CHAPTER 5

WETLAND CLASSIFICATION SYSTEM

Scientifically wetlands have been regarded as ecotones between water and land and depict a succession pattern from aquatic to upland vegetation. In view of this no unified and acceptable wetland classification exists which can be used for operational purposes. According to Cowardin et al (1979) 'there is no single, correct, indisputable, ecologically sound definition for wetlands, primarily because of diversity of wetlands and because the demarcation between dry and wet environments lies along a continuum'. However, the developments in remote sensing technology have made it possible to set the wetland boundary with a reasonable accuracy and develop a Wetland Classification System for operational use. Accordingly, the wetland classification system should be such that the various wetland types are amenable to be mapped at local, regional, national and global scales using this technology.

WETLAND SYSTEMS

Wetlands exhibit enormous diversity according to their genesis, geographical location, water regime and chemistry, dominant plants and soil or sediment characteristics. There are considerable variations within a single wetland area and many different types of wetland may be found in close proximity. Following are the ecological systems with which wetlands are commonly associated:

- Marine (coastal wetlands including rock shores and coral reefs).
- Estuarine (including deltas, tidal marshes, and mangrove swamps).
- Lacustrine (wetlands associated with lakes)
- Riverine (wetlands along rivers and streams)
- Palustrine (meaning 'marshy'- marshes, swamps and bogs)
In addition, man-made wetlands such as fish and shrimp ponds, salt pans, reservoirs, gravel pits, sewage farms and canals etc. also have become important due to ecological succession and have developed into habitats for a variety of flora and fauna.

INDIAN WETLAND CLASSIFICATION SYSTEM

Two types of wetland definitions are in vogue, one which are broad and the others which are narrow. Narrow definitions look at wetlands as ecotones, i.e. transition zone between terrestrial and aquatic communities (USF&WS, IBP definitions) while broad definitions categorize wetlands keeping in view management perspectives (Ramsar, CE definitions). Narrow definitions have one more disadvantage in that they treat only a part of the water body as wetland. As for example, littoral part or area of emergent vegetation will only be included in the wetland and not the main body of water. This is very important as there is continuous flux of matter and energy between open water and littoral region/emergent vegetation regime and is must for any meaningful conservation or protection of the wetland.

For devising a suitable wetland classification system it is essential that it should be simple, easy to replicate and incorporate all wetland types. In India no suitable wetland classification existed for a comprehensive inventory of wetlands in the country prior to the execution of Nation-wide Wetland Mapping Project based on satellite remote sensing by the Space Applications Centre, Ahmedabad. The classification system is based on Ramsar Convention definition of wetlands which provides a broad framework for delineating wetlands and also amenable to remote sensor data has been used for inventory of wetlands. It considers all parts of a water mass including deeper parts as well as its ecotonal area as part of the wetland as embodied in the Ramsar definition. Accordingly, for operative purposes, all submerged or water-saturated lands, natural or man-made, inland or coastal,
permanent or temporary, vegetated or non-vegetated are included in the wetlands (Garg et al, 1998). Another feature of this definition is its amenability to remote sensor data.

The classification system, besides including all the wetlands, incorporates all the deep-water habitats and the impoundments such as reservoirs, ash ponds/ cooling ponds, and abandoned quarries. However, the classification system does not include deep seas. The main criteria followed in this system are:

- Wetland hydrology *i.e.* manifestation of water on the satellite imagery.

- Wetland vegetation -- mainly hydrophytes and other aquatic vegetation in a part or whole of the water body as observed from satellite data.

The salient features of the classification system are:

- It takes into account all wetlands whether inland or coastal, natural or man-made.

- It provides qualitative information on the turbidity (high, moderate, low) status of all wetlands including inland and coastal.

- It provides information on the extent of vegetation present in the inland wetlands, both in pre-monsoon and post-monsoon seasons, wherever discernible on satellite imagery.

- In addition, the classification system is very simple and easy to replicate.

The final wetland classification system is given below (Table 5.1):
### Table 5.1: Wetland Classification System

<table>
<thead>
<tr>
<th>INLAND WETLANDS</th>
<th>1. Natural</th>
<th>1.1 Lakes/Ponds</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1.2 Ox-Bow Lakes/Cut-Off Meanders</td>
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<td>1.3 Waterlogged (Seasonal)</td>
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<td>1.4 Playas</td>
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<td>1.5 Swamp/Marsh</td>
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</tbody>
</table>

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<th>2. Man-Made</th>
<th>2.1 Reservoirs</th>
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<tbody>
<tr>
<td></td>
<td>2.2 Tanks</td>
</tr>
<tr>
<td></td>
<td>2.3 Waterlogged</td>
</tr>
<tr>
<td></td>
<td>2.4 Abandoned Quarries</td>
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<td></td>
<td>2.5 Ash/Cooling Pond</td>
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<tr>
<th>COASTAL WETLANDS</th>
<th>3. Natural</th>
<th>3.1 Estuary</th>
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<tbody>
<tr>
<td></td>
<td>3.2 Lagoon</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.3 Creek</td>
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<td></td>
<td>3.4 Backwater (Kayal)</td>
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<td></td>
<td>3.5 Bay</td>
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<td></td>
<td>3.6 Tidal Flat/Mud Flat</td>
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<td></td>
<td>3.7 Sand/Beach/Spit/Bar</td>
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<td></td>
<td>3.8 Coral Reef</td>
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<td>3.9 Rocky Coast</td>
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<td></td>
<td>3.10 Mangroves</td>
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<td></td>
<td>3.11 Salt Marsh/Vegetation</td>
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<td></td>
<td>3.12 Other Vegetation</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Man-Made</th>
<th>4.1 Salt Pans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.2 Aquaculture Ponds</td>
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</table>

1. Rivers have not been included in the classification system, however, are shown in the maps.
2. The extent of vegetation, if present, in the inland wetlands is indicated on the maps.
3. Qualitative turbidity ratings (low, moderate, high) to be given, wherever possible.
4. Wetlands put to regular agriculture use have not been included.

### DEFINITION OF WETLAND TYPES

Definitions of wetland categories used in the study are given in Table 5.1 and their appearances on satellite imagery shown in Plates I-VI (Garg et al, 1998).

**Inland Wetlands**

1. **Natural**

   1.1 **Lakes**: Larger bodies of standing water occupying distinct basins (Reid et al, 1976).
1.1 **Pond**: Generally, suggest a small, quiet body of standing water, usually shallow enough to permit the growth of rooted plants from one shore to another (Reid *et al*., 1976).

**Comment**: The only difference between lake and pond is of size and that also is not quantified. In view of this, both are clubbed together.

1.2 **Ox-bow lakes/ Cut off meanders**: A meandering stream may erode the outside shores of its broad bends, and in time the loops may become cut-off, leaving basins. The resulting shallow crescent-shaped lakes are called oxbow lakes (Reid *et al*., 1976).

1.3 **Waterlogged (seasonal)**: Said of an area in which water stands near, at, or above the land surface, so that the roots of all plants except hydrophytes are drowned and the plants die (Margarete *et al*., 1974).

**Comment**: Such type of waterlogging occurs due to floods during monsoon and can be delineated using post-monsoon satellite data.

1.4 **Playas**: Term used in South-West United States for marsh-like ponds similar to potholes but with different geologic origin (Mitsch and Gosselink, 1986).

**Comment**: Playas are normally found in arid regions in the undrained areas. Due to heavy rains the playa may be covered with a shallow sheet of water. In India, these are found in the desertic regions of Rajasthan. Famous Sambhar lake is an example of a playa.

1.5 **Swamp/Marsh**: Wetland dominated by trees or shrubs (U.S. Definition). In Europe, a forested fen (a peat accumulating wetland that has no significant inflows or outflows and supports acidophilic
mosses, particularly *Sphagnum*) could be called a swamp. In some areas reed grass - dominated wetlands are also called swamps). (Mitsch and Gosselink, 1986).

**Marsh:** A frequently or continually inundated wetland characterised by emergent herbaceous vegetation adapted to saturated soil conditions. In European terminology a marsh has a mineral soil substrate and does not accumulate peat (Mitsch and Gosselink, 1986).

**Comment:** Using satellite data it is difficult to differentiate between swamp and marsh. Hence, both are clubbed together.

2. **Man-Made**

2.1. **Reservoir:** A pond or lake built for the storage of water, usually by the construction of a dam across a river (Margarate et al, 1974).

2.2 **Tanks:** A term used in Ceylon and the drier parts of Peninsular India for an artificial pond, pool or lake formed by building a mud wall across the valley of a small stream to retain the monsoon (Margarate et al, 1974).

2.3 **Waterlogged:** This type of waterlogging is caused mainly by unlined canal seepage and other irrigation network. In Gujarat, this category has been combined with natural waterlogging.

2.4 **Abandoned Quarries:** Quarry is defined as "An open or surface working or excavation for the extraction of stone, ore, coal, gravel or minerals." In such pits water accumulate (McGraw Hill Encyclopaedia of Environmental Sciences, 1974).
SATellite View of Wetland Types

Lake (Dal Lake, J&K)

Ox-Bow Lakes/Cut-Off Meanders

High Altitude Lake (Amto Gor, Ladakh Of J&K)

Waterlogged (Seasonal) Areas In Assam

Plate I
SATELLITE VIEW OF WETLAND TYPES

MAN-MADE WATERLOGGING (CANAL SEEPAGE IN HARYANA)

ABANDONED QUARRIES (JHARIA COAL FIELDS, BIHAR)

COOLING POND (BOKARO STEEL PLANT, BIHAR)

ESTUARY (KALI NADI, KARNATAKA COAST)

PLATE III
SATELLITE VIEW OF WETLAND TYPES

LAGOON (PULICAT ON EAST COAST OF A.P. AND TAMIL NADU)

CREEK (ON WEST COAST, GOA)

BACKWATER (VEMBANAD KAYAL, KERALA)

BAY (ON EAST COAST, ANDHRA PRADESH)

PLATE IV
SATELLITE VIEW OF WETLAND TYPES

TIDAL FLATS/MUD FLATS (GULF OF KACHCHH, GUJARAT)

BEACH/SAND (WEST COAST, KARNATAKA)

FRINGING CORAL (SOUTH ANADAMAN)

ROCKY COAST (WEST COAST NEAR DAMAN)

PLATE V
SATellite View of Wetland Types

Mangroves dissected by creeks (part of W.Bengal)

Salt pans coast of Gujarat

Salt marsh/marsh vegetation on East Coast (Andhra Pradesh)

Aquaculture ponds on East Coast (Andhra Pradesh)

Plate VI
2.5 **Ash pond/Cooling pond**: The water body created for discharging effluents in industry, especially in thermal power plants (Encyclopaedic Directory of Environment, 1988).

**Cooling pond**: An artificial lake used for the natural cooling of condenser-cooling water serving a conventional power station (Encyclopaedic Directory of Environment, 1988).

### Coastal Wetlands

3. **Natural**

3.1 **Estuary**: A confined coastal water body with an open connection to sea and a measurable quantity of salt in its water. At and near the region where the fresh water from the land meets the salt water of the sea, a distinctive aquatic environment occurs, the estuary. The estuary is an ecotone - a rather complex buffer zone," sharing some characteristics of both types of aquatic ecosystems, but identical to neither (Clark, 1977; Reid *et al.*, 1976).

**Comment**: It was observed that setting of the boundary from remote sensing data is difficult and may be erroneous. In view of this, estuaries are indicated, wherever, possible on the maps. In addition, mud flats which are part of the estuary at low tide, have been mapped separately.

3.2 **Lagoons**: Such coastal bodies of water, partly separated from the sea by barrier beaches or bass of marine origin, are more properly termed lagoons. As a rule, lagoons are elongate and lie parallel to the shoreline. They are usually characteristic of, but not restricted to, shores of emergence. Lagoons are generally shallower and more saline than typical estuaries (Reid *et al.*, 1976). Not present in Gujarat.
3.3 **Creek:** A notable physiographic feature of salt marshes, especially low mashes, in the development of tidal creeks in the marsh itself. These creeks develop as do rivers "with minor irregularities sooner or later causing the water to be deflected into definite channels" (Mitsch and Gosselink, 1986). This category is indicated on the maps but due to narrow width area has not been estimated.

3.4 **Backwater:** A creek, arm of the sea or series of connected lagoons, usually parallel to the coast, separated from the sea by a narrow strip of land but communicating with it through barred outlets (Margarate et al, 1974). Category absent in Gujarat.

3.5 **Bay:** A large estuary with a relatively high degree of flushing (Clark, 1997). Absent on Gujarat coast.

3.6 **Tidal flat/ mudflat:** Most unvegetated areas that are alternately exposed and inundated by the falling and rising of the tide. They may be mudflats or sand flats depending on the coarseness of the material of which they are made (Clark, 1977).

3.7 **Sand/Beach:** Beach is an unvegetated part of the shoreline formed of loose material, usually sand that extends from the upper berm (a ridge or ridges on the backshore of the beach, formed by the deposit of material by wave action, that marks the upper limit of ordinary high tides and wave wash) to low water mark (Clark, 1977).

3.8 **Coral reef:** Consolidated living colonies of microscopic organisms found in warm tropical waters. The term coral reef, or organic reef is applied to the rock-like reefs built-up of living things, principally corals. They consist of accumulations of calcareous deposits of corals and corraline algae with the intervening space connected
with sand, which consists largely of shells of foraminifera. Present reefs are living associations growing on this accumulation of past (Clark, 1977).

3.9 **Rocky Coast**: Beach consisting of rocky material.

3.10. **Mangrove**: The mangrove swamp is an association of halophytic trees, shrubs, and other plants growing in brackish to saline tidal waters of tropical and sub-tropical coastlines (Mitsch and Gosselink, 1986).

3.11 **Salt Marsh/marsh vegetation**: Natural or semi-natural halophytic grassland and dwarf brushwood on the alluvial sediments bordering saline water bodies whose water level fluctuates either tidally or non-tidally (Mitsch and Gosselink, 1986).

3.12 **Other Vegetation**: Vegetation other than hydrophytic (*Suaeda* sp. etc.) present in the coastal areas.

**Man-made**

4.1 **Salt pans**: An undrained usually small and shallow rectangular, man-made depression or hollow in which saline water accumulates and evaporates leaving a salt deposit (Margarate *et al.*, 1974).

4.2 **Aquaculture ponds**: Aquaculture is defined as "The breeding and rearing of fresh-water or marine fish in captivity. Fish farming or ranching". The water bodies used for the above are called aquaculture ponds (Encyclopaedic Directory of Environment, 1988). Not delineated in the state.