

Site Management Plan Taunsa Barrage Wildlife Sanctuary



"Mystical Morning" Taunsa Barrage, Punjab
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A part of
**Central Indus
Wetlands Complex**



April 2011

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List of Acronyms and Abbreviations

| | |
|--------------|--|
| BOD | Biological Oxygen Demand |
| CBD | Convention on Biological Diversity |
| CBO | Community Based Organisations |
| CCB | Community Citizen Board |
| CIWC | Central Indus Wetlands Complex |
| CITES | Convention on International Trade in Endangered Species of Flora and Fauna |
| COD | Chemical Oxygen Demand |
| CZA | Central Zoo Authority |
| DDT | Dichloro Diphenyl Trichloroethane |
| EC | Electrical Conductivity |
| EPA | Environment Protection Agency |
| EU | European Union |
| FAO | Food and Agricultural Organisation |
| GCA | Gharial Conservation Alliance |
| GIS | Geographic Information System |
| IUCN | International Union for the Conservation of Nature |
| MoE | Ministry of Environment |
| NCCW | National Council for Conservation of Wildlife |
| NEQS | National Environment Quality Standards |
| NRSP | National Rural Support programme |
| NTFP | Non Timber Forest Products |
| PA | Protected Area |
| PCRET | Pakistan Council for Renewable Energy Technology |
| PDDC | Punjab Dairy Development Council |
| PMNH | Pakistan Museum of Natural History |
| PRA | Participatory Rural Appraisal |
| PWP | Pakistan Wetlands Programme |
| PVA | Population Viability Analysis |
| RAPPAM | Rapid Assessment of Priority Protected Areas Management |
| Sp. | Species |
| TDS | Total Dissolved Solids |
| TRAFFIC | Wildlife Trade Monitoring Network |
| TSS | Total Suspended Solids |
| UN | United Nations |
| UNCCD | United Nations Convention on Combating Desertification |
| UNFF | United Nations Forum on Forest |
| VWCC | Village Wetlands Conservation Committee |
| WHO | World Health Organisation |
| WWF-Pakistan | World Wide Fund for Nature – Pakistan |
| ZSD | Zoological Survey Department |

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Dr. Masood Arshad

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1.0. Introduction

1.1. Why are wetlands important?

Wetlands are often significant for their ecological, hydrological, social and economical values. Functioning wetlands can be a critical part of the environment as they support a high level of biological productivity and diversity, provide habitat for *flora* and *fauna* including rare and threatened communities and species, maintain local and regional hydrological regimes, remove nutrients and pollutants, act as stores for rain and flood waters and support human activities and values.

1.2. Wetlands of Pakistan

Pakistan is hosting more than 225 significant wetlands of diverse nature and environment ranging from marine habitats to snow deserts of Himalayas and Karakorum; these wetlands are seasonal and permanent, covering about 9.7% of land surface. The country has 19 internationally recognised Ramsar Sites (Fig. 1) so far that are of great ecological significance, supporting unique habitats and associated biodiversity. Beside these, about 134 million human beings are benefited from these different types of wetlands (Fig. 2).

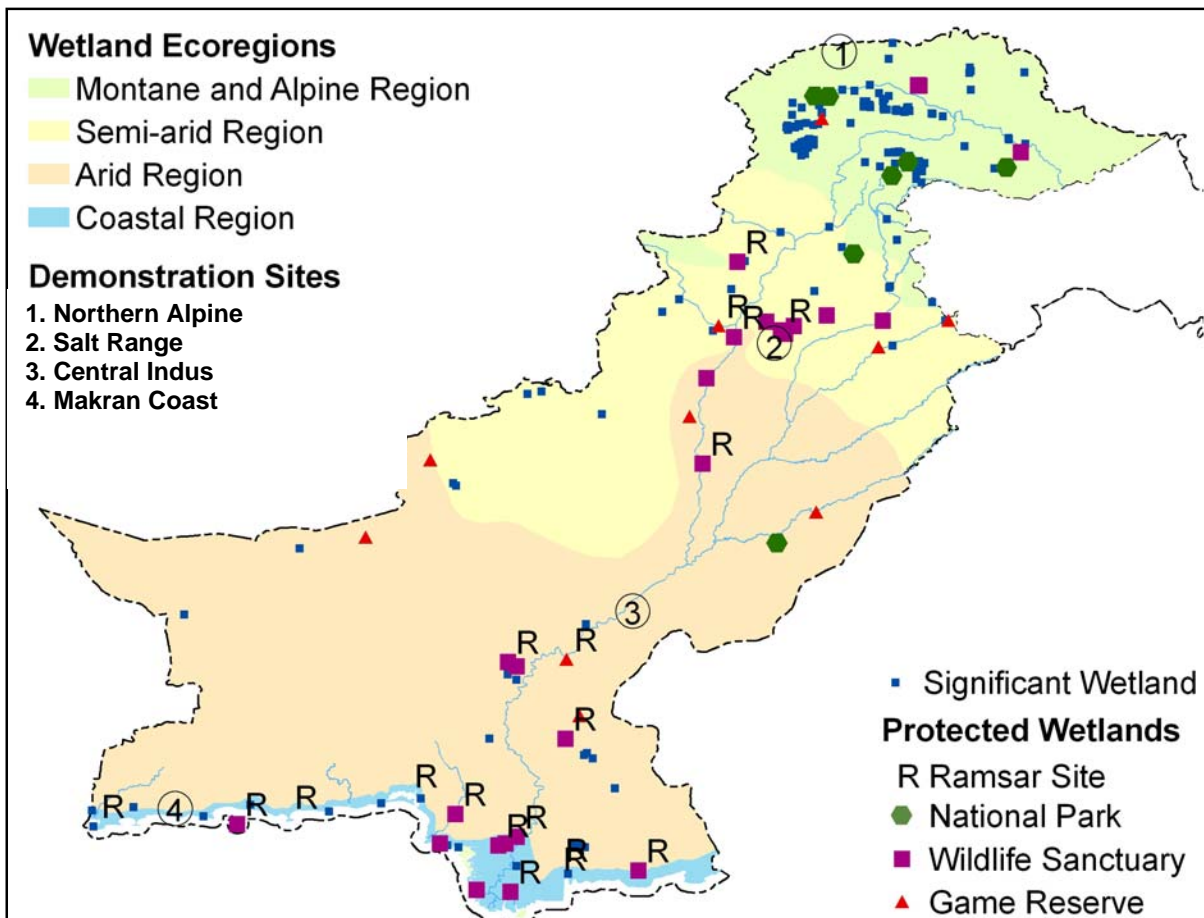


Figure 1. Distribution of Significant Wetlands, Wetlands Eco-regions and Ramsar Sites of Pakistan. R denotes Ramsar Sites (19 in number).

1.3. National and global environmental context

Geographical location and boundary of Pakistan, regardless of its small size, represents a large variety of ecological conditions and is characterised by nine major ecological zones.

Three major ecological realms such as *Indo-Malayan*, *Palaeartic* and *Ethiopian* (African) amalgamate in the country and support the biodiversity of all these ecological regions. Pakistan is an arid country, which was once water sufficient but now it has become a water scarce country and if same situation prevail it may be included in the list of water deficit countries. The wetlands are one of the main sources of water for human such as agriculture, domestic use and for industrial purposes. These wetlands also provide habitat to a range of wetlands biodiversity which is of great economic value to human being and is directly related to the livelihoods of the dependent communities. The plenty of wetlands is crucial to dilute the flood intensity and infrastructure losses in addition to their importance to govern the agriculture-based economy of the country. These wetlands are of immense ecological importance for their unique ecosystems which are supporting the biodiversity of international concerns. About eighteen threatened wetlands dependent mammal species are found in the country including endemic Indus River Dolphin (*Platanista minor*) and the Punjab Urial (*Ovis vignei punjabiensis*). These habitats are host to 20 threatened bird species; 12 reptiles; 2 endemic amphibian species; and 198 freshwater including 15 endemic, and 788 marine and estuarine fish species.

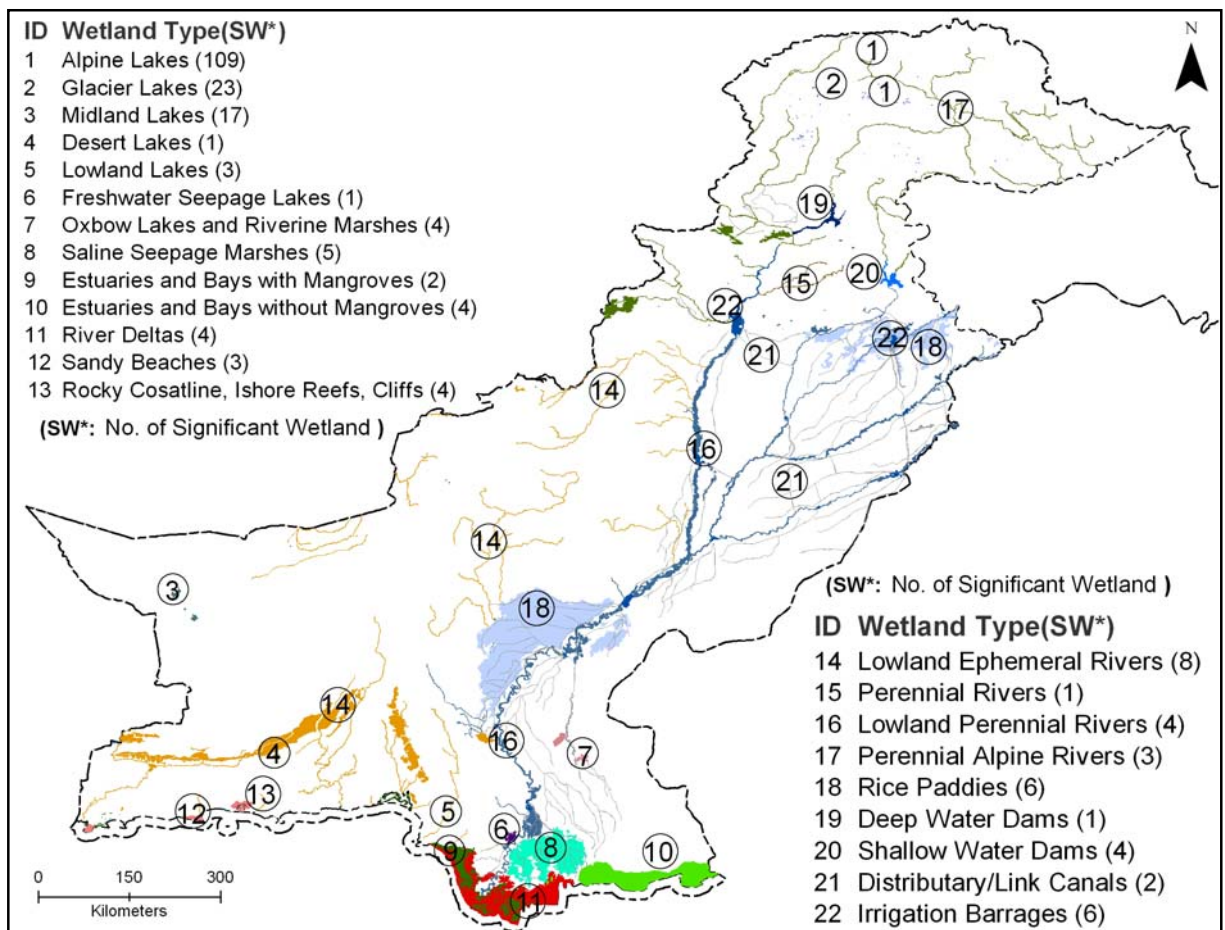


Figure 2. Wetlands Types of Pakistan

1.4. Issues and problems of the wetlands in Pakistan

Pakistan's wetlands and associated *flora* and *fauna* are facing a wide range of threats that can be categorised into three major groups; (1) **Unsustainable anthropogenic use of wetlands**: these activities include the over-exploitation of wetlands resources such as destructive fishing practices, over-harvesting of wetlands vegetation, over-grazing and illegal hunting of birds, mammals and reptiles. (2) **Physical changes to wetlands on an**

ecosystem level: land reclamation, deforestation, expansion of agricultural fields in the close vicinity of wetlands and over-grazing are causing much severe structural threats to wetlands. (3) **Off-site activities that cause physical and chemical changes to wetlands:** these are practices that do not take place directly on or around wetlands and carried out in some other locations but they have significant impacts on wetlands. Threats of this category include the changes in water volume like water flow and water pollution.

1.5. Gaps and weaknesses in the Policy Environment / Legislation

Pakistan has a difficult policy environment. This is particularly true of policy level interactions and planning interventions associated with environmental protection, conservation, or recognition of poverty-environment linkages. However, the situation is changing. In recent years, the Government of Pakistan have initiated policy and planning measures to rectify the situation. However, appropriate institutional design remains missing particularly in terms of delineation of authority, adequate resource provision (human, physical, financial) and accountability mechanisms. The Government of Pakistan has through the Poverty Reduction Strategy Paper and the 10th 5-year Development Plan, also known as the 'People's Development Plan' (formerly the Medium Term Development Framework 2005- 2010) attempted to integrate environment in its long-term planning documents. However, this recognition of the importance of conservation and the value of environmental sustainability remains restricted to specific sectors such as agriculture, water, pollution, and forest (and associated natural resources). The activities and programmes proposed in these documents fail to make the link with appropriate poverty environment indicators and present a fractured image of state level natural resource management.

Policy documents such as the National Conservation Strategy (1992), the National Environmental Action Plan (2001), the National Environmental Policy (2005) and the proposed National Water Policy play an important role in describing the state's perspective on environment and natural resource management. They provide a roadmap for future policy and practical engagements. However, concrete impacts of these policy documents, the actions and planning trajectories they outline remain nebulous.

The Government of Pakistan is party to 5 natural resource related Conventions i.e. Convention on Biological Diversity (CBD), UN Convention to Combat Desertification (UNCCD), Convention on Migratory Species, Ramsar Convention on Wetlands, and Convention on International Trade of Engendered Species of Wild Fauna & Flora (CITES). In addition to these Conventions, Pakistan is also an active party to UN Forum on Forests (UNFF). While at the federal level, there is some awareness and understanding of the obligations, duties and opportunities emanating from these agreements but at the provincial and district levels, stakeholders, responsible for actively implementing targeted actions, collecting necessary data etc in line with these agreements remain largely uninformed.

In terms of legislation, the cornerstone of Pakistan's environmental legislation is the Pakistan Environmental Protection Act of 1997. The Act works under the presumption of environmental federalism wherein it creates the authority for the delegation of environmental management functions and powers to Environmental Protection Agencies at the provincial level. The provincial governments, in turn, have the authority to further delegate these powers. They also have the scope to adopt more stringent environmental regulations rather than adopt the bare minimum of standards and engage in a race to the bottom. The presumption of environmental federalism is further supplemented by the Local Government Ordinance of 2001. The Ordinance promotes responsibility and accountability at the local level and was designed to engage citizens in public political life from the smallest unit of government – the Union Council.

While the benefits of environmental federalism are plentiful, its application in Pakistan remains challenging on two fronts. First, the Pakistan Environmental Protection Agency remains charged with developing appropriate oversight and monitoring guidelines for the

functions and activities of all provincial environmental protection agencies. Second, the Pakistan Environmental Protection Agency is responsible for building capacity and allocating sufficient resources to provincial agencies necessary to meet their delegated responsibilities. In general terms, government institutions, ministries, departments and associated public bodies are responsible for enforcing policies and ensuring the appropriate implementation of sanctioned plans. However, in order to do this effectively, institutional mandates need to be clear and transparent and implementing bodies require sufficient human, physical, and financial resources buttressed by legislative authority. Finally, an effective and transparent accountability mechanism should exist to evaluate institutions on how effectively they meet their respective mandates and utilise their resources.

The preceding discussion holds true for the Province of Punjab. Linking environmental conservation and sustainable natural resource use, Punjab's wealth of natural resources and diversity of ecosystems is a significant part of its overall development, particularly since large rural populations is dependent on these natural resources for their livelihood. Deterioration of these natural assets such as reduction in freshwater flows, habitat destruction, deforestation, pollution, water logging and salinity may be indicative of poor natural resource management, weak enforcement of environmental protection legislation, and feeble policy actions. Both civil society and several government departments exhibit a grave lack of awareness of environmental laws and rights. While this may be attributed to the fact that environmental law is a comparatively new area in Pakistan; it should also be attributed to poor dissemination of information and outreach. One of the cross cutting issues that affect forest and wildlife management in Pakistan is the existing legal framework which does not provide incentives for the local communities and corporate sector on the one hand, and provides no scope for the adoption of emerging concepts and management innovations. Moreover, the laws are obsolete in terms of the fines levied and the penalties imposed for poaching, fishing during prohibited seasons, infrastructure development in protected areas, unsanctioned logging, encroachment on forested land and other protected areas etc.

1.6. Pakistan Wetlands Programme: concept and design

However, these precious habitats are facing severe threats of degradation due to human interference, over-exploitation and mismanagement, which demands special cure. In order to safeguard and protect these precious wetlands, the World Wide Fund for Nature Pakistan (WWF – P) in consultation with other partner organisations in the year 2000 undertook conservation initiatives, which resulted in the form of an inception of the Pakistan Wetlands Programme (PWP) in 2005.

The overall aim of the PWP is to promote wetlands conservation and their associated globally significant biodiversity through poverty alleviation of wetlands dependent human communities. In order to achieve the major aim of the project, two major set of objectives were defined:

- Create and maintain an enabling environment for effective and sustainable conservation of natural wetlands at federal, provincial / territorial and local levels through public awareness, capacity-building and identifying gaps in policy and legislation at national level;
- Implement sustainable wetlands conservation at four representative sites that will serve as replicable models for subsequent nationwide wetlands conservation initiatives through development and application of wetlands management plans;

1.7. Wetlands Complexes Management Plans

The four wetlands complexes (Fig. 3) were included in the PWP after a series of consultation with national, provincial and local stakeholders. The sites were specifically chosen to be broadly representative of prevailing conditions and typical wetlands

conservation problems in each of four separate ecological regions. These wetlands complexes include:

- Northern Alpine Wetlands Complex
- Salt Range Wetlands Complex
- Central Indus Wetlands Complex
- Makran Coastal Wetlands Complex

The major aim of each of the wetlands complex is to sustainably conserve wetlands biodiversity by designing and implementing a comprehensive management plan.

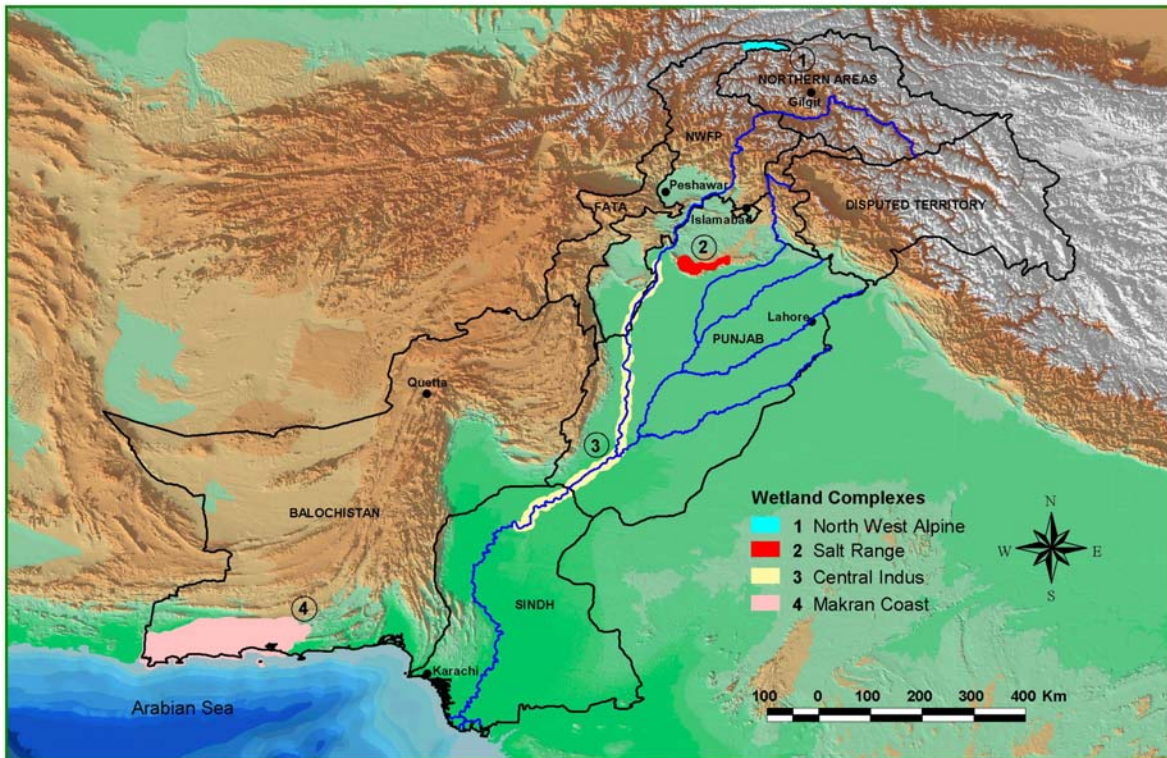


Figure 3. Four major wetlands complexes covered under Pakistan Wetlands Programme

1.8. The Management Plan Concept

The management plan is a product of the planning process, documenting the management approach, the decisions made, the basis for these, and the guidance for future management for an entire PA over a given period of time. It should contain information on what is to be achieved by management and the rationale behind the management decisions made. The management plan can be defined as:

“a written, circulated and approved document which describes the site or area and the problems and opportunities for management of its nature conservation, land form or landscape features, enabling objectives based on this information to be met through relevant work over a stated period of time” (Eurosite, 1999)

These should be succinct documents identifying key features of the site, clearly establishing management objectives based on the associated risks and threats, the number of competing interests, the level of stakeholder involvement and the associated social issues and indicating actions to be implemented. The task of preparing plans is challenging, keeping in view the multiple objectives i.e. biological and cultural, a wide array of social preferences and values, institutional structures and barriers, philosophical outlooks, forms of

knowledge and conflicting opinions. In addition, plans also need to be flexible enough to cater for unforeseen events which might arise during the duration of the Plan.

The level of operational detail to include in a management plan is a decision for the respective Department to determine. How detailed the plan should be in terms of its operational content will most probably depend on whether there are other systems set up within the Department or whether the management plan is expected to provide the detailed day-to-day guidance to the Park authority.

The need for having a management plan is emphasised by the following statement:

“If there is no general management plan; preservation, development and use activities in a Park will occur in a haphazard basis, often in response to political pressures with little consideration as to the implications for the future. This result is likely to be lost opportunities and irreversible damage to park resources and values”

1.9. Wetlands Management Plan for Taunsa Barrage Wildlife Sanctuary

Taunsa Barrage Wildlife Sanctuary is one of the hotspots identified in the Central Indus Wetlands Complex. The management plan for Taunsa Barrage Wildlife Sanctuary will consist of: Introduction to the area, details of Biophysical and Social Environment, process involved in the development of management plan, potential issues and threats, vision for the Taunsa Barrage Wildlife Sanctuary, management plan and the implementation and monitoring mechanism. The outline for this management plan have been adopted from the guidelines of Ramsar Convention of developing management plans.

2.0. Taunsa Barrage Wildlife Sanctuary

2.1. Introduction

Taunsa Barrage, situated at 31° 31' N and 70° 51' E in the south-western part of Punjab (Fig. 4) in Tehsil Kot Addu district Muzaffar Garh was built over river Indus in 1958. The canal command area fed by this barrage spreads over 44,800 km² populated by about 12 million people residing in three main districts namely Dera Ghazi Khan, Muzaffar Garh and Rajan Pur beside transferring water through Taunsa-Panjnad Link to the districts of Rahim Yar Khan and Bahawalpur. Three main canals originating from Taunsa Barrage feed the areas mentioned above namely; Dera Ghazi Khan Canal (8900 Cusecs), Muzaffar Garh Canal (8300 Cusecs) and Taunsa-Panjnad Link (12,000 cusecs).

2.2. Taunsa Barrage Wildlife Sanctuary

A Wildlife Sanctuary at Taunsa Barrage was declared during 1972 under Punjab Wildlife Act 1974. Realising the wide variety of migratory waterfowls in the area, this Sanctuary was later declared as Ramsar Site during 1996 (Khurshid & Chaudhry 1998). According to the first notification, the Sanctuary was comprised of an area of 6,567 hectares that extended almost 10km in upstream area from Barrage. Since its declaration, the Sanctuary has been re-notified many times; the last on December 10, 2004 vide Notification No. SOP (WL) 12-1/2002-II with its total area of 7,000 acres (2,834 ha), thus reducing to 43% of the original area.

Taunsa Barrage consists of a big water reservoir behind the barrage and a series of ponds and lakes between embankments. This wetland is important due to the presence of a large variety of fishes, reptiles, birds and mammals and especially due to the presence of wetland threatened species like the Hog Deer (*Axis porcinus*), Indus Dolphin (*Platanista minor*), Smooth-coated Indian Otter (*Lutrogale perspicillata*), Marbled Teal (*Marmaronetta angustirostris*) and Pond Spotted Turtle (*Geoclemys hamiltonii*). The wetland is also an important breeding site for the Lesser Whistling Teal (*Dendrocygna javanica*), Ruddy Crake (*Laterallus ruber*) and Pheasant-tailed Jacana (*Hydrophasianus chirurgus*). The Bar-headed Goose (*Anser indicus*), Ruddy Shelduck (*Tadorna ferruginea*), Painted Snipe (*Rostratula benghalensis*) and Pallas Fishing Eagle (*Haliaeetus leucoryphus*) are other important species found at this wetland. Other local bird species found are Black Partridge (*Francolinus francolinus*), Grey Partridge (*Francolinus pondicerianus*), Quail (*Coturnix coturnix*), Blue Bird (*Sialia sialis*), Jungle Pigeon, Sun Bird, Doves, House Sparrow (*Passer domesticus*), Warblers, Russian Sparrow, Crow (*Corvus splendens*), Owl, Parakeet (*Psittacula krameri*) and Crow pheasant (*Centropus sinensis*). Other large mammal species of concern are Jackal (*Canis aureus*), Cape Hare (*Lepus capensis*), Porcupine (*Hystrix indica*) and Wild boar (*Sus scrofa*).

2.3. Taunsa Barrage as Ramsar Site

Taunsa Barrage was designated a Ramsar site on March 22, 1996. The rare marbled teal *Marmaronetta angustirostris* is a regular passage migrant and winter visitor in small numbers. The rare Indus dolphin *Platanista minor* and otter *Lutrogale perspicillata* are present in the river in small numbers. The site forms a very important wintering area for waterbirds, (notably Anatidae), and a breeding area for several species, notably *Dendrocygna javanica*, and a staging area for certain cranes (*Grus grus* and *Anthropoides virgo*) and shorebirds. *Dendrocygna javanica* is a common breeding summer visitor.

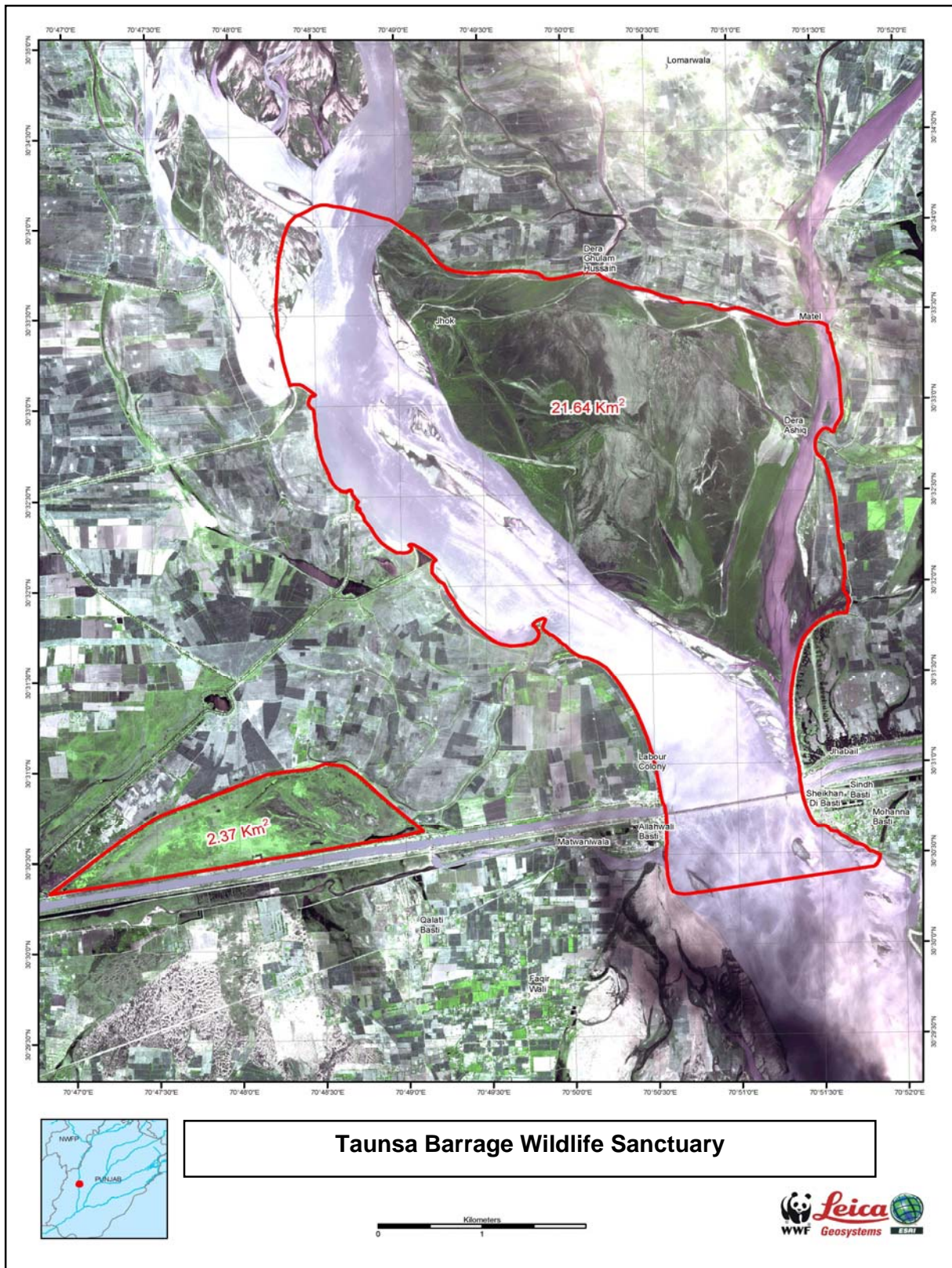


Figure 4. Taunsa Barrage Wildlife Sanctuary

2.4. Land Tenure

The barrage is government owned property. The surrounding area is partially government owned and partially private property. The site is managed as a Wildlife Sanctuary by the

Punjab Wildlife and Parks Department whose responsibility is to reduce hunting pressure as well as safeguard wildlife species and the associated habitat.

The wetlands are managed as protected areas under clauses 16 & 18 of the Punjab Wildlife (Protection, Preservation, Conservation and Management) Act (1974) which read as follows:

Wildlife Sanctuary:

- I. Government may by notification in the Official Gazette declare any area which is the property of the Government or over which Government has proprietary rights to be "Wildlife Sanctuary" and may demarcate it in such a manner as may be prescribed.
- II. The "Wildlife Sanctuary" shall be set aside as an undisturbed breeding ground for the protection of wildlife and access thereto for public shall, except in accordance with the rules, be prohibited, and no exploitation of forest therein shall be allowed except for reducing hazards, epidemic or insect attacks or other natural disasters.
- III. No person shall:
 - i. Enter or reside;
 - ii. Cultivate any land;
 - iii. Damage or destroy vegetation;
 - iv. Hunt, kill or capture any wildlife or fire any gun or other firearm within one mile of the boundary;
 - v. Introduce any exotic species of animals or plants;
 - vi. Introduce any domestic animal or allow it to stray;
 - vii. Pollute water in a Wildlife Sanctuary provided that Government may for a specific purpose, as or deemed expedient, authorise the doing of the aforementioned act (other than those mentioned in Clause IV).

2.5. Principal Management Objectives

Based on the regulations defined for the improved management of Wildlife Sanctuary, the principal management objectives for Central Indus Wetlands Complex with specific reference to Taunsa Barrage Wildlife Sanctuary are to:

- ensure the long-term conservation of the wetlands biodiversity and associated significant habitat;
- monitor and examine water quality, impacts and ways in which to maintain good water quality and prevent potential contamination of the water entering the system over the long term;
- undertake effective liaison between the various stakeholders and community regarding the appropriate environmental management for the area in balance with the area's recreational objectives;
- restore and rehabilitate riverine communities to ensure the long-term viability of existing *flora* and *fauna*;
- educate local residents and the wider community in relation to natural resources of the area; and
- Maintain and upgrade a baseline environment data set and overall biodiversity inventory for the Taunsa Barrage Wildlife Sanctuary, on a regular basis.

3.0. Biophysical Environment

3.1. Edapho-climatic conditions

Taunsa Barrage Wildlife Sanctuary is comprised of alluvial plains comprising of fine to grained soil dominated with deposits of calcareous nature. A part of the area lies on the western end and comprises piedmont plains dominated by clay particles that form deep and wide cracks upon drying. The Electrical Conductivity (EC) of the normal soil; ranges from 0.4 to 3.9 ms/cm and for saline soils 4.1 to 220 ms/cm. The pH of normal soils ranges from 7.9 to 8.9 and that of saline / sodic soils can be as high as 9.1. The soils are generally deficient in available phosphorus and organic matter.

The climate of the area is arid with extremely hot summers (temperature varies between 39 - 46°C during June) and mild winters (temperature varies between 19 - 5°C). The average annual rainfall is about 200 mm of which 80% is received in summer. Relative humidity in the area varies from 25% to 88% while evapo-transpiration of the area is around 50%. The wind velocity in the area remains in the range of 15-30 km/h, however, during summer it exceeds up to 30-35 km/h with dust storms and haze. The wind directions are from north to south or from north-west towards south-east. It often turns to storm during summer months (Khurshid & Chaudhry 1998).

3.2. Hydrology

A field study was conducted at Taunsa Barrage to establish the baseline conditions for water quality including both surface water and groundwater. Field survey was conducted during three seasons i.e. Fall (Sep-Oct), Winter (Jan-Feb) and Summer (May-Jun). Standard sampling procedures were followed at each sampling location to ensure the integrity of the samples collected and validity of test results.

The surface water quality analysis has been done from the point of view of irrigation as well as suitability of water for aquatic *flora* and *fauna*. Pesticide residual analysis was also carried out to analyse the impacts of any pesticides used in the vicinity of the Project area on the water quality as well as on the health of aquatic *flora* and *fauna*. In addition to the physical and chemical parameters and pesticide residual analysis, microbiological analysis of surface water was also carried out to determine the quality of water for drinking purposes.

All parameters were compared with National Environmental Quality Standards (NEQS) as well as other international standards such as US EPA, Food and Agriculture Organization (FAO), European Union (EU) and World Health Organization (WHO) where applicable and/or available.

The analytical figures of surface water samples show more or less uniform pollution characteristics, which indicate that source of pollution is likely to be situated upstream of Taunsa Barrage except the COD level which has its maximum level of 163.6 mg/l during winter season at the downstream right bank.

Temperature of water is found stagnant between 16°C to 17°C during winter, 21°C to 22°C during fall and 28°C to 32°C during summer as per existing weather conditions of the area. The amount of Total Suspended Solids (TSS) in Indus River was recorded very high particularly during fall and summer seasons. However, during winter season the concentration of TSS was recorded within the NEQS limits. High concentrations of suspended solids can cause many problems for stream health and aquatic life by clogging fish gills, reduce growth rates, decrease resistance to disease, and prevent egg and larval development. When suspended solids settle to the bottom of a water body, they can smother the eggs of fish and aquatic insects, as well as suffocate newly hatched insect larvae. The amount of Total Dissolved Solids (TDS) in Indus River at Taunsa Barrage is just about right. Turbidity of Indus River varies during different seasons. Low turbid water

was observed during winter season and high turbidity was recorded during fall and summer seasons.

The microbiological results of surface water show that the bacteria colony count was quite high at almost all locations and in all three seasons. It is, therefore, concluded that as far as microbiological analysis is concerned the river water without proper treatment is un-safe for drinking purposes. The surface water samples were also analysed for pesticides residuals and it was found out that no pesticide residuals were detected during fall and summer seasons. However, in winter high concentrations of pesticides were detected at both locations, i.e. main river channel and side channel in upstream. The results also show that the concentration of pesticides is recorded slightly high in the main river channel as compared to the side channel during the winter season.

Groundwater quality was also analysed in order to determine its suitability for drinking purposes. 26 parameters of concern for drinking water quality were analysed and the test results for drinking water were compared with WHO drinking water guidelines. All samples collected were found to be having excellent portability characteristics to be utilised for human consumption.

pH and corresponding alkalinities attributing good digestive characteristics to four groundwater resources while Sulphates, Chlorides that are regarded as major TDS contributors are found quite less. Figures of Colour, Odour, Turbidity and Suspended Solids show no signs of visible contamination within the four samples.

Microbiological report of groundwater analysis reflects that cited samples are free from faecal contamination. The report also reflects that there exists no pathogenic contamination.

From study of overall composition of groundwater resources it is found that its all characteristics are more or less in agreement with surface water characteristics most likely be due to river water infiltration into nearby earth situated beside banks of Indus River. Figures of Cyanides & Fluorides are also found lying well within safe limits as defined by WHO in its maximum permissible limits for drinking water.

3.3. Vegetation of Taunsa Barrage Wildlife Sanctuary

WWF-Pakistan conducted a detailed assessment of the sanctuary's terrestrial vegetation over the last three seasons (Fall, Winter and Summer) 2005-2006. During the studies, plant communities were delineated, forage production was appraised and the carrying capacity of the Sanctuary was determined. Habitat quality of the sanctuary was also evaluated with respect to feed and refuge of the wild herbivores and bird fauna. Threats to wildlife sanctuary were also identified and remedial measures were suggested for future consideration.

The first survey was conducted during fall 2005. The study revealed three important plant communities i.e., *Cyno-imperata-Sachharum*, *Cyno-Tamarix-Saccharum* and *Cyperus-Fimbristylis-Typha* in the core and buffer zones of the Sanctuary. Dry matter Forage production was recorded as 1897, 1546 and 770 kg/ha in core, buffer upstream and buffer downstream areas, respectively. The winter (2005-06) survey exhibited *Cynodon-Fimbristylis-Tamarix*, *Saccharum-Cyno-Tamarix* and *SaccharumTypha* plant communities in the same area whereas, dry matter forage production was 1524, 1004 and 371 kg/ha in core, buffer upstream and buffer downstream zones, respectively. During summer (2006) study, *Cynodon-Imperata-Saccharum*, *Saccharum-Cyno-Tamarix* and *Cyno-lamiaceae-maleolotus* plant communities were observed in the Sanctuary. Dry matter forage production was 2201, 1330 and 315 kg/ha for core, buffer upstream and buffer downstream zones, respectively. Comparatively, the forage production remained highest during Summer followed by Fall and lowest in the Winter season. However, carrying capacities of the core, upstream and downstream buffer zones was 163, 130 and 189 AU/ha, respectively, which clearly indicate a slight difference in stocking rates of the herbivores over the entire study period.

3.4. Fauna of Taunsa Barrage Wildlife Sanctuary

3.4.1. Large Mammals of Taunsa Barrage Wildlife Sanctuary

Three seasons' baseline data were collected during 2005 and 2006 as part of the ecological monitoring of the Taunsa Barrage. The survey site covered the Sanctuary and its buffer zones which were defined before the study commenced. A total distance of eight kilometres was travelled upstream Taunsa Barrage, 1.96 km of a side channel and downstream 2.6 km were surveyed for the Indus River Dolphin (*Platanista gangetica minor*). *Bela* and its buffer zones were surveyed at night through transects. Criteria were defined to give local conservation status and categorise species of Taunsa Wildlife Sanctuary on the basis of IUCN category. Indus Dolphin and Hog Deer are endangered species in the Sanctuary, Asiatic Jackal, Jungle Cat and Wild Boar are common species. However, Red Fox and Indian Smooth-coated Otter appear to be extinct from the area.

The Indus Dolphin numbers vary seasonally with the water availability. The upstream and downstream numbers in Taunsa Wildlife Sanctuary are contiguous with the respective sub-populations such as Chashma - Taunsa sub-population and Taunsa – Guddu sub-population. The dolphins found in the Wildlife Sanctuary are not isolated and they are moving seasonally. The Hog Deer occurs as an isolated population in the *Bela* and the survival of this population is dependent on the effective management. Population Viability Analysis (PVA) indicates that if this population is assumed to be of 25 individuals it will go extinct within 18 years and if considered 15 individuals it will be extinct in 10 years only. Only habitat restoration to increase carrying capacity and supplementation of this population from other Hog Deer stock (either trans-located from other wild populations where such removal of individuals would not negatively affect the population or suitable captive stock) can ensure the long term viability of this population.

3.4.2. Small Mammals of Taunsa Barrage Wildlife Sanctuary

In the ecological baseline studies, 21 small and meso-mammal species have been recorded from the Taunsa Barrage area. The species *Bandicoota bengalensis*, *Nisokia indica*, *Funambulus pennanti*, *Herpestes edwadsi*, *Golunda ellioti*, *Tatera indica*, *Rattus rattus*, *Mus musculus*, and *Suncus stoliczkanus*, *Scotophilus heathii*, *Pipistralus kohli*, *Pipistralus ceylonicus*, and *Pipistralus tenuis* are the common small mammal species in the area whereas *Herpestes jivanicus*, *Hemiechinus collaris*, *Hystrix indica*, *Lepus nigricolis*, and *Suncus murinus* are less common. The species *Lutra lutra* and *Rhinopoma microphyllum* are the rare species in the study area.

The *Bela* area upstream Taunsa Barrage presents a general wilderness but very poor with respect to the presence of small mammal species especially the burrowing species. The area is flooded at least once in a year and the population of small mammals is crashed. It seems that the invader species of small mammals i.e., *Bandicoota bengalensis*, *Mus musculus* and *Nisokia indica* invade the area, rebuilt their population and the process is repeated again and again. Winter season comes after the flood seasons of the Monsoon, and the *Bela* area by the end of December or the start of January get connected with the surrounding areas in the north. Until winter season this process was already started but the *Bela* area was still flooded and therefore colonisation of *Bela* was not evident. Towards north, where water channel separates the *Bela* from main land, the Bandicoot species was observed busy in making the burrows even during the day time. However water does not affect the population of bat species for which this is not a barrier.

The population of small mammals on left and right banks of the reservoir was observed to be very high. The spurs on the left bank provide an alluvial and compact soil for burrowing mammals and hence large colonies of *Golunda ellioti* were observed and the animal was collected from these colonies. The bank on the right side of the reservoir has lot of boulders, agricultural fields and alluvial soil providing plenty of good habitat for small mammals, hence, small mammals density is high on the right Bank.

The diversity index was found lowest in the *Bela* area during the fall and winter season due to low species diversity and low evenness but it was higher in the summer season as both, species diversity and evenness increased in *Bela* area. The diversity index in the upstream buffer area remains more or less constant during all the three seasons. The area provides variety of microhabitats in the form of agricultural fields, soft alluvial soils in the form of spurs and side embankments, series of stone piles, trees, grassy mesic areas, patches of sacrum and typha and human settlements. These habitats are not significantly affected by the flooding.

3.4.3. Amphibians and Reptiles of Taunsa Barrage Wildlife Sanctuary

Three species of amphibians and 13 species of reptiles are being reported from the area. The presence of *Python molurus* has been indicated in the study area as the reported killing of this species confirms its presence in the area.

The turtle species *Kachuga smithii*, *Geoclemys hamiltonii*, *Aspideretes gangeticus*, *Chitra indica* and *Lissemys punctata* do exist and have been observed at Taunsa.

The data indicate that the *Bela* area is the least productive area and the 'remaining sites in the buffer zone show relatively high diversity in all the seasons. This is because of the fact that habitat of *Bela* is not stable and becomes catastrophic for the burrowing species when it is inundated. Seasonal patterns of reptiles show that summer is most productive for reptiles. Distribution of amphibians also shows similar pattern as that of reptiles indicating the buffer zone most productive.

3.4.4. Avi fauna of Taunsa Barrage Wildlife Sanctuary

The study area is rich in bird diversity, with a combination of passerines and non-passerine birds including waterfowl, forest, mountain, desert dwellers, and raptors. The Indus is an endemic bird area and provides an important refuge and migratory flyway to the wintering waterfowl in particular, and other important species in general. A total of 253 species of birds are reported in the study area, the majority of which are migratory (Roberts, 1991; 1992).

Some species are locally and globally threatened, these include Jordan's babbler (*Chrysomma altilostris*), the red or rufous vented Prinia (*Prinia burnesii*), the oriental white-backed vulture (*Gyps bengalensis*), the marbled teal (*Marmaronetta angustirostris*), the ferruginous duck (*Athya nyroca*), Pallas's fish eagle (*Haliaeetus leucoryphus*), the white-browed bush chat (*Saxicola macrorhyncha stoliczka*), the sociable lapwing (*Chettusia gregaria*), the imperial eagle (*Aquila heliaca*), the greater spotted eagle (*Aquila clanga*), the Indian skimmer (*Rynchops albicollis*), and the red necked falcon or red-headed merlin (*Falco chicquera*) (BirdLife, 2001).

Surveys of the suitable habitats of Taunsa wildlife Sanctuary were conducted from October 5, 2005 to October 15, 2005 (Fall season 2005), from December 25, 2005 to January 02, 2006 (Winter season 2005/06) and from May 22, 2006 to May 27, 2006 (Summer season 2006). During fall season 2005, a total of 67 bird species of 30 families and 14 orders were observed. According to the global IUCN Redlist criteria, Pallid harrier (*Circus macrourus*), Red-vented prinia (*Prinia burnesii*) and Black-bellied tern (*Sterna acuticauda*) are near threatened {(NT ver 3.1 (2001))}, while the status of remaining 64 species is Least Concern {(LC ver 3.1 (2001))}.

Similarly during a survey in winter season 2005/06, a total of 79 bird species of 34 families and 15 orders were observed. According to the global IUCN Redlist criteria, Red-vented Prinia (*Prinia burnesii*) and Black-bellied tern (*Sterna acuticauda*) are near threatened {(NT ver 3.1 (2001))}, while the status of remaining 77 species is Least Concern {(LC ver 3.1 (2001))}.

During summer season 2006 survey, a total of 113 bird species of 45 families and 18 orders were observed. According to global IUCN Redlist criteria, Oriental white-backed vulture (*Gyps bengalensis*) is critically endangered {CR A2ce+3ce ver 3.1 (2001)}, Pallas's

or Ring-tailed fish eagle (*Haliaeetus leucoryphus*) is vulnerable {VU C1 ver 3.1 (2001)} and Red-vented Prinia (*Prinia burnesii*) and Black-bellied tern (*Sterna acuticauda*) are near threatened {NT ver 3.1 (2001)}, while the status of remaining 109 species is Least Concern {LC ver 3.1 (2001)}.

During all the three fall 2005, winter 2005/06 and summer 2006 seasons, a total of 153 bird species representing 52 families and 19 orders were observed. Out of total 153 species, 53.6% (n=82) were resident, 9.8% (n=15) summer breeding, 5.2% (n=08) irregular year round visitor, 5.9% (n=09) double passage or ordinary migrant, 21.6% (n=33) winter visitors, 0.7% (n=01) occasional breeding, 1.3% (n=02) summer visitor and not breeding and 1.3% (n=02) summer breeding and wintering and 0.7% (n=01) were summer and autumn migrants.

3.4.5. Fish fauna of Taunsa Barrage Wildlife Sanctuary

Among the 67 species recorded from the project area, 20 species viz., *Chitala chitala*, *Cirrhinus reba*, *Cirrhinus mrigala*, *Gibelion catla*, *Labeo calbasu*, *Labeo dyocheilus pakistanicus*, *Labeo gonius*, *Labeo rohita*, *Cyprinus carpio*, *Sperata sarwari*, *Rita rita*, *Bagarius bagarius*, *Wallago attu*, *Channa morulius*, *Clupisoma garua*, *Eutropiichthys vacha*, *Oreochromis mossambicus*, *Cyprinus carpio*, *Ctenopharyngodon idella*, *Aristichthys nobilis*, and *Hypophthalmichthys*, are commercially important.

Among the commercially important species *Cirrhinus reba*, *Cirrhinus mrigala*, *Gibelion catla*, *Labeo calbasu*, *Labeo dyocheilus pakistanicus*, *Labeo gonius*, *Labeo rohita*, *Cyprinus carpio*, *Ctenopharyngodon idella*, *Aristichthys nobilis*, and *Hypophthalmichthys*, are herbivorous. The species *Chitala chitala*, *Sperata sarwari*, *Rita rita*, *Bagarius bagarius*, *Wallago attu*, *Clupisoma garua*, *Channa morulius*, and *Eutropiichthys vacha* are carnivorous.

Oreochromis mossambicus, *Cyprinus carpio*, *Ctenopharyngodon idella*, *Aristichthys nobilis*, and *Hypophthalmichthys molitrix* are exotic species.

The rest 47 fish species have less economic importance but are an integral part of the ecological system and biodiversity. The family Cyprinidae is the most speciose family represented by 31 species while the other 36 species are divided among the fourteen families in various combinations. The species *Gonialosa manmina*, *Botia lohachata*, *Nangra nangra*, *Sisor raddophorus*, *Systemus sarana* recorded from Taunsa Barrage are considered rare species in Pakistan. The species, *Nangra nangra* and *Sisor raddophorus* are, however, very rare. The existence of these specimens in any museum from a particular locality is not documented from Pakistan and this is for the first time that these specimens have been physically collected in Pakistan.

4.0. Social Environment

4.1. Background

As evident from the Punjab Wildlife Act, human use inside a Wildlife Sanctuary is strictly controlled unless permitted by the Government. However, in practice, most Protected Areas (PAs) in Pakistan are subject to extraction of natural resources by local people to meet their livelihood needs. The high level of poverty in the country and continued dependence on natural resources for rural livelihoods (e.g. agriculture, fishing etc) means that PAs are often perceived as common property resources especially for poor and marginalised groups. The biodiversity earmarked for protection in these areas is not only the source of direct cash income for local people but also provides materials that act as inputs for productive income (e.g. fodder) and meet needs for shelter and food consumption (e.g. timber, *Typha spp.* and *Tamarix spp.* is used for house construction and vegetables and NTFPs are extracted to meet dietary needs). While beneficial for local livelihoods, the extraction of these resources often leads to disastrous results on the biodiversity of the PA.

4.1.1. Evidence of human use inside Taunsa Barrage Wildlife Sanctuary

The main rationale for this baseline study is to primarily ascertain the level of natural resource extraction within the Sanctuary and assess if human activities in close proximity to the Sanctuary are also affecting its resources.

Human impacts on the Sanctuary stem from both direct use of its resources and indirect activities in its buffer areas leading to pervasive effects. Direct human impact is easy to observe inside the Sanctuary. The area is used for fuelwood extraction by the surrounding villages. Sources of inexpensive fuel are few in the region and fuelwood is available free of cost from the Sanctuary. Agricultural families are comparatively less reliant on fuelwood than other families as they reported the use of crop stalks for burning also.

There is also indiscriminate cutting of *Typha* and *Tamarix* in the Sanctuary and piles of these were seen stacked on the only human settlement inside the Sanctuary and on farmsteads situated close to the northern edge. This is a source of habitat disturbance and results in reduction of vegetation that is necessary for the survival of species. *Typha*, *Tamarix* and *Saccharum* are used to make mats, baskets and other household items. They are a source of supplemental income for most fishing households.

Grazing pressure on the Sanctuary is also high. A herd of about 50 cattle is maintained on the farmstead situated inside the Sanctuary. Another herd of about 40- 50 cattle was observed entering the Sanctuary from the northern boundary. In the heart of the Sanctuary, about 100 head of cattle were observed. Another smaller herd was seen inside the Sanctuary on the northern side. Fresh cattle dung was seen at several points in the Sanctuary.

Fishing is a major activity in the Sanctuary. The Sanctuary floods seasonally during the summer months and the flooded area that extends beyond the Sanctuary's borders is referred to as the "pond area". Two contracts issued by the Punjab Fisheries Department fall within the extent of the Sanctuary. One contract, awarded for 6 00,000 Pak. Rs. for 2006, extends over most of the Sanctuary's area. Its northern limit is *Hanjrai* while its western limit extends to some 1.5 kilometres west of Taunsa Barrage. Its southern boundary is *Basti Sheikh*, *Sindhi Basti* and *Gharuwala*. Migrant fishermen from Sindh also increase the number of fishermen in this area on a seasonal basis.

The second contract extends in the north from the southern edge of Taunsa Barrage to the boundary of Tehsil Kot Addu in the South. Its western limit is also the boundary of Kot Addu while the village Loon Wala marks its eastern boundary. This contract was issued for 2,700,000 Rupees. This contractor also draws upon the fishermen in the same villages

to provide fishing labour. Fishing also takes place on a subsistence basis by farming households mainly during the wet season. They sometimes sell fish as a supplemental source of income.

Other Non Timber Forest Products (NTFPs) are also reportedly extracted from the Sanctuary. These include the lotus roots (locally called “*bhay*”). During seasonal flooding of the “pond area” lotus flowers grow abundantly and mainly temporary settlers extract the roots of this flower for sale.

Many interviewees (mostly under conditions of anonymity) have reported hunting of birds and mammals. Several cases of bird hunting (for sale) in the market were reported during interviews and organised sport hunts by local people cannot be ruled out.

A farmstead is maintained on the western side of the Sanctuary and land has been cleared for fodder cultivation. Tracks have been cleared to facilitate vehicle manoeuvre.

Indirect human impacts on the Sanctuary are difficult to assess but can be identified from human activities within a one kilometre radius. These include agrochemical use from agriculture in the surrounding area and the effects of construction under the Punjab Barrages Rehabilitation Project. Agricultural land borders the Sanctuary to the north, west and the east. Common crops grown in the region are cotton, wheat and sugarcane. Agrochemical use for agricultural production is common. Cotton, in particular, requires high applications of fertilisers and pesticides that is a major source of water pollution due to leaching into the ecosystem.

4.1.2. Broader factors affecting human use

Despite the controls levied by the Punjab Wildlife Act, the Sanctuary’s resources are used indiscriminately for various purposes. This is a direct result of the lack of clarity between the responsibilities and jurisdiction of various government departments. The land included in the Sanctuary officially belongs to Punjab Irrigation Department. Punjab Irrigation Department is authorised to lease the land and does so within the Sanctuary’s area. The Punjab Fisheries Department issues contracts for fishing inside the Sanctuary also. This creates uncertainty at the government department level and restricts an effective imposition of the Punjab Wildlife Act. The institutional interaction and power relationships between governmental agencies is a key factor that needs analysis to understand access to the Sanctuary’s resources.

Although an assessment of human impact will answer the question “how much” in terms of natural resource use, the “why” aspect of extraction also remains to be determined. To answer the “why” aspect, an analysis of the social structure of stakeholder communities is essential since the reasons behind the current level of natural resource extraction are embedded in the social influence and importance of stakeholders. This influence and importance governs the access to and use of natural resources inside the Sanctuary by stakeholder communities.

Another key question that remains to be assessed is the impact on the Sanctuary’s resources of both direct threats and longer-term pressures. These need to be assessed on a temporal scale to determine if the level of natural resource use has changed in comparison to the past or is likely to change in the future given the social dynamics of the region. The baseline study assessing socio-economic conditions of natural resource use inside Taunsa Barrage Wildlife Sanctuary aims to investigate the characteristics of human use inside the Sanctuary and its environs. Broad questions include: Who are the stakeholder communities using the Sanctuary’s resources; what is the nature and extent of human use of the Sanctuary’s resources at present; and, which stakeholders influence access to and use of the Sanctuary’s resources and why.

A total of four field visits were conducted to Taunsa Barrage Wildlife Sanctuary during 2005-2006 (October 2005; February 2006; March, 2006; and May 2006) for socio-economic assessment. These visits were focused on the reconnaissance assessments, conducted interviews with key stakeholders, assessed potential villages by visiting all settlements within a 5 km radius, surveyed the Sanctuary area to assess levels of human use and conducted Participatory Rural Appraisals (PRAs).

4.2. Stakeholder analysis

4.2.1. Stakeholder Influence and Importance

Stakeholder analysis indicates a general consistency of views on the importance and influence of stakeholder. The importance of stakeholders is defined through the nature and intensity of their interaction with the Sanctuary while influence is defined by actual control over access and use of the Sanctuary's resources. Stakeholder analysis was conducted through semi-structured interviews with government organisations. The views of local communities were elicited through the use of Venn diagrams and ranking tools within PRAs.

Interviewees were asked to provide an overall assessment of the level of stakeholder importance and influence and rate it as high, medium or low. Reasons were elicited for each rating to base the analysis on concrete examples and in some instances interviewees changed their overall rating when probed to provide examples/reasons to support it. Using Venn diagrams and ranking exercises, people were asked to firstly list the stakeholders that have an interaction with their village. The size of the circles in the Venn Diagrams signified the relative importance of stakeholders in terms of interaction and power. Stakeholders were then ranked according to their importance or power within the Village in general and in relation to the Sanctuary in particular.

4.2.2. Analysis of data on Stakeholder Roles

4.2.2.1. Government agencies

Importance (Use) of stakeholders: During interviews, the staffs belonging to government agencies were asked to name stakeholders that use Taunsa Barrage Wildlife Sanctuary and rank them according to the level/intensity of use. In terms of level of use, the analysis indicates that communities from *Loomarwala* receive the highest rating followed by fishing communities (mainly from *Basti Sheikh*). The most common reasons cited for the ratings were the ease of access to the Sanctuary for residents of *Loomarwala*; ethnic and political allegiance to large and influential landowners; and physical proximity to the Sanctuary.

Loomarwala and *Basti Sheikh* were identified to have the largest use in terms of numbers of people/households. The next highest rating was given to the influential landowners (*Hinjra* family). These land owners use Sanctuary on an occasional basis themselves but their functionalities occupy land inside the Sanctuary.

Influence (power) of stakeholders: In terms of influence or power over the use of the Sanctuary's resources, the highest rating was given to landowners east and north of the Sanctuary (*Hinjra*). They were described by all respondents as exerting the most influence. The decision-making authority in terms of allowing access to and use of the Sanctuary's resources lies overwhelmingly in their hands. The reasons for this rating were based on political standing, large land ownership and physical presence of functionaries inside the Sanctuary. Respondents also reported that the Sanctuary has been leased to the landowners by Punjab Irrigation and Power Department and as lessee the occupants had the right to grant access to whoever they deemed fit. The staff of the Punjab Wildlife and Parks Department observed that this should not be the case in principle but accepted the situation as *fait accompli*.

Punjab Irrigation and Power Department was given the highest rating among government departments. However, respondents remarked that their importance was the highest on the basis of land ownership; they were rarely seen to use this power to control access and

regulate the use of the Sanctuary's resources. Common reasons for this ranking were (i) land ownership of the Sanctuary (ii) amount of funds available for expenditure and (iii) number of staff employed. Punjab Fisheries Department was seen to have the least influence among government agencies as their power was seen to be restricted to the award of contracts. Beyond this, their formal mandate to influence fishing practices was seen to be selective and based on isolated cases of enforcement.

The landowners west of the Sanctuary in *Sinjer Saidan* (*Sayyeds*) were seen to be slightly more powerful than those to the south (*Khar*) due to political alignment with influential political figures. The *Khar* family was seen to have exerted an influence in the past and their continued influence in the region on a wider scale was recognised. However, this influence was not seen as being especially active in the Wildlife Sanctuary at present.

Fishing contractors were given the second highest rating in terms of influence. At least one respondent stated that this rating was based on the control they exert over access to fishing. Fishing contractors were quoted to employ patrols on motorbikes to ensure that only boats/fishermen under contract to them undertake fishing within their contracted area. Only one respondent identified *Loomarwala* as a powerful stakeholder based on their social proximity to the landowners settled inside the Sanctuary.

4.2.2.2. Local communities

Influence: Through PRAs, the local communities were asked to identify and then rank various stakeholders according to the influence (power) they exerted over the Sanctuary and its resources. Local communities rated the Punjab Irrigation and Power Department as the most influential stakeholders. The Irrigation Department's influence was defined in terms of their role in controlling fishing near the Barrage and placing restrictions on boats crossing the Barrage. The Punjab Fisheries Department's influence was described in terms of the fines that they are empowered to levy. Two fishing villages (*Sindhi Basti* and *Basti Sheikh*) identified the Punjab Wildlife and Parks Department as exerting some influence over access to the Sanctuary by placing fines. Others reported that their influence was non-existent. Some villages did not even know about their existence (*Allahwali Basti*, *Gharuwala* and *Loomarwala*).

The influence of local landlord (*Hinjra Family*) was also rated as high, primarily due to their ability to control access to the Sanctuary. Several villages (*Gharuwala*, *Basti Sheikh*, *Loomarwala*) also mentioned that the Family played a crucial role in arbitrating disputes. The *Khar* Family was mentioned in terms of exerting an overall influence and their role in providing electricity when they held political office in the area was lauded. However, they were not perceived to hold any direct influence on access to the Sanctuary's resources.

4.3. Rapid Assessment of Priority Protected Area Management (RAPPAM)

A questionnaire based on the Rapid Assessment of Priority Protected Area Management (RAPPAM), pioneered by WWF-International, was conducted. Although, only a small number of people proved to have detailed knowledge of Taunsa Barrage Wildlife Sanctuary to complete the analysis, the exercise yielded some important information about the pressures and threats on the Sanctuary and the current management conditions as baseline information.

4.3.1. Pressure and Threats

The discussion of pressures and threats on the Sanctuary was the most comprehensive part of the analysis. Pressures are described as activities that have exerted an effect on the Sanctuary over the past five years and continue to exist at present. Respondents identified no less than nine pressures on the Sanctuary. Fishing, grazing and fuelwood collection were identified as pressures by all respondents.

An assessment of threats (defined as activities that are likely to continue in the next five years) indicates that grass collection, fishing, fuelwood cutting and grazing are the most impending threats in the next five years. The extent of grass cutting and grazing is expected to be throughout the Sanctuary. Severe impacts are posed by threats such as grazing, *Typha spp.*, *Tamarix spp.* and fuelwood collection and perceived flooding due to Punjab Barrages Rehabilitation Project. Fishing, flooding and fuelwood collection were also reported as having long-term effects on the ecosystem.

The most commonly cited pressures and threats on the Sanctuary were (i) livestock grazing, (ii) *Typha spp./ Tamarix spp.* extraction (iii) fishing (iv) fuelwood collection and (v) hunting. Of the pressures and threats exerted on the Sanctuary, grazing was rated as the most severe both as a pressure and threat. Most respondents felt that grazing pressure was likely to increase due to a steady and increasing trend in livestock numbers.

Fishing was recorded as a pressure as well as a threat while fuelwood collection ranked third. Fishing was not described as a severely harmful pressure but the catalyst that allowed people to access the Sanctuary. The trend for greater fishing in the Sanctuary was predicted to increase as a threat with the prevalence of current drought conditions making fishermen less reliant on ponds and more dependent on river-based fishing. Fuelwood collection was consistently identified as exerting a severe impact.

The collection of grasses (*Typha sp. / Tamarix sp. and Saccharum sp.*) was rated consistently as a pressure and threat. Respondents identified that it was not a particularly damaging threat as the grasses regenerate after flooding each year. However, the habitat disturbance due to human presence was a key factor in disturbing the ecosystem.

Forest fires were rated on the same scale as hunting but received less points as a pressure compared to hunting. Respondents reported that the occurrence of fires had been controlled with improved training and detection and were likely to decrease as a threat. Hunting was predicted to remain as a constant pressure and threat given that the social and political conditions which supported it were not likely to change in the next five years.

4.3.2. Socio-economic Importance

An assessment of socio-economic importance of Taunsa Barrage Wildlife Sanctuary yielded fairly consistent responses. The Sanctuary is seen as an important source of livelihood for local communities and meets subsistence needs. Although it has no religious or cultural value, it provides an important scientific and educational value mainly as a staging ground for migratory birds. Its value as a habitat of animal/plant species that have a social or cultural value was moderate and as a place of aesthetic and recreational value, it was rated on an average level. However, its importance as a contributor to ecosystem services and benefits was high since it supported birds that feed on crop pests.

4.3.3. Vulnerability, Management and Finances

Respondents identified that difficulties in monitoring law enforcement were mainly attributable to lack of equipment and staff skills. The Sanctuary was seen to lack financial support to enable better enforcement practices through staff employment and training. The long-term financial security of the Sanctuary was rated as dismal although its legal security as a Protected Area was considered adequate because its PA status has continued consistently despite revision in boundaries. The main problem was identified as the lack of agreement in enforcement between Punjab Irrigation and Power Department and Punjab Wildlife and Parks Department. The Sanctuary has been declared on government land belonging to Punjab Irrigation and Power Department and part of the land is leased out by them. This is in direct violation of Punjab Wildlife Act that does not allow any human use inside the Sanctuary. Since this conflict remains unresolved at an official level, it leads to conflicts of enforcement and lack of jurisdictional rights for the staff of Punjab Wildlife and Parks Department.

5.0. Potential Issues and Threats

5.1. Management Issues

5.1.1. Ambiguity in roles and responsibilities of Government line agencies

Despite the controls levied by the Punjab Wildlife (Protection, Preservation, Conservation and Management) Act 1974, the Wildlife Sanctuary has been indiscriminately exploited both for subsistence and commercial purposes, which is a direct result of the confused state of resource ownership and ambiguity in the roles and responsibilities of various government agencies.

5.1.2. Lack of coordination

The land included in the Wildlife Sanctuary officially belongs to Punjab Irrigation and Power Department, Fisheries to Punjab Fisheries Department, whereas, flora and fauna belongs to Punjab Forest and Punjab Wildlife and Parks Department respectively. Interestingly, Punjab Irrigation and Power Department has been leasing the land and Punjab Fisheries Department is issuing fishing contracts within the Sanctuary areas without any consultation with the custodian Punjab Wildlife and Parks Department.

5.1.3. Weak law enforcement

Fires break out in the core zone during pre-monsoon and summer seasons and often destroy precious riparian vegetation and wildlife. Fishing is totally commercial in the Wildlife Sanctuary permitting the fishermen to catch as much fish as they can even using improper fishing nets, ways and timings. Though laws are there to restrict over-exploitation of resources from the Sanctuary but weak enforcement has been a constant threat to its ecological integrity.

5.1.4. Inadequate protection staff and their lack of technical skills

Due to lack of technical staff available for the protection of the Wildlife Sanctuary, necessary training skills and resources, the Punjab Wildlife and Parks Department has failed to enforce law in such areas.

5.2. Ecological Issues and Threats

5.2.1. Forest fires

Forest fires are a common phenomenon in the Sanctuary area especially in the core zone which is the vital habitat for Hog Deer. Most of these fires are set by the local communities who graze their cattle in the core zone. Occurrence of frequent fires reflects the negligence of the custodian authorities to probe into the situation and apprehend the culprits.

5.2.2. Illegal hunting/poaching of wildlife

Hunting is probably one of the most cross-cutting issues that wildlife managers face in Pakistan. Unless the hunting is for subsistence, most forms of the sport are carried out by the elite class who see themselves above the laws of the relevant department (and often this proves true).

Waterfowl Sport hunting: Sport hunting of waterfowl is on rise in the area. Hunting is done by gun shooting and by netting. Most of the local people work for the influential landlords of the area and kill ducks ruthlessly. Most boatmen observed during the study period carried a single barrel 12 bore plus the accessories needed to stalk birds on the water. The use of hides at certain places was also observed right inside the Wildlife Sanctuary to kill the migratory waterfowls. There are also evidences of collection of eggs and chicks from the wild which is limiting the breeding of bird population.

Large mammal hunting and poaching: Although there are no natural predators of adult Hog deer (*Axis porcinus*) in the Taunsa Barrage Wildlife Sanctuary, fawns are taken by jackals and jungle cats (Roberts 1997). Illegal hunting seems to be a frequent occurrence,

especially during the flood season when these deer disperse out of the *Bela*. The environmental fluctuations are high in *Bela*, flooding would cause mortalities and would also limit the food supply thus increasing inter and intra species competition. There is a high hunting pressure also because the surrounding areas of the sanctuary are cultivated and natural riverine vegetation is depleted and has negatively impacted the migration routes of the population. The situation of food supply is also affected by the presence of livestock.

Illegal capture and trade in reptiles' especially freshwater turtles: Carcasses of freshwater turtles on the bank of Indus River were found in the study area. A group of people are involved in the trade of turtles. They hunt them from the wild and supply them to traders in Lahore. They kill turtles only to obtain a small hinder part of the carapace of soft shell turtles *Aspideratus gangeticus* and *Chitra indica*. These cruel people nail the live turtle with an arrow, chop the required part of its body and throw it back to die. After obtaining the required part they boil them in the container, clean them and finally dry them. The finished form changes into a shape that even an experienced herpetologist can hardly identify it as a turtle part. There are several such groups operating all over the country involved in turtle capture and trade, which has drastically declined the populations of softshell turtles.

5.2.3. Illegal fishing practices

Over-fishing: Over fishing is commonly practiced in the area and the fishermen catch fish even during the breeding season. This is due to the inadequate capacity of the respective departments to promote sustainable fisheries management.

Introduction of exotic species: Many species of fishes specially the Tilapia, Common carp, Grass carp, Silver carp, Big head carp have been introduced in Taunsa barrage. These species specially the Tilapia has imposed a negative impact on major carps of Pakistan and their population has certainly declined. The Tilapia is a proliferate breeder and its population increases enormously. This rapid increase in population of this fish puts the local species in a strong competition for food, and breeding grounds.

Use of illegal mesh size: The legal mesh size allowed for fishing is 1.5 inches. In order to collect more and more fish, the fishermen illegally use nets of smaller mesh sizes to maximise their catch. Regulation of mesh size has been widely used for controlling the minimum commercial size in protected fish populations. Generally the catch in reservoirs of mrigal, rohu, and calbasu of less than 1kg in weight, and of catla of less than 4 kg in weight is prohibited for fishing in lakes and reservoirs.

Lack of recruitment facilities: Extraction of tonnes of commercial fishes from each year from the reservoir not only depletes the stocks of commercial fisheries but also disturbs the species composition. The stocks of commercial fishes are maintained at a steady state by outside recruitments of commercial fishes by breeding them in the hatcheries and stocking the reservoirs.

Illegal fishing in closed areas: The area immediately upstream reservoir gates are declared the Sanctuary area for fishes as maximum fish is concentrated in that area. People illegally practice fishing in this sensitive areas at night. An important factor in creating high productivity of valuable fishes is the regulation of fish stocks by means of protective measures such as closed areas.

Illegal fishing during closed seasons: In Pakistan June, July and August are considered closed seasons for fishing as most of the carp fishes breed during these months. Some poachers exercise fishing even during these months as fishes concentrate in their breeding grounds for breeding. A strict watching and ward, implementation and law enforcement is inevitable for maintaining healthy stocks of fishes.

Lack of appropriate fish data: In large water bodies, yearly limits for the catch of most valuable fishes are based on scientific information of population abundance, growth, recruitment and mortality rates, relationship between catch from a stock and the amount of fishing, and the size of fish at first capture. All this information is lacking about this reservoir.

Fishing rights: The fisheries rights at Taunsa Barrage are auctioned for a sum of Rs. 4 million annually. The contractors usually use intensive fishing to catch maximum tonnage of fish to earn more profit.

Ineffective fish ladders: Fish ladders constructed in Taunsa Barrage are ineffective and are serving as fish traps rather than fish passes.

5.2.4. Illicit fuelwood extraction / Habitat destruction

Fuelwood extraction: Fuelwood extraction by the surrounding communities from the Wildlife Sanctuary is a continuous phenomenon, as the area is deficient in cheaper sources of fuel and free fuelwood is readily available from the Protected Area. Major fuelwood used by the people living in the periphery of this Wildlife Sanctuary is *Tamarix dioica* (Gaz lai), *Saccharum spontaneum* (Kai), *Saccharum bengalensis* (Kana, Sarkanda), *Acacia nilotica* (Kikar) and animal droppings (dung and dung-cakes). The most preferred fuelwood is dry sticks of *Tamarix dioica* (Gaz lai) and source of this fuelwood is the Wildlife Sanctuary. Fuelwood of “Kikar” (*Acacia nilotica*) is collected from Wildlife Sanctuary as well as from farmlands. No family residing in the area purchases fuelwood from market. Average use of fuelwood per household is from 800-1000 kg per month, which is reduced to 400 to 600 kg per month in summer. High consumption of fuelwood during winter is because of the severity of cold weather. They warm their houses by burning sticks of *Tamarix dioica* along with *Saccharum bengalensis*. Illicit cutting of forests for timber and fuelwood has been severely affecting the habitat of the Sanctuary.

Habitat destruction: An approximate population of 19,000 living in 1,700 households heavily relies on the extraction of natural resources (mainly vegetation) from the surrounding area. The majority of this vegetation comprises of *Tamarix dioica*, *Saccharum spp.* and *Typha angustata* which are dominant and sub-dominant species for main habitat types used by birds and mammals. The vegetation cover provides a significant habitat for wildlife species and also serve as a breeding area for certain resident birds and animals.

5.2.5. Encroachment

Some people have been cultivating a considerable portion of the land amidst the core zone of the Wildlife Sanctuary to grow maize, millets, peas and gram for their livestock. For this purpose, they have cleared off the natural vegetation, altering the natural ecosystem, degrading wildlife habitat, introducing non indigenous species and causing many more adverse environmental impacts (e.g. agro-chemical pollution etc.). Local people are also encroaching area under wetland for increasing agricultural lands during low water regimes especially areas around the Taunsa Barrage.

5.2.6. Unsustainable extraction of NTFPs

Unsustainable use of Non Timber Forest Products: Besides timber and fuelwood consumption, the vegetation from Taunsa Barrage is used to make baskets, huts, brooms, house walls, mats, ropes and twines, sticks of hand fans, roofs of their houses, animal fodder and as vegetable (*Lotus*).

- Sticks of *Tamarix dioica* are mainly used for making of baskets and sticks for hand-fans. *Saccharum spontaneum* and *Saccharum bengalensis* are used to prepare temporary house walls, thatching of roofs of their houses, brooms and as animal fodder. Local people living in these villages/’Basties’ are expert in making such products and one person can make more than 12 baskets per day easily. Generally, six to eight kilogram

sticks of *Tamarix* plant are required for the making of a medium-sized basket but the quantity may vary with size of the basket.

- Similarly, *Typha angustata*, locally called as “Bhay” is extensively used by the local people to make foot-mats, rugs and ropes and twines etc. *Typha* mainly collected from the pond areas, inside / outside of the Sanctuary where thick vegetation occurs. Approximately 4 kg *Typha* plant material is required to make a rug/foot-mat of 3x1m size.
- Lotus seed collection is common in the area. Generally, lotus seeds are collected from September to November and are sold in the markets of Multan, Dera Ghazi Khan, Muzaffar Garh and Kot Addu. They get Rs.3/- to 4/- per sac of Lotus and during the season they sell about 250-300 sacs of lotus. Normally, the earning of a family by selling lotus is Rs.100/- per day.
- Honey collection and selling in the market is very rare in the area, but if they find any honey comb, they collect it for their domestic use. Some of the Sindhi families earn their income by capturing fishes from the pond area and from Indus River. They capture an average of 10-15 kg fish per day and sell it as Rs.100/kg.

No doubt these resources are the primary sources of living and income for the local communities but its unsustainable harvest, as has been happening, may lead to disastrous socio-ecological consequences in the long run.

Missing link with urban market for promotion of community products: As far as marketing of community products are concerned, middle-men is involved which fetches very low income (Rs. 20/- to 40/- per basket) for communities. Selling these items directly in the market may bring in more earnings (Rs. 45/- to 50/- per basket). The main markets exist in Kot Addu, Multan and Dera Ghazi Khan. The monthly income of a family by selling these baskets ranges from Rs. 10,000 to 12,000, but their income strictly depends upon the availability of *Tamarix* and *Saccharum* from the Taunsa Barrage Wildlife Sanctuary.

5.2.7. Illegal grazing of domestic livestock in the Protected Area

Impacts of illegal grazing in and around the Protected Area: Most of the people living in the neighbouring villages own domestic animals (including sheep, goat, cow and buffalos). They generally graze these animals inside the Wildlife Sanctuary and along the banks of the river, canals and spurs. Resultantly, there is a heavy grazing and fuelwood cutting pressure in the Sanctuary area. A herd of about 50 cattle is maintained on the farmstead situated inside the Sanctuary. Moreover, 5 - 10 herds, each of 50 – 100 cattle from the adjacent villages graze freely in the core zone of the Sanctuary.

- Such an unrestricted grazing has been badly affecting the range ecology and its productivity, which is otherwise a vital habitat for Hog deer and other mammal species of the area.
- The presence of over-efficient habitat engineers such as free-grazing livestock has undoubtedly degraded the floral diversity of the natural habitat in the area but more so in and around the Wildlife Sanctuary. The reclamation of the flooded areas between spurs for agriculture is reported (2005-2006) to have removed habitat for a variety of waterfowl including species such as Flamingo, Storks and Spoonbills.

Competition with domestic livestock: There are two ‘Deras’ of Gadee tribe inside the *Bela* and approximately 50 cattle are permanent residents of this forest. Additionally, there are 3-4 communities of *Baloch* tribe that use *Bela* for their resources, which amount to roughly 3,000 to 4,000 people. Buffalos graze the area extensively; dung and foot prints are common in the *Bela*.

- Cattle can have adverse impact on the wild ungulate population in two critical ways; competition for food and disease transmission. A causal discussion with these residents

on *Bela* showed that their cattle have suffered from Foot and Mouth Disease (FMD). FMD can be transmitted to the wild ungulates (Hog deer and Wild boar) in the *Bela*.

- Grasses on *Bela* follow a seasonal pattern and are important food supplies of Hog Deer. Cattle can cause erosion of top soil which is critical for the growth of grasses. Hog deer rely on the shoot of plants and grasses which tend to grow in October, once the streams in the *Bela* dry up. The rut season of Hog deer is between August and October (Roberts 1991) and these grasses provide important nutrients to pregnant females and fawns.

5.2.8. Presence of invasive species

Apart from the impacts of cattle, species of domestic animals such as cats and dogs are also present. The Punjab Wildlife (Protection, Preservation, Conservation and Management) Act 1974 clearly states that no species can be introduced in the Protected Area especially in the Wildlife Sanctuary.

- Downstream Taunsa Barrage, a predatory carp like fish locally called as '*Mujahid*' or '*Fauji Khagga*', *Bugairui bugairuis*, was introduced in the area by Russian engineers when the Guddu Thermal Plant was under construction in 1970s. It is a highly prized species by the fishermen because of large size (maximum weight recorded so far is 150 kg). There are some reports that it is present from Chashma, Taunsa, Guddu, Sukkur to Kotri and Trimu Headworks (*Pers. comm.* Rana Zahid Iqbal, Superintendent, Punjab Fisheries Department). There are no reports of its catches in the last 5-6 year in Guddu and Sukkur stretch of the Indus, previously fishermen even claimed that it is capable of eating Indus Dolphin calf (*Pers. comm.* Hussain Bux Bhagat, Deputy Conservator, Sindh Wildlife Department).
- The introduction of exotic and fast growing trees in and around the Protected Area leads to further deterioration of the existing habitats. The resident bird species cannot adopt the changing habitat conditions, which results in the dispersal of local species from the area.

5.3. Socio-economic Issues and Threats

5.3.1. Lack of information and awareness

- Both the resident communities and the stakeholders seriously lack up-to-date information and awareness about the ecology and ecosystem of the Wildlife Sanctuary. Stakeholders, particularly, Irrigation, Fisheries and Wildlife Departments are considering the Sanctuary as an economic commodity, wherefrom they are generating income against leases and contracts. These Departments are not considering its ecological role, biodiversity value and the importance of ecosystem of the protected area. Communities, having abysmal situation of literacy are also ignorant about the basic environmental phenomena and its impacts on their lives, livelihoods and economy.
- There are only two information boards installed near the Barrage area on the left bank, which only warns general public and poachers against illegal hunting and mention the penalties. The rest of the Sanctuary area does not provide any information about the species or their conservation status. There is absolutely no information available for birds that are protected throughout the year and which cannot be hunted even if the license is available.

5.3.2. Poverty and limited livelihood opportunities

- The Sanctuary is an important source of livelihood for local people who meet their daily subsistence needs through various uses. Having scarcity of the diversified livelihood options in the face of rising poverty, local people illegally extract maximum resources e.g. timber, fuelwood, fish, NTFPs and forage to fulfil their domestic and other needs by earning money through sale of the extracted resources. In addition, lack of such

opportunities in the region has led to a great increase in subsistence hunting amongst the local people. This phenomenon continues to be unattended for the last several years, which has degraded the ecological integrity of the Sanctuary.

- In addition, brick kilns in Kot Addu located a few kilometres away from Taunsa Barrage burn date palm wood and *Tamarix* that apart from exacerbating pollution is also using resources that are likely to come from the Sanctuary. The local communities use these resources as a source to generate income to improve their livelihoods.
- There is also a limited role of the communities in the overall planning and management of the resources of the Sanctuary. The respective line Departments have not included locals in decision making which has resulted in the loss of ecological integrity of the Protected Area.

5.3.3. Non-biodegradable Pollution originating from broad range of human activities

Agro-chemical pollution

- The agriculture runoff is posing a threat to the aquatic fauna including fish and the Indus dolphin. Several marshy areas near the river are facing problems due to heavy use of fertilisers and pesticides in the vicinity. The buffer zone of the sanctuary is under agriculture use, the main crops of the area are cotton, wheat, mango and Til (*Sesamum indicum*). Farming community in buffer zone use a variety of chemical fertilisers and pesticides for enhanced crop production and pest control, respectively. These pesticides leach into the ground water and have potential harmful impacts on the water and through bioaccumulation can even impact endangered species like the Indus Dolphin. There are a great number of insectivorous birds, which are greatly affected due to these insecticides. The Agriculture Department advises farmers to poison grains before sowing; this practice is fatal to the grainivore birds of the Sanctuary.
- According to a joint research project of Pakistan-China European Union (1988-2001), it is shown that amongst the bird eggs, the highest levels correspond to DDTs, mainly DDE (87% in little egret and 98% in cattle egret). DDE is present in aquatic preys both, in fish and frogs collected in Taunsa, but not in the insects sampled in the terrestrial media. In the eggs, cyclodiene compounds are the second organo-chlorine pollutants in importance, followed by PCB's and HCHs. Due to lack of awareness, the ecological damage and human dangers of chemical pollution is increasing manifold.

Industrial pollution: Fatima Sugar Mills is located in the area which consume around 1,500-2,000 litres of water and generate about 1,000 litres of wastewater per tonne of cane crushed. The effluent is mainly floor washing wastewater and condensate water. Leakage in valves and glands of the pipeline add sugarcane juice, syrup and molasses in the effluent. The sugar mill effluent has a Biological Oxygen Demand (BOD) of 1,000-1,500 mg/litre, but appears relatively clean initially. Once the water is stagnant, it turns black and starts emitting foul odour. If untreated effluent is discharged in water courses, it depletes dissolved oxygen in water and makes the environment unfit for aquatic life. If untreated effluent is discharged on land, decaying organic solids and oil and grease clog the soil pores. According to the National Environment Quality Standards (NEQS) the BOD of waste water should be less than 80mg/litre.

Automobile Pollution

- Combustion of the fuel by automobiles and its subsequent release of heavy load of carbon and lead will be absorbed by the neighbouring vegetation, which may result in alteration of the physiology and internal metabolism of *flora* that may transfer these obnoxious gases to breeding birds.
- Diesel pumps for the extraction of water lead to leakage of oil, which directly pollute the river water.

Municipal pollution: Municipal pollution is increasing manifold generally due to the lack of proper management and inadequate technical capacity on part of the Environmental Protection Agency (EPA). It is disposed openly in heaps and was seen scattered along the river bank. This waste not only provides an un-aesthetic look but is an excellent substratum for a variety of disease causing organisms. Apart of this waste is carried into the river body by winds thus leading to a high oxygen demand and depletion of oxygen levels with harmful effects on the aquatic life.

Heavy metal pollution: Pollution by heavy metals is increasing in Taunsa Barrage due to the weathering of rocks of Suleiman Range and River Kabul. This is leading to detrimental effects on the biodiversity of the area particularly on the avi-fauna. Heavy metals like Chromium, Mercury and Lead have been detected in the eggs of little egrets and cattle egret. Cobalt and Iron are also found in a great quantity in the water at the Barrage (Pakistan-China European Union, 1998-2001).

6.0. Vision for the Taunsa Barrage Wildlife Sanctuary

6.1. Strategic Objectives

6.1.1. Management Planning

Management planning is a subset of the more general discipline of planning, applied to PAs across the globe but with varying degrees of success. It is a tool rather a process for guiding Park authorities on how an area should be managed, today and in the future. This process does not end with the production of the plan, but it requires that on-going monitoring takes place to test the effectiveness of the plan. Lessons learnt from monitoring should be used to review the appropriateness of management purposes and policies. This feedback loop may thus lead to amendments to the original plan, to keep it on the right track, or in additions to the next version of the plan that is produced.

Before embarking on the design of a Management Plan, a clear idea of the costs and available resources should be gathered, particularly where there are to be resource and user surveys, public consultation and engagement of consultants. A realistic appraisal needs to be made to ensure that all costs associated with the plan can be fully met, bearing in mind that the planning process may take some years to complete. In the case of Taunsa Barrage Wildlife Sanctuary, the financial allocations for the implementation of the management plan have been included in Pakistan Wetlands Programme to some extent. This further provides opportunities of implementation of interventions through partnerships and raising additional funds from national and international donors primarily to sustain PA operations and community interventions.

The time needed to prepare a Management Plan, for even a small site, is rarely less than 24 months due to the need for extensive consultations and surveys for addressing complex issues and subsequent drafting of the document. A realistic estimate of the time required should be made at the beginning of the process and allowed for.

Management by objectives is proactive rather than reactive and also 'results oriented' emphasising accomplishments and outcomes. Four distinct steps have been identified within this type of management and decision making:

- Formulation of clear, concise statements or objectives;
- Development of realistic action plans and implementation guidelines;
- Systematic monitoring and measuring of performance and achievement through reviewing the action plans and the implementation status of the guidelines; and,
- Taking corrective actions necessary to achieve planned results.

6.1.2. Guidelines for a good Management Plan

A management plan should be:

- Clear and accessible: easy to read, jargon free and well presented;
- Concise and comprehensive: no longer than is absolutely necessary;
- Accurate and objective: without major errors or statements likely to date;
- Systematic and logical: with management policies derived from an assessment of the site;
- Acceptable and motivating to all those with interests in and emotional attachment to site;
- Precise and practical: with clear objectives, realistic methods for achieving them;
- Focused and effective: fulfilling its purpose as a tool for site management;
- Precise with flexibility;
- Comprehensive with simplicity; and,
- Management oriented with ease of understanding by the public.

6.2. Developing management vision for Taunsa Barrage Wildlife Sanctuary

The management planning process should develop and articulate an ideal condition, state or appearance for the future of the PA. Vision statements describe the desired or envisaged result of the policies for the conservation of the PA and provide coherent direction for management objectives. Importantly a vision statement should be aspirational and should:

- Describe the kind of PA that the plan is seeking to achieve in the long-term. This will help people to understand what it is hoped the area will be like in the future, the reasons for this, and the action needed to achieve the vision;
- Be a long-term statement which is unlikely to change significantly over time. It should therefore provide continuity in the process of managing PA in a sustainable way; and,
- Include environmental, recreational, cultural, social and economic aspects of the area.

The vision statement for Taunsa Barrage Wildlife Sanctuary is as follows:

Taunsa Barrage Wildlife Sanctuary is envisaged as the flagship of a system of Wetland Protected Areas in the Punjab Province, where definitive measures are implemented to ensure the viability of the biological diversity and ecological processes according to the pre-set guidelines laid out in the management plan that also protects the heritage and enhances the livelihoods of local communities adjacent to the Protected Area.

Objectives follow from the management vision. They are more specific statements of intentions, setting out the conditions that management aims to achieve. They are thus statements of outcomes rather than how to achieve them. To the extent possible, these objectives should be prioritised to guide subsequent decisions and there is a need to reconcile the different objectives through appropriate planning responses.

In developing initial management objectives, a three-staged approach can be used:

- Design overall management objectives;
- Develop issue-specific management responses; and,
- Prepare initial management options that define management interventions

The following guidelines for writing generic and specific objectives helped to define objectives of the Taunsa Barrage Wildlife Sanctuary for its long-term sustainability:

- Precise/specific;
- Measurable, achievable and realistic;
- Reflect PA purpose, significance and exceptional values;
- Spell out the ends desired, but not the means to those ends;
- Adequately address the issues;
- Accompanied by a rationale; and,
- Written in priority order.

6.3. Describing management objectives for Taunsa Barrage Wildlife Sanctuary

Typically the specific management objectives for Taunsa Barrage Wildlife Sanctuary would be formulated to cover the following major aspects of PA planning and management:

- Human resource management;
- Effective law enforcement;
- Wildlife Sanctuary emergency services;
- Establishment, upgrading and maintenance of essential infrastructure and services;
- Wildlife management programmes;
- Ecological surveys and monitoring programme;

- Public information programme and awareness raising;
- Community outreach programmes;
- Research studies; and,
- Development of partnerships and linkages

6.3.1. Generic objectives of the Management Plan

Keeping in view the objectives of the establishment of Taunsa Barrage Wildlife Sanctuary, following management guidelines are presented for the effective improvement of PA and its resources:

- To have management policies that are oriented towards the conservation of natural resources of the region in general and Taunsa Barrage Wildlife Sanctuary in particular, and are based on realities with sufficient flexibility to accommodate existing human uses until alternatives are available for local subsistence;
- To have clear, specific and problem-oriented management objectives for the Sanctuary which, if achieved, could greatly help in meeting the overall objective of the PA; and,
- To have specific and feasible management action programmes for achieving individual objectives of the plan that could be easily monitored and evaluated at various stages of implementation.

6.3.2. Specific objectives of the Management Plan

The specific objectives of the Taunsa Barrage Wildlife Sanctuary management plan for effective implementation of the policies, objectives and action programmes are mentioned below. Success indicators and timelines may be assigned to these objectives during the development of workplans.

- To provide guidelines and set priorities for a baseline biodiversity assessment and to make the data accessible to the stakeholders for future management and research;
- To provide management planning and operational guidelines to the PA staff for the achievement of specific objectives for enhanced management;
- To help implement existing wildlife legislation in addition to meeting international conservation obligations;
- To protect and improve local status of the wildlife species of the Sanctuary in general and endangered and flagship species and their associated habitats in particular;
- To maintain close liaison with PA authorities for the improvement of existing infrastructure, communication and administration for effective law enforcement;
- To provide opportunities for engaging communities in planning and management for effectiveness of the conservation and protection efforts in the Sanctuary;
- To create alternate sources of income and energy for the traditional users to improve their quality of life and minimise their subsistence and dependence on the natural resources;
- To help build the professional capacity of the staff for effective administration and natural resource management;
- To enhance eco-tourism and improve visitors' facilities and services;
- To help improve scientific research on species and habitat management;
- To explore new avenues for improved management of the PA through developing partnerships and establishing linkages with local, national and international donors and partners; and,
- To enhance awareness of local communities and to build their capacity for improved resource management and exploring alternative livelihoods.

7.0. Process adopted for the development of Management Plan

7.1. Literature Review

An extensive literature review was carried out in order to collect relevant information for the site. All sources of information such as: WWF – Pakistan’s library, Internet, previous records of Punjab Wildlife and Parks Department and Irrigation Department and reports from other projects being operational in the area, were used to collect and analyse relevant information for the development of management plan for the site.

7.2. Ramsar Guidelines

Well established Ramsar Guidelines were followed for the development of this management plan. The Ramsar guidelines consisted of three different sections: (i) Description of the area, (ii) Evaluation and objectives; and, (iii) Action Plan, which were used for the development of management plan of Taunsa Barrage Wildlife Sanctuary.

7.3. Previous Management Plans

A draft management plan was developed during 1990’s for Taunsa Barrage Wildlife Sanctuary by Punjab Wildlife and Parks Department, but was not finalised. The draft plan contained necessary information regarding the site and was helpful in developing the next generation of wetland management plan of this site.

7.4. Environmental Assessment and Monitoring

During 2005 – 2008, extensive environmental assessment and monitoring were carried out by WWF – Pakistan as a part of the Taunsa Barrage rehabilitation and modernisation project, funded by the World Bank. This was the first ever comprehensive baseline assessment of the Ramsar Site which revealed significant hydrological, physical, ecological and socio-economic information. This sets the basis for most of the information being reflected in this document. In addition, socio-economic assessment, community discussions and partner meetings helped in further redefining the priorities set in the current management plan.

7.5. Post Flood Ecological Assessment 2010

The recent floods of 2010 were the worst in the history of Pakistan in terms of damage to human life, livestock, infrastructure and agriculture in addition to ecosystem losses. WWF – Pakistan carried out an extensive post flood ecological assessment of the area. A few relevant data was also used from this assessment in the current document in order to further enhance its suitability to the site.

7.6. Field Observations and Meetings

WWF – Pakistan has been involved in the conservation and management of significant wetlands of the country through enhancing awareness, capacity-building programmes and improving management. The Pakistan Wetlands Programme has been working in this region and has its presence in the region for the last 5 years while working with communities and other government and non-government partners. During this time, several issues have emerged as a result of unsustainable use of the natural resources. These issues have been clearly highlighted in the present document.

7.7. Community Consultations and Partner Meetings

During the implementation process of the Pakistan Wetlands Programme, extensive consultations are being made, which has helped in redefining issues and the suggested solutions. Several detailed consultations with the staff of the Punjab Wildlife and Parks Department have already been organised but some issues still need more discussion as our knowledge and information improves.

8.0. Strategic Plan for Management

Taunsa Barrage Wildlife Sanctuary faces a number of anthropogenic pressures. Several pressures are rooted in social and economic issues that are far too wide ranging and endemic for any meaningful intervention at a site specific level. Poverty, for instance, is pervasive in the region as is social class. Political influence, too, is rooted in land ownership and results in direct control of the Sanctuary. However, a few meaningful steps can still be initiated to promote an improved condition of the Sanctuary.

8.1. Management interventions

8.1.1. Objectives of management interventions

The major objectives for these management interventions are to:

- Clarify roles and responsibilities of various government line agencies at the provincial level to resolve issues of resource ownership conflicts in wetlands conservation;
- Enhance coordination between various partners in wetlands conservation in order to effectively address site level management issues; and,
- Help build the technical skills and knowledge of the staff of government line agencies and other partners in improved management of wetlands.

8.1.2. Strategic Interventions

8.1.2.1. Provincial Wetlands Management Committee: A Provincial Wetlands Management Committee will be formulated to promote wetlands conservation at the highest level within the province. This will not only facilitate the implementation of various wetlands management international conventions, national policies and provincial rules and regulations but will also effectively enhance coordination among various stakeholders in order to clarify their roles and responsibilities, which should be clearly defined in the Terms of References of the Committee. The Committee members include nominations from various Departments including Punjab Irrigation and Power Department, Punjab Forestry, Wildlife and Fisheries Department, Planning and Development Department, Punjab Tourism and Resort Development Department, Punjab Environmental Protection Agency and representatives of WWF-Pakistan under the Chairmanship of provincial Secretary Forestry, Wildlife and Fisheries Department.

8.1.2.2. Site Level Wetlands Management Committee: The site level wetlands management committees will be formulated to help implement wetlands conservation interventions at the level of individual wetland. The Committee will be responsible for increased coordination at the site level which will promote partnerships and linkages in order to strengthen individual wetlands conservation. The Committee members include nominations from the local representatives of various Departments and community members preferably under the Chairmanship of respective Deputy Director Wildlife, as wetlands conservation is the provincial agenda to be tackled by Punjab Wildlife and Parks Department or the respective District Coordination Officer (DCO) as it comes under the overall administration of the District Government. The Terms of References for the Committee should be clearly defined in order to improve the status of individual wetlands, which will meet more regularly to discuss management, ecological and social issues.

8.1.2.3. Improved law enforcement through additional trained staff: Keeping in view the significance of the biodiversity of the wetland, the present staff deputed for the Wildlife Sanctuary by the Punjab Wildlife and Parks Department is inadequate, which is mostly based outside the Sanctuary area. There is a need to depute at least a senior staff officer (BPS 17) and associated eight protective field staff under his supervision for wetlands and associated biodiversity conservation at the Sanctuary.

Additional trained field staff in proper management and ecological techniques necessary for the up-gradation of the natural resources of the Sanctuary, community liaison, field data recording and reporting, law enforcement initiatives, effective linkages and partnerships through dialogues with other departments should be placed in the Sanctuary.

In addition, based on the ecological assessment of the Sanctuary, the already defined area for the Sanctuary needs to be revisited and re-notified accordingly.

8.2. Ecological interventions

8.2.1. Objectives of Ecological Interventions

The major objectives of ecological interventions are to:

- Establish monitoring protocols for the regular assessment of ecological needs and upgrade information in the national and international databases regarding Taunsa Barrage Wildlife Sanctuary;
- Maintain and improve the ecological integrity of the Sanctuary through improved ecological interventions related to reducing harmful practices (pollution, hunting / poaching, illicit cutting, illegal fishing practices, unsustainable extraction of NTFPs, forest fires etc.); and,
- Promote the sustainable use of natural resources for the local communities living in and around the Wildlife Sanctuary.

8.2.2. Strategic interventions

8.2.2.1. *Forest Fires:* Intentional forest fires should be stopped through regular interaction and dialogues with the local communities who graze their cattle and other livestock within the Sanctuary for fresh vegetative cover in the next growing season. The significance of the Protected Area and its associated biodiversity especially as a habitat for Hog Deer (*Axis porcinus*) needs to be enhanced through effective awareness raising initiatives and promoting harmful effects of forest fires.

8.2.2.2. *Illegal hunting/poaching of Wildlife*

- Information is particularly needed on the distribution, abundance and habitat of micro and mega fauna species. Biodiversity indices are particularly valuable for monitoring the abundance of species for evaluating the effect of human disturbance. Wildlife monitoring programmes should be conducted on regular basis to determine the population trends.
- Taunsa wildlife sanctuary is a protected area for more focused efforts to conserve biodiversity. The extent and configuration of protected areas should be based on information on resident and migratory wildlife, movement patterns, suitability of available habitat for aquatic wildlife and potential for reducing threats.
- Strict law enforcement should be practised within the Sanctuary area with the help of additional trained staff and through effective monitoring and watch and ward. This could be achieved through an active support of the local partners e.g. communities and other CBOs, who are living in and around the Protected Area. In addition, local tribal chiefs can be contacted in order to get support to enhance the status of wildlife species in the Sanctuary.
- Regular awareness campaigns related to illegal sport hunting of Waterfowls need to be initiated. There is a need to organise a “*Waterfowl Sport Hunters Meet*” in collaboration with the senior staff of the Punjab Wildlife and Parks Department to discuss the issues of illegal waterfowl hunting in the province. Regular contacts and dialogues need to maintain with the *Punjab Chapter* of the Waterfowl Sport Hunters

and law enforcement and awareness raising initiatives need to be implemented jointly in collaboration with all stakeholders.

- Periodic monitoring checks of the large mammals especially Hog Deer needs to be carried out jointly by the staff of WWF-Pakistan and Punjab Wildlife and Parks Department. It is also proposed to install night vision, coloured camera traps for the assessment of population of Hog Deer. Local communities and support organisations should be strengthened to effectively protect Hog Deer against illegal hunting /poaching. In addition, the local staff of the Punjab Wildlife and Parks Department and the selected community representatives should be trained for emergency situations, especially during floods to rescue large mammals. Further, the staff of the Punjab Wildlife and Parks Department should be trained in mass capture and translocation of large mammals for effective wildlife management.
- An effective network of local communities should be strengthened to stop poisoning of freshwater turtles. A well targeted awareness campaign is needed to initiate turtle conservation in and around the Protected Area. Provincial legislations and the international conservation status of the species support the highest protection levels of the species but there is a need to work closely with communities to stop this illegal practice. In addition, there is a need to blacklist all traders, highlight them in the print and electronic media and strict punitive actions should be taken against the culprits. As far as the identification of turtles and their parts are concerned, a series of training events should be organised for the staff of Wildlife Departments and Pakistan Customs Department to enhance their level of understanding and confiscate such efforts of consignments which are destined to international destinations. Further, serious efforts should be made within the country to monitor wildlife trade in the country through establishment of a representative office of the Global TRAFFIC network, which will not only act as a watchdog in the country but will also strengthen the capacity of the stakeholders to stop such practices.

8.2.2.3. *Illegal fishing practices*

- *Over-fishing:* Over-fishing is an illegal practice and should be stopped in the pond area which is only possible through regular interaction and frequent dialogues at the highest level i.e. Punjab Provincial Wetlands Management Committee. This could be brought as an agenda item for discussion in the Committee meeting. In addition, strict protective measures need to be adopted for those fishermen who are active in the pond area especially during the fish breeding season. Alternate livelihood opportunities need to be discussed and implemented with the fishermen communities to support their daily subsistence needs to avoid fishing during the breeding seasons. Code of ethics for fishing all year round needs to be developed and fully implemented in collaboration with the fishermen and the contractors.
- *Introduction of exotic fish species:* Punjab Fisheries Department in collaboration with Punjab Wildlife and Parks Department should supplement the existing fish stock in the pond area with local species, which will help in phasing out the exotic species. As defined in the Wildlife Sanctuary regulations, the exotic species should not be introduced because it competes with the local fauna in terms of its competition with food and breeding grounds. This could be debated at the provincial level (Committee), where all the stakeholders discuss and help maintain the ecological integrity of the Taunsa Barrage Wildlife Sanctuary.
- *Use of illegal mesh size:* The issue of illegal mesh size should be closely monitored by the Punjab Fisheries Department in order to put a check on local fishermen and contractors. There is a need to review the contract which is signed between the Punjab Fisheries Department and the contractor, which should include a specific clause of

penalties if there are any violations observed. In addition, a specific well targeted awareness campaign describing the harmful impacts of smaller mesh size highlighted and fishermen communities (*Mohannas*) taken into confidence which will ensure long-term big catch in the Sanctuary's pond area.

- *Lack of recruitment facilities:* A specific fish size should be allowed for each species from the Sanctuary area. It is a matter of law enforcement and the contractor should be fined for any violations in the contract. The availability of the smaller fish may also help in providing abundant food for migratory waterfowls as well as for the smaller population size of Indus Blind Dolphin (*Platanista minor*) upstream.
- *Illegal fishing in closed areas:* A well targeted awareness campaign coupled with developing alternate livelihood opportunities for the local communities and fishermen should be launched. The closed areas to maintain and regulate fish stock near to Barrage gates as specified by the Punjab Fisheries Department in collaboration with the contractor should be monitored effectively and strict penalties defined for any violations. It is also proposed to allocate a specific share of fish at cheap rates by the contractor at the Barrage site on specific days in order to support local communities.
- *Illegal fishing during closed seasons:* A strict watch and ward mechanism should be implemented by Punjab Fisheries Department in collaboration with contractor, especially through an establishment of a committee. The breeding areas and seasons are inevitable for maintaining healthy stocks of fishes especially from June to August. Poachers should be heavily fined under the Punjab Fisheries Act and Punjab Wildlife Act as both the regulations support either poaching of fish during breeding season or illegal fishing in the Protected Area.
- *Lack of appropriate fish data:* There is a need to establish baseline information about the fish catch and the yearly limits for the catch by the Punjab Fisheries Department. Specific protocols for long-term monitoring need to be developed which may help the Department in establishing scientific information regarding population abundance, growth, recruitment and mortality rates, relationship between catch from a stock and the amount of fishing, and the size of fish at first capture.
- *Fishing rights:* A local level committee in collaboration with Punjab Fisheries Department may place a monitoring check on the contractor for fish catch of specific size and weight, depending on the species. In addition, specific penalties are defined for violations which may even result in the cancellation of contract. It is also proposed to promote local contractors to avail the chance of getting contract for the Pond Area.
- *Ineffective fish ladders:* Recent modernisation of the Taunsa Barrage Wildlife Sanctuary has improved the fish ladders to a great extent but still there are reports of Dolphin mortality. The impact of newly developed fish ladders needs to be studied in the perspective of Indus Dolphin and a research study should be commissioned.

8.2.2.4. *Illicit fuelwood extraction / Habitat destruction*

- *Fuelwood extraction:* Feasible, acceptable and easily installable alternate energy options should be explored in order to reduce pressure on natural forests of the Wildlife Sanctuary. Keeping in view the lessons learnt during implementation of various biodiversity conservation and community development projects, it is strongly proposed to focus on the provision of Biogas plants, fuel-efficient stoves, energy plantations of salt tolerant species for fuelwood, solar geysers and solar cookers. Community share has also been proposed a minimum of 20% of the total cost of the unit. There are several agencies and organisations working in this sector that includes Punjab Dairy Development Council (PDDC), Pakistan Council for Renewable Energy Technology (PCRET), should be contacted for installation of these alternate energy options on a cost

sharing basis. These options may reduce pressure on natural indigenous flora but a research study needs to be commissioned in order to determine the impacts of such options on the existing fuelwood use by local communities.

- *Habitat destruction:* Based on the options mentioned above (section 5.3.4.1) and while working with community groups through conservation agreements, monitoring of fuelwood extraction from the Sanctuary area will be checked. In addition, effective watch and ward mechanism should be established in collaboration with the local monitoring team established as Village Wetlands Conservation Committees. The local communities should not be allowed to extract fuelwood from the core zone of the sanctuary which is the main habitat of Hog Deer. However, initiatives such as energy plantations of salt tolerant species, livelihood improvement through the sustainable use of natural resources (baskets, ropes, mats, etc.) in the buffer zone, may provide an opportunity for the core zone to provide safe habitat to the remaining population of Hog Deer and other large mammals and resident breeding birds. A well targeted awareness campaign may also help in conserving biodiversity of the area.

8.2.2.5. *Encroachment:* There is a need to determine a baseline assessment of status of land encroachment inside the Wildlife Sanctuary for agro-pastoral purposes. In addition, there is also a need to determine the baseline assessment of wildlife of the region, which is being affected from illegal encroachment and habitat destruction as a result. Once the assessment is complete in all terms with the support of GIS facility and a general consensus amongst the stakeholders is reached, the information should be sent to relevant government authorities for necessary action in order to protect the ecological integrity of the Sanctuary. In addition, awareness coupled with alternate livelihood opportunities for the local communities should be launched in order to reduce harmful practices within the core zone of the Sanctuary. Floodplain management also needs to be carefully undertaken through various land uses plans which will not only reduce the risk of damage to human life, livestock and infrastructure but will also be beneficial to the healthy ecosystem, which is in one way, generates source of revenue for the local communities

8.2.2.6. *Unsustainable extraction of Non Timber Forest Products*

- *Unsustainable use of Non Timber Forest Products:* A baseline assessment needs to be conducted to know the status and kind of communities involved in NTFPs for earning their livelihood. A comprehensive set of information needs to be developed e.g. list of natural resource based products, species used, area from where the NTFPs are collected, quantity of NTFPs collected, income generation from these products in order to appreciate the role of wetlands in livelihood generation, quality of products etc. This exercise would be helpful in improving the status of not only the vegetation being collected in and around the Sanctuary area, but will also help in devising a strategy for sustainable extraction of the NTFPs. The recommendations of the assessment will provide opportunities for the local communities to further improve and enhance their livelihood from natural resource based products.
- *Value Addition of NTFPs:* In order to reduce collection of Typha and Tamarix sp, a supply chain analysis of basket weaving and other products needs to be undertaken to identify potential areas for value addition to this activity and the findings can be incorporated in a small-scale business support venture to increase value. This could be tied to agreements on reducing extraction levels inside the Sanctuary.
- *Missing link with urban market for promotion of community products:* The role of middlemen needs to be reduced in order to fetch better economic opportunities for the local communities involved in developing natural resource based products. A range of activities needs to be initiated at sites within the project area which include development of Community Resource Centres with displays of community products at Taunsa Barrage

and Kot Addu, Conservation and Information Centres with corners for community products at Taunsa Barrage, displaying products at exhibitions (Lahore and Islamabad) and nature carnivals (Faisalabad, Lahore, Karachi, Islamabad), Vocational Training Centres especially for women, etc. In addition, the products already being sold in the markets need to be studied and local communities should be guided and advised for value addition of their products. Commercial players in the market especially at Kot Addu, Muzaffar Garh, Dera Ghazi Khan and Multan should be introduced to the communities so that communities can negotiate directly for their products and prices. This may help the communities in their livelihood improvement and also enhance protection status of the Sanctuary.

8.2.2.7. *Illegal grazing of domestic livestock in the Protected Area*

- *Impacts of illegal grazing in and around the Protected Area:* A partnership agreement needs to be signed with the Village Wetlands Conservation Committees surrounding the Sanctuary area over the use of grazing areas for their domestic livestock in order to protect the remaining habitat for large mammals such as Hog deer. Initiation of alternate livelihood opportunities, alternate energy options and partnership for enhanced involvement in protected area planning and management coupled with local monitoring and watch and ward mechanism will effectively address the domestic livestock grazing issue.
- *Competition with domestic livestock:* Livestock vaccination and de-worming coupled with awareness campaign should be launched in order to avoid disease transmission especially from domestic to wild ungulates. In addition, effective law enforcement and partnership agreements with village committees will further help in the protection of the Sanctuary area especially the core zone, as they both compete for food and shelter and there is an increased risk of disease transmission as well. Grazing in the buffer zones can be managed jointly by the local people in collaboration with the field staff of Punjab Wildlife and Parks Department through grazing on rotational basis. The core zone should be completely banned from grazing as these grasses provide important nutrients to pregnant Hog deer females and fawns.
- *Fodder options:* In order to reduce grazing pressure on the Sanctuary, fodder options also need to be explored further especially for households in *Loomarwala Basti*.

8.2.2.8. *Presence of invasive species:* The Punjab Wildlife (Protection, Preservation, Conservation and Management) Act 1974 clearly states that no species can be introduced in the Wildlife Sanctuary and this can be effectively addressed through local law enforcement and in collaboration with communities. In addition, invasive and introduced fish species need not to be supplemented in the main channel especially in the pond area. The Punjab Fisheries Department should be contacted and the issue of exotic species should be discussed as an agenda item in the Punjab Provincial Wetlands Management Committee meeting. This committee is chaired by Secretary Forestry, Wildlife and Fisheries, where all the relevant heads of the Departments are present in addition to other stakeholders. Punjab Forest Department may also be requested for not promoting exotic fast growing tree species in and around the Sanctuary area. The local tree species provide shelter and habitat to a wide range of birds and animals.

8.3. Social Interventions

8.3.1. Objectives of Social Interventions

Any efforts towards initiating community participation need to be carefully chosen with a long-term view rather than short-term project implementation aims. Communities in the region follow occupations that have been handed down to them over generations and with low literacy and few economic development opportunities, there are limited alternatives for them. Any change in livelihoods initiated for the duration of a short-term project are likely

to make little permanent mark on changing the extraction patterns that characterise anthropogenic pressure on the Sanctuary. Since the area is characterised by high levels of poverty, especially among communities that use the Sanctuary's resources, promoting people's participation can play a key role changing the management and use of the Sanctuary. However, the existing social structure of the area is extremely hierarchical and the influence of large land owners is undeniable. Introducing any social organisation in such a region must be a very slow and sustained approach.

The main objectives of social interventions are to:

- Organise local communities into Village level Wetlands Conservation Committees for improved management of the natural resources of the Taunsa Barrage Wildlife Sanctuary.
- Improve the social maturity of the established committees through registration as Community Citizen Boards (CCBs) for their efficient involvement and in improved management of the existing natural resources of the area.
- Promote collaborative management approaches with local communities through signing partnership agreements and dialogues to reduce harmful practices for improving biodiversity conservation and community development.
- Enhance conservation awareness level of the local communities living in and around the Protected Area for effective management of the resources.

8.3.2. Strategic Interventions

8.3.2.1. Village level Wetlands Conservation Committees: Information of the existing Protected Area and the surrounding communities and other stakeholders should be mapped in order to define the boundaries of the project interventions. Initial contacts and dialogues should be made with local communities through existing CBOs and Village level Wetlands Conservation Committees (VWCCs) will be established. Separate women committees will also be established in order to recognise their specific role in wetlands resource use and management. A network of VWCCs need be established and partnership agreements should be signed for collaborative management of resources. Terms of References, Constitution and Nominations of the Committees should be developed accordingly.

8.3.2.2. Community Citizen Boards (CCBs): The established VWCCs should be registered with the Social Welfare Department as CCBs to enhance their status based on their involvement, performance and maturity level. The CCBs should be provided training in Office and accounts management, proposal development, developing linkages and partnerships, field level implementation of interventions etc.

8.3.2.3. Poverty and limited livelihood opportunities

- As already mentioned in Ecological Interventions, there is a need to develop a series of alternate livelihood development opportunities for the local communities. This may also include components of well organised eco-tourism options in the Sanctuary, which involves local communities to a great extent. This should be further enhanced by signing partnership agreements with Punjab Tourism and Resort Development Department and other Tourism related projects in the province. Taunsa Barrage Wildlife Sanctuary holds the potential to become a tourist spot as long as tourist numbers to the area are carefully controlled. It is fairly close to the Barrage and quite easily accessible by boat to a steady stream of tourists from Multan and adjoining areas. In particular, the area has attracted people for the Indus Boat Safari and the Sanctuary can form an added attraction for an existing tourism base. However, the facilities for tourism need further development.

Well-managed tourism can contribute to conservation while providing employment and revenue to the local communities. At a minimum, local people should be trained and hired as guides, boatmen, and support staff. Tourism must be managed to ensure that it does not contribute to environmental degradation or cultural disintegration. A portion

of all profits should be invested in local conservation and social development. Programmes that use participating tourist to accomplish research and conservation goal should be encouraged.

- Further, training should be imparted to local communities in various alternate livelihood skill development and enhancement, establishment of fruit orchards, improved fishing practices, poultry farming, apiculture and kitchen gardening etc. in addition to the use of natural resource base products. A study of brick kilns also need to be conducted to determine the level of natural resource use for generating the income opportunities of the communities living on the edges of the Protected Area.

8.3.2.4. Non-biodegradable Pollution originating from broad range of human activities: A preliminary assessment need to be conducted to determine the pollution loads in the Indus River especially in the Wildlife Sanctuary. Based on the detailed assessment of the area with regards to pollution, a pollution disaster and management plan should be developed keeping in view the international monitoring standards. This should include the source of pollution, kind of pollution, impacts on biodiversity, sampling and analysis, presentations to various stakeholders, partners involved in addressing the issues, options of treatment plants, recommendations for improvement or mitigation plan and an activity schedule for stakeholders to work on. This plan will address all issues related to agro-chemical pollution through Integrated Pest Management, industrial pollution through treatment effluent plants, automobile pollution, chemical pollution and municipal pollution. Keeping in view the expertise available with WWF-Pakistan's Freshwater and Toxics Programme and the role of Punjab Environment Protection Department in overall addressing pollution issues in the province, detailed terms of references and the budget should be developed for effective development of the plan. Further, project proposals should be developed for implementation of the plan in collaboration with the partners. Partnership should be developed with other projects and programmes already initiated in the region.

8.3.2.5. Lack of information and awareness: Training and awareness-raising initiatives may be good means of promoting some change and have already shown results in sensitising the local communities towards the conservation of the Indus Dolphin in Sindh Protected Areas. However, these need to be backed with tangible economic incentives for local people to ensure that any gains in conservation are not attained through a resultant increase in vulnerability of rural livelihoods. There is a need to establish an ecological role of the Sanctuary not as an economic commodity. The biodiversity value and the importance of the ecosystem of the Protected Area need to be enhanced and promoted to general public. The resident communities and the stakeholders seriously lack up-to-date information and awareness and the basic environmental phenomena and its impacts on their lives, livelihoods and economy. The information boards and the resource material need to be developed and installed for the Sanctuary at prominent places in collaboration with Punjab Wildlife and Parks Department to enhance species or their conservation status, promote information regarding migratory and resident birds, code of ethics and the protection status of wildlife of the Sanctuary. In addition, an Information Centre for the Taunsa Barrage Wildlife Sanctuary is proposed that can address such education and awareness raising objectives. In this regard, a tripartite MoU has already been signed between Punjab Wildlife and Parks Department, Punjab Irrigation Department and WWF-Pakistan that discusses roles and responsibilities of each party for the sustainable management of the Sanctuary.

9.0. Implementation Plan

There are 78 interventions that have been grouped together in three major components for effective implementation of the management plan for Taunsa Barrage Wildlife Sanctuary. These include Management interventions, Ecological interventions and Socio-economic interventions and are presented in the form of a matrix that not only includes the priority for an individual intervention but also describes the responsibilities of the primary and secondary stakeholders in order to guide implementation of the recommendations. These interventions are a result of our community discussions and field observations and experiences in the region. However, consultative meetings with Punjab Wildlife and Parks Department will result in further redefining the interventions.

The time frame for this management plan is 10 years. It is intended that all interventions will be implemented during this time frame. Some interventions are already being implemented under the Pakistan Wetlands Programme, but the priority assigned to each intervention can be used for guidance in their implementation. All those interventions which are going to be initiated and completed by the end of PWP will be presented in the form of a matrix. In addition, individual activity level workplan also needs to be developed for effective implementation of the interventions.

In addition, species specific management plans are also described in the form of a matrix, which describes the species and related issues, possible set of prescriptions, means of verifications, responsibilities and the time frame. The list of species discussed in the management plans describes the entire Central Indus Wetlands Complex stretch and their overall distribution range but most of the species ranges are covered in Taunsa Barrage Wildlife Sanctuary. The information described is for the entire habitat range of the species, which will ultimately be a part of the overall complex level management plan. A few significant species of interest are mentioned in this management plan.

Funding to implement interventions of this management plan can be sought from a range of potential donors through developing proposals, co-financing, in kind contributions from existing programmes and building partnerships with other government line agencies.

Matrix showing interventions, responsibilities of implementing partners with priorities

| # | Interventions | Priority | Responsibility | | Duration |
|-----------|---|----------|--------------------------------------|---|---------------|
| | | | Primary | Secondary | |
| 1. | Management Interventions | | | | |
| 1.1. | Establish Provincial Wetlands Management Committee under the Chairmanship of Secretary Forestry, Wildlife and Fisheries, Government of Punjab with representatives of other relevant Departments to guide wetlands conservation in the province. | High | WWF-Pakistan | Punjab Forestry, Wildlife and Fisheries Department | Immediate |
| 1.2. | Establish Site Specific Wetlands Management Committee under the Chairmanship of respective Deputy Director, Wildlife (Punjab Wildlife and Parks Department) with local representatives of other line Departments to help implement specific wetlands interventions at the Site level. | High | WWF-Pakistan | Punjab Forestry, Wildlife and Fisheries Department | Immediate |
| 1.3. | Depute additional eight Wildlife Watchers for enhanced protection and monitoring of Taunsa Barrage Wildlife Sanctuary (Ramsar Site) especially for Hog deer, Freshwater Turtles, Indus Dolphin and curbing illegal hunting during bird migratory season | High | Punjab Wildlife and Parks Department | Punjab Fisheries Department, Punjab Irrigation Department | Short-term |
| 1.4. | Depute one senior Wildlife Officer of BPS 17 with office at Taunsa Barrage / Kot Addu for effective management of wetlands and associated biodiversity related interventions. | Medium | Punjab Wildlife and Parks Department | - | Short-term |
| 1.5. | Train field Wildlife Watchers in "wildlife identification techniques, survey techniques, data recording and compilation, use of binoculars and spotting scope, first aid, emergency services and effective watch and ward" | High | WWF-Pakistan | Punjab Wildlife and Parks Department | Short-term |
| 1.6. | Train local community activists in effective watch and ward, to support wetlands and biodiversity conservation in and around Wildlife Sanctuary | High | WWF-Pakistan | Punjab Wildlife and Parks Department | Short-term |
| 2. | Ecological Interventions | | | | |
| 2.1. | Forest Fires | | | | |
| 2.1.1 | <i>Liase with livestock herders / grazers to stop intentional forest fires in order to protect habitat for Hog deer and other large mammals found in "Bela".</i> | High | WWF-Pakistan | Punjab Forest Department | Short-term |
| 2.1.2 | <i>Provide training to Community Activists and Wildlife Watchers to stop forest fires (Emergency services)</i> | High | WWF-Pakistan | Punjab Wildlife and Parks Department | Medium - term |
| 2.1.3 | <i>Explore alternate fodder options for domestic livestock in collaboration with local communities (VWCCs)</i> | Medium | WWF-Pakistan | Other local Partners | Long-term |
| 2.2. | Illegal hunting / poaching of wildlife | | | | |
| 2.2.1 | <i>Undertake regular wildlife monitoring programmes, especially Hog Deer, Smooth Coated Otter, Indus Dolphin and Freshwater turtles in collaboration with partners</i> | Medium | Punjab Wildlife and Parks Department | WWF-Pakistan | Long-term |
| 2.2.2 | <i>Recommend changes (if any) in the Protected Area boundaries based on the ecological assessment and needs of the species in question.</i> | Medium | WWF-Pakistan | Punjab Wildlife and Parks Department | Medium - term |
| 2.2.3 | <i>Contact local tribal chiefs and other community activists to seek their support in curbing illegal hunting of wildlife</i> | Medium | WWF-Pakistan | Punjab Wildlife and Parks Department | Long-term |
| 2.2.4 | <i>Initiate regular awareness campaigns with waterfowl sport hunters by organising a "Waterfowl Sport Hunters Meet" to seek their sport and influence in the area</i> | High | WWF-Pakistan | Conservation and Hunting Association of Pakistan (CHAP) | Long-term |

| # | Interventions | Priority | Responsibility | | Duration |
|--------|---|----------|-----------------------------|---|---------------|
| | | | Primary | Secondary | |
| 2.2.5 | Install night vision, coloured trap cameras for the population assessment of large mammals especially Hog deer in the Bela and other suitable habitats | Medium | WWF-Pakistan | Punjab Wildlife and Parks Department | Medium - term |
| 2.2.6 | Train local communities in "rescue operations and immediate response" during emergency situations for large mammals especially Indus Dolphin and Hog Deer | Medium | WWF-Pakistan | Punjab Wildlife and Parks Department | Medium - term |
| 2.2.7 | Train the staff of Punjab Wildlife and Parks Department in mass capture and translocation of ungulates (Hog Deer) in order to supplement wild populations from captivity for population viability | Low | WWF-Pakistan | Punjab Wildlife and Parks Department | Long-term |
| 2.2.8 | Initiate awareness campaign against illegal poachers, and traders regarding freshwater turtles surrounding Taunsa Barrage Wildlife Sanctuary | High | WWF-Pakistan | Punjab Wildlife and Parks Department | Long-term |
| 2.2.9 | Strengthen the established communities in watch and ward and immediately inform the government authorities | High | WWF-Pakistan | Punjab Wildlife and Parks Department | Long-term |
| 2.2.10 | Provide training to the staff of Punjab Wildlife and Parks Department and Pakistan Customs Department in identification of freshwater turtle and their parts | High | WWF-Pakistan, TRAFFIC | Punjab Wildlife and Parks Department & Pakistan Customs | Long-term |
| 2.2.11 | Support the TRAFFIC Pakistan Office to effectively monitor wildlife trade especially freshwater turtles | High | WWF-Pakistan, TRAFFIC | Punjab Wildlife and Parks Department | Long-term |
| 2.3. | Illegal fishing practices – over fishing | | | | |
| 2.3.1 | Discuss the issue of over-fishing as one of the agenda items in the Provincial Wetlands Management Committee | High | WWF-Pakistan | Punjab Fisheries Department | Long-term |
| 2.3.2 | Explore the possibility of introducing alternate livelihood options for the fishermen communities to avoid fishing during breeding season | High | WWF-Pakistan | Punjab Fisheries Department | Medium - term |
| 2.3.3 | Enforce strict measures for fishermen and the contractor for over-fishing (small size and weight) and especially during breeding season | Medium | Punjab Fisheries Department | WWF-Pakistan | Medium - term |
| 2.3.4 | Display code of ethics for fishing in the pond area | Medium | WWF-Pakistan | Punjab Fisheries Department | Long-term |
| | Illegal fishing practices – introduction of exotic species | | | | |
| 2.4.5 | Supplement the existing fish stock of the pond area with local species in order to phase out exotic species and to reduce their impacts on the aquatic flora and fauna | Medium | Punjab Fisheries Department | Contractor | Long-term |
| 2.4.6 | Discuss the issue of exotic species in the natural waters in the meeting of Provincial Wetlands Management Committee in order to maintain the ecological integrity of the Protected Area | Medium | Punjab Fisheries Department | - | Long-term |
| | Illegal fishing practices – Use of illegal mesh size | | | | |
| 2.3.7 | Review the existing contract of the Contractor and make necessary changes regarding the use of mesh sizes in the pond area to ensure a big catch in future | Medium | Punjab Fisheries Department | Contractor | Long-term |
| 2.3.8 | Initiate a well targeted awareness campaign for local fishermen and others regarding the use of smaller mesh sizes to avoid catching small size and under-weighted | Medium | WWF-Pakistan | Punjab Fisheries Department | Long-term |
| | Illegal fishing practices – Lack of recruitment facilities | | | | |
| 2.3.9 | Review and make necessary changes in the contract with Contractor on the catch of small size fish used as a food for Indus Dolphin, develop the next generation of large size of the fish and recommend the cancellation of the contract of the Contractor, if found in such business | Low | Punjab Fisheries Department | Contractor | Medium - term |

| # | Interventions | Priority | Responsibility | | Duration |
|--------|--|----------|---------------------------------------|-----------------------------|---------------|
| | | | Primary | Secondary | |
| | Illegal fishing practices – Illegal fishing during closed seasons and closed areas | | | | |
| 2.3.10 | <i>Initiate a well targeted awareness campaign for the fishermen and other local community members to avoid fishing in closed areas and closed seasons for next generation of fish, and also avoid harmful practices of poisoning by local communities</i> | Medium | WWF-Pakistan | Punjab Fisheries Department | Medium - term |
| 2.3.11 | <i>Monitor fish catch near the Barrage Gates during breeding seasons</i> | Medium | Punjab Fisheries Department | WWF-Pakistan | Medium - term |
| 2.3.12 | <i>Initiate the mechanism of fines to poachers involved in over-fishing during breeding seasons and closed areas</i> | Low | Punjab Fisheries Department | Contractor | Long-term |
| 2.3.13 | <i>Specify a specific share of fish to local communities at the Barrage site at cheap rates, as it should be mentioned in the Contract, to avoid harmful fishing</i> | Medium | Punjab Fisheries Department | Contractor | Long-term |
| | Illegal fishing practices – Lack of appropriate fish data | | | | |
| 2.3.14 | <i>Establish baseline scientific information about the fish catch and the yearly limits for the catch by the Punjab Fisheries Department. This include information regarding population abundance, growth, recruitment and mortality rates, relationship between catch from a stock and the amount of fishing, and the size of fish at first capture</i> | Medium | Punjab Fisheries Department, Academia | WWF-Pakistan | Medium - term |
| | Illegal fishing practices – Fishing rights | | | | |
| 2.3.15 | <i>Establish a local level committee in collaboration with Punjab Fisheries Department for a monitoring check on the contractor for fish catch of specific size and weight, depending on the species.</i> | Medium | WWF-Pakistan | Punjab Fisheries Department | Medium - term |
| 2.3.16 | <i>Define specific penalties for violations which may even result in the cancellation of contract. This may also create an opportunity for local contractors to avail the chance of getting contract for the Pond Area.</i> | Low | Punjab Fisheries Department | WWF-Pakistan | Medium - term |
| | Illegal fishing practices – Ineffective fish ladder | | | | |
| 2.3.17 | <i>Commission a research study on effectiveness of fish ladders for Indus Dolphin and recommend measures for its improvement</i> | Medium | WWF-Pakistan | Punjab Fisheries Department | Short-term |
| 2.4. | Illicit fuelwood extraction / habitat destruction | | | | |
| 2.4.1 | <i>Explore feasible, acceptable and easily installable alternate energy options to reduce pressure on natural forests of the Wildlife Sanctuary. This may include the provision of Biogas plants, fuel-efficient stoves, energy plantations of salt tolerant species for fuelwood, solar geysers and solar cookers.</i> | High | WWF-Pakistan | PDDC, PCRET, local partners | Long-term |
| 2.4.2 | <i>Negotiate community share of at least 20% of the total cost of the unit.</i> | High | WWF-Pakistan | VWCCs | Short-term |
| 2.4.3 | <i>Develop partnerships and linkages with Punjab Dairy Development Council (PDDC), Pakistan Council for Renewable Energy Technology (PCRET) for installation of these alternate energy options on a cost sharing basis</i> | High | WWF-Pakistan | PDDC, PCRET, VWCCs | Medium - term |
| 2.4.4 | <i>Initiate a research study to determine the impacts of such alternate energy options on the existing fuelwood use by local communities.</i> | High | WWF-Pakistan | Academia | Medium - term |
| 2.4.5 | <i>Sign conservation agreements with the local</i> | High | WWF-Pakistan | VWCCs | Medium- |

| # | Interventions | Priority | Responsibility | | Duration |
|-------|--|---------------|-----------------------------|---|--------------------|
| | | | Primary | Secondary | |
| | <i>communities to monitor fuelwood extraction from the Sanctuary area.</i> | | | | <i>term</i> |
| 2.4.6 | <i>Develop a mechanism of effective watch and ward in collaboration with existing VWCCs to monitor fuelwood extraction from the core zone of the sanctuary which is the main habitat of Hog Deer</i> | <i>High</i> | <i>WWF-Pakistan</i> | <i>Punjab Wildlife and Parks Department</i> | <i>Medium-term</i> |
| 2.4.7 | <i>Identify suitable areas for energy plantations of salt tolerant species, livelihood improvement through the sustainable use of natural resources (baskets, ropes, mats, etc.) in the buffer zone, may provide an opportunity for the core zone to provide safe habitat to the remaining population of Hog Deer and other large mammals and resident breeding birds.</i> | <i>High</i> | <i>WWF-Pakistan</i> | <i>Punjab Forest Department</i> | <i>Medium-term</i> |
| 2.5. | Encroachment | | | | |
| 2.5.1 | <i>Establish a baseline assessment of status of land encroachment inside the Wildlife Sanctuary for agro-pastoral purposes through GIS-based approach.</i> | <i>Medium</i> | <i>WWF-Pakistan GIS Lab</i> | <i>Punjab Forest and Wildlife Department</i> | <i>Medium-term</i> |
| 2.5.2 | <i>Determine the baseline assessment of wildlife of the region, which is being affected from illegal encroachment and habitat destruction as a result.</i> | <i>Medium</i> | <i>WWF-Pakistan</i> | <i>Punjab Wildlife and Parks Department</i> | <i>Medium-term</i> |
| 2.5.3 | <i>Develop a consensus amongst the stakeholders to share information with relevant government authorities for necessary action in order to protect the ecological integrity of the Sanctuary.</i> | <i>Medium</i> | <i>WWF-Pakistan</i> | <i>Other Government Line Agencies</i> | <i>Short-term</i> |
| 2.6. | Unsustainable extraction of NTFPs | | | | |
| 2.6.1 | <i>Initiate a baseline need assessment to know the status and kind of communities involved in NTFPs for earning their livelihood from natural resources.</i> | <i>Medium</i> | <i>WWF-Pakistan</i> | <i>Punjab Forest and Wildlife Department</i> | <i>Short-term</i> |
| 2.6.2 | <i>Generate comprehensive information on the list of natural resource based products, species used, area from where the NTFPs are collected, quantity of NTFPs collected, income generation from these products in order to appreciate the role of wetlands in livelihood generation, quality of products etc.</i> | <i>Medium</i> | <i>WWF-Pakistan</i> | <i>Punjab Forest and Wildlife Department, VWCCs</i> | <i>Short-term</i> |
| 2.6.3 | <i>Undertake a supply chain analysis of basket weaving and other products in order to reduce collection of Typha and Tamarix sp and to identify potential areas for value addition to this activity. This could be tied to agreements on reducing extraction levels inside the Sanctuary.</i> | <i>Medium</i> | <i>WWF-Pakistan</i> | <i>Punjab Forest Department</i> | <i>Short-term</i> |
| 2.6.4 | <i>Reduce the role of middlemen in order to fetch better economic opportunities for the local communities involved in developing natural resource based products.</i> | <i>Medium</i> | <i>WWF-Pakistan</i> | <i>Local Partners, VWCCS</i> | <i>Medium-term</i> |
| 2.6.5 | <i>Initiate a range of activities at sites including development of Community Resource Centres, Conservation and Information Centres, displaying products at exhibitions and nature carnivals, Vocational Training Centres, etc.</i> | <i>Medium</i> | <i>WWF-Pakistan</i> | <i>Punjab Irrigation Department</i> | <i>Long-term</i> |
| 2.6.6 | <i>Study the products already being sold in the markets to guide local communities for value addition of their products</i> | <i>Medium</i> | <i>WWF-Pakistan</i> | <i>Other local partners</i> | <i>Short-term</i> |
| 2.6.7 | <i>Introduce commercial players in the market especially at Kot Addu, Muzaffar Garh, Dera Ghazi Khan and Multan so that communities can negotiate directly for their products and prices.</i> | <i>High</i> | <i>WWF-Pakistan</i> | <i>VWCCS</i> | <i>Medium-term</i> |

| # | Interventions | Priority | Responsibility | | Duration |
|-----------|--|----------|---|---|-------------|
| | | | Primary | Secondary | |
| 2.7. | Illegal grazing of domestic livestock in the Protected Area | | | | |
| 2.7.1 | <i>Sign partnership agreement with VWCCs surrounding the Sanctuary area over the use of grazing areas for their domestic livestock in order to protect the remaining habitat for large mammals such as Hog deer.</i> | High | WWF-Pakistan | VWCCs, Punjab Forest Department | Medium-term |
| 2.7.2 | <i>Initiate livestock vaccination and de-worming coupled with awareness campaign in order to avoid disease transmission especially from domestic to wild ungulates</i> | High | WWF-Pakistan | Punjab Livestock Department, Saibaan Welfare Foundation | Medium-term |
| 2.7.3 | <i>Explore fodder options in the buffer zone of the Sanctuary in order to reduce grazing pressure especially for households in Loomarwala Basti.</i> | Low | WWF-Pakistan | VWCCs | Medium-term |
| 2.8. | Presence of invasive species | | | | |
| 2.8.1 | <i>Avoid the introduction of invasive species in the Protected Areas as per The Punjab Wildlife (Protection, Preservation, Conservation and Management) Act 1974. Invasive (fast growing tree species) and introduced fish species need not to be supplemented in the main channel especially in the pond area.</i> | Medium | Punjab Wildlife and Parks Department, Punjab Fisheries Department | WWF-Pakistan | Long-term |
| 3. | Socio-economic Interventions | | | | |
| 3.1. | Community mobilisation | | | | |
| 3.1.1 | <i>Organise local wetland dependent communities and fishermen (Mohanna) communities surrounding the Wildlife Sanctuary, as Village Wetlands Conservation Committees (VWCCs) through nominations of the Office Bearers and development of Terms of References of the Committee.</i> | High | WWF-Pakistan | National Rural Support Programme (NRSP) | Long-term |
| 3.1.2 | <i>Sign Terms of Partnerships with organised communities for implementation of wetlands management interventions</i> | High | WWF-Pakistan | NRSP, VWCCs | Short-term |
| 3.1.3 | <i>Register VWCCs as CCBs (Community Citizen Boards) with local Social Welfare Departments as qualifying criteria to get financial support from District Government for socio-economic interventions of their area.</i> | High | WWF-Pakistan | Social Welfare Department | Short-term |
| 3.1.4 | <i>Provide training to VWCCS and CCBs in record keeping, account maintenance, office maintenance, data recording, developing proposals, establishing linkages and partnerships, effective watch and ward, ownership of resources and interventions.</i> | High | NRSP | WWF-Pakistan, Social Welfare Department | Medium-term |
| 3.1.5 | <i>Develop a social maturity index for the organised communities in order to ensure their sustainability</i> | Medium | WWF-Pakistan | NRSP, VWCCs | Medium-term |
| 3.2. | Skill development to alleviate poverty and improve alternate livelihood opportunities | | | | |
| 3.2.1 | <i>Initiate a study to develop and implement alternate livelihood action plan in collaboration with wetland dependent communities living on the edges of the Protected Area.</i> | Medium | WWF-Pakistan | VWCCs | Medium-term |
| 3.2.2 | <i>Provide training to local communities in skill development and enhancement to improve their alternate livelihood as identified by the locals. e.g. eco-tourism, kitchen gardening, poultry farming, apiculture, fish cage culture, adopting best management practices, livestock management through vaccination and de-worming, Vocational training centres, marketing natural resource based products, improved fishing practices etc.</i> | High | WWF-Pakistan, NRSP | Social Welfare Department | Medium-term |
| 3.2.3 | <i>Promote eco-tourism in the area through signing</i> | High | WWF-Pakistan | Punjab Tourism and | Short-term |

| # | Interventions | Priority | Responsibility | | Duration |
|--------|--|---------------|--|---|--------------------|
| | | | Primary | Secondary | |
| | <i>Memorandum of Understanding (MoU) with Punjab Tourism and Resort Development Department and Sustainable Tourism Foundation of Pakistan.</i> | | | <i>Resort Development Department</i> | |
| 3.2.4 | <i>Provide training to local community activists as guides, boatmen and support staff in enhancing opportunities of eco-tourism through community collaboration</i> | <i>High</i> | <i>WWF-Pakistan</i> | <i>Adventure Foundation of Pakistan, STFP</i> | <i>Medium-term</i> |
| 3.2.5 | <i>Promote the richness of the area to attract tourists from adjoining areas and enhance the local income</i> | <i>High</i> | <i>WWF-Pakistan</i> | <i>Punjab Tourism and Resort Development Department, STFP</i> | <i>Medium-term</i> |
| 3.2.6 | <i>Enhance partnerships and linkages with other programmes operational in the area for supporting local livelihoods</i> | <i>Medium</i> | <i>WWF-Pakistan</i> | - | <i>Long-term</i> |
| 3.2.7 | <i>Develop funding proposals for national and international donors to specifically address the issues of poverty-environment nexus</i> | <i>High</i> | <i>WWF-Pakistan</i> | <i>VWCCs</i> | <i>Short-term</i> |
| 3.2.8 | <i>Develop a mechanism to hire local community activists for various ecological and social interventions for their direct financial benefit and build confidence and trust in order to seek their support,</i> | <i>Medium</i> | <i>WWF-Pakistan</i> | <i>VWCCs</i> | <i>Short-term</i> |
| 3.3. | Non-biodegradable Pollution originating from broad range of human activities | | | | |
| 3.3.1 | <i>Undertake preliminary research studies at selected points within the Indus River Section to determine levels of pollution of all kinds.</i> | <i>High</i> | <i>WWF-Pakistan</i> | <i>Academia</i> | <i>Short-term</i> |
| 3.3.2 | <i>Develop Indus River Pollution Disaster and Management Plan in collaboration with WWF-Pakistan's Freshwater and Toxics Programme and Environmental Protection Agencies of Punjab, Sindh and Khyber Pakhtunkhwa</i> | <i>High</i> | <i>WWF-Pakistan</i> | <i>EPA, Punjab, Sindh</i> | <i>Medium-term</i> |
| 3.3.3 | <i>Explore other local options of installing effluent treatment plants, initiating awareness raising campaigns for farmers, to reduce the use of harmful pesticides,</i> | <i>Medium</i> | <i>EPA, Punjab, Sindh and Industries</i> | <i>WWF-Pakistan</i> | <i>Long-term</i> |
| 3.3.4 | <i>Help build the capacity and resources of the fishermen to enhance the performance of their motorboats by stopping leakage and oil spill</i> | <i>High</i> | <i>WWF-Pakistan</i> | <i>VWCCs</i> | <i>Short-term</i> |
| 3.3.5 | <i>Build partnerships and linkages with other national stakeholders to develop the capacity of the EPAs in effectively controlling pollution entering into the river</i> | <i>Medium</i> | <i>WWF-Pakistan</i> | <i>EPAs</i> | <i>Medium-term</i> |
| 3.4. | Promoting Conservation Education and Awareness | | | | |
| 3.4.1. | <i>Enhance information through installing information boards and resource materials</i> | <i>High</i> | <i>WWF-Pakistan</i> | <i>Punjab Wildlife and Parks Department, Punjab Irrigation Department</i> | <i>Medium term</i> |
| 3.4.2. | <i>Establish Information Centre at Taunsa Barrage Wildlife Sanctuary in collaboration with partners through MoU signed with Punjab Wildlife and Parks Department and Punjab Irrigation Department</i> | <i>High</i> | <i>WWF-Pakistan</i> | <i>Punjab Wildlife and Parks Department, Punjab Irrigation Department</i> | <i>Medium term</i> |

Species Specific Management Plans

A. Indus River Dolphin – *Platanista minor*

| # | Threat | Possible set of prescriptions | Means of Verifications | Lead Agency | Other partners | Timeline | |
|---------------------|--|--|--|--|---|--|----------------|
| Indus River Dolphin | 1.1. Limited information about dolphin distribution, population dynamics and habitat use | 1.1.1. Undertake comprehensive population surveys (5 – years interval) | Survey reports with GIS-based maps | PWP, ZSD (MoE) with the support of Provincial Wildlife Departments | Conservation agencies (WWF-P), research institutions, Cetacean Specialist Group, Academia | Feb.-Mar., 2011 (On-going) | |
| | | | Publications in refereed journals | | | Two months after the survey | |
| | | 1.1.2. Carry out annual monitoring of hotspots as already identified | Annual <i>Adhoc</i> reports | | | Adhoc Surveys after 2011 population assessment | |
| | | | 1.1.3. Undertake habitat assessment (e.g. Environ. Flow, prey availability, Water quality etc.) in different sections of the Indus River at 5-years interval | | | Habitat assessment reports based on pre-determined parameters | GIS-based maps |
| | 1.2.1. Conduct a Training Need Assessment of the stakeholders | Training Need Assessment Report with implementation mechanism | | MoE with the support of Provincial Wildlife Departments | WWFP (PWP, Indus for All and other programmes), Provincial, territorial and Federal agencies, Other conservation partners | 2011 | |
| | 1.2.2. Organise specialised training courses as per the Training Need Assessment | Number of trainings conducted | Ongoing (immediate) | | | | |
| | | Number of professionals trained | Ongoing (immediate) | | | | |
| | | Number of training reports | Two weeks after the training | | | | |
| | 1.2.3. Help develop sectoral plans / PC-1's of the wildlife agencies for the provision of equipment, trained professionals and specialised trainings | Provision of budget for training, equipment etc. in Sectoral Plans / PC-1's | | 2011-2012 | | | |
| | | 1.3.1. Carry out rescue operations of stranded Dolphins using already established standardised protocols | Certified event reports | Sindh and Punjab Wildlife Departments | WWFP (PWP etc.), Communities, Media, Provincial, territorial and Federal agencies | Each year after canal closures | |
| | 1.4. Suspected inbreeding | 1.4.1. Translocate stranded dolphins to other potential segments | Certified activity reports | Sindh, Punjab and NWFP Wildlife Departments, MoE | WWFP, Local communities, Media | Soon after rescue operations based on assessment of animal's condition | |
| | | 1.4.2. Get formal provincial approvals for translocation outside provinces | Correspondence between the provinces for approvals | | | Immediate, for translocation outside provinces | |
| | 1.5. Entanglement in fishing nets / by-catch | 1.5.1. Establishment of no-fishing zones | | Notification of No Fishing Zone (PA) | Sindh Wildlife Department, MoE | WWFP, Local communities, Media, Local conservation partners | Immediate |
| | | | | Published awareness material | | | Immediate |
| | | 1.5.2. Awareness of fishing community | | Media reports | | | Ongoing |

B. Hog Deer – *Axis porcinus*

| # | Threat | Possible set of prescriptions | Means of Verifications | Lead Agency | Other partners | Timeline | |
|---------------------------------------|--|--|---|---|---|---|-----------|
| Hog Deer | 1. 1. Overall population status is not known | Carry out surveys to determine population estimates in various known natural pockets of Sindh and Punjab | Survey reports | Provincial Wildlife Departments | PWP, Indus for All, WWF-P, ZSD | 2011 | |
| | | | Identification of hotspots | | | 2011 | |
| | | | Publication in refereed journals | | | 2011 | |
| | | Potential habitat assessment and mapping (Historic, Current and Potential for rehabilitation) | GIS-based maps and camera traps | | | 2011 | |
| | 1.2. Illegal hunting | Assess population in community controlled conservation areas | Survey reports | 2011 | | | |
| | | | Enhance law enforcement | FORs and Challans | Provincial Wildlife Departments | PWP, Indus For All Programme, ZSD, Armed Forces, Communities, Local Conservation Partners | Ongoing |
| | | | Community-based conservation initiatives (watch and ward etc.) | Event and activity reports | 2011 | | |
| | | | Species specific awareness campaign targeting different stakeholders including Armed Forces | Published awareness material | 2011 | | |
| | 1.3. Habitat degradation, fragmentation and conversion | Training of stakeholders especially the Armed Forces | Specific training modules | 2011 | | | |
| | | | Declare Hog Deer Reserves (PAs) in Punjab and Sindh | Notification of PAs in Sindh and Punjab | Sindh, Punjab and NWFP Wildlife Departments | PWP, Indus for All Programme, WWF-P, ZSD, Communities, National and International Experts | 2011 |
| | | | Identify and establish potential corridors for Hog deer migration/ movement | GIS-based habitat maps showing potential areas as corridors | | | 2011 |
| | | | | Letter of Agreements with relevant stakeholders for corridors | | | 2011 |
| | | | Participatory management initiatives | Letter of Agreements | | | 2011 |
| | | | | Community watchers in place | | | 2011 |
| | | | Reintroduction/ rehabilitation in suitable habitats in its former natural habitat in NWFP, Sindh and Punjab | Sites assessment reports | | | 2011 |
| | | | | Animal release reports | | | 2011-2012 |
| Population monitoring reports | 2011-2012 | | | | | | |
| 1.4. Encroachment on Hog deer habitat | Define land tenure system | Reduction in allocation of lands to influentials etc. Boundary demarcation | Provincial Wildlife Departments | Board of Revenue, PWP, Indus for All Programme, Irrigation and Power Departments of Punjab and Sindh, Sindh Forest Department | 2011 – 2012 (Ongoing) | | |
| | | Revenue records | | | 2011 – 2012 (Ongoing) | | |
| | Community-based participatory species and habitat management | Registered CBOs | | | 2011-2012 (Ongoing) | | |
| Enhance law enforcement | Record of FORs and Challans | Ongoing | | | | | |

C. Indian Smooth-coated Otter – *Lutrogale perspicillata*

| # | Threat | Possible set of prescriptions | Means of Verifications | Lead Agency | Other partners | Timeline |
|----------------------------|--|--|--|--|---|-----------------------|
| Indian Smooth-coated Otter | Uncertain taxonomic status of Indian Smooth-coated Otter | Undertake species specific surveys in its known home range | Survey reports with results published in refereed journals | ZSD (MoE), Indus For All Programme | NCCW, PWP, PMNH, WWF-P, Provincial and Territorial Wildlife Departments, OSG | 2011-2012 |
| | | Conduct DNA analysis for taxonomic study | DNA sequencing with results published in refereed journal | | | 2011-2012 |
| | Apparent population decline in its entire home range | Species specific awareness campaign | Published awareness material | Provincial and Territorial Wildlife Agencies | PWP, Indus For All Programme, ZSD, PMNH, WWF-P, Media, Otter Specialist Group (OSG), Other expert groups and partners | 2011-2012 |
| | | | Media and event reports | | | Ongoing |
| | | Captive breeding on experimental basis | Captive Breeding Site | | | 2011-2012 |
| | | Habitat evaluation / mapping | Photographs | | | 2011-2012 |
| | | Declaration of Otter Reserves | GIS-based habitat mapping | | | 2011 |
| | Otter – private fish farmer's Conflict | Electric fencing of private fish farms on experimental basis | Successful fence trials | MoE, PWP and Indus For All Programme | Sindh Wildlife Department, WWF-P, Fishermen, Farmers | Immediate (2011-2012) |
| | | Enhanced law enforcement | Records of FORs | | | Ongoing |
| | Illegal hunting (live animals as pet, as a competitor and for trade) | Enhanced law enforcement | Records of FORs and Challans | Provincial Wildlife Departments | MoE, NCCW, Indus For All Programme, WWF-Pakistan, PWP | Ongoing |
| | | | Wildlife agencies and customs, Coast Guards reports | | | Ongoing |
| | | Awareness campaign | Published awareness material | | | Immediate (2011-2012) |

D. Gharial / Gavial – *Gavialis gangeticus*

| # | Threat | Possible set of prescriptions | Means of Verifications | Lead Agency | Other partners | Timeline |
|--------------------|---|---|--|---------------------------------------|---|-----------|
| Gharial / Gavial | A locally extinct species – re-establishment in its natural habitat | Confirmatory surveys of Gharial in Nara region | Survey reports | PWP and Indus For All Programme | Sindh and Punjab Wildlife Departments, ZSD, PMNH, Local Communities, WWF-P, WWF India, CZA India, Gharial Conservation Alliance (GCA), Wildlife Institute of India, <i>Aman ki Asha</i> | 2011 |
| | | Identification and assessment of historic habitats e.g. Nara Region - Sindh | Assessment reports | | | 2011 |
| | | | GIS-based Habitat maps | | | 2011 |
| | | Hire a Gharial International Expert to short-list potential sites for re-establishment with a detailed Action Plan including the procurement of Gharial for release | ToRs and Feasibility assessment reports. | | | 2011 |
| | | Investigate the availability of Gharial (preferably Indus basin genotype) from India preferably through WWF-P | Correspondence with Indian authorities | | | 2011 |
| | | | Agreements between WWF-P and WWF India and other authorities | | | 2011-2012 |
| | Designate the selected site as PA | Notification of PA | 2012 | | | |
| | Establish captive breeding facility for Gharials in its natural habitat (Sindh and Punjab), in order to supplement population in the wild | Approvals by the Government | 2011-2012 | | | |
| | | Photographs | 2011-2012 | | | |
| | Low acceptance of Gharial amongst the local communities | Species specific awareness campaign for acceptance by local communities | Consultative meeting reports | Sindh and Punjab Wildlife Departments | PWP, Indus for All Programme, ZSD, WWF-P, Local Communities, Media | 2011-2012 |
| | | | Published awareness material | | | 2011-2012 |
| | | Community-based participatory management of species and habitats (CBOs, Community watchers, fishing) | Registered CBOs | | | 2011 |
| Community Watchers | | | 2011-2012 | | | |
| | | Agreements with communities | | | 2011-2012 | |

E. Marsh Crocodile / Mugger – *Crocodylus palustris*

| # | Threat | Possible set of prescriptions | Means of Verifications | Lead Agency | Other partners | Timeline |
|--------------------------|--|--|---|---------------------------------------|--|--------------|
| Marsh Crocodile / Mugger | Overall population status is not known | Undertake rigorous population surveys in Sindh (CIWC) in its natural home range and in areas where relocation has been initiated | Survey reports | Sindh and Punjab Wildlife Departments | PWP, Indus for All Programme, ZSD, Individual researchers and Academia | 2011-2012 |
| | | | Photographs | | | 2011-2012 |
| | | Potential habitat assessment and mapping (Historic, current and potential) | GIS-based historic home range map | | | 2011-2012 |
| | Illegal hunting | Enhance law enforcement | Records of FORs and Challans | Sindh and Punjab Wildlife Departments | PWP, Indus For All, ZSD, Local Communities | 2011 onwards |
| | | Community-based conservation initiatives | Community watch and ward mechanism | | | 2011-2012 |
| | | Species specific awareness campaign | Published awareness material | | | 2011-2012 |
| | Habitat fragmentation | Develop and implement species recovery plans for selected sites through participatory management initiatives | Minutes of the meetings with stakeholders on the issues | Sindh and Punjab Wildlife Department | PWP, Indus For All Programme, ZSD | 2011-2012 |
| | | | Species recovery plan | | | 2011 |
| | | Monitor water quality | Water quality reports | | | 2011-2012 |
| | Poorly maintained <i>ex situ</i> breeding facilities | Maintain and upgrade the existing captive bred facilities at Faisalabad for augmenting the existing natural populations | Assessment report of the Faisalabad facility | Sindh and Punjab Wildlife Departments | PWP, Indus For All Programme, ZSD | 2011-2012 |
| | | | Photographs | | | 2011-2012 |
| | | Establish trial crocodile farm in the vicinity of potential natural habitats. | Site selection report | | | 2011-2012 |
| Photographs | | | 2011-2012 | | | |

F. Terrestrial Freshwater Turtles and Tortoises

| # | Threat | Possible set of prescriptions | Means of Verifications | Lead Agency | Other partners | Timeline |
|--|--|---|---|---|--|---------------------------------------|
| Terrestrial Freshwater Turtles and Tortoises | Ineffective protection due to low density and widely spread fragmented populations of freshwater turtles | Training of custom/coast guards and wildlife authorities at significant posts to curb that practice | Training Need Assessments and the training reports | PWP, Indus For All Programme | Customs Department, Provincial Wildlife Departments, Motorway and Highway Police | 2011-2012 |
| | | Compensation measures – Protected Areas along Motorways etc. | Minutes of the meeting with NHA and Motorways | | | 2011-2012 |
| | Poor awareness regarding freshwater turtles and the roles they play in the aquatic ecosystem | Awareness campaign focusing on the role of turtles as a natural scavengers | Published awareness material | PWP, Indus For All Programme | MoE and WWF-P, Provincial Wildlife Departments, Local Communities | 2011-2012 |
| | Absence of formal inter-provincial coordination mechanism | Include specific agenda items in the meetings of NCCW | Minutes of the meetings | NCCW (MoE) | Conservation Agencies | 2011-2012 |
| | Low priority conservation status in Provincial Wildlife Acts | Add freshwater turtles / tortoises in the schedule of protected animals in the Provincial Wildlife Acts and also in the approved National CITES Law | Government Notifications | Provincial Wildlife Departments, MoE | PWP, Indus For All Programme, Other Conservation Agencies | 2011-2012 |
| | | Improve existing wildlife Acts | Model Wildlife Laws approved with the inclusion of turtles and tortoises | | | 2011-2012 |
| | Illegal capture and trade (National and International) | National and International lobbying to stop international trade | Correspondence | NCCW, MOE and Provincial Wildlife Departments | Indus For All Programme, WWF-P, Customs / Coast Guards, Local Communities | 2011-2012 |
| | | | Effectively monitor trade at International Gateways – law enforcement - confiscations | | | Check posts at International Gateways |
| | | Establish trial turtle breeding farm for exploring commercial potential initially in the public sector | Record of Challans and FORs | | | 2011 (Ongoing) |
| | | | Site selection / assessment | | | 2011-2012 |
| Initiate community-based conservation projects at selected sites | Photographs | 2011-2012 | | | | |
| | | Community organisation and mobilisation – correspondence / meeting minutes | | | 2011-2012 | |

G. Cranes

| # | Threat | Possible set of prescriptions | Means of Verifications | Lead Agency | Other partners | Timeline |
|---|---|---|--|--|--|---------------------|
| Cranes | Lack of community's awareness about crane conservation | Species specific awareness campaign | Published awareness material on cranes | Provincial Wildlife Departments | MoE, PWP, Indus For All, ZSD, International Crane Foundation, Cracid Breeding Facility - Belgium | 2011 |
| | | Community-based conservation initiatives to promote crane conservation in Pakistan in collaboration with International Crane Foundation and other national and international stakeholders | Letter of Agreements signed with national and international agencies | | | 2011-2012 |
| | | | Letter of Agreements signed with registered CBOs | | | 2011-2011 |
| | | | All related correspondence | | | 2011-2012 |
| | Illegal hunting and capture | Effective law enforcement, patrolling and monitoring in provinces and territories | Records of Challans and FOR's | Provincial Wildlife Departments | MoE, PWP, Indus For All Programme, Communities | 2011 (Ongoing) |
| | | Declare Protected Areas (PAs) in Balochistan to protect wild cranes | Notification of PAs as Crane Refuges | | | 2011-2012 |
| | | Population and habitat surveys of cranes in their natural habitats especially on their migratory routes as well | Population surveys and habitat assessment reports | | | 2011 (Ongoing) |
| | Captive breeding facilities | Maintain and upgrade the existing captive breeding facilities to curb wild capture in Khyber Pakhtunkhwa | Husbandry manual | Khyber Pakhtunkhwa Wildlife Department | MoE, Communities, Indus For All Programme, WWF-P | 2011-2012 |
| | | | Reports | | | |
| | | | Photographs | | | |
| | Inadequate research studies on cranes | Encourage academia and institutions to conduct studies on behavioural and reproductive aspects of cranes in wild and captivity | Project Proposals | Khyber Pakhtunkhwa Wildlife Department in collaboration with PWP | WWF-P, MoE, ZSD, Academia, Researchers, Indus For All programme | 2011-2012 (Ongoing) |
| | | | Agreements with Academia | | | 2011-2012 (Ongoing) |
| | | | Number of Internship Reports | | | 2011-2012 (Ongoing) |
| | | | Agreements between Khyber Pakhtunkhwa Wildlife Department and PWP | | | 2011 |
| | | Strengthen facilities at Pakistan International Crane Centre, Lakki for research, conservation and education | Necessary infrastructure available | | | 2011-2012 (Ongoing) |
| Relevant literature available | | | 2011-2012 | | | |
| Letter of Agreements signed with national and international groups | | | 2011-2012 | | | |
| Number of professionals working | | | 2011-2012 | | | |
| Age old traditions of crane capturing in southern parts of Khyber Pakhtunkhwa and other regions of the country endangering wild crane populations | Identify potential community activists and build their capacity for trade off | Agreements between communities and Khyber Pakhtunkhwa Wildlife Department and PWP | Khyber Pakhtunkhwa Wildlife Department | WWF-P, PWP, Communities, Other Conservation Agencies / Partners | 2011-2012 (ongoing) | |