SINDH IRRIGATION AND DRAINAGE AUTHORITY

WATER SECTOR IMPROVEMENT PROJECT PHASE – I (WSIP-I)

Preparation of Regional Plan for Left Bank of Indus

Proposed Project on

Rehabilitation of Deh Akro – II

And

Chotiari Wetland Complex

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In Association with
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Background and Rationale

Wetlands are the storehouses of globally endangered biodiversity of flora and fauna because of their extensive and rich food webs and biodiversity. There is great reliance on the wetlands as they are the main source of livelihood to the poor communities. Wetlands are ecosystems that provide numerous goods and services that have an economic value, not only to the local population living in its periphery but also to communities living outside the wetland area. Furthermore, wetlands also provide recreational opportunities and amenities, and flood control and storm buffering. Wetlands also provide a range of ecosystem services, including ground water recharge, flood control and water purification and also eco-tourism.

There are nineteen (19) wetlands declared as Ramsar Sites in Pakistan, nine are located in Sindh province of which six are situated on the left bank of Indus namely, Deh Akro, Nurruri lagoon, Jubbo lagoon, Runn of Kutch, Indus delta, and The Indus Dolphin Reserve. They have gained importance due to their unique biodiversity and habitat which shelters large number of species.

There are three important wetland complexes located on the left bank Indus in Sindh, the study area, namely Deh Akro II, Coastal wetlands and Chotiari reservoir and wetlands located in Shaheed Benazirabad, Badin and Sanghar districts, respectively. Deh Akro II and some wetlands of coastal wetlands are declared as Ramsar Sites under UN Wetland Convention at Ramsar, Iran.

Chotiari wetland complex extends over 20,243 ha and includes about 36 lakes, of which five are freshwater and 31 brackish water, fed by seepage from the Nara Canal and its Jamrao offshoot. Located in a typical stable sand desert habitat, the lakes occupy flat bottomed valleys surrounded by 5 to 10 m high sand dunes.

Deh Akro II is wildlife protected area and declared as Ramsar site under UN Convention on Wetlands. It consists of four major habitats; desert, wetland, marsh and agricultural. It is a natural inland wetland ecosystem, which supports a variety of rare and endangered wildlife species. This area hosts a considerable number of rare fauna. Many indigenous fish species are also found. Water scarcity during a persistent dry spell is adversely affecting the area. There are 36 wetlands forming a complex and having pre-dominant wildlife species of Crocodiles. This area is managed by Wildlife Department, Government of Sindh.

Issues and Problems to Wetlands

Wetlands are threatened by variety of factors both in the coastal zone and inland. Lack of proper management and ignorance of the importance of healthy wetlands are the primary causes. The stakeholders during the consultative workshops have identified the following issues and problems:

In Deh Akro II the major issue in this area is the shortage of water required for the survival and growth of wildlife species. At some times of year, especially during drought periods some wetlands get dried causing serious threat to the wildlife species available in these wetlands. Another issue in this wetland complex is the inadequate protection of wildlife from people for hunting and predators.

In Chotiari Wetland Complex there are two components of this complex viz. Chotiari Reservoir and Chotiari Wetlands. The entire area is managed by Irrigation Department, Government of Sindh for irrigation purposes. With the construction of Reservoir there is a serious problem of seepage through its earthen banks creating waterlogged conditions in the adjoining agricultural fields mostly privately owned. Stakeholders during consultations identified serious issue of waterlogging done by the reservoir and emphasized on its control through appropriate structural or non-structural measures.

Project Location

Deh Akro II is located in the desert area of district Benazirabad and about 30km east of Nawabshah City. The Chotiari Reservoir is located in District Sanghar and about 20km East of Sanghar City.

Scope and objectives of proposed Project

The principal objectives of the proposed project are as under:

1. To address the issues identified by the stakeholders for both the Wetland complexes such as provision of water to make the wetlands alive and productive, check seepage from reservoir to halt waterlogging, and provide assured protection to biodiversity available in these wetland complexes.
2. To formulate a Regional Wetland Management Strategy in the province of Sindh to ensure development of plans and manage the wetlands on scientific lines.

Proposed Activities / Solutions

1) Preparation of Regional Management Strategy/Restoration Strategy

The plan has two components: a Regional Management Strategy (Management Plan Restoration Strategy, including an outline of the studies to be undertaken in order to design a proper restoration and management plan for each wetland in Sindh) and three Action Plans (restoration options for three wetlands: Deh Akro, Chiotari Reservoir, Dhands and Tidal Link).

Within the Regional Strategy, each section will have two parts: one part describing the section's topic at the level of the Sindh province, one part describing this topic locally for each of the wetland complexes.

2) Regional Management Strategy

Management Plans aim to establish and maintain the sustainable use and development of the resources of wetland areas so as to improve quality of life, maintain biological diversity, productivity and quality of the concerned wetlands, through efficient and integrated management. For achieving this, long term vision and planning is necessary, and this is why the planning cycle is organized around "time loops".

3) Site-Specific Action Plans

The second component of the Regional Management Plan includes three Action Plans for three of the main wetland complexes found on the Indus River left bank in Sindh (Deh Akro, Chiotari, Dhands). The Action Plans (corresponding to the "Restoration and management strategy" subcomponent in the Regional Strategy tree) include:

- Structural measures
- Non-structural measures
- Socio-economic aspects
- Knowledge gaps – validation studies to be undertaken

Proposed Solutions for Deh Akro II

Ideally, the original water supply should be restored in order to avoid the environmental and economic negative effects of lakes drying out. In reality, this will probably be impossible. What could be possible however would be to provide the complex with just enough extra water to prevent the lakes from completely drying out and allow them to sustain life on a year-round basis.

Both structural and non-structural measures are hereinafter suggested. Structural measures concern the construction of an underground pipe linking the Nara Canal to the head lake(s) as illustrated by Fig. 9. This pipe would be only a few kilometers long (depending on local topography and natural slope), and its diameter should be wide enough to allow a strong flow

to pass through. The idea indeed would be to open the connection between the canal and the pipe only during peak flow time in the Nara Canal.

This would allow avoiding two potential problems linked with diverting water from the Nara Canal through a pipe. The first is general water availability for irrigation downstream. Diverting some water during peak flow only should avoid creating water shortages downstream. The second is the danger that the pipe gets clogged by siltation. Having only high speed flows in the pipe should allow it to keep itself free of deposits.

Non-structural measures concern dredging of the shallowest lakes in order to restore their storage capacity and resilience to droughts. This will depend on local orology and of dune stability in the immediate surroundings of the concerned lakes.

Proposed Solution for Chotiari Reservoir

Two options are suggested with two different structural measures, depending on the depth reached by underground seepage water. A complementary non-structural measure is also presented to improve the efficiency of the structural measures.

The first structural measure would consist in digging moats along the western and southern embankments of the reservoir. These moats would intercept seepage water before these can reach farmland areas. The alternative structural measure would be to create a grid of surface drains that would prevent the topsoil from becoming waterlogged or even flooded.

Implementation Arrangements

Deh Akro II is presently being managed by the Sindh Wildlife Department. The proposed project will also be implemented through this department and the local communities residing around the Deh Akro II Wildlife Complex. Chotiari Reservoir Complex is presently being managed by the SIDA. The activities proposed are of technical nature, thus will be implemented by the Government of Sindh through SIDA.

Proposed Monitoring Plan

Ideally, overall monitoring of the Regional Wetland Management Strategy should be done by the Regional Wetland Committee, if recommendations made under "Institutional context", are implemented. It should include people with expertise in:

- Institutional strengthening
- Legislative consolidation (environmental law)
- Wetland ecology
- Hydrogeology
- Sociology
- Rural Economy

And it should be able to rely on inputs by field teams (an ecologist and a social specialist) regarding site-specific management plans.

The proposed solutions will not have any negative environmental and re-settlement issues.

Project Justification

The total investment of the proposed is Rs. 488.0 million. The objective of this investment is to improve the existing management system through a strategy or action plan and enhance capacity of stakeholders involved. Deh Akro II is an internationally recognized site and declared as Ramsar Site for protection of wildlife. Thus, as requirement of its international significance no any activity detrimental for the wildlife and flora or harvesting of its products is allowed. Only limited rehabilitation activities required for management, protection and governance of natural resource are allowed. In Dek Akro II only shelter, food, water and maintenance of ecological significance have been provided. Likewise, for Chotiari Complex the adverse impact of reservoir due to seepage from bunds and underground i.e. waterlogging has been checked through biological and limited structural activities which will address the

above stated problem for improving ecology and productivity within and outside the project area.

Thus this project cannot be evaluated in financial or economic terms but only environmental assessment is required.

Environmental Assessment

The proposed intervention is environment friendly as it will not create any environmental problems but will improve the existing environmental problem of waterlogging in the area and provide water for wildlife.

The activities in the Deh Akro II are provision of fresh water from Nara Canal system to address the problem of water scarcity and reduce the impact of drought in a complex of 32 wetlands. This site has rare species of crocodiles and fish and other wildlife which will benefit from the project interventions.

The main problem needing immediate redressal in Chotiari Reservoir is the creation of water logging in the adjoining field through seepage from the chotiari reservoir. Due to seepage from bunds the adjoining fertile and productive agricultural lands have become waterlogged and no cultivation is possible. The activities proposed in this site are construction of moat to check seepage and construct the interceptor drains to collect seepage water and dispose of in the Nara Canal for reuse as the quality of seepage water is good for use for irrigation to the agricultural crops. In this way not only the adverse problem of water logging will be addresses but also the affected agricultural lands will be productive.

It is thus concluded that the proposed project of rehabilitation of Deh Akro II and Chotiari Reservoir is environment friendly and also socially acceptable as there are no any negative impacts

ICID Environmental Checklist for the proposed project

The environmental checklist formulated by International Commission for Irrigation and Drainage has also been used to assess the impacts of proposed activities on the physical and other components of the environment such as hydrology, pollution, soils, sediments and ecology of the areas.

Resettlement Issues

Deh Akro II is a Ramsar Site and is being managed by the Sindh Wildlife Department, thus no any resettlement will take place. Likewise the Chotiari Reservoir Complex is also being managed by the Government of Sindh, through SIDA. Thus for both the sites no resettlement will take place

1 Introduction and Background

Wetlands are ecosystems that provide numerous goods and services that have an economic value, not only to the local population living in its periphery but also to communities living outside the wetland area. Furthermore, wetlands also provide recreational opportunities and amenities, and flood control and storm buffering. Wetlands are often perceived to have little or no value compared to other uses of its lands and water that may yield more visible and immediate economic benefits. Some of the uses that threaten wetlands are:

- drainage for irrigation and agriculture
- as a source of drinking water
- using the wetlands waters for electricity generation
- human settlements
- dredging sediments and exploiting mineral resources
- intensive harvesting of wetland goods

As a consequence, wetlands all over the world are continually modified and reclaimed at great cost, which is paradoxical since wetlands have actually a high economic value. Decision-makers often have insufficient understanding of the values of wetlands, including the economic value, so the protection of wetlands does not appear to be a serious alternative. Analyzing 89 existing valuation studies, WWF estimates that the Ramsar Convention's global wetland area of about 12.8 million km² would have an annual global value of US$70 billion. Recognizing the economic importance of wetlands in addition to their biodiversity, scientific value, climate regulation, potential tourism, socio-cultural and other important wetland values (that were not included in WWF's calculations) is yet another good reason to reverse global wetland loss.

Despite the generally arid nature of Pakistan's climate, the region supports an estimated 780,000 ha of wetlands and in excess of 225 significant wetland resources are on record. By 2002, sixteen of these have been internationally recognized by the Ramsar Convention Bureau as being of global importance, supporting important biodiversity such as bird migration routes and wintering grounds. The diverse assortment of freshwater and marine wetlands that occur within the territorial boundaries of Pakistan support unique assemblages of biodiversity including globally important habitats, species and genomes. A significant fraction of Pakistan's wetlands-dependent biodiversity is classified as endemic threatened and vulnerable in internationally recognized evaluations such as IUCN's Red Data Book.

Moreover, the same resource also sustains an estimated 130 million permanent human residents and 3 - 4 million displaced persons from adjacent countries. The wetlands of the region are, therefore, generally degrading under a broad spectrum of anthropogenic threats most of which are a direct product of poverty, but many of which are exacerbated by human ignorance and mismanagement.

Sindh Province is no different and the same national level background and analysis applies at provincial level as well.

While the country is making efforts to conserve its wetlands, it is constrained in this task by lack of access to physical and financial resources and immediate political and economic problems. For the time being, the national and site level investment in wetlands is generally

inadequate to meet the challenge of conserving globally important biodiversity. At the national level, the key significant drawback is the absence of an effective enabling environment that could encourage and sustain initiatives for biodiversity conservation. Key barriers to creating an enabling environment remain:

- the lack of effective and integrated policies;
- the absence of decision-making tools and reliable information to support effective wetlands
- conservation planning;
- technical deficiencies related to skills and equipment; and
- the lack of general public awareness or political pressure that would favor wetlands conservation.

Technical capacity in almost every aspect of wetlands management tends to be inadequate due to the lack of resources for scientific and specialized wetlands management training, appropriate equipment and exposure to international approaches to wetlands management. While Pakistan has produced a Wetlands Action Plan in 2000, *the lack of a comprehensive Wetlands Management Strategy hindered policy formulation, coordination and management of wetlands* at national and provincial scale.

2 Site-specific issues and problems

Consultative workshops, focused group meetings, on-site discussions with concerned stakeholders and review of literature reveals following issues and problems to be addressed in the proposed intervention for wetlands.

2.1 Deh Akro II Wetland Complex

Deh Akro II is wildlife protected area and declared as Ramsar Site under UN Convention on Wetlands. There are 36 wetlands forming a complex and having pre-dominant wildlife species of Crocodiles'. This area is managed by Wildlife Department, Government of Sindh. The stakeholders have identified the following issues and problems:

Shortage of water

The major issue in this area is the shortage of water required for the survival and growth of wildlife species. At some times of year, especially during drought periods some wetlands get dried causing serious threat to the wildlife species available in these wetlands.

Inadequate Protection

Another issue in this wetland complex is the inadequate protection of wildlife from people for hunting and predators.

2.2 Chotiari Wetland Complex

There are two components of this complex viz. Chotiari Reservoir and Chotiari Wetlands. The entire area is managed by Irrigation Department, Government of Sindh for irrigation purposes. With the construction of Reservoir there is a serious problem of seepage through its earthen banks creating waterlogged conditions in the adjoining agricultural fields mostly privately owned. Stakeholders during consultations identified serious issue of waterlogging

done by the reservoir and emphasized on its control through appropriate structural or non-structural measures.

3 Scope and objectives

The general objective of the proposed project is to promote wetland preservation within the Sindh Province while reducing poverty for communities living around wetlands. The specific objectives are to adapt the regional institutional setting to the wetland management context, harmonizing and updating policies, delineating a Regional Management Strategy (including defining guidelines for wetland-specific restoration and management plans) and a monitoring plan, and suggesting structural and non-structural measures (including specifying field studies to be conducted) for restoration of three wetland complexes.

The principal objectives of the proposed project are as under:

To address the issues identified by the stakeholders for both the Wetland Complex such as provision of water to make the wetlands alive and productive, check seepage from reservoir to halt waterlogging, and provide assured protection to biodiversity available in these wetland complexes.

To formulate a Regional Wetland Management Strategy in the province of Sindh to ensure development of plans and manage the wetlands on scientific lines.

Wetland management strategies should aim to identify values and threats to wetlands, and to develop plans and actions to address these threats and promote the identified values. Therefore, a comprehensive wetland management plan is a plan to resolve development and protection conflicts where wetlands affect a significant portion of a community. It should encompass the identification, study, and evaluation of wetland functions and community values, and development needs and investments with regard to wetlands protection and regulation. Indeed, a management plan that addresses only wetlands protection is likely to fail. When the inter-relationships among wetlands, urban development, public facilities, open space, wildlife habitat, streamside protection, recreation corridors, aesthetics, urban design, and water quality are taken into account in a balanced way, the management plan can offer benefits for the environment and the entire community. While wetlands protection alone may be prohibitive in cost and may lack overall community support, when combined with many interests, a multi-objective approach can save substantial amount of financial resources and can generate broad public support.

With this in mind, the scope of this project has been tied to a sustainable management cycle approach. Description of intervention), and includes two levels: a regional level (Regional Wetland Management Strategy) and a localized level (site-specific Action Plans).

The Regional Wetland Management Strategy includes all three major aspects of the management cycle: institutional and policy aspects, wetland-specific environmental and socio-economic analysis coupled with management plan implementation, and monitoring plan. The site-specific Action Plans offer suggestions for restoration options (including knowledge gaps) for three specific wetland complexes (Deh Akro, Chotiari, and Dhands and Tidal Link).

4 Approach and methodology

The methodology adopted was based on a three-level approach that included:

- The planning process

- Secondary data collection, revision and critical evaluation and analysis
- Primary data collection, revision and critical analysis

The planning process included the identification of sources of data needed, documentation and analysis of current conditions and identification of issues and problems related to the present project, and, following our best professional judgment, design of solutions to address those issues and problems that were identified.

Extensive secondary data was collected, reviewed and analyzed (reports, literature, maps, relevant data on wetlands, wetland management strategies, wetland restoration options and techniques, groundwater, drains, canals, irrigation, available statistics on population and economic indicators, etc).

Primary data collection involved several field trips to the three selected wetland complexes in order to gather essential general site-specific information (baseline situation, issues and problems, feasibility of restoration options).

5 Description of the project area

5.1 Location

The proposed project includes two major wetland complexes i.e. Deh Akro II and Chotiari. There are three wetland complexes located in left bank of Indus, delta and coastal zone namely Deh Akro II in district Beanzirabad, Chotiari reservoir and wetlands in Sanghar district and coastal wetland complex in Thatta and Badin districts. As presented in section 1 "Introduction", the Regional management Strategy encompasses the whole of Sindh Province, while site-specific Action Plans concern three particular wetland complexes (Figure 12.1) on the Indus River Left Bank: Deh Akro wetland complex, Chotiari Reservoir and wetland complex, and Dhands wetland complex around the Tidal Link.

5.2 Lakes (wetlands) within Thar Desert (Deh Akro -II)

5.2.1 Physiography

Marsh Land- Thar Complex: Group of small and Large Lakes occurs along the old course of Nara river (at present Nara Canal), adjacent to the fringe of Thar desert. The main parts of visited area occur in north-west around the head of Jamrao canal. The surveyed lakes (wet lands) occupy about 60% of the area and remaining is occupied by stable sand dunes of the Thar Desert.

Wetlands: The Lakes are perennially wet and are mostly saline. Whereas adjacent lands to canals are under the effect of seepage and remains sub merged most of the time. The edges of wet lands are dominantly covered with water-reed and other grasses.

Old Desert Margin: The surveyed area contains huge mass of alien sand deposits, which is possible a mixture of wind resorted alluvium of the river Indus, alien sands from the sea coast. The sandy ridges are usually gently sloping, but in some parts there are steep slopes. These sand dunes support some natural vegetation used as poor grazing for animals.

Soils: The soils around the different series of trapped Lakes within dunes are mostly sandy in nature, dominantly grayish brown, micaceous sands and loamy fine sands without any profile development. These soils occupy mostly gently sloping stable sand dunes and support some scrub vegetation used for poor grazing, few parts of land consist of shifting dunes. Locally there are some brown / dark brown silt loams and very fine sandy loams in the low interdunal

areas. These soils are porous and homogenized to about 50 cm depth with very weak coarse sub angular blocky structure, their substratum is usually stratified and sandy, some of the parts of these silty soils are saline and gypsiferous. At places soils of interdenal areas are subject to burial by shifting sands from the surrounding dunes, these soils are some where under cultivation during rainfall season.

Climate: This area has hot and arid climate, the hottest months are May-June when the average temperature goes up to the range of 110°-115° F (43°-45°). The coldest months are December and January when maximum temperature ranges from 70°-80°F (18-27°C); but frost are rare. Rainfall is sparse and erratic, but most likely in July-August; average rainfall is about 125 mm (5 inches). Evaporation rates vary from 11 mm/ day (0.4 inch/ day) in the hottest months to only 3 mm/ day (0.1 inch/ day).

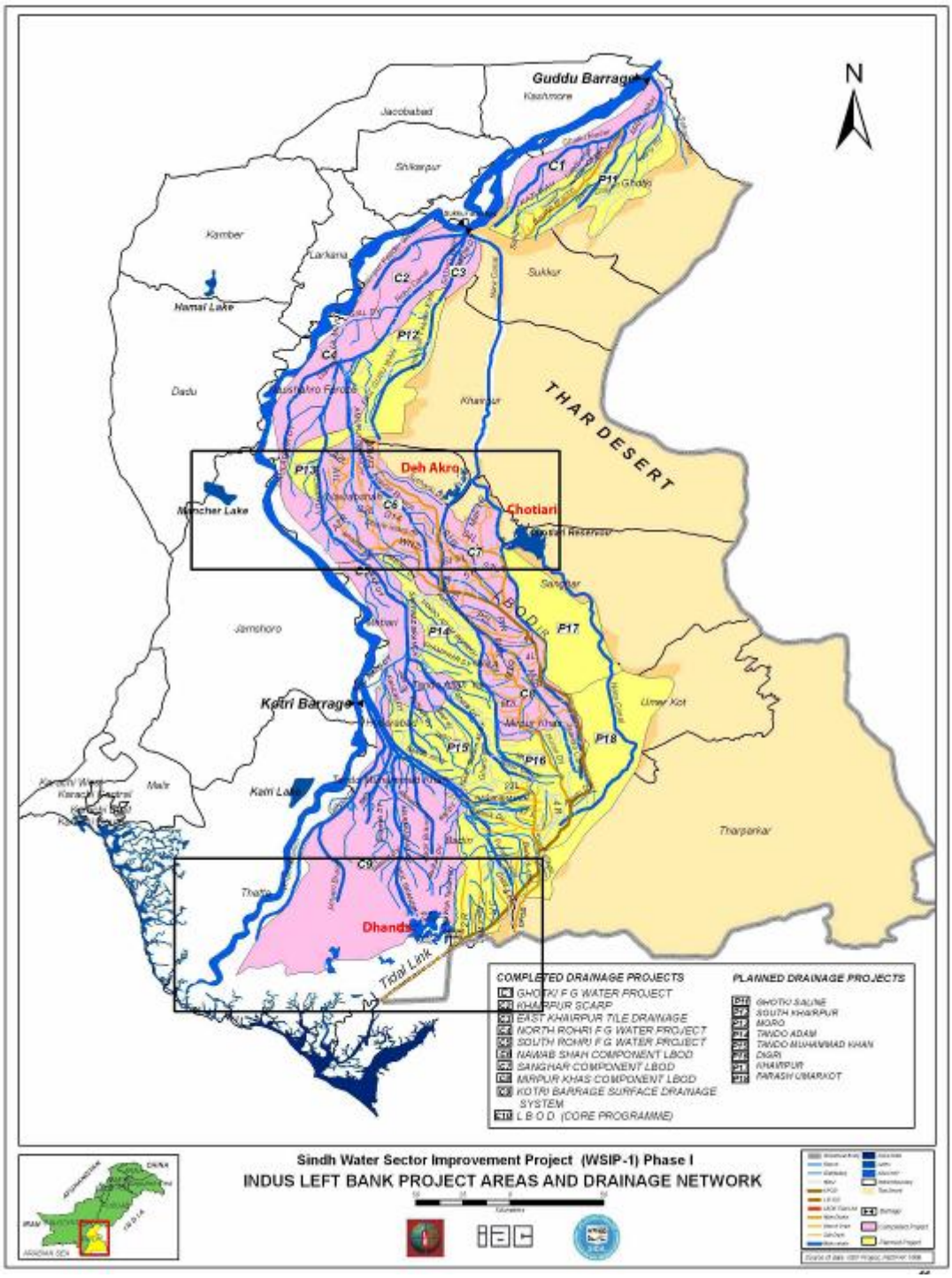

Figure 1: Sindh Province and location of Wetland Complex sites

Land Use: The land use around the lakes (wetlands) of deh Akro has little exposure for agriculture production. Only the low lying areas (interdunal valleys) within the sand dunes have very little potential for agriculture subject to availability of irrigation water (sweet water) from the irrigation system or from the lakes having water quality better for growing the agriculture crops suitable according to the soil conditions.

The sand dunes around the interdunal valleys and around the lakes (wet lands) have no capability to grow any agriculture crop except the natural vegetation cover, which provides

poor grazing for livestock. The edges of lakes (wet lands) are mostly saline covered with water-reed and drubh grass.

5.3 Chotiari Reservoir

5.3.1 Physiography

The Reservoir : The existing Chotiari Reservoir area is a habitat of wetland and open water, desert scrub and sand dunes. The reservoir is formed from a number of small, elongated and narrow lakes (Dhands) with a maximum depth of 15 to 45 feet. The edges of the lake are covered with mosaic like reed beds, alluvial fans, irrigation channels, riverine forest, desert dune swamps. The reservoir is a home to a large number of migratory and resident birds and it supports a viable fishing and agricultural industry.

The physical features around the Reservoir: In north-east the lake is surrounded by Thar Desert fringe and the natural swamps trapped within the high dunes. Where as in north-west and south, the edges of reservoir touches the lands under cultivation, these lands are relatively flat, having an approximate slope of 0.5 feet per mile. The cultivated lands are alluvial deposits of the river Indus and its tributaries and most of this area falls under the category of covered and meander flood plain having mostly coarse medium and medium fine textured soil types.

Soils: Soils around the Chotiari reservoir are of different type and are classified into two categories.

Soils of old desert margin: Soils of this plain occupy the gently sloping longitudinal and modified sand ridges. The soils are predominantly grayish brown, single grain, calcareous sands and loamy sands. They contain higher proportion of quartz but less mica then the soils of flood plains, the substratum is also sandy. The soils support some scrub vegetation used for grazing. However, interdunal valleys have somewhat homogenized loamy and clayey soils formed by the deposition of alluvial material.

Soils of Shallowly Covered Sub-recent Estuary Plain: These soils are mainly formed in alluvial sediments and mostly the upper layer of soils is fine or medium fine textured (silty clay and silty clay loam) overlying the substratum of the estuary plain consists of extremely sorted, unstable, distinctly mottled, very fine sandy loams and silt loams. These soils are likely to pose a drainage problem and intensive irrigated agriculture.

Climate: The climate conditions around the Chotiari reservoir are mainly arid and semi arid tropical marine. It is characterized by intense summer heat and mild winters. May is the hottest month with a mean maximum temperature of 108° F (42.2 C°). Strongly dust storms below from south-west to north-east for about forty days, from the middle of May to end of June. The monsoon starts towards the end of June and extends for about two months but the rainfall is erratic. January is the coldest month with a mean minimum temperature of about 44° F (6.67 C°). Frost may occur for few days during December and January.

Land Use: The land around the Chotiari reservoir is used in different ways depending mainly upon water supply, nature of soils, relief and socio-economic conditions. Therefore, Land use patterns vary considerably from place to place. Generally the Land use of the adjacent area of Chotiari reservoir is classified into two different categories.

General Cropping with Perennial Canal Irrigation*:* The lands in north-west and south-west are under cultivation to different agriculture crops. The lands are level to nearly level,

medium to fine textured, moderately well drained and irrigated by the perennial irrigation system. The general standards of farming is fairly good and are capable to grow cash crops like sugarcane, cotton in summer and wheat, oil seed, chilies are the main winter crops.

Poor grazing and restricted general cropping: This landform exists in north and north-east of Chotiari reservoir and comprises mainly very fine sandy soils, with irregular relief in the shape of sand dunes of high elevation as compared to the cropping area. This part of land is restricted to general cropping only it is capable to grow scrub vegetation which provides some poor grazing and fire wood.

5.3.2 Irrigation supplies

5.3.2.1 Sindh background

The Nara Canal system is one of the largest irrigation systems in the world covering command area of 1.01 MHA (2.502 million acres). The Nara canal off take on Left Bank of River Indus from Sukkur barrage with design discharge capacity of 13649 cusecs, and maximum authorized Discharge is 13750 cusecs however maximum inflow up to 17000 cusecs has been conveyed from canal. The system was constructed in 1930s and it was designed to irrigate about 30% of cultivable command Area (CCA). Water allowance for Nara Canal 2.8 cusec / 000 acres however the irrigated area has increased substantially. The Nara irrigation system is divided into two district sections.

- Upper Nara between Sukkur Barrage and Jamrao Weir (11% of total CCA)
- Lower Nara below Jamrao Weir (89% of total CCA)

The first 155 km of the Nara Canal serves approximately 27000 acres (109312 ha) which is 11% of the total CCA of the Nara System. The Nara System below Jamrao weir constitutes 89% of the total CCA of the Nara System. The area below Jamrao weir (RD 575 of Nara Canal) is served by 4 main canal systems Jamrao, Mithrao Khipro and Lower Nara Canal.

- The Jamrao system consist of the Jamrao Canal length 77 miles (129km) 3 Branch Canals (west Branch, Dim Branch and Shahu Branch) 16 distributaries serving 2,90,000 acres (117060 ha) and 58 minors serving 368000 acres (149053 ha) and (total) 126500 acres (51200 ha) are served by direct off takes.
- The Mithrao System Consist of Mithrao Canal Length 77 miles (129 km) 2 Branch Canals Nabisar Branch and Naukot Branch, 15 distributaries serving 288500 acres (116776 ha) and 33 minors serving 206375 acres (83553 ha). A total of 92500 acres (37,463 ha) area is served by direct off takes.
- The Khipro system consists of Khipro Canal length 47 miles (79 km). 1 Branch Canal Samaro Branch, 7 distributaries serving 132000 acres (53441 ha) and 15 minors serving 70000 acres (28,374 ha) and 35700 acres (14446 ha) are served by direct off takes.
- The Lower Nara Canal consists of Lower Nara Canal from Jamrao weir length 116 miles (194 km) and Thar Canal length 13.8 miles (23 km) system consists of 14 distributaries serving 209160 acres (84,679 ha) and 9 minors serving 38887 acres (19832 ha) on the Thar Canal 96000 acres (38,886 ha), are served by direct off- takes.

Significant improvements to Nara canal System have been undertaken through various development projects: LBOD stage 1, Sindh On farm Water Management Project, National Drainage Program. These improvements comprise as under.

- Remodeling of Nara Canal head reach and construction of 2 fall structures.
- Construction of Jamrao weir and Canal.
- Construction of Chotiari Reservoir.
- Replacement of West Branch Head Regulator of Jamrao Canal.
- Re alignment of Lower Nara Canal.
- Improvement of Distributaries and Minors.
- Improvement of Water courses.

Substantial works have been planned to be undertaken under component B of Sindh Water Sector Improvement Project Phase-1 (WSIP-1) such as rehabilitation/ replacement of major structures as well as canal prism for improving operational efficiency of irrigation network of Nara Canal System. These include construction of fall structures at RD 550. Replacement / Rehabilitation of Head of Regulator of Lower Nara Canal, Mithrao Canal Khipro Canal, rehabilitation of Canals and replacement/ Rehabilitation of Structures in these Canals system and Improvement of Distributaries/ Minors.

Irrigation Canal Type	**Length km**	**Density m/ha**
Main canals	2513	0.5
Branch and sub branch canals	4450	0.9
Distributaries	4276	0.8
Minor canals	6323	1.2
Water courses (no. 43,000)	12900	2.5

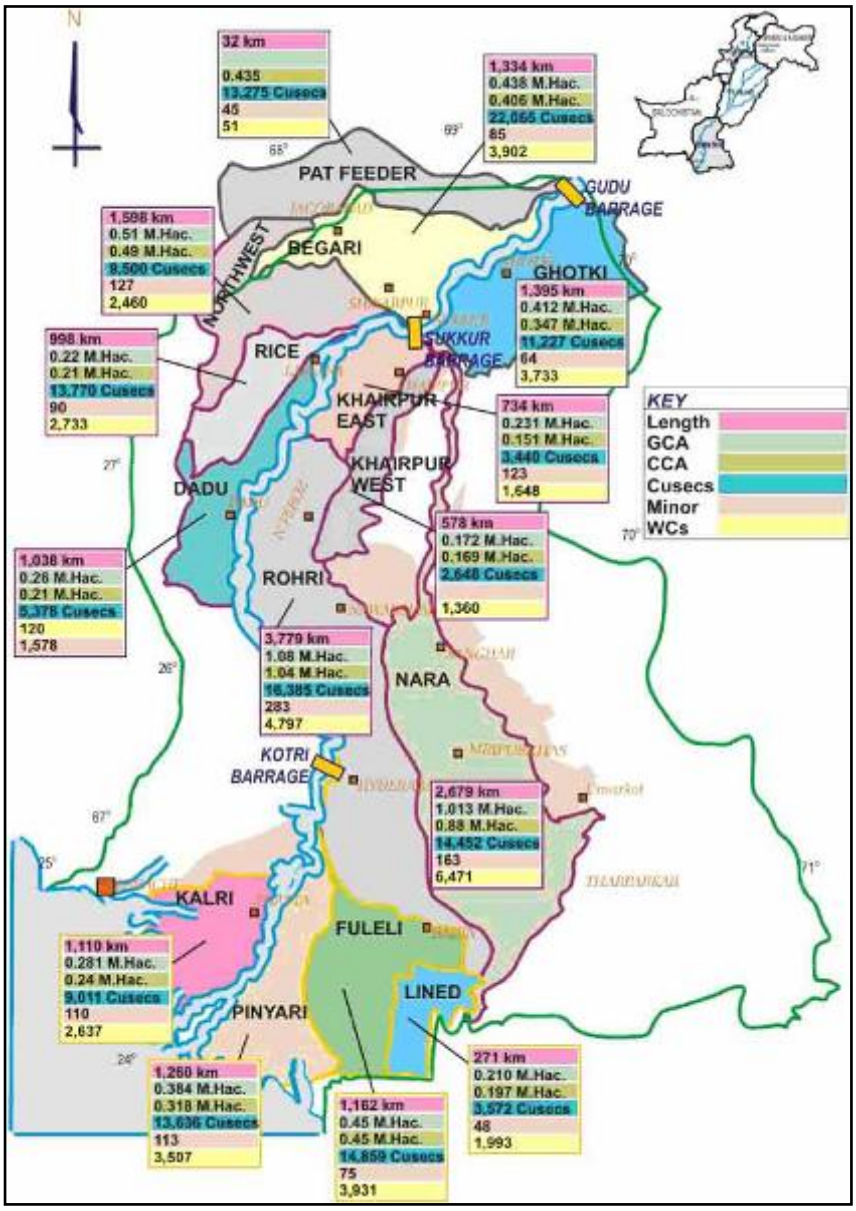

Figure 2: Irrigation network and command areas in Sindh

5.3.3 Site-specific features

Chotiari Reservoir

Chotiari Reservoir is an off-stream reservoir. The reservoir was constructed as a part of the Left Bank Outfall Drain stage 1 project. The reservoir is 7.8 miles (13 km) wide and 9.6 miles (16 km) long covering an area of 45000 acres (18,218 ha) at normal pool level. Chotiari Reservoir has been constructed to increase storage capacity of existing lakes from 0.17 MAF to 0.71 MAF (0.87 BCM). The live storage capacity of Chotiari reservoir is 0.67 MAF (0.82 BCM). Be drawn from Nara Canal during monsoon flood in the Indus River for filling Chotiari Reservoir. Water will be released from Chotiari Reservoir in the winter and early summer months to Lower Nara Canal below Makhi weir to increase Cropping intensity on about 324000 acres (131174 ha) of Lower Nara Canal command.

Water required for filling Chotiari Reservoir is based on the assumption that it will be managed from Sindh Provincial share and saving of water lost by seepage below Kotri

barrage between mid June and late October rising to a maximum level in late July and August.

Chotiari Reservoir was handed over by WAPDA to Sindh Irrigation and Drainage Authority in 2002. Status of water storage in Chotiari Reservoir on storage from 2003 to 2010 is presented in Table 6. Storage in the Chotiari Reservoir during 2007 was 0.60 MAF which was 84.5% of maximum storage capacity of Reservoir.

Filling of Chotiari Reservoir is essential to overcome the shortages of water in the critical periods especially during Rabi Season in lower commands of Lower Nara Canal. The storage figures during different year from 2003 onwards indicate the facility has not been utilized in spite of the water shortage problems experienced in lower command of Lower Nara Canal. For efficient water management in Nara Canal system filling of Chotiari Reservoir is critical.

Year	Date	Maximum Gauge / Level of the Chotiari Reservoir	Maximum Chotiari reservoir Gauge Achieved	Reduced level Achieved	Water Stored in the Reservoir as per Capacity Curve / Manual	Percentage of (0.71 M.A.F)
2003	1st December	23.0(RL.87.5ft) (i.e.0.71 MAF)	12.75	R.L. 77.25ft	0.275 MAF	38.73%
2004	2nd November	-do-	06.50	R.L. 71.0ft	0.12 MAF	16.90%
2005	20th November	-do-	11.90	R.L. 76.4ft	0.24 MAF	33.80%
2006	20th December	-do-	16.90	R.L. 81.4ft	0.43 MAF	60.56%
2007	21st April	-do-	20.6	R.L. 85.10ft	0.60 MAF	84.50%
2008	31st December	-do-	9.0	R.L. 73.5ft	0.17 MAF	23.94%
2009	31st December	-do-	7.40	R.L. 71.90ft	0.14 MAF	19.25%
2010	31st January	-do-	6.00	R.L. 69.50ft	0.11 MAF	15.60%

6 Wetlands for which an action plan is proposed in this study

6.1 Deh Akro wetland complex (26°50'N 68°20'E)

Situated along the Nara Canal in the westernmost reaches of the Thar Desert, it extends over 20,243 ha and includes about 36 lakes, of which five are freshwater and 31 brackish water, fed by seepage from the canal. Located in a typical stable sand desert habitat, the lakes occupy flat bottomed valleys surrounded by 5 to 10 m high sand dunes.

Figure 3: Satellite view of the Deh Akro wetland complex

It hosts a large variety of flora, with 24 main species of plants, shrubs and small trees, and a rich fauna including the Marah crocodile, Monitor lizard, Indian cobra or Desert boa. It is an important wintering area for migratory birds.

6.2 Chotiari Reservoir and wetland complex

This wetland complex was originally very similar to the Deh Akro Complex, formed of a large number of narrow elongated lakes (all orientated NNE-SSW, as can be seen on Table 12.1. Its southern and western sides have been raised to create a reservoir, directly fed by an inlet from the Nara Canal. The rest of the wetland complex is sustained by seepage water from the canal. The reservoir occupies an area of about 18,000 ha and has water storage capacity of 0.75 MAF, flooding an area of approximately 160 km^2.

Figure 4: Satellite view of the Chotiari Reservoir wetland complex

The flora recorded in the wetland complex and reservoir includes 115 species of plants belonging to 83 genera and 40 families, and the fauna includes 10 species of large mammals and 21 species of small mammals, 67 species of birds (33 migrants and 34 residents), 32 species of reptiles, 2 species of amphibians and 45 species of fish.

Water in the reservoir and surrounding wetlands is of reasonably good quality and reflects water quality in the Nara Canal. Measurements show normal ranges for water quality parameters (Table 1) except for total suspended solids, biochemical oxygen demand and chemical oxygen demand, and for oil and grease, which all display higher than normal values.

Table 1: Water quality measured at five sites in and around Chotiari Reservoir wetland complex

Parameters mg/L	**Sampling Stations**					**NEQS (Rev.)**
Physical Parameters	ST-1	ST-2	ST-3	ST-4	ST-5	
pH	7.2	7.1	7.1	7.2	7.1	6-9
Temperature ℃	26.10	25.60	25.60	26.80	26.40	40 - 43℃
Salinity $^{0}/_{00}$	0.10	0.10	0.10	0.10	0.10	
Total Dissolved Solids (TDS)	156	158	178	162	172	3500
Total Suspended Solids (TSS)	952	940	968	1100	1135	200
Chemical Parameters						

Biochemical Oxygen Demand (BODs)	193	192	195	190	178	80
Chemical Oxygen Demand (COD)	268	272	276	275	282	150
Phenol	0.042	0.056	ND	ND	ND	0.1
Nitrate	0.86	0.45	0.79	0.66	0.83	50
Cadmium (Composite)	0.021	0.015	ND	ND	ND	0.1
Chromium (Composite)	Nil	Nil	ND	ND	ND	1.0
Oil and Grease (n-Hexane Extract)	210	ND	ND	ND	ND	10

Note: ND = Not Done

7 Due Diligence

7.1 Description of proposed project

The proposed project is to be executed at two sites including i) Deh Akro II complex and ii) Chotiari Reservoir and associated wetlands. The rehabilitation and management strategies and specific activities in both the sites are different and as per site specific objectives. There are two broad categories of the project are i) Regional Management Strategy which will cover both sites/complexes and other wetlands of similar nature and ii) Rehabilitation of both the wetland complexes through site-specific activities to address the problems identified for both the areas.

The plan has two components: a Regional Management Strategy (Management Plan Restoration Strategy, including an outline of the studies to be undertaken in order to design a proper restoration and management plan for each wetland in Sindh) and three Action Plans (restoration options for three wetlands: Deh Akro and Chotiari Reservoir.

Within the Regional Strategy, each section will have two parts: one part describing the section's topic at the level of the Sindh province, one part describing this topic locally (for each of the wetland complexes).

The proposed activities for rehabilitation of Deh Akro II is to address the problem of shortage of water required for survival of threatened wildlife species and for Chotiari Reservoir is to address the problem of water logging created by the reservoir and adversely affecting the fertile agricultural lands and improve the ecological aspects of the Chotiari complex.

Detailed description of above components of the proposed project is given in the following paragraphs.

7.1.1 Regional Management Strategy

The importance of a Management Strategy

Management Plans aim to establish and maintain the sustainable use and development of the resources of wetland areas so as to improve quality of life, maintain biological diversity, productivity and quality of the concerned wetlands, through efficient and integrated management. For achieving this, long term vision and planning is necessary, and this is why the planning cycle is organized around "time loops" as shown in Figure 5.

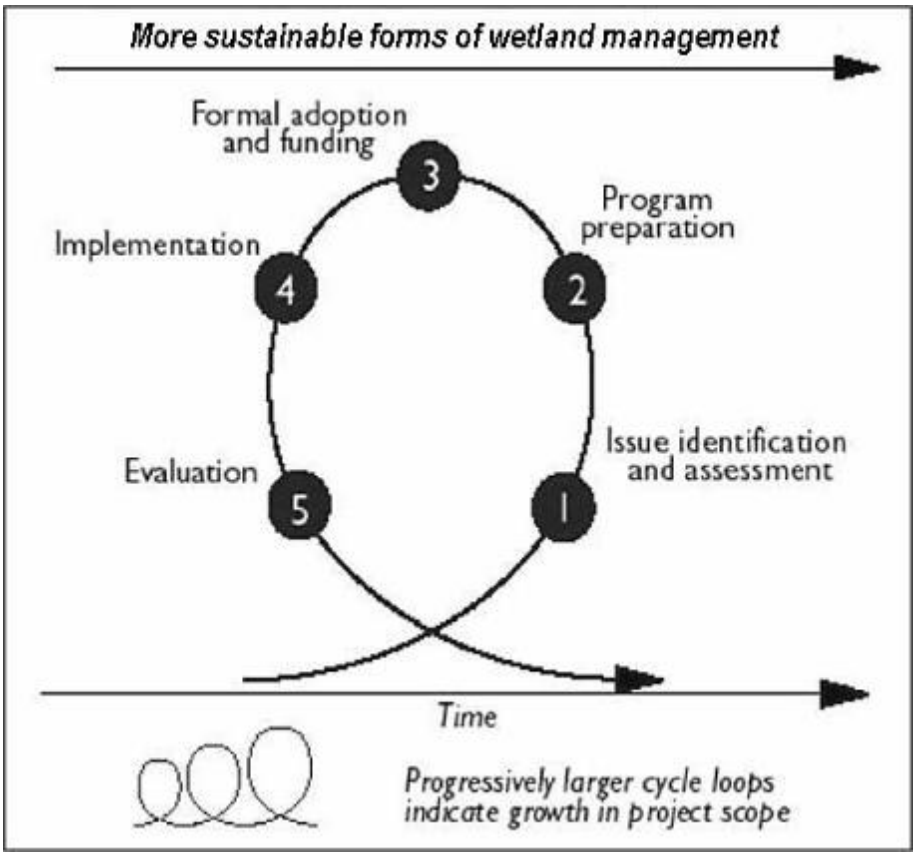

Figure 5: The Planning Cycle

The specific content of wetland management plans can vary depending on the specific values of the wetland and the complexity of the issues involved. It should however include a minimum number of basic components, as graphically summarized in Figure-6 by IUCN (2009), although these maybe distributed or grouped differently.

PHYSICAL WETLAND	BIODIVERSE ECOSYSTEM	ECOSYSTEM SERVICES (VALUES AND COSTS)	LOCAL LIVELIHOOD SYSTEMS	POLICIES, GOVERNANCE, INSTITUTIONS, MARKETS
• Geology and topography • Seasonal hydrological regime	• Wetland ecosystems • Component species diversity • Species ecology, distributions and conservation status	• Purified water (domestic use, irrigation, electricity generation) • Food and building materials • Flood control	• Agriculture • Fishery • Forest products	• Markets • Fisheries policy and access conditions • Protected areas management

Figure 6: Basic standard components of wetland management plans

A recommended format and content is provided hereafter, but it is important to remember that this can be varied to meet specific circumstances, where changes can be justified.

However, most wetland management plans have similar components, though they may look very different or have very different management strategies. Key to any wetland management plan is to identify the wetlands within the area of concern; in this case, the Sindh Province (the "Site context" component of the plan, see below). Once the wetlands are identified, it is important to determine how those wetlands are functioning in the ecosystem. Wetland function, in addition to a variety of social and economic factors such as proximity to schools, amount of forested buffer surrounding a wetland, and capacity to store floodwaters, for example, will be important factors in determining how the wetlands will be managed in the

future. For example, wetlands that are highly functional and located near a school may be protected from future development, while lower functioning wetlands near an existing road may be candidates for restoration, storm water treatment, or development.

The management categories are developed based on a series of goals and objectives set for the management plan. These goals and objectives are usually set by the stakeholders who will be affected most by the management plan. The stakeholders can include government officials, landowners, state and federal agencies, business owners, developers, concerned citizens, and others who are interested in the management of the resource at stake. Other components of wetland management plans often include educating the public and gathering public feedback about the plan. The final stage of developing a wetland management plan is developing the management tools to be used to implement the plan (the "Institutional context" component of the plan, see below). These tools can include ordinances, a refined regulatory process, a wetland mitigation bank, and a whole suite of other options to be developed by the stakeholders.

The Regional Strategy is thus organized around three components, each featuring a number of subcomponents:

- Institutional context (policy harmonization and institutional framework, capacity building, awareness raising)
- Site context (development and implementation of wetland-specific management plans, development of a wetland GIS database)
- Monitoring plan (including communities' education, awareness and participatory initiatives).

The three Action Plans referred to earlier are to be viewed as sub-components of the « Site context » component of the Regional Management Strategy.

A schematic view of the general organization of the Regional Management Strategy is given by Figure-5. For clarity, only those sub-components important for grasping the meaning of the components they refer to are included in the Figure-7 shown below.

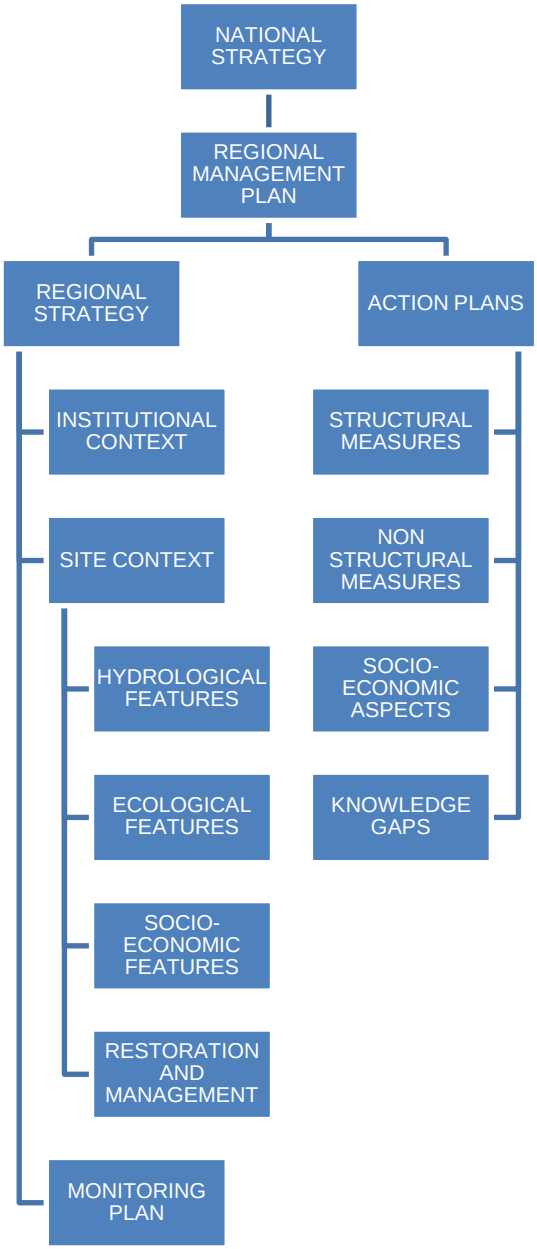

Figure 7: General Organogram for Regional Management Strategy

Management Strategy Components and Sub-components tree

- Institutional context
  - adaptation of existing set up
  - relevant legislation
  - capacity building
  - Human resources…
- Site context
  - Physical features
    - Location and setting
    - Land tenure and zoning
    - Climate
    - Physical geography
    - Wetland types
    - Adjacent land use
    - Wetland infrastructure
  - Hydrological features
    - Catchment analysis
    - Inflow and Outflows
    - Wetland capacity
    - Flow regime
    - Tidal influence
    - Impacts of climate change
    - Water quality (diffuse and point source pollutions)
  - Ecological features
    - Flora assessment
    - Fauna assessment
    - Threatened and endangered species
  - Socio-economic features
    - Existing and potential user groups
    - Value of the wetland to the community
    - Community consultation
    - participatory activities
    - awareness raising
    - poverty reduction initiatives

- Restoration and management strategy
  - Issues and problems
  - Non-structural measures (including community participation)
  - Structural measures

- Monitoring plan
  - Water quality monitoring
  - Threatened and endangered species monitoring
  - Flora monitoring
  - Fauna monitoring
  - Environmental education

Monitoring Plan

Third component of the Regional Management Strategy, the monitoring plan is an essential part of it. This is how the strategy's efficiency and effectiveness can be assessed, and fine tuned and adapted, for future better management "The Planning Cycle".

It is a universal rule that monitoring plans, in order to be efficient (or even in order to be implemented in the first place) need to be as simple and as straightforward as possible. The present monitoring plan should include a maximum of seven factors to be assessed at given intervals (two are of regional dimension, five of site-specific dimension):

- Institutional adaptation
- Legislative consolidation
- Water quality monitoring (as a minimum: water level, conductivity, BOD or DO)
- Threatened and significant species monitoring
- Flora monitoring
- Fauna monitoring
- Community environmental education and participation

7.1.2 Proposed action: Monitoring Plan (third component of Regional Strategy)

Ideally, overall monitoring of the Regional Wetland Management Strategy should be done by the Regional Wetland Committee, if recommendations made under "Institutional context", are implemented. It should include people with expertise in:

- Institutional strengthening
- Legislative consolidation (environmental law)
- Wetland ecology
- Hydrogeology
- Sociology
- Rural Economy

And it should be able to rely on inputs by field teams (an ecologist and a social specialist) regarding site-specific management plans (ref: "Institutional context").

Site-specific Action Plans

The second component of the Regional Management Plan includes three Action Plans for three of the main wetland complexes found on the Indus River left bank in Sindh (Deh Akro, Chotiari, Dhands and tidal link). The Action Plans (corresponding to the "Restoration and management strategy" subcomponent in the Regional Strategy tree) include:

- Structural measures
- Non-structural measures
- Socio-economic aspects
- Knowledge gaps – validation studies to be undertaken

7.1.3 Deh Akro

Site context

The Deh Akro wetland complex is situated in the western reaches of the Thar Desert (Figure-6 "Location"), in Nawabshah, where the Jamrao Canal offshoots from the Nara Canal.

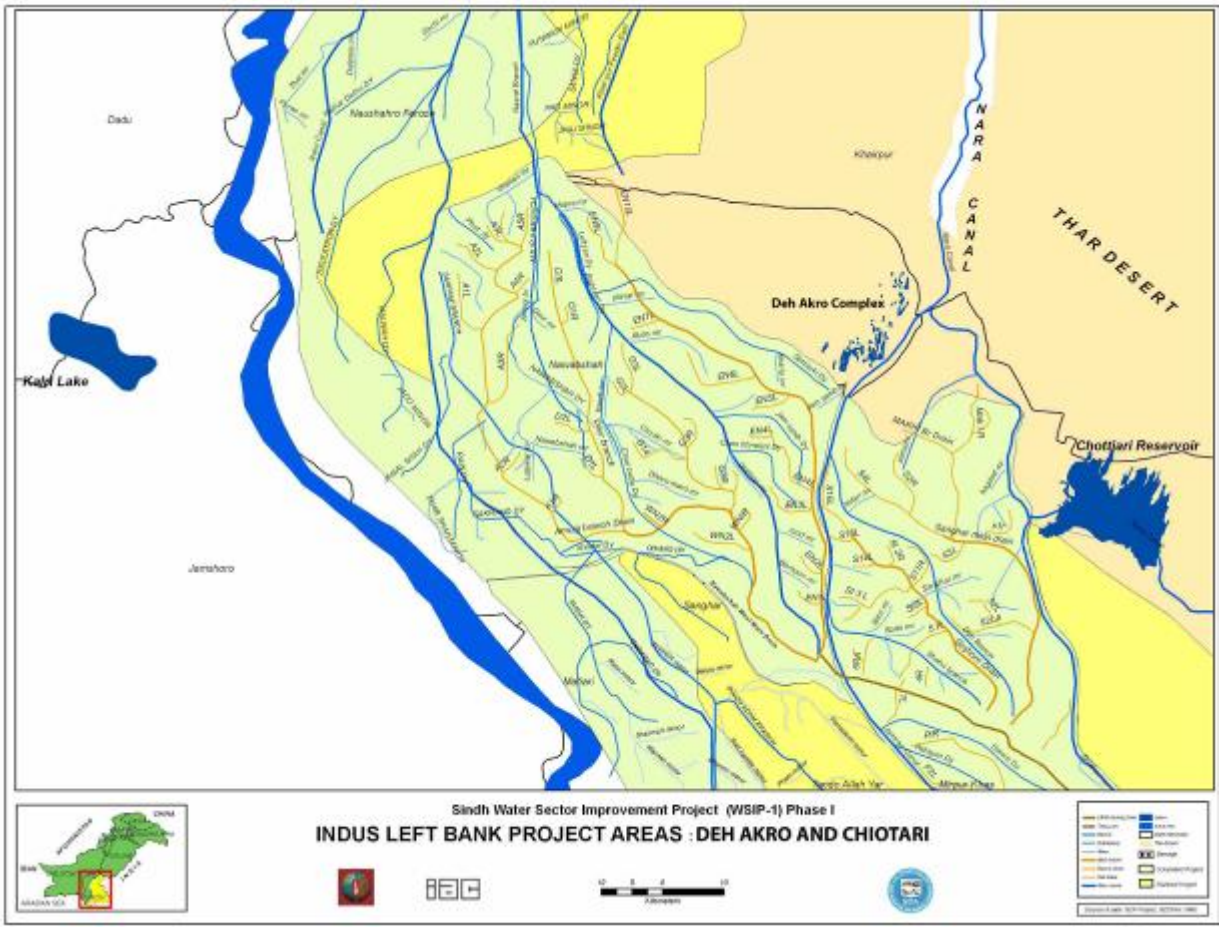

Figure 8: Location of Deh Akro and Chotiari Wetland complexes

The wetland complex extends over 20,243 ha and includes about 36 lakes, of which five are freshwater and 31 brackish water, fed by seepage from the Nara Canal and its Jamrao offshoot.

Located in a typical stable sand desert habitat, the lakes occupy flat bottomed valleys surrounded by 5 to 10 m high sand dunes (Pictures 1and 2).

Deh Akro is a wildlife sanctuary consisting of four major habitats; desert, wetland, marsh and agricultural. It is a natural inland wetland ecosystem, which supports a variety of rare and endangered wildlife species. This area hosts a considerable number of rare fauna. Many indigenous fish species are also found. Water scarcity during a persistent dry spell is adversely affecting the area.

There are nineteen (19) wetlands declared as Ramsar Sites in Pakistan, nine are located in Sindh province of which six are situated on the left bank of Indus namely, Deh Akro, Nurruri lagoon, Jubbo lagoon, Runn of Kutch, Indus delta, and The Indus Dolphin Reserve. They have gained importance due to their unique biodiversity and habitat which shelters large number of species. Table below shows the location and area of Ramsar Sites located on the left bank of Indus Figure A and B.

Name of wetland	**Location (District)**	**Area (ha)**
Nurreri Lagoon	Badin	2,540
Jubbo Lagoon	Thatta	706
Deh Akro	Shaheed Benazirabad	20,500
Indus Dolphin Reserve	Between Guddu and Sukkur	125,000
The Indus Delta	Thatta and Badin	472,800
Rann of Kutch	Tharparkar	566,375

Figure 9: A and B, Two lakes of the Deh Akro wetland complex

Issues identified

The wetland complex used to be fed by a natural stream. However this stream does not exist anymore, having been incorporated into the Nara Canal when the latter was built. The complex is still supplied in freshwater from the canals through seepage, but it can be assumed that this brings in less water than the original input and at a slower rate. Indeed, some of the shallowest lakes, or those furthest away from the canals, dry up during the dry season; with disastrous environmental and economic consequences (see section "*Socio-economic aspects*" below).

Proposed solutions

Ideally, the original water supply should be restored in order to avoid the environmental and economic negative effects of lakes drying out. In reality, this will probably be impossible. What could be possible however would be to provide the complex with just enough extra water to prevent the lakes from completely drying out and allow them to sustain life on a year-round basis.

Both structural and non-structural measures are hereinafter suggested. Structural measures concern the construction of an underground pipe linking the Nara Canal to the head lake(s) as illustrated by Figure-8. This pipe would be only a few kilometers long (depending on local topography and natural slope), and its diameter should be wide enough to allow a strong flow to pass through. The idea indeed would be to open the connection between the canal and the pipe only during peak flow time in the Nara Canal.

This would allow avoiding two potential problems linked with diverting water from the Nara Canal through a pipe. The first is general water availability for irrigation downstream. Diverting some water during peak flow only should avoid creating water shortages downstream. The second is the danger that the pipe gets clogged by siltation. Having only high speed flows in the pipe should allow it to keep itself free of deposits.

Non-structural measures concern dredging of the shallowest lakes in order to restore their storage capacity and resilience to droughts. This will depend on local orology and of dune stability in the immediate surroundings of the concerned lakes.

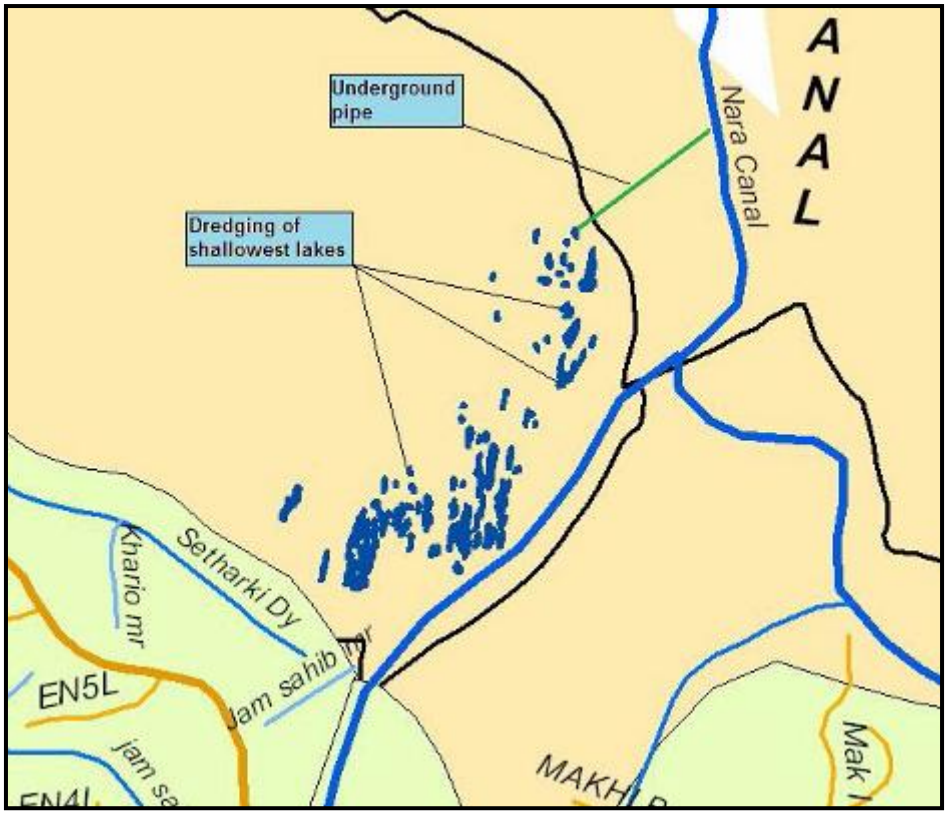

Figure 10: Suggested structural and non-structural measures for Deh Akro wetland complex

Socio-economic aspects

The lakes are used for fishing and as drinking points for cattle by the surrounding communities. These communities also practice agriculture, but only rain-fed agriculture, which means that during the dry season they have to rely on other sources of livelihoods, such as subsistence fishing and cattle raring, or they have to migrate to irrigated areas where they can work in other farmers' fields.

Knowledge gaps

Two areas need further investigation through field studies in order to gather essential missing data necessary to validate the measures proposed, or to adapt or modify them, before implementation.

It will first be necessary to carry out a complete study of water flows through the wetland complex (surface water flow, vertical flow, horizontal groundwater flow. Site context: hydrological features). The results of these investigations will make it possible to determine the minimum volume of extra water input that would still make a difference for the wetland complex functioning, and whether or not this minimum amount could indeed be diverted from the Nara Canal in times of high flow.

The orology of the area around the shallowest lakes will have to be studied (dominant wind strength and direction, wind-blown dust, rate of dust deposition) in order to determine how quickly dredged lakes would get filled up and whether or not it would be worth dredging some of these shallowest lakes.

8 Chotiari Reservoir

Site context

Chotiari Reservoir and wetland complex are situated south-east of the Deh Akro wetland complex, within the western reaches of the Thar Desert (Figure-11 "Deh Akro"). It was originally very similar

to the Deh Akro complex, formed of a large number of narrow elongated lakes. Its southern and western sides have been raised to create a reservoir, directly fed by an inlet from the Nara Canal. The rest of the wetland complex is sustained by seepage water from the canal. The reservoir occupies an area of about 18,000 ha and has water storage capacity of 0.75 MAF, flooding an area of approximately 160 km^2. The areas along the western and southern sides of the reservoir are covered in farmland.

Issues identified

Following the building of the reservoir's embankment on the western and southern sides of the wetland complex, and the subsequent rising of the water level in the reservoir (maximum retention level of 87.50 ft and dead storage level of 64.50 ft), the areas below the embankment (both western and southern sides) became severely waterlogged and even flooded (Figure-11). It seems that following the rise in water level inside the reservoir, seepage under its embankment has dramatically increased, flooding large areas of valuable farmland.

Figure 11: Flooded area below Chotiari Reservoir

Proposed solution

Two options are suggested with two different structural measures, depending on the depth reached by underground seepage water. A complementary non-structural measure is also presented to improve the efficiency of the structural measures.

The first structural measure would consist in digging moats along the western and southern embankments of the reservoir (Figure-12a). These moats would intercept seepage water before these can reach farmland areas cross-section in Figure-13. The alternative structural measure (Figure-12b) would be to create a grid of surface drains that would prevent the topsoil from becoming waterlogged or even flooded.

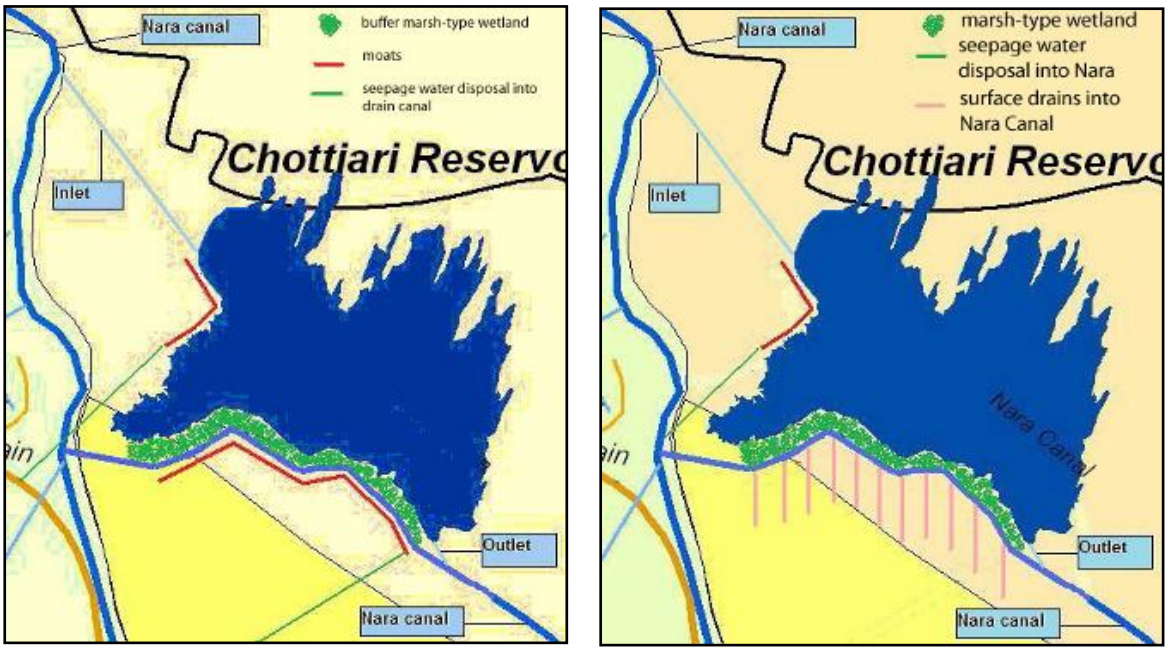

Figure 12: (a) & (b): option with moats (left) and option with surface drainage channels (right).

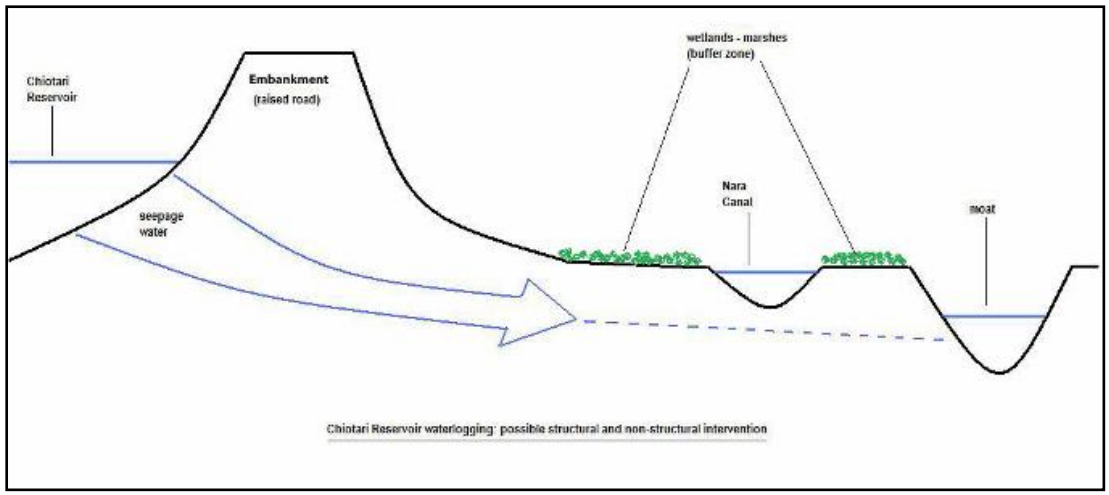

Figure 13: Interception of seepage water by a moat and establishment of buffer zone.

For each option, collected seepage water could be disposed off either in the Nara Canal, or in the nearest drainage canal Sanghar Main Drain, depending on water quality (conductivity) and quantity compared to the flow in the Nara Canal.

A non structural measure, identical for either structural option, is proposed in order to increase overall efficiency. It concerns the establishment of a marsh-type wetland belt acting as buffer zone (belt-shaped floodplain) between the reservoir and the moat, or between the reservoir and the grid of surface drains, depending on the structural option chosen (Figure-12 (a) & (b)).

Socio-economic aspects

At present, large areas of valuable farmland have been, and are still being, lost to water logging and flooding. This reduces opportunities for local communities relying mainly on farming activities for subsistence. The return of this land to farming status would no doubt significantly improve livelihood opportunities in the area.

Knowledge gaps

In order to select one or another structural option, two knowledge gaps need to be filled. A hydro geological study needs to be conducted to determine vertical flow and groundwater horizontal flow so these can be characterized (depth, flow rate). At the same time, seepage water quality needs to be monitored in order to determine specific conductivity. Once seepage water depth, flow rate and quality have been determined, it will be possible to select the best combination of structural measure and disposal method of seepage water.

9 Outcome and scope

The scope and outcome of this study are to be found at two spatial levels as well as two temporal levels. Spatial levels are both local and large scale. The Regional Management Strategy is the large scale spatial level, encompassing the whole territory of Sindh, while site-specific Action Plans represent the local scale, concerning three well defined intervention areas (Deh Akro and Chotiari Dhands wetland complexes).

The study and its outcome are also to be framed against two time-scales: medium term and long term. On a medium term time scale, the suggested Action Plans can be implemented and produce a noticeable effect on the environment and the livelihoods of the concerned communities. The Regional Management Strategy is however to be projected in the long term. It has of course immediate effects, albeit localized, through the three Action Plans, but as time passes, it will eventually affect the whole of Sindh Province when all its wetlands have each benefited from their own Action Plan. This is the consequence of a management strategy based on the time-loop principle from a long term perspective Figure-14. As time passes, the scope of the project grows to encompass a larger and larger spatial scale.

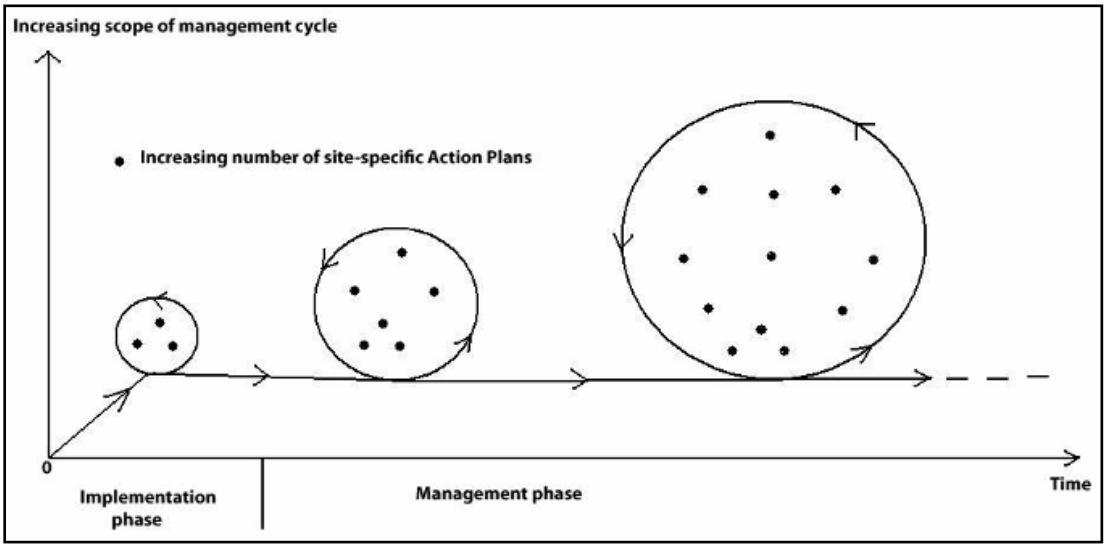

Figure 14: Increasing scope of management cycle, from implementation phase through to management phase and forward

10 Implementation arrangements

Nothing touching environment and ecology is ever black or white, or ever fits neatly into one unchanging mould. The proposed project, directly dealing with environmental and ecological matters, is no exception. And this is best illustrated by the implementation arrangement suggested hereinafter.

The whole project revolves around wetland restoration and management, which really should be implemented by a Wetland Management Committee or Agency. However, such body does not yet

exist; it will be one of the expected outputs of the present project, which will define its composition, structural relationships, role, competences, prerogatives and decision power. It is therefore suggested that the project's component on Deh Akro-II be started under the supervision of the Sindh Wildlife Department and Chotiari Reservoir component be implemented and supervised by Sindh Irrigation Department or Sindh Irrigation and Drainage Authority (SIDA).

After initial studies have been launched and the necessary institutional and legislative analysis have begun to produce their first results, an embryonic Regional Wetland Management "entity" will start taking shape. From then on, it should gradually assume more and more responsibilities in project's implementation until it can fully cover all its aspects (Figure-15).

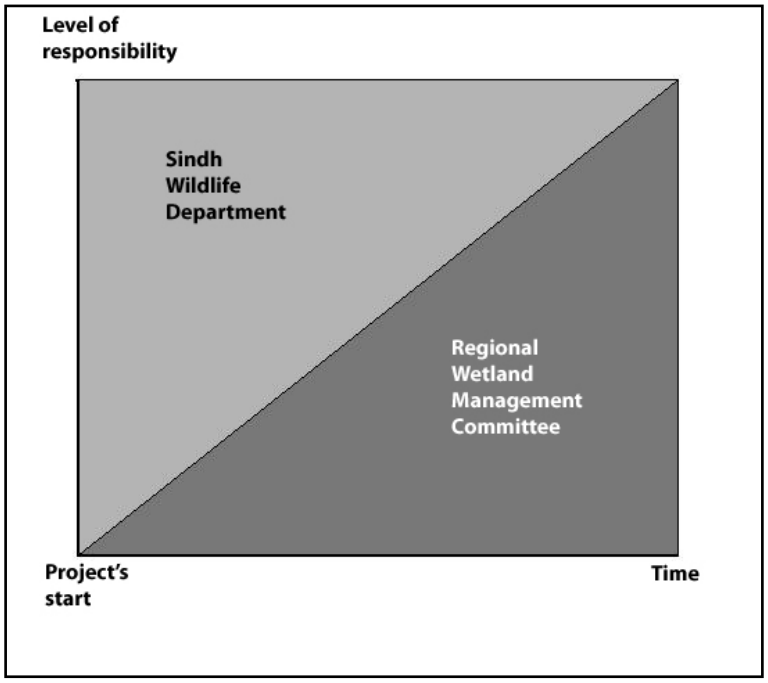

Figure 15: Responsibility shift as implementation progresses over time.

When this happens, it can then be said that the "implementation" phase of this "never ending" project has been completed successfully and that the "management" phase has started.

11 Project estimated cost

Total estimated cost worked out during the pre-feasibility is Rs. 488.00 million (Table 2).

Table 2: Estimated Cost of proposed project

S. No.	Major head of work	Activity	Estimated Cost (Rs. Millions)	Remarks
1	Investigative studies	Hydrologic, floral and faunal, socio-economic and other studies	6.0	To be out-sourced
2	Regional Management Strategy	Preparation of management Plan	10.50	To be out-sourced
3	Construction of under-ground pipe line	Initial survey and investigations	4.00	
		Material & construction cost	39.50	
		Construction of head regulator	12.50	
4	Construction of interceptor pipe lines	Dredging	16.00	
5	Checking of seepage	Construction of Moat	120.00	
		Construction of interceptor lines/drains	112.00	
		Installation of tube wells	12.00	
		Construction of structures	31.50	
		Construction of interceptor drain parallel to Nara Canal	39.90	
6	Supervision	Engagement Technical staff	62.10	
		Engagement of support staff (field & office)	22.00	
	Total Estimated Cost		**488.00**	

12 Project period

The total period of the proposed project is 05 years

Detailed estimates structural work i.e. construction of interceptor drain parallel to Nara Canal at Chotiari Reservoir are given in Table 3.

Table 3: Estimate for construction of interceptor drain Parallel to Nara canal at Chotiari Reservoir

Abstract Sheet					
Quantity	**S. No**	**Item**	**Rate (Rs.)**	**Unit**	**Amount**
14,157,000 Sq. ft	1	Jungle clearance and Removing to width of 121 feet distance	30.25	1000 sq. ft	428249.25
	2	Cost of Tube wells including control panel wires and transformers	800000.00	lumsum	800000.00
19,426,308 Cft	3	Channel Excavation	992.20	1000 CFT	19,274,783
1536 cft	4	Sump Excavation	992.20	1000 CFT	1,524
11,356,224 Cft	5	E/W compaction in soft ordinary hard soil (a) Leveling of earth work in 6" layer. (b) leveling and dressing complete	167.00	1000 CFT	1,896,489
11,356,224 Cft	6	Earth work compaction by sheep foot roller and power roller, with optimum moisture content for 85 % modified AASHTO density.	553.73	1000 CFT	6,288,282

64 cft	7	Lean Concrete of Ratio 1:4:6 Required	125.73	CFT	8,047
512 cft	8	Required Quantity of Concrete of 1:2:4 Ratio	235.00	CFT	120,320
1.393 Tons	9	Total Steel required for reinforced Cement Concrete	95000.00	Ton	132,335
Sub Total					**28,950,029**

Add 10 % contingencies	2,895,003
Add 15% for Cross-Drainage works	4,342,504
Total	36,187,537
Add 10 % escalation	3,618,754
Grand Total	39,806,290
	Rs. 39.806 Million

12.1.1 10.1 Source of funding

The funding for this important project will be jointly from the Government and the foreign or local donor agency.

13 Overall project Justification

In order to justify the proposed project financially, economically and environmentally financial, economic and environmental justifications was conducted as per international requirements/standards as both sites are highly protected areas declared under rules for such sites.

The outcome of these evaluations is described in the following paragraphs.

13.1 Financial and Economic Evaluations

The total investment of the proposed is Rs. 488.0 million. The objective of this investment is to improve the existing management system through a strategy or action plan and enhance capacity of stakeholders involved. Deh Akro II is an internationally recognized site and declared as Ramsar Site for protection of wildlife. Thus, as requirement of its international only no any activity detrimental for the wildlife and flora or harvesting of its any products. Only limited rehabilitation activities required for management, protection and governance of natural resource are allowed. In Dek Akro II only shelter, food, water and maintenance of ecological significance have been provided. Likewise, for Chotiari Complex the adverse impact of reservoir due to seepage from bunds and underground i.e waterlogging has been checked through biological and limited structural activities which will address the above stated problem for improving ecology and productivity within and outside the project area.

Thus this project cannot be evaluated in financial or economic terms but only environmental assessment is required.

13.2 Environmental Assessment

The proposed intervention is environment friendly as it will not create any environmental problems but will improve the existing environmental problem of waterlogging in the area and provide water for wildlife.

The activities in the Deh Akro II are provision of fresh water from Nara Canal system to address the problem of water scarcity and reduce the impact of drought in a complex of 32 wetlands. This site has rare species of crocodiles and fish and other wildlife which will benefit from the project interventions.

The main problem needing immediate redressal in Chotiari Reservoir is the creation of water logging in the adjoining field through seepage from the chotiari reservoir. Due to seepage from bunds the adjoining fertile and productive agricultural lands have become waterlogged and no cultivation is possible. The activities proposed in this site are construction of moat to check seepage and construct the interceptor drains to collect seepage water and dispose of in the Nara Canal for reuse as the quality of seepage water is good for use for irrigation to the agricultural crops. In this way not only the adverse problem of water logging will be addresses but also the affected agricultural lands will be productive.

It is thus concluded that the proposed project of rehabilitation of Deh Akro II and Chotiari Reservoir is environment friendly and also socially acceptable as there are no any negative impacts

13.3 ICID Environmental Checklist for the proposed project

The environmental checklist formulated by International Commission for Irrigation and Drainage has also been used to assess the impacts of proposed activities on the physical and other components of the environment such as hydrology, pollution, soils, sediments and ecology of the areas.

For each environmental effect place a cross (X) in one of the columns		Positive or very likely	Positive impact Possible	No impact Likely	Negative impact Possible	Negative impact very likely	No judgment at possible	Comments
Hydrology	1.1 Low flow regime		X					
	1.2 Flood regime			X				
	1.3 Operation of dams			X				
	1.4 Fall of water table		X					
	1.5 Rise of water table			X				
Pollution	2.1 Solute dispersion			X				
	2.2 Toxic substances			X				
	2.3 Organic pollution			X				
	2.4 Anaerobic effects			X				
	2.5 Gas emissions						X	
Soils	3.1 Soil salinity			X				
	3.2 Soil properties	X						
	3.3 Saline groundwater	X						
	3.4 Saline drainage	X						
	3.5 Saline intrusion			X				
Sedimen	4.1 Local erosion			X				
	4.2 Hinterland effects		X					

For each environmental effect place a cross (X) in one of the columns		Positive or very likely	Positive impact Possible	No impact Likely	Negative impact Possible	Negative impact very likely	No judgment at possible	Comments
	4.3 River morphology			X				
	4.4 Channel regime			X				
	4.5 Sedimentation			X				
	4.6 Estuary erosion						X	
Ecology	5.1 Project lands	X						
	5.2 Water bodies	X						
	5.3 Surrounding area	X						
	5.4 Valleys and shores		X					
	5.5 Wetlands and plains	X						
	5.6 Rare species	X						
	5.7 Animal migration			X				
	5.8 Natural Industry		X					
Socio-economic	6.1 Population change			X				

Conclusions

It is concluded that the proposed project is environment friendly as the activities proposed in the project do not pose any negative impact on the flora, fauna and archeological sites and other components of physical components of the overall environment. Both the project sites are wetlands of utmost importance containing diversified type of biotic life, hence will have a positive impact.

Resettlement issues

No resettlement is envisaged under the short to medium term of the Regional Management Strategy, the three proposed Action Plans and rehabilitation of both the complexes. However, as the Regional Strategy develops and includes additional wetlands and wetland complexes, each with their own restoration and management plan, some of these plans may incur resettlements. Although any recommendation from this point of view can only remain general at this stage, it is good to set some general framework that can be streamlined into the Regional Management Strategy that will be developed under this suggested study.

Table 4: Rehabilitation of Deh Akro II Chotiari Complex Detailed Costs

		Quantities						
	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
I. Investment Costs								
A. Machinery, Equipment, Vehicles, and Office furniture & Fixtures								
Tubewells	#	5	5	5	-	-	-	15
B. Survey & Investigations								
Survey and Mapping	ls							
C. Civil Works								
Moat	ls							
Interceptor Drain Lines	#							
Interceptor Drains	#							
Pipe Lines	#							
Head Regulator	#							
Subtotal								
D. Plantation Cost	ls							
E. Capacity Building								
Farmer Training Cost	ls							
F. Consultancies, Studies, and Services								
1. Investigative Studies	ls							
2. Regional Management Strategy	ls							
Subtotal								
G. Operations Cost								
1. Project Staff Cost								
Project Manager (XEN)	pm	12	12	12	12	12	-	60
Assistant Engineer	4 pm	12	12	12	12	12	-	60
Supervisors	8 pm	12	12	12	12	12	-	60
Superintendent	2 pm	12	12	12	12	12	-	60
Office Assistant	4 pm	12	12	12	12	12	-	60
Accountant	pm	12	12	12	12	12	-	60
Computer Operator	2 pm	12	12	12	12	12	-	60
Tubewell Operators	pm	60	120	180	180	180	-	720
Chowkidars	15 pm	12	12	12	12	12	-	60
Subtotal								
2. Travel Cost (TA/DA)	ls							
3. Vehicle Operating Cost	ls	5	5	5	5	5	-	25
4. Expendables & Utilities	ls							
5. O&M Drainage Structures	ls							
6. Tubewell Operations Cost	per tw	5	10	15	15	15	-	60
7. Unallocated Miscellaneous	ls							
Subtotal								
Total Investment Costs								
II. Recurrent Costs								

	Unit Cost	Base Cost (PRs Million)						
	(PRs)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
I. Investment Costs								
A. Machinery, Equipment, Vehicles, and Office furniture & Fixtures								
Tubewells	800,000	4.0	4.0	4.0	-	-	-	12.0
B. Survey & Investigations								
Survey and Mapping		3.0	1.0	-	-	-	-	4.0
C. Civil Works								
Moat		25.0	60.0	40.0	25.0	-	-	150.0
Interceptor Drain Lines		25.0	50.0	35.0	10.0	10.0	-	130.0
Interceptor Drains		-	2.0	8.0	6.0	-	-	16.0
Pipe Lines		-	20.0	19.5	-	-	-	39.5
Head Regulator		12.5	-	-	-	-	-	12.5
Subtotal		62.5	132.0	102.5	41.0	10.0	-	348.0
D. Plantation Cost		-	-	-	-	-	-	-
E. Capacity Building								
Farmer Training Cost		-	-	-	-	-	-	-
F. Consultancies, Studies, and Services								
1. Investigative Studies		6.0	-	-	-	-	-	6.0
2. Regional Management Strategy		4.0	6.5	-	-	-	-	10.5
Subtotal		10.0	6.5	-	-	-	-	16.5
G. Operations Cost								
1. Project Staff Cost								
Project Manager (XEN)	100,000	1.2	1.2	1.2	1.2	1.2	-	6.0
Assistant Engineer	60,000/ pm	2.9	2.9	2.9	2.9	2.9	-	14.4
Supervisors	40,000/ pm	3.8	3.8	3.8	3.8	3.8	-	19.2
Superintendent	35,000/ pm	0.8	0.8	0.8	0.8	0.8	-	4.2
Office Assistant	20,000/ pm	1.0	1.0	1.0	1.0	1.0	-	4.8
Accountant	25,000	0.3	0.3	0.3	0.3	0.3	-	1.5
Computer Operator	20,000/ pm	0.5	0.5	0.5	0.5	0.5	-	2.4
Tubewell Operators	12,000	0.7	1.4	2.2	2.2	2.2	-	8.6
Chowkidars	12,000/ pm	2.2	2.2	2.2	2.2	2.2	-	10.8
Subtotal		13.4	14.1	14.8	14.8	14.8	-	71.9
2. Travel Cost (TA/DA)		0.1	0.1	0.1	0.1	0.1	-	0.5
3. Vehicle Operating Cost	240,000	1.2	1.2	1.2	1.2	1.2	-	6.0
4. Expendables & Utilities		1.2	1.2	1.2	1.2	1.2	-	6.0
5. O&M Drainage Structures		-	0.8	2.7	4.3	5.1	-	12.8
6. Tubewell Operations Cost	120,000	0.6	1.2	1.8	1.8	1.8	-	7.2
7. Unallocated Miscellaneous		0.6	0.6	0.6	0.6	0.6	-	3.0
Subtotal		17.1	19.2	22.5	24.0	24.8	-	107.5
Total Investment Costs		96.6	162.7	129.0	65.0	34.8	-	488.0
II. Recurrent Costs								
		96.6	162.7	129.0	65.0	34.8	-	488.0

	Totals Including Contingencies (PRs Million)						
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
I. Investment Costs							
A. Machinery, Equipment, Vehicles, and Office furniture & Fixtures							
Tubewells	4.3	4.4	4.6	-	-	-	13.3
B. Survey & Investigations							
Survey and Mapping	3.5	1.2	-	-	-	-	4.7
C. Civil Works							
Moat	29.2	73.7	51.6	33.8	-	-	188.4
Interceptor Drain Lines	29.2	61.4	45.1	13.5	14.2	-	163.5
Interceptor Drains	-	2.5	10.3	8.1	-	-	20.9
Pipe Lines	-	24.6	25.1	-	-	-	49.7
Head Regulator	14.6	-	-	-	-	-	14.6
Subtotal	73.1	162.1	132.2	55.5	14.2	-	437.1
D. Plantation Cost	-	-	-	-	-	-	-
E. Capacity Building							
Farmer Training Cost	-	-	-	-	-	-	-
F. Consultancies, Studies, and Services							
1. Investigative Studies	7.0	-	-	-	-	-	7.0
2. Regional Management Strategy	4.7	8.0	-	-	-	-	12.7
Subtotal	11.7	8.0	-	-	-	-	19.7
G. Operation Cost							
1. Project Staff Cost							
Project Manager (XEN)	1.3	1.3	1.4	1.4	1.5	-	6.9
Assistant Engineer	3.1	3.2	3.3	3.4	3.5	-	16.5
Supervisors	4.1	4.3	4.4	4.5	4.7	-	22.0
Superintendent	0.9	0.9	1.0	1.0	1.0	-	4.8
Office Assistant	1.0	1.1	1.1	1.1	1.2	-	5.5
Accountant	0.3	0.3	0.3	0.4	0.4	-	1.7
Computer Operator	0.5	0.5	0.5	0.6	0.6	-	2.7
Tubewell Operators	0.8	1.6	2.5	2.5	2.6	-	10.0
Chowkidars	2.3	2.4	2.5	2.5	2.6	-	12.3
Subtotal	14.4	15.6	16.9	17.4	18.0	-	82.4
2. Travel Cost (TA/DA)	0.1	0.1	0.1	0.1	0.1	-	0.6
3. Vehicle Operating Cost	1.3	1.4	1.4	1.5	1.5	-	7.1
4. Expendables & Utilities	1.3	1.4	1.4	1.5	1.5	-	7.1
5. O&M Drainage Structures	-	0.9	3.5	5.8	7.2	-	17.4
6. Tubewell Operations Cost	0.7	1.5	2.3	2.4	2.6	-	9.5
7. Unallocated Miscellaneous	0.7	0.7	0.8	0.8	0.9	-	3.9
Subtotal	18.6	21.6	26.5	29.5	31.8	-	128.0
Total Investment Costs	111.2	197.4	163.3	85.1	46.0	-	602.9
II. Recurrent Costs							
	111.2	197.4	163.3	85.1	46.0	-	602.9