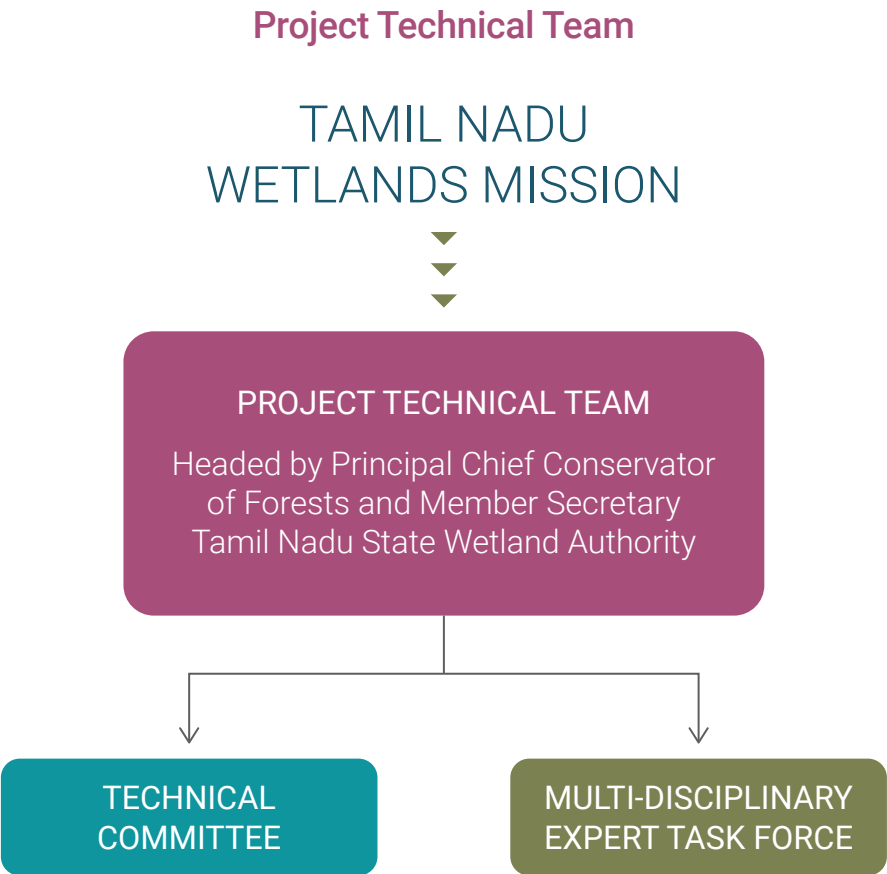
In order to accomplish the daunting task of the ecological restoration of the wetlands in the State of Tamil Nadu, the following shall be established:

Project Technical Team (PTT): The Project Technical Team shall be recruited in the Office of the Additional Principal Chief Conservator of Forests and Member Secretary, Tamil Nadu State Wetland Authority for technical guidance, support and field visits that facilitates wetland notification process, preparation of Integrated Management Plan (IMP) and for monitoring of the ecological restoration of the wetlands.

Project Technical Team shall also be responsible for developing the Carbon Asset for following :-

- a) Mangrove Plantation
- b) Sea Grass Plantation
- c) Coral Reef
- d) Wetland Restoration
- e) Other Activities

The Project Technical Team shall structure private-public partnerships and facilitate the funding requirement for Carbon Asset Management (CAM) and facilitate the implementation, monitoring and realization of Carbon Credits and shall also explore opportunities for mobilising additional resources as and when required. Benefits arising out of the Carbon Credits, shall be provided to the local communities. The envisaged Organisation Structure of the Project Technical Team shall be following:-



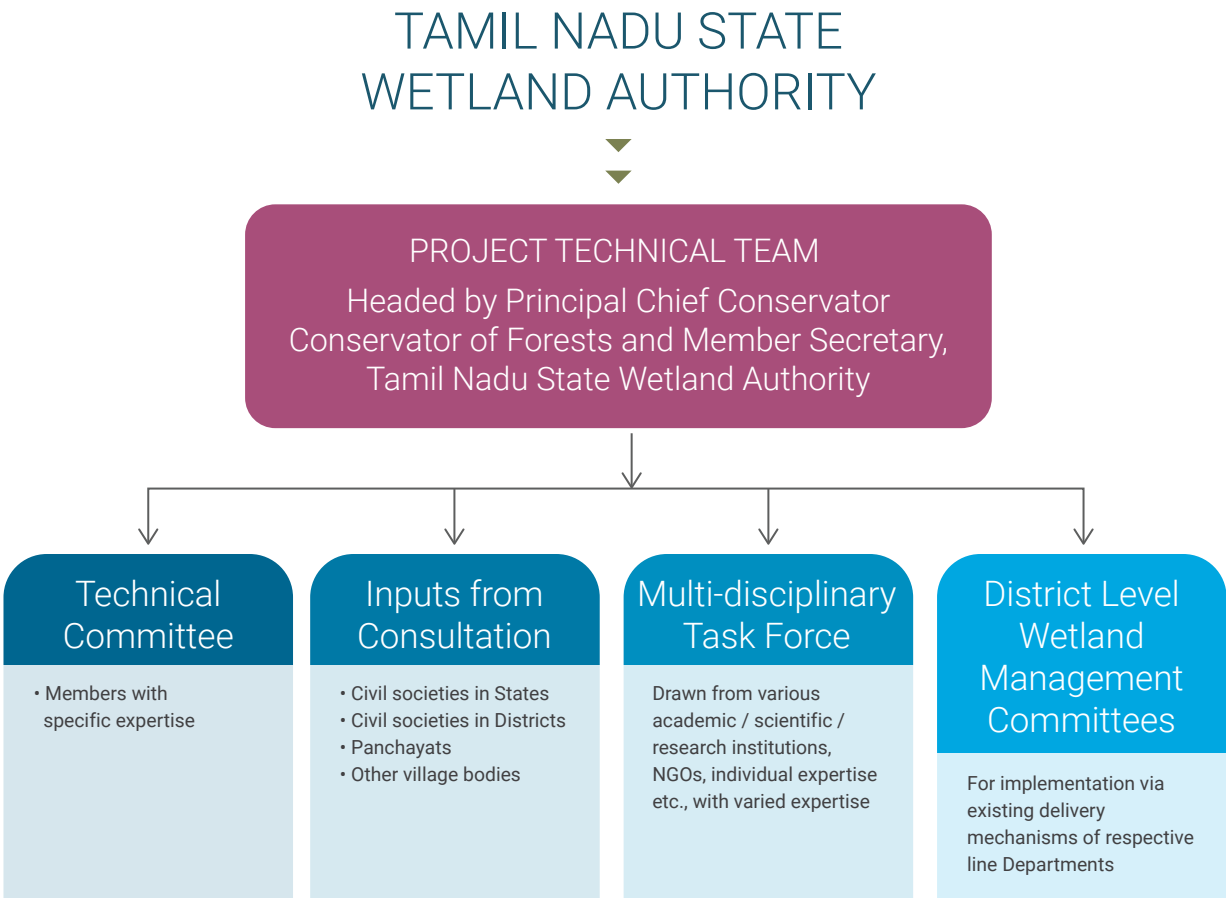
Work flow for the Project Technical Team

- 1) To ensure regulatory mechanism for identified valuable wetlands, to prevent their degradation and enhance their conservation and develop a State inventory of wetlands.
- 2) Identification of Wetlands viz., Estuaries, Wetlands within Forest Areas, Tiger Reserves for notification and ecological restoration.
- 3) To frame conservation and wise use strategies for each significant wetland, with participation of local communities, and other relevant stakeholders.
- 4) To take explicit account of impacts on wetlands in particular, the reduction in economic value of wetland environmental services explicitly factoring in the cost-benefit analysis.
- 5) To consider unique wetlands as entities with “Incomparable Values” by developing strategies for their protection/restoration.

- 6) To integrate wetland conservation, including conservation of natural and degraded wetlands and into sectoral development plans for poverty mitigation and livelihood improvement.
- 7) To ensure ecological restoration of natural and degraded wetlands for climate change mitigation by making natural wetlands as potential carbon sinks.
- 8) To formulate and implement eco-tourism strategies for identified wetlands through multistakeholder partnerships involving public agencies, local communities, and investors.

These objectives will focus on wetland habitats, managing, enhancing, or restoring existing wetland habitat to benefit wetland-dependent wildlife and communities, improve sediment and water quality in the greater watershed to address hydrology issues such as flooding or storm water runoff, to contribute to climate change or drought adaptation, converting existing operations-related features such as storm water management facilities into functional wetland habitat.

Implementation Strategy For Tamil Nadu Wetlands Mission



Implementation Strategy For Tamil Nadu Wetlands Mission

The implementation strategy for devising an appropriate wetland management plan shall be through multi-sectoral linkages by ensuring that the wetlands are included in the sectoral development plan of the line departments. The activity wise multi-Sectoral integration shall be as following

Management Plan components	Activities	Key considerations	Identified Government Departments/ Agencies
Boundary delineation and demarcation	Boundary mapping and delineation	• Site boundaries should be established with reference to inundation regimes, soil conditions and vegetation types. • Landscape connectivity should also be taken into account when wetlands exist in patches. All activities should be completed within the first year.	DLWMC in consultation with the district level Owner department (s)
	Removal of encroachments	• Boundaries should be notified and legally protected wherever possible. All activities should be completed within the first year.	DLWMC in consultation with the district level Owner department (s)
	Shoreline management	• Mostly required for wetlands in urban and peri-urban setting. • Stabilisation of bunds surrounding the wetlands, naturalization of slopes using vegetative measures. • Development of promenade for urban lakes can be included based on an evaluation of natural drainage and shoreline ecosystem niches.	Forest Department Department of Environment
Catchment conservation	Afforestation and aided regeneration	• Catchment conservation plans should be developed at watershed scales and based on Joint Forest Management approaches. • Native species should be used for forestry operations. • Pilot watershed should be periodically monitored to assess changes in soil moisture regimes. • Livelihood interventions for catchment communities aimed at reducing dependence on wood as an energy source should be included as appropriate.	Forest Department Department of Environment
	Small scale engineering measures (gully plugging, check dams, gabion structures etc.)	• Community participation in design, implementation and post-project maintenance of structures should be ensured.	Rural Development & Panchayati Raj (RD&PR) Dept., Public Works Dept. Forest Dept., in consultation with the DLWMC
Water management	Selective dredging and desilting to improve hydrological connectivity	• Selective Dredging based on assessments of bathymetric profile and species interactions. • For inflowing channels, dredging can be used to improve water inflow.	DLWMC
	Interception, diversion and treatment of point sources of pollution	• Mostly recommended for wetlands in the urban and peri-urban setting.	Tamil Nadu Pollution Control Board (TAMIL NADU PCB)

Management Plan components	Activities	Key considerations	Identified Government Departments/ Agencies
		Provision of comprehensive sanitation and safe drinking water coverage to communities living around the wetlands may be ensured.	Tamil Nadu Pollution Control Board (TAMIL NADU PCB)
		Engineering (STPs) as well as biological options (constructed wetlands) should be evaluated for application. Planning for Operation and Maintenance expenses should be included for all engineering structures	
	Construction and operation of hydraulic structures for maintenance of water regimes and flood control	For each significant structure, environmental impact assessments should be carried out prior to construction.	Tamil Nadu Water Investment Company Ltd. (TWIC), Institute of Water Studies (IWS), NCSCM and other agencies identified by TAMIL NADU SWA
	Balancing water allocation for human and ecological purposes	Environmental flows for wetlands, hydrological regimes of which are affected by hydraulic structures, should be assessed and implemented in consultation with water managers	Tamil Nadu Water Investment Company Ltd. (TWIC), Institute of Water Studies (IWS), NCSCM and other agencies identified by TAMIL NADU SWA
Biodiversity conservation	Habitat evaluation and improvement	Plantation of terrestrial plant species in wetlands should be avoided unless it is required to improve the habitat quality.	Forest Department Department of Environment
	Improvement and maintenance of migratory routes, breeding and spawning grounds for key species	Community groups should be involved in habitat monitoring and maintenance of migratory routes, breeding and spawning grounds	SACON and other Organizations identified by the TAMIL NADU SWA
	Management of Invasive species	A mix of mechanical and biological methods for controlling species invasion.	
		For plant invasives, economic utilization along with physical removal.	
Sustainable resource development and livelihood improvement	Microenterprise Development for Reducing dependence On wetland resources For livelihoods	Identification of micro-enterprise development options should be based on an assessment of community livelihoods, capacities, resources and market linkages.	MSME, RD &PR Dept., Crafts Council of India, etc.
	Sustainable fisheries development	Only capture based fisheries techniques should be promoted in natural wetlands	Fisheries Department, Central Marine Fisheries Research Institute (CMFRI
		Options for improving culture fisheries in areas around wetlands may be included or reduce dependence on capture fisheries	

Management Plan components	Activities	Key considerations	Identified Government Departments/ Agencies
Institutional development	Setting regulatory regimes	• Site regulation should be harmonized with national and State level regulations • Local customary self-regulation which supports maintenance of conservation values.	District Level Wetland Management Committee
	Development of monitoring and evaluation system	• Comprehensive monitoring and evaluation mechanism for hydrological, ecological, socio-economic and institutional features should be made a part of the management system • Involvement of stakeholders in monitoring should be encouraged	Madras Institute of Development Studies (MIDS), Madras School of Economics (MSE), TAMIL NADU AU and other agencies as identified by the TAMIL NADU SWA
	Communication and Outreach	• Increasing awareness on values and functions of wetland should be made an integral part of the management plan. • The use of television, print, electronic and social media for awareness generation and outreach may be included as appropriate. Developing and disseminating dos and don'ts in wetlands for general public may also be considered	Department of Public Instruction (DPI), Information and Technology Department and other agencies as identified by the TAMIL NADU SWA

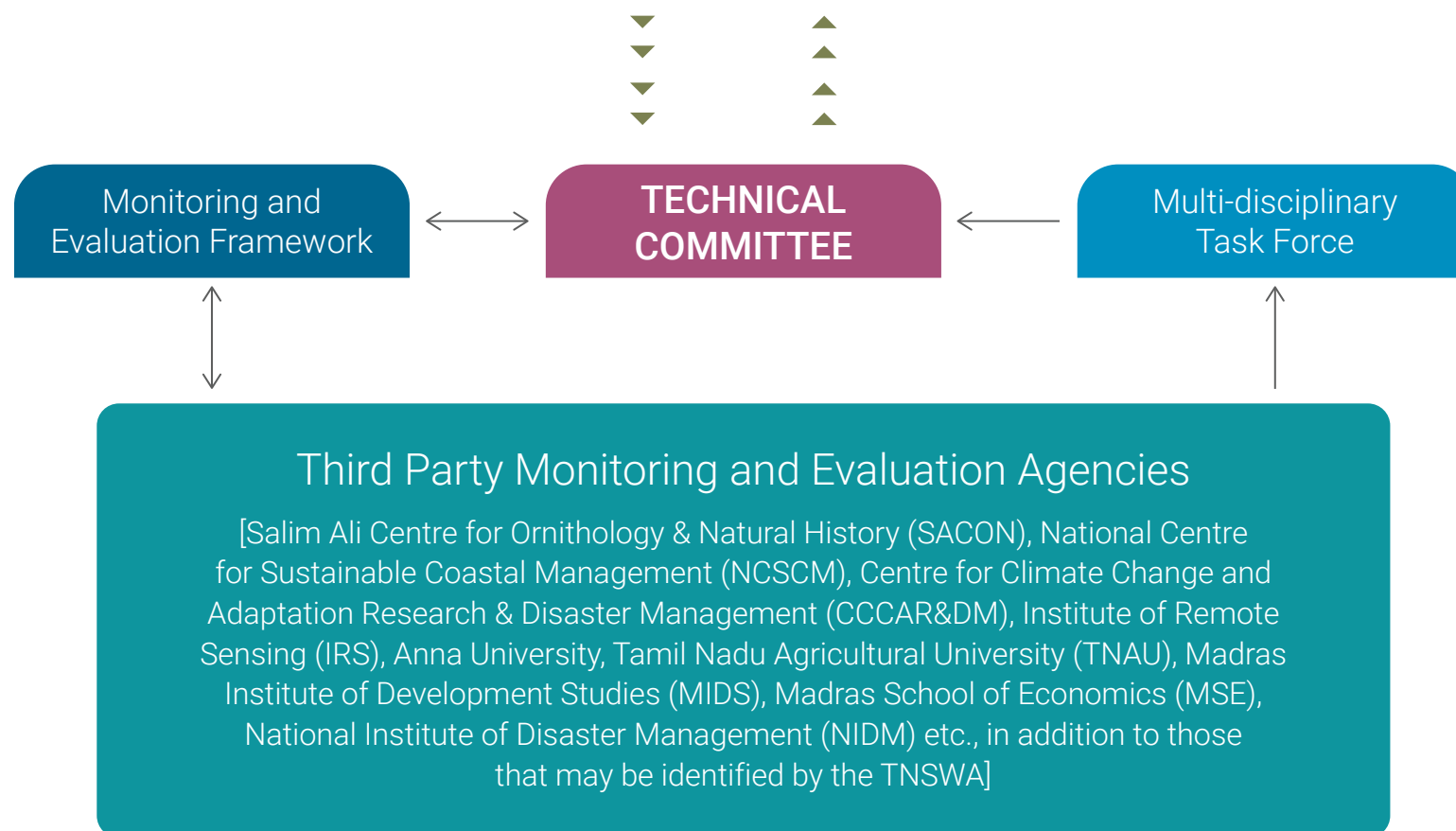
Third Party Monitoring and Evaluation Framework

As the Mission enters the implementation phase, it would be important to monitor the changes happening on the ground. Every combination of watershed characteristic, sources of stress, and restoration techniques being unique in nature it shall be ensured through the third-party monitoring that the restoration efforts are proceeding exactly as planned. Adopting the implementation plans to some changes or new information shall be considered as a mid-course correction. Monitoring before and during the implementation shall be crucial for finding out whether goals are being achieved as and if they are not, “mid-course” adjustments shall be undertaken. Post-implementation monitoring shall help determine whether additional actions or adjustments are needed and can provide useful information for future restoration efforts. (unesdoc.unesco.org)

The broad M&E framework proposed to be followed is shown below.

Monitoring and Evaluation Frame Work

TAMIL NADU STATE WETLAND AUTHORITY (TNSWA)



The Monitoring and Evaluation process for the Integrated Management Plan (IMP) shall follow the following approach:

- Prioritising key wetland features for management planning
- Natural variability within these features, including thresholds
- Threats that limit the maintenance of wetlands features in the desirable State

Evaluation of wetland features shall be done on the basis of criteria as mentioned in the Wetlands (Conservation and Management) Rules 2017 like

- Naturality
- Rarity
- Criticality for ecosystem functioning
- Socio economic importance, and
- Requirement under the extant regulatory regime.

The evaluation process shall lead to narrowing down of the list of wetland features, for which threats shall be identified. The integrated management plan shall be formulated in response to these threats. Through this process, it shall ensure that the Plan does not merely focus on symptoms (for example, poor water quality) but on the root causes of the wetland's degradation both in terms of quality and status. Evaluation shall be undertaken to understand whether existing institutional arrangements are sufficient and effective in addressing the threats to wetlands. Based on the gaps identified, an institutional arrangement for implementation of the management plan shall be developed. This shall include the followings:

- Enlisting of Government Departments having programmes which impact (or have the potential to impact) wetlands features or threats on these features;
- Analysis of laws and regulation related to wetland, access and use of wetland resources, biodiversity or any dimension;
- Ownership, rights and privileges pertaining to wetlands;



• *Acacia nilotica*

- iv. Analysis of the role of CSOs and communities in wetlands management, with particular reference to their views, rights and capacities; and,
- v. Gaps and challenges, and the ways are means to address those aspects.

Further in consonance with the requirements of Wetlands (Conservation and Management) Rules, 2017, the following shall be enforced:

- i. Activities prohibited within the boundary of wetlands;
- ii. Activities to be regulated within wetlands and zone of influence and regulation thresholds; and,
- iii. Activities permitted.

Identification of site-specific management aspects would be required to ensure that the site features are maintained or improved and it shall be ensured that any work which is undertaken towards the wetland restoration must be measurable so as to enable reporting on

progress towards meeting them (for example, reducing silt load from the wetland catchment by x%) and achievable at least in the medium or long term of an objective that cannot be achieved and which can lead to an overall loss of sense of direction and misallocation of resources (for example, completely preventing nutrient enrichment in a wetland located in the intensive agricultural landscape is an unachievable objective, a much better proposition would be to reduce the current rate by xx%) , an achievable objectives shall be planned to ensure that the anthropogenic factors do not further deteriorate the wetlands ecology.A monitoring and evaluation plan to enable assessment of overall management effectiveness and identify needs for mid-term correction shall be put in the place and the performance indicators for each of the integrated management objectives shall be associated with this process and shall be identified and monitored on ground for the holistic improvement of the status and health of the wetland

Following shall be the Performance indicators for Periodic Monitoring and Evaluation for ensuring that the wetlands are not losing their ecological, economical and hydrological values.

Wetland feature	Management objective	Performance Indicator	Means of measurement
Area	• Maintain wetland area	• Wetland area which has not been altered for non-wetland usages	• Area estimated from analysis of remote sensing images and ground truthing.
Catchments	• Reduction in silt load from catchment	• Silt load	• Monitoring pilot watersheds
Hydrological regimes	• Reduce pollution • Enhance hydrological connectivity within wetlands complex	• Biological Oxygen Demand, Chemical Oxygen Demand or any other water quality parameter assessed against a threshold • Area of wetland complex inundated during high flood period	• Water quality monitoring • Analysis of remote sensing data and hydrological surveys
Biodiversity	• Maintain and enhance habitat of water birds	• Area of wetland used by water birds	• Physical survey
	• Reduce area under invasive macrophytes	• Area under invasive macrophytes	• Analysis of remote sensing images and ground truthing
	• Maintain fish species richness	• Fish species richness	• Sampling
Socio-economics	• Reduce use of harmful fishing practices	• Number of destructive fishing gear used in the wetland	• Survey
	• Reduce direct dependence of communities on capture fisheries	• Reduction in % of income derived from wetland	• Socio-economic surveys

(*) = relevant for all wetlands and must from a part of the monitoring system.

(**) = relevant for wetlands located in urban and peri-urban areas. Other parameters may be included based on the assessment of relevance and wetland contexts.

Besides setting up performance indicators for the IMP, would also essential to set up a monitoring system for the wetland to be able to assess changes in ecosystem condition over a period of

time undertaken. Photographic and videographic documentation (before, during and after management intervention) shall also be as part of monitoring process. Aquatic drones/buoy-based sensor induced transmission for online data updating shall be used for large wetlands, which will further help in enriching the management practices. Following parameters as mentioned under the Wetlands (Conservation and Management) Rules 2017 shall be scrupulously followed to ensure wetlands continue to provide improved ecosystem goods and services for the wetland dependent communities.

Wetland feature	Monitoring parameter	Monitoring method	Recommended Frequency
Wetland extent	• Wetland area* • Land use and land cover within the wetland area • Connectivity with other adjoining wetlands, river/ streams, coastal zone	• Remote sensing and ground truthing	- Once in a year - Once in a year - Once in a year
Wetland Catchment	• Climate • Land Use Land Cover* • Total sediment yield • Total nutrient yield	• Data from the nearest weather station • Remote sensing and ground truthing • Stream gauging station	- Monthly - Once in 3 years - Monthly
Hydrological regimes	• Water inflow and outflow* • Water holding capacity • Peak inundation • Dissolved Oxygen • Biological Oxygen Demand* • Chemical Oxygen Demand** • Number of point sources discharging untreated sewage into the wetland**	• Stream gauging station • Bathymetric survey • Remote sensing and groundtruthing • Data from water quality sampling stations • Data from water quality sampling stations • Surveys	- Monthly - Once in 5 years - Once in 2 years - At least monthly - At least monthly - Once a year
Biodiversity and Habitat	• Population of major wetland dependent species groups (such as water birds, mammals etc.,)* • Habitat use by key species • Number of migratory species using the wetland as a habitat • Are a under invasive macrophytes**	• Mid-winter counts • Physical surveys • Physical surveys • Physical surveys	- Once a year - Once a year - Once a year - Once a year

Wetland feature	Monitoring parameter	Monitoring method	Recommended Frequency
Ecosystem Services	• Annual Fish yield • Number of tourists • Volume of surface water abstracted from wetland • Volume of groundwater recharged • Proportion of flood water stored in the wetland • Use of wetland for research and education	• Sampling • Surveys • Hydrographic surveys • Hydrographic surveys • Hydrographic surveys • Surveys	• Monthly samples collated into an annual estimate • Monthly samples collated into an annual estimate • Monthly samples collated into an annual estimate • Once a year • Once a year • Annual estimate
Wetland Catchment	• Climate • Land Use Land Cover* • Total sediment yield • Total nutrient yield	• Data from the nearest weather station • Remote sensing and ground truthing • Stream gauging station	Monthly Once in 3 years Monthly
Livelihoods	• Population living around the wetland* • Population depending on wetlands for livelihoods • Number of households around the wetland using safe sanitation practices • Participation of communities in wetlands management	• Surveys • Surveys • Surveys • Surveys	Once every three years Once every three years Once every three years Once every three years

Technical Committee: Comprising of key experienced scientific experts who shall guide and give scientific inputs and expert guidance through periodic brainstorming sessions and/ or meetings conducted by the Tamil Nadu State Wetland Authority and steer all the planned activities. The committee shall be headed by the PCCF and Member Secretary, Tamil Nadu State Wetland Authority and the Ex-officio Mission Director, Tamil Nadu Wetlands Mission.

Independent Multidisciplinary Experts Task Force: A Task Force of inter-disciplinary nature shall be set up consisting of individual / representatives of organisations with specific experts such as botanists, zoologists, wildlife biologists, socio-economist, climate expert, agriculturist, pedologist, hydrologist, NGOs, educational institutes, research organisations etc. The Chairperson of the Task Force shall be headed by the PCCF and Member Secretary or any other officer of the Tamil Nadu State Wetland Authority and Ex-officio Mission Director who shall call for meetings as and when required. The Task Force shall through their multi-perspective approaches, shall discuss and provide inputs into planning a range of activities, make periodic visits as and when necessary, to assess and check the progress on ground and give inputs and mid-course corrective

measures for achieving the overall objectives of the mission.

Documentation: Process Documentation as well as Visual Information Documentation shall be undertaken wherein the process documentation shall be a creation of a descriptive document that will provide all the steps necessary leading to the completion of a set of defined tasks or process relating to Tamil Nadu Wetlands Mission. It shall have checklists of activities, process maps, diagrams or flow charts, process of project initiation, execution and implementation of project activities, developing of policies etc. Visual Information Documentation i.e., VIDOC i.e., collating of project activities and information in a proper sequence through motion media (videos, films etc.), still photography or audio recording of technical and non-technical events as and when they occur, shall also be given the priority under the Mission.

Hiring an Agency for Documentation: Qualified Agency shall be hired which shall be responsible to document various activities related to Mission right from the inception period. The Agency shall deliver the documented reports as and when required by the PCCF and Member Secretary or any other officer of the Tamil Nadu



• Vedanthangal Bird Sanctuary

State Wetland Authority and Ex-officio Mission Director, Tamil Nadu Wetlands Mission.

Digital Project Monitoring: It is proposed to undertake digital monitoring processes for certain key project tasks to accomplish quick monitoring and corrective measures while undertaking the project activities.

Identifying of Funding Sources: The proposed activities under the Tamil Nadu Wetlands Mission are enormous and shall therefore require large funding, that cannot be provided from a single source. It is therefore proposed to identify various sources of funding such as Central or State Schemes, State Agencies or Authorities or Bodies (such as Tamil Nadu Pollution Control Board, Department of

Environment, National Highways Authority, National Wetland Centre, Green Climate Fund etc.), Private Agencies etc.

The above-mentioned setup shall help in the Steering of the wetland restoration efforts scrupulously aligning with the Wetlands (Conservation and Management) Rules, 2017 for generating the multiple ecosystem services for the benefit of people and biodiversity in the State.

In Consonance with the Wetlands (Conservation and Management), Rules 2017, the Tamil Nadu State Wetland Authority shall monitor and supervise the District wise action plan for the next five years which is as follows

Implementation Strategy For Tamil Nadu Wetlands Mission

District	Identification & Digital Inventory of natural wetlands on watershed basis	Preparation of Brief Documents	Draft & Final Notification	Preparation of RAMSAR Site Information Sheet	Preparation of Integrated Management Plan	Ecological Restoration
Ariyalur	1	1	1	1	1	1
Chengalpattu	5	5	5	2	5	5
Chennai	2	2	2	1	2	2
Cuddalore	6	6	6	3	6	6
Dharmapuri	1	1	1	1	1	1
Dindigul	6	6	6	1	6	6
Erode	10	10	10	2	10	10
Kanchipuram	1	1	1	1	1	1
Kanyakumari	4	4	4	3	4	4
Mayiladuthurai	2	2	2	1	2	2
Nagapattinam	4	4	4	2	4	4
Namakkal	2	2	2	1	2	2
Pudukkottai	4	4	4	2	4	4
Ramanathapuram	17	17	17	7	17	17
Salem	2	2	2	1	2	2
Sivagangai	1	1	1	1	1	1
Thanjavur	5	5	5	3	5	5
Thiruvarur	6	6	6	2	6	6
The Nilgiris	4	4	4	2	4	4
Thoothukudi	6	6	6	4	6	6
Tirunelveli	4	4	4	3	4	4
Tiruppur	1	1	1	1	1	1
Tiruvallur	2	2	2	2	2	2
Viluppuram	4	4	4	3	4	4
Villupuram	4	4	4	3	4	4
TOTAL TARGET	100	100	100	50	100	100



• Mud-Puddling Butterflies

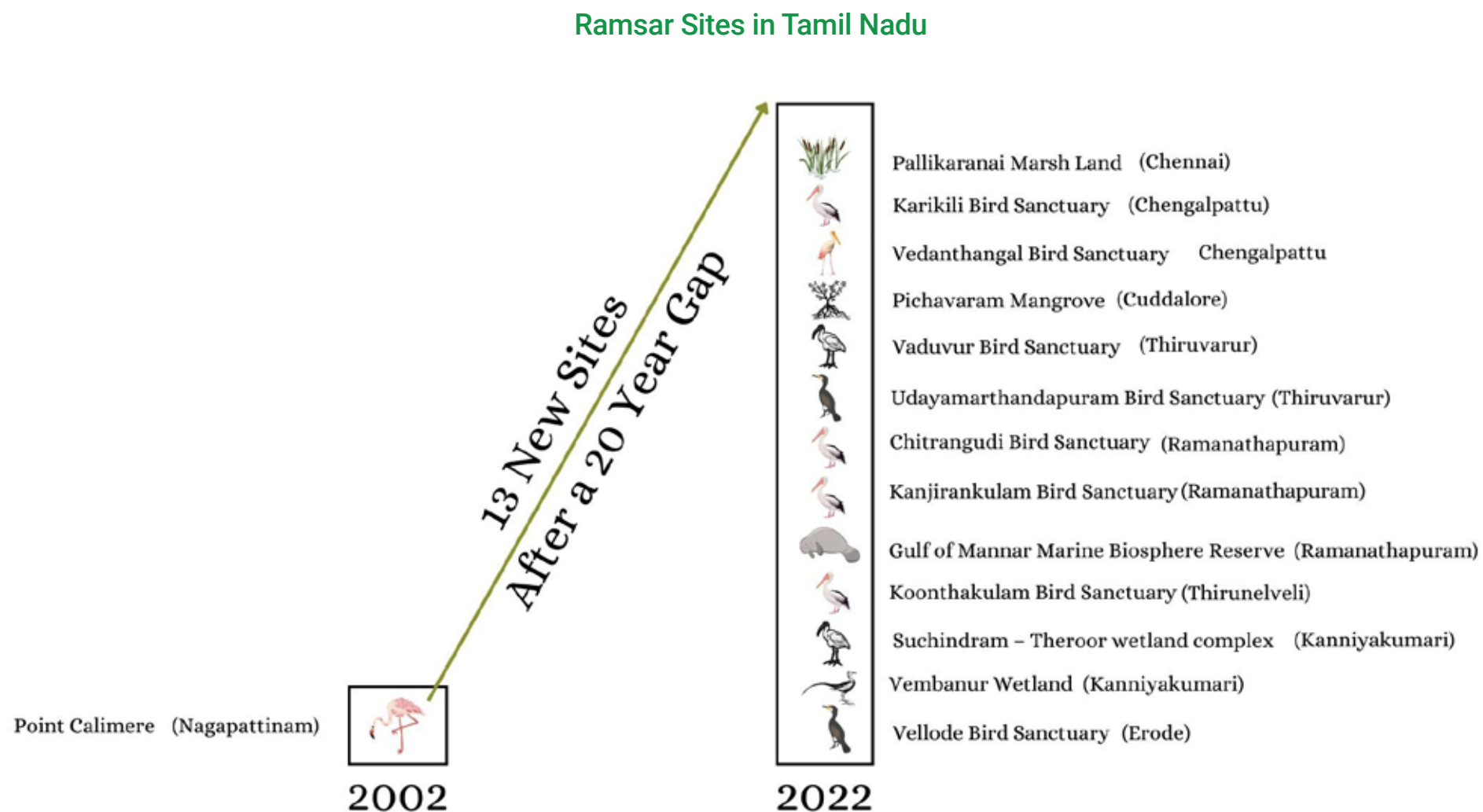
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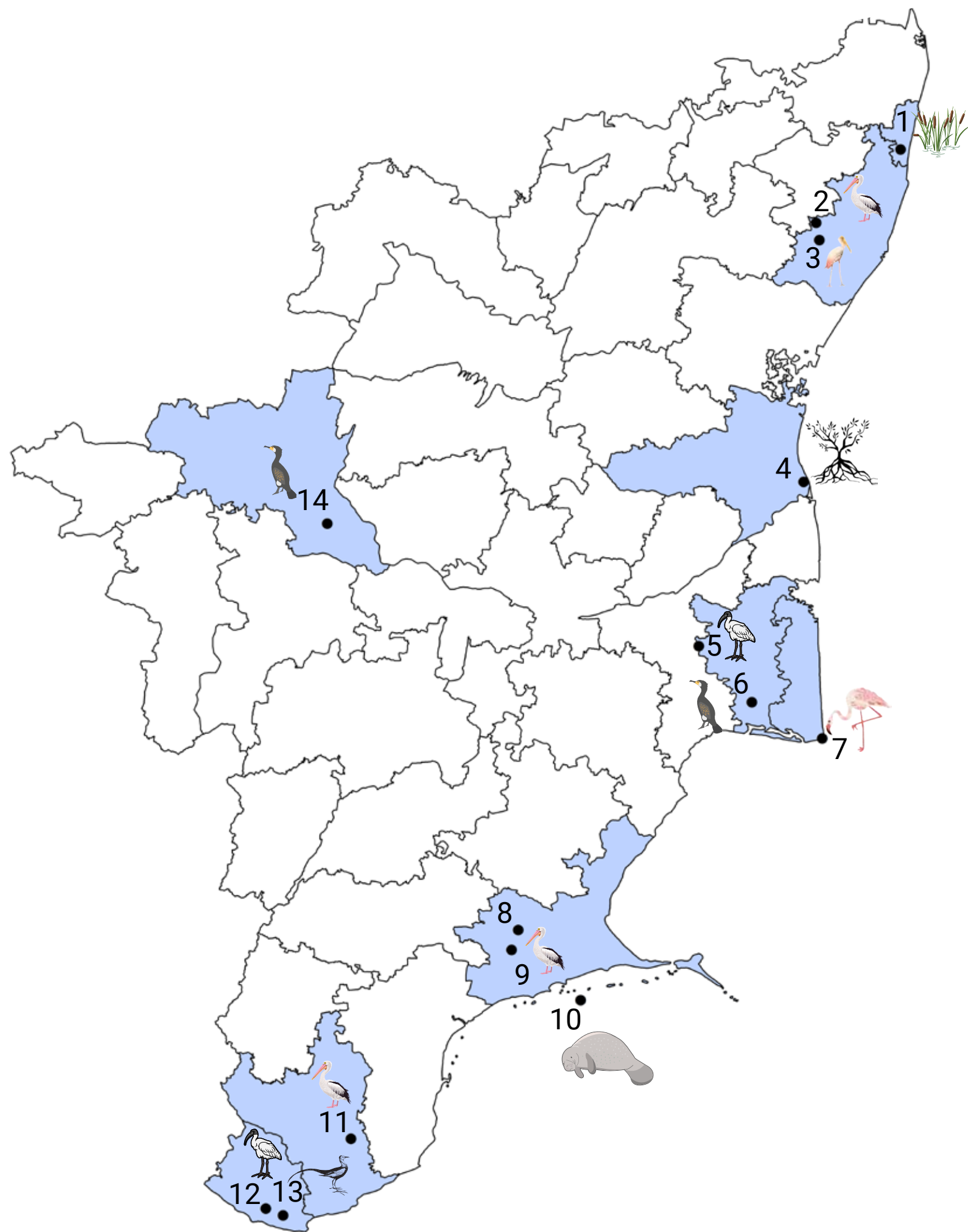
Priority Area Under Tamil Nadu Wetlands Mission

4.1

Designation of Ramsar Sites in Tamil Nadu

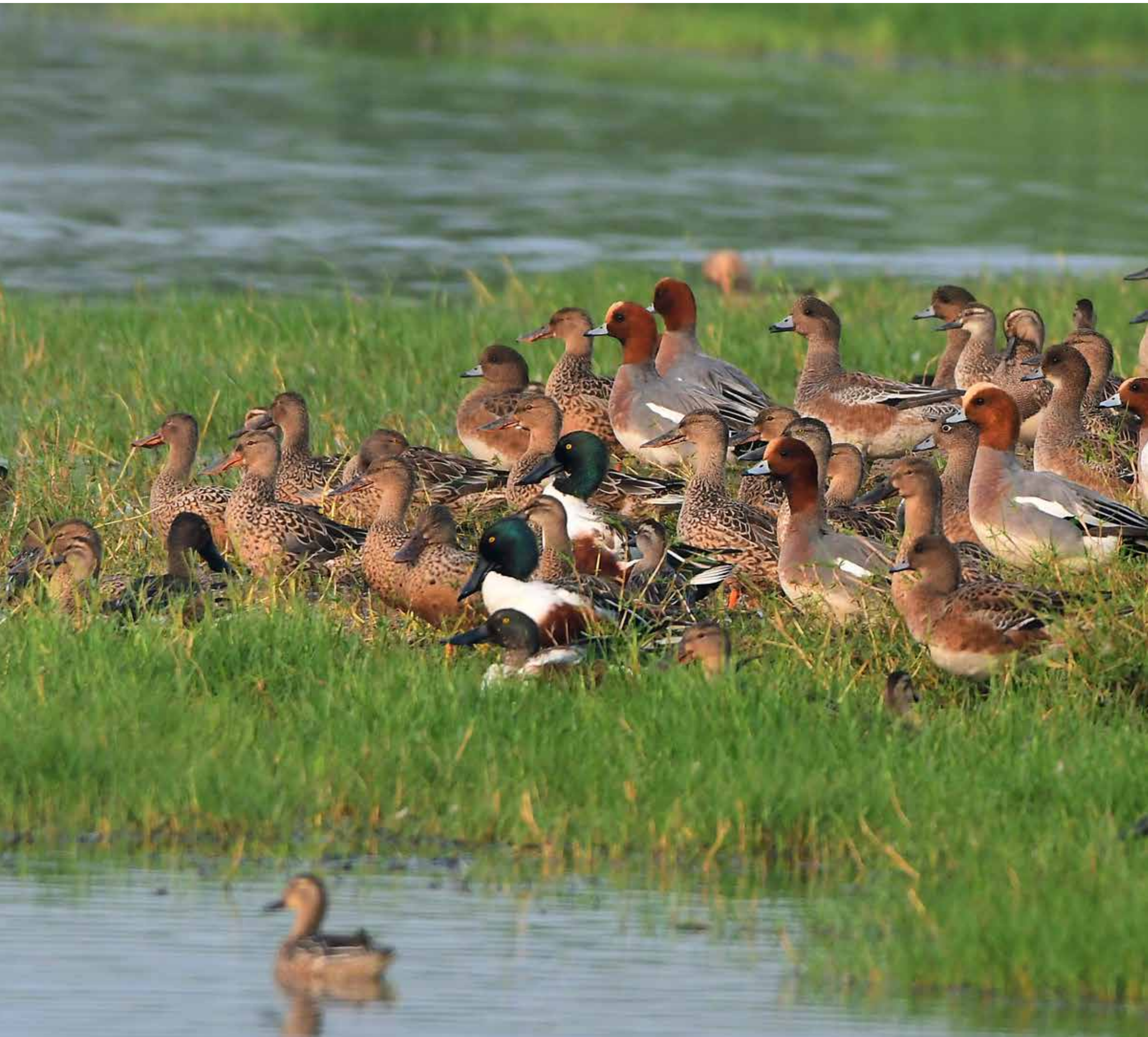
Point Calimere Wildlife & Bird Sanctuary was the only Ramsar site in Tamil Nadu which was declared on 19th August 2002 with Ramsar Site No. 1210. Recently in the Year 2022, 13 new Ramsar sites have been designated in the State after a period of 20 years. Since then, the State of Tamil Nadu has become the leading State with 14 Ramsar sites in the Country.





Ramsar Sites - Tamil Nadu

- 1 Pallikaranai Marsh Reserve Forest (Chennai)
- 2 Karikili Bird Sanctuary (Chengalpattu)
- 3 Vedanthangal Bird Sanctuary (Chengalpattu)
- 4 Pichavaram Mangrove (Cuddalore)
- 5 Vaduvur Bird Sanctuary (Thiruvarur)
- 6 Udayamarthandapuram Bird Sanctuary (Thiruvarur)
- 7 Point Calimere Wildlife and Bird Sanctuary (Nagapattinam)
- 8 Chitrangudi Bird Sanctuary (Ramanathapuram)
- 9 Kanjirankulam Bird Sanctuary (Ramanathapuram)
- 10 Gulf of Mannar Marine Biosphere Reserve (Ramanathapuram)
- 11 Koonthakulam Bird Sanctuary (Thirunelveli)
- 12 Suchuindram – Theroor wetland complex (Kanniyakumari)
- 13 Vembannur Wetland Complex (Kanniyakumari)
- 14 Vellode Bird Sanctuary (Erode)





• Pallikaranai

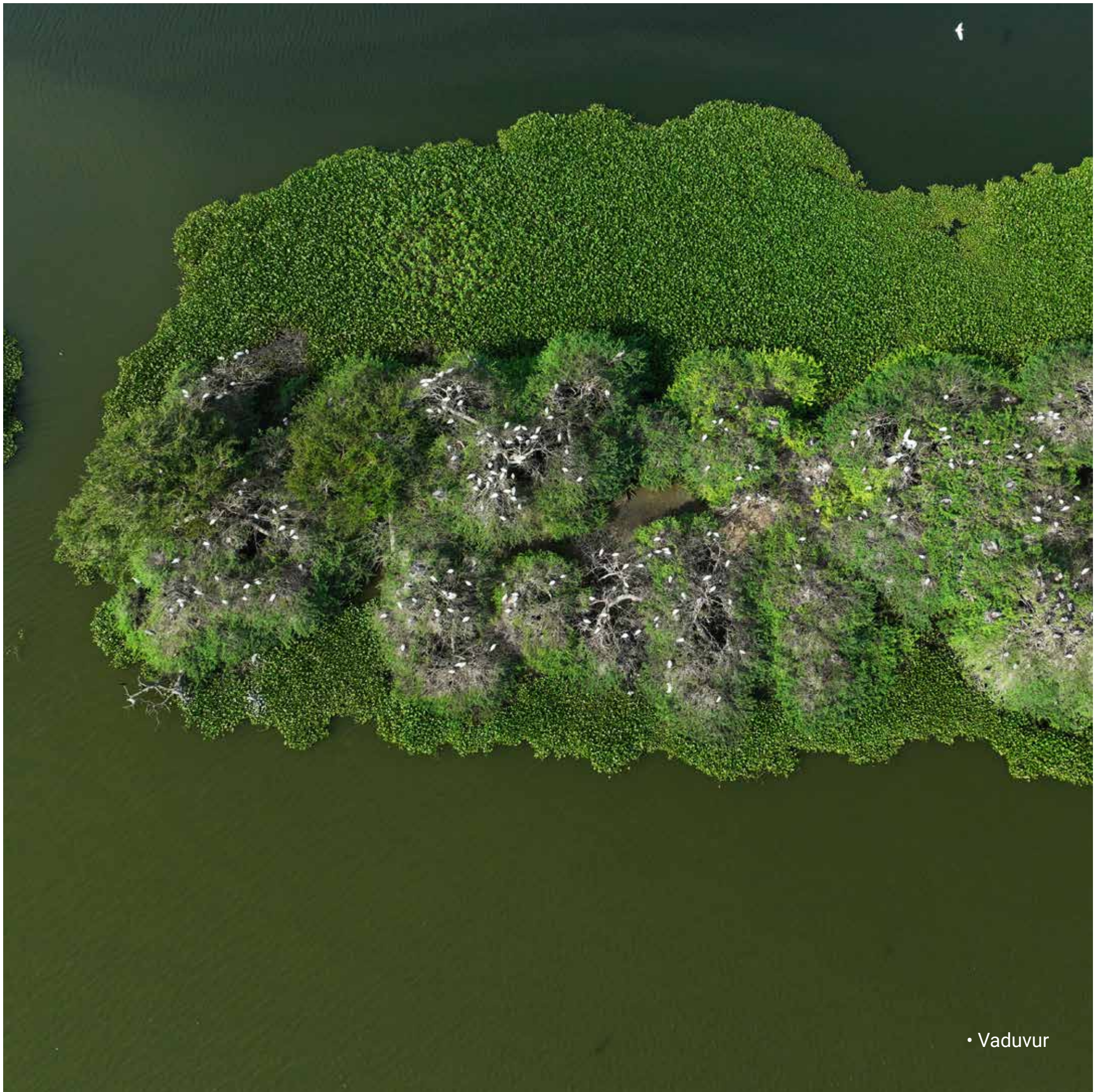




• Vedanthangal



• Pichavaram



• Vaduvur



• Udhayamarthandapuram



• Point Calimere



• Kanjirankulam



• Gulf of Mannar



• Koonthankulam



• Suchindram





Fact sheet of
Kanjirankulam
Bird Sanctuary

Fact sheet of
Vaduvur
Bird Sanctuary

	Site No. 2486	Site No. 2493
Declaration Date	13.08.2022	13.08.2022
Designated Date	08.04.2022	08.04.2022
Co-ordinates	09°21'35"N 78°28'44"E	10°42'10"N 79°18'59"E
Area Extent (ha)	96.89	112.64
District	Ramanathapram	Thiruvavarur
Elevation (m)	30 to 70	36 to 38
Depth (m)	1 to 3	2.5 to 4
Rainfall (mm)	350 to 900	1129
Salinity (ppt)	< 0.5	0.359
Wetland Type	Fresh water lake	Fresh water lake
Soil	Organic	Mineral
Water pH	7.5	8.8
Water TDS (ppm)	2060	370
Water Conductivity (μS/cm)	405Q	1510



Fact sheet of
Suchindram
Theroor wetland complex

Fact sheet of
Chitrangudi
Bird Sanctuary

	Site No. 2492	Site No. 2491
Declaration Date	13.08.2022	13.08.2022
Designated Date	08.04.2022	08.11.2021
Co-ordinates	08°09'03"N 77°27'14"E	09°20'28"N 78°28'40"E
Area Extent (ha)	94.23	260.47
District	Kanyakumari	Ramanathapuram
Elevation (m)	30	33 to 36
Depth (m)	3 to 4	1.5-2.5
Rainfall (mm)	1460	715.2
Salinity (ppt)	0.389	0.174
Wetland Type	Fresh water lake	Fresh water lake
Soil	Mineral	Mineral
Water pH	7.5	7.5
Water TDS (ppm)	136	2060
Water Conductivity (μS/cm)	176	405



Fact sheet of
Koonthankulam
Bird Sanctuary

Fact sheet of
Vedanthangal
Bird Sanctuary

	Site No. 2479	Site No. 2477
Declaration Date	03.08.2022	03.08.2022
Designated Date	08.11.2021	08.04.2022
Co-ordinates	08°29'44"N 78°45'14"E	12°32'47"N 79°51'21"E
Area Extent (ha)	72.04	40.35
District	Tirunelveli	Chengalpattu
Elevation (m)	69 to 75	23 to 122
Depth (m)	2	5
Rainfall (mm)	48.5 to 179	400 to 1700
Salinity (ppt)	0.174	< 0.5
Wetland Type	Fresh water lake	Fresh water lake
Soil	Organic	Organic
Water pH	7.5	7.4
Water TDS (ppm)	2060	-
Water Conductivity (μS/cm)	405	-



Fact sheet of
Udhayamarthandapuram
Bird Sanctuary

Fact sheet of
Vellode
Bird Sanctuary

	Site No. 2476	Site No. 2475
Declaration Date	03.08.2022	03.08.2022
Designated Date	08.04.2022	08.04.2022
Co-ordinates	10°27'02"N 79°33'16"E	11°15'06"N 77°39'06"E
Area Extent (ha)	43.77	77.185
District	Thiruvarur	Erode
Elevation (m)	08 to 12	140 to 160
Depth (m)	2.5-4	2
Rainfall (mm)	1000 to 1200	575 to 833
Salinity (ppt)	0.245	< 5
Wetland Type	Inland (Flood plains)	Fresh water lake
Soil	Mineral	Mineral
Water pH	9.5	8
Water TDS (ppm)	244	130
Water Conductivity (µS/cm)	519	494



Fact sheet of
Vembannur
Bird Sanctuary

Fact sheet of
Pichavaram
Mangrove Forest

	Site No. 2474	Site No. 2482
Declaration Date	03.08.2022	26.07.2022
Designated Date	08.04.2022	08.04.2022
Co-ordinates	08°10'54"N 77°22'34"E	11°26'17"N 79°47'11"E
Area Extent (ha)	19.75	1478.64
District	Kanyakumari	Cuddalore
Elevation (m)	19	6
Depth (m)	7	0.3 to 3.5
Rainfall (mm)	1456.8	1000 to 1500
Salinity (ppt)	0.174	0.5 to 30
Wetland Type	Pond	Mangrove
Soil	Mineral	Mineral, organic
Water pH	6.7	7.8-8.1
Water TDS (ppm)	147	-
Water Conductivity (μS/cm)	182	-



Fact sheet of
Karikili
Bird Sanctuary

Fact sheet of
Pallikaranai
Marsh Reserve Forest

	Site No. 2480	Site No. 2481
Declaration Date	26.07.2022	26.07.2022
Designated Date	08.04.2022	08.04.2022
Co-ordinates	12° 35' 56" N 79° 50'32" E	12° 55' 40" N 80° 13'13" E
Area Extent (ha)	58.44	1247.54
District	Chengalpattu	Chennai
Elevation (m)	49	2 to 4
Depth (m)	5	2.5
Rainfall (mm)	400 to 1700	68.2
Salinity (ppt)	< 0.5	1.824
Wetland Type	Water Storage Reservoir / Tank	Natural
Soil	Clayey Nature	Organic
Water pH	7.4	>7.4
Water TDS (ppm)	-	342
Water Conductivity (μS/cm)	-	435



Fact sheet of
Point Calimere
Wildlife and Bird Sanctuary

Site No. 1210

Declaration Date	19.08.2002
Designated Date	19.08.2002
Co-ordinates	10°17'22"N 79°25'52"E
Area Extent (ha)	38500
District	Nagapattinam, Thiruvarur & Thanjavur
Elevation (m)	0-6
Depth (m)	2.7
Rainfall (mm)	1280
Salinity (ppt)	45 (summer)
Wetland Type	Salt swamps, Mangroves, Backwater, Mudflats, Grass lands and tropical dry ever green forest
Soil	Clayey sandy
Water pH	7.5
Water TDS (ppm)	4236
Water Conductivity (μS/cm)	2750



Fact sheet of
Gulf of Mannar
Biosphere Reserve

Site No. 2472

Declaration Date	03.08.2022
Designated Date	08.04.2022
Co-ordinates	9°9'12.38" N 78°46'44.05" E
Area Extent (ha)	52671.88
District	Thoothukudi & Ramanathapuram
Elevation (m)	1
Depth (m)	5.8
Rainfall (mm)	817 (Ramanathapuram) 646 (Thoothukudi)
Salinity (ppt)	31.7 to 35.2
Wetland Type	Permanent Shallow Marine Waters (Mannar Valaiguda)
Soil	Typical Coastal Sand
Water pH	6.89 to 7.21
Water TDS (ppm)	-
Water Conductivity (µS/cm)	-



• Sathyamangalam Tiger Reserve

5

Expected Deliverables



• Ennore Creek

5.1

Identification, mapping and inventorisation of 100 wetlands with focus on livelihood options

One of the main objectives of the Tamil Nadu Wetlands Mission shall be to identify and ecologically restore 100 Wetlands within a period of five years. Accordingly, under the Mission 150 wetlands have been identified.

Furthermore, the Indian State of Forest Report, 2021 also mentions about the wetlands in the tiger reserves. These wetlands shall also be inventorized and shall be taken up for notification and ecological restoration with community-based approach as well as through Community Public Private Partnership (CPPP) mode.

The details of the wetlands in the tiger reserve of State of Tamil Nadu as per the Indian State of Forest Report, 2021 is as follows:

Wetlands inside Tiger Reserves

S. No	Name of Tiger Reserve	Area as per digitalised Tiger Reserve boundary	Inland Wetland Man-made		Inland Wetland Natural		Wetlands (<2.25 ha)		Total Wetlands		Wetland Area as % of Tiger Reserve Area
			No	Area	No	Area	No	Area	No	Area	
1	Anamalai	1,76,776.00	23	2,665.14	12	1,113.72	47	47	82	3,825.86	2.16
2	Kalakad Mundathurai	1,56,414.00	170	3,853.01	34	1,973.56	85	85	289	5,911.57	3.78
3	Mudhumalai	75,081.00	7	62.94	2	272.70	10	10	19	345.64	0.46
4	Sathyamagalam	1,58,177.00	17	1832.43	4	211.76	19	19	40	2,063.19	1.30
5	Srivilliputhur Megamalai	50,112.00	2	14.66	2	55.48	5	5	9	75.14	0.15



• Sathyamangalam Tiger Reserve

The wetlands inside the Tiger Reserves shall be given due importance in terms of ecological restoration under the Tamil Nadu Wetland Mission as it will serve dual purpose of improving the habitat for the keystone Species as also for other wild animals which shall be instrumental in minimising the Human – wildlife conflict situation due to the improved water and fodder resources inside the Tiger Reserves which are the important habitats for Tigers, Leopards, Elephants. Sloth Bears, etc. These wetlands shall also help in recharging the ground water table besides being valuable carbon sink as a Climate Change Mitigation tool.

These wetlands shall be very useful in, water and food security for the local communities by way of increasing the ground water table in the vicinity of the Tiger Reserves as well as for monitoring the habitat site quality for the wild animals in the overall interest of forest, wildlife and biodiversity of the Tiger Reserve. The customary and traditional rights over such wetlands shall be protected in line with “wise use” principles of wetlands management and such rights shall not be curtailed on account of the regulatory regime.

5.2

Extensive documentation viz., Integrated Wetlands Management Plan for wetlands under the Wetlands (Conservation and Management) Rules, 2017.

Wetlands are one of the most embedded and interlinked ecosystems with human livelihoods and well-being. A balanced management approach, addressing biodiversity conservation values while providing for sustainable utilisation in a way compatible with the maintenance of natural properties of the ecosystem, needs to be adopted for these ecosystems. It is, therefore, recommended that management of Ramsar sites and other wetlands shall be guided by an “Integrated Management Plan”. An integrated wetlands management plan shall be formulated scrupulously following the provision made in the Wetlands (Conservation and Management) Rules, 2017.



• Vembannur wetland

The Integrated Management Plan's shall be divided in to following chapters.

Preamble	Concise policy statement describing the rationale for the application of human, technical and financial resources for the wetland management
Description of wetland features	Collation and synthesis of data to describe: wetland location and extent, catchment, hydrological regimes, biodiversity, ecosystem services, socioeconomic and livelihoods
Evaluation of wetland features	Based on the description of features, identification of priority wetland features that need to be maintained, and key threats that adversely affect these features
Institutional arrangements	• Provide an overview of the current institutional arrangements in the context of wetlands management; • Discuss why the current institutional arrangements are insufficient in ensuring wetlands conservation and wise use; • Propose institutional arrangement for wetland management, with specific focus on: a) Nodal Agency b) Role of various departments and agencies and coordination mechanism, and c) Role of civil society and communities. • Develop an organogram for management plan implementation. • Regulatory regime specifying activities prohibited within wetlands, activities to be regulated within wetlands and zone of influence and regulation thresholds and activities permitted
Setting Management Objectives	• Provide a statement of the overall goal that the management plan seeks to achieve; • Summarize the ecological and economic benefits that are expected from management plan implementation; • Enlist specific objectives; • Describe strategy(ies) for achieving each of the management objectives; • Provide a strategy for implementing regulatory regime – including list of activities liable to be prohibited, regulated and permitted within the wetland (wetlands complex)
Monitoring and Evaluation Plan	• Present an overview of monitoring the wetland, and management plan implementation; • Describe monitoring parameters, the frequency of monitoring and the agency that will be responsible for monitoring; • Describe how coordination between different monitoring agencies will be achieved; • Discuss the infrastructure and human resource requirement for implementing the management plan. (As far as possible, include local universities, research organizations and NGOs in wetlands monitoring); • Discuss the frequency in which reporting shall be done and the responsible agency; Discuss how the monitoring outcomes will be used to adapt management
Action Plan	Listing of management components and specific activities to achieve management objectives. For each activity, implementation location, prioritisation, implementing agency and timeline should be specified.
Budget	Assessment of financial resources required for implementing the management plan and sources of funds.

Integrated Management Planning shall be undertaken through the specialised agencies following the bottom-up approach and during the preliminary reconnaissance, the local communities who have been closely associated with the particular wetland shall be involved in the knowledge sharing workshop. This would help the Mission in determining the status about the existing condition of the wetlands before the actual interventions are put in place. As a field level exercise, the causative factors and interventions required to restore the ecological health of the wetlands shall be accorded the necessary priority. The knowledge of the local communities shall be accorded due importance in understanding the drainage patterns and biodiversity status of the wetlands. Thereafter a brief Project Appraisal Report (PAR), taking into account the inputs from various stakeholders i.e., with the support of the Government Departments, NGOs, local Communities shall be formulated within a period of three months for advance planning of the interventions for restoration of identified wetlands for maximizing the functioning of the wetlands up to its full potential. Thereafter, based on the outcome of the consultations with the Government Departments and local communities, the Integrated Management Planning shall be devised for the implementation of the said plan for restoring the wetlands duly following the inter-sectoral approach. Once the wetlands are restored up to its full potential such wetlands shall be handed over to the local communities for future management under the guidance and supervision of Tamil Nadu State Wetland Authority and Field experts. The role of the Tamil Nadu State Wetland Authority with respect to the Integrated Management Plan implementation shall be restricted to overall supervision, monitoring and suggesting corrective measures with regard to hydrological, edaphic and ecological parameters of the wetland for ensuring the flow of continuous benefits to the local communities in terms of ground water recharge, flood and drought mitigation, food, biodiversity, fish and other harvestable natural resources.

The Integrated Management Plans address issues, concerns and management strategies to specifically align with the Sustainable Development Goals and National Biodiversity Targets, for ecosystem based ecological restoration of the Wetlands for improvement of the livelihood and health aspects of the local communities. The Integrated Management Plan for Point Calimere Ramsar site has already been prepared by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and approved by District Level Management Committee and shall be implemented as per the decision of the Government after its final approval by the competent authority.

Further, The Integrated Management Plan for another 12 Ramsar sites shall be prepared by Salim Ali Centre for Ornithology and Natural History (SACON), Coimbatore. The Ramsar sites and wetlands shall be conserved and managed based on the principle of “wise use “for

the benefit of the local community. The following activities shall be given priority for ecological restoration of Ramsar sites.

(a) ECOLOGICAL RESTORATION ACTIVITIES

- a) Selective dredging of the wetland (after bathymetric study)
- b) Strengthening of the bund
- c) Removal of invasive species
- d) Inflow and outflow desilting
- e) Reintroduction of native species
- f) Identifying and managing the point sources of pollution (industrial, commercial and domestic)



• Removal of water hyacinth in Vaduvur bird sanctuary



• Pichavaram mangrove



• Pallikaranai

(b) COMMUNITY INTERACTION & KNOWLEDGE TRANSFER ACTIVITIES (Eco - tourism aspects)

- Improving the local livelihoods connected with wetlands
- Boating in certain section of wetland
- Interactive activities along the footpath (temporary structures) -eg. Low impact audio & visuals of wetland biodiversity.
- Cafes with wetland view at a distance from wetland
- Footpath at a height around the wetland with proper fencing
- Children's Park at appropriate distance if required
- Interpretation centre
 - 3-D biodiversity models
 - Introduction to sounds of animals & birds
 - Interactive inflow-outflow models (using LEDs)
 - Games related to wetland management
 - Documentaries

5.3

Notification of identified wetlands under the Environment (Protection) Act, 1986 and Rules framed there their protection and conservation.

The notifications process for 29 natural wetlands duly approved by the District Level Wetland Management Committees have been submitted to Government for inter-departmental consultation. The notification proposals submitted to the State Government includes the following natural wetlands as identified and communicated by the Department of Revenue and disaster Management vide their letter dated 10.02.2023

Sl.No	Name of the Wetland	District	Area in Ha.
1.	Oomayanpatty Lake	Namakkal	102
2.	Amirthasagaram Lake	Namakkal	115
3.	Moovanallur Lake	Thiruvarur	36.87
4.	Vakkueri	Thiruvarur	56.03
5.	Thirumeni Lake	Thiruvarur	310.96

The notification proposals prepared and submitted to the District level Wetland Management Committees for validation and approval are as follows

Sl.No	Name of the Wetland	District	Area in Ha.
1.	Pulicat Lake	Tiruvallur	3714.87
2.	Kodiyakarai Wetland Complex Kodiyakarai Kodiyakadu Panchanathikulam	Nagapattinam	196.64
3.	Thirupani Puthan Tharuvai	Tuticorin	303.17
4.	Najarayan kulam	Tirupur	125.86
5.	Kazhuveli	Villupuram	3262.00
6.	Uthayamarthandapuram	Tiruvarur	45.28
7.	Vaduvoor	Tiruvarur	128.10
8.	Chitrangudi	Ramanathapuram	231.00
9.	Pallikaranai	Chennai	834.00
10.	Vellode Bird Sanctuary	Erode	77.50
11.	Suchindram	Kanyakumary	96.6.
12.	Theroor	Kanyakumary	163.00
13.	Vembanur	Kanyakumary	20.00
14.	Koonthankulam Bird Sanctuary	Tirunelveli	72.30

5.4

Comprehensive eco-restoration of wetlands in accordance with proven scientific strategies and evidence-based methodologies

The coastal wetlands / inland wetlands shall be ecologically restored. The priority shall be given for the assessment of communities dependent on wetland for cultivation along with the area under cultivation and the status of ground water table for the year 2022 shall be considered as baseline data. The science based ecological restoration shall be given impetus for further expanding the origins of livelihood in terms of increasing area under cultivation and improving water quality in their water recharging structures.

5.4.1 Ecological Restoration of Otteri Lake

The Otteri Lake located inside Arignar Anna Zoological Park, Vandalur is a prime source of water for animals, ground water recharge for the Zoo as well as a sustainable water resource for the Otteri village. The Otteri Lake has catchment area of about 0.91 Sq. Km and it also receives drainage water from channels traversing across the zoo area and adjacent Vandalur Reserve Forest Area. The water spread area of the lake is about 16 acres with storing capacity of 2.22 Mc. ft with a live storage depth of 8.53 ft and total depth of 10.50 ft. According to a bird census conducted, 3481 birds of 21 different species are currently being spotted in the Otteri Lake.

In order to improve the habitat for resident and migratory birds and also to improve the ground water recharge for the 200 and the surrounding residents, it has been decided to ecologically restore

Otteri lake located inside the Arignar Anna Zoological Park, Vandalur under the Tamil Nadu Wetlands Mission, for making it as a model lake in terms of ecological restoration works for showcasing the works to the visitors & students for awareness generation on the wise use of wetlands. The proposal for ecological restoration of Otteri Lake and other wetlands shall meet the following objectives:

- (i) Ground water recharge
- (ii) Improving fish habitat.
- (iii) Biodiversity conservation
- (iv) Improving the eco-tourism

The eco restoration works shall consist of following activities:

- (i) Removal of invasive species
- (ii) Dredging at periphery of lake
- (iii) Desilting, widening and construction of side walls and check walls for inflow channels
- (iv) Strengthening of tank bund
- (v) Strengthening and repairs to weir

The expected outcome from the ecological restoration of Otteri lake and other wetlands, shall be as follows: -

- (i) Improvement in the ground water recharge of the lake for the benefit of aquatic fauna and flora.
- (ii) Restoration of the natural biodiversity and native vegetation by eradicating of the invasive species.
- (iii) Improvement of the habitat for facilitating the birds perch in the entire season.
- (iv) Improved water quality inside the Otteri lake through silt / sediment free water storage for enhanced biodiversity status.
- (v) Restoration of good quality water for long time and its use by the surrounding local communities.
- (vi) Increase of the migratory bird population in future.



• Otteri Lake

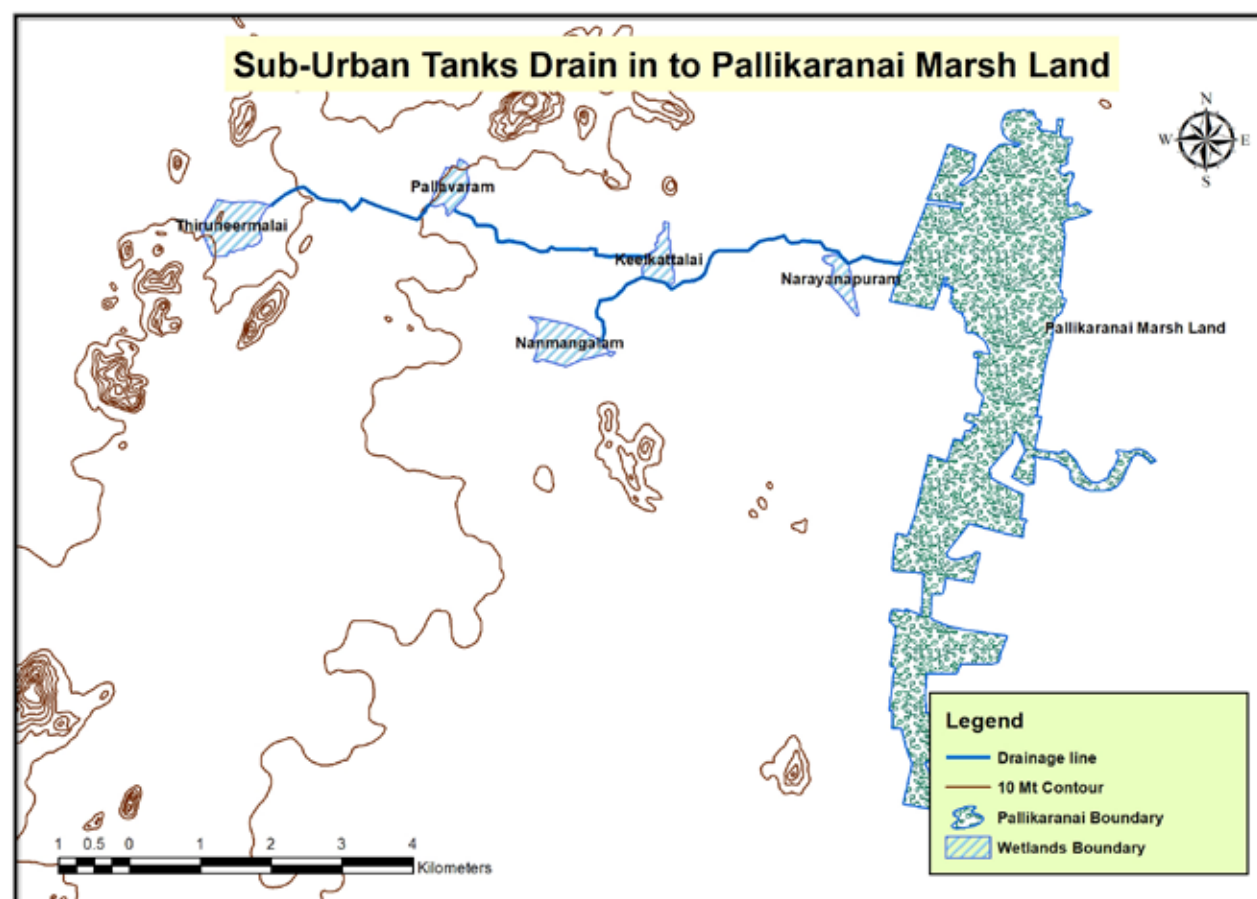
5.4.2 Ecological Restoration of Pallikaranai Marsh Land

Pallikaranai is the largest and the only wetland in the urban landscape in the heart of Chennai which has been declared as a Ramsar Site and it faces a numerous challenge from all parts like effluent discharge from the industries, sewerage discharge from households, encroachments from nearby inhabitants.

Pallikaranai marshland is subjected to various anthropogenic pressures and it has shrunk about more than 35% in area. Pallikaranai has been declared as Ramsar site fulfilling the criteria No 1,2,3,4,5,6 and 7 and under the Tamil Nadu Wetlands Mission, the endeavour shall be to prevent the further degradation of the Pallikaranai marsh land in terms of area and quality of habitats. The Pallikaranai Marsh Land is surrounded by 32 small and large water bodies are in order to ensure that the Pallikaranai Marsh Land does not lose its flood regulating capacity and it revives its flood mitigation role in view of the recurrent floods in the Chennai city. The role of the Pallikaranai marshland shall be extremely crucial to mitigate the floods and drought under the changing climate scenario. It has been studied that it may not be possible to improve the flood regulating capacity of the Pallikaranai Marsh Land until and unless few waterbodies / urban wetlands like Narayanapuram lake, Keelkattalai lake, Nanmangalam

lake, Pallavaram lake, Thiruneermalai lake and Sembakkam lake are linked to the Pallikaranai for allowing the excess rainwater (due to intense and sudden precipitation) flows down to Bay of Bengal via Buckingham canal as and when there is an intense precipitation because of climate change scenario. Therefore, in order to ecologically restore the Pallikaranai Marsh Land, for protection and conservation of its hydrological, edaphic and biodiversity parameters, it is proposed to link the Pallikaranai Marsh Land with the above-mentioned lakes/wetlands with the support of the Water Resources Department for undertaking the ecosystem-based in consultation with the technical committee of the Tamil Nadu State Wetland Authority. The ecological restoration of Pallikaranai Marsh Land shall be given the highest priority being a large urban wetland emphasising on the intersectoral convergence between the Greater Chennai Corporation, Water Resource department, Municipal and Water Supply Department or else there is every possibility that the Pallikaranai Marsh Land may be severely degraded in future and may be placed under Montreux record which is the negative list of the wetlands declared by the International Convention on wetlands for Ramsar sites. Also, invasive species removal shall be accorded high priority with the people's participation and the value addition due to this removal shall be linked to the livelihood of the local community.

Sub-Urban Tanks in to the Pallikaranai Marsh Land



5.4.3 Restoration of Seagrass Meadows

Seagrasses are one of the important coastal wetlands. They are highly productive ecosystems and provide shelter and food for near-shore fisheries, marine reptiles and mammals. The ecological contribution of this ecosystem to niche maintenance is remarkable in the coastal waters of continental shelves. Suganthi Devadason Marine Research Institute (SDMRI) has been conducting seagrass restoration works in Gulf of Mannar and Palk Bay from 2008. In this connection, a proposal has been submitted by SDMRI where the quantifiable works can be undertaken under the “Tamil Nadu Wetlands Mission” for estimating the change in the rehabilitated coastal ecosystem and also increase in the blue carbon sequestered by the seagrasses. Now since the Gulf of Mannar Biosphere Reserve, Ramanathapuram has been designated as Ramsar Site, the extent of rehabilitation of degraded coastal wetlands and sequestration of blue carbon in the Ramsar Site shall be scientifically estimated as an impact assessment study for showcasing our achievement in the ecological restoration of the Gulf of Mannar Biosphere Reserves.

The IPCC (2003) recommended that countries should aspire for Tier 3 system for the measurement of key carbon stocks of ecosystems. Tier 3 system underlines the need for repeated estimates of change or flux of carbon through direct field measurements or by modelling. The IPCC (2003) guidelines shall be scrupulously followed while estimating the blue carbon stock in the mangrove, sea grasses and salt marshes ecosystem. Blue carbon stock of sea grass meadows shall be computed according to the procedure mentioned in (Jones et. al. 2005) from soil carbon density of sediment core samples, wherein the sediment samples of up to 30cm depth in triplicate shall be taken from each site using a locally fabricated sediment corer (Kaladharan et. al. 2020) to get the cores of 10cm interval. Hence, from each selected site nine sediment cores (three numbers in core A, 0-10cm, three cores of B, 10-20cm and 3 cores of C, 20-30 cm) shall be obtained. After determining the dry weight and the



• Sea Grass Planting Method in Gulf of Mannar



• Sea Grass Planting Method in Gulf of Mannar

dry bulk density of the cores, organic carbon content (Corg) in the sediment cores shall be arrived according to the chromic acid wet oxidation method (Walkley and Black 1934). Other methodologies of recent times using the GIS and RS technology shall also be used for soil organic carbon content to corroborate with the conventional methods.

Although occupying only 0.1- 0.2% of the ocean surface, sea grass meadows are known to bury 22- 44 Tg Corg / yr on a global scale which accounts 10-18% of the total carbon burial in the oceans. Studies have indicated that their carbon stocks are comparable to that of tropical forests and tidal wetlands (Kaladharan et. al. 2020). Over the last decade globally sea grass meadows have experienced drastic decline however in the Gulf of Mannar 14 acres have been successfully restored by the SDMRI in a period of 10 years, i.e., from 2011 to 2021.

Under the Tamil Nadu Wetlands Mission, Sea grass restoration shall be given the priority keeping in view the fact that decrease in the seagrass vegetation cover already planted inside the Gulf of Mannar and the Palk Bay may cause increase in CO₂ emissions from soil organic carbon stored in Sea grass habitats (Kaladharan et. al. 2020).

Based on the current carbon trading price of AU\$35/tonnes in 2020 (Bedulli et. al. 2020) the blue carbon stores of seagrass habitats in Pulicat Lake could be worth INR 5,58,6560 (74487 USD) besides their various other ecosystem services. Similarly for the Gulf of Mannar and the Palk Bay, the blue carbon stores could be USD 17,820 and USD 43,99,682 (Kaladharan et. al. 2020). Hence there is an urgent need for the restoration of seagrass habitat in Gulf of Mannar and Pulicat Lake besides the conservation and protection of the existing seagrass ecosystems from any degree of anthropogenic pressures for ensuring that these invaluable ecosystems continue to play significant role in the climate change mitigation.

5.4.4 Ecosystem Health Cards

The ecosystem health cards shall be used for the purpose of estimation of carbon, methane and nitrous oxide stored inside the soil and sediments. Also, it will facilitate in achieving net zero carbon economy in the year 2070 by storing blue carbon inside the coastal and inland wetlands where the carbon is stored in the sediments and sub stratum and do not get easily exposed to the air due to existence of anaerobic conditions of the soil. For the first time under the “Tamil Nadu Wetlands Mission”, the collection of data on hydrological and edaphic factors profiling including the sediments stored in the wetlands is proposed to be undertaken to estimate the ecological and hydrological characters including the analysis of soil / sediment carbon, methane and nitrous oxide for 100 wetlands (inclusive of 13 Ramsar sites)

The following ecological, edaphic and hydrological parameters, proposed to be collected as a part of the wetland ecosystem health cards:

- (i) Hydrological Parameters
 - a) Colour, b) Odour, c) Salinity, d) Water turbidity, e) Nutrients in Water f) Whether Eutrophic, Mesotrophic or Oligotrophic, g) Dissolved Oxygen (DO) h) Biological Oxygen Demand (BOD), i) Chemical Oxygen Demand (COD) j) TDS, k) TSS, l) Turbidity, m) EC.
- (ii) Edaphic Parameters
 - a) Soil Type, b) Soil Nutrients, c) Heavy Metal content, d) Drainage (good or poorly drained), e) Soil Carbon (C), f) Soil Methane (CH₄), g) Soil Nitrous Oxide (N₂O)
- (iii) Sediment Parameters
 - a) Sediment Carbon (C), b) Sediment Methane (CH₄), c) Sediment Nitrous Oxide (N₂O), d) Sediment Nutrients, e) Sediment Heavy Metal Content

The expected outcome from the analysis of hydrological, edaphic and ecological parameters would be as follows.

- i. Estimation of Biophysical parameters of the wetlands
- ii. Estimation of Physio-Chemical parameters of water, soil and sediments including
- iii. Bathymetric studies of few selected wetlands including the Ramsar sites.
- iv. Preparation of final report on the study of all analytical data for preparation of brief document for formulation of Integrated Management Plans and ecological restoration of 100 wetlands.
- v. The joint publication of report on the wetland ecosystem health cards by the Tamil Nadu State Wetland Authority and

the Centre for Environment Studies, Anna University Capacity building and awareness for the citizens on the ecosystem status of the wetlands.

5.5

Creating awareness on wetland conservation through public awareness campaign



• Soil and Water quality test at Muthupet

5.5.1 Creation of Wetland Conservation Centre (WCC)

The Wetlands provide various ecosystem goods and services which are unknown to the local communities though they have been deriving the benefits from the nearby wetlands. Following are the ecosystem services which are generally utilised by the local communities like

- I. Source of water for drinking and agriculture
- II. Fisheries
- III. Medicinal plants
- IV. Groundwater recharge
- V. Water purification
- VI. Sink for sediments
- VII. Recreational and tourism site
- VIII. Cultivation of aquatic food plants

The Total Economic Valuation (TEV) of these ecosystem services will be carried out for 100 wetlands under the Tamil Nadu Wetlands Mission and dissemination of wide spread awareness shall be ensured to the local communities about the Monetary value attached to the ecosystem services without adversely affecting the pre-existing rights and privileges being given to the local communities on the wetlands along with present and potential threats to the wetlands due to climate and anthropogenic factors so that the wetlands continue to provide wide ranging ecosystem services on sustainable basis.



• Muthupet

Further the line departments shall be made aware about the need for IMP for addressing conservation and “wise use” planning of wetlands and for the need for mainstreaming the wetlands within the sectoral development planning for protection and conservation for the wetlands. The creation of Wetlands Conservation Centre at Muthupet shall be instrumental in showcasing of the various goods and services rendered by the mangrove ecosystem.



• Boardwalk at Muthupet Mangrove

5.5.2 Capacity Building Programme

One of the main objectives of the Tamil Nadu Wetlands Mission is to conduct Capacity Building Programme to enlighten the official deal with the wetland and the local communities depend on the wetlands. Since, the wetlands are degrading at an alarming rate globally as well as in the Country. This wetlands degradation is happening due to the fact that the official in charge of the wetlands/ water bodies are not aware about the ecological and socio-economic benefits of the wetlands for the State and the local communities. The local communities are also not aware about the role of the wetlands in the irrigation, ground water recharge, water purification, recreation, tourism, disasters reduction as well as climate change mitigation and adaptation. Due to the lack of the total economic value of the ecosystem services for the wetlands, the drive to protect the wetland from the urbanization and other anthropogenic activities is found missing. Under the “Tamil Nadu Wetlands Mission” there is a need to build the capacities of the government officials as well as the local community leaders by arranging a regular training program on the wetland restoration through the expert institutions like National Centre for Sustainable Coastal Management, National Institute of Ocean Technology, Indian Institute of Technology Madras, Anna University Chennai, Madras Institute of Development Studies and Madras School of Economics. The said training program shall be organized in the Tamil Nadu Forest Academy and other places to bridge the knowledge gap in the field of Wetlands Protection Management and Conservation. An appropriate training module shall be devised for imparting the capacity building program for the sustenance of the wetland’s conservation activities in the State for enhancing the ecological and socio-economic values of the wetlands for making the Wetlands Mission a community-based Programme.

5.5.3 Community Based Restoration Activities

The climate change and human activities have threatened the existence of the wetlands altering its hydrological regimes. Above 33% of the wetlands have almost degraded by the anthropogenic and climatic factors. The wetlands are unique ecosystems despite their small footprint, wetlands play significant role in providing freshwater, biodiversity conservation, disaster management, carbon capture and fighting climate change. Due to the anthropogenic pressure, several wetlands have become wastelands and require restoration for the benefit of the future generation. Under the Tamil Nadu Wetlands Mission, the wise use of the wetlands shall be promoted through the co-operation of Governments, Scientific institution and civil Societies.

The need to arrest the degradation of the wetlands has become imminent for food, water and climate security and therefore the community-based restoration activities shall be accorded priority in maintaining the ecological functions of the wetlands without



adversely affecting the rights and privileges of the local communities. The local communities shall be enlightened by way of awareness and educative materials on the contribution of the wetlands in poverty reduction, water security, food security, health security for the future generation and they shall be motivated to take part in wetlands restoration in partnership with Tamil Nadu Wetlands Mission. Under the Mission, a participatory approach shall be adopted where local stake holders shall be empowered to identify best wetlands management practices and awareness shall be created amongst them using publicity materials and story telling method to make them realise the importance of wetlands. Also, the eco-tourism facilities of international standards shall be developed in all the Ramsar sites to showcase the importance of wetlands to the public which would in turn support the livelihood of the local communities.

Community-based restoration shall be a holistic approach that will empower the local communities to take ownership and responsibility for the management and conservation of wetlands. By transferring the ownership of wetlands to the communities in the long run will enable them to become stewards of these valuable ecosystems. The transfer of ownership of the wetlands to the local communities shall ensure that the decision-making processes on the various aspects of the wetland management are inclusive, participatory, and reflective of the local communities’ needs and aspirations.

To support the communities in their role as custodians of wetlands, technical assistance and guidance shall be provided under Tamil Nadu Wetlands Mission. Such a support shall augment the capacities of the communities in terms of understanding wetland ecosystems, partnering of the field experts and ecological engineers in the restoration techniques, promotion of sustainable management practices like natural farming, sustainable harvesting of bio-resources, preventing the discharge of industrial effluents, solid waste etc, in and around the wetlands. Technical experts shall



In the United Nations decade of restoration (2021-2031), the wetlands restoration shall be made people centric with truly collaborative and co-creative engagements with the local communities for rendering greater justice to the notion of wise use of wetlands.

be roped in to collaborate with the communities to share technical knowledge, provide training sessions and offer continuous support to address any challenges that may arise during the restoration and management process by the local communities. The community-based restoration and management approach shall not only ensure the long-term conservation of these ecosystems but also shall strengthen the social fabric by empowering communities to take control of their natural resources. Through the Tamil Nadu Wetlands Mission, a platform shall be created for collaboration between technical institutions, experts and local communities for the sustainable management and conservation of wetlands in the region.

Community based restoration shall also be, accorded priority for those wetlands which are < 2.25 hectare for its restoration with the

assistance of non-governmental organizations (NGOs) and Expert institutions. Best community-based groups and individuals shall be judged as the champions of the wetland's protection and restoration, shall be encouraged for scaling up their efforts in the restoration process for motivating other communities and individuals in the protection and ecological restoration of the wetlands. The communities and the individual's contribution in the restoration process shall be acknowledged for the best restoration works and such communities and individuals shall be rewarded annually by giving them public recognition of the good work undertaken by such groups / individuals in the field of wetlands conservation, protection and management for its replication by other communities and individuals in community-based planning and restoration of the wetlands.

5.6

Research, wetland inventorisation and monitoring of wetland resources for effective management.

5.6.1 Wetlands Monitoring and Evaluation of Ramsar Sites

Drone based Lidar and RGB Technology shall be tried for undertaking the wetlands characterization and mapping of the Ramsar sites and the other wetlands which will include the extent of water spread area, encroachments, dumping sites, vegetation, inflows, outflows,

boundary fixation, so that baseline data is available for comparing the various ecological, hydrological and socio-economic factors of the Ramsar sites for preventing its further degradation in the interest of local livelihood.

The said mapping shall be of great value for long term protection of the wetlands against the anthropogenic pressure since we will have baseline information on the boundary of the wetlands, present scenario of habitations in the buffer zone, high resolution drainage patterns, sub soil surface features etc. The drone-based survey shall also be instrumental in monitoring the degradation status of the wetlands in the future on the basis of changes in the baseline information and shall facilitate the Mission in taking the



corrective measures with the help of the line Departments i.e. Water Resources Department, Municipal Administration and Water Supply Department, Rural Development and Panchayati Raj Department, Agriculture Department, Department of Fisheries, etc.,

It is pertinent to mention here that for the first time in any State, such kind of drone mapping with the help of Drone LIDAR & RGB technology was tried in the Pallikaranai Marshland area, a Ramsar site for understanding the intricate details about the area of the wetlands, hydrological functions and soil/subsurface features of wetlands for its protection and conservation on its sustainable basis for the promotion of the livelihood of the local communities. In addition, Drone LIDAR & RGB based technology for mapping of the wetlands add an advantage over the orbital satellite images as said technology provides an opportunity to produce the very high spatial resolution imagery (<5 centimetre) that might be able to delineate even the smaller wetlands with great precision. The Drone LIDAR & RGB technology shall further enable us with multilayer GIS outputs such as KML, contour values, 2D and 3D features and Digital Elevation Model (DEM) with more accurate features pertaining to the wetlands and shall be instrumental in preventing the wetlands degradation in future.

5.7

Sustainable livelihood options to ensure productivity while protecting wetland resource.

5.7.1 Ecological Restoration of Ennore Creek with Focus on Livelihood of Local Fisherfolk

Ennore Creek is a backwater located in Ennore, Chennai along the Coromandel Coast of the Bay of Bengal. It is located in the zone of comprising lagoons with salt marshes and backwaters, submerged under water during high tide and forming an arm of the sea with the opening to the Bay of Bengal at the creek. The creek is nearly 400 m wide, elongated in northeast–southwest direction and merging with the backwater bodies. Once a flourishing mangrove swamp, the creek has been degraded to patches in the fringes mainly due to human activities in the region. The depth of the creek varies from 1m to 2 m and is shallow near the mouth and it acts as an outlet for the excess water from the Poondi reservoir. The Ennore creek is a very vital wetland ecosystem as it is a part of the Pulicat water system, including the Pulicat lagoon and the Buckingham Canal. The creek has been experiencing siltation due to emergence of the Ennore Port and the mangrove plantation found in the estuarine area

which supports lots of faunal species is getting adversely affected due to the excessive pollution and excessive siltation due to the developmental activities. The creek is surrounded by fishing villages, croplands and aquaculture ponds and the salt manufacturing, lime shell quarrying and fishing remains the major livelihood of the region.

Ecological Restoration of Ennore Creek with focus on livelihood of local fisherfolks is urgently required under the Tamil Nadu Wetlands Mission for their welfare in Ennore area, as nearly 9000 fisherfolk families reside here. Their occupation solely depends on Kosasthalaiyar River, Buckingham Canal and Uppamgaliyaru etc. During the erection of foundation of high-tension tower by TANGEDCO, the coffer dam was constructed across the Kosasthalaiyar River, which has adversely impacted the movement of boats of the fisherfolks for their fishing, daily and routine activities. Moreover, the continuous sediment siltation has reduced the depth of the water which has hindered the fishing inside the creek area near VNC Bridge besides affecting the reproduction activities of fishes, prawns, crabs etc., Due to the above reason, the daily income of fisherfolks has been drastically reduced.

Fly ash mixing into the river has also occurred mainly due to the leak in the ash pipeline and the leakage from the ash pond. The natural macro drain for storm water run-off connected to the fly ash pond area also has been a major carrier of fly ash into the Ennore



• Ennore Creek

backwaters. The fly ash deposition in the Kosasthaliyar River and Buckingham Canal is causing reduction in the flood-regulating capacity of the creek and the said pollution has drastically altered the hydrology, ecology, topography of the area and the groundwater quality. Further the surface and ground water has got contaminated with dissolved salts, aluminium, arsenic, lead, manganese and zinc etc., which need to be brought down within the permissible limit.

In this region, the team of fisherfolks require urgent actions for free movement of boats and to improve their livelihood by way of

capturing fishes, prawns, crabs etc., A bathymetric study at the appropriate locations and coordinates shall be undertaken for estimating the damage to the existing location and appropriate implementation shall be planned accordingly.

Proposed Ecological Restoration Site Location

S.No	Name of the Location	Coordinates
1.	VNC Bridge (Samuthira Munai)	13°13'54.95"N 80°19'3.21"E
2.	Konnamudukku (oxbow)	13°16'2.44"N 80°19'25.65"E
3.	Karukkumaram Padu	13°17'28.06"N 80°19'47.71"E
4.	Near VNC Bridge	13°14'12.55"N80°19'4.45"E

The Project Technical Team shall approach the Chief Engineer Chennai region, Superintending Engineer, Executive Engineer of the Araniyar Basin Division, Chennai regarding the de-silting of debris and fine sand particles to appropriate level. The Water Resources Department shall be involved in the de-silting processes as a deposit work. The work shall be executed during lowest low tide level (LLTL) below 1.5m and the tentative cost shall be worked out after proper inspection of the site.

It is suggested that the Ecological Restoration of Ennore Creek with focus on livelihood of local fisherfolks at the location of VNC bridge (13°13'54.95"N80°19'3.21"E) and Karukkumaram Padu (13°17'28.06"N 80°19'47.71"E) is required to be de-silted and the debris removal has to be undertaken to restore the locations in order to facilitate the smooth movement of the boats of the fisherfolks for their fishing, routine activities and sustenance of their livelihood. Hence, an Integrated Management Plan for de-silting of the above locations for removal of debris and silt particles along with information on appropriate dumping site, shall be prepared for improving the livelihood of the fisherfolks residing in and around the Ennore Creek. The spread of invasive mussel *Mytella strigata* has become a cause of concern for the local communities and the said invasive species has spread to the Ennore creek from Kerala side. Furthermore, the frequent transportation of fishing vessels from the inshore waters to the estuaries have facilitated their spread. This invasion has wiped out the population of green mussels and back water oysters *Magallana bilineata* and *Saccostrea cucullata* populations, which support the livelihoods of hundreds of fishers in the area besides damaging the aqua culture systems. The increasing populations of *M.strigata* , coupled with its ability survive across the salinity gradients from the mouth of the estuary to the river discharge zone in the tail end, may have long term implications on biodiversity and ecosystem services of the lake. Therefore, in depth

study shall be conducted afresh or earlier studies on the prevention of the *M.strigata* shall be utilized to eradicate this menace from the Ennore creek, so that the near original habitat and ecosystem is restored in the Ennore Creek for improving the livelihood of the local fisherfolk communities. The mangrove plantation shall also be undertaken along the Ennore Creek for improving the microhabitat for the fishes and prawns for improving the livelihood opportunities for the local communities.

In conclusion it is hoped that the Wetlands Mission undertaken by the Tamil Nadu State Wetland Authority along with its vision statements, through its strategic approaches would lay a strong foundation for the State to accomplish the overall goal of

“Safeguarding our wetlands for the people, by the people for improving the biodiversity status and livelihood of the people”.

6

Frequently Asked Questions (FAQs)

W E T L A N D S

1

What are wetlands?

Wetlands are areas converted with water throughout the year or for a particular period of time including marine water areas where depth at low tide is not more than 6 meters.

2

Why are they important to me ?

50% of Worlds' drinking water comes from groundwater and wetlands are the major source of groundwater recharge.

Natural water filters (removes dangerous pollutants from water)

Support livelihoods and directly provide income to millions of families. (fishing, agriculture, horticulture, tourism)

Protect from natural disaster like floods, droughts, tsunamis and cyclones

Reduce threats of Global Warming

Reduce soil erosion (protecting fertile upper layers of the soil important for production)

Provide home to a wide variety of microorganisms, plants and animals important for our survival and the environment.

Important sites of cultural heritage.

Provide spaces to relax. (boating, walking, beautiful scenery)

WETLANDS

3

What will happen if there are no wetlands?

- Reduction in availability of usable water
- Increased events of droughts and floods
- Higher risk of diseases (water related diseases or emergent diseases)
- Coastal areas more prone to damage by natural disasters (tsunami & cyclones)
- Loss of income
- Loss in food production
- Loss of biodiversity
- Loss of recreational spaces
- Loss of strength to minimize severe changes in climate

4

How should I care for them?

Do's

- Know about wetlands in your area
- Register to be a Wetland Mitra and volunteer to care for the wetlands
- Spread awareness within your social groups
- Visit wetlands, enjoy recreational benefits and understand their connection with life

Don't's

- Don't dump wastes on wetlands in your area
- Don't poach birds and animals
- Don't destroy natural vegetation
- Don't introduce any alien plants or animals into wetlands as permanent residents. (Eg. Release of aquarium fishes into a wetland)



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Appendix

- BOD - Biological Oxygen Demand
- CAM - Carbon Asset Management
- CMFRI - Central Marine Fisheries Research Institute
- COD - Chemical Oxygen Demand
- CPPP - Community Public Private Partnership
- DEM – Digital Elevation Model
- DLWMC – District Level Wetland Management Committee
- DMAWS - Department of Municipal Administration and Water Supply
- DO - Dissolved Oxygen
- DPI - Department of Public Instruction
- EC - Electrical conductivity
- GIS – Geographical Information System
- IMP - Integrated Management Plan
- IPCC - Intergovernmental Panel on Climate Change
- IUCN - International Union for Conservation of Nature
- IWS - Institute of Water Studies
- LIDAR & RGB - Light Detection and Ranging & Red Green Blue
- LLTL – Lowest Low Tide Level
- MEA - United Nations Millennium Ecosystem assessment
- MIDS - Madras Institute of Development Studies
- MoEF&CC - Ministry of Environment, Forest and Climate Change
- MSE - Madras School of Economics
- MSME - Ministry of Micro, Small and Medium Enterprises
- NCSCM - National Centre for Sustainable Coastal Management
- NGO - Non-Governmental Organisation
- NWIA – National Wetland Inventory Atlas
- PAR – Participatory Appraisal Planning
- PCCF & MS – Principal Chief Conservator of Forests and Member Secretary
- PES - Payment for ecosystem services
- pH - Potential of Hydrogen
- ppt – Parts Per Thousand
- PTT - Project Technical Team
- RD and PR - Department of Rural Development and Panchayat Raj
- SACON - Salim Ali Centre for Ornithology and Natural History
- SDG- Sustainable Development Goals
- SDMRI - Suganthi Devadason Marine Research Institute
- STP – Sewage Treatment Plant
- TANGEDCO - Tamil Nadu Generation and Distribution Corporation Ltd
- TDS - Total Dissolved Solids
- TEV - Total Economic Valuation
- TNPCB - Tamil Nadu Pollution Control Board
- TNSWA – Tamil Nadu State Wetland Authority
- TNWM - Tamil Nadu Wetlands Mission
- TSS - Total Suspended Solids
- TWIC - Tamil Nadu Water Investment Company Ltd
- UNEP - United Nations Environment Programme
- VIDOC - Visual Information Documentation
- WCC - Wetland Conservation Centre

Creative & Designing

ICON AESTHETICS

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