CONSERVATION OF WETLANDS AND WATER BODIES FOR FLOOD AND EROSION MITIGATION

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SYNOPSIS

A **wetland** is a land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem. Primarily, the factor that distinguishes wetlands from other land forms or water bodies is the characteristic vegetation of aquatic plants, adapted to its unique hydric soil. As per the Ramsar International Wetland Conservation Treaty (Article 1.1), "wetlands are 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." Again, the Article 2.1 states that "Wetlands may incorporate riparian and coastal zones adjacent to the wetlands and islands or bodies of marine water deeper than six (6) metres at low tide lying within the wetlands." Wetlands play a number of roles in the environment, principally flood and erosion control, water purification and shoreline stability etc. Wetlands are also considered the most biologically diverse of all ecosystems, serving as home to a wide range of plant and animal life. However, due to rampant anthropogenic activities these once endowed areas have been severely degraded and are shrinking. This paper analyses the functions of natural wetlands in flood and erosion mitigation besides discussing their habitat, recreational, productive and other related environmental functions and puts forward policy recommendations for impact mitigation, health restoration and need-based creation of new wetlands.

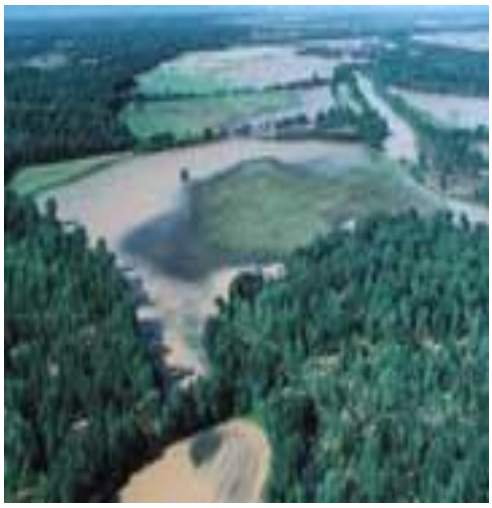
1. Introduction

Wetlands occur naturally on every continent except Antarctica, the largest including the Amazon River basin, the West Siberian Plain and the Pantanal. The water found in wetlands can be freshwater, brackish, or saltwater. The main wetland types include swamps, marshes, bogs and fens and sub-types include mangrove, carr, pocosin and varzea. They can also be constructed artificially as a water management tool, which may play a role in the developing field of water-sensitive urban design. The UN Millennium Ecosystem Assessment determined that environmental degradation is more prominent within wetland systems than any other ecosystem on Earth. International conservation efforts are being used in conjunction with the development of rapid assessment tools to inform people about wetland issues.

Traditionally, wetlands have been thought of as wastelands, as places suitable only for murder mysteries. But contrary to this perception, in reality wetlands perform a number of critical eco-system functions. They moderate impacts from flooding, control erosion, purify water and provide habitat for fish and wildlife. They also provide a unique natural environment for people to enjoy outdoor recreation activities. This paper discusses various ecological and environmental functions of wetlands including their roles in flood and erosion mitigation, health of wetland and conservation and policy measures required for maintaining proper health of wetlands and their restoration.

2. Flooding

Wetlands located along the shores of oceans, lakes, rivers and streams protect surrounding properties from flooding by acting as a storage reservoir, temporarily storing flood water and slowly releasing it back into the system (sponge effect). As storm water enters a wetland from surface runoff or adjacent water bodies, it is slowed down by trees, shrubs, reeds, rushes and other wetland plants. Slowing the flow of water allows more time for it to percolate through the soil rather than surface runoff. Wetlands with a large surface area also act as a large sink, diffusing large flows over a greater land area and slowing the momentum of rushing water. In this way, wetlands help protect adjacent and downstream property from flood damage.



(Wetland Storing Flood Water)

3. Erosion

The effects of rushing water can be very destructive. Fast-flowing water can carry a large load of soil particles from the land which are then washed into lakes, rivers and streams. Excessive sediment in water is considered both a chemical and physical pollutant; it can carry bacteria and toxic particles and can alter the habitat of the receiving water for plants and animals. Wetland vegetation reduces the erosive effect of rushing water by slowing the velocity of floodwaters, binding the soil with its roots and causing suspended soil particles to settle out before they reach open waters. Wetlands also protect bank-lines from erosion by dissipating the energy from waves and currents.

(Erosion by Floodwater)

4. Water Purification

Wetlands are particularly good water filters because of their location between land and open water. This allows them to intercept and assimilate many pollutants before they enter rivers, streams or lakes. Rainwater that runs off buildings and streets in agricultural, residential and industrial areas picks up sediments, nutrients, toxic materials and other wastes. If that rainwater flows through a wetland before it enters a river or stream, some of these pollutants are filtered by the soil and plants, which protect the ecosystems downstream. However, wetlands alone can’t solve our pollution problems since every wetland has a limited capacity to absorb nutrients, metals, sediments, etc. Overloading a wetland with pollution reduces its ability to serve this function for all time to come.

5. Sediment Trapping

Water flowing into wetlands slows down dramatically as it comes into contact with wetland vegetation. Suspended soil particles or sediments will settle out of the water and bind to the stems and roots of plants. The role wetlands play in trapping excess sediments and preventing them from entering river and lake systems is important for a number of reasons as given below:

- ✓ Sediments accumulating at the bottom of streams and lakes can smother (to cover completely) fish spawning areas and bottom-dwelling aquatic life;
- ✓ Wetland filtering reduces siltation of ports, harbours, rivers and reservoirs, saving a lot of money that would have to be spent otherwise on dredging or removing the sediment;
- ✓ Sediment particles are often vehicles for transporting pollutants such as pesticides and heavy metals. Studies have shown that as much as 80-90% of sediments in the water column may be removed as they move through wetlands!

6. Chemical and Organic Waste Processing

Water flowing through urban areas often contains heavy metals including cadmium, chromium, copper, lead and nickel. Most of these substances are usually bound to sediments entering the wetland system. Wetland plants can trap heavy metals and pathogens (such as bacteria and viruses) from runoff waters and fix them temporarily in plant tissues. Thick, organic, wetland soils can trap pollutants and keep them out of adjacent water bodies. Accumulation of these pollutants, however, can harm wildlife as they are passed up the food chain (biological magnification). Certain wetland plants can alter and render harmless viruses, coliform bacteria and suspended solids after initial sewage treatment, serving as nature's treatment facilities for domestic wastes.

7. Nutrient Removal

Elements such as phosphorus and nitrogen are essential ingredients of life for plants and animals and are therefore considered nutrients; however, too much of a good thing can cause problems. An excess of nutrients carried into surface waters can result in eutrophication an exponential growth or bloom of algae covering the water surface. The rapid growth of algae significantly reduces the amount of oxygen available to other aquatic life, potentially suffocating many of them. Because phosphorus and nitrogen are present in all human wastes, getting the nutrients out of wastewater is a large and expensive challenge. Wetlands are effective in removing and storing nutrients such as nitrogen and phosphorus from waters flowing through them. Some wetlands are capable of removing 85-90% of phosphorus and nitrogen from runoff water. Microorganisms and wetland plants absorb these nutrients, release some of the nitrogen as gas and store the remainder in the soil. Algae and some vascular plants can also convert nitrates and phosphates to usable by-products, thereby removing them from the system. Many towns are beginning to experiment with wetlands as effective alternatives to costly sewage treatment plants. The Government of Assam too may initiate projects in this direction.

8. Groundwater Discharge and Recharge

Wetlands that are hydrologically connected to groundwater help in maintaining water supplies by:

- ✓ Recharging groundwater supplies as water stored in wetlands will slowly percolate into the underlying aquifer
- ✓ Discharging groundwater as water flows from the groundwater system to surface water bodies, sometimes maintaining a minimum amount of flow for rivers and streams during dry periods
- ✓ However, not all wetlands perform both of these functions; some wetlands primarily recharge groundwater while others mostly discharge groundwater

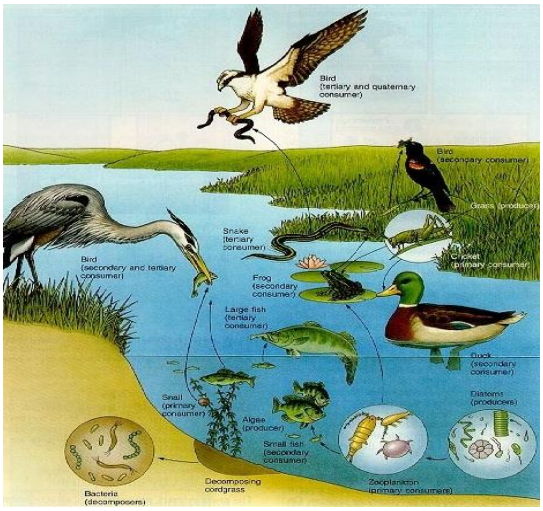
9. Habitat Functions

Wetlands provide essential habitat for a wide variety of birds, mammals, reptiles, amphibians, fish and insects up to 45% of which are endangered. The high rate of wetland loss has contributed to the endangered status of many species. Some species spend most of their life within wetlands, while others occasionally visit wetlands for food, water, or shelter. Those species that require wetland habitat to complete at least a portion of their life cycle are called obligate species. Wetlands attract wildlife for a number of reasons:

- ✓ their vegetative cover provides shelter from predators
- ✓ they provide ideal nesting conditions for many waterfowl
- ✓ they provide migratory birds with a safe stop over location to rest during long migrations
- ✓ they provide essential spawning/nursery habitat for commercially important fish etc
- ✓ Many have an extensive, complex food chain that supports numerous species, including man

10. Food Webs

The vast amount of organic matter that accumulates in wetlands is the beginning of food webs (number of food chains put together) for thousands of aquatic plants and animals. Because of their nutrient-rich waters, they are among the most productive ecosystems in the world. When wetland plants die, their tissues are broken down by bacteria and fungi into detritus, nutrient-rich fragments that are flushed out by floodwater and made available to fish, invertebrates etc. These organisms in turn are preyed upon by larger wetland inhabitants. In addition to the above, wetlands are also valuable for the variety of commercial products harvested from them.



11. Recreation and Aesthetics

Even though wetland acreage in India is diminishing, recreational use remains brisk, particularly for hunting and fishing. People enjoy hunting waterfowl and other migratory birds and also wetland-dependent fish. Hiking, canoeing and photography are among the many activities that draw people to wetlands.

12. Loss of Wetland-Factors

- ✓ Drainage for agriculture : 25%
- ✓ Human settlement : 22%
- ✓ Fishing and associated disturbances : 19%
- ✓ Hunting and associated disturbances : 12%
- ✓ Soil erosion and siltation : 12%
- ✓ Pollution from industries : 10%

Total **: 100%**

13. Glimpse of Deepor Beel, Guwahati

(View of Deepor Beel)

(Settlement in Deepor Beel)

(Sewage from Guwahati)

(Infestation by Water Hyacinth, Hydrilla)

(Garbage Dumping)

(rag Pickers)

14. Concerns

- ✓ Rapidly deteriorating
- ✓ Since 1900 more than 50% of the world's wetlands have disappeared
- ✓ About 500 sq. km of wetland is degraded every year in Asia especially in countries like India
- ✓ Rate of loss of wetland in India is about 2-3% of area annually
- ✓ About 70-80% of wetlands in Ganga basin have been lost in the last 50 years
- ✓ There are many stakeholders whose diverse interest lay claim on the ecosystem functions
- ✓ Agricultural producers drain/convert wetlands to agricultural land to meet food requirement
- ✓ Water abstraction for drinking, irrigation, industries and human settlements
- ✓ Soil acidification, erosion and nutrient loss
- ✓ Hydrological changes
- ✓ Loss of bio-diversity and ecosystem functions
- ✓ Majority neglected ecosystems with very little or no management inputs
- ✓ Lack of co-ordination and complicity coupled with contradictory objectives of policies have lead to unwise, unsustainable and destructive exploitation of wetland

15. Major Problems and Threats to Wetlands

In the context of Assam in specific, the major problems pertaining to wetlands have been identified as:

- ✓ Large-scale encroachment leading to increasing pressure on wetlands due to population growth
- ✓ Hunting, trapping and killing of wild birds and mammals
- ✓ unplanned and illegal fishing practices leading to decrease in the fish population
- ✓ Conversion of wetland areas for agricultural and human settlement
- ✓ Draining of harmful and toxic agro-chemicals (especially into rural wetlands) and other pollutants along with untreated wastewater (urban wetlands). This is the main issue of concern not only for the wetland ecosystem (s) but also for the produce (fish etc) human beings consume leading to biological magnification and subsequent health problems.

16. Recommended Conservation Measures

- ➢ State government must formulate and adopt a wetland policy and ensure its proper implementation. Such a move would have a great effort on future environment security, as well act as a lifeline to numerous people whose lives depend on wetlands.
- ➢ Protection of boundary of wetland, demarcation of boundary by fixing pillars
- ➢ Realizing the gravity of the encroachment problem stricter legislation to ensure prevention of the fast growing human encroachment and pollution should be enacted. All types of illegal encroachment should be vacated from the beel areas.
- ➢ Control of commercial fishing.
- ➢ Control of exploitation of aquatic products.
- ➢ Extensive survey and quantification of flora and identification of threatened species.
- ➢ All neighbouring residents of the area should be made aware of the fact that open spaces, wetlands also play a vital role in maintaining a healthy environment.

17. Conservation and Mitigation Plan

Most of the wetlands (Deepor beel in Guwahati, Panidihing in Sivsagar, Loktak in Manipur etc to name a few) are under threat due mainly to anthropogenic activities. Therefore, preparation and implementation of impact mitigation plans have become incumbent on us to conserve the existing ones and further to restore the health of the degraded ones. It is high time that the Government prepares and executes mitigation plans that could be based on the following order of preference:

- ✓ Minimization of impacts and disturbance to wetlands and adjacent buffer areas, in that order.
- ✓ Preservation of remaining wetlands and adjacent buffer areas through the dedication and establishment of perpetual conservation easements, development restriction areas or equivalent.
- ✓ Rectification by repairing or restoring existing damaged wetlands or adjacent buffer areas, including enhancement thereto.
- ✓ Mitigation may take the following forms, either singly or in combination:
    - Implementation of preventative practices to protect the natural condition and functions of the remaining unaltered wetland.
    - Restoration or enhancement (e.g., improving the density and diversity of native woody plant species) of remaining or other upland buffer.
    - Restoration of areas of significantly disturbed or degraded wetlands to reclaim or to bring back one or more of the functions that have been partially or completely lost by such actions as draining and filling.
    - The in-kind replacement of impacted wetland by the construction of new wetland, usually by flooding or excavating land that were not previously occupied by a wetland, that re-creates as nearly as possible the original wetland in terms of type, functions, geographic location and setting and that is larger than the original wetland by a ratio acceptable to the approval authority.

18. Policy Needs

It is obvious from above that the onus is on the government to frame suitable policies towards conservation of wetland. In this regard the following points are put forward.

- ✓ All mitigation measures shall balance the benefits of gaining new wetland area(s) with the loss to upland (non-wetland) areas caused by wetland creation.
- ✓ Any mitigation plan developed to compensate for the loss of wetland or wetland/watercourse buffer shall include baseline data as needed to adequately review the effectiveness of the plan.
- ✓ Any mitigation plan prepared pursuant to this section and accepted by the approval authority shall become part of the permit to conduct a regulated activity.
- ✓ All mitigation plans shall include map (s) with sufficient detail and at a scale to be able to determine where the wetland is located and its size, boundaries and topographic features.

- ✓ A narrative which describes goals and specific objectives for the mitigation wetland or wetland buffer, including the functions and benefits to be provided and clear performance standards and criteria for assessing project success.

- ✓ A description of the physical, hydrological and ecological characteristics of the impacted wetland or wetland buffer and proposed restored or created wetland or buffer, in sufficient detail to enable the approval authority to determine whether wetland or wetland buffer impacts will be permanently mitigated.

- ✓ Details on construction, including dyke, excavation, or other means by which the wetland will be restored or created, including existing and proposed topographic contours.

- ✓ Efficient Utilization and Management of Drinking Water and Control of Water Pollution

- ✓ Construction/reconstruction schedule to be phased appropriately keeping in mind seasons.

- ✓ Measures to control erosion and sedimentation during construction.

- ✓ Plantings, source of stock, procedures for transplanting/seeding the stock, area(s) to be planted and planting schedule.

- ✓ If vegetation from the wild is to be used, identify the source and measures to prevent introduction of undesirable exotics.

- ✓ If applicable, explain why chemicals will be used and precautions to be taken to minimize their application and protect the wetland or wetland buffer from excessive chemicals.

- ✓ Details on management of the mitigation site, including:

    - o Measures to assure persistence of the wetland (e.g., protection against predation by birds and other animals).

    - o Vegetative management.

    - o Sediment and erosion control.

    - o Plans for monitoring site during and after construction, including methods and a schedule for data collection and provisions for mid-course corrections.

    - o Provisions for long-term protection of the site (e.g., permanent conservation easement) with such protections to be described on the approved plan and to be issued via a separate recorded document.

    - o Provision for bonding or other financial guarantees.

- ✓ A description of the periodic reporting, including at the end of the construction, during the monitoring period and at the end of the monitoring period. In light of baseline data.

- ✓ The name, qualifications and experience of the person(s) implementing the mitigation plan