

Wetlands and their Role in Water Conservation: A Review

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Abstract

A wetland is an area of land whose soil is saturated with moisture either permanently or seasonally. Such areas may also be covered partially or completely by shallow pools of water. Wetlands include swamps, marshes, and bogs. The water found in wetlands can be saltwater, freshwater, or brackish. The world's largest wetland is the Pantanal which straddles Brazil, Bolivia and Paraguayan South America. Wetlands are considered the most biologically diverse of all ecosystems. Plant life found in wetlands includes mangrove, water lilies, cattails, sedges, tamarack, black etc. A swamp is a wetland with some flooding of large areas of land by shallow bodies of water. Saltwater is water from a sea or ocean. Fresh water is naturally occurring water on the Earth's surface in bogs, ponds, lakes, rivers and streams, and underground as groundwater in aquifers and underground streams. Brackish water is water that has more salinity than fresh water, but not as much as seawater spruce, cypress, gum tree, and many others. Animal life includes many different amphibians, reptiles, birds, insects, and mammals. In many locations, such as the United Kingdom, Iraq, South Africa and the United States, wetlands are the subject of conservation efforts and biodiversity Action Plans.

1. Introduction

Wetlands also serve as natural wastewater purification systems at some places. The study of wetlands has recently been termed as paludology in some publications. Wetlands have been categorized both as biomes and ecosystems. A patch of land that develops pools of water after a rainstorm would not be considered a "wetland" though the land is wet. Wetlands have unique characteristics: they are generally distinguished from other water bodies or landforms based on their water level and on the types of plants that thrive within them. Specifically, wetlands are characterized as having a water table that stands at or near the land surface for a long enough season each year to support aquatic plants. Put simply, wetlands are lands made up of hydric soil.

Wetlands have also been described as ecotones, providing a transition between dry land and water bodies. Mitsch and Gosselink have defined an ecosystem as a biological environment consisting of all the organisms living in a particular area. An ecotone is a transition area between two adjacent but different patches of landscape. It is an interface between truly terrestrial ecosystems and aquatic systems, making them inherently different from each other, yet highly dependent on both. Ramsar Convention under the Ramsar International wetland conservation treaty defines wetlands as follows:

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."

Article 2.1: "[Wetlands] may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six meters at low tide lying within the wetlands".

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In the United States, wetlands are defined as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas". Some US states, such as Massachusetts and New York, have separate definitions that may differ from the federal government.

2. Wetlands and climate change

Wetlands perform two important functions in relation to climate change. They have mitigation effects through their ability to sink carbon, and adaptation effects through their ability to store and regulate water. Mitigation Peat swamp forests and soils are being drained, burnt, mined and overgrazed contributing severely to climate change. As Peat lands form only 3% of the entire world's land area, their degradation equal 7% of all fossil fuel carbon dioxide (CO₂) emissions. As a result of peat drainage, the organic carbon that was built up over thousands of years and is normally under water is suddenly exposed to the air. It decomposes and turns into carbon dioxide (CO₂), which is released into the atmosphere. Peat fires cause the same process and in addition create enormous clouds of smoke that cross international borders, such as happen every year in Southeast Asia. Through the building of dams, Wetlands International is halting the drainage of peat lands in Southeast Asia, thereby avoiding enormous CO₂ emissions. Reforestation with native tree species as well as setting up community fire brigades are also part of an integral, very cost effective approach shown in Central Kalimantan and Sumatra, Indonesia. Adaptation Mangroves, floodplains, highland and other wetlands can reduce the impacts of increased precipitation, storms, glacier melting and even sea level rise. The water regulating and storage functions of these wetlands are crucial in adapting to a changing climate. Therefore, in order to protect people living close or even far

downstream from wetlands and their source of livelihoods, we must conserve and restore wetlands. In this way, they can continue to play their critical role.

3. Wetland conservation

Wetlands have historically been the victim of large-scale draining efforts for real estate development, or flooding for use as recreational lakes. By 1993 half the world's wetlands had been drained. Since the 1970s, more focus has been put on preserving wetlands for their natural function — sometimes also at great expense. Wetlands provide a valuable flood control function. Wetlands are very effective at filtering and cleaning water pollution, (often from agricultural runoff from the farms that replaced the wetlands in the first place). To replace these wetland ecosystem services enormous amounts of money have been spent on purification plants and remediation measures, constructing dams, levees and other artificial flood controls. Wetlands are vital ecosystems that also provide livelihoods for the millions of people who live within and around them. The Millennium Development Goals (MDGs) called for different sectors to join forces to secure wetland environments in the context of sustainable development and improving human well being. A three-year project carried out by Wetlands International in partnership with the International Water Management Institute found that it is possible to conserve wetlands while improving the livelihoods of people living among them. Case studies conducted in Malawi and Zambia looked at how dambos – wet, grassy valleys or depressions where water seeps to the surface – can be farmed sustainably to improve livelihoods. When mismanaged or overused dambos often become degraded, which was starting to happen at the study sites. Project staff took knowledge from local farmers on how specific dambos functioned, and then trained them in relevant soil and water management practices, emphasizing the fact that dambos need to be managed in the context of the wider environment. Before the project, there were cases where people had died from starvation due to food shortages. By the end of it, many more people had access to sufficient water to grow vegetables. A key achievement was that villagers had secure food supplies during long, dry months. They also benefited from other spin-offs. For example, they gained better nutrition through growing a wider range of crops and were also able to invest in health and education by selling produce and saving money.

The Convention on Wetlands of International Importance, especially as Waterfowl Habitat, or Ramsar Convention, is an international treaty designed to address global concerns regarding wetland loss and degradation. The primary purposes of the treaty are to list wetlands of international importance and to promote their wise use, with the ultimate goal of preserving the world's wetlands. Methods include restricting access to the majority portion of wetland areas, as well as educating the public to combat the misconception that wetlands are wastelands. The Convention works closely with five International Organization Partners. These are: Birdlife, IUCN, International Water Management Institute, Wetlands International and WWF. The partners provide technical expertise, help conduct or facilitate field studies and provide financial support. The IOPs also participate regularly as

observers in all meetings of the Conference of the parties and the Standing Committee and as full members of the Scientific and technical review panel.

3.1 New Zealand

Over 90% of the wetlands in New Zealand have been drained since European settlement, predominantly to create farmland. Wetlands now have a degree of protection under the Resource Management Act.

3.2 South Africa

The South African Department of Environmental Affairs and Tourism in conjunction with the departments of Water Affairs and Forestry, and of Agriculture, supports the conservation and rehabilitation of wetlands through the Working for Wetlands program. The aim of this program is to encourage the protection, rehabilitation and sustainable use of South African wetlands through co-operative governance and partnerships. The program is also a poverty relief effort, providing employment in wetland maintenance.

3.3 Sweden

The Swedish national wetland inventory (VMI) is one of the world's most extensive systematic inventories of nature types that have ever been done. VMI has surveyed the wetlands of Sweden below the alpine region during a 25-year period. In total 35000 objects (sites) are included in VMI, corresponding to an area of 4.3 million hectares, or 10% of the land area of Sweden. The aim of the survey has been to increase the general knowledge of wetlands in Sweden, as a basis for environmental monitoring and natural resources planning. By investigating the impact of human activities on wetlands and identifying the most valuable wetlands, their values can be preserved for future generations. The results from the inventory were also meant to function as background data for the authorities' decisions concerning e.g. drainage permits.

3.4 United States of America

The USA came to understand how biologically productive wetlands are, so the USA passed laws limiting wetlands destruction, and created requirements that if a wetland had to be drained, developers at least had to offset the loss by creating artificial wetlands. One example is the project by the U.S. Army Corps of Engineers to control flooding and enhance development by taming the Everglades, a project which has now been reversed to restore much of the wetlands as a natural habitat for plant and animal life, as well as a method of flood control. Another project in the works to restore the Everglades is the U.S. Sugar Corp Land Transaction. The project entails the acquisition of U.S. Sugar Corp. land, which would allow for water delivery, water treatment and water storage of sufficient quantity and quality to mimic the Everglades' natural system. The Everglades Foundation, a foundation whose mission is to protect and restore one of the world's unique natural ecosystems, and other environment-based organizations support the state of Florida acting to secure U.S. Sugar Corp. land. Future improvements in wetland vegetation mapping could include the use of more recent and better geospatial data.

4. Climate Temperature

Wetlands contrast the hot and arid landscape around Middle Spring, Fish Springs National Wildlife Refuge, Utah. Temperatures vary greatly depending on the location of the wetland. Many of the world's wetlands are in temperate zones (midway between the North and South Poles and the equator). In these zones, summers are warm and winters are cold, but temperatures are not extreme. However, wetlands found in the tropic zone, which is around the equator, are always warm. Temperatures in wetlands on the Arabian Peninsula, for example, can reach 50 °C (122 °F). In northeastern Siberia, which has a polar climate, wetland temperatures can be as cold as -50 °C (-58 °F). And in a moderate zone, such as the Gulf of Mexico, is usually 11 °C (51 °F). The amount of rainfall a wetland receives depends upon its location. Wetlands in Wales, Scotland, and Western Ireland receive about 150 cm (59 in) per year. Those in Southeast Asia, where heavy rains occur, can receive up to 1000 cm (200 in). In the northern areas of North America, wetlands exist where as little as 18 centimeters (6 inches) of rain fall each month.

5. Indian wetlands

Wetlands are integral to a healthy environment. They help to retain water during dry periods, thus keeping the water table high and relatively stable. During periods of flooding, they act to reduce flood levels and to trap suspended solids and nutrients to the lakes than if they flow directly into the lakes. The removal of such wetland systems because of urbanization or other factors typically causes lake water quality to worsen. In addition, wetlands are important feeding, breeding, and drinking areas for wildlife and provide a stopping place and refuge for waterfowl. As with any natural habitat, wetlands are important in supporting species diversity and have a complex and important food web. The recent millennium assessment of ecosystems puts freshwater biodiversity as the most threatened of all types of biodiversity. These wetland values are increasingly facing several anthropogenic pressures. The rapidly expanding human population, large scale changes in land use/landcover and burgeoning development projects and improper use of watersheds has all caused a substantial decline of wetland resources of the country. Absence of reliable and updated information and data on extent of wetlands, their conservation values and socioeconomic importance has greatly hampered development of policy, legislation and administrative interventions by the state.

For the long-term conservation planning of wetlands, spatial data and information is required for any intervention. Wetland eco-system constitute an integral part of cultural and biodiversity landscape of India. It is estimated that 3.5 millions ha exists in the country according to the 1992-1993 study by the Space Application Centre. However, this information pertains to wetlands above 56ha in size. Past research on wetland conservation in the country has shown conclusively that micro wetlands or satellite wetlands around a bigger wetland act as a constellation of habitat mosaic for resident and migratory waterfowl. This is of special importance for inland wetland habitats in the flyways of migratory birds in the Indo-Gangetic plains and in Deccan peninsula. Often, the size of these micro wetlands is much smaller than 50ha. Therefore, there is a great need to map wetlands of size smaller than 50ha. Spatial

information on wetlands resources is a critical and an urgently needed for an effective conservation of these important eco-systems. Use of advanced spatial technology tools or a country like India, with its vast biological and cultural diversity, a comprehensive use of remote sensing, GIS and other related technologies will be of great use in conservation. Classifying and mapping wetlands based on geomorphology, water quality and other biological attributes can lead to qualitative assessment. Results obtained could be used in planning, inventorying and monitoring wetlands in the country.

6. Wetlands Classification Scheme

6.1 Inland Wetlands

6.1.1 Natural Lakes/Ponds

- Ox-bow lakes/ Cut-off Meanders
- Waterlogged (Seasonal) Playas
- Swamp/Marsh

6.1.2 Man-made Reservoirs

- Tanks
- Waterlogged
- Abandoned quarries
- Ash pond/cooling pond

6.2 Coastal Wetlands

6.2.1 Natural Estuary

- Lagoon Creek
- Backwater (Kayal)
- Bay
- Tidal flat/Split/Bar Coral reef
- Rocky coast
- Mangrove forest
- Salt marsh/marsh vegetation
- Other vegetation

6.3 Man-made Salt pans

- Aquaculture

7. Role of wetland in water conservation

World is in a water crisis. It is already estimated that millions of people in the world currently have no access to potable water and environmentalists warn that if conservation efforts to better maintain current water sources are not increased, the India may also run out of water altogether by 2030. The World Wide Fund for Nature (WWF) considers India to be a water-scarce country, because of the low levels of rainfall most of the country receives. Added to the threat posed by global warming, a high level of poverty which leaves much of the country without access to plumbing or electricity, and an ever-increasing population growth rate, India has to act fast to save the water supply it does have. Its wetlands, if reclaimed and rehabilitated, can help replenish the thirsty nation. The future of India and its valuable water sources rely heavily on the education of the public - both those with access to technology, and those without it. Like many other nations, India is a country divided by financial extremes with striking poverty levels closely tied in to access to education. Wetlands serve as natural water conservation tools. With the help of their vegetation, they literally act as sponges, preventing the evaporation of water, particularly

during periods of intense Asian heat. They also serve as natural water filters, adding to the health benefits of the nation's peoples in purifying the water by trapping pollutants, bacteria, and viruses which cause illness such as dysentery and diarrhoea, key problems in African nations. Wetlands also benefit local peoples with their products - such as timber, fish, and rice. They protect humankind by serving as a natural means of flood control, and they protect the region from erosion. In addition, the wetlands offer many recreational and educational benefits. The wetlands of India are also home to a variety of plant and animal life, including some extremely rare and almost extinct species of birds. But sadly, it is estimated that India has lost 35-60

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percent of its wetlands over the past 40 years. Prior to modern scientific understanding of these precious ecosystems, wetlands were often thought of as valueless, or nothing more than mosquito breeding grounds, which would be of better use if developed for agriculture, dams, or buildings. It is now up to environmentalists and conservation minded individuals to help protect and replenish the diminishing wetlands of India - before it's too late. So, in addition to the wetlands conservation work of the Indian government and its affiliates, some Indian individuals are doing their own part to promote education, and practical, culture-friendly conservation.