WETLANDS IN PAKISTAN: WHAT IS HAPPENING TO THEM?

By:

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Abstract

Pakistan, despite having an arid climate, supports over 780,000 ha of wetlands covering 9.7% of the total land area, with 225 nationally significant wetlands, of which 19 have been recognised as Ramsar sites of global significance. Wetland types represent the passage of the Indus River from the glaciers and high alpine lakes, through riverine and freshwater lakes to the coastal wetlands of the Indus Delta. These wetlands provide often unrecognised benefits and services, such as provisioning - food and fibre production - regulating services such as water balance, groundwater recharge, flood mitigation and storm protection; cultural and social functions such as sacred and religious importance; providing recreation and tourism opportunities; and supporting functions such as soil formation and sediment retention. Main threats to wetlands include shortages of water to maintain the wetlands, poor water quality from increasing pollution, change in land use, encroachment and over-exploitation of natural resources, such as fish and wildlife. Most often the over-exploitation is driven by the lack of alternative livelihoods so that poor communities may have no option. The underlying causes of these direct threats are related to the perception that wetland natural resources are part of an open-access system. Management of the natural resources, if it exists at all, is usually ineffective and penalties for illegal or inappropriate resource-use are often not significant enough to be prohibitive. These inappropriate practices generally stem from policy shortcomings, legal gaps and inconsistencies, failure to enforce regulations, and institutional overlap of responsibilities for management of wetlands and lack of coordination. Consistently decision-makers and regulators do not adequately transfer appropriate environmental costs directly to users – both water users, resulting in water wastage, and polluters, who continue to degrade wetlands. Lack of awareness both amongst the general public and more importantly amongst key policy and decision makers at national and provincial levels undermines most efforts at wetland conservation and sustainable use. Some suggestions have been given to promote the conservation and sustainable use of wetlands.

Wetlands

The Convention on the Conservation of Waterfowl and Wetlands as the habitat of waterfowl, popularly known as the Ramsar Convention, defines

wetlands as “areas of marsh, fen, peat land 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”. It may also incorporate riparian and coastal zones adjacent to the wetlands, to conserve the integrity of wetlands. Pakistan supports over 780,000 ha of wetlands covering 9.7% of the total land area, with 225 nationally significant wetlands, of which 19 have been recognised as Ramsar sites of global significance (Annex). Wetland types represent the passage of the Indus River from the glaciers and high alpine lakes, through riverine and freshwater lakes to the coastal wetlands of the Indus Delta. Five major wetland types are generally recognized: i) m**arine** (coastal wetlands including coastal lagoons, rocky shores, and coral reefs); ii) e**stuarine** (including deltas, tidal marshes, and mangrove swamps); iii) l**acustrine** (wetlands associated with lakes); iv) r**iverine** (wetlands along rivers and streams); and v) p**alustrine** (meaning “marshy” - marshes, swamps and bogs).

Pakistan has been blessed with a wide variety of these wetland types in all parts of the country (Map shows the important wetlands in Pakistan including the Ramsar sites). The wetlands that are specifically found in Pakistan include the following:

Glaciers: Pakistan has more area under glaciers than any other country – 13,680 km^2, i.e. about 13% of the mountain area of the Upper Indus Basin. The largest is Siachen glacier, which is 75 km long in the eastern Karakorum.

Alpine lakes: There are over 25 significant high altitude lakes in Pakistan, often fed by glaciers, lying at altitudes between 2,000 m and over 4,000 m. Most of these are in Gilgit-Baltistan (GB), Khyber Pukhtunkhwa (KPK), and three alpine lakes in Azad Jammu & Kashmir (AJ&K). Alpine lakes are characterised by cold, oligotrophic conditions with restricted but often unique flora and fauna.

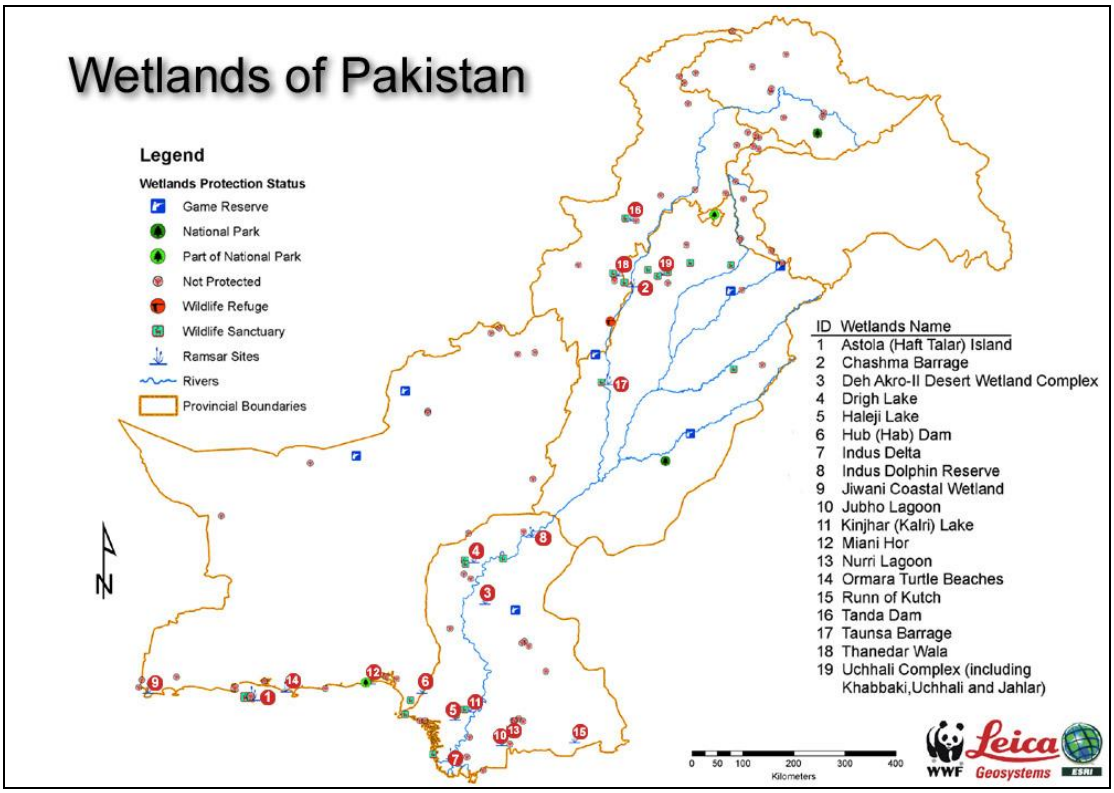
Peat lands: Peat lands in Pakistan are at around 20 km^2. Most of these are high altitude peat lands in Deosai, Ghizer (Shandur) in GB and Chitral in KPK.

Springs and streams occur throughout the country, wherever suitable groundwater conditions prevail, including along the coast. The streams collect the water from the watersheds and feed into the river systems.

Rivers: Pakistan’s principal river is the Indus, arising in the Himalayas, and flowing through the GB and out of the hills at Attock in areas bordering Punjab and KPK. It has a total length of 2,897 km; five major tributaries from the east arising in India (Jhelum, Chenab, Beas, Ravi and Sutlej), come together to make the Panjnad before joining the Indus in Southern Punjab. The flows of the latter three rivers are largely controlled by India. From the west, it is joined by a

multitude of small rivers in GB and Hindu Kush mountains of KPK and the rivers that make up the Kabul river system (including Kunar (Chitral), Panjkora (Dir) and Swat. Broadly speaking, the rivers in the northern hilly areas are fast flowing, cold water rivers with typical flora and fauna. Once the Indus and its tributaries reach the plains, the river has a more productive, warm water ecosystem. The Indus flows through Punjab and Sindh and discharges into the Arabian Sea in the Delta south east of Karachi. The rivers of Balochistan (Dasht, Hingol, Hub and many others) are much smaller and often seasonal. One of the key features of the lowland rivers is riverine forests, an important wetland type, that grow on the banks and in the floodplains of the Indus and Balochistan rivers. These are threatened by water abstraction and loss of the floodplains.

Important Wetlands of Pakistan. Ramsar Sites numbered.



Natural lowland lakes: A number of natural lowland lakes in Punjab and Sindh, can be classified into freshwater and brackish according to their salt content. In Punjab the major natural lakes in the Salt Range, include Kallar Kahar, Khabbeki, Jahlar, Ucchali and Nammal Lakes. Simli and Rawal Lakes near Islamabad are formed from the melting snow and natural springs of Murree Hills and are the drinking water source for Islamabad. In Sindh, Manchar Lake is the largest freshwater lake in Pakistan and one of the largest in Asia, located

west of the Indus River. The area of the lake fluctuates with the seasons from as little as 350 km² to 520 km². The lake is fed by numerous small streams in the Khirthar Mountains and empties into the Indus River. Keenjhar or Kalri Lake in Thatta District is another very large freshwater lake used for water supply. Both these lakes are threatened with pollution from different sources.

Small dams and large reservoirs: Man-made lakes formed by dams for hydropower and water supply are important wetland resources. They include the small water supply and irrigation lakes such as are found in Balochistan, and the larger lakes formed by dams such as Tarbela dam which has an area of 250 km^2; Mangla dam and reservoir on the Jhelum River between Punjab and AJ&K; Warsak dam in KPK; and other larger water supply reservoirs like Khanpur in KPK, Nammal in Punjab, Haleji in Sindh and Hub dam along the border between Sindh and Balochistan.

Barrage head ponds: Six major barrages built on the Indus River (besides other barrage head ponds built on the tributaries of the Indus) provide irrigation water for agricultural areas along the river - Jinnah, Chashma and Taunsa in Punjab; Guddu, Sukkur and Kotri in Sindh. These barrage head ponds are important for wetland biodiversity as well.

Irrigation and drainage canals: The irrigation and drainage canal networks throughout the country, particularly in KPK, Punjab and Sindh, form wetland complexes. There are a number of link canals between the “five rivers”. Where the canals are unlined, seepage may create adjacent waterlogged areas and swamps, which can be important for local aquatic resources e.g., wetlands in Thal, Punjab, and the wetland complex created by the Nara canal in Sindh, and the associated Chotiari reservoir. Effective drainage of irrigation water is critical to prevent water logging and soil salinisation, and Left and Right Bank Outfall Drains (LBOD and RBOD) in Sindh have associated wetland areas.

Urban wetlands: Water filled depressions caused by construction, lakes in parks and golf courses and waste water treatment lagoons and constructed wetlands are all forms of man-made urban wetlands, that serve recreational, and purification purposes, as well as being habitat for flora and fauna. All cities in Pakistan have urban wetlands, which are often overlooked, but important locally. Near the coast around Karachi, salt extraction creates saline ponds attracting certain bird species.

Marshes are extensive areas of both freshwater and saline marshes in Sindh, including the Deh-Akro desert wetland complex north of Karachi, and the Rann of Kutch, which are both Ramsar sites. Other smaller marshes are associated with barrages and seepage from irrigation canals. When canals pass

through desert areas, the wetlands created by seepage can be locally important such as drainage ponds created in Cholistan, Punjab.

Coastal wetlands: Pakistan's coastal wetlands are a very important category and include mangroves, estuaries, beaches and coral reefs: **Mangroves –** cover about 160,000 ha of the Indus Delta (600,000 ha). Reduction of fresh water flows, forest exploitation and environmental degradation have led to extensive losses, although there have been significant efforts at rehabilitation in some parts. The Makran coastline in Balochistan also contains some valuable pockets of mangroves covering about 10,000 ha, notably at Miani Hor, Kalmat Hor, and Gwatar Bay; **Estuaries:** The Indus flows out to the sea through the Qalandri Creek in the Indus Delta, forming the biggest estuary. Because of water abstraction upstream, the river may now discharge water to the sea only for three months a year. The only permanent rivers forming estuaries along the Balochistan coast are the Hub and Hingol rivers; other rivers flowing into the sea along the coast are only seasonal. Miani Hor and Kalmat Hor are deep inlets with mangroves and salt marshes; **Beaches:** Extensive beaches are interspersed with rocky outcrops and peninsulas along the coastline from Karachi to Pasni. Sandspit and Hawksbay near Karachi, and Hingol, Ormara, Jiwani and Pasni along the Makran coast are important turtle nesting beaches; and **Coral reefs:** The recently discovered active coral reefs in Pakistan are on Astola Island, a Ramsar site-the largest offshore island; also important for turtles nesting. Fossil coral reefs are however found in southern Badin District.

Distribution of these different types of wetlands in the provinces and federally administered area has been shown in Table 1.

IMPORTANCE/FUNCTIONS

Wetland biodiversity

The biodiversity of Pakistan's wetlands reflects the passage of the Indus River from the high mountains to the sea and the full diversity of wetland ecosystems. The Indus Flyway is a critical migration route for water birds – ducks, geese, cranes and shorebirds.

Eighteen threatened species of wetlands dependent mammals are found in the country including the endemic Punjab Urial (*Ovis vignei punjabiensis*) and Indus River Dolphin *(Platanista minor)*; twenty threatened bird species, twelve reptiles and two endemic amphibians are also supported by wetlands. The wetlands also support 187 indigenous freshwater fish species (including fifteen endemics) and 788 marine and estuarine fish species.[1] There are two exotic introductions (brown trout and rainbow trout) and 26 indigenous species of cold water fish in Pakistan. The snow trout, *Schizothorax plagiostomus* reaches enormous size on the Deosai Plateau, and could be suitable for cultivation. The

indigenous cold water species include 7 endemics, such as *Schizothorax skarduensis* and *Triplophysa yasinensis.* There are two important migratory fish, the Mahseer, *Tor putitora* and the Shermahi, *Clupisoma garua,* which are threatened by dams. One of the most famous warm water migratory fish is the Palla, *Tenualosa ilisha,* which used to be caught in large numbers in the Lower Indus up to and beyond Kotri. With the reduction in flows down the Indus, there has been a significant fall in the catches of Palla.

Ecosystem services and benefits

The Millennium Ecosystem Assessment categorises the services into four types – Providing, Regulating, Cultural and Supporting (see Table 2). The range of services illustrates the importance of wetlands.

Providing basic necessities

Food production of fish, wild game, fruits, and grains: Food production is one of the principal services provided by the wetlands. The biodiversity and productivity of wetlands is very great in terms of fish, birds and mammals. In 2001, fishery statistics showed that out of nearly 600,000 tonnes of fish caught, 166,000 tonnes were from inland fisheries, and the rest (73%) were marine, of which nearly 300,000 tonnes were caught off the coast of Sindh and 125,000 tonnes off the coast of Balochistan. The marine fishery is heavily dependent for its productivity upon the mangroves of Sindh and Balochistan, which are breeding and nursery grounds for many marine commercial species. Inland fisheries in the lakes and rivers are locally important, with a strong emphasis on promoting aquaculture.

Table 1: Distribution of different types of wetlands in Pakistan

(Source: PWP/WWF Pakistan)

	Type of wetland																		
Provincial representation	Glaciers	Alpine lakes	Springs and streams	Rivers		Lowland natural lakes		Small dams	Large reservoirs	Barrage headponds	Canals irrigation & drainage works	Rice paddy	Urban wetlands	Peat swamps	Marshes	Coastal wetlands			
				cold water	warm water	freshwater	brackish									Mangroves	Estuaries	Beaches	Coral reefs
Northern Areas	■	■	■	■				■			■	■		■					
AJK	■	■	■	■							■	■		■					
FATA			■		■			■				■							
Federal			■		■			■	■				■						
NWFP	■	■	■	■	■			■	■		■	■	■		■				
Punjab			■		■	■	■	■		■	■	■	■		■				
Balochistan			■		■	■	■	■			■	■				■	■	■	■
Sindh			■		■	■	■	■		■	■	■	■		■	■	■	■	

The wetlands of Pakistan lie on one of the principal bird migration routes, the Indus Flyway; many thousands of ducks and wildfowl use the wetland systems – alpine lakes, lowland lakes, barrages and rivers and marshes as staging points in their migrations, and for wintering. Without this wetland network many species would be unable to complete their annual migrations. Wildfowl and other resident bird species provide local food source for communities living around the wetlands. The catchment areas of wetlands also provide game-both mammals and birds that are widely hunted.

Rice is a key agricultural product for Pakistan; rice paddies are important seasonal wetlands that depend upon the health of the water and wetland network for their productivity. Pakistan has about 17 million ha of irrigated farmland that can be considered as seasonal wetlands.

Fresh water storage and retention of water for domestic, industrial, and agricultural use: The efficient storage and retention of water for water supply, and for industrial and agricultural use is critical in an arid country like Pakistan. As Pakistan is moving into a situation of water deficit and without its wetland resources, the man-made storage reservoirs, and natural lakes and marshes, providing water storage would be very difficult.

Fiber and fuel production of logs, fuel wood, peat, and fodder: The riverine forests and mangroves provide timber and fuel wood for local communities. The mangroves of Sindh and Balochistan provide fodder for camels and other livestock. The peat lands in the north represent a fuel source that has yet to be exploited. Grasses and reeds are the basic resource of cottage industry.

Regulation of services

Climate regulation – wetlands as a source and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes: Wetlands are a major feature in climate regulation processes as one of the major pools of sequestered carbon hence the degradation and loss of wetlands would seriously increase greenhouse gas emissions. Large water bodies and forested areas also have a cooling effect upon local climate reducing temperatures and increasing humidity and precipitation – an attribute that is important in the hot dry climate of Pakistan.

Water regulation (hydrological flows) and groundwater recharge / discharge: Glaciers are receding globally, especially the Himalayan glaciers. Glaciers in the Karakorum and Himalayas provide more than 70 percent of the water in the Indus River. Glacial area has dropped by 35-50 percent since the 1930s and hundreds of small glaciers have already vanished. The Indus is critical to Pakistan's food and water security. The hydrological flows in the Indus are

critical for the well being of Pakistan as a whole. The degradation of the Indus Delta ecosystem resulting from increased abstraction upstream illustrates the dependence on flows of the Indus.

Water purification and waste treatment retention, recovery, and removal of excess nutrients and other pollutants: The natural biological processes in rivers breakdown and carry away organic pollution from domestic and industrial wastes. Marshes and swamps may be most effective at pollution control. Gross pollution from untreated wastes however, does not allow the natural systems to recover, resulting in severe degradation of many water courses and wetlands. Many of Pakistan's rivers and coastal wetlands are grossly polluted and contaminated from the wastes of major cities with resulting degradation, and loss of biodiversity and productivity.

Erosion regulation, retention of soils and sediments: Wetlands slow down the flow of water through a catchment, trap sediment and reduce erosion. Sediments fill up reservoirs and dams, reducing the useful life of such dams. Marshes and swamps are effective collectors of sediments. Riverine forests assist in stabilizing river banks and reducing bank erosion during floods.

Natural hazard regulation, flood control and storm protection: The role of mangrove forests and coastal wetlands in providing storm and tsunami protection is increasingly being recognized. Wetlands are used for flood control – floodplains and marshes provide an escape for floodwaters, holding them back and reducing the flood intensity. Urban wetlands reduce the impacts of flooding in cities, absorbing floodwaters. Wetlands also help groundwater infiltration.

Pollination habitat for pollinators: Bees and other insects provide important pollination services. Wetland areas, such as mangroves, are an ideal situation for apiculture, with specialist mangrove honey attracting high prices. Other insects abound in wetland areas, and their loss may affect neighbouring agricultural areas.

Cultural significance

Spiritual and inspirational source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems: Spiritual and religious attributes, with shrines of Pirs and other religious leaders are linked to some coastal and wetland areas. Kallar Kahar Lake in the Salt Range has shrines, and archaeological and historical features that attract visitors. Mythological stories are also attached to some wetlands, e.g. Saiful Malook and Shangri La. These attract pilgrims and visitors during festivals.

Recreational opportunities: Lakes, beaches, rivers and streams are important recreational sites, especially in an arid climate. The recreational values of Kallar Kahar Lake in the Salt Range, wetlands in the northern mountainous

areas, Haleji and Keenjhar Lakes in Sindh, and the Karachi coastline are important tourist attractions.

Supporting natural systems

Soil formation, sediment retention and accumulation of organic matter: The natural progression of lakes and marshes gradually filling up as sediment accumulates, drying and forming valuable land suitable for agriculture is well recognized, although encroachment of wetlands often preempts this process. Mangrove areas also allow the accumulation of estuarine and coastal sediments, causing a progression of deltas, and reducing coastal erosion.

Nutrient cycling storage, recycling, processing, and acquisition of nutrients: Wetlands accumulate nutrients and help to remove them from building up in free-standing and flowing waters where they can become problematic. Too high nutrient levels can cause eutrification, algal blooms in both fresh and marine waters, sometimes causing fish kills and problems with water supply. Agricultural run-off with high fertilizer content and nutrients are a potential issue; wetlands perform a useful function in reducing the risk of such problems.

Management of Wetlands

The wetlands in general have dual management regimes. Management normally rests with the ownership. The agency/organization that owns the land has the say in management. Many wetlands have been given the conservation status i.e. i)Wildlife Sanctuaries---Haleji, Keenjhar, Hub in Sindh; Taunsa, Chashma in Punjab; Tanda in KPK, ii) National Parks---Patisar lake-Lal Suhanrs NP in Punjab; Alpine lakes in Deosai NP in GB, and iii) Game Reserves---Rasul, Uchhali, Jahlar in Punjab; Thanedar wala in KPK; and Zangi Nawar, Band Khushdil Khan in Balochistan. The management of these wetlands as Conservation areas therefore remains secondary.

Management by different agencies with various jurisdictions in river basins and coastal areas, some with conflicting or duplicating mandates, constrains ecosystem management at that level. Strategically the most important federal agencies in the context of conservation and wise use of wetlands are, IRSA, NCCW, Pak EPA, Water Section & Environment sections of Planning and Development Division, Environment Directorate General of WAPDA, Marine Fisheries Department. At the provincial level the wildlife and fisheries departments, Environmental Cells in PIDAs, provincial EPAs, Water and Sanitation agencies are most important.

Jurisdictional overlaps and inconsistencies are common. At least three to four agencies (WAPDA / irrigation or small dams/ fisheries/ wildlife) manage the respective resources of some wetlands without shared understanding, jointly developed management plans or action plans and with little coordination. The

national or the sub-national administrative authorities do not have adequate powers and human, technical and financial resources to implement wetland conservation and wise use programmes, if there are any. The procedures do not exist for coordination within agencies managing wetlands and cross-sectorally between different relevant agencies.

The priority of water and power agencies, fisheries departments and tourism organizations is development oriented, without considering the needs of environment in general and wetlands in particular. The wildlife agencies are reacting to problems to avoid adverse impacts, rather than developing forward-looking wetland management initiatives.

ISSUES/THREATS

Water availability

Reduced and irregular water availability throughout Pakistan is amongst the major causes of wetland loss and degradation. The wetlands will disappear without adequate water supply. Almost all wetlands in Pakistan face water availability issues that include climate change, flood and drought, watershed management, demand for water, environmental flows, and hydropower developments:

Climate change is one of the biggest threats to water availability for wetlands, since increasing temperatures will increase the rate of glacier shrinkage. In the short term there could be an increase in flows available in the Indus system as the glaciers melt, even to the extent of increased risk of flooding. In the longer term, because of reduced glaciers there could be less water available for alpine lakes and the Indus River and its wetlands. Climate change is likely to increase climate variability – high rainfall and storm events will become more frequent. Climate change threatens to decrease water availability in Pakistan as a whole.

Flood and drought: In the years 1998 to 2004 there was a prolonged drought in Sindh and Balochistan caused mainly by the erratic rainfall. There is a natural variability of rainfall in Pakistan, such that prolonged periods of low rainfall in some years lead to drought conditions whereas flood conditions can occur when there is heavy localised rainfall, or flash floods in a watershed. Floods can wash out wetlands, cause damage to river banks and riverine forests, and cause erosion and increased sediment transport.

Watershed management issues: Unwise land use in watersheds has led to increased run-off of rainfall and soil erosion throughout many parts of Pakistan. The rainwater flows more rapidly into the rivers and flooding has increased. The recharge of groundwater may be impaired since the rain water has less chance to infiltrate. In some watersheds there has been a tendency to build larger water storage dams, e.g. in Balochistan[2], when smaller dams might

be more effective. Reforestation of the denuded hillsides, proper land use practices and improved water harvesting through check dams and constructed wetlands to improve infiltration are the measures to improve watershed management.

The demand for water: There is an ever growing demand for water throughout the country for domestic supply to the expanding cities, for industry and especially for agriculture. There is already severe water scarcity in Pakistan due to over extraction of water for agriculture, leading to saline intrusion in the Delta. In 1995, the Indus River supplied only 830 m^3 water/person/year compared to the UN minimum of 1,000 m^3/person/year.[3] Many natural wetlands in Sindh are becoming more water depleted illustrating the impact of water demand upon wetlands. Haleji Lake, a Ramsar site, is losing its value as a sanctuary for migratory water birds as a result of water shortages, sedimentation, spread of aquatic vegetation, and loss of the wetland.

Environmental flows: There is a requirement for minimum water in rivers and streams, lakes and marshes and in groundwater; without these wetland ecological services and benefits will be lost. Such ecosystem requirements for water are often overlooked, with statements that all water available in the country should be put to "productive use". However, the loss of these services – providing, regulation, cultural and supporting – would be as disastrous as the direct shortage of water. Optimum freshwater flow is required in the Indus Delta, *and for that matter below Kotri Barrage as well*, to maintain the delta ecosystems e.g. mangroves, fish nursery and breeding grounds and protection against storm and tsunami. Ensuring environmental flows at all levels- including river flows downstream of large and small dams, requires a change in awareness about ecosystem requirements for water.

Hydropower developments: Large hydropower dams like Tarbela and Mangla threaten wetlands because of the changes in the river flow that they produce. The construction of a dam impounds the water upstream creating a man-made lake that has different biota and productivity. The flooding of areas upstream of the dam irrevocably changes the nature of any unique wetlands there. The operation of hydropower dams changes daily and seasonal flows of water downstream, impacting the fish and other aquatic life in the river, especially if there are migratory species, and the livelihoods of the people that depend upon them. Flooding of large areas, resettlement of large number of people, and the potential loss of water for downstream areas are the major concerns. The stretch of river between Tarbela and Ghazi Barotha hydropower plant has been converted from a major river to only a seasonal wetland as a result of water diversion.

Water quality

Change in water quality caused by pollution can adversely affect wetlands causing a loss in biodiversity and productivity. Several forms of water pollution may include:

Organic pollution: The discharge of organic matter into water bodies, untreated domestic sewage, livestock wastes, food and drink processing, textiles, tanneries etc., results in the depletion of dissolved oxygen. Reduced dissolved oxygen levels in the water result into difficult conditions for different forms of aquatic life. Eventually the water becomes anaerobic, foul smelling and severely degraded, with only specialised forms of life. Most industrial waste waters are discharged untreated into the rivers and thence into the coastal zone. A considerable portion of the solid waste garbage is dumped informally in drains, streams, rivers and creeks.

Bacterial pollution: The discharge of untreated sewage carries high levels of pathogenic bacteria into the waters. Surface and ground waters can become contaminated and threaten drinking water supplies. Contaminated ground water can infiltrate into leaky water supply pipes. Gastrointestinal diseases caused by poor drinking water quality are one of the biggest causes of disease and infant mortality in Pakistan.

Chemical pollution: Industries use many chemicals in their production processes, which are often discharged in the waste waters. These may include heavy metals, e.g. chromium from tanneries and metal plating, lead from car batteries. Many metal ions, when dissolved in water are very toxic to aquatic life and can poison water bodies, sometimes permanently. Mud and sediments may accumulate these toxic materials and release them when they are disturbed through dredging or floods, giving rise to fish kills. Other inorganic wastes may include arsenic or cyanide, or complex organic compounds such as PCBs (polychlorinated bi-phenyls) which are very highly toxic and can accumulate in the food chain. Industrial pollution has caused losses is fish production in rivers and natural flowing inland water streams, and both the coastal areas of Sindh and Balochistan and in the Central Indus wetlands.

Agricultural chemicals: Agricultural chemicals – herbicides and pesticides find their ways into irrigation drainage channels and thence into water bodies. As the contamination comes from “non-point” sources, it is difficult to control. The Right Bank Outfall Drain discharges directly into Manchar Lake, carrying with it both a mixture of agricultural chemicals and nutrients. This affects the suitability of the Lake for water supply and also pollutes the Indus when surplus water from the lake joins it after the floods.

Nutrients: Nitrates and phosphates are used in inorganic fertilisers on most agricultural lands to increase crop yields. All the nutrients are not absorbed by the growing crops and a significant proportion gets washed down into drainage canals and into rivers, lakes and streams. In natural water bodies, the buildup of nutrients can become a problem giving rise to algal blooms, which then die and decay imposing a heavy oxygen demand on the water leading to

massive fish kills. Eutrophication is a problem in a number of water bodies, especially those receiving agricultural run-off, for example the freshwater lakes in Sindh – Kheenjar, Manchar and Haleji, and Patisar and Taunsa in Punjab.

Salinity: The discharge of saline waters into freshwaters seriously impacts upon the water quality and the biodiversity of the water body. Some areas of Pakistan have naturally high salinity, e.g. in the Salt Range where water bodies are naturally saline. Irrigation without adequate drainage has also given rise to high salinities in the soils, which may be washed into freshwater lakes and rivers. Flow of effluents into Manchar, and the passage of Left Bank Outfall Drain close to the wetland in lower Sindh is also affecting the wetlands.

Oil pollution: Although usually seen as a marine and coastal issue, oil pollution can occur in any body of water where oil is released e.g. from vehicle maintenance. Even a small quantity of oil on the water surface can stop aeration and reduce dissolved oxygen. Certain elements in oil are also toxic to aquatic life. In marine and coastal areas, the issue may be much larger because of the quantities of oil being carried by tankers. Generally oil spillage is relatively commonplace but small scale. In July 2003, the Tasman Spirit, a tanker containing 67,500 tonnes of light crude oil grounded in the KPTs navigational channel, spilled an estimated 37,000 tonnes. Oiling was recorded along Clifton Beach, Oyster Islands and inside Karachi Harbour and China creek. Ballast waters, carried by cargo ships, may also contain oil and other wastes, and are sometimes discharged into the coastal areas, although KPT and Port Qasim have regulations and procedures for controlling the discharge of ballast.

Table 2: Matrix showing the key ecosystem services associated with different types of wetlands in Pakistan

Key Ecosystem Services	Type of wetland																		
	Glaciers	Alpine lakes	Springs and streams	Rivers		Lowland natural lakes		Small dams	Large reservoirs	Barrage headponds	Canals irrigation & drainage works	Rice paddy	Urban wetlands	Peat swamps	Marshes	Coastal wetlands			
				cold water	warm water	freshwater	brackish									Mangroves	Estuaries	Beaches	Coral reefs
Provisioning																			
Food production of fish, wild game, fruits, and grains																			
Fresh water storage and retention of water for domestic, industrial, and agricultural use																			
Fiber and fuel production of logs, fuelwood, peat, fodder																			
Biochemical extraction of medicines and other materials from biota																			
Genetic materials genes for resistance to plant pathogens, ornamental species, and so on																			
Regulating																			
Climate regulation source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes																			
Water regulation (hydrological flows) groundwater recharge/discharge																			
Water purification and waste treatment retention, recovery, and removal of excess nutrients and other pollutants																			
Erosion regulation retention of soils and sediments																			
Natural hazard regulation flood control, storm protection																			
Pollination habitat for pollinators																			
Cultural																			
Spiritual and inspirational source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems																			
Recreational opportunities for recreational activities																			
Educational opportunities for formal and informal education and training																			
Supporting																			
Soil formation sediment retention and accumulation of organic matter																			
Nutrient cycling storage, recycling, processing, and acquisition of nutrients																			

Key Role	
Minor role	

Land use change

Land use change is the main cause of loss of large areas of wetland throughout Pakistan, coming about mainly through the conversion of wetlands into agricultural land, both in large scale irrigation schemes, and through smaller encroachment on wetland areas by individual farmers, clearing and draining them to make them suitable for agriculture. Expansion of agricultural area is a common practice in the Indus Plains. The riverine forests have been cleared for agriculture especially in Sindh. Shrinking Indus floodplains, due to water abstraction, are also encroached for agriculture progresses. The wetlands are also threatened by urban and industrial developments e.g. Karachi, central Punjab cities and towns, and the mountainous areas like Murree.

Key development projects affecting wetlands include irrigation schemes, hydropower dams and reservoirs, thermal and nuclear power stations, and any industrial developments that require abstraction of large volumes of water or discharge of waste waters.

Land use changes occur in watershed areas, through deforestation for the supply of fuel wood and timber, and for conversion of land for agricultural purposes leading to increased run-off and soil erosion, with higher sediment loads in the rivers, and increased sedimentation in reservoirs and lakes. Widespread deforestation has caused substantial losses of wetlands habitat through siltation.

Overexploitation of natural resources

The natural resources within the wetlands, the vegetation, mammals, birds and fish are all under pressure. Floating and emergent vegetation may be excessively extracted for fuel and grazing or to support industries such as rope, basket, mat and blind making. Overgrazing with too many livestock, beyond their carrying capacity, degrades the wetlands e.g. the Salt Range lakes and the Alpine lakes where the land around has become degraded and barren. Livestock also add organic pollution to the water.

Hunting, especially for animals, and shooting of migratory waterfowl is traditional both for sport for the elites and subsistence for rural people. Over-exploitation of these mammals and birds reduces the populations. Fishery resources are being depleted because of fishing pressures combined with other environmental pressures. Fishing pressure also includes the use of explosives, inappropriate nets, net material or netting techniques, over extraction of juvenile life forms, unacceptably high by-catch levels and failure to observe prescribed seasonal and species-specific restrictions.

Tourism is the non-consumptive use of wetlands resources. Sustainable tourism can bring important revenues for wetland management, but increased

tourism pressures can have serious water pollution impacts, disturbance of wildlife and degradation of the wetlands.

Invasive Alien Species such as mesquite (*Prosopis juliflora),* water hyacinth *(Eichhornia crassipes)*, kariba weed or water fern *(Salvinia molesta),* and water cabbage (*Pistia stratiotes)* also affect biodiversity and the ecological character of wetlands.

Social threats

Population increase (177 million people in Dec 2009) has also put pressure upon land and water resources, raising the demand for water and productive land, and for all forms of wetland natural resources. The value of land in urban areas is often so great that it makes it worthwhile for landowners near wetlands to encroach upon them, filling in wetland edges and building upon them, even if this is illegal. Once encroachment has occurred, the wetland is damaged irreparably. No natural values of wetlands can compete with the potential land values, so economic justifications for wetland conservation are useless in this context.

Development pressures on wetlands inevitably displace traditional users. The fishermen are often most at risk from large scale development of the coastal areas, but there has been evidence of protest and social unrest at the displacement of some fishing communities in Karachi. Social unrest may also occur over water resources with the increased water demand.

Lack of awareness is probably the biggest issue facing wetlands conservation. People do not generally know about wetlands, why they are important and what threatens them. They are not aware of what they will lose if the wetlands that they enjoy or use will be lost. If they are not aware of the value of the wetlands, they will make little effort to protect them, not to pollute them, and they will not protest if they are encroached or developed.

Legal and policy shortcomings

Wetlands have not specifically been covered under national or provincial policies and legislation and need to be included in the future revisions and a specific policy must be enunciated to safeguard the future of wetlands keeping in view the services rendered by different kinds of wetlands and to address the issues as outlined above.

Addressing the Issues

An analysis of issues and threats leads to the following shortcomings:

1. Legislation and policy issues;
2. Absence of decision-making tools and reliable data base to support effective wetlands conservation planning;

3. Technical deficiencies related to capacity, skills and equipment; and
4. Lack of general public awareness or political will favouring wetlands conservation.

Few comprehensive decision support systems or management tools are available for regional resource planning. Base data for the management is extremely short and needs to be gathered. The scope of the GIS facilities is being improved at Pakistan Forest Institute Peshawar, National Council for the Conservation of Wildlife at Islamabad and WWF-P at Lahore to gather data on biodiversity or socio-economic conditions in wetlands and their buffer zones. Technical capacity in almost every aspect of wetlands management needs to be enhanced for scientific and specialised wetlands management training, appropriate equipment and exposure to international approaches to wetlands management. The Pakistan Wetlands Action Plan, 2000, was never implemented due to the lack of a comprehensive Wetlands Management Strategy, policy formation, coordination and management of wetlands at a national scale. Financial sustainability has also not been fully explored without which long-term initiatives in biodiversity conservation have not been addressed.

Conservation activities have been limited to partial enforcement of resource use regulations. Some community-based biodiversity management initiatives had been supported elsewhere by the appropriate agencies in GB, KPK and Sindh, not specifically to the wetlands. Biodiversity monitoring of wetlands has been adequate, limited only to some short-term conservation initiatives, with the active involvement of some donors and conservation organisations. Significant activities comprised of a programme for the rescue of Indus Dolphins stranded in irrigation canals during the dry season in Sukkur barrage canals and support for eco-tourism initiatives on the Indus River, conservation of endangered Green Turtle (*Chelonia mydas*) and the rehabilitation of mangroves, monitoring of waterfowl, Punjab Urial populations and some limited community-based ventures, mainly related to environmental awareness.

Through a GEF / Netherlands funded “Pakistan Wetlands Programme” being implemented by WWF, the following interventions are being made:

- National level coordination for the conservation of wetlands biodiversity in Pakistan is being provided by establishing sustainable institutions.
- Comprehensive, current wetlands information is being generated through tools utilising spatial and other data from the Wetlands GIS Database to help planning and land-use decision-making of wetlands conservation.

- A National Wetlands Conservation Strategy (NWCS) is being developed.
- Technical competence of government agencies and NGOs is being enhanced through comprehensive training and capacity building programmes.
- A nation-wide awareness campaign is underway.
- Long-term sustainability of wetlands, conservation initiatives have been developed and adopted.
- Management Plans are being developed for sustainable development of important wetlands in the country.

Besides WWF other organisations, like IUCN Pakistan, in collaboration with Government agencies responsible for the conservation of wetlands are undertaking conservation oriented actions like rehabilitation of mangroves in the Indus Delta, and the development of the National and Provincial Conservation Strategies.

Other management authorities including WAPDA, Punjab Irrigation Department, the Wildlife Departments, the Fisheries Departments and the EPAs also have interests in conservation activities for wetlands, but these are largely marked by a lack of coordination and awareness about what each is doing.

The following broad actions are suggested to address the issues:

Comprehensive wetland conservation policies: Development and implementation of wetland conservation and management policies and strategies at federal, provincial levels and in federally administered regions in water, energy and natural resource-based sectors and industries, harmonised with existing sectoral policies, and included in land and water-use policies.

Co-operation with national and international jurisdictions: Establishment of a National Wetlands Committee and provincial wetland committees with a comprehensive mandate to foster co-operation for the conservation of wetland resources and biodiversity and Supporting international environmental conservation initiatives and treaties, e.g. Ramsar Convention on Wetlands, the Convention on Biological Diversity, and the Convention on Migratory Species, World Heritage Convention and the programmes of BirdLife International, IUCN, IWMI, Wetlands International and WWF.[4]

Wetland data management: Establishment of standard national approaches to wetland classification, inventory and data integration, a comprehensive national data-base on the location and status of wetlands, national wetlands status and trends survey on a regular basis.

Research and Training in Wetland Sciences: Development and improvement of existing facilities of research and training related to wetland sciences including research methodologies, processes and tools for data collection on key biodiversity components and human resource development.

Wetland conservation and management: Initiation of support programmes to secure wetland habitats, establishment of a national network of protected wetland areas, prioritising wetlands for targeted conservation objectives, encouraging collaborative wetland management, and developing the capacity of local communities and wetland users to participate in the conservation, management and sustainable use of specific wetland areas, conduct of the EIAs on all development programmes related to wetlands and wetland based communities, and addressing issues of water pollution affecting specific wetlands.

Awareness and education of people on the value of wetlands: Establishment of a comprehensive national wetland education and awareness campaign through innovative technologies in co-operation with all governments and the non-government and private sectors, highlighting the economic, social and beneficial functions and values provided by the wetland ecosystems.

Financial mechanisms for wetland conservation and sustainable use: Secure appropriate budgets for wetland conservation and management within national and provincial government agencies, seeking support from international and national sources of funding, and development of appropriate financial mechanisms for supporting wetland conservation and sustainable use, based on concepts such as “polluter pays principle” and “payment for environmental services”.

ANNEX

The Ramsar List of Wetlands of International Importance in Pakistan

19 sites; Surface area 1,343,627 hectares

S. No.	Ramsar site	Province	Area (ha)	Protection status
1	Astola (Haft Talar) Island	Balochistan	5,000	
2	Chashma Barrage	Punjab	34,099	Wildlife Sanctuary
3	Deh Akro-II Desert Wetland Complex	Sindh	20,500	Wildlife Sanctuary
4	Drigh Lake	Sindh	164	Wildlife Sanctuary
5	Haleji Lake	Sindh	1,704	Wildlife Sanctuary
6	Hub (Hab) Dam	Sindh, Balochistan	27,000	Wildlife Sanctuary

S. No.	Ramsar site	Province	Area (ha)	Protection status
7	Indus Delta	Sindh	472,800	Includes Wildlife Sanctuaries
8	Indus Dolphin Reserve	Sindh	125,000	
9	Jiwani Coastal Wetland	Balochistan	4,600	
10	Jubho Lagoon	Sindh	706	
11	Kinjhar (Kalri) Lake	Sindh	13,468	Wildlife Sanctuary
12	Miani Hor	Balochistan	55,000	
13	Nurri Lagoon	Sindh	2,540	
14	Ormara Turtle Beaches	Balochistan	2,400	
15	Runn of Kutch	Sindh	566,375	Wildlife Sanctuary
16	Tanda Dam	Khyber-Pukhtunkhwa	405	Wildlife Reserve
17	Taunsa Barrage	Punjab	6,576	Wildlife Sanctuary
18	Thanedar Wala	Khyber-Pukhtunkhwa	4,047	Game Reserve
19	Uchhali Complex (including Khabbaki; Uchhali and Jahlar Lakes)	Punjab	1,243	Wildlife Sanctuary; Game Reserves