Annex 1

PAKISTAN

NATIONAL DRAINAGE PROGRAM PROJECT
(CREDIT NO. 2999-PK)

Follow Up to the
Meeting of the Executive Directors of the World Bank (October 31, 2006) on the
Inspection Panel Investigation Report No. 36382-PK and
Management Report and Recommendation

PROGRESS REPORT ON

IMPLEMENTATION OF THE ACTION PLAN

July 5, 2007

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Acronyms

AKPBS	Aga Khan Planning and Building Service
AWB	Area Water Board
CGAP	Consultative Group to Assist the Poorest
DPOD	Dhoro Puran Outfall Drain
FAO	United Nations Food and Agriculture Organization
FAO-TCP	FAO Technical Cooperation Program
FO	Farmers' Organizations
GoP	Government of Pakistan
GoS	Government of Sindh
KPOD	Kadhan Pateji Outfall Drain
LBOD	Left Bank Outfall Drain
NDP	Pakistan National Drainage Program
NGO	Nongovernmental organization
NWFP	North West Frontier Province
PO	Partner Organization
PPAF	Pakistan Poverty Alleviation Fund
SAFWCO	Sindh Agricultural and Forestry Workers Coordinating Organization
SCAD	Sindh Coastal Areas Development Program
SCAN	Sindh Coastal Areas Network
SIDA	Sindh Irrigation and Drainage Authority
WAPDA	Water and Power Development Authority
WB	World Bank
WSIP	Sindh Water Sector Improvement Project

PAKISTAN
NATIONAL DRAINAGE PROGRAM PROJECT
(Credit No. 2999-PK)

MANAGEMENT REPORT ON STATUS OF IMPLEMENTATION OF THE ACTION PLAN FOLLOWING THE INSPECTION PANEL INVESTIGATION REPORT (No. 36382-PK) AND MANAGEMENT REPORT AND RECOMMENDATION (INSP/R2004-0007/4&5)

Introduction

1. On October 31, 2006, the Executive Directors discussed the findings of the Inspection Panel's Investigation Report and the Management Report and Recommendation on the Pakistan National Drainage Project (NDP, closed in December, 2004).

2. The Panel found that the design of an earlier project, the Left Bank Outfall Drain (LBOD, closed in December 1997), whose ongoing contracts were funded and completed under the NDP for about 3.3 percent of LBOD's total cost), underestimated prevailing conditions and the risk of extreme meteorological events. This contributed to the breakdown of the outfall system, suffering of local people in the lower Badin district, and to adverse impacts to fisheries and wetland habitats, known as "dhands". The Panel also found instances of non-compliance with Bank operational policies.

3. The Management Report stated that while the LBOD and NDP projects did create opportunities for poor people by expanding agriculture substantially, all involved in the projects could have done a better job of mitigating the risks and impact of natural disasters on the poor within and outside the project areas.

4. After the closing of the NDP,[1] Management has continued to work with the GoP and GoS to address the reform agenda initiated under the project, as well as to address the drainage and outfall challenges arising from the LBOD. An Action Plan prepared for this purpose identifies suitable strategies and instruments to progress on the reform agenda and to support the poorest people of the lower Badin and Thatta districts. The plan includes a poverty alleviation fund, a flood response plan, and a new lending in the water sector approved by the Executive Directors.

5. At the Board's request, this report provides an update on progress made in the implementation of the Action Plan before the 2007 monsoon season. It describes the activities and projects initiated for the short term, as well as those being developed for the medium and longer term. The summary of the Action Plan is provided in Table 2. Four annexes are attached. These materials have also been posted on www.worldbank.org.pk.

[1] The Implementation Completion and Results report was sent to the Executive Directors in May 2007.

Bank Management has committed to report back to the Board again in November 2007 on the implementation of the Action Plan.

Summary of Progress on Implementation of The Action Plan

6. Local communities and civil society organizations in Thatta district were visited in April 2007 by senior Bank Management. Overall, the GoP and GoS have been diligent in implementing the follow up actions approved by the Executive Directors as part of the agreed Action Plan. This report highlights the major results of the first eight months of the implementation of the Action Plan:

- Significant progress has been made to address the harsh conditions of the population living in the area. Direct actions to alleviate poverty are in place through an inclusive consultation process with the communities. The Pakistan Poverty Alleviation Fund (PPAF) agreed to intervene in the area in June 2006. Since then, ten nongovernmental organizations (NGOs) have engaged in efforts to improve the living conditions of the transient fisherfolk communities. This has resulted in 290 community projects prepared, approved, and being implemented with a commitment of about US$2.8 million. The PPAF is proving to be the right instrument to address extreme poverty in the communities outside the irrigation network given its targeting effectiveness and its partnership with capable NGOs. The mobilization capacity of the PPAF contributed significantly to the emergency relief efforts following the earthquake of October 2005 in NWFP and Jammu & Kashmir.

- A rapid assessment of ecological and livelihood conditions of the “dhands” in the vicinity of the outfall system has progressed less than expected. The consultation process on the terms of reference for the study with the Government and partners active in the area, the identification of a source of financing, and the appointment of qualified consultants took longer than planned. The assessment is now under way, and the first phase results will be available in September, 2007.

- Progress has been made in assessing and improving local government flood management systems. The assessment was carried in April/May, 2007 and discussed with the Government. Also, the district government of Badin, with the help of the Bank, has developed a “Contingency Plan to Combat Cyclones and Floods” for 2007. A similar plan is under preparation for the Mirpurkhas district. While the preparation of these plans represents an important initiative in addressing flood risks and vulnerability, capacity building at the local level will remain a long term issue, and the Bank will continue to assist the Government in supporting this action over the medium to long term.

- Progress has been made in carrying out an assessment of the functionality of the outfall system as well as in implementing the most urgent repairs. The assessment was carried out in April/May, 2007 and discussed with the Government. Increased efforts to repair the damages to the irrigation and drainage infrastructure that occurred during the floods of 2003 and 2006 have been made over the last couple

of years by the GoS with a commitment of US$12.6 million, of which US$2.5 million were spent in the last year. While the risk of floods has been reduced by enlarging the flow capacity of the outfall drains, the GoS has yet to put in place a detailed maintenance program for the drainage network. The maintenance program is expected to be effective by November 2007 and will be supported under the Water Sector Improvement Project (WSIP). Detailed plans to improve the functioning of the complex drainage infrastructure have also been initiated and will be supported under the WSIP.

- Appraisal and negotiations of the Sindh WSIP have been completed in March, 2007 and Board presentation is expected in September, 2007. The delays experienced between negotiations and Board presentation stem from the required clearances of the negotiated documents from the GoS and the GoP. This process has not finalized yet, and approval from Federal authorities is expected during their next meeting in August. Major lessons learned during the last ten years of the Bank's involvement in the water sector have been incorporated into project design.

7. Management believes that while immediate actions have been taken to address the main issues affecting the area as a consequence of the floods of 2003 and 2006, flood risks in the coastal zone of the Indus river system will continue to be high. Historically, these areas have been flooded as part of natural phenomena. Efforts to reduce such risks need to be sustained through structural and non-structural measures in the medium and long term, which are being contemplated under the WSIP and potential follow-up operations.

Progress on Immediate and Short Term Actions

8. The Bank's short term actions were selected to provide an immediate response to the plight of affected people and to address other related issues, including:

- Implementation of the Sindh Coastal Area Development Program (SCAD) in southern Sindh, including review of the social profile of the population in Badin and Thatta districts under the PPAF livelihoods program, with the aim of identifying specific nomadic and other vulnerable groups and addressing additional livelihood support issues;

- Rapid assessment of ecological and livelihood conditions in the dhands to identify immediate measures to improve these conditions;

- Rapid assessment of existing local government flood risk management systems to reduce flood damage and vulnerability by building capacity and improving flood risk response;

- Assessment of the condition of the right embankment of the LBOD spinal drain and its discharge to the Kadhan Pateji Outfall Drain (KPOD) and preparation of a detailed maintenance plan; and

- Timely implementation of the WSIP in order to ensure a rapid startup of the technical studies to design measures to improve the performance of LBOD and prepare a comprehensive flood and drainage plan for the left bank of the Indus River in southern Sindh.

9. **Implementation of the SCAD.** The SCAD was established under the PPAF with the objective of rehabilitating the livelihoods of coastal communities and developing local capacity through better integration of Sindh coastal areas with the rest of the country and economy (see Annex 1). The SCAD includes: (a) improving access to basic services, including health, education, and drinking water supply and sanitation; (b) increasing incomes through improved crop, fisheries and livestock production as well as marketing and micro-finance services; (c) securing access to, and better management of, coastal area natural resources; (d) forming viable community organizations that are inclusive, well governed, and can operate in partnership with the public and private sector; (e) integrating these areas with the national economy by developing rural growth centers; promoting integrated development of physical infrastructure, including construction of productive infrastructure, such as jetties and wharfs; and developing transport and mobility, through the construction of inter- and intra-village roads and intermediate modes of transport, using infrastructure grants and micro-credit; (vi) promoting technological innovations, particularly the use of solar and wind energy for pumping water and generating electricity; and (vi) reducing physical vulnerability, through the construction of flood protection and sea water containment structures and better response mechanisms by communities. 8.

Box 1. SCAD Implementation in Keti Bunder

Keti Bunder is a small town along the Sindh Coast in Thatta district, with a population of 1,460 persons living in 285 households. The majority of the population is engaged in fishing and the average monthly income per household is about US$70. Only 3 percent of the female population and 21 percent of the male population is literate. In the last ten years the community has been affected by droughts and floods. Drinking water is supplied by tankers from another town. Expenditure on water represents 30 percent of the income of the household. Not surprisingly, the major health issues are waterborne diseases.

The PPAF, through the Aga Khan Planning and Building Service partner organization (AKPBS), is implementing several projects with the active participation of the community: safe drinking water; street cleaning; household latrines; waste and storm water disposal; oxidation ponds and repairs of the existing protection bund.

Financing agreements have been signed over the last year with ten partner organizations (POs) participating in the SCAD through an informal organization, the Sindh Coastal Areas Network (SCAN). The network provides a platform for improving the quality of life, alleviating poverty and reducing vulnerability in the SCAD area through a coordinated, cooperative and collaborative effort of all members, local community organizations and external support agencies. Out of US$18 million allocated for the SCAD under the PPAF, US$2.5 million have already been committed. The main activities being carried out are:

- The Social Safety Nets Survey has been completed;

- Social mobilization commenced in January 2007;

- A survey has been carried out to map all settlements in the coastal area and identify nomadic groups. The survey covers 2,830 settlements and includes socio-economic conditions especially in terms of housing, occupation, water and sanitation. The maps generated from the spot survey provide a GIS basis on which progress can be recorded;

- Eighteen community infrastructure projects (service and income improvement projects such as water supply and sanitation, roads, latrines, etc.) and seven integrated area upgrading projects, which include several community infrastructure and income improvement interventions at the village level, have been initiated;

- The table below summarizes the number of sub-projects approved by location. Annex 1 provides a breakdown of the types of projects being implemented and Annex 2 describes a CGAP/World Bank/PPAF pilot project to link safety nets with microfinance; and

- The sub-districts (Talukas) along LBOD/KPOD—Badin, Golarchi, Tando Bago and Jati—are being targeted for early program implementation. Three POs are intervening in these areas and 98 projects have been initiated in 36 villages.

Table 1: SCAD Projects by Partner Organization and District[2]

S. No	*Partner Organization*	*Districts*	*Amount Approved/ Committed (M.Rs)*	*Projects*	*Community Organizations*	*Beneficiaries*
1	NRSP	Badin	53.48	83	83	21,580
2	SPO	Thatta	17.736	25	25	6,500
3	AKPBS	Thatta	23.972	43	46	12,000
4	IET	Karachi W	6.506	10	11	5,120
5	SCOPE	Malir	6.5	27	27	8,640
6	HANDS	Karachi E	3.587	14	14	5,040
7	BRDS	Badin	3.601	15	15	5,400
8	SAFWCO	Thatta	19.657	36	36	9,380
9	Sindh RSP	Thatta	1.72	7	7	1,680
10	TRDP	Tharparkar	18.0	30	30	7,500
Total			**154.759 (US$2.5 million)**	**290**	**294**	**82,840**

[2] The Table is a revision of the table that was included in the Action Plan. Two activities have been added in the section on "Immediate and Short Term" actions, and some of the dates have been amended for reasons that are explained in this report.

10. Progress of the SCAD program under PPAF financing is overall satisfactory considering its promptness in mobilizing resources and partner organizations starting June 2006, and its community driven approach. While the PPAF covers the whole Sindh coastal area, targeted interventions are also being implemented specifically to communities under the direct influence of LBOD. While the PPAF has yet to show visible results, the demand-driven approach requires initial investments in social mobilization prior to income generating activities to ensure sustainability and community empowerment. The PPAF is also perceived as being too widely spread. However, when the SCAD program was conceived, the policy choice was to address poverty issues more broadly than what would be needed strictly around the LBOD area.

11. **Rapid Assessment of Ecological and Livelihood Conditions in the Dhands.** The dhands study has suffered significant delays due to extensive consultations on the scope of the study with the Government and existing organizations active in the area. Identifying the source of financing and appropriate expertise also proved more difficult than expected. However, the assessment is now under way. Funding through the Bank-Netherlands Trust Fund for Pakistan has been approved, contracts have been signed, and field work started in mid-June 2007.

12. The overall study has been divided into three coordinated sub-components. Component A, to be carried out by the National Institute of Oceanography, will (i) review the monitoring data concerning the interaction of the dhands wetland system and the LBOD outfall, including the Tidal Link, (ii) describe the direct physical impacts on the wetland system, and (iii) using new field data, investigate the intrusion of marine ecosystems into the dhands and model its effects. Component B will assess the status of the freshwater ecosystem and its wetland functions and services, including fisheries and water quality, and identify adverse and favorable trends. Component C will conduct consultations with local stakeholders in Badin and in and around the dhands, and undertake a socio economic assessment of the fishing communities directly linked to the dhands.

13. Field work, data analysis, and reporting are planned to be completed by mid-August, 2007. Findings and recommendations will be discussed with stakeholders in a final series of consultations, including GoS, and the report will be finalized by end of September, 2007.

14. **Rapid Assessment of Existing Local Government Flood Risk Management Systems**. The rapid assessment was carried out in April/May, 2007 and discussed with the Government. Badin is one of the most flood vulnerable areas of Pakistan. Flooding is frequent during the monsoon season and the period of flood inundation is typically very long. The region has few natural drains and its vicinity to the Indian border limits the possibilities of water disposal. For this reason, the area has low population, with the exception of transient fisherfolk located near the dhands, who normally move upland during severe weather. The flooding in this area is a natural occurrence. However, the floods of 2003 were particularly severe and evacuation and relief operations had to be carried out by the Army, the Provincial Relief Committee, and the District Coordination

Offices. The area was again hit by floods during 2006 and damages and relief operations occurred principally in Mirpurkhas district, north of the coastal zone.

15. Most recently, on June 23, 2007, tropical cyclone Yemyin 03B lashed the coastal area of Pakistan. While Karachi was the most affected area, floods were also reported in the area under LBOD influence. As part of its contingency plan, the GoS organized a task force to operate the canal network and reduce the water flows to prevent additional flooding in lower Sindh. Rohri canal and Nara canal were closed and irrigation officials reported that the banks of LBOD, Mirpurkhas main drain and other drains were normal and under control. The LBOD system was not affected by the cyclone. Under the PPAF activities, the Sindh Agricultural and Forestry Workers Coordinating Organization (SAFWCO) has begun social mobilization in the affected areas and implementation of relief actions, such as distribution of food, forage and seeds to the population.

16. The past experience of the 2003 and 2006 floods was the basis for preparing a "Contingency Plan to Combat Cyclones and Floods" in 2007 by the District Coordination Officer in Badin. This flood management plan includes: an early warning system; strict watch of the LBOD system; and location of refuges and other infrastructure that can be used in case of emergencies. It also establishes the role of different institutions during emergencies and identifies actions needed to improve the situation of the people and the role of the government and NGOs in cases similar to those in 2003.

17. The flood management plan for Badin needs further improvement. The Bank has identified and discussed with the GoS and the Sindh Irrigation and Drainage Authority (SIDA) the approaches that are needed, such as a clear definition of who is responsible for early alerts and warnings; improvements in the communication network; and responsibilities of the different institutions involved in dealing with flood management, including NGOs. A Bank consultant met with NGOs, including one of the requesters, to incorporate their ideas and concerns in the Flood Management Plan, during a field visit to lower Sindh on April 20, 2007. The institutional capacity of SIDA is expected to be improved through the capacity building component under WSIP. SIDA is working to improve the coordination required to make the Contingency Plan work. Mirpurkhas district also is preparing a Flood Management Plan, using the Badin example as a template (see Annex 3).

18. While the preparation of these plans represents a promising beginning in addressing flood risks and vulnerability, low institutional capacity at the local level keeps remaining a long term issue, and since the closing of the NDP in 2004 the Bank's leverage in influencing decision making and investments has considerably reduced. Government efforts to reduce flood risks and vulnerability in the area can be supported however through the forthcoming WSIP, which among other things plans to help the Government examine long term options and solutions to irrigation and drainage issue of the outfall area.

19. **Assessment of the Right Bank of the LBOD Spinal Drain and KPOD.** The assessment was carried out in April/May 2007 and discussed with the Government. The emergency repair work to restore the functionality of the outfall drains—KPOD and

Dhoro Puran Outfall Drain (DPOD)—was undertaken during 2004 and 2005 by the GoS, in association with the 5th Corps of Engineers, Pakistan Army. About 394 cuts and breaches in drains and 224 cuts in canals were repaired by the Left Bank and Nara Area Water Boards (AWBs) and further strengthening of both banks of LBOD and KPOD has been continued after the 2006 floods. As of May 31, 2007, a total of Rs.756 million (US$12.6 million) has been committed in repairs and reinforcement of the system; to date about Rs. 322 million (US$5.3 million) has been spent, US$2.5 million of which in the last year. However, SIDA has estimated that a total of Rs 1,053 million (US$17.55 million) is still needed to complete the strengthening of the outfall system (see Annex 4) and the implementation will take over two years.

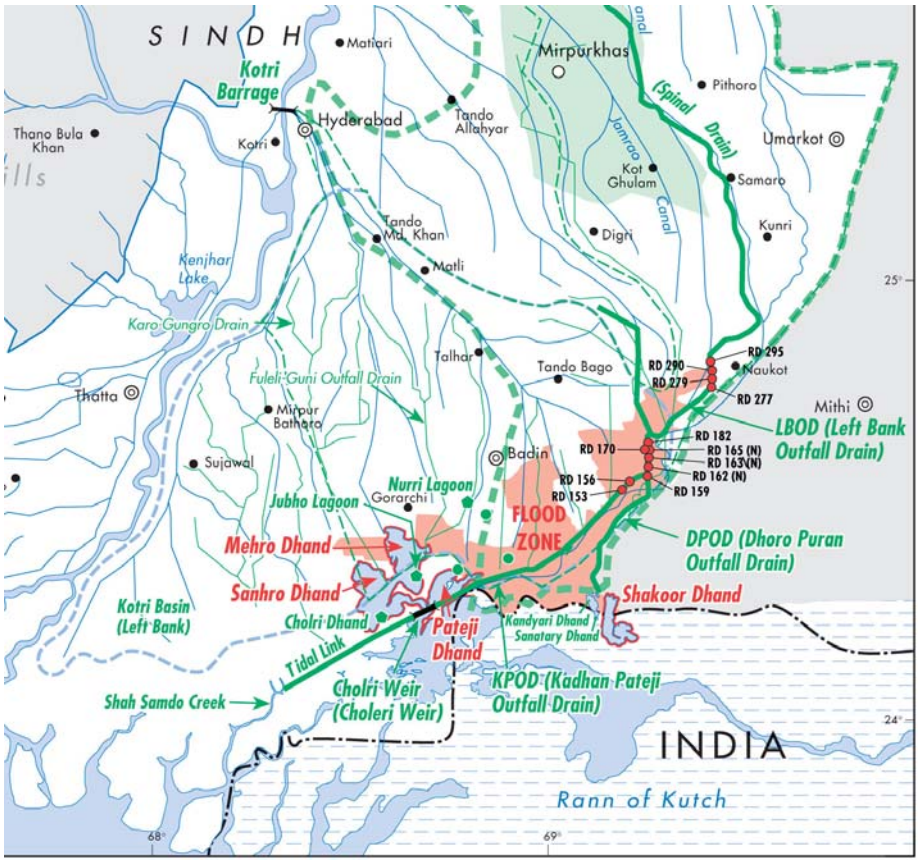


Figure 1. Left Bank of Indus River in Southern Sindh
(Source: POE Drainage Master Plan)

20. In carrying out repair works and strengthening of drain banks, the discharge capacity of the KPOD and LBOD spinal drains has been increased to about 9,000 cubic feet per second (cusecs) as compared to the original design of 4,400 cusecs. This has been done by moving the bank out from the service road in the right bank of the drain (inspection path) by at least 20 feet and raising its level. The other bank, which does not have a path for field based inspection, has been raised in most reaches of the drain. Finally, the weir controlling the flow to the DPOD has been modified by reducing its crest level to discharge more water. With these measures, the storm water carrying

capacity of the drainage system has been increased significantly, enabling it to handle larger volumes of water and thus protecting the area against flooding.

21. The actions taken by the GoS to strengthen LBOD and KPOD will reduce the risk of flooding in the area. However, the GoS has yet to put in place a detailed maintenance program for the drainage network and this work is expected to start by November 2007 and will be supported under WSIP. Detailed plans to improve the functioning of the complex drainage infrastructure will require long term solution including the need to evaluate possible new structural options. A comprehensive solution to the flooding around the left bank of the Indus and safe disposal of drainage/flood waters will need to be developed through the studies envisaged under WSIP, as indicated below. The Bank provided guidance in the further refining of the flood management plan and the methodology will also be used for developing a sound Asset Management Plan in LBOD following the experience used in Punjab.

22. **Implementation of WSIP Phase-I Project**. The WSIP was negotiated in March 2007. It was approved by the GoS and the GoP. It will be submitted for approval of the Executive Committee of the National Economic Council in July 2007 and to the Bank's Board of Executive Directors in September 2007. The delays experienced between negotiations and Board presentation stems from the need to wait for required clearances of the negotiated documents from both the Government of Sindh and the Government of Pakistan.

23. The overarching objective of the WSIP is to improve the efficiency and effectiveness of irrigation water distribution in three AWBs—Ghotki, Nara and Left Bank—particularly with respect to measures of reliability, equity and user satisfaction. This would be achieved by: (a) deepening and broadening the institutional reforms that are already underway in Sindh; (b) improving the irrigation system in a systematic way, covering key hydraulic infrastructure, main and branch canals, and distributaries and minors; and (c) enhancing long-term sustainability of the irrigation system through participatory irrigation management and developing institutions to improve operation and maintenance of the system and cost recovery. Improved water management would lead to increased agricultural production, employment and incomes from about 1.8 million hectares or more than 30 percent of the irrigated area in Sindh, which is one of the poorest regions of the country. The WSIP covers the catchment area of the LBOD.

24. The WSIP will finance the following components:

(a) Community Development and Capacity Building (US$10 million): capacity of SIDA, AWBs, and Farmers' Organizations (FOs) would be strengthened under the project, enabling them to perform their responsibilities according to the Sindh Water Management Ordinance of 2002. The project would strengthen the capacity of FOs to carry out operation and maintenance of the irrigation and drainage systems;

(b) Rehabilitation and Improvement of Irrigation and Drainage System (US$139.8 million): the main and branch canals, distributaries/minors (secondary

level canals) and drainage system in FOs areas would be rehabilitated and improved and a modern water measurement and accounting system would be installed throughout the canal systems in the three AWBs;

(c) Management Plans for Major Irrigation & Drainage Infrastructure (US$12 million): A feasibility study for rehabilitation of the Gudu barrage would be prepared and assistance provided to prepare studies for rehabilitation of the Sukkur and Kotri barrages. A regional master plan would be prepared to deal with floods and drainage issues on the left bank of the Indus River and measures designed for improvement of the Indus delta and the coastal zone;

(d) Monitoring and Evaluation of the Project Impact and Environmental Management Plan (US$4.2 million): This component would be for monitoring and evaluation and supervision of the environmental management and social action plans; and

(e) Project Coordination, Monitoring, Technical Assistance and Training (US$9 million): This component would support project coordination, monitoring of implementation activities, management and supervision of procurement by an independent project management consultant/ procurement agent, and technical assistance and training.

25. Particularly relevant is Component C of the WSIP, which includes detailed studies and preparation of a regional master plan in consultation with stakeholders. This plan would address flooding and drainage issues in the area on the left bank of the Indus River, taking into consideration structural and non-structural measures, including remedial measures for any outstanding deficiencies in the LBOD and measures for the retention and/or safe disposal of storm and flood water. A separate plan would be prepared for rehabilitation and improvement of the delta area, wetlands and coastal zone, taking into consideration the environmental importance of the region and its economic potential, and drawing upon international experience. Feasibility studies would be completed and detailed designs would be prepared for priority works for implementation under a future investment project that Sindh may undertake with the assistance of its development partners.

Progress on Medium Term Actions

26. **Flood Management Plan for the Left Bank of the Indus River**. A common understanding has been reached with the Governments of Sindh and Pakistan regarding the approach, methodology, and allocation of resources for preparation of a master plan to manage flood issues in the area of the Indus River and the coastal zone. About US$7 million have been allocated under WSIP to carry out this work, along with preparation of feasibility studies and detailed designs of priority works identified under the plan. WAPDA has begun studies in the area to determine the need for a structure in KPOD to control the back flows coming from the Tidal Link and the overall criteria for redesigning the capacity of the outfall system.

27. **Coastal Development Program.** Under the FAO Technical Cooperation Program (FAO-TCP), a mission visited Sindh on December 6-19, 2006 to develop a project concept note for a Coastal Development Program. While mission's findings were discussed with the GoS and GoP, the final concept and the scope of the activities for the FAO-TCP are still under discussion and are not expected to be finalized before March 2008. Additionally, an Asian Development Bank (ADB) supported project (US$40 million) is financing mainly demand-driven community infrastructure. The PPAF has allocated about US$18 million. These are substantive resources for the coastal area, which counts about two million inhabitants. The coastal development program will need therefore to ensure alignment of its interventions and also address some of the issues identified under the regional planning studies mentioned above. The approach to coastal development will be finalized during the WSIP studies.

Long-Term Outcomes

28. In the context of improving management of irrigation and drainage infrastructure, services and equitable distribution of water in Pakistan, the Bank has intensified the dialogue with all Provinces in an effort to pursue institutional reforms coupled with infrastructure development. In Punjab, the Irrigation Sector Development Policy Loan (DPL-II)[3] is actively promoting a new governance agenda in the irrigation sector to increase accountability and transparency in service provision and farmer participation. In Sindh, the WSIP would cover 30 percent of the irrigated area in which the Government has taken action to reform irrigation and drainage institutions, establish AWBs and develop FOs for irrigation management. The implementation of WSIP is a significant step in addressing the present governance issues in the Province by strengthening the financial management and procurement systems and pursuing the process of devolving irrigation management to the farmer community for greater accountability and transparency. In Balochistan a small scale irrigation and watershed management project combined with drought mitigation measures is being prepared. In NWFP the Bank is pursuing a dialogue to sustain the initial reform efforts carried out under the previous on-farm water management project.

29. An improved institutional framework for water resources management is also central to the Bank's ongoing discussions with the GoP on further development of dams and water resources infrastructure on the Indus River. Pakistan is moving steadily to ensure the sustainable management of the Indus system; this will include the preparation and implementation of a comprehensive framework of policy and institutional reforms and development plans, all to provide sustainable and equitably-shared benefits to the people of Pakistan. This concept has been fully endorsed by key stakeholders at the highest level in the Government and by most civil society organizations. The challenge for the Bank and other donors is to move the process forward in a manner that ensures

[3] To support the Government of Punjab Medium Term Irrigation Sector Reform Program begun in 2005 to implement institutional and policy reforms to improve their asset management plans; to make interprovincial water allocation and distribution more transparent; to decentralize irrigation management to water users associations; and to improve water productivity.

full government ownership at the federal and provincial levels and leadership in the water reform process, compliant with international best practice.

Conclusions

30. Implementation of the five actions under the Action Plan agreed by the Executive Directors during the discussion of the findings of the Inspection Panel's Investigation Report and the Management Report and Recommendation on the Pakistan NDP project is broadly on track. Although the solution to many of the poverty, ecological and flood management issues of the outfall area of Sindh are of a long term nature and require management and structural measures, the activities initiated under the Action Plan are an important step in the right direction. Despite strong support at a high level in the GoS, weak capacity at the local level will remain a serious issue and will need considerable strengthening. The Sindh coastal zone and, in particular, the LBOD outfall system will continue to remain a high-risk subject.

31. Management's assessment is that addressing the complex socio-ecological and structural issues affecting this area will continue to be a difficult challenge compounded by recurrent and adverse weather events. Management will remain actively engaged in following up on these issues. The NDP project is now closed, but the Bank will continue to support the Government through the on-going dialogue, the PPAF, the WSIP and the coastal zone management initiative under preparation. Management will report again to the Board on further progress in implementation of the Action Plan and other issues as needed, in November 2007.

32. As stated in October 2006 Report, in Management's view the Bank was diligent in the application of its policies and procedures in this case. The Bank has done its best to help the Borrower to address two distinct problems with specific inherent complexities: the technical challenges of an outfall system in southern Sindh presented by LBOD, and the national reform process challenges taken up by NDP. NDP succeeded in initiating a process of critical governance reforms, changing the direction and strategy in the sector towards decentralization, participatory management and the empowerment of farmers. This was a critical step in transforming a governance system that was over 100 years old. This process will continue for some time, but the foundation has been securely established.

33. In regard to LBOD, with hindsight, the Bank could have made some judgments differently, especially by calling for more explicit consideration of risks and tradeoffs in the context of a participatory planning process during the LBOD design stage, by finding a way to support the implementation of the LBOD Environmental Management Plan at a much earlier stage, and by encouraging and supporting Sindh to undertake the livelihood diagnostic study in the coastal areas of Badin that were not benefited directly by LBOD. The Government of Pakistan and Sindh have promptly responded to the flood emergencies in the outfall area of LBOD, which as has been repeatedly assessed by different experts as a flood prone zone.

Table 2: Action Plan

Activities & Projects	A	B	C	Responsibility	Updated-Schedule
Immediate and Short Term					
• Implementation of Livelihood Improvement Program in Badin and Thatta Districts				Pakistan Poverty Alleviation Fund (PPAF)	2006-2007
Phase I (US$2 million)	✓				2007-2009
Phase II (US$16 million	✓				
• Sindh WSIP	✓	✓	✓		
Appraisal				GoS/GoP/SIDA	Nov. 2006
Board Presentation				WB	Aug. 2007
Effectiveness				GoS/GoP/SIDA	Nov. 2007
• Socio-economic and environmental diagnostic study of the dhands and surrounding areas	✓		✓	WB/SIDA	Sep. 2007
• Assessment of the conditions of the right embankment of the LBOD spinal drain and KPOD. Preparation of a maintenance plan.		✓		SIDA/WAPDA	July 2007
Rapid Assessment of Existing Local and Government Flood Risk Management Systems.		✓		SIDA/Local Governments.	May 2007
Medium Term					
• **Flood Management Master Plan for the left bank of the Indus River in southern Sindh**	✓	✓	✓	SIDA	2007-2009
• **Coastal Development Program**	✓		✓	WB/FAO-TCP	Mar. 2008
• **Project Concept Note**					
Long Term Outcomes					
• **Improved management (O&M) of irrigation and drainage infrastructure; improved service delivery and governance; and transparent and more equitable water allocation and distribution**	✓	✓	✓	GoP/GoS/WB	2006-2009
• **Modern institutional framework for Indus Basin water resources management**	✓	✓	✓	GoP/GoS/WB	2009-2016
• **Sustained governance reform agenda**		✓	✓	GoP/GoS/WB	2009-2016

KEY: A: Poverty and livelihoods, **B:** Flood risk, **C:** Threatened ecosystems

Annex 2
PPAF's Sindh Coastal Areas Development Program (SCAD)

Introduction

The Sindh coastal areas have experienced a myriad of social and economic impacts as a result of natural disasters many of which have occurred in the last decade. Certain communities, particularly fishermen, have been the most vulnerable, relying on debt and migration as coping mechanisms. In order to help these vulnerable communities out of poverty, the PPAF, its existing/potential partner organizations (POs) working in and near the coastal areas, the World Bank and the communities discussed the role each can play to implement an integrated upgrading program for the area. Interactions with communities were conducted through an immersion process, where representatives from PPAF, the Bank, partner organizations and consultants spent days and nights in the homes of fishing communities, learning what challenges they face and their hopes and fears. This intensive interaction has helped everyone better understand what needs to be done and how.

Outreach and Partner Organizations

1. With a view to deepening its outreach in the coastal belt, the PPAF has partnered with highly regarded civil society organizations with a track record of consistently high performance. At present there are ten POs (see box) participating in the Sindh Coastal Areas Development Program (SCAD); inclusion of several more is likely in the near future. A formal network, i.e., Sindh Coastal Areas Network (SCAN) of these ten POs, has also been formed. Sindh Coastal Areas Network (SCAN) provides a much needed platform for the exchange of views, experiences and building synergies to improve the quality of life and reduce vulnerability in the SCAD program areas.

Box - Sindh Coastal Areas Development Program: Participating POs

1. Aga Khan Planning & Building Services (AKPBS)
2. Badin Rural Development Society (BRDS)
3. Health and Nutrition Development Society (HANDS)
4. Indus Earth Trust (IET)
5. National Rural Support Program (NRSP)
6. Sindh Agricultural and Forestry Workers Coordinating Organization (SAWFCO)
7. Society for Conservation and Protection of Environment (SCOPE)
8. Sindh Rural Support Program (SRSP), and
9. Strengthening Participatory Organizations (SPO)
10. Thardeep Rural Development Program (TRDP)

Program Strategy

The strategy for the SCAD includes: (i) improving access to basic services including health, education and drinking water supply and sanitation; (ii) increasing incomes through improved crop, fisheries and livestock production, as well as marketing and micro-finance services; (iii) securing access to, and better management of, coastal area natural resources; (iv) forming viable

community organizations that are inclusive, well governed and can operate in partnership with the public and private sector; (v) integrating these areas with the national economy by developing rural growth centers; promoting integrated development of physical infrastructure, including construction of productive infrastructure, such as jetties and wharfs; and developing transport and mobility, through the construction of inter and intra-village roads and intermediate modes of transport, using infrastructure grants and micro-credit; (vi) promoting technological innovations, particularly the use of solar and wind energy for pumping water and generating electricity; and (vi) reducing physical vulnerability, through the construction of flood protection and sea water containment structures and better coping mechanisms of communities.

Nature of ongoing and planned Interventions

Physical Infrastructure

- Developing Rural Growth Centers (Integrated Area Upgrading Projects)
- Reducing Physical Vulnerability
- Constructing Productive Infrastructure
- Developing Transport and Mobility
- Promoting Technological Innovations
- Integrating Work-Fare Concepts in Infrastructure Projects

Improvement of Health and Education Services

- Adopting, Upgrading and Operating Government Facilities
- Developing New Community Managed Facilities

Capacity Building and Social Mobilization

- PO Staff Trainings
- Community Trainings

From Social Safety Nets to Micro-Finance

- Built-in Work-Fare Program in Infrastructure Development
- Social Safety Nets
- Food Stamps for Participating in Community Meetings and Social Work
- Cash Transfers
- Asset Transfer

Envisioned Activities under SCAN

- Promoting mutual learning through a SCAN web page, output specific workshops, and exchange visits
- Study tours to relevant success stories of the region
- Facilitating linkages with various development sector organizations, R&D institutions, manufacturers and suppliers of equipment
- Dissemination of baseline data, case studies and progress reviews of projects handled by various members
- Dissemination of best practice case studies and information on innovative products
- Publication of a bi-annual news letter

Progress to Date

Brief over view of the activities undertaken

- SCAD Action Plan (2007-12) have been prepared
  Baseline Survey of 3,300 Settlements Completed

Delineation of Union Councils boundaries in progress
Action Plan for project implementation has been launched

- Social Mobilization Commenced in January 2007
- Activities have been initiated in 336 settlements in 11 Talukas (17 union councils)
- 563 community organizations established its PPAF and its Pos, under SCAD target is to organize 5,000 communities in 3,300 settlements
- 3 Health and Education Facilities Adopted and Improvement Process Initiated
- Social Safety Nets Survey Completed
- 8 Existing and 2 New POs identified for the Program and Financing Agreements Signed
- Functioning of the Sindh Coastal Area Network (SCAN) has developed and disseminated a "Constitution of the SCAN" which was adopted by all POs in Karachi in April 2007.

Mapping All the Coastal Settlements

A survey has been carried out to map all settlements in the coastal areas to be covered by the PPAF under the SCAD program. The survey covers about 3,300 settlements and includes socio-economic information for Sindh's coastal zones, especially in terms of housing, occupation, water and sanitation (indicators of poverty). The maps generated from the spot survey provide a GIS basis on which more analysis can be undertaken by PPAF at a later date, including recording changes and progress in a visual format. The findings have been collated and mapping of coastal settlements has been completed.

Investment Program

The total investment program for the period 2006 – 2011 is given in the table below along with breakdown of type of programs planned under SCAD (infrastructure, health and education and capacity building). The total program is US$25.6 million of which US$3.2 million have been committed and US$0.7 million have been disbursed, another US$0.7 million are expected to be disbursed by December 2007 and US$3.2 million June 2008. Annual phasing of the program over the period of 2006-11 is also in the figure below. Of the total planned investments about 78 percent will be for infrastructure, 13 percent for health and Education and 9 percent for capacity building.

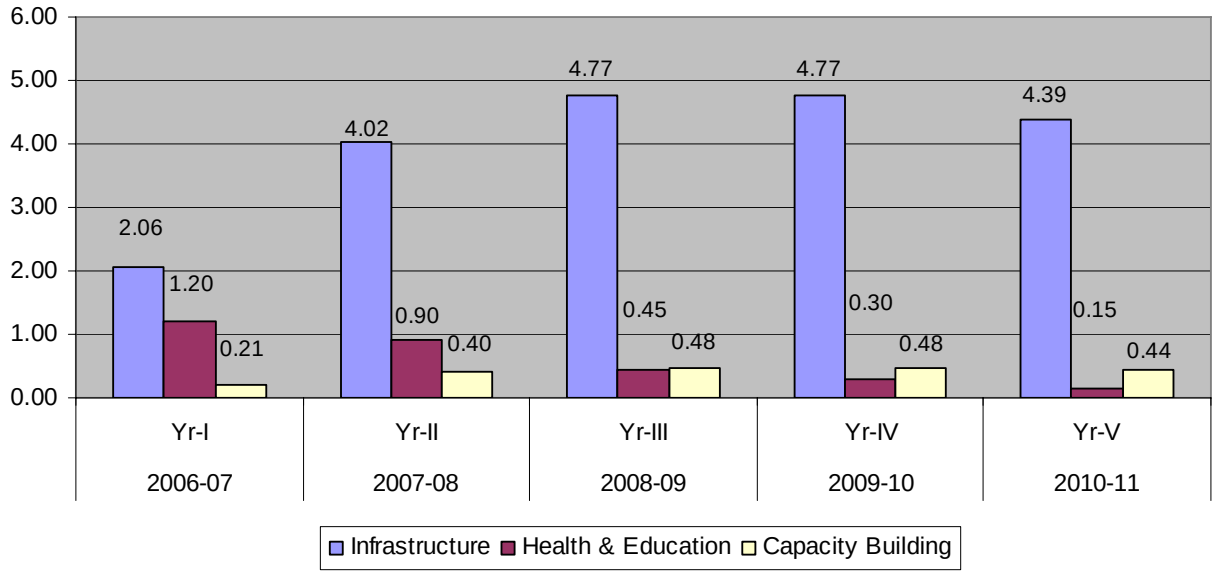
Investment Program (2006 -2011) as of September 2007
(US$ millions)

Description	Planned	Committed	Disbursed
Infrastructure	20.02	3.05	0.65
Health & Education	3.31	0.12	0.04
Capacity Building	2.25	0.03	0.01
Total	**25.58**	**3.20**	**0.70**

The investment program is largely focused to the LBOD Backwash area (See Map 1 below). The PPAF is currently implementing development activities in 336 settlements, around 65 percent of which are in the Left Bank Outfall Drain (LBOD) area. Out of total 218 SCAD Community Infrastructure Projects, 73 percent are located in LBOD Backwash area. About 113 projects in nine union councils in LBOD Backwash area (See Table 1 for names, location, village

coordinates, type of schemes and cost of projects) area have been completed and 46 projects are ongoing (given in Table 2). About 10 projects have been completed in areas other than LBOD Backwash area (Table 3) and 49 projects are ongoing in other areas. Majority of projects so far in the LBOD Backwash area have been for safe drinking water supply and sanitation. The settlements in this region are very small, scattered and remote and population expressed priority in safe drinking water supply projects, link roads and improved access to markets and health facilities.

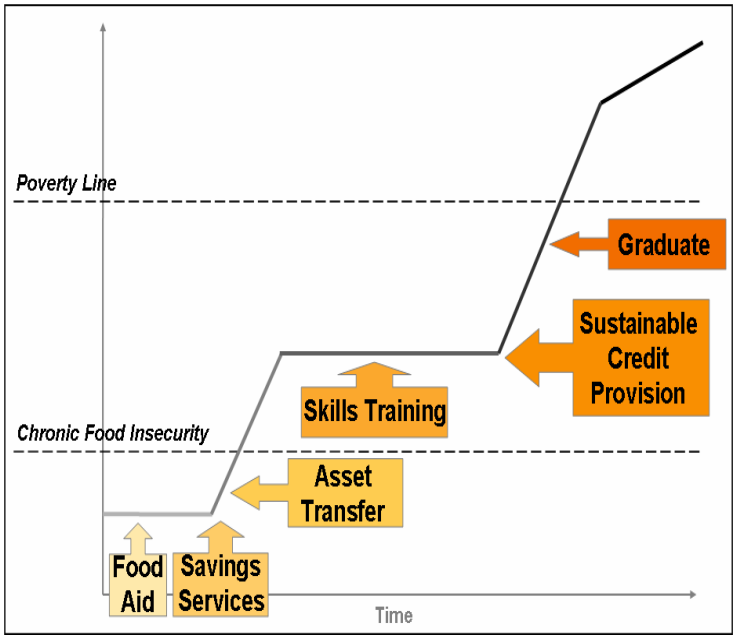
PPAF-SCAD Investment Program (2006 -2011)



Social Safety Nets Pilot

The PPAF, with support and technical assistance from the Consultative Group to Assist the Poorest (CGAP), has also embarked on a program of social safety nets for the Sindh coastal areas. Detail of this innovative pilot which can potentially have far reaching impacts for the extremely poor and destitute are given in the diagram below – an approach also supported by IFAD. PPAF has been following this approach to target ultra poor. The same approach is used in LBOD Backwash areas, where some of the poorest communities in Pakistan are known to reside. It can be seen that this approach deals with chronic food insecurity (through food aid, saving services and asset transfer before graduating to skills training and sustainable credit provision to help raise people above the poverty line.

TARGETING ULTRA POOR APPROACH (SUPPORTED BY IFAD)



Targeting Ultra Poor (TUP)

- Financial Assistance US$ 1 million
- Period: 30 Months
- Supporting Agencies
  - CGAP
  - Ford Foundation
  - IFAD
- Outreach/Coverage
  - 110 villages
  - 1,000 HHs
  - 5 POs
- Assistance per HH
  - Asset transfer: Rs.15,000
  - Subsistence Allowance: Rs.18,000 per year
  - Special Health Care: Rs.1,000 per year
  - Trainings: Rs.2,700

Constraints

The PPAF has disbursed and/or committed over 100 percent of its funds and therefore, is faced with financial constraints to accelerate implementation. It is hoped that once additional financing for the Social Mobilization is approved it would be able to support SCAD prior to PPAF III (scheduled to commence in fiscal year 2008-2009).

Map 1 - Coverage under the Program -- Project in LBOD Backwash area

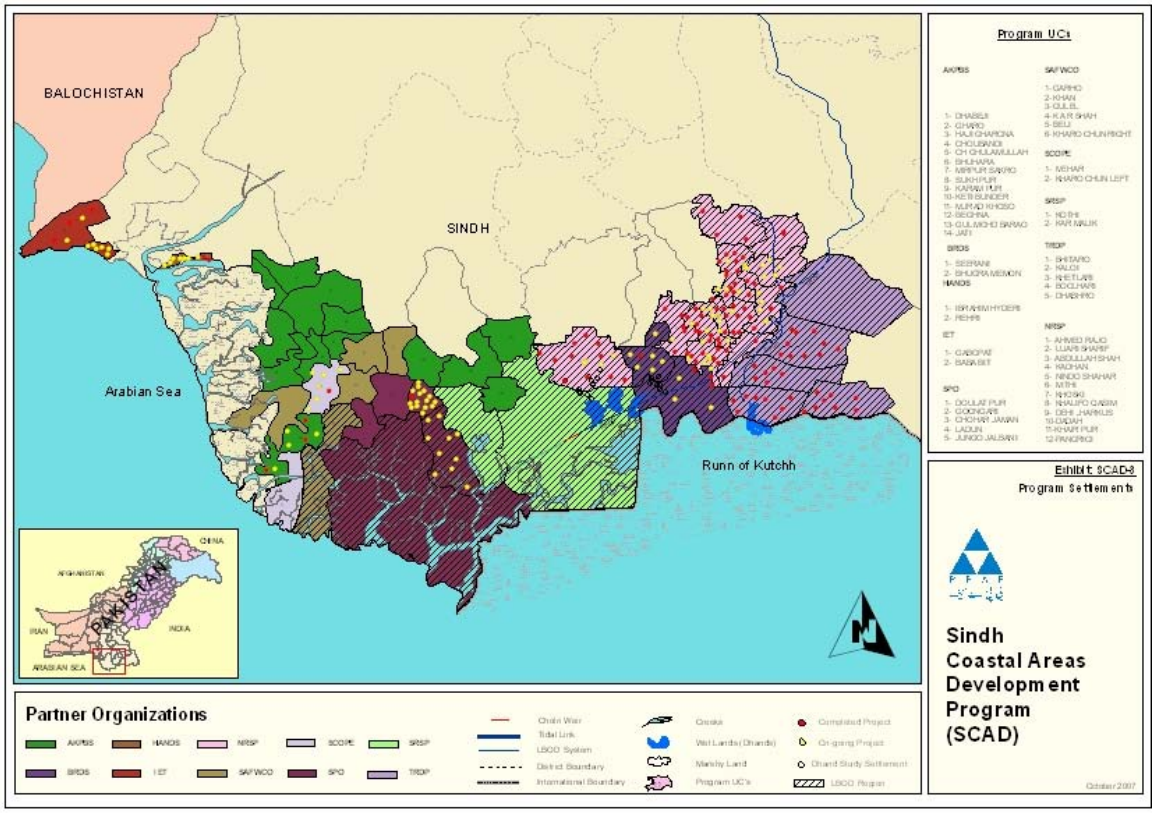


Table 1: SCAD PROGRAM SETTLEMENTS : LBOD BACKWASH REGION(LBR)

COMPLETED PROJECTS

Sr. No.	PO	Tehsil	UC	Village	Latitude			Longitude			Type of Intervention(s)	Estimated Cost (Rs.) (PPAF Share)
					Degree	Minute	Second	Degree	Minute	Second		
1	NRSP	BADIN	Abdullah shah	Haji Saleh Nohrio	24.000	34.000	26.200	68.000	55.000	52.400	Lift Irrigation	2,654,112
2	NRSP	BADIN		Haji Urus Soomro	24.000	38.000	35.700	68.000	55.000	33.400	Culverts	
3	NRSP	BADIN		Peroze Khan Jamali	24.000	33.000	22.900	69.000	2.000	38.100	Culverts	
4	NRSP	BADIN		Sallah Nohrio	24.000	36.000	11.900	68.000	55.000	34.200	DWSS	
5	NRSP	BADIN		Sallah Nohrio	24.000	36.000	16.800	68.000	55.000	20.200	Culverts	
6	NRSP	BADIN		Ishaque Soomro	24.000	37.000	23.200	68.000	55.000	44.500	Culverts	
7	NRSP	BADIN		Ishaque Soomro	24.000	37.000	20.400	68.000	55.000	29.600	DWSS	
8	NRSP	BADIN		Ibrahim Nohrio	24.000	37.000	25.600	68.000	56.000	46.000	Link Road	
9	NRSP	BADIN		Abdul Raheem Mehran Pota	24.000	35.000	25.700	68.000	55.000	58.100	Hand Pumps	
10	NRSP	BADIN		Haji Mohammad Soomro	24.000	37.000	43.500	68.000	54.000	56.700	DWSS	
11	NRSP	BADIN		Mohammad Khan Jamali	24.000	34.000	6.500	68.000	57.000	54.100	DWSS	
12	NRSP	BADIN		Obhayo Panhwer	24.000	34.000	23.900	69.000	0.000	56.600	DWSS	
13	NRSP	GOLARCHI	Ahmed Raju	Chak-10	29.000	30.000	22.800	68.000	38.000	43.900	DWSS	2,939,971
14	NRSP	GOLARCHI		Chak-15	24.000	28.000	55.600	68.000	40.000	15.700	DWSS	
15	NRSP	GOLARCHI		Chak-30	24.000	34.000	55.500	68.000	34.000	33.600	Link Road	
16	NRSP	GOLARCHI		Chak-7	24.000	33.000	17.240	68.000	35.000	23.530	Linning of Water Channel	
17	NRSP	GOLARCHI		Dawood Nohrio	24.000	32.000	24.100	68.000	38.000	9.000	Culverts	
18	NRSP	GOLARCHI		Chak-15	24.000	28.000	59.800	68.000	40.000	15.800	Culverts	
19	NRSP	GOLARCHI		Chak-10	24.000	30.000	23.700	68.000	38.000	37.500	Culverts	
20	NRSP	GOLARCHI		Chak-15	24.000	28.000	59.800	68.000	40.000	18.600	Culverts	
21	NRSP	GOLARCHI		Chak-10	24.000	29.000	52.200	68.000	38.000	37.500	Culverts	
22	NRSP	TANDO BAGO	Dadah	Bajhi Khaskheli	24.000	56.000	41.500	69.000	8.000	10.200	DWSS	1,007,000
23	NRSP	TANDO BAGO		Ghulam Nabi Jarwar	24.000	58.000	4.700	69.000	6.000	41.100	DWSS	
24	NRSP	TANDO BAGO		Pir Bux Khoso	24.000	56.000	29.900	69.000	5.000	4.800	Link Road	
25	NRSP	TANDO BAGO		Haji Noor M.Jarwar	24.000	58.000	44.000	69.000	7.000	34.400	DWSS	

26	NRSP	TANDO BAGO	Dei Jurkus	Mohammad Khoso	24.000	39.000	46.800	69.000	13.000	49.400	DWSS	1,589,546
27	NRSP	TANDO BAGO		Mohammad Yousif Bhoot	24.000	35.000	7.000	69.000	9.000	28.500	DWSS	
28	NRSP	TANDO BAGO		Haji Sallar Soomro	24.000	36.000	56.400	69.000	7.000	29.800	Street Pavement	
29	NRSP	TANDO BAGO		Mohammad Ishaque Bhaunrio	24.000	45.000	35.800	69.000	10.000	6.000	Hand Pumps	
30	NRSP	TANDO BAGO		Janjwa Farm	24.000	37.000	49.200	69.000	12.000	4.100	Link Road	
31	NRSP	BADIN	Kadhan	Menghwar Muhalla	24.000	28.000	42.700	68.000	59.000	4.200	Street Pavement	2,896,434
32	NRSP	BADIN		Suleman Notiar	24.000	30.000	58.400	68.000	59.000	52.300	Link Road	
33	NRSP	BADIN		Natho Khan Bajeer	24.000	27.000	54.500	68.000	57.000	20.900	Link Road	
34	NRSP	BADIN		Tahir Bajeer	24.000	28.000	9.700	68.000	56.000	8.500	Link Road	
35	NRSP	BADIN		Jumoo Subero	24.000	29.000	24.300	68.000	59.000	48.400	Hand Pumps	
36	NRSP	BADIN		Allah Dino Bajeer	24.000	29.000	0.020	68.000	56.000	5.200	Hand Pumps	
37	NRSP	BADIN		Mohammad Rafique Dal	24.000	27.000	33.600	68.000	59.000	25.400	Street Pavement	
38	NRSP	BADIN		Qasim Jamali	24.000	28.000	47.600	68.000	59.000	27.200	Street Pavement	
39	NRSP	BADIN		Adam Bajeer	24.000	28.000	16.100	68.000	57.000	9.800	Street Pavement	
40	NRSP	BADIN		Ali Muhammad Jamali	24.000	28.000	34.000	68.000	59.000	20.000	Street Pavement	
41	NRSP	TANDO BAGO	Khalifo Qasim	Khabhar Bhoot	24.000	38.000	43.500	69.000	5.000	39.600	DWSS	2,914,112
42	NRSP	TANDO BAGO		Haji Ahmed Samoon	24.000	41.000	19.100	69.000	4.000	27.400	DWSS	
43	NRSP	TANDO BAGO		Ahmed kathai	24.000	38.000	52.800	69.000	5.000	39.000	DWSS	
44	NRSP	TANDO BAGO		ALi Mohammad Nohrio	24.000	40.000	39.600	69.000	6.000	51.900	DWSS	
45	NRSP	TANDO BAGO		Dilawar Khan Ahmedani	24.000	41.000	9.500	69.000	7.000	31.600	Link Road	
46	NRSP	TANDO BAGO		Haji Ahmed Samoon	24.000	41.000	22.300	69.000	4.000	27.200	Street Pavement	
47	NRSP	TANDO BAGO		Khabhar Bhoot	24.000	38.000	43.500	69.000	5.000	39.600	Street Pavement	
48	NRSP	TANDO BAGO		Khalifo Abdul Latif Daris	24.000	45.000	3.500	69.000	6.000	30.800	Hand Pumps	
49	NRSP	TANDO BAGO		Mohammad Hanif Dal	24.000	46.000	48.100	69.000	7.000	26.500	Hand Pumps	
50	NRSP	TANDO		Abdullah Khan Junejo	24.000	41.000	59.100	69.000	3.000	22.500	DWSS	

		BAGO										
51	NRSP	TANDO BAGO	Khoski	Ghanwar Junejo	24.000	35.000	41.900	69.000	4.000	17.500	DWSS	3,091,631
52	NRSP	TANDO BAGO		Aleem Daris	24.000	36.000	51.700	69.000	4.000	53.600	DWSS	
53	NRSP	TANDO BAGO		Qaiser Ahmedani	24.000	34.000	33.700	69.000	6.000	4.500	DWSS	
54	NRSP	TANDO BAGO		Haji Mohammad Yousif Bhurghari	24.000	38.000	42.500	69.000	2.000	39.600	Link Road	
55	NRSP	TANDO BAGO		Mohammad Siddique Bhoot	24.000	40.000	38.300	69.000	6.000	38.500	DWSS	
56	NRSP	TANDO BAGO		Haji Khameeso Chalgiri	24.000	37.000	19.900	69.000	3.000	28.300	DWSS	
57	NRSP	TANDO BAGO		Chak FFR	24.000	37.000	7.400	69.000	11.000	6.700	Link Road	
58	NRSP	TANDO BAGO		Mohammad Hashim Lakhatio	24.000	38.000	17.000	69.000	3.000	32.300	Hand Pumps	
59	NRSP	TANDO BAGO		Qaiser Khan Khoso	24.000	38.000	14.400	69.000	0.400	21.100	Cross Drainage Structure	
60	NRSP	TANDO BAGO		Punhoon Rebari	24.000	40.000	12.000	69.000	8.000	59.700	Hand Pumps	
61	NRSP	TANDO BAGO		Talib Khoso	24.000	38.000	14.400	69.000	4.000	3.900	Street Pavement	
62	NRSP	BADIN	Lunwari sharif	Mohammad Juman Dasiro	24.000	33.000	12.800	68.000	50.000	59.000	Bridge	843,000
63	NRSP	BADIN		Noor Mohammad Dasiro	24.000	33.000	7.100	68.000	51.000	35.900	Link Road	
64	NRSP	BADIN	Mithi-III	Eidu Nohrio	24.000	31.000	26.000	69.000	5.000	20.500	Street Pavement	554,000
65	NRSP	BADIN	Nindo	Budhal Punhwer	24.000	38.000	38.600	68.000	58.000	47.600	DWSS	2,117,408
66	NRSP	BADIN		Haji Umer Soomro	24.000	40.000	22.300	68.000	58.000	37.200	DWSS	
67	NRSP	BADIN		Haji Umer Soomro	24.000	42.000	25.300	68.000	59.300	39.100	Bridge/Culverts	
68	NRSP	BADIN		Fazal Mohammad Shah	24.000	38.000	17.000	68.000	58.000	31.100	DWSS	
69	NRSP	BADIN		Fazal Mohammad Shah	24.000	38.000	10.300	68.000	58.000	25.300	Link Road	
70	NRSP	BADIN		Mohammad Arab Bhoot	24.000	38.000	56.600	68.000	59.000	38.500	DWSS	
71	NRSP	BADIN		Jummu Gudaro	24.000	39.000	58.500	68.000	58.000	4.600	Hand Pumps	
72	NRSP	BADIN		Mohammad Soomar Panhwar	24.000	38.000	8.100	68.000	59.000	1.800	Bridge	
73	NRSP	BADIN		Juman Shah	24.000	39.000	51.200	68.000	59.000	35.500	DWSS	

74	NRSP	BADIN		Ali Mohammad Jamali	24.000	34.000	49.500	69.000	1.000	36.600	DWSS	
75	NRSP	BADIN		Allah Rakhio Bhurghari	24.000	35.000	13.600	69.000	2.000	13.800	Street Pavement	
76	TRDP	Diplo	Bolhari	Padhrio	24.000	44.000	18.800	69.000	29.000	33.900	DWSS	280,710
77	TRDP	Diplo		Charail	24.000	41.000	15.540	69.000	27.000	20.570	DWSS	
78	TRDP	Diplo		Khoi Moora	24.000	41.000	56.200	69.000	28.000	32.900	Hand Pumps	
79	TRDP	Diplo		Senhar Khoi	24.000	19.000	15.880	69.000	29.000	2.090	Hand Pumps	
80	TRDP	Diplo		Dakan	24.000	23.000	1.740	69.000	27.000	30.700	DWSS	
81	TRDP	Diplo	Dabhro	Deermoon	24.000	17.000	51.820	69.000	31.000	55.750	DWSS	721,558
82	TRDP	Diplo		Malkar	24.000	17.000	41.320	69.000	34.000	7.100	DWSS	
83	TRDP	Diplo		Indi	24.000	19.000	6.190	69.000	32.000	52.220	Hand Pumps	
84	TRDP	Diplo		Khatho Nohri	24.000	17.000	40.790	69.000	22.000	33.310	Hand Pumps	
85	TRDP	Diplo		Amerano	24.000	22.000	55.830	69.000	31.000	25.680	Hand Pumps	
86	TRDP	Diplo		Dondio	24.000	23.000	4.150	69.000	30.000	20.790	Hand Pumps	
87	TRDP	Diplo		Sakri	24.000	22.000	52.800	69.000	25.000	33.900	Hand Pumps	
88	TRDP	Diplo		Sakri	24.000	22.000	53.500	69.000	25.000	31.700	Hand Pumps	
89	TRDP	Diplo		Dondio	24.000	23.000	1.120	69.000	31.000	10.680	Hand Pumps	
90	TRDP	Diplo		Sakri Juneja	24.000	22.000	52.800	69.000	25.000	33.900	Hand Pumps	
91	TRDP	Diplo		Sakri Juneja	24.000	22.000	51.900	69.000	25.000	31.700	Hand Pumps	
92	TRDP	Diplo		Sakri Juneja	24.000	22.000	56.500	69.000	25.000	30.500	Hand Pumps	
93	TRDP	Diplo		Sakri Juneja	24.000	22.000	51.100	69.000	25.000	39.500	Hand Pumps	
94	TRDP	Diplo		Sakri Juneja	24.000	22.000	57.320	69.000	25.000	45.000	Hand Pumps	
95	TRDP	Diplo		Sakri Juneja	24.000	22.000	53.500	69.000	25.000	36.700	Hand Pumps	
96	TRDP	Diplo		Bitri	24.000	21.000	2.690	69.000	28.000	32.100	Hand Pumps	
97	TRDP	Diplo		Kheenrohi	24.000	20.000	2.460	69.000	27.500	38.200	Hand Pumps	
98	TRDP	Diplo		Karivari	24.000	17.000	48.280	69.000	28.000	40.320	Hand Pumps	
99	TRDP	Diplo		Karivari	24.000	22.000	59.250	69.000	26.000	36.040	Hand Pumps	
100	TRDP	Diplo		Sandooque	24.000	26.000	9.840	69.000	26.000	4.320	Hand Pumps	
101	TRDP	Diplo	Kaloi	Kaloi	24.000	39.000	11.300	69.000	17.000	19.900	Hand Pumps	96,000
102	TRDP	Diplo		Kaloi	24.000	39.000	33.500	69.000	17.000	30.500	Hand Pumps	
103	TRDP	Diplo	Khetlari	Rohelo	24.000	39.000	49.100	69.000	24.000	51.900	Hand Pumps	746,555
104	TRDP	Diplo		Bhojakar	24.000	40.200	6.300	69.000	31.200	14.280	DWSS	
105	TRDP	Diplo		Pabuhar Meghwar	24.000	39.000	52.500	69.000	21.000	55.800	Hand Pumps	
106	TRDP	Diplo		Mahrand	24.000	41.000	1.300	69.000	18.000	37.600	Hand Pumps	
107	TRDP	Diplo		Rohilo Bhai Khan	24.000	39.000	54.200	69.000	24.000	56.200	Hand Pumps	
108	TRDP	Diplo		Fazal Soomro Satsariro	24.000	40.000	46.900	69.000	27.000	16.000	DWSS	
109	TRDP	Diplo		Malhai Ji Dhani	24.000	38.500	39.800	69.000	24.000	14.000	Hand Pumps	
110	TRDP	Diplo		Khakhanihar	24.000	32.000	18.900	69.000	21.000	24.600	Hand Pumps	

111	TRDP	Diplo		Hajamro	24.000	43.000	6.100	69.000	31.000	24.300	Hand Pumps	
112	TRDP	Diplo		Dedwari	24.000	39.600	13.700	69.000	26.400	23.400	Hand Pumps	
113	BRDS	Badin	Seerani	Bhugro Mal	24.000	30.000	3.100	68.000	47.000	12.300	Hand Pumps	35,329
											Total	**22,487,366**

*** IAUP - Integrated Area Upgradation Project**
DWSS - Drinking Water Supply Scheme

Figures in GREY are to be ground trouthed.

Table 2: SCAD PROGRAM SETTLEMENTS LBOD BACKWASH REGION (LBR)

ONGOING PROJECTS

Sr. No.	PO	Tehsil	UC	Village	Latitude			Longitude			Type of Intervention(s)	Estimated Cost (Rs.) (PPAF Share)
					Degree	Minute	Second	Degree	Minute	Second		
1	BRDS	Badin	Bhugra Memon	Seth Khamoon Mallah	24.000	21.000	40.500	68.000	51.000	23.600	Link Road	1,111,707
2	BRDS	Badin		Ramzan Lund	24.000	21.000	26.946	68.000	54.000	15.933	Bridge	
3	BRDS	Badin	Seerani	Ishaque Khaskheli	24.000	31.000	35.300	68.000	48.000	25.300	Hand Pumps	1,233,500
4	BRDS	Badin		Ahmed Abad	24.000	26.000	12.400	68.000	45.000	7.800	Hand Pumps	
5	BRDS	Badin		Arib Sheedi	24.000	28.000	25.500	68.000	45.000	15.100	Hand Pumps	
6	BRDS	Badin		Allah Dino Khaskheli	24.000	32.000	18.800	68.000	49.000	7.600	Hand Pumps	
7	BRDS	Badin		Pini Ladho Rajo	24.000	30.000	23.703	68.000	44.000	7.033	DWSS*	
8	BRDS	Badin		Hameer Bheel	24.000	29.000	52.476	68.000	47.000	19.473	Sanitation	
9	BRDS	Badin		Khudha Dino Bheel	24.000	29.000	57.488	68.000	47.000	32.870	Hand Pumps	
10	NRSP	Badin	Abdullah shah	Mohammad Yousif Bajeer	24.000	36.000	2.960	69.000	11.200	4.090	Hand Pumps	1,336,118
11	NRSP	Badin		Abdul Rahim Mehranpoto	24.000	35.000	24.600	68.000	55.000	57.000	Link Road	
12	NRSP	Badin		Khamiso Mehranpoto	24.000	35.000	25.200	68.000	55.000	57.700	Culverts	
13	NRSP	BADIN		Babu Panhwar	24.000	34.000	0.010	69.000	3.000	0.060	Bridge	
14	NRSP	Golarchi	Ahmed Raju	Chack-15	24.000	29.000	0.200	68.000	40.000	6.000	Sanitation	1,656,348
15	NRSP	Golarchi		Ghulam Ali Chandio	24.000	27.000	46.900	68.000	34.000	21.700	Hand Pumps	
16	NRSP	Badin		Mohammad Rahim Chandio	24.000	27.000	35.600	68.000	34.000	14.700	Link Road	
17	NRSP	TANDO BAGO	Dei Jurkus	Mohammad Yousif Bhoot	24.000	35.000	7.000	69.000	9.000	28.500	IAUP*	5,353,874
18	NRSP	TANDO BAGO		Haji Din Muhammad	24.000	44.000	21.100	69.000	13.000	35.600	IAUP*	

19	NRSP	Badin	Kadhan	Lakha Dino Jamali	24.000	27.000	34.800	68.000	58.000	39.000	Link Road	2,068,106
20	NRSP	Badin		Haji Mandhro Khaskheli	24.000	26.000	30.400	69.000	0.000	8.200	Link Road	
21	NRSP	Badin		Tamachi Bajeer	24.000	28.000	30.800	68.000	59.000	41.600	Street Pavement	
22	NRSP	Badin		Bilawal Bajeer	24.000	28.000	20.400	68.000	55.000	29.500	Hand Pumps	
23	NRSP	Badin		Qasim Jamali	24.000	28.000	50.000	68.000	59.000	28.000	Street Pavement	
24	NRSP	BADIN		Razi Khan Chandio	24.000	30.000	21.300	69.000	0.000	43.700	Culverts	
25	NRSP	TANDO BAGO	Khairpur Gambo	Abdul Karim Leghari	24.000	53.000	17.100	69.000	17.000	6.900	Hand Pumps	172,000
26	NRSP	Tando Bago	Khalifo Qasim	Yar Mohammad Halepoto	24.000	42.000	33.000	69.000	3.000	16.200	DWSS*	2,267,744
27	NRSP	Tando Bago		Gul Mohammad Khoso	24.000	47.000	26.900	69.000	6.000	55.600	Cross Drainage Structure	
28	NRSP	Tando Bago		Muhammad Soomar Junejo	24.000	46.000	46.500	69.000	7.000	3.600	Hand Pumps	
29	NRSP	Tando Bago		Qadir Bux Dal	24.000	42.000	31.800	69.000	1.000	31.100	Street Pavement	
30	NRSP	TANDO BAGO		Abdul Karim Bhurghari	24.000	40.000	39.600	69.000	4.000	45.200	DWSS	
31	NRSP	TANDO BAGO		Habibullah Khangher	24.000	44.000	55.700	69.000	6.000	24.200	DWSS	
32	NRSP	Tando Bago	Khoski	Qaisar Khan Khoso	24.000	38.000	11.000	69.000	4.000	23.800	Street Pavement	1,509,520
33	NRSP	Tando Bago		Muhammad Hashim Lakhatio	24.000	48.000	14.300	69.000	3.000	32.100	Street Pavement	
34	NRSP	TANDO BAGO		Imam Bux Ahmedani	24.000	41.000	15.100	69.000	7.000	20.200	DWSS	
35	NRSP	Badin	Mithi-III	Ali Muhammad Rehwani	24.000	39.000	59.200	69.000	9.620	32.900	Hand Pumps	111,668
36	NRSP	Tando Bago	Pangrio	Mohammad Ramzan Lail	24.000	47.000	6.000	69.000	13.000	58.900	Lift Irrigation	1,227,511
37	NRSP	Tando Bago		Abdul Rehman Ahmedani	24.000	45.000	19.200	69.000	13.000	4.300	Link Road	
38	NRSP	Tando Bago		Muhammad Usman Hajani	24.000	48.000	37.600	69.000	12.000	7.500	Hand Pumps	
39	SPO	Shahbandar	Ladyoon	Noor Mohd Chandio	24	18	26	68	04	58	DWSS*	2,790,523
40	SPO	Shahbandar		Haji Shafi Mohd. Jat	24	18	36	68	05	23	Bridge	

41	SPO	Shahbandar		Umar Khan Leghari	24	16	59.000	68	05	23	Brick Pavement	
42	SPO	Shahbandar		Mohd.Usman Sanjrani	24	24	05	67	59	21	Sanitation	
43	SPO	Shahbandar		Haji Ishaque Chang	24	18	41	68	4	37	Hand Pumps	
44	SPO	Shahbandar		Haji Suhrab Chang	24	18	30	68	3	31	Hand Pumps	
45	SPO	Shahbandar		Moulvi Fateh Ali Jatoi	24	21	23	68	3.000	32	Brick Pavement	
46	SPO	Shahbandar		Saboo Dars	24	23	8	68	3	25	Brick Pavement	
											Total	**20,838,619**

* IAUP - Integrated Area Upgradation Project
DWSS - Drinking Water Supply Scheme

Figures in GREY are to be ground trouthed.

Table 3: SCAD PROGRAM SETTLEMENTS (OTHER AREAS)

COMPLETED PROJECTS

Sr. No.	PO	Tehsil	UC	Village	Latitude			Longitude			Type of Intervention(s)	Estimated Cost (Rs.) (PPAF Share)
					Degree	Minute	Second	Degree	Minute	Second		
1	SCOPE	Kharochan	Kharochan	Haji Ali Mohd. Jat	24	7.000	40.200	67	35.000	33.600	Community Level Bio Sand Filters	172,000
2	HANDS	Bin Qasim Town	Rehri	Dabla Para	24	48	57.7	67	13	14.4	Communication	285,693
3	HANDS	Bin Qasim Town		Pan Para	24.000	48.000	58.200	67.000	13.000	39.600	Surface Water Tank	
4	AKPBS	Keti Bunder	Keti Bunder	Keti Bunder	67	27	.03	24	8	.526	IAUP*	7,533,815
5	AKPBS	Keti Bunder		Keti Bunder	67	27	.03	24	8	.526	IAUP*	
6	AKPBS	Keti Bunder		Siddique Runjo	67	27	.198	24	7	.878	IAUP*	
7	IET	Keimari	Baba Bhit No.4	Baba Island	24.000	49.000	24.100	66.000	57.000	41.900	Solid wate Bins	60,000
8	IET	Keimari	Gabo Bhat No . 4	Haji Samaro	24.000	55.000	33.400	66.000	46.000	55.800	Sanitation	433,400
9	IET	Keimari		Juma Hammed	24.000	58.000	21.900	66.000	49.000	48.000	Wind Turbine	
10	SPO	Shahbandar	Choohar Jamali	Mawo Khan Jamali	24	24	43	68	01	29	Hand Pumps	75,100
											Total	**8,560,008**

* IAUP - Integrated Area Upgradation Project
DWSS - Drinking Water Supply Scheme

Figures in GREY are to be ground trouthed.

Table 4: SCAD PROGRAM SETTLEMENTS (OTHER AREAS)

ONGOING PROJECTS

Sr. No.	PO	Tehsil	UC	Village	Latitude			Longitude			Type of Intervention(s)	Estimated Cost (Rs.) (PPAF Share)
					Degree	Minute	Second	Degree	Minute	Second		
1	AKPBS	Keti Bunder	Keti Bunder	Keti Bunder	24.000	8.000	0.526	67.000	27.000	0.030	IAUP*	5,934,204
2	AKPBS	Keti Bunder		Miro Dablo	24.000	8.000	0.202	67.000	26.000	0.730	IAUP*	
3	AKPBS	Ghorabari	Vur	Vur	24.000	36.000	36.210	67.000	48.000	44.030	IAUP*	3,262,945
4	AKPBS	Ghorabari		Muhammadabad	24.000	34.000	54.080	67.000	44.000	45.740	IAUP*	
5	AKPBS	Keti Bunder	Keti Bunder	Haji Abu Jat	24.000	7.000	41.900	67.000	28.000	4.400	Protection Bund	7,877,663
6	AKPBS	Keti Bunder		Haji Abu Jat	24.000	7.000	41.900	67.000	28.000	4.400	Protection Bund	
7	AKPBS	Keti Bunder		Haji Ismail Jat	24.000	10.000	59.500	67.000	30.000	58.126	DWSS*	
8	AKPBS	Keti Bunder		Umar Jat	24.000	10.000	59.500	67.000	30.000	58.126	DWSS*	
9	AKPBS	Keti Bunder		Jhaloo	24.000	12.000	5.600	67.000	30.000	58.200	DWSS*	
10	AKPBS	Keti Bunder		Moosa Jat	24.000	7.000	40.400	67.000	27.000	37.200	DWSS*	
11	AKPBS	Keti Bunder		Karmi Samo	24.000	12.000	59.000	67.000	33.000	19.800	DWSS*	
12	AKPBS	Keti Bunder		Ahmed Samo	24.000	12.000	36.700	67.000	33.000	14.500	DWSS*	
13	SCOPE	Kharochan	Kharochan	Haji Mohd Jat	24	8.000	23.270	67	33.000	14.210	Community Level Bio Sand Filters	856,696
14	SCOPE	Kharochan		Haji Yousf Kitiyar	24	6.000	47.540	67	35.000	13.870	Community Level Bio Sand Filters	
15	SCOPE	Kharochan		Haji Mohd Jat	24	8.000	28.060	67	35.000	18.660	Community Latrines	
16	SCOPE	Kharochan		Haji Ali Mohd. Jat	24	6.000	52.330	67	33.000	57.290	Community Latrines	

17	SCOPE	Kharochan		Haji Ali Zaman Jat	24	5.000	50.110	67	34.000	54.730	Community Latrines	
18	SCOPE	Kharochan		Haji Alam Jat	24	6.000	18.820	67	35.000	56.950	Community Latrines	
19	HANDS	Bin Qasim Town	Rehri	Siddique Khaskheli	24.000	49.000	15.400	67.000	14.000	8.300	Underground Water Tank	734,670
20	HANDS	Bin Qasim Town		Chashma Goth	24.000	49.000	0.400	67.000	13.000	50.700	Communications	
21	HANDS	Bin Qasim Town	Ibrahim Hydri	Khaskheli & Sachwani	24.000	48.000	54.800	67.000	13.000	49.400	Communications	502,911
22	HANDS	Bin Qasim Town		Gabol and Latif Para	24.000	47.000	39.800	67.000	8.000	45.100	Hand Pumps	
23	HANDS	Bin Qasim Town		Lasi Para	24.000	47.000	56.200	67.000	8.000	35.600	Hand Pumps	
24	HANDS	Bin Qasim Town		Khaskheli Muhalla	24.000	47.000	43.800	67.000	8.000	44.000	Hand Pumps	
25	HANDS	Bin Qasim Town		Mirani Muhalla	24.000	47.000	37.700	67.000	8.000	34.700	Street Pavement	
26	SPO	Shahbandar	Choohar Jamali	Allahdino Jamali	24	23	28	68	00	58	Hand Pumps	5,083,061
27	SPO	Shahbandar		Haji Haroon Magsi	24	22	25	68	01	19	Sanitation	
28	SPO	Shahbandar		Haji Karam Ali Rind	24	24	16	68	01	38	Sanitation	
29	SPO	Shahbandar		Manthar Samoon	24	24	27	67	59	15	Bridge	
30	SPO	Shahbandar		Mola Bux Sanjrani	24	23	11	67	59	34	DWSS*	
31	SPO	Shahbandar		Hakim Sanjrani	24	23	08	67	58	43	Bridge	
32	SPO	Shahbandar		Mir Mohd. Rind	24	23	12	67	58	52	Sanitation	
33	SPO	Shahbandar		Allah Bachayo Mallah	24	23	11	67	59	53	Brick Pavement	
34	SPO	Shahbandar		Haji Umar Wagan	24.000	20.000	44.860	67.000	59.000	48.090	Brick Pavement	
35	SPO	Shahbandar		Landhi	24	22	40	68	1	25	Bridge	
36	SPO	Shahbandar		Mahmood Khaskheli	24	23	12	68	0	42	Irrigation	
37	SPO	Shahbandar		Mir Muhammad Solangi	24	23	12	67	58	52	Bridge	

38	SPO	Shahbandar		M. Siddique Magsi	24	22	12	68	1	7	Bridge	
39	SPO	Shahbandar		Sukhio Dal	24.000	20.000	53.040	67.000	59.000	20.740	Hand Pumps	
40	SPO	Shahbandar		Kandoo Magsi	24	23	30	68	2	36	Brick Pavement	
41	SPO	Shahbandar		Waroo Khaskheli	24	23	53	68	0	59	Irrigation	
42	IET	Keimari	Gabo Bhat No . 4	Murad Hayat	24.000	57.000	58.700	66.000	49.000	9.000	IAUP*	4,920,000
43	IET	Keimari		Haji Samaro	24.000	55.000	33.400	66.000	46.000	55.800	Solar Lights	
44	IET	Keimari		Shams Pir-1	24.000	51.000	17.500	66.000	54.000	44.300	Solid Waste Management	
45	IET	Keimari		Shams Pir-2	24.000	51.000	15.700	66.000	54.000	46.300	Solid Waste Management	
46	IET	Keimari		Shams Pir-3	24.000	51.000	4.500	66.000	54.000	41.200	Waste Water Treatment	
47	IET	Keimari		Shams Pir-4	24.000	51.000	13.300	66.000	54.000	58.900	Waste Water Treatment	
48	IET	Keimari		Shams Pir-5	24.000	50.000	9.200	66.000	55.000	8.500	Waste Water Treatment	
49	IET	Keimari		Mubarak Village	24.000	50.000	50.000	66.000	39.000	46.600	DWSS*	
											Total	**29,172,150**

* IAUP - Integrated Area Upgradation Project
DWSS - Drinking Water Supply Scheme

Figures in GREY are to be ground trouthed.

ANNEX 3

PAKISTAN
SOCIO-ECONOMIC AND ENVIRONMENTAL DIAGNOSTIC STUDY OF THE BADIN DHANDS

SUMMARY REPORT
NOVEMBER 12, 2007

CURRENCY EQUIVALENTS

Pakistan Rupee US$1.00=Rs 60.5

ABBREVIATIONS AND TERMS

AF	Acre feet	PLA	Participatory Learning Actions
BOD	Biological oxygen demand	PRA	Participatory Rural Appraisal
cfs	Cubic feet per second	PPAF	Pakistan Poverty Alleviation Fund
SCAD	Sindh Coastal Area Development	ppt	Parts per thousand
CDA	Coastal Development Authority	RD	Reduced Distance
COD	Chemical oxygen demand	RIS	Ramsar Information Sheet
DPOD	Dhoro Puran Outfall Drain	SCARP	Salinity Control and Reclamation Project
ha	Hectares	SDPI	Sustainable Development Policy Institute
IUCN	International Union for the Conservations of Nature	SIDA	Sindh Irrigation and Drainage Authority
km^2	Square kilometers	WAPDA	Water and Power Development Authority
KPOD	Kadhan Pateji Outfall Drain	WB	World Bank
LBOD	Left Bank Outfall Drain	WHO	World Health Organization
µg/l	Micrograms per liter	TKN	Total Kjeldahl Nitrogen
mg/l	Milligrams per liter	TL	Tidal Link drain
NEQS	National Environmental Quality Standards	UC	Union Council
NIO	National Institute of Oceanography	USEPA	US Environmental Protection Agency
NRSP	National Rural Support Program		

UNITS

1AF=1,233.6m^3
1000 cfs=28.32m^3/s
1 acre=0.405ha
1 ft=0.3028m
1 RD = 1000feet = 0.1894mi = 0.305km
0.1 in/ac/day = 6.45 mm/ha/day

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ACKNOWLEDGMENTS

On October 31, 2006, the Executive Directors of the World Bank discussed the findings of the Inspection Panel's Investigation Report and the Management Report and Recommendation on the Pakistan National Drainage Program (NDP) Project. Management responded to the concerns of the Requesters by formulating a comprehensive Action Plan and identifying suitable strategies and instruments through which the Action Plan can be undertaken. Among the issues raised by the requesters was the impact that the Left Bank Outfall Drain (LBOD) and its Tidal Link Canal has had on the four coastal lakes (*dhands)* in Badin District of Sindh Province, and on the socio-economic welfare and livelihoods of the people living near the dhands especially after the breakdowns in the outfall system caused by a major tropical cyclone in 1999.

The third of the five actions planned in the immediate and short term component of the Action Plan is a Socio-Economic and Environmental Diagnostic Study of the Dhands and Surrounding Areas. The aim of this diagnostic study was a rapid assessment of the ecological and livelihood conditions in the dhands in order to identify immediate measures that could be undertake to improve livelihoods and ecological conditions. The study was organized and managed by Dr. Walter A. Garvey who also authored this Summary Report.

The Summary Report was based on the work of three teams of Sindh scientists and specialists that included field work in Badin and the Dhands carried out between late June and October, 2007:

(i) Hydrogeomorphic and marine ecological studies were carried out by a team of scientists from the National Institute of Oceanography (NIO) led Mr. Syed Moazzam Ali (team leader) that included Dr. Samina Kidwai, marine ecologist, and Dr. Tariq Masood Ali Khan, meteorologist and physical oceonographer.

(ii) The freshwater ecological and fishery assessment was led by Dr. Syed Najam Khurshid, ecologist and a team that included Dr. M. A. Mahar, Chairman of the Department of Fisheries, University of Sindh Jamshoro. Dr. S. I. H. Jafri, retired professor of Limnology and Fisheries, University of Sindh, Jamshoro was senior advisor to the team. Water chemistry and pollution studies were carried out at the Institute of Chemistry, University of Karachi.

(iii) The socio-economic assessment was carried out by the team of Ms. Hamida Masood Shah, social scientist (team leader) and Mr. Syed Asher Ali, social scientists. The team was assisted by Mr. Jamal Mustafa Shoro, socio-economist.

1 INTRODUCTION

1.1 Background

1. Badin District[1] is located in the extreme southeastern area of Sindh province. It is a flat, very gently sloping landscape that merges into the eastern portion of the Indus Delta. This area is prone to intense rainfall in the monsoon season and natural calamities that typically cause widespread shallow flooding that often persists for long periods because of the poor drainage. In recent times the area was affected by a cyclone in 1999 followed by an extreme drought that was experienced throughout the Indus River basin, an earthquake in 2001, and extreme rainfall in 2003. Cyclones cause higher than normal tides and storm surges that result in seawater intrusion across the coastal plain and impede drainage. The widespread and persistent flooding adversely affects agriculture and the health and livelihoods of people living in and around the coastal zone. It is a vulnerable and risky environment in which to sustain a livelihood.

2. The upper part of Badin District, including some areas very close to the coastal zone, receives irrigation water from the Indus River at the Kotri Barrage. These irrigated lands primarily produce rice and sugarcane as well as small amounts of other cash and subsistence crops[2]. However, Badin is at the tail end of the Indus basin irrigation system and suffers from unreliable irrigation water supply, water shortages, water logging and salinity. About 70% of the groundwater in Sindh is saline, and the percentage is probably higher in most of Badin District especially the southern portion near the coastal zone.

3. Badin is one of the poorer districts of Sindh by most every socio-economic measure - health, education, maternal mortality and morbidity, income per capita, access to safe drinking water, etc. In southern Badin there are few paved roads, limited electricity coverage, and community infrastructure such as schools and clinics are lacking. The major occupations are fishing, agriculture and livestock. Badin has some oil fields, six sugar mills and 12 rice husking mills that provide employment to about 6-7000 persons, a small fraction of the labor force.

4. Most of the people who do not own irrigated land live close to water bodies or lakes and their sources of livelihood are fishing, raising livestock[3] and agricultural labor and other informal labor when that is possible. The fisherfolk, known as *Mallah*, are one of the poorest groups in the area. One of the most important water bodies and fisheries in Badin is a group of four large, interconnected shallow lakes or *dhands* located in the coastal zone. These lakes have undergone drastic changes in the past 10 years as a result of the construction of the Left Bank Outfall Drain (LBOD) that passes directly through two of the lakes as well as drought and cyclones. The consequences of these changes, their impact on the poor fisherfolk and others who have been affected and the prospects for the future are the focus of this study.

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1 District Government Badin & IUCN, *Badin: District Vision, A Framework for Sustainable Development,* Sindh Pakistan 2006

2 The area of Badin District is about 1,715,000 acres of which 767,000 acres are cultivable. The net cropped area is about 451,000 acres, 58% of the cultivable area, limited mainly by the availability of irrigation water. In recent years the area devoted to the cultivation of sunflower has grown substantially and is now the third largest cash crop.

3 The estimated livestock population in 1998 of 1,140,000 (60% large animals) declined to 857,500 after the 2003 floods due to disease and sale of animals as a coping mechanism (World Bank, 2005)

1.2 Objective of the Study

5. The overall aim of this study is to assess the effects the construction of LBOD and its subsequent breakdowns have had on the Badin dhands and the people whose livelihoods depend on them, and to identify options to mitigate these impacts. The study has two interrelated immediate objectives:

- Determine extent and severity of the effects of damages to the TL and Cholri Weir and their present performance and function, on the people (permanent and transient) living near the dhands or in areas that have been directly impacted, and formulate a short-term and long-term livelihood assistance program taking into consideration other ongoing programs in the area, in particular, the Sindh Coastal Area Development Program (SCAD) of the Pakistan Poverty Alleviation Fund (PPAF).
- Determine the present physical and ecological condition of the dhands paying particular attention to water quality and hydrology, ecology and biodiversity, the productivity and quality of the fishery, and the quality and utilization of waterfowl habitat, assess the severity and reversibility of these impacts, formulate measures and assess options to stabilize and improve present conditions, and formulate a cost-effective monitoring program that would enable continuing management of these valuable natural resources.

6. The study is a rapid assessment covering only a portion of the 2007 monsoon season (late June through September), but it is based in part on the continuing hydraulic monitoring of the LBOD Tidal Link canal, and to a limited extent the dhands, carried out since 1993 by the National Institute of Oceanography (NIO) for WAPDA until 2004, and presently by SIDA. However, apart from this hydraulic monitoring (meteorology, tides, seawater movement, currents, channel hydraulics and bathymetry, etc.) and a single fishery and waterfowl survey of the dhands carried out in 1997, there has been no ecological monitoring or study undertaken of the dhands, and no assessment of the population who live near and depend on the dhands nor identification of their development needs and concerns. An important aim of this study is to integrate these three lines of investigation into a single overall, holistic assessment of an economically and socially important coastal water body for the first time.

2 SOCIO-ECONOMIC CONTEXT OF THE BADIN DHANDS

2.1 The Region

7. Badin district is part of the Lower Indus Plain formed by the alluvial deposits of Indus River through the ancient Hakra, Nullah and Gungra water courses. Being a vast alluvial plain, its land is highly uniform in character and is not diversified by hills or rivers. The southern part of the district is close to the delta of the river Indus and the land surface is therefore relatively low in comparison with the northern half. The drainage system is grossly inadequate and poorly maintained. Consequently, the system does not have the capacity to carry even a nominal increase in precipitation. Flooding is generated by canal and salt water from the irrigation and drainage systems flowing into the area. The delta adjoins the Badin and Golarchi (Shahed Fazil Rahu) talukas of Badin District in which it has two main creeks namely the Shah Samando and the Sir.

8. The climate of Badin District is moderate. The climate is tempered by the sea breeze, which blows for 8 months from March to October, making the hot weather tolerable. Rainfall is highly erratic with an average of about 170 mm. The monsoon dominates from July to September. Rainfall is highly unpredictable and year without rainfall are quite common.

9. According to the 1998 national census, the population of Badin was 1,136,040 compared to 776,610 in 1981. The population grew by 46.28 percent in 17 years which indicates an average annual growth rate of 2.26 percent. With this degree of growth, the population will double in the next 25 years. Almost 90 percent of the population speaks Sindhi. The average household size in the district is 5.3 persons per house.

10. Although there is no strong tribal or feudal culture, there are various tribes. Important among them are the Syed, Soomra, Talpur, Leghari, Bhurghri, Memon, Mandhra, Maheri, Ansari, Sama, Juneja, Sheedi and Mallah. New settlers come mainly from Punjab and Baluchistan.

11. The local population is predominantly Muslim. Important among the minorities are the Hindu (jati) who constitute 18.65 percent of the whole. The coastal area communities are mainly occupied by the Mallah and Mandhra clans, which comprise fisher-folk and herders who rear camels, goats and cows. The agrarian communities, mainly Talpur, Syed, Memon and Punjabi castes, live inland and constitute landowners, sharecroppers, traders and livestock owners.

12. Agriculture is the mainstay of the economy. A number of lakes and freshwater fish ponds allow some communities, particularly the Mallahs, to engage in the fishing occupation. Educated and skilled persons are employed in administrative positions in companies in Badin and outside. The district produces sugarcane, rice, oil and gas and the industries related to these commodities recruit the local population.

13. Badin has many important shrines and historical sites. Monthly and annual congregations are held at most of the religious shrines.

2.2 Study Methodology

14. This socio economic assessment has focused on the people who live near the Badin dhands in the coastal zone (Pateji, Cholri, Sanhro and Mehro), whose livelihoods depend on the resources located in that area, and who have been affected by recent natural disasters in the area including breakdowns in the LBOD outfall system (principally the Tidal Link). A combination of quantitative and qualitative methods of research were adopted for collection of primary data, and considerable secondary data was collected from government and non-government agencies including government departments, local and regional NGOs, CBOs and individuals. The tools and methods used to carry out the socio-economic assessment are explained below.

(i) Consultative Meetings/Workshop with Stakeholders at District Level - Before initiating the survey, a district-level consultative meeting with the stake holders of Government departments and local NGO representatives was held in the office of District Coordination Officer, Badin. All Executive Directors, District Officers of district line departments, representatives of local NGOs attended the meeting (list of participants attached in Annex F). The scope of the study was discussed with the participants to obtain technical inputs and incorporate their opinion where

necessary in the conduct of the study. District Badin officials provided strong support throughout the study.

(ii) Desk Review - The Executive District officer provided full support in providing maps and deputed a *tapedar* to provide as much information as was available. The maps as given by the revenue department were old and not updated, with the result that it was difficult to locate/mark out all villages on map (many village names and locations have changed but the new names have not been recorded). SIDA also provided maps to aide in the process.

In addition, individual meetings with Government institutions (DCO, Badin, line departments, WAPDA & SIDA, Director General, Coastal Development Authority (CDA), Director General, National Institute of Oceanography (NIO), Karachi, NGOs and private organizations (NRSP, BRDS, HANDS, NCHD, LHDP, FHDRO) were also held at Badin. This exercise helped in gathering information about situation of the area, ground realities, impact of livelihood of fishermen, LBOD impact and damages through tidal link etc and the steps taken by stakeholders for the resolution of issue of the area. In particular District *Nazim*, *Naib Nazim, Taluka Nazim* and Union Council *Nazims* were also part of preliminary discussions that continued throughout the study

(iii) Meeting with Key Informants & Stakeholders - Before initiating the PLA excersize and the household survey, an interactive meetings and informal discussion were held with key informants in more than 58 villages. Persons included shopkeepers, social person and residents, teachers, religious persons, etc.

(iv) Participatory Learning Action (PLA) Exercise - Total 8 PLA/PRA exercises were conducted during July and August in the area near the four dhands and the Tidal LInk. The main objectives of the PLA exercises were collection of information, and selection of villages for household survey, and verifying location of villages on maps in villages of the study area.

- Interactive Meeting/Informal Discussion with Key Informants
- Focus Group Discussion (FGD)
- Social Mapping of villages by using Participatory Rural Appraisal (PRA) technique

The PLA methodology included, group meetings, drawing of village maps showing all information about infrastructures, gainful employment opportunities, social and cultural status, literacy. In addition, in certain villages transect walk was also initiated to collect information. The village people, especially women took active part in PLA exercise and provided insight into the village situation and past history.

(v) Focus Group Discussions (FGD) - This technique proved highly useful in collecting data from the groups sharing the similar interests, living conditions and livelihood means. Total 20 FGDs were held in dhand villages (list of villages listed as part of. The FGDs provided and overview the dhand area and the existing situation, the location of villages affected by the Tidal Link, and information about

migration of families and their reasons. Information about the working of NGOs (such as BRDS, LHDP, and NCHD) working in the area and their support or schemes was also collected.

In women FGDs, information about the mothers mortality rate (number of women died during pregnancies) and infants mortality rate were collected. The information about the villagers (male and female) for earning their livelihood, kind of job, location (either at city, village or at dhand) were also collected

(vi) Participatory Rural Appraisal (PRA) - This methodology included, group meetings, drawing of village maps showing all information about infrastructures, gainful employment opportunities, social and cultural status, literacy etc. In addition in certain villages transect walk was also initiated to collect information as best possible way. White sheets were provided to 7-10 persons for drawing the main features of main villages and information of basic facilities such as school, dispensary, hand pumps, watercourse etc. Furthermore, they also drew the surrounding villages. The village people especially the women took active part in PRA exercise and gave insight of the village situation and past history.

- Social Mapping - Since most of the people are illiterate in the village, social mapping which is the technique of PLA was adopted to gather following information pertaining to main village and its surrounding villages of the target area.
- Social History - The local communities provided the actual information about scattered villages surrounding the area. It was found that in the study area some of villages have two names. For example, the actual name of Yameen Jat was Chak 57 in the revenue record. The land in this village had been allotted to retired army officers/officials but they sold their lands for different reasons including natural calamites. The village is presently known as Yameen Jat, but sometimes old people still call it Chak 57.

(vii) Household Survey - To collect specific information, a household survey was conducted. Initially pre tested questionnaire was used to collect household information from each village in the dhand area. After analysis of the information, the questionnaire was reviewed and used in household survey to collect specific information. A total of 58 villages and 300+ HHs were covered in the survey. (list of villages attached as Annexure 1)

- Target Groups - The study focused on poor and vulnerable households within the study area, and in particular, villages and households adversely affected by recent natural disasters including the breakdowns in the Tidal Link, and the resident, transient and seasonal fisherfolk utilizing the dhands.
- Survey of Target Villages – An effort was made to identify the target villages. However, most of the villages were not at the location as marked on the maps. They either shifted or were reportedly destroyed by recent natural disasters including the heavy rains of July 2003. The coordinates of the target villages were located by GPS (Annex C, Table C.1).

- Household survey questionnaire – Based on the qualitative data and information gathering outlined above and the village survey, a preliminary household survey questionnaire was design, pre-tested (about 100 questionnaires) and modified. A sample of 312 households from 54 villages were then surveyed by four teams each consisting of one man and one women[4]. The sample was representative in terms of social stratum, vulnerable groups, gender etc.

(viii) Village consultative Workshops – Thirteen village consultative workshops were held (7 with men and 5 with women) involving 74 villages and 669 participants (Annex C, Tables C.1 & C.2). The outcomes of each of these workshops are summarized in Annex E including the issues and problems identified by the villagers and their suggested solutions. The outcomes of these workshops are discussed below in Chapter 5.

2.3 Demographics, Education, Health and Gender

15. According to the sample population, the proportion of males to females is 53 percent to 47 percent while the sex ratio is 113 (113 males per hundred females). This suggests that mortality rates are persistently higher for males than for females. The average family size is between 8 and 9 (based on the sampled population of 2765 in 312 households). Thirty six percent of males are below the age of 14, roughly the same as the total sampled population. The dependency ratio is 293.52, which means that for every one bread earner, there are about 3 dependents. A total of 71 percent of females and 65 percent of males are reportedly married. The trend of early marriages is higher in the females. The sample population is characterized by large family sizes, high proportion of dependency and a high fertility rates. This suggest a strong need for reproductive health services, with an emphasis on the provision of accessible services, rather than awareness-raising only.

16. Seventy two percent of the population reported having no education (58% of males and 89% of females), and 15% reported having primary education. At present 33% of boys and 24% of girls are reported to be enrolled. Since only 5% of boys and 2% of girls are reported to be enrolled in middle school, the drop-out rate appears to be very high. Educational services show that while there are primary schools available for boys, education facilities for girls are almost non existent. Often where school rooms have been built they have minimal staffing or just poorly built and maintained physical structures. Among children up to 16 years, more than half of the boys and more than 70 percent of girls are out of school, and among adult women nearly 90 percent are illiterate. Factors like lack of schools, large family size, low income and poverty appears to be major obstacles in the attainment of basic education and literacy.

17. Health facilities are almost at zero level in the study area with no network of basic units, clinics, dispensaries and hospitals. The very few that do exist were reportedly just physical structures with little or no staff, equipment of supplies. Households largely access large government/private hospitals located more than 40 km away while some government and private facilities are found within 10 km. Combined with poor roads and low transport services, the health facilities within 10 km are also very hard to access.

[4] The HH survey teams were selected from 95 candidates who replied to a public advertisement placed in the local newspaper by the Socio-Economic Assessment team. About one month was spent in the field administering the questionnaire. On average, 2 HHs were covered by each data collector in one day.

18. Men are the major decision makers in all economic, social and family matters having more authority, while women are clearly precluded and excluded. During village level consultations it emerged clearly that the women and girls of the area are an ignored community and no efforts are so far visible for their welfare, development and empowerment. Very few girls' schools exist in the area, and no maternity home or reproductive services were reported. It was felt that the expertise of local women in handicraft was being exploited, since they did not have much control on rates or earnings.

2.4 Livelihoods and incomes

19. Only 60% of males and 11% of females reported being involved in remunerative wrok, hence, More than half of the population is unemployed (about 40 percent male and 87 percent females). Twenty three percent of males (3% of females with an additional 2% in livestock) were employed in agriculture, 17% in fisheries and 11% in informal or casual labor (4% of females). The high unemployment suggests that the main occupations like agriculture and fishery are not able to absorb all the people of working age and cannot be said to be yielding positive results and related benefits. The high rate of unemployment and large family size must make it difficult for families to even meet their subsistence needs.

20. The main sources of household income were reported to be (57%), fishing (34%) and livestock (21%). About 70% of households own livestock, mostly buffalos (54%), goats (47%) and cows (43%). Of those who reported being engaged in fishing, about half were fishing on Sanhro Dhand, 35% on Mehro Dhand, 25% on Pateji Dhand and 22% on Cholri Dhand. A majority (69%) of the fisherfolk reported catching less than 10 kg per day. About 39% reported that they marketed their fish catch though middlemen, 32% marketed their catch directly to the nearest city, 28% marketed their catch with the help of a contractor. However most of the households only own less than 10 acres of land while average fish catch is also as low as less than 10 kgs per day. Of the households reporting monthly income between Rs 2,501-7,500 per month is engaged in agriculture and fishing. The proportion of people in job/ services and small business is lower, but the length of these professions' goes back to 15-20 years with earnings up to Rs 5,000. The level of incomes for females is even lower, very few are economically active and most who work are engaged in livestock and agriculture.

21. About 61% of both males and females above the age of 13 reported having no income, and 24% reported earning less than Rs 3000 per month, or less than about Rs 100/day. Nearly half (46%) of households reported total monthly expenditures less than Rs 7,500. The overall level of earning indicates that a large majority of households live at or below subsistence level, where they are just able to meet their basic needs for food, shelter and clothing for their larger families. Hence, after meeting food consumption they are left with little to spend even on basic needs like health, utility and educational needs of the family members. The economic status of the households can thus be defined as very poor - low monthly income, low expenditures and investment on livelihood improvements and low savings.

2.5 Infrastructure and Services

2.5.1 Houseing, drinking water and sanitation

22. Ninety seven percent of houses are *katcha* (39% are made of mud, and 58% of wood and mud). Housing in the area is of very low quality. People are unable to afford stable structures, and the high water tables, waterlogging and salinity make these *kutcha* houses very vulnerable.

23. Only about one-third of households have access to drinking water within 2 km, - about half of those households use handpumps (mostly drawing water from shallow groundwater in or close to the villages) and the balance obtain drinking water from watercourses and canals. Water from handpumps are reportedly the cleanest for drinking purposes while canal water is considered unsafe (smelly, salty and dirty).

24. There appears to be a lack of infrastructure for consolidated management of human waste and waste water disposal. All the houses have either no sewerage system or open drains, while only one house has under ground/covered drains. An overwhelming majority of households dispose human waste in open fields.

2.5.2 Transport, Roads and Communications

25. Twenty percent of households reported having access to electricity. While the system of communications is not well established in the area, 51% of households reported having access to mobile phones. Most of the streets and link roads are *katcha* and in poor condition. Due to the unavailability of road and communication network, the accessibility of urban markets for marketing fish and prawn is quite difficult. During consultations participants suggested that with improved roads, fish culture and agriculture could benefit. Cold storages could be built at Bhugra Memon, Bedami, Kadhan, Serani and Badin to facilitate storage and movement of fish and prawn consignments to urban markets.

2.6 Vulnerability and Coping Mechanisms

26. Primary findings show that households frequently face disasters like rains, floods, and cyclones, with loss of human life as well as damages of agriculture, fisheries, livestock and houses. About 81% of households reported experiencing floods 1-2 times per year, and 91% reported calamities from heavy rains 1-2 times per year (13%, 3-4 times per year). Nearly half the households reported experiencing flooding due to LBOD. Damages to agriculture were reported due to floods, rains and cyclones, but damages to livestock were mainly reported due to floods. Sixty percent reported damages to the fisheries due to cyclones, and 53% due to LBOD.

27. There is no system for disaster coping and no planned mechanisms to handle these calamities (except local, indigenous mechanisms – nearly all households reported a high level of community cooperation in coping with disasters, rains and other emergencies such as accidents and heath). Forty one percent reported that they do nothing before a disaster, 22% reported they have no resources to make any arrangement before a disaster. Very few households were able to indicate an actual indigenous mechanism to handle disasters.

3 EVOLUTION OF THE DELTA, THE LBOD OUTFALL SYSTEM AND THE BADIN DHANDS

3.1 Ongoing Evolution of the Indus Delta

28. For many millennia the Indus River carried large volumes of water and sediment into the Arabian Sea. This flow was strong enough to push sea currents during the southwest monsoon up to 100 miles from the shore. The Indus River delta (Figure 1) was built up by these sediments transported by the main Indus River and numerous distributaries. The Indus River discharged into the sea at different locations along the coast at different times; for example, there are indications, for example, that the main river or one of its principal distributaries may have discharged into the Rann of Kutch about 100 km east of its present course near Badin at one time.

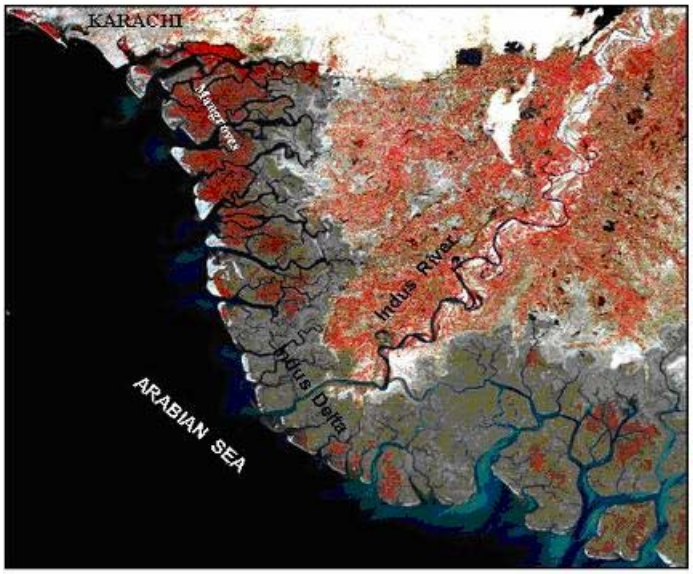


Figure 1 Indus River and delta today

29. Beginning in the late 1850s and stretching up to the present, more than 70% of the average annual flow of the Indus River and its tributaries has been stored in reservoirs and diverted from the river by barrages or weirs into canals for irrigated agriculture. While this has provided a platform for Pakistan's development and enormous economic benefits, it has greatly reduced the quantity of sediment transported to the delta, and limited freshwater flow into the delta to the monsoon season in those years when flood flows exceed diversion capacity. As a consequence, seawater has intruded into the active delta and the Indus River, reaching about 65 km upstream at least up to the Thatta-Sujawal.

30. The active delta is now confined to a comparatively small area where the present Indus River course enters the Arabian Sea. The remainder of the delta, stretching south and southeastward from the present Indus River to the Rann of Kutch is abandoned. The former distributaries are moribund and completely filled with sediment.

- The abandoned delta has evolved into a broad, flat, largely barren, salt-mud and salt encrusted inter-tidal zone lying between the upland agricultural areas, which slope very gradually north and northwestward, and the edge of the sea that is dissected by numerous small tidal creeks;
- The micro-topography of this inter-tidal zone or coastal zone features numerous shallow depressions that fill with water from heavy monsoon rainfall, surface runoff and drainage from the upland agricultural areas, and storm surges and high tides during large monsoon tropical storms.

- The four major brackish lakes or *dhands* in Badin District located at the extreme eastern side of the delta that are the subject of this study were formed in these types of depressions. These Badin dhands are hydraulically connected to the larger Rann of Kutch, which has resulted in their being persistently brackish to saline and semi-permanent features.

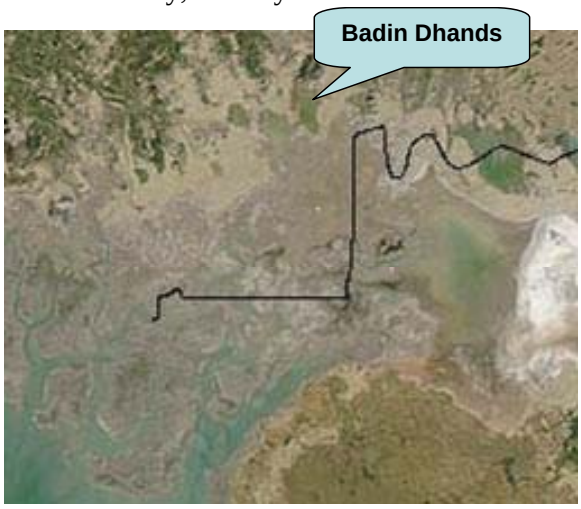
3.1.1 Sea Encroachment and Land Loss

31. The coast has begun to erode and retreat landward because of the reduced sediment flow. The area of mangrove forest that once covered the littoral zone has declined from 260,000 to 160,000 ha (1992) because of the increased salinity resulting from reduced freshwater flow and because of over harvesting of trees for fuel wood and building materials. The coastal erosion and loss of mangrove forests has destroyed the coastal defenses against cyclonic storms and storm surges

32. The slope of the inter-tidal zone is 1 in 25,000. Hence, small increases in sea level due to higher than normal tides and storm surges are able to penetrate far inland . Moreover, recent studies have shown that sea level rise (an increase in mean sea level) is already occurring along the Pakistan coast, albeit somewhat smaller than is being experienced globally or elsewhere in the Indian Ocean

33. The combination of the flat slope of the inter-tidal zone, sea level rise, and the ongoing erosion and destruction of natural coastal defenses has increased the risk that high tides and storm surges will penetrate further inland all along the coast.

34. Examination of satellite imagery before and after the May, 1999 cyclone showed that the high water mark or the line of furthest seawater penetration (the line of the Highest Astronomical Tide) that divides the upland agricultural lands from the inter-tidal zone moved significantly inland. As the condition of the Indus delta and the coastal zone continues to deteriorate in the future, the risk of seawater intrusion and flooding of these lands will steadily increase.



3.2 The Dhands in Badin District

35. At the eastern end of the Indus delta in Sindh's Badin District (between 24-25° N and 68-69° E) there are four large brackish lakes (*dhands)* naturally connected to the Rann of Kutch, a coastal marsh and lagoon stretching eastward into the Indian State of Gujarat that is a wetland of global significance (Figure 2, next page). The dhands cover an area of about 70 km^2 and are formed in a large undulating depression in the inter-tidal zone a short distance south and southeast of the agricultural land in Badin District[5]. They are

[5] The irrigation network extends very close to the north and eastern sides of the dhands.

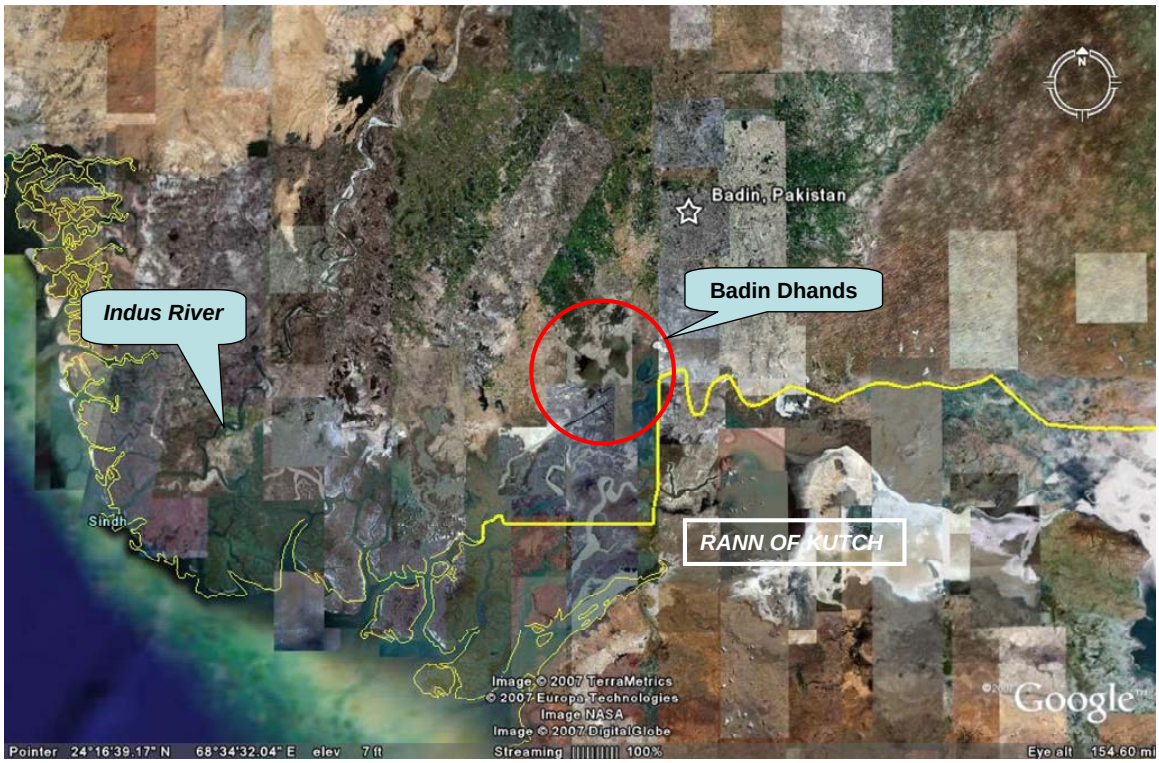


Figure 2 Badin Dhands, Rann of Kutch and Indus Delta

shallow with an average depth ranging from about 0.37 to 1.8 m[6], very turbid, and their average water temperature in the summer monsoon season ranges from 25 to 33° C.

36. The extent of these dhands would normally vary considerably during the year, and from year to year: in the monsoon season (from say May to September), they would expand as they are filled with rainfall, surface runoff from the north, groundwater discharge, and water flowing from the similarly filling Rann of Kutch. Since the general direction of the land slope in Badin is southeastward, the dhands represented a natural catch basin for storm runoff and sub-surface drainage from Badin. When the rains typically cease in September or October and evaporation steadily increases in the subsequent dry season, the dhands would gradually recede, lose their connection to the similarly retreating Rann of Kutch, and in most years large portions would dry up. This expansion and recession process is governed by a highly dynamic and complex water balance.

37. There are no records prior to the mid-1990s but it is likely that the dhands were always backish or saline because of the pervasive salinity of the coastal zone and most of the important components of the dhands water balance. Rainwater is of course without significant salinity, but storm drainage would likely pick up some salinity as it travels to the dhands from saline upland soils and the salt-mud and salt crust that dominates the surface of the coastal zone. Groundwater discharge, though likely to be a small component because of the low gradient and low-permeability

[6] Since the destruction of Cholri Weir, drainage of the dhands during ebb tide apparently establishes some strong currents particularly in the passages between the dhands. The NIO marine ecological team noted a scour hole near the southern shore of the passage between Mehro and Sanhro dhand that was 12m deep.

soils, is nevertheless saline. The salinity of the Rann of Kutch is reported to be much greater than sea water, as high as 40-60 ppt and these high salinity water waters would also have increased the salinity of the dhands. Evaporation dominated the dry season water balance further concentrating the salts. Hence, the salinity in the dhands from year to year depended on the volume of fresh or slightly brackish water it received.

38. Beginning in the 1960s, an extensive drainage network was built in the irrigated land to the north, and the terminus of several of these major drains were connected to these lakes providing a significant supply of comparatively fresh water (of say 1-3 ppt), helping to stabilize the volume and extent of the dhands, moderating the overall salinity and helping to create a valuable fishery and migratory waterfowl habitat. The 1997 survey of the dhands reports extensive growth of freshwater macrophytes (*typha spp*, *cyperus spp*, etc). Records of waterfowl populations on these dhands do not begin until the late 1980s, but by that time they had become one of the most important wintering waterfowl habitats in the coastal zone. This change appears to have stimulated the inward migration to the area around the lakes of fisherfolk from elsewhere in Sindh as well as increasing numbers of landless people from southern Badin whose livelihood depended in part on fishing.

3.3 Construction of the LBOD Outfall System

39. This study in part concerns the current functional or operational relationship between the Tidal Link canal, a key element of the LBOD outfall system, and the dhands because it has been thought that they strongly influence on both the dhand ecosystems and the livelihoods of people living near and depending on the dhands[7]. This section discusses the origin of the Tidal Link, its structural relationship to the dhands, and the controversies that surrounded its design and construction. Subsequent sections in this Chapter discuss its operating history in relation to the dhands and their current relationship.

3.3.1 Irrigation Development in Sindh Province

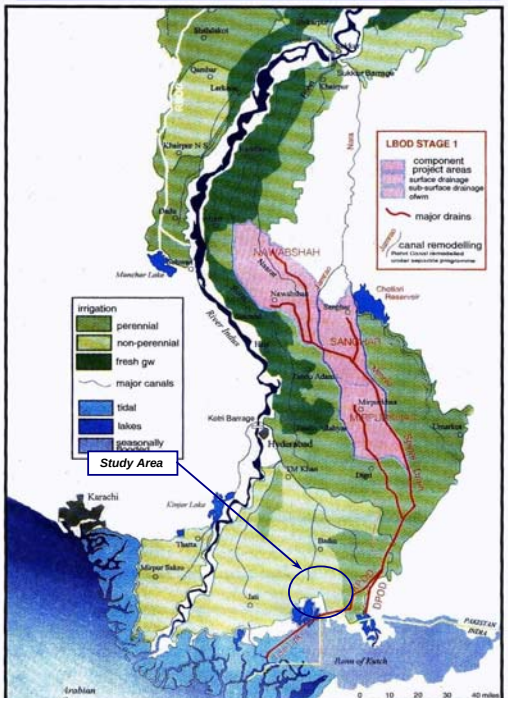
40. Beginning in the 1930s, barrages were constructed across the main Indus River to divert the river's flow into a network of canals to expand irrigated agriculture in Sindh. A total of about 5.5 mha have been developed, including 1.75 Mha in Badin District supplied through three canal networks that begin at the Kotri Barrage, the last barrage on the Indus River before the delta and the sea.

41. Sindh Province occupies nearly all of the Indus River Basin in southern Pakistan and is the terminus of the Indus plain as it reaches the sea. The terrain is nearly level with a slope southwards and southeastwards towards the Rann of Kutch and the sea that ranges from 1 in 15,000 to 1 in 20,000. Groundwater tables are high and commonly saline. Only about 30 percent of the groundwater in Sindh is usable for agriculture or drinking water.

[7] WAPDA is reported to have initiated an engineering study of the LBOD outfall system, particularly of alternatives to improve safety and reliability under severe conditions in light of past operating experience, particularly during the 1999 cyclone, which severely damaged the Tidal Link, and the 2003 heavy rainfall that led to several damaging breaches in KPOD. This study is expected to be completed sometime in 2008.

42. Drainage is critical for the success of Sindh's agriculture and for livelihoods, but drainage problems are severe. The Indus River is located on a ridge in the extreme west of the province and the flat terrain slopes very gradually southeastward away from the river. Hence the Indus River does not function as a natural drain, and the little natural surface drainage that does exist is impeded by roads, irrigation bunds and canals. Without strenuous efforts to improve and maintain both surface and sub-surface drainage capacity and functionality, agriculture in southern Sindh is under constant threat of deterioration and livelihoods are vulnerable.

Figure 3 LBOD and the Study Area



3.3.2 Coping with the Threat of Salinity and Waterlogging.

43. The risk that Sindh's irrigated agriculture would be unsustainable because of the accumulation of salt was recognized early in its development. The Salinity Control and Reclamation Program (SCARP) was initiated in the middle 1960s to lower water tables and remove salt using tubewells. These worked very well in fresh groundwater areas where the pumped groundwater could be returned to the canals and readily used for irrigation. But the groundwater in Sindh is mostly saline, and the pumped water from these drainage tubewells had to be evacuated from the basin. The view that agricultural drainage water in Sindh would need to be collected and evacuated out of the basin to the sea was strongly held by Pakistani water professionals and policy makers.

44. During the 1970s, Sindh began construction of a spinal drain[8] to collect drainage water from a portion of the Nara Canal command area (Figure 3 to the right) and convey it about 100 miles southeastward to the Dhoro Puran, an ancient, moribund Indus River channel near the Thar desert that empties into the coastal area. In 1980, design studies were initiated for a complete spinal drain and outfall system that could serve about 1.25 million acres of the Nara Canal command area in central Sindh and convey the saline drainage water to the sea. This system was referred to as the Left Bank Outfall Drain (LBOD).

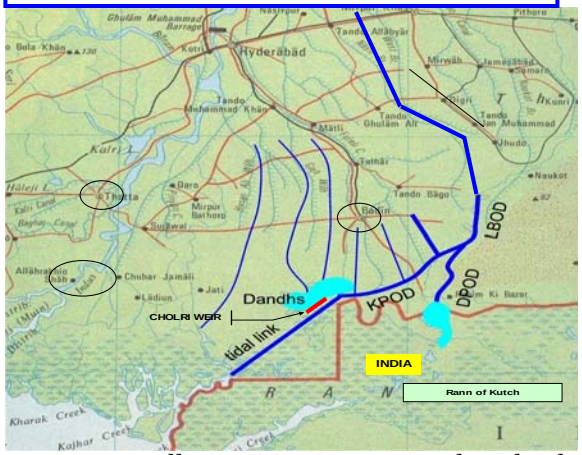
3.3.3 Key Features of LBOD

45. The LBOD Stage I project provided drainage tubewells and tile drains to lower the water table and collect saline water as well as new and remodeled surface drains to collect and transfer this saline water to a new spinal drain. The accumulated discharge of the spinal drain was

[8] The term "spinal drain" refers to a drain (sometimes called a trunk drain) that collects drainage water from secondary and other drains. It typically has very few inlets and is not connected, except through the drainage network, to farmers' fields.

connected downstream to two older drains: Kadhan Pateji Outfall Drain (KPOD)[9]; and the Dhoro Puran Outfall Drain (DPOD)[10][11]. This brought the generally brackish agricultural drainage water of LBOD to the edge of the coastal zone and the border of Pakistan and India.

Figure 4 Linking LBOD to the Arabian Sea



46. Shakoor Dhand and the Rann of Kutch lie astride the Indian-Pakistan border. The Badin dhands lie entirely in Pakistan, but are generally connected to the Rann of Kutch especially at high tide. The natural pattern of surface drainage and overland flow, especially of storm runoff, from this coastal and near-coastal zone in Badin District is south and *southeastward* towards the dhands and the Rann of Kutch. Hence the natural approach would have been to direct the LBOD discharge towards the Rann of Kutch. However, to avoid discharging LBOD directly into India and into this environmentally sensitive international wetland, a Tidal Link Canal was built 42 km *southwestward* across the dhands and the coastal zone of Sindh from KPOD to the nearest active tidal creek, Shah Samado Creek[12] (Figure 4).

47. The Tidal Link Canal was isolated from the Rann of Kutch and the dhands by high embankments. An weir with a crest height of 1.403 and length of 1800 ft, called the Cholri Weir, was built where the Tidal Link Canal passed through Cholri Dhand in order to attenuate high water levels in the Tidal Link Canal during high tide by allowing water to flow into the dhands during this period, and to protect the dhands from excessive drainage during low tide when the water would flow back into the Tidal Link Canal (because the water level in the Tidal Link was lower than the crest of the weir and the water level in the dhand. Since sea water was not expected to come closer than about 11 km downstream of the weir at the time of the design of the Tidal Link, the negative effects of the intrusion of the much more saline sea water would also be minimized (the salinity of the LBOD discharge flowing down the Tidal Link canal was expected to be in the range of about 5-10 ppt which would not threaten the dhands). The outlet works of LBOD thus consisted of the DPOD, which discharges through the Dhoro Puran natural channel into Shakoor

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9 A trunk drain built to collect saline discharge from numerous small drains in the command area of the canals that issue from the Kotri Barrage and serve much of Badin District - and carry this drainage discharge into Pateji Dhand and the Rann of Kutch

10 An natural channel thought to be a remnant of an ancient Indus River distributary channel that flowed into Shakoor Dhand near the Rann of Kutch

11 The bifurcation of the Spinal Drain flow was made just upstream of the connection with KPOD by means of an uncontrolled broad crested weir located in a side channel excavated in the left bank so that a portion of the spinal drain discharge during high flows when the drain was carrying relatively fresh storm water would be diverted through the Dhoro Puran Link to the Dhoro Puran channel, a moribund natural channel that empties into Shakoor Dhand. This dhand had been a part of the Rann of Kutch but land movement during an earthquake had reduced the connection to conditions of high water in the dhand. LBOD discharges entering Shakoor Dhand would flow into the Rann of Kutch in India when water levels were high in the Shakoor Dhand but these LBOD flows were expected to be primarily storm water that is comparatively fresh.

12 Shah Samando Creek lies in Pakistan, but it is a natural extension of Sir Creek which forms a part of the disputed border with India.

Dhand, the enlarged KPOD drain, now discharging into the Tidal Link, the Tidal Link Canal connected directly to the sea, and the Cholri Weir.

3.3.4 Controversies Concerning the Tidal Link

48. Many local people and Sindh professionals expressed several basic concerns with the overall concept. First, the Tidal Link would change the basic direction of natural drainage flow in the region from the southeast towards the Rann of Kutch, to the southwest across the delta to the active tidal zone exposing the upper part of the coastal zone near the dhands and adjacent agricultural lands to tides, storm surges and seawater intrusion.

49. Second, the Tidal Link passes through Pateji and Cholri dhands which are connected to the two other dhands, Sanhro and Mehro. The three key functions of these brackish lakes, namely as an important fishery, as migratory waterfowl habitat, and as the natural drainage catch basin for the agricultural areas of southern Badin, might be threatened by the disruption in drainage patterns and increases in salinity. The natural drainage path of excess water in these dhands stemming from heavy rainfall in Badin would be blocked by the high embankments of the Tidal Link threatening lower Badin with increased flooding. Instead, discharge of excess water from the dhands would have to pass over the Cholri Weir into the Tidal Link and then to the sea via the Tidal Link. This drainage congestion might cause the backup of the natural drainage worsening flooding of agricultural land and settlements. Tidal action in the Tidal Link could allow seawater to intrude upstream in the Tidal Link entering the Dhands to threaten agricultural lands and alter the then ecologically favorable salinity pattern. These tidal actions in the Tidal Link near Cholri Dhand could also result in excessive drainage of the dhands.

3.4 Performance of the Tidal Link prior to 1999

50. The Tidal Link canal was built between 1993 and 1995 in a hostile environment that was subject to strong tides, southwest monsoon winds[13], and possible cyclones and storm surges. It was unlined, built using local materials excavated from the coastal plain, and did not include a controlled inlet or outlet (head works or regulatory gates). The Tidal Link canal was designed to be the final element of the LBOD system carrying its saline drainage water to the sea via Shah Samando Creek leading to Sir Creek (the nearest active tidal area to LBOD). Since the performance of the Tidal Link would depend on these environmental conditions including tides, sediment movements and meteorological conditions, it was seen as important to monitor its hydraulic performance under these highly variable conditions to ensure that its core functions were effective.

3.4.1 The Tidal Link Monitoring Program

51. WAPDA (South) through its SCARP Monitoring Organization (SMO) initiated the monitoring program by means of a contract with the National Institute of Oceanography (NIO). Beginning in 2006 the Sindh Irrigation and Drainage Authority (SIDA) has assumed support for the monitoring program also through a contract with NIO. The work has proceeded up to the present in three phases

[13] From April to September, the predominant average wind direction in the dhand area is SW (occasionally W-SW or S-SW). From October to March it is from the N-NE (NIO, 2003)

- The initial monitoring program supported by WAPDA was carried out from November 1992 (field work began in March 1993) to Dec. 1997 (the Tidal Link was constructed between 1993 and late 1995, and commissioned in 1996)
- The program resumed with WAPDA support in March 1999 and continued to June 2004
- The current phase supported by SIDA began in June 2006 and is scheduled to end in June 2008.

52. The parameters monitored under the program include:

- Water level / Tidal levels Variations
- Water Currents
- Water salinity distribution (in the Tidal Link and the dhands)
- Suspended Load
- Sedimentation and Erosion
- Erosion patterns
- Water Flows during Ebb and Flood Tides
- Water Discharges
- Meteorological observations (Wind speed, Direction, Air temperature, Humidity etc.)

3.4.2 Summary of Tidal Link Performance 1994-1997.

53. The major overall conclusion of the June 1998 NIO Report[14] on the monitoring program carried out between March, 1993 and December, 1997 was that the Tidal Link drain was performing in accordance with its design and discharging the drain waters efficiently despite the resistance from inflowing seawater during flood tides and despite some erosion and siltation in the Tidal Link channel (i.e. there was a net outflow from the Tidal Link to the sea). The Report noted that there was considerable erosion in the Tidal Link channel at five different locations occurring mainly during the strong ebb tides, and that sedimentation was noticeably reducing the depth of the channel in at least one 6-7 km reach of the channel. The monitoring program results, (NIO 2003)[15] that concern the relationship between the Tidal Link and the dhands include:

- The maximum spring tides in the Tidal Link near the Cholri Dhand in 1997 were 1.89 in August, averaging about 1.6 from May to September (the crest height of the Cholri Weir was 1.403 m). However the duration of the spring tide levels greater than the crest of the Cholri Weir averaged only about 2-3 hours. In the remaining 18-20 hours tide levels were below the level of the weir.

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[14] NIO, Final Technical Report, *Hydraulic Monitoring of the Tidal Link Drain (LBOD),* SCARP Monitoring (South) Organization (SMO), Water and Power Development Authority, Hyderabad, June, 1998.

[15] NIO, Final Technical Report, *Hydraulic Monitoring of Tidal Link Drain, LBOD, April 1999-December 2002,* 2003

- Hence, water was flowing from the dhands to the Tidal Link for about 18-20 hours of every 24-hour tide cycle. Moreover, flow from the Tidal Link to the Dhands only occurred from February to October. Water level data for Cholri Dhand near the Tidal Link from 1995 to 1997 show it to be remarkably stable varying only slightly around a level of 1.56 m (about 5 ft).
- During 1997 the average outflow from the dhands to the Tidal Link was 3,258 cfs while the average inflow was estimated to be 316 cfs. If the surface area of the dhand is assumed to be the reported value of 70 km^2, then the average net outflow was equivalent to less than 1 inch or about 2 cm per month[16] over the entire area of the dhands.
- The influence of the spring tide appeared to be quickly dissipated in Cholri Dhand, i.e., although tidal fluctuations are experienced at the northern most limits of Sanhro and Mehro dhands[17], the small inflow from the Tidal Link does not appear to influence these areas.
- The salinity of the Tidal Link water near Cholri Dhand in the 17 months of 1996-1997 for which there is data, generally ranged between 10-15 ppt with the exception of three months (April 1996, May 1997 and August 1997) in which salinity ranged from about 25-40 ppt[18].
- The effect of salinity entering the dhands from the tidal link was small, averaging less than 1 ppt in the southern and southeastern portions of Cholri Dhand nearest the Tidal Link, and negligible elsewhere.
- Water level fluctuations in the drains that flow into Sanhro and Mehro Dhands (Karo Gungro and Fuleli Gunni respectively), and in the Serani Drain which flows into KPOD a few kilometers upstream of the Tidal Link, caused by tidal fluctuations in the Tidal Link, were about 0.70 m or about 2-2.5 ft[19]. The observed salinity of the flow in these drains ranged from 1-6 ppt with post-monsoon and winter salinities reaching this upper limit.

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16 Water level recorders has not be installed in the dhands, bathymetric data for the dhands has not been updated since the early 1980s, and no topographic data is available at the very small contour interval needed to analyze drainage patterns and flooding in the lands near the dhands, so there is no way to estimate the volume of water that actually drains into the dhands from the Badin area or to estimate the amount to be drained through the dhands to the Tidal Link. This is unfortunate because this determination would address the concerns of the people living in this area, i.e., under what conditions would drainage be impeded, and increased inundation result, during typical Tidal Link operations in the monsoon season.

17 The beach slope in these northern areas is extremely low, particularly in Sanhro Dhand near the Zero Point village; hence, the inter-tidal zone is wide since even a very small change in water level would manifest itself in a large movement of the water line.

18 The observed salinity of KPOD drainage water where it enters the Tidal Link (about 11 km upstream of the Cholri Weir) during this same period ranged between about 5 and 8 ppt with the exception of one month, November 1997, when it reached 10 ppt.

19 Given the generally very flat slopes of these drains, the extent to which changes of this order of magnitude in the water level at the outlet of these drains extends upstream and the possible effects of such changes in water level might have on upstream structures and farm land should be investigated. Discharge measurements and cross sections used together with a simple backwater model should be sufficient to identify where problems if any might exists, and perhaps identify low cost mitigation measures.

3.4.3 Impact of the May, 1999 Cyclone

54. In May 1999 an enormous tropical cyclone (Cyclone "2A", May 19-22, 1999) moved across the Sindh coast centered over Badin. This cyclone caused great damage to property, loss of life and extensive and prolonged flooding. It also had a dramatic affect on the configuration and functioning of the Tidal Link[20].

(i) The storm surge and unusually high tide caused by the cyclone ranged from 4.6 to 7.2 masl - traveling in the same direction as the Tidal Link. Land in the coastal zone was inundated from Jati to Badin

(ii) The Tidal Link was severely damaged with more than two dozen breaches in the earthen embankments of the Tidal Link reported by NIO, and more than 50 reported by others. These breaches began where the Tidal Link crosses Pateji and Cholri Dhands and continued downstream for more than 17 km. There is free water exchange now between the Tidal Link, the adjacent dhands and the Rann of Kutch over this entire distance.

(iii) The Cholri Weir had been damaged in 1998 during heavy monsoon rains, and it was completely destroyed by the cyclone (i.e., after the cyclone no functional barrier existed between the Tidal Link and Cholri Dhand)

(iv) The salinity of water in the Tidal Link increased as shown in Table 1. This elevated salinity could now be traced beyond the junction of the Tidal Link and KPOD to a point about 6 km upstream of where Serani Drain enters KPOD.

Table 1 Tidal Link Salinity Before and After Cyclone "2A"

Location	Before Cyclone 2A			After Cyclone 2A			
	Sept. 1996	Sept. 1997	Sept. 1998	Apr. 1999	Sept. 1999	Sept. 2000	Sept. 2001
Karo Gungro Outfall Drain (discharges into northern Sanhro)	1.25	5.00	Monitoring program halted and resumed in April 1999	Dry	4.00	Dry	Dry
Feluli Gunni Drain (discharges into northern Mehro)	1.00	2.00		Dry	1.19	Dry	3.50
Serani Outfall Drain (discharges into KPOD)	2.00	10.00		10.35	32.00	9.30	6.20
RD -55 (adjacent to Cholri)	10.00	10.00		14.65	25.00	37.00	40.00
RD -93 (12 km d/s of Cholri)	20.00	18.00		32.00	35.00	42.50	47.00
RD -125 (22 km d/s of Cholri)	25.00	10.00		42.56	48.00	43.00	50.00

Source: NIO, 2003.

3.5 Present Relationship of the Outfall System and the Dhands

[20] NIO, *Impact of Cyclone "2A" on the Tidal Link Drain and Adjacent Areas based on Historical Data*

55. WAPDA resumed the The Tidal Link monitoring program through NIO from March 1999 to December 2002 under the National Drainage Program (NDP)[21]. After a brief hiatus between 2003 and 2006 it was resumed by NIO with support from SIDA.

3.5.1 New Hydraulic Regime Established

56. The 1999 cyclone brought about major changes in the functioning of the Tidal Link, and changes in the relationship between the Tidal Link and the dhands (Figure 5).

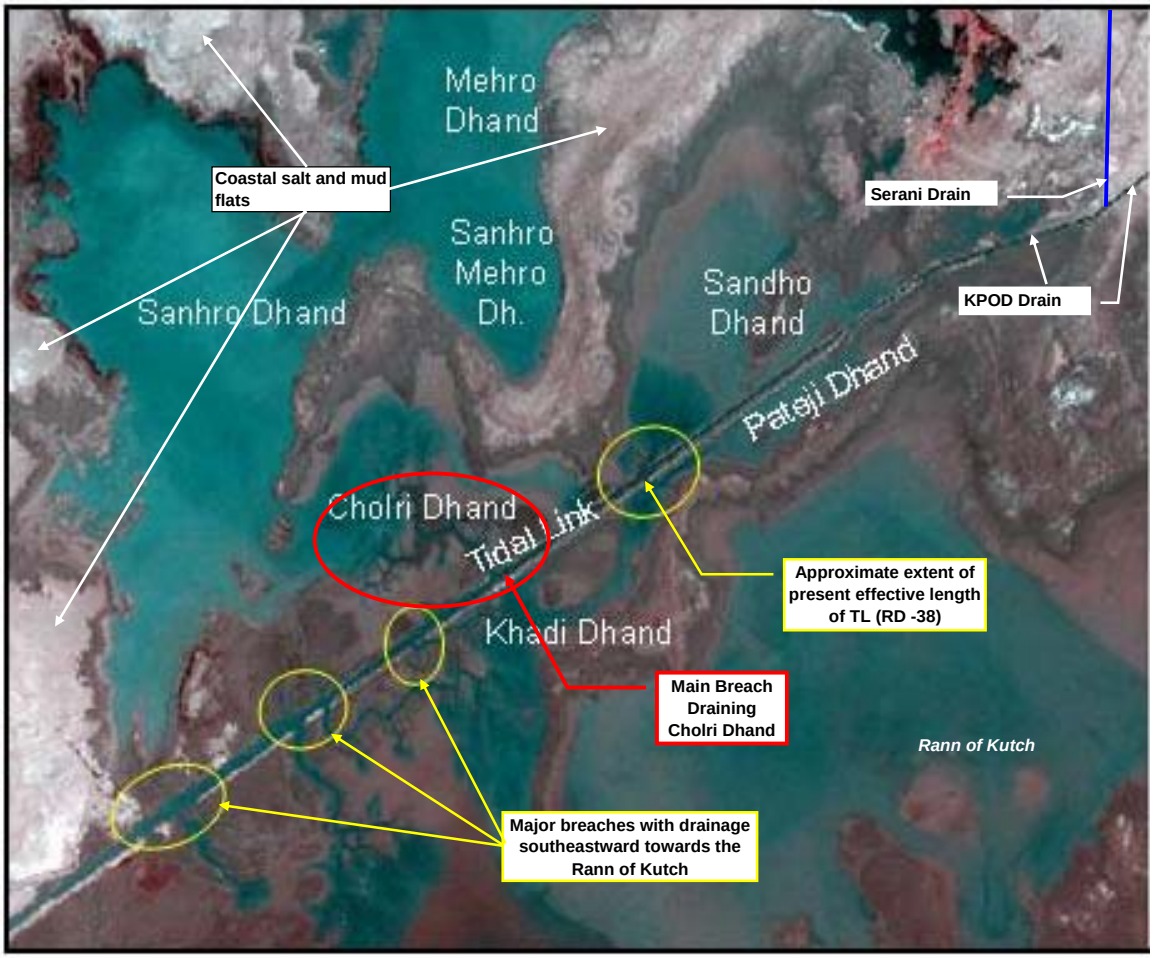


Figure 5 The Tidal Link and the Dhands after 1999

(i) During most of the year, particularly during Southwest monsoon, the effective length of the Tidal Link Drain for discharges from LBOD has now been reduced to about 4 km - from KPOD downstream to a point where the first large breach in the Tidal Link occurs adjacent to Pateji Dhand (Figure 5). Most of the LBOD discharge into KPOD and then into the Tidal Link Drain does not reach its intended destination at the coast in Shah Somando Creek.

[21] NIO, *Hydraulic Monitoring of Tidal Link Drain, LBOD*, Final Technical Report, April 1999-December 2002, SCARP Monitoring Organization, WAPDA (South), Hyderabad, Sindh, 2003

(ii) The influence of higher salinity water including seawater and water from the Rann of Kutch has increased within the Tidal Link. The salinity profile of the Tidal Link in the months of December and June, 1999 and 2002 respectively, are shown in Figure 6 & 7. The marked influence of high salinity in the Tidal Link can now be traced several km upstream within KPOD to a point above where the Serani Drain joins KPOD, instead of a point downstream of Cholri Dhand before the cyclone;

Figure 6 Salinity profile of Tidal Link and KPOD (December)

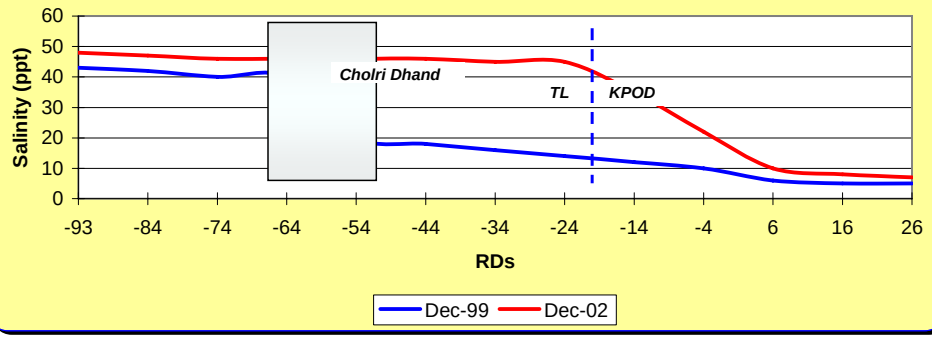
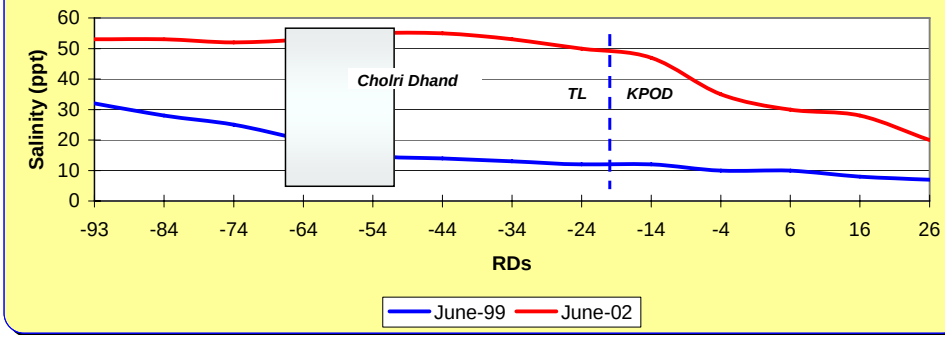


Figure 7 Salinity profile of Tidal Link and KPOD (June)



(iii) Over most of its length, the Tidal Link has become a large mixing bowl, including the area where it passes through the dhands, with water moving upstream in the Tidal Link during flood tide and mixing freely with the water of the Rann of Kutch, KPOD and the dhands.

(iv) The natural passage between dhands and the Rann of Kutch, previously blocked by the embankments of Tidal Link Drain, is now reopened.

(v) With the destruction of the Cholri Weir and the opening of many large breaches, water flows and water exchanges are now more frequent between dhands, Tidal Link Drain and the adjacent Rann of Kutch.

(vi) The natural drainage pattern from Badin through the dhands to the Rann of Kutch has now been re-established. The difference is that seawater moving in the system

at flood tide is now a part of the mix[22], but this seawater does not appear to be the dominant influence on salinity in the dhands

(vii) Drainage from the dhands to the tidal link at ebb tide is strong, and a visible drainage network (having the appearance of a typical tidal creek) has formed in Cholri Dhand and to a lesser extent in Pateji Dhand (Figure 5).

57. Despite the reopened drainage pathways, the situation ex-ante had not been fully restored by the cyclone. Storm surges and unusually high tides can penetrate into the dhands area more easily than under the erstwhile natural conditions (even though the whole coastal zone was becoming increasingly threatened by such events because of the diminished coastal defenses), and the general level of salinity had risen.

4 STATUS OF THE DHAND ECOSYSTEMS[23]

4.1 Variations in the Salinity of the Dhands

58. One of the most important indicators of the status of the dhand ecosystem is the level of salinity. While a number of factors such as pH, temperature, conductivity, dissolved oxygen, turbidity, nutrients and pollution may strongly influence an ecosystem and its productivity, it is salinity or the range of salinity in the dhands that largely determines the types of organisms that can survive and hence the type of ecosystems that may exist and the types of functions the dhands could support. The period over which monitoring data is available present a picture of extraordinary variability. These data are summarized below in Table 2.

59. In 1997 the average salinity was brackish but at levels that would support species adapted to these significant but low salinities such as one finds in an estuary. The upper limits of the range of salinity in Cholri and Pateji Dhands were closer to levels more favorable for marine species. The very high salinities in Pateji Dhand reflect the cut-off of drains that once flowed into this dhand (Serani and KPOD), low circulation because there is only a weak connection to Cholri Dhand, and high evaporation.

60. After the cyclone in May, 1999 as noted above, the dhands were openly connected through numerous breaches to the Tidal Link which had become more strongly saline, and to the Rann of Kutch where salinity was typically greater than that of sea water (which averages about 33 ppt along the Sindh coast). The salinity of the dhands became elevated to levels above seawater, at least in the dry season when observations were made, and remained so from 2001 to at least 2003 (when the monitoring program ceased).

61. The marked increase in salinity shown in the Tidal Link profiles (Figure 6 & 7) and in the dhands cannot all be attributed to seawater since the salinity of the Arabian Sea near Shah Somando Creek averages about 33 ppt. In the absence of other sources of high salinity, the increased penetration of seawater in the Tidal Link would likely result in a significant increase in

[22] This potentially has a not insignificant benefit – most of the organisms in the Badin dhands are of marine origin, and in particular, the movement of fish fry, and shrimp larve and other marine organisms into the dhands is facilitated by this open connection with the sea.

[23] A suggested guideline for rapid wetland assessment is given in Annex B.

the salinity of the dhands. However, no studies have been carried out to estimate the proportions of different sources of water that presently form the mixture in the Tidal Link near Cholri and Pateji Dhand. The most saline of the possible

62. sources is the Rann of Kutch, and it seems quite likely that water from the Rann of Kutch passing through the Tidal Link into the dhands, in the absence of large freshwater flows into the

Table 2 Surface Water Salinity in the Badin Dhands (1997 to 2007)

Location	Salinity (ppt)					
	Average and Range Jan. to June 1997[a]	January 2001	January 2002	December 2002	December 2003	Average and Range January 2007
Sanhro Dhand	7.7 (6-10.5)	31-40	35-38	40-48	43-48	17.3 (15-20)
Sanhro/Mehro Dhand (lower Mehro Dhand and the passage to Sanhro Dhand)	6.6 (7-11)	35-38	38-42	40-43		
Mehro Dhand	3.7 (1-7)	35-38	38-42		40-45	12,9 (8-18)
Cholri Dhand	13.6 (6-20)[b]	27-36	36-39	40-44	41-45	19.5 (16-23)
Pateji Dhand	49.9 (26-50)	26-33	35-37	36-40	40-41	15.8 (15-17)

a: Based on data collected by WAPDA from 178 sampling points analyzed by NIO
b: The range close to Cholri Weir was 20-32 ppt.

dhands, is a major influence on the very high levels of salinity observed between 1999 and 2007 in both the Tidal Link (above that of seawater) and the dhands. Satellite imagery often shows the northwestern portion of the Rann of Kutch to be without water in the dry season, but recent imagery shows that there are many points along the length of the Tidal Link where hyper-saline water from the Rann of Kutch and Sir Creek can enter the Tidal Link.

63. The monitoring program resumed in June 2006 (see Section 3.4.1) and the first comprehensive sampling of the dhands was carried out in January 2007. It showed a remarkable decrease in salinity in all of the dhands including Pateji Dhand (Table 2). The overall average salinity of the dhands declined from about 43 ppt to about 17 ppt.

64. The first measurements and observations of salinity in the Tidal Link since resuming the monitoring program show little or no change in the post-cyclone salinity. The principal freshwater and moderately brackish inflows to the dhands are the discharge of the drains, rainfall and storm drainage as overland flow. The period 1999 to 2003 was a continuous period of extreme drought in the Indus Basin accompanied by shortages of water in the irrigation canal system and little flow in the drains. It seems likely therefore that despite the high salinity in the Tidal Link and Rann of Kutch, the principle cause of the elevated salinity in the dhands up to 2003 (no measurements are available for 2004 and 2005) was a significant decrease in freshwater or very low salinity water

inflow due to the drought conditions. Conversely, the recovery to the more moderate dry season levels shown for January, 2007 is likely due improved water availability in the irrigation system and higher rainfall.

4.1.1 Intra-annual changes in salinity.

65. Sampling in the dhands for salinity and water quality was carried out in late June, late July and early August, 2007 by the marine and freshwater ecological assessment teams for this study as summarized in Table 3.

Table 3 Observed Salinity (June-August, 2007)

Location	Salinity Ppt
Mehro Dhand	3-10
Lower Mehro Dhand And passage to Sanhro Dhand	4-6.9
Sanhro	1.4-10
Tidal Link (including Serani Drain	1.2-4.5
Pateji Dhand	22.6
Source: see Tables A.1 and B.3	

66. These results show that the salinity had decreased significantly from the levels observed in January (Table 2), with the exception of Pateji Dhands where the salinity at the single station sampled was higher than the average of eight stations sampled by NIO in January, 2007. Overall, 11 of 17 samples in Sanhro and Mehro Dhands[24] and the Tidal Link (in KPOD u/s and d/s of Serani Drain and within the drain) were less than 5 ppt, and 13 of 17 were less than 7 ppt. Hence in most locations the salinity measured in June-August, 2007 had decreased by about half in the five months since the NIO survey in January 2007.

67. Even more remarkable, the freshwater ecological assessment team sampled three stations in late June in the northern area of Mehro Dhand where the Fuleli Gunni drain enters the dhand[25]. The Team found that within about 1-2 km of the shore the salinity ranged from 3 to 10 ppt, but beyond this point the salinity was 20 ppt and above, near and above the upper limit of salinity observed by NIO in January. By the last week of July when the team returned to the field and the first week of August when the NIO marine ecological assessment team had been in the field, the salinity of Sanhro and Mehro dhands had decrease to the levels described above.

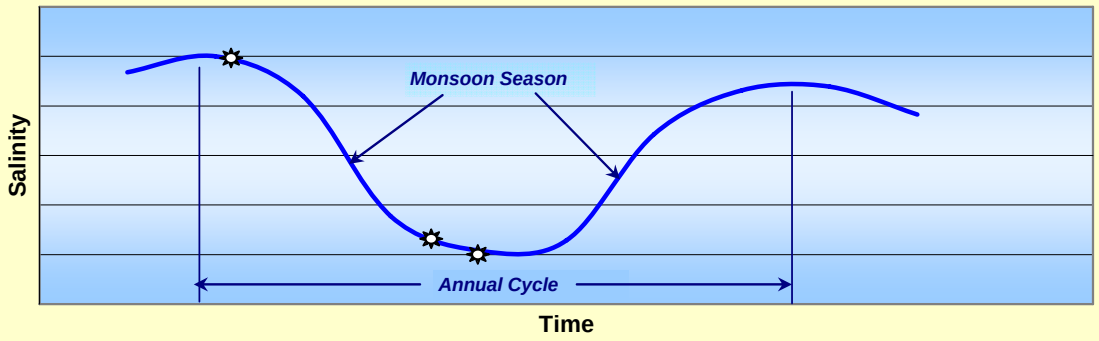
68. This experience suggests a hypothesis concerning how salinity might vary during the year shown schematically in Figure 8. The hypothesis is that salinity varies throughout the year in a cyclical manner depending on the strength in terms of volume and salinity of each components of the water balance of the dhands. The very rapid change observed in July also suggests that the dominant component is rainfall (probably direct on or very near the dhands) – there was prolonged and intense rainfall in July near the Dhands.

[24] No sampling by either team was carried out in Cholri Dhand because of dangerous currents and poor access.

[25] The team was driven from the field after sampling these three stations by three days of incessant rain that made the dhands inaccessible.

69. Earlier monitoring data suggested that there is a significant salinity gradient in the dhands, with lower salinities in the upper areas of Sanhro and Mehro dhands that gradually increases towards Cholri Dhand. Figure 8 and the 2007 sampling data suggest that there is also a seasonal shift that imposes an overlay on the gradient between the dhands. Moreover, it appears that this pattern of salinity variation is highly dynamic and varies from year to year depending on a number of exogenous factors such as rainfall and Indus Basin water availabilty that have inherently high variability.

Figure 8 Hypothetical General Pattern of Annual Salinity Variation in the Badin Dhands



70. Only a few points are known for 2007 on this hypothetical curve as shown in Figure 8 -- the NIO survey in January, and the two samplings carried out by the study teams. The next NIO survey would normally take place in December 2007 or January 2008, giving a fourth point on the curve that would be the next dry season peak salinity. Since the conditions for high productivity in the dhands and the yield of the fishery depend on, among other things, the shape of this curve, the timing and duration of different levels of salinity, and the maximum and minimum levels of salinity, a deeper understanding of these phenomena including the water balance would seem to be essential for future management of the dhands.

71. The above discussion does not explain the fall in salinity between December 2003 and January 2007. Between the surveys of the dhands carried out in December 2002 and December 2003 there was a very heavy month of rainfall in July that caused widespread flooding in Badin. The salinity in the dhands in the 2003 monsoon season may have declined as depicted in Figure 8, but it did not apparently cause a decline in the annual peak salinity (Table 2). Hence, the decline in peak dry season salinity between December 2003 and January 2007 is most likely to have been caused by a longer term process in which there was a sustained increase in fresh or moderately brackish inflows into the dhands from the drains as water availability in the Indus Basin irrigation system increased after the drought.

Table 4 Water Quality Assessment of the Badin Dhands

Location	No of Samples	Water Quality Indicator – Average of Samples							
		Temp. Water °C	pH	Salinity ppt	Conductivity mS/cm	TDS g/l	PO_4 mg/l	NO_3 mg/l	Water Depth m
Mehro Dhand	3	26.5	7.04	7.8	16.8	11.3	1.00	1.4	0.88
Lower Mehro Dhand	3	28.8	6.81	5.6	10.57	5.5	1.07	14.1	1.3
Sanhro	4	31.5	6.98	3.2	6.52	3.3	1.51	2.4	0.78
Tidal Link	3	31.4	6.63	2.7	5.79	2.9	1.06	27.6	-
Pateji Dhand	1	34	7.04	22.6	43.3	26.0	1.21	5.2	0.94
See Table B.3, Annex B									

4.2 Water Quality and Pollution

72. Water quality samples were taken and analyzed by both the marine and freshwater assessment teams as a part of the ecological assessment of the Badin Dhands. These data are summarized below in Table 4 (see Annexes A & B).

73. The most notable water quality characteristic found in the samples Table 4 is the high levels of nutrients, which are more than sufficient to ensure the productivity of the dhands in terms of the numbers and diversity of phytoplankton to support a substantial fishery. These high nutrient levels have not caused evident eutrophication or excessive growth of algae and other phytoplankton, possibly because the dhands are so shallow, well mixed and very turbid – light penetration measurements with a Sechi disk during the sampling ranged from zero to a few inches.

74. Table 5 summarizes the water quality sampling results from the limnological[26] and fisheries[27] studies of the Dhands carried out in July to October, 1997, which can be compared in part to the results from this study summarized earlier in Table 4. The results are quite similar for those parameters in common. The range of concentration of dissolved oxygen in the samples collected in Sanhro and Mehro Dhands by the NIO marine ecological team (Table A.1, Annex A) was 4.09-5.78, similar to those reported in the 1997 study[28].

[26] Leghari, S.M., Jafri, S.I.H, Mahar, M.A., *et al*, *Limnological Study of Sonharo, Mehro, Pateji and Cholri Lakes of District Badin, Sindh Pakistan*, Pakistan Journal of Biological Sciences 3(11): 1904-2000. 2000

[27] Jafri, S.I.H., Ali, S.S., Mahar, M.A., *et al*, *Fisheries Potential of Tidal Link Lakes (District Badin) of Sindh Coast (Northern Arabian Sea)*, Pakistan J. of Zool., vol. 32(4), pp 301-306, 2000.

[28] If these 1997 studies had included salinity measurements in September and October, these data might provide additional points on the hypothetical curve of annual salinity variation shown in Figure 8.

75. Table 6 assembles the available data from the 1997 monitoring program (NIO) and the limnological studies (Leghari *et* al) for the dry season (January) and the Monsoon season (July-October) respectively, and compares it to the results of the 2007 monitoring program (NIO) and the sampling in June, July and August of 2007 done under this study. There are of course many inconsistencies in sampling locations which make these data only roughly comparable.

Table 5 Water Quality Parameters Observed in 1997 Study of the Dhands

Parameter	Units	Drains	Sanhro & Mehro Dhands	Pateji & Cholri Dhands and Cholri Weir
pH		8.28	7.7-8.5	8.21
Conductivity	m/s/cm	2.74	3.68-9.97	11.88-31.2
Salinity	ppt	1.5	2.1-5.9	8-22.2
Hardness ($CaCO_3$)	mg/l	750	633-1150	1660-2362
Chlorine (Cl)	mg/l	524	1180-2765	1365-4845
TDS	g/l	1643	2.35-6.34	7.6-19.1
Dissolved Oxygen	mg/l	7.7	4.6-7.6	4.5-5.7
Phosphate[a]	μg/l	12-41	40-230	80-120
Silica	mg/l	0.27-0.8	33.	6.2
Ammonia	mg/l	0.20	0.2-0.5	0.5

a: Total Hydrolysable
Source: Leghari *et al,* 2000

76. Nevertheless they show a remarkably similar pattern, both between the two years and to the hypothetical pattern shown in Figure 8. One is tempted to conclude that the dhands have recovered, at least in terms of salinity variation, and perhaps levels, to the conditions that prevailed in 1997.

Table 6 Comparison of 1997 and 2007 Dry Season and Monsoon Season Salinity (ppt)

Year	Sanhro & Mehro Dhands		Pateji & Cholri Dhands and Cholri Weir	
	Dry Season	Monsoon Season	Dry Season	Monsoon Season
1997	1-11	2.1-5.97	6-20[a]	8-22.2
2007	8-16	1.4-10.5	16-23	22.6[b]

a : Range for Pateji was 26-50:
b: One sample in Pateji Dhand only
Source: Table 2; Leghari, *et al*, 2000; Annexes A & B

77. Tables 7 and 8 show the results of the analysis of the water quality samples for various pollution indicators in comparison to various standards including WHO drinking water guidelines, USEPA water quality criteria, and Pakistan National Environmental Quality Standards (NEQS). The Pakistan NEQS are effluent or discharge standards. There are no ambient water quality criteria or standards in Pakistan. The criteria and guidelines shown in these tables are only illustrative of how the sampled conditions compare to possible criteria.

78. Nearly all the freshwater and brackish lakes and water bodies in Pakistan are under major threat from pollution, and some have already deteriorated to the point that economically and socially important functions have been lost or severely degraded. Examples in Sindh include Manchar and Drigh Lakes. Developing water quality criteria for freshwater and brackish lakes and water bodies in Pakistan based on the use and functions of these water bodies would strengthen monitoring programs and improve the rationale for stronger enforcement of current regulation of the discharge of pollutants.

79. Despite the limited scope of the sampling summarized in Tables 7 and 8 the analysis suggests that pollution may be an important future concern in the Badin Dhands. Already there is substantial anecdotal evidence from interviews with fisherfolk (especially near Karo Ghangro Drain which flows into the north end of Sanhro Dhand) that pollution is one of their major concerns. They attribute substantial fish kills in the drains and in the dhands near the drain discharge area to this pollution as well as numerous health problems including skin and gastro-intestinal diseases. Both the Karo Ghangro and Fuleli Gunni drains are black, septic and fowl smelling from the extreme pollution discharged by upstream sugar mills, domestic sewage from the larger villages and towns, and small scale industries and workshops.

Table 7 Ecological Assessment of the Badin Dhands - Pollution Indicators (June-July, 2007)

Site		pH mg/l	TSS mg/l	Salinity mg/l	BOD_5 mg/l	COD mg/l	NO_3 mg/l	PO_4 mg/l	Phenol mg/l	TKN mg/l
WHO Drinking Water Guideline					-	-	50[d]			
USEPA Ambient Water Quality Criteria				-			10	0.0175[c]	0.30	1.27[b]
Pakistan NEQS for discharge into inland waters		6-9	200	-	80	150[a]	-	-	0.10	-
Various Sites in the Dhands										
1	Mehro Lake	8.12	120	1.40	52	360	1.4	1.00	<0.01	4.82
2	Sanhro Lake open water	8.28	98	2.40	61	400	1.5	2.00	<0.01	5.71
3	Pateji Lake	8.49	79	22.20	55	1080	5.2	1.21	<0.01	5.44
4	Sanhro near Shore	8.20	101	1.20	75	140	3.3	1.01	<0.01	5.22
5	Tidal Link Drain	8.04	121	4.50	55	160	27.6	1.06	<0.01	5.12
6	Mehro	8.50	104	5.20	61	520	14.1	1.07	<0.01	6.72
7	Karo Ghangoro drain	7.60	89	1.20	44	160	19.3	2.05	<0.01	6.50
8	Karo Ghangoro drain outlet	8.38	77	1.40	53	560	2.9	1.02	<0.01	5.56
Sites within the main drains entering the Dhands										
1	Serani Drain	7.28	200	2.40	82	158	3.00	6.9	4.124	7.54
2	Junction of Gunni Fulali and Mirwah Drain	8.28	179	3.0	79	132	1.10	5.1	4.546	6.96
3	Mehro	8.54	194	4.1	89	164	2.60	5.7	4.723	7.89

a: The NEQS for discharge into the sea is 400 mg/l
b: Total nitrogen (TN) for lakes and reservoirs in South Florida Coastal Plain Ecoregion
c: Total Phosphorous (P) for lakes and reservoirs in South Florida Coastal Plain Ecoregion
d:: Short-term exposure – the guideline for Nitrite (NO_2) is much more stringent (short-term exposure-3; long-term exposure-0.2)

Table 8 Ecological Assessment of the Badin Dhands - Pollution Indicators (June-July, 2007)

Site		Metals							Pesticides			
		Cn mg/l	As mg/l	Cr mg/l	Cd mg/l	Pb mg/l	Cu mg/l	Ni mg/l	Malathion µg/l	Cyper-methrin µg/l	Aldrin µg/l	Dialdrin µg/l
WHO Drinking Water Guideline		0.07	0.01	0.05	0.003	0.02	2.0	0.02	-	-	0.00003	0.00003
USEPA Ambient Water Quality Criteria		0.001	0.036	0.05	0.0088	0.008	0.003	0.008	0.0001		0.0013	0.000019
Pakistan NEQS for discharge into sea & inland waters		1.0	1.0	1.0	0.10	0.50	1.0	1.0	-	-	-	--
Various Sites in the Dhands												
1	Mehro Lake	0.20	0.005	0.03	<0.001	0.051	0.032	<0.001	<0.001	<0.001	<0.001	<0.001
2	Sanhro Lake open water	1.40	0.010	0.13	<0.001	0.041	0.046	<0.001	<0.001	<0.001	<0.001	<0.001
3	Pataji Lake	4.75	0.005	0.07	<0.001	0.056	0.042	<0.001	<0.001	<0.001	<0.001	<0.001
4	Sanhro near Shore	0.89	<0.001	0.12	<0.001	<0.048	0.042	<0.001	<0.001	<0.001	<0.001	<0.001
5	Tidal Link Drain	2.91	0.005	0.14	<0.001	<0.046	0.036	<0.001	<0.001	<0.001	<0.001	<0.001
6	Mehro	1.34	0.005	0.21	<0.001	<0.036	<0.032	<0.001	<0.001	<0.001	<0.001	<0.001
7	Karo Ghangro drain	1.84	0.005	0.24	<0.001	<0.032	<0.036	<0.001	<0.001	<0.001	<0.001	<0.001
8	Karo Ghangro drain outlet	1.64	<0.001	0.07	<0.001	<0.034	<0.032	<0.001	<0.001	<0.001	<0.001	<0.001
Sites within the main drains entering the Dhands												
1	Serani Drain	1.205	0.003	0.042	<0.001	0.041	0.023	<0.001	<0.001	<0.001	<0.001	<0.001
2	Junction of Fuleli Guni and Mir Drain	0.702	0.010	0.136	<0.001	0.036	0.056	<0.001	<0.001	<0.001	<0.001	<0.001
3	Mehro	0.895	0.005	0.054	<0.001	0.062	0.039	<0.001	<0.001	<0.001	<0.001	<0.001

80. The pollution indicators in Tables 7 & 8 highlight several potential issues:

(i) Both the biological and organic loads on the dhands from the drains including Serani, Feluli Gunni, Kara Ghangro and KPOD are extremely high. An ambient BOD5 concentration of 10 mg/l in a river or lake would typically cause that water body to be classed as extremely polluted. The values found in both the dhands and the drains are an order of magnitude greater that that indicator level, and the COD concentration in Pateji Dhand is 100 times that value;

(ii) BOD and COD concentrations are commonly a criteria or limit for discharge into water bodies, rather than a criteria or limit for the water body itself, principally because the natural process of oxidizing and consuming organic matter reduce these levels in the water body. What makes this process induced by high levels of BOD or COD loading an important concern is the high consumption of oxygen in the water which can severely harm the ecosystem.

(iii) What is remarkable about the values found in the dhands is that while the values of both BOD and COD are very high in the drains and exceed the Pakistan NEQS, there is very little evidence from the sampling in the dhands that there is a substantial decline in dissolved oxygen in the dhands resulting from the degradation of this high organic load. The dissolved oxygen (DO) concentrations in Sanhro Dhand reported by NIO (Annex A, Table A.1) range from 4.09 to 5.78 mg/l, well above what one might expect to find where BOD and COD loadings are so high. The range of water temperatures reported by NIO for these sampling sites was 31° to 33° C.

(iv) Nitrate (NO3) levels are high and a concern in Mehro Dhand, the Tidal Link and Karo Ghangro drain. While Nitrites (NO2) are a more important concern in drinking water, nitrites can have serious impact on the fishery by limiting fish growth.

(v) As noted earlier the dhands are rich in nutrients, particularly phosphorous (as PO4) and total nitrogen, which support biodiversity, in particular the growth of phytoplankton that is the base of the food chain for fish and shrimps

(vi) The analysis of the samples for the presence of pesticide and pesticide residues appears to be inconclusive because of a lack of sensitivity of the laboratory methods in view of the very low concentrations at which many pesticides are toxic and harmful.

(vii) Four potentially toxic metals significantly exceed typical water quality criteria – cyanide, chromium, lead, and copper. The Pakistan NEQS appear to be based on the assumption that the receiving water body will have sufficient flow to provide dilution of these metals to an acceptable level. This does not appear to be the case in the dhands. Unfortunately analysis of tissue samples of fish, shrimps and other organisms was not within the scope of this study. Such analysis should be an urgent priority for future studies to determine whether the high concentration of these metals in the water is being bio-concentrated into even higher and potentially

harmful levels for human consumption and ecological sustainability in the tissues of the fish and shrimps being taken from the dhands and marketed commercially

81. The pollution of the drains is rightfully blamed on upstream discharge of sugar mill wastes. Over one-half of the water used in sugar cane processing[29] (about 53%) is discharged as waste water into nearby drains[30]. This effluent is high in BOD, COD, and temperature and is also highly colored. The waste water is typically also rich in nitrogenous substances and phosphates. Lead sub-acetate is used in analyzing sugar content. The resulting drain flow is black, septic and fowl smelling. When the Pakistan Rangers controlled the dhands fishery, they stopped the discharge of these wastes. This encouraged fish to move upstream in the drains where they were regularly caught by local fisherfolk. Now that the Rangers control has been removed and the fishery is under the control of the fisherfolk through the licensing system, fish can no longer survive in the drains and fish kills are reported by the fisherfolk where the polluted drains enter the dhands.

82. However, the sugar mill pollution does not explain the high levels of toxic metals in the drains and the dhands (Table 8). This must be coming from various kinds of small scale industry and workshops, including tanneries and textile industries scattered across Badin District whose wastewater is likely discharged directly into the drains or discharged with domestic wastewater. The high concentrations of toxic metals and biological and possibly pathogenic organisms suggests that bio-concentration of these substances in the food chain within the dhands and within the commercial species of fish, shrimp and crabs being harvested from the dhands may become a serious economic and possibly public health problem. Future water quality monitoring and surveys of the dhands should include tissue analysis of these commercial species and other indicator species to determine the status and trend of this potentially serious threat.

4.3 The Dhand Ecosystems

4.3.1 Biodiversity and Productivity

83. The Badin dhands together with the Tidal Link now form a wetland that is a highly productive ecosystem. This wetland system is estuarine, and it is the only remaining functional estuary in Sindh Province. Data gathered in 1997, and in 2007 as a part of this study, show that this wetland system supports a rich body of phytoplankton and zooplankton that are the primary producers responsible for energy in these wetlands and for a broad and complex food web on which many species of fish and crustaceans are totally dependent. Many species of fish and shrimp breed and mature in these wetlands. The high productivity of these wetlands also supports large numbers of birds. The economically important species of fish and shrimp are being exploited by local communities and represent important sources of food as well as a means of livelihood.

84. The only previous ecological survey of the Badin dhands was carried out from June to October 1997 (Jafri, 2000 and Leghari, 2000). These studies reported an abundance of freshwater macrophytes (17 species in the freshwater zone of Sanhro and Mehro dhands) and 114 species of algae. These studies also indicated that the fish species found in the dhands were primarily of

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[29] Akbar, N.M. and Khwaja, M.A., *Study of Effluents from Selected Sugar Mills in Pakistan: Potential Environmental Health and Economic Consequences of Excessive Pollution Load,* Sustainable Development Policy Institute (SDPI), June, 2006

[30] A sugar mill processing 4000 tons/day of sugar cane discharges about 1800 tons/day of water, or about 262 cfs of wastewater (SDPI, 2006).

marine origin and few (only 5 species) were of freshwater origin. During that survey the observed salinity of the dhands ranged from 5.9 to 22 ppt.

85. In the present study (2007), which was considerably less extensive and comprehensive, 44 species of phytoplankton (Annex B, Table B.7) and 14 species of zooplankton (Table B.8) were observed in the Sanhro, Mehro and Pateji dhands and in the Tidal Link. Twenty species of fish (Table B.5) and five species of crustacieans (Table B.6) were observed including 3 species of shrimp and two species of crab.

86. Since the cyclone in 1999 tidal fluctuations are evident throughout the Badin dhands. The shore of the dhands fluctuates daily, and because of the very gentle slope, large beach areas are exposed. This change in habitat has caused significant damage to the extensive macrophytes, including *typha* (bulrush or cattails) and *cyperus* (sedges) that were formerly present along the shore, particularly in Sanhro and Mehro dhands. The species *phragmites* (common reed) is now beginning to appear near where the drains enter the dhands. Longer term and more extensive study will be required to determine what the present trends are and what the implications of this change in habitat are.

4.3.2 Implications for the Fishery

87. The Badin dhands are rich in nutrients which support ample biological life. Because of their shallow depth (about 2-5 feet), and the mixing of water of different salinities, they form a specialized estuarine habitat that is very important for many species of fish and shrimp. More then 33 species of fish have been reported from these lakes of which 28 species of fish are of marine origin and only five are of freshwater origin. Out of these 33 species, 28 are commercially important. Commonly about 10 marine species are commercially harvested from these lakes but there is no authentic, long-term data available that shows the quantity of harvested fish and shrimp.

88. Despite the smaller numbers observed in 2007, due perhaps to the less extensive sampling, the results are nevertheless consistent with those in 1997. The 2007 data and field observations suggest that the biodiversity is now more limited but specialized with *euryhaline* species that are able to adapt to the high variability and levels of salinity, and is substantial enough at present to support and sustain a significant subsistence fishery.

89. This wetland complex is also home to many highly specialized species particularly those adapted to the fluctuation of salinity. For example, mud crabs are numerous and their size is also large in comparison to those are found in the marine environment. Tilapia (*Oreochromis mossambicus)* is commonly a freshwater species but it can tolerate salinity ranging from 3-20 ppt and appears to be successfully breeding in these dhands. Some flamingo species (*Phoenicopterus* sp) are also adapted to live in these saline conditions, where they feed on microscopic organisms sieved with a highly specialized curved bill. These species are facing a wide range of threats: including climate change, shortage of freshwater, habitat destruction and pollution.

90. The shrimp fishery is the most important commercial activity associated with these dhands. Eight species of shrimps have been reported from these dhands and all of them are harvested commercially. Three species of crab were recorded from these lakes but only mud crab (*Scylla scrrata)* is harvested commercially. Many species of fish use these lakes as nursery ground and spend of their early stage of life in these wetlands. It appears that both in Sanhro and Mehro dhands where canal water, rain and agriculture run-off enters, a zone of freshwater is created for some time

and distance, beyond which the water of higher salinity is present. This longitudinal salinity gradient between Sanhro and Mehro dhands and Cholri Dhand[31] may play a significant role in the breeding and growth of commercially important fish and crustacean species.

91. More consistent and perhaps expanded monitoring of the dhands will be required to determine the relationship between the levels, temporal variation and longitudinal profile of salinity in the dhands and the overall productivity of the fishery. Whether the present patterns of salinity actually constrain the fishery or not (i.e., limit the overall production to subsistence levels) can only be determined over time through such a program. The discussion of water quality and pollution in the previous section suggests that monitoring of the pollution loads and the response of the dhands to these loads should become and integral part of this monitoring program. The Sindh Fishery Department does maintain and operate hatcheries in the Badin area, but there has not been an effort to stock the dhands and determine if the fishery can be enhanced to higher commercial levels.

4.3.3 Avifauna Habitat and Populations

92. The avifauna of the Badin dhands is one of the most impressive concentrations of wetland avifauna in Sindh. Large numbers of migrating waterfowl visit these dhands during annual migrations to and from feeding and breeding grounds. These flyways are not just international but inter-continental. In each year thousands of waterfowl breeding in northern Hemisphere winter in these wetlands. This estuarine wetland complex is especially important as these wetlands are some of the first water bodies in Sindh where these migratory birds arrive.

93. Bird data was collected in June and July as a part of this study (Annex B, Table B.9 & B.10). The migratory bird season does not begin in earnest until mid-September to mid-October and later, but some of migratory species were observed in the area. These are mainly birds that were injured or could not fly due to being overweight at the end of last migratory season. For example, during the June field visit at Mehro dhand, bulky coots were observed. The occurrence of certain species of waterfowl in summer is very common. Pelican, shelduck, oyestercatchers and painted snipes were seen in June and July. Breeding of black wing stilt, little terns, whiskered terns , red wattled lapwings, weaver birds, common mynahs, bank mynahs, common blue kingfisher, pied king fisher, and white breasted king fisher was also observed in the area. In addition to waterfowl species, forest birds of the surrounding habitat were also observed.

94. The Sindh Wildlife Department has conducted an annual waterbird census in the Juboh lagoon and Nurri lagoon (both are Ramsar sites[32]) intermittently in the month of January since the early 1980's. The census was conduct in Nurri Lagoon in 1988-1992, 2001-2004 and in 2005, and in Juboh Lagoon in 1991, 2001-2004 and 2006 (see Annex B, Table B.9). The census data are summarized in Figure 9

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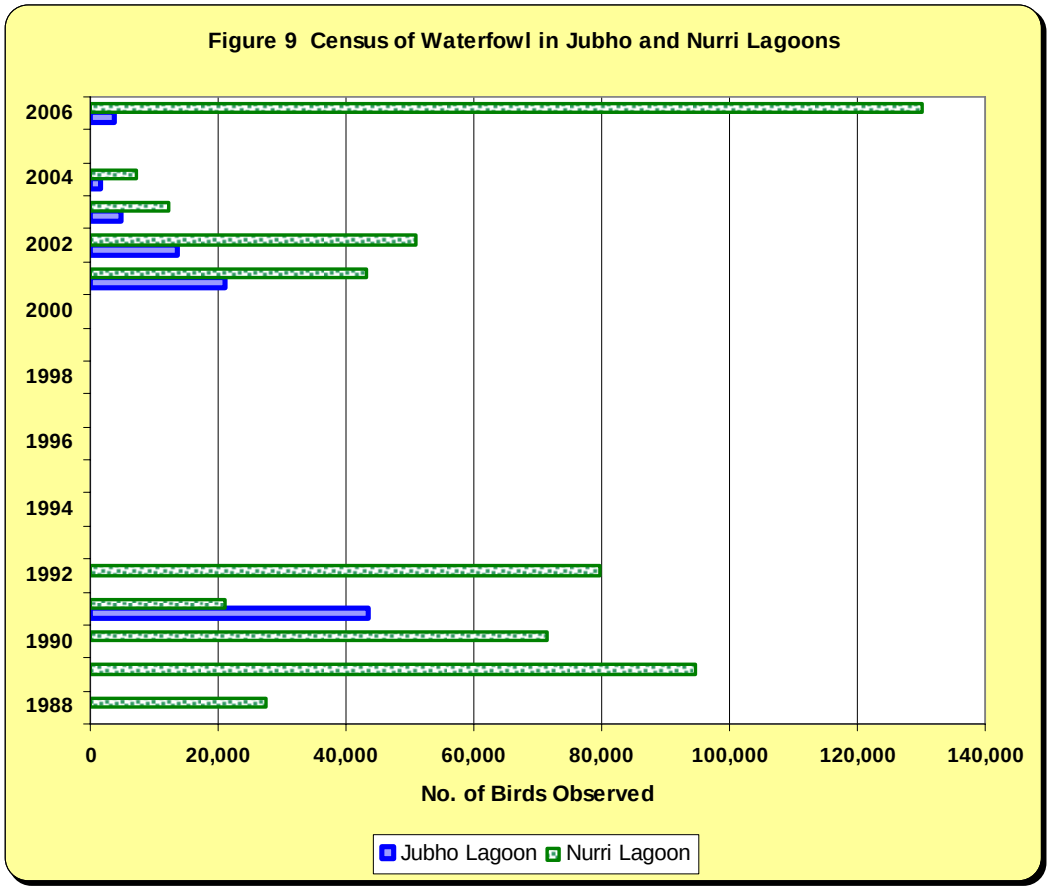
[31] During the June field survey a salinity gradient was observed in a narrow belt (about 1-2 km wide) along the shore of Mehro Dhand, which is not likely to be of great significance. By August salinities much lower than 10 ppt extended over large parts of Sanhro and Mehro Dhand. It is the gradient between this extensive area of moderately brackish water and the higher salinity water in Cholri and Pateji Dhands that is of greater significance.

[32] Both Juboh and Nurri Lagoon have been Ramsar Sites since April, 2001. However, the coordinates given for these sites in the Ramsar Information Sheets are wrong. Nurri Lagoon is an extensive monsoon season wetland area to the north of Mehro Dhand lying on both sides of the Feluli Guni and Mir drains. At one time Nurri Lagoon was said to have one of the greatest concentrations of migratory waterfowl in Pakistan.



(i) With the exception of 1991, the observed number of waterfowl in Jubho Lagoon has been consistently less than in Nurri Lagoon

(ii) The census data shows an alarming decline in the number of birds in Jubho Lagoon, from 21,096 in 2001 (half the number observed in 1991) to only 1,480 in 2004. There was only a slight recovery or increase in 2006. The number of species observed has also declined from a range of 23 to 24 in 2001-2004, to only five in 2006 of which over 80% of the total number of birds observed (3,650) were coots (*Fulica atra).*

(iii) The census data for Nurri Lagoon also shows a precipitous decline in the total number of birds observed from 2001 to 2004, but an extraordinary recovery in 2006 to over 130,000 birds, exceeding the maximum previously observed (94,742 in 1989). The number of species observed each year has fluctuated over the period of record between 17 and 41. The number observed in 2006 was 24, a little below the average of 31 species observed between 2001 and 2004.

95. The Badin dhands are both a staging and wintering area for migratory waterfowl including important regional migrants such as the flamingo[33] (mainly *Phoenicopterus roseus* but also small numbers of the Lesser flamingo *Phoeniconaias minor)*. The breeding season of these birds' starts after the monsoon season when they shift to their breeding sites in the Rann of Kutch leaving only non breeders in the Badin dhands area. The number of flamingos observed in both Jubho and Nerri Lagoons has declined to about 2-5% of the peak observed in the 1980s.

96. Despite the importance of the Badin dhands for both migratory and resident waterfowl, it has been little studied and there is no consistent, long term data that would permit one to understand how different species utilize the wetlands and what the significance of changes in habitat and changes in the chemical-biological profile of the dhands might mean for these species. Despite the remarkable recovery of Nurri Lagoon in 2006, the precipitous declines in the number of birds and species since 2001 is likely to be indicative of important changes in habitat and possibly the chemical and biological profile of the dhands, but the knowledge base does not exist to determine what these may be, and hence, at present it is not really possible to develop and implement a management plan for these wetlands with respect to waterfowl. The recovery in Nurri Lagoon may be attributable to a return to more normal patterns of rainfall from the previous years of severe drought, but this does not seem to have had the same effect in Jubho Lagoon.

5 NEEDS, TRENDS AND OPTIONS

5.1 Economic and Social Development

5.1.1 Village consultative workshops

97. While the results of the household survey, summarized in Chapter 2 provide a convenient overview of the people who live and sustain their livelihoods in and near the dhands, and who are most vulnerable to the frequent natural disasters that visit this region, it is important to bring the *voices* of these people into the present study. Many forcefully said during the various phases of the socio-economic assessment component of this study that no one had ever directly asked their views before. The consultative workshops are part of a larger methodology to identify the issues and problems faced by the fishing and agriculture communities whose living conditions and livelihood are connected with the LBOD outfall drain (especially the Tidal Link) and the surrounding four Dhands i.e. Choleri, Pateji, Mehro and Sanhro

98. Thirteen village based consultative workshops were organized in the region of the dhands as a part of this study (Annex C, Tables C.1 and C.2). At each venue a separate workshop was held for men and women. Table C.2 of Annex C identifies the location of each consultative workshop,

[33] Flamingos were counted in many thousands in mid 80's, including 40,000 in Nurri Lagoon in 1989. This locally migrant species breeds in Pachham Island in the centre of the Rann of Kutch in India (an area sometimes called "Flamingo city"). This area contains half of the total world population of Greater Flamingo and the largest single assemblage any where in the species range. These birds use the Badin dhands as their resting, roosting and feeding grounds (these shallow waters are ideal feeding habitat to these filter feeders). *P. roseus* is the predominant species, with only small numbers of the Lessor flamingo (*P. minor)* ever having been observed.

the number and names of the villages represented among the participants, and the number of participants[34]. A total of about 553 people from 61 villages participated in the workshops.

99. The objectives in organizing the village consultative workshops in connection with study were to:

- Brief the participants about the purpose of conducting of the workshop
- Understand the issues and assess the dependency of livelihood on natural resource system, especially the dhand wetlands connected to the LBOD (Pateji Dhand) for economic survival
- Assess the damages resulting from natural calamities and their impact on livelihood and resulting coping mechanism of the people.
- Involve the local communities in the process of issues identification and their prioritization.
- Document the issues and problems in the light of group findings

100. At each workshop, the objective, purpose and scope of the study was explained to the participants and they were given an opportunity to question the study team. The objectives and organization of the workshop were explained and the participants were divided into two or four groups (depending on the overall number of parricipants) and each group was asked to debate and list the key problems and issues in their area. Each group selected their own lead person who wrote the outcomes of the group discussions on flip charts. In addition one facilitator was assigned to assist each group that did not have literate person to record the outcomes. When the lists were complete the groups was asked to prioritize the list. The group outcomes were presented in a plenary session and open to discussion by all participants.

5.1.2 Summary of the views of the affected villagers

101. Summaries of the outcomes of each of the workshops are given in Annex E. There was much overlap between the concerns of the men and women's groups, but the women tended to concentrate most of their concerns on the expansion of livelihood opportunities, and a broad range of health and education issues. The concerns of both men and women's groups are consolidated below into six categories of issues and problems:

(i) Issues related to <u>community infrastructure and services, access and transport, safety, and health and education</u> – one could argue from the record that these were the core, priority concerns of the villagers.

- There is an almost total lack of village and community infrastructure including <u>*pucca* schools, and in some cases no schools</u>[35] – the schools that exist lack teachers because of the access problems, and alternative primary and

[34] A complete list of participant names and their village are provided for each consultative workshop in the Final Report of the socio-economic assessment

[35] Though the area lacks a network of schools, in some places NCHD facilitated schools are functioning. There are *pacca* schools in some villages. In Ahmed Rajoo and Bhugra Memon, middle and primary schools are functioning whereas in Chak No. 84 (Haroon Rajoo) and Golo Mandhro, primary schools are functioning. There is also one school supported by Pakistan Rangers at Zero Point.

secondary schools are commonly at least 6 to 15 km away; the drop out rate from class five and six is high, and the literacy rate among girls is especially low (2-3%);

- health facilities and services – There are few clinics and fewer trained staff, equipment, and medicines[36]; among the health issues cited were: none of the children under 5 are vaccinated, no female immunization, numerous skin diseases caused in part by the polluted drains, water borne diseases especially among children because of the dirty water from water courses or drains, and malaria and TB are prevalent.

- There are no paved roads, even ones connecting a cluster of villages to the main Union Council or District network – this at the root of a great many problems, including marketing of fish catch, access for teachers to the villages that do have at least a *katcha* school, adverse health consequences and great cost when trying to reach distant health clinics or hospitals that are typically 15-35 km or more from the village (sometimes all the way to Badin), and great difficulty trying escape the consequences of frequent natural disasters

- There is no electricity supply anywhere in the villages in this region around the dhands except villages Bhugra Memon and Golo Mandhro

(ii) Drinking water supply was seen uniformly as a priority issue. In fact, through the Sindh coastal zone there is an almost complete absence of safe drinking water[37]. The primary sources of drinking water are the watercourses (Badin obtains its water supply from the Fuleli Canal which is polluted), but since this area is at the extreme tail end of the irrigation system there is often no water in the watercourses and when there is it is polluted and turbid. The alternative source of drinking water is the polluted watercourses and drains and the dhands since the groundwater is too saline to drink. The water purification plants being provided by BRDS and other NGOs were seen as a positive development, but the existing ones, commonly targeted towards the larger villages, are too small to serve any but the smallest village

(iii) There was animated discussion of pollution issues in the drains from two perspectives:

- It is preventing fish from migrating up the drains, harming livestock, damaging the fishery and killing fish in both the drains and the dhands, and causing rampant weed growth in the drains

[36] There is a Basic Health Unit (BHU) in village Ahmed Rajoo covering approximately 60 villages of the area wherein a dispensary by Pakistan Rangers was functioning 2-3 year back. The infrastructure of dispensary is existing. A private dispensary located in Raja Farm is being run by philanthropist. A local NGO BRDS is facilitating the Dispensary with Lady Health Worker (LHW) visiting area once a week. Due to unavailability of hospitals and maternity home, the mortality rate among women and infants is high. Moreover in emergencies the patients are taken to nearby cities paying huge traveling cost (Rs. 1500-2000).

[37] Villagers at Zero Point people are buying one gallon of water @ Rs. 10/- and water drum (approx. 220 litres) @ Rs. 800.

- It is causing serious health problems and worsening the drinking water supply problem
- The polluted water has heavily caused to the agricultural lands turning them in saline on one hand and more importantly destroying the infrastructure including homes, roads etc. particularly in monsoon season compelling the people to look for refuge.

(iv) Both the men and women's groups focused on the need for greater economic opportunity to expand their livelihoods as well improvements to the fishery and the value added in fishing. The participants cited the degradation of resources, particularly fisheries and agriculture, shortage of water and pollution as the main causes of unemployment and under-employment. They cited degradation of the dhands and the damaged Tidal Link as the main threat to livelihoods. There has been little or no effort to build social capital through the development and training of community organizations, especially women's self-help groups. The participants noted that people are not educated but they are self-reliant citing the abundance of fishery and agricultural resources and opportunities before LBOD.

- Women in particular focused on the need for help and support to expand livelihood opportunities including employment opportunities for themselves and the youth: in the area of crafts (embroidery is a common skill much in evidence), for example, they expressed the need for training, materials to upgrade products, assistance in marketing and improved market access; they also expressed the need for assistance to expand and improve livestock and animal husbandry skills, and for support to expand rainfed and salt tolerant crop cultivation
- The men tended to focus on problems with the fishery and ways to improve both the volume, quality and value added: - Cold storage (no electricity supply?), improved market access, and jetties to improve and expand access particularly by traders who buy the catch and to increase the ease and efficiency of handling the catch were cited. With the improving road facility a cold storage could be built at Bhugra Memon (has electricity), Bedami, Kadhan, Serani and Badin to transport the fish and prawn in urban market. Some participants said that a number of fish species have disappeared from the dhands due to sugar mill pollution and increased salinity, but anecdotal evidence suggests that the decline in salinity in 2007 discussed in Section 4.1 had already resulted in increases in the size and volume of the valuable shrimp catch.
- Participants, both men and women, repeatedly spoke of the lack of credit and financial resources

(v) Issues and views concerning LBOD and the Tidal Link were highlighted but they were by no means the predominate issue. These issues reflect the continuing concern that LBOD is at least a part if not the primary cause of severe flooding during heavy rain and cyclones. Three main points were generally made:

- LBOD should be diverted into Shakoor Dhand [through DPOD, removing its outflow or discharge from the system] or a protective embankment should be constructed [to prevent intrusion of saline water into the dhands}
- An embankment or other control structure should be build near the China Bridge [RD 85, a few kilometers upstream of the Tidal Link outlet to control abnormally high tides, tidal surges and seawater intrusion]
- Backflow in the drains when there are heavy rains, including Serani drain and LBOD, is causing damage to land, crops, livestock, housing and belongings – "rains in 2003 played havoc because of breaches in the Tidal Link"
- Due to natural calamities and LBOD havoc, the inhabitants finding the area unsafe migrated to other adjoining districts to have the source of livelihood.
- Apart from villages around Dhands, there were reportedly other 40-50 villages under the sphere of 20 km in which the agricultural lands were affected by the breaches of LBOD damages/TL/monsoons (UC-Serani, Kadhan & Raj Malik, Jatti and some other far flung villages of Bhugra Memon and Ahmad Rajoo UCs).
- Participants reported that hundereds of residents have migrated due to damages of tidal link as well as LBOD breaches caused by heavy monssons and cyclones etc. Villageres from both the UCs (Ahmad Rajo and Bhugra Memon) reportedly migrated to Badin, Thatta and Sanghar.

(vi) Safety and security – the adverse impacts and conditions during extreme storms and heavy rains were sited frequently in relation to many of the issues noted above. Emergency centers and improved road access were cited as important ways to mitigate some of these impacts[38][39]. One particularly novel and very practical proposal combined the need for pucca schools and safety – the suggestion was to build concrete or block schools elevated off the ground surface so that the schools and their roofs could be used as refuges during severe storms and heavy rains. Refuges such as this are the most common and in many cases the most effective measure to reduce loss of life, belongings and livestock during extreme storm events in delta regions, particularly where advance warning is not timely and paved roads are not available to facilitate escape.

5.1.3 District consultations

102. Two workshops were organized with District and other local officials and representatives of NGOs and other civil society organizations including leading citizens. The first was organized with the assistance of the Deputy District Coordination Officer, Badin to familiarize important

[38] There is no data on the height of the water in the neighborhood of these villages which are located northwest, north and northeast of the dhands during the high tides and storm surge that occurred as a result of the 1999 cyclone nor during the heavy storm in July 2003. But simulation studies based on new topographic data for the region could enable estimates of potential flood levels in this area, and hence, how high such buildings would have to be to provide this and possibly other dual functions. It is doubtful that such building would have to be more than about 1-1.5 m above the ground.

[39] An effective early warning system, even without improved roads, could at least save lives if not belongings and livestock.

district officials with the objectives and scope of the study and to elicit their support and assistance in carrying out the study and collecting data. This workshop was held June 20, 2007 and was attended by 25 people (a summary of the outcomes of this meeting is given in Annex F including the list of participants). The officials were highly supportive, evidenced by their numerous positive suggestions and assistance during the conduct of the study.

103. The second District workshop was organized in the BRDS Committee Room on October 6, 2007. The purpose of this meeting was to brief officials on the outcome of the study and to seek their views on both the key issues and suggested solutions. The workshop was attended by 52 participants, including the District Naib Nazim, several *Taluka* and Union Council Nazims, key District official, journalists, representatives of NGO working in the region and civil society representatives. The outcomes of this workshop are summarized below:

(i) Summary of the participants views on the key issues and problems

- The drinking water in the area is unsafe posing danger to life
- Due to the damage of tidal link and breaches in LBOD and backflow of sea water is causing deterioration in dhand system and affecting the surrounding villages and land, crops, livestock and natural species.
- Due to sugar mills' effluent discharged through Karo Ghunghro drain, Serani drain and other drains, the production of fish and prawn have reduced to great extent. Consequently the unemployment in fisher folk has raised, compelled them to migrate for the livelihood.
- The Industrial zone of sugar mills has polluted dhand water affecting human, (especially infants and women), animal and natural life.
- Due to cyclones, monsoon and stagnant saline water, the infrastructure of area has been damaged. In these events, the katcha road become worse resulting in many problems including marketing of fish catch, earning their livelihood, difficulty in access to health clinics, etc.
- The drinking water supply to Badin district is from Fuleli canal offtakes from Kotri Barrage, Hyderabad. The canal brings the effluent of bangle and other industries from this city. This same water is used for domestic purposes in Badin District.
- The basic health facilities particularly mother and child health (MCH) are meager. Thus people are confronting lot of difficulties to reach hospitals in emergency and paying huge cost

(ii) Summary of the participants views on the solutions

- Drinking water supply occupied highest place in priority as given by stakeholders as well. It was suggested that the canal water should be provided throughout year to meet the requirement of drinking and irrigation purpose.
- An alternate solution also came from the participants to install disinfection, filtration and reverse osmosis plants and supply of water should be ensured from the near by Taluka water supply scheme.

- Measures should be taken to rehabilitate the natural environment for fisher folk.
- Policy measures should be adopted to stop mixing of industrial effluent into Fuleli canal at Hyderabad.
- EPA act should be implemented to prevent untreated effluent discharge from sugar mills into the Karo Ghanghro and Serani drains connecting to main tidal link and LBOD.
- Infrastructure mainly road should be constructed in the area for further development.
- LBOD should be diverted into Shakoor Dhand and protective embankment should be built in order to prevent sea water intrusion into the dhands.
- Proper shelter arrangement should be made for Dhand people during monsoon

104. While the discussion at the workshops focused on a wide range of development issues in Badin and the area of the dhands, including the necessity of controlling sugar mill wastes to save the communities from unsafe drinking water, there is little doubt that the participants see the LBOD outfall system, especially the Tidal Link as a major problem and irritant. The participants discussed at length the problems they view as being caused by LBOD, tidal link and intrusion of sea water. In their view the LBOD was wrongly designed and the tidal link remains a constant source of disturbance for the area. One proposal was the construction of a protective embankment 60 feet wide with concrete material to protect the area from abnormal sea tides.

5.2 The Dhand Ecosystems

5.2.1 The Badin Dhands appear to be recovering

105. Taken as a whole, the ecosystem assessment suggests that the Badin Dhands are recovering from the severe impacts of the 1999 cyclone and the long drought in the Indus Basin. They are substantially changed in many important ways. They are subject to daily tidal fluctuations, the influx of high salinity water, and strong drainage outflows during ebb tides in the Tidal Link. They are fully exposed to high storm tides and surges occurring during severe monsoon storms and cyclones that can bring a large pulse of sea water. Nevertheless with the resumption of normal rainfall patterns and increased flow in the drains, salinity has fallen relatively quickly to a favorable range, and while the biodiversity appears to be restricted to an estuarine type that is adapted to these salinity patterns (which would be the normal situation in the dhands), it also appears to be robust and able to support at least a subsistence fishery. While the waterfowl habitat has been severely damaged the improving conditions in the dhands and a more normal rainfall pattern appears to have resulted in the highest recorded bird census ever in the Nurri Lagoon.

5.2.2 The recovery is tenuous

106. While the recent trend appears to be very favorable, the accompanying recovery is tenuous at best. The delicate balances within the dhands are easily tipped in an unfavorable direction as possibly evidenced by the period of severe salinity from 2001 to 2004. There are several reasons for this. First, the total volume of the dhands is relatively low, only about 77 Mm^3 or 62,400 AF

(or less)[40]. Hence relatively small changes in the inflows of moderately brackish water from the drains, freshwater from rainfall and storm runoff, or inflow of high salinity water from the Tidal Link, can have large effects on the salinity, which appears to be the factor controlling the productivity of the dhands. The evidence from 2004 and 2007 suggests that these changes can be very rapid and prolonged, but that recovery can be equally rapid under favorable hydrological conditions despite the breakdowns in the Tidal Link.

107. Over the longer term, there are two other important threats. Because of the relatively small volume of the dhands, continued pollution of the drains and its concentration in the dhands can, through bio-accumulation, cause serious harm to the commercial fishery. No doubt the strong drainage that now exists through the Tidal Link has the beneficial effect of carrying away some of the pollutants, but the residual levels of key pollutants, especially the metals, are already excessive. The long term effects of the strong drainage of Cholri Dhand at low tide and the influx of sediment laden water at high tide represent threats whose long term impact is not possible to discern at this time. The Tidal Link and the dhands may achieve a new equilibrium, in terms of the physical characteristics of the dhands (especially their depth and extent) that is compatible with sustainable livelihoods of the people living around the dhands. But it is also possible that the dhands will be gradually filled and drained, eliminating both the fishery and the waterfowl habitat, by these processes aided by future monsoon storms and cyclones.

5.2.3 Key issues to be addressed to sustain the ecosystem and its functions

108. Sustaining and improving the ecosystem functions of the Tidal Link-Dhands wetland will require proactive management of the processes and factors that most importantly influence those functions. In turn, management of this wetland ecosystem requires a deeper knowledge of both those processes and factors and the underlying ecosystem.

5.3 Monitoring and Research

109. It is noteworthy that there is no ecological or socio-economic component in ongoing monitoring program (Chapter 3). It is focused almost exclusively on the *hydraulic functions* of the Tidal Link (i.e., conveying the saline discharge of LBOD to the Arabian Sea). The second phase of the program (1999-2004) was expanded to include salinity of the dhands, and for a short time water levels in the inflowing drains were monitored once a month. There was no effort to deepen the understanding of the factors that influence the ecological integrity of the dhands, their productivity, nor the people whose livelihoods depend directly or indirectly on the *economic and environmental functions and ecological services* of the dhands. The importance of this is evident from the discussion in Chapter 2 and Section 5.1.

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[40] The dhands would typically be at their lowest level of the year near the start of the monsoon season. Assume the May level is about 80% of normal or about 62 Mm^3. A freshwater inflow of roughly 220mm is required to restore the dhands to its normal volume at the end of the monsoon season (less whatever additional volume would accumulate from inflows from the Tidal Link, but these of course bring with them higher salinity). Normal rainfall at Badin averages only about 150 mm. If drain inflows are reduced, then only a storm such as occurred in July 2003 (about 125 mm fell in that month alone) could restore the full volume of the dhands (an balance additional salinity that may inflow from the Tidal Link). It is easy to see how sensitive and variable is the water balance, and hence the inter-annual variations in salinity of the dhands, and how just a few dry years in succession can lead to a long period of decline and possibly slow recovery.

110. WAPDA is a national implementing agency concerned with the task of ensuring the successful construction and functioning of the LBOD drainage and outfall system, hence it is not surprising that it should focus the monitoring program on the hydraulic functioning of the Tidal Link canal. The lack of a comprehensive monitoring program was caused by many factors, but two stand out: first, the environmental monitoring and management program designed by the LBOD consultants was not implemented; and second, the lack of coordination among concerned Sindh government agencies and WAPDA limited the vision of what the issues were and hence, what the monitoring program could and should achieve; i.e., what basic knowledge should it aim to develop, and what questions should it address. The focus was never on the broader development issues of this region as they relate to the dhands and its economically important environmental services, and more broadly, the coastal zone.

6 STUDY RECOMMENDATIONS

6.1 Overview

111. The earlier Chapters in this report outline the current conditions in the Badin Dhands, and describe the major factors and processes that are most directly influencing the important economic and social functions of these dhands. A wide range of interventions have been suggested by both the affected people in the region and District authorities. Most of these proposals are well understood and typical of interventions being implemented elsewhere in many areas of Sindh today. But the context of these interventions in the Sindh coastal zone, and most particularly in the area of the Badin dhands. is unique. This is an area of high risk from natural disasters, especially cyclones and heavy monsoon season storms that cause extensive and damaging floods, in which narrowly conceived, piecemeal interventions appear to have made the risks even greater. Moreover, success depends to a significant degree on managing a highly productive and economically important ecosystem, something with which Sindh has had little experience and even less success in the past. This is so despite the availability of necessary scientific and technical expertise within the Sindh community.

112. All would agree that a comprehensive strategy is needed rather than isolated piecemeal interventions. Despite the poor record on coordination among federal, provincial and district level authorities and agencies in the past, the coastal zone provides a unique setting in which to try to develop such a comprehensive strategy and to coordinate action among the many governmental and non-governmental agencies that would be involved in its implementation. The setting and issues are quite unlike any other in Sindh, and its potential economic importance to Sindh is now being recognized by the provincial government.

6.2 Social and economic development of the people of the region

113. The abject and pervasive poverty and limited livelihood opportunities of the people living and depending on the Badin dhands needs to be addressed. The specific needs identified by the people (Section 5.1) are neither extravagant nor impractical. But as pointed out above, meeting these needs may require an innovative strategy and considerable innovation because of the depth of poverty and the inherent natural risks that exist in this region. Since the damages and losses cannot be entirely eliminated, the approach has to take into account fully these risks in designing and building new infrastructure.

6.2.1 Linkages to the PPAF Sindh Coastal Area Development (SCAD) Program

114. The Sindh Coastal Areas Development (SCAD) Program has been established under the Pakistan Poverty Alleviation Fund (PPAF) with the objective of rehabilitating the livelihoods of coastal communities and developing their capacity through integration of the coastal area communities with the rest of the country and economy. SCAD includes: (i) better access to basic services including health, education and drinking water supply and sanitation; (ii) increasing incomes through improved crop, fisheries and livestock production, marketing and micro-finance services; (iii) securing access to, and better management of the coastal area natural resources; (iv) forming viable community organizations that are inclusive, well governed and can operate in partnership with public and private sector; (v) integrating these areas with the national space and economy through developing rural growth centers, integrated development of physical infrastructure including construction of productive infrastructure, such as jetties and wharfs, and developing transport and mobility, through the construction of inter and intra-village roads and intermediate modes of transport through infrastructure grants and micro-credit; (vi) promoting technological innovations, particularly the use of solar and wind energy for pumping of water and generation of electricity; and (vi) reducing physical vulnerability, through the construction of flood protection and sea water containment structures and better coping mechanisms of communities.

115. The concept of this ongoing, Bank supported program fits very will with the desires and immediate needs of the communities as identified by the 553 people from 71 villages and settlements who participated in the consultative workshops discussed in Chapter 5. However, the initial approach taken by the PPAF's partner organizations, in particular the National Rural Support Program (NRSP) (the largest operating in the Badin coastal area) has been to focus on community mobilization, capacity building and micro-finance for micro-enterprise development to expand livelihood opportunities. The problem is that the dhand area communities are too weak to benefit from such a program. Not only does PPAF have to more strongly focus SCAD on the poorest dhand area communities but the program strategy needs to be re-thought to reach these poorest of the poor.

6.2.2 Developing a new strategy

116. This new strategy, fully integrated and coordinated with the District and Provincial poverty and infrastructure development strategies and programs, should focus initially on a grant-based program (even soft or interest free revolving community investment funds are beyond the reach of these communities because they cannot generate enough income to participate) to address the community prerequisites that would enable them to take advantage to the current SCAD approach. This new strategy should focus on two areas:

(i) *Stabilizing and improving livelihoods* – the core of livelihoods in these communities is the fishery supplemented whenever possible by agricultural and informal labor. A major effort is needed, in collaboration with the communities, to manage and upgrade the fishery and related infrastructure and technology. This will require better monitoring and management of the dhands (it is not quite clear who's role it is to manage the dhands, but SIDA would have an important role in sustaining adequate inflow through the drains), improving access to the fishery by helping the communities to upgrade their technology and access to the fishery (e.g. docks and fish landing and processing points), experimentation with expanded stocking of fish and shrimp in the dhands (including the development of

aquaculture in the dhands area to produce fish and shrimp larvae to stock the dhands), and piloting the use of solar and/or wind powered fish cooling and storage facilities. There is a risk of course that the target beneficiaries will be excluded from the benefits of such an initiative by new migrants and others intent on capturing the benefits. Hence, at the outset new approaches to managing the dhands and the fishery have to be developed in collaboration with the communities to ensure that this does not happen.

(ii) *Safety and Security and related infrastructure needs* – In the absence of improved safety and security from natural risks, there is little incentive for the people in the dhands area to invest their time and meager resources in improving their livelihoods or their community infrastructure. Improved and hardened refuge (where lives and possessions including livestock can be secured from loss and damage) coupled with improved all-weather access roads and strengthened early warning systems could greatly improve both refuge and escape when natural disasters such as cyclones and severe storms threaten. As suggested by the villagers themselves, such refuges can be integrated with improved education and health facilities to provide more broad based community development.

117. Concentrating on these core needs might provide the necessary platform for the dhand communities to begin to participate more fully in the PPAF program and to begin integrating their livelihoods into the Badin and Sindh economies. However, this in not likely to happen unless representatives of the dhands communities, the UC, Taluka and District authorities, the Provincial authorities (including, for example, CDA, SIDA and other key agencies), and the key partner organizations such as PPAF, NRSP and other NGOs are able to sit together to agree on a strategy, priorities, a concrete action plan, and financing from multiple sources to ensure that the action plan goes forward.

6.3 Macro issues that need to be addressed

118. While many of the proposed interventions require mainly local actions within the area with support from range of agencies, the root causes of the problems are often elsewhere beyond the direct influence of local authorities or villagers. The 2005 WB assessment of the Sindh coastal zone[41], identified several macro issues that need to be addressed to ensure interventions in the Sindh coastal zone are both meaningful and sustainable. Among those most relevant to the outcome of this study are:

(i) *Recognize the uniqueness of the region* – a road, a school or other social and economic infrastructure cannot be built and maintained in the same way that it is done in the relatively safe and hazard free areas of northern Badin where the base of community livelihoods is stronger and more secure. As we have suggested the need for a new and different strategy needs to be recoginized and steps take to develop and implement it.

(ii) *Freshwater inflows* –adequate and reliable inflow of fresh and mildly brackish water into Badin District and to its coastal zone is perhaps the most critical factor

[41] World Bank, *Socio-economic Study and Proposal for Livelihood Improvements: Badin and Thatta Districts, Sindh, Pakistan,* April, 2005

influencing the people of this region. Access to safe drinking water in Badin and the coastal zone depends entirely on the flow of water in the canals and drains, as does the stability and productivity of the dhand ecosystem. The long standing dispute among Pakistan's provinces concerning the amount of Indus River water to be allocated to uses below the Kotri Barrage need urgently to be settled, and a significant portion of this flow needs to be allocated to Badin for drinking water and environmental management. The infrastructure is in place to convey this water to the coastal communities and the dhands.

(iii) *Controlling pollution* – as noted earlier Badin District is not only located at the tail end of the entire Indus Basin irrigation system, but the direction of natural drainage (and hence most water conveyance infrastructure such as canals and drains) in lower Sindh is generally southeastward towards Badin and the coastal zone. It is not surprising then that uncontrolled discharges of pollution are concentrating in Badin and in particular in the dhands, and as has been noted above this is a looming threat to public health and the economic functions of the dhands. It's of little value to blame the upper riparian provinces for this situation. The control of pollution within Sindh, not only from sugar mills but other industrial sources, would have an enormously beneficial impact on drinking water and on the economically valuable coastal zone ecosystems.

6.4 Creating the knowledge base for managing the Badin coastal zone

119. The paucity of real data and facts concerning the situation on the ground in the Badin coastal zone, and the complex causes of degradation (and the extent to which this is occuring or has occurred) and the related risks, has led to widely divergent views on what can and should be done that are often at variance with what little is actually known. The consequence of this is that very little gets done because it is so difficult to reach a consensus with confidence that the actions adopted will lead to real improvements. In this void each agency, governmental and non-governmental, acts in the context of its own mandate and narrow objectives and on its own understanding of the facts. No comprehensive strategy that addresses and accounts for the complexities of the system and ensures that the combination of actions by different agencies is sustainable is possible in this setting. One essential requirement for such a comprehensive strategy would be agreement on what the overall objectives should be and the creation of an institutional framework that together would guide the formulation of actions by any agency. One would hope that the newly created Sindh Coastal Development Authority (CDA) could fulfill this critical function.

120. The ongoing Tidal Link monitoring program provides critically needed data and information, but these are only a part of what is needed. The ongoing monitoring program does not provide data and information to understand the physical interaction of the dhands and the Tidal Link, the dhand ecosystems, or the drainage patterns in the Badin coastal zone. No analytical tools have been developed to analyze the response of the system to heavy monsoon rainfall, cyclones, storm surges and abnormally high tides. This is crucial to not only understanding the extent and causes of the problems, but to formulating and investing wisely in sustainable actions to mitigate and alleviate both the damages and the risks. Some of the things that are needed urgently include:

(i) The detailed topography of both the dhands (the lake bottom) and the surrounding coastal and agricultural lands – because of the extremely flat terrain, the contour interval needs to be on the order of 30 to 50 cm;

(ii) Flow measurement and more frequent monitoring of inflows to the dhands from the drains and the Tidal Link as well as outflows to the Tidal Link – and monitoring of rainfall in the immediate area of the dhands. Quantitative knowledge of these flows to the dhands, and measurement of flows and rainfall, is essential for estimating and eventually managing the water balance of the dhands

(iii) Expand the present hydro-meterological monitoring capability to make estimates of evaporation

(iv) Building on the experience of the 1997 and 2007 ecological assessments of the dhands, design a long term program of limnological and ecological monitoring to provide the data needed to understand and manage the dhand ecosystem, the fishery including its productivity and waterfowl responses to habitat changes.

(v) As a part of the continuing program of ecological monitoring and assessment, monitor the physical, chemical, including pollution, and biological quality of the water in the dhands and in the inflowing drains including the Tidal Link.

6.5 Creating a comprehensive flood and hazard risk management plan

121. Southern Badin District and the dhands area need a comprehensive plan to manage storm runoff and floods and the risks associated with natural disasters such as storm surge and heavy rainfall. As one can see from the workshops and discussions held with local authorities and local people, much if not all the blame for these risks is placed on the LBOD outfall system. The LBOD outfall system may indeed be a part of the problem, but so too is the destruction of coastal defenses, the absence of an effective drainage network, the lack of infrastructure to enable escape and evacuation, and the lack of an effective early warning system. Hence the problems and the complex web of causes that have resulted in such widespread loss of life and property are much larger in scope than the building of a barrier in the Tidal Link or increased diversion of KPOD flows towards Shakoor Dhand.

122. What is need it a systematic and comprehensive planning study of drainage, flooding and other natural risks based on the upgraded and modernized knowledge base discussed above. The preparation of such a plan was earlier agreed with local stakeholders during preparation of the national Drainage Master Plan (DMP) under which the Kotri drainage sub-basin was taken as one of the detailed case studies. This approach was also recommended by the World Bank's 2005 Panel of Experts (POE) assessment of the situation in the LBOD outfall system in which a number of options for addressing some of the problems in the region including the Tidal Link and the dhands were discussed.

123. The plan should address issues related to surface and sub-surface drainage, waterlogging and salinity control and flood risk management, and should include appropriate structural and non-structural options (e.g., flood warning and communications, flood proofing (including refuge and excape) and improved preparedness and response systems). Most importantly the planning should be done with the full participation and consultation with not only the people of the agricultural area

and local authorities, but also the people living in the coastal zone, especially near the dhands who are directly affected. This means that the planning and the plan should not be confined to the physical system, but should include the ecological dimensions and the socio-economic development needs and issues of the region as well.

Annex 4
Food and Agriculture Organization of United Nations

UP-DATED REPORT

ON

ASSESSMENT OF

BADIN AND MIRPURKHAS DISTRICTS FLOOD MANAGEMENT PLAN

Prepared By:

Muhammad Ehsan, Consultant

November 19, 2007

Islamabad Office

ABBREVIATIONS AND ACRONYMS

AWB	Area Water Board
CCB	Community Contract Basis
DCO	District Coordination Officer
EDO	Executive District Officer
FAO	Food and Agriculture Organization
GDP	Gross domestic Product
GOP	Government of Pakistan
GOS	Government of Sindh
HANDS	Health and Nutrition Development Society
HESCO	Hyderabad Electric Supply Company
ICZM	Integrated Coastal Zone Management
IUCN	International Union for Conservation of Nature and Natural Resources
LBOD	Left Bank Outfall Drain
MAF	Million Acre Feet
NGOs	Non Governmental Organizations
NIO	National Institute of Oceanography
NRSP	National Rural Support Program
OFWM	On Farm Water Management
PEPA	Pakistan Environment Protection Agency
PFF	Pakistan Fisher Folk Forum
PMU	Project Management Unit
RBOD	Right Bank Outfall Drain
SCAD	Sindh Coastal Area Development
SCDRP	Sindh Coastal Rehabilitation Project
SRSP	Sindh Rural Support Program
SUPARCO	Space and Upper Atmospheric Research Organization
TMA	Tehsil Municipal Administration
WAPDA	Water and Power Development Authority
WSIP	Water Sector Improvement Project

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UP-DATED ASSESSMENT OF BADIN AND MIRPURKHAS DISTRICTS FLOOD MANAGEMENT PLANS

A.BACKGROUND

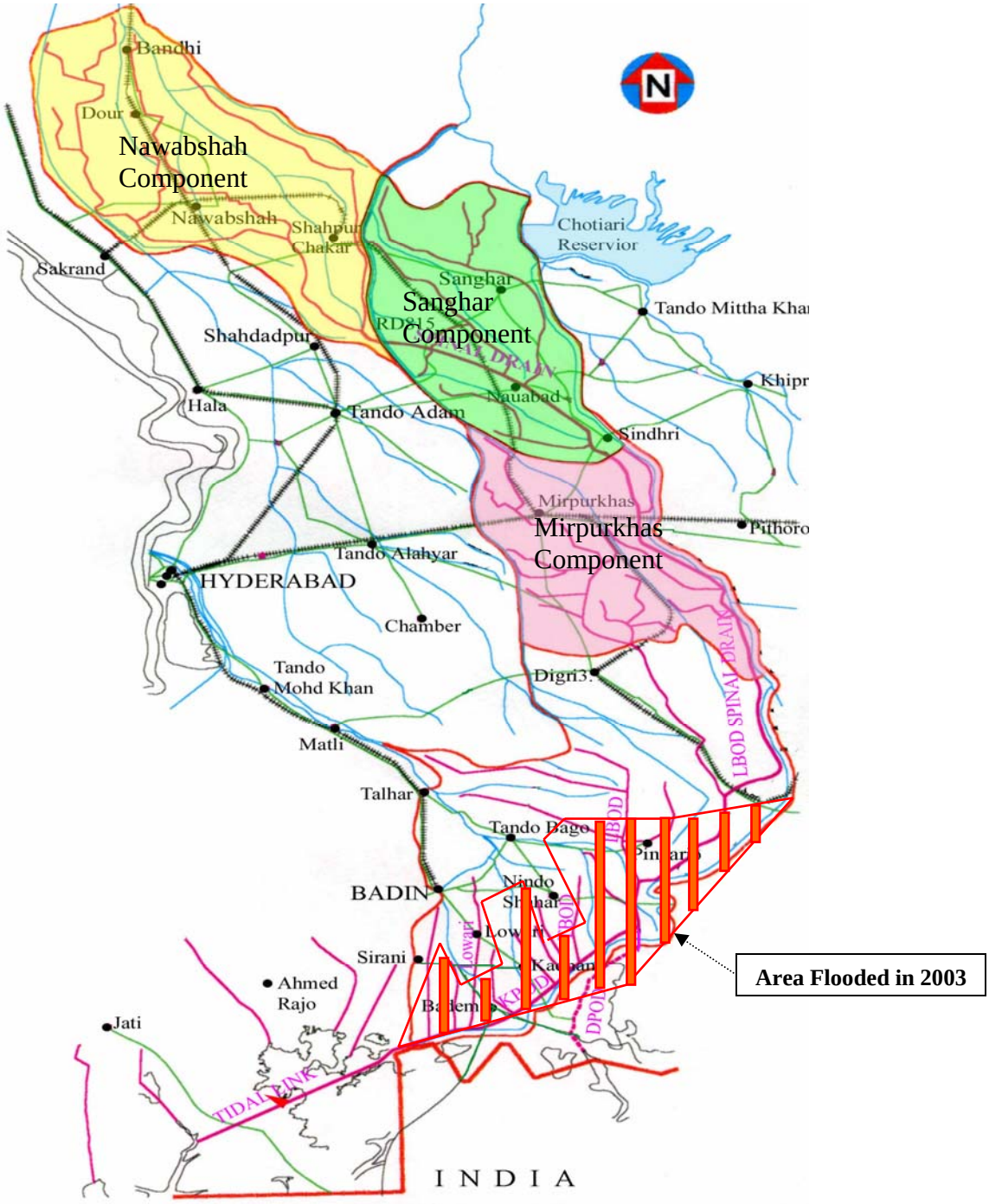
1. Messrs Khadim Talpur, Mohammad Ali Shah, Mustafar Talpur, Munawar Hassan Memon, Iqbal Hyder, Mir Mohammad Buledi, and Najma Junejo on their own behalf and on behalf of "others who live in the area known as District Badin, Sindh Pakistan" in the Indus River Basin submitted a Request for Inspection to the Inspection Panel of WAPDA on September 10, 2004. The Request raised issues most of which related to the prior LBOD Stage 1 Project, which closed in 1997. The location and component of the LBOD Project is shown in **Fig.1**. The Requesters claimed that the LBOD system was faulty and they had incurred losses because of its poor design. The Requesters claimed that the Bank had failed to observe or had otherwise violated various provisions of its own operational Policies and Procedures. They also voiced concerns that the NDP project would extend the system to serve the entire Indus Basin, adding more effluents from the upper basin, through a National Surface Drainage System (NSDS).

2. Although the NDP project as originally conceived in the 1997 Staff Appraisal Report (SAR) was to have laid the groundwork for the NSDS, the concept was subsequently rejected as a result of extensive studies and reviews. Thus NDP did not extend the LBOD Spinal Drain constructed under LBOD Stage 1 Project that was closed in 1997. Responding to the claims in the Request about LBOD, the Management authorized an investigation through a Panel of Experts.

3. The Inspection Panel conducted the required investigations. The Panel met with the Requesters, local authorities and stakeholders including fisher folk, and discussed with Government of Sindh (GOS) authorities actions which could be undertaken in the short and medium term to address flood vulnerability and socio-economic and livelihood issues of people living in close proximity to LBOD and in the coastal zone of southern Sindh. The Panel issued its report outlining the findings of the investigation. The Management issued its Response in July 2006.

4. One of the five activities contained in a Short Term Action Plan approved by the Board of Executive Directors of the Bank in the light of Panel's recommendations is: "Rapid assessment of existing local government flood risk management systems to reduce flood damage and vulnerability by building capacity and improving flood risk response."

Fig.1 – Location and Components of LBOD System



B. INTRODUCTION

5. For carrying out activity "Rapid assessment of existing local government flood risk management systems to reduce flood damage and vulnerability by building capacity and improving flood risk response" services of a consultant[1] were retained.

6. Starting work on April 09, 2007, the consultant studied various reports related to flood events of 2003 and 2006 and the damaged caused by them, previously prepared[2]. The consultant undertook a mission to site from April 15, 2007 to April 21, 2005. He visited Karachi, Hyderabad, Mirpurkhas, Badin, Mirpurkhas Main Drain, LBOD, KPOD and starting point of Tidal Link to learn about the project area and see repair works accomplished and/or on-going, and to discuss the issues with government officials, technical staff of the concerned agencies and Institutes, local government officials, and NGOs[3]. Government and non-government officials and technical experts were extremely generous with their time and provided data and background information and reports to the consultant. The World Bank Islamabad Office, the office of PC of NDP Sindh, the staff and management of the Sindh Irrigation and Drainage Authority (SIDA), the Chief Engineer and Staff of WAPDA's Hyderabad Office, the Director (Left Bank Canals AWB) and the Director (Nara Canal AWB) provided substantive support to the Consultant.

7. Based on the findings of the mission, review of the previous reports and discussions held with the staff and management of the Sindh Irrigation and Drainage Authority (SIDA), the Chief Engineer and Staff of WAPDA's Hyderabad Office, the Director (Left Bank Canals AWB) and the Director (Nara Canal AWB), DCO Badin, DCO Mirpurkhas, Nazim Badin, Staff and DG of NIO and representatives of NGOs, the Consultant prepared the report entitled " Assessment of Badin and Mirpurkhas Districts Flood Management Plans ", and submitted it on June 14, 2007. This report among other things contained a detailed Flood Mangement Plan entitled "Recommended Contingency Plan to Combat Cyclones & Floods – Badin District" as Appendix 3, which was based on similar document prepared by the DCO badin but contained some gaps. Since no such document had been prepared by Mirpukhas district official it was not possible to prepare a Contingency Plan to Combat Cyclones & Floods for Mirpurkhas District.

8. The services of the Consultant[4] have been again retained to up-date the assessment report prepared in June 2007, with a particular focus on preparing a Contingency Plan to Combat Cyclones & Floods for Mirpurkhas District and improving the already preared FMP of Badin Districts, as desired by the responsible local government of Badin District and NGOs. The Consultant undertook a mission to site from November 06, 2007 to November 11, 2007. He visited Badin and Mirpurkhas, Badin and met officials and representatives of NGOs to discuss if they desired any improvement in the "Recommended Contingency Plan to Combat Cyclones & Floods – Badin District", and get information to prepare a Contingency Plan to Combat Cyclones & Floods for Mirpurkhas District.

9. This report is updated version of the report prepared in June 2007 and now contains the Contingency Plan to Combat Cyclones & Floods for Mirpurkhas District (Appendix 4) beside some revision in previously prepared FMP for Badin District" now entitled " Contingency Plan to Combat Cyclones & Floods – Badin District"(Appendix 3).

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[1] Mr. Muhammad Ehsan
[2] List of documents consulted in preparing this report is given in Appendix 1
[3] A list of organizations and officials met by the consultant is given in Appendix 2.
[4] Mr. Muhammad Ehsan

C.FLOOD EVENTS

Review of 2003 – Flood and affected Population

10. During the month of July 2003, Nawabshah, Mirpurkhas and Badin districts received heavy rainfalls[5]: Nawabshah (304 mm), Mirpurkhas (192 mm) and Badin (292 mm). The run-off produced by the rains in Nawabshah and Mirpurkhas districts, which includes the catchment area of LBOD System, enters the surface drains of LBOD System and goes to sea through LBOD Outfall system. Review of the design of LBOD Outfall system indicates that it has been designed to cater for a drainage rate of 1.5 cfs / sq. mile which is equivalent to surface drainage rate of 42 mm (1.67 inches) in a month. Rainfall received in 25 days of July 2003 was on the average 295 mm, which was 7 times the discharge capacity of LBOD.

11. Considering the envisaged run-off factor of 20%, LBOD system received 0.286 MAF of the total quantity of 1.43 MAF produced by the catchment area of LBOD due to rains. In order to drain out rain water, 2,050 drain inlets, with a capacity 1.8 cfs each, have been provided in the drains. The design discharge of LBOD Outfall system is thus 4,000 cusecs (7,934 AF/day) but it can accommodate up to 6,000 cusecs (11,900 AF/day) utilizing the freeboard. At this rate it would have taken ordinarily 24 days to evacuate this volume of water. In addition, Badin catchments area of 3.3 million acres received about 300 mm rainfall which also entered in LBOD System.

12. For expediting evacuation of rain water from their fields the population of Nawab Shah, Sanghar and Mirpurkhas made cuts in the drains of LBOD system that further increased the flow in Outfall Drain. This caused overflowing in the LBOD. The situation further aggravated due to flows from canal escapes and breaches that entered LBOD. It is pertinent to note that I&P Department did not close the inflows to irrigation canals despite the rainfall that worsened the flow condition in LBOD system which had to carry many times more discharge than the capacity of drains. High tide in sea and high level in Shakoor Dhand obstructed the flow, and area in the vicinity of Badin district suffered badly. It was observed on July 25, 2003 that a discharge of about 9000 cusecs passed through Spinal Drain in the proximity of RD 159+000. There were several breaches in the system particularly in KPOD. The area flooded is shown in **Fig.1**.

13. According to the information provided by the local government of Badin, the monsoon 2003 floods affected 390,469 persons in 1,407 villages of Badin district alone. The death toll was 88 persons and 321 injured. The 11,699 houses were destroyed while 21,063 houses were partially damaged. 9,110 heads of cattle were lost and 229,931 acres of cropped land was affected. In response, the authorities established 100 relief camps in the affected areas for relief operation and 23,650 persons were provided food and shelter for more than a month. **Table 1** gives the names and population badly affected by 2003 floods.

[5] Metreological Records of rainfall

Table 1: Villages and Population Badly Affected by 2003 Floods

Sr. No.	Name Village	Affected Population
1	Khamoon Mallah	320
2	Khamoon Mallah-II	209
3	Shadman Lund	278
4	Missri Mallah	225
5	Haji Hajjam	200
6	Hanif Mallah	275
7	Gaji Mallah	150
8	Yousuf Mallah	175
9	Ramzan Sheedi	51
10	Jumoon Mallah	204
11	Faqir Mohammed Mallah	118
12	Ibrahim Mallah	107
13	Master Allah Bux Mallah	85
14	Haji Ahmed Mallah	93
15	Gul Mohammed Talpur	357
16	Ramzan Khaskheli	230
17	Lakho Pir	2,000
18	Bahadur Khan Lund	300
19	Pir Bux Mandhro	104
20	Yousuf Bhatti	138
21	Mohammed Hassan Mandhro	96
22	Jurio Mallah	180
23	Haji Raboo	50
24	Sono Khan Chandio	120
25	Malhar Mallah	156
26	Rafiq Bengali	54
27	Rafiq Dal	60
28	Tamachi Bajeer	50
29	Photo Chandio	60
30	Ali Shah	72
31	Mohammed Khaskheli	54
32	Manthar Khaskheli	120
33	Adam Khaskheli	120
34	Gudo Khore	42
35	Hashim Mallah	62
36	Samoon	100
37	Ali Bengali	120
38	Anwer Bengali	60
39	Rajab Mallah	54
40	Karo Mallah	78
41	Nawab Ali Jamali	48
42	Mohammed Chandio	60
43	Mohammed Notiar	72
44	Natho Bajeer	54
45	Ramzan Chandio	84
46	Khamiso Dhandhal	48
47	Ahmed Notiar	120
48	Natho Jamali	42
49	Allah Dino Notiar	36
50	Pinyo Mallah	90
51	Sahbdino Jat	180
52	Lakhadino Notiar	60
53	Beer Mallah	90
54	Khan Dal	48
55	Haji Sujawal Jat	60
56	Behdmi	840
57	Allah Rakhio Jat	150
58	Photo Jat	104
59	Murad Malir	1,406
60	Patel Qasim Dal	900
61	Nabi Bux Lund	360

Review of 2006 – Flood and affected Population

14. Similar to the event of unusual rains generated flood during the month of July 2003, there was a flood event again in the LBOD project area in April 2006. There were intensive rains the particulars of which are given in **Table 2**.

Table 2: Rainfall in April 2006

Sr. No.	Taluka	Rainfall (mm)
1.	Badin	298
2.	Matli	231
3.	Talhar	205
4.	S.F. Rahu	110
5.	Tando Bago	144
6.	Mirpurkhas	272
7.	Digri	362
8.	Jhudo	150
9.	Kot Ghulam Muhammad	207
10.	Sindhri	281
11.	H.B.Mari	273

15. Besides sheet flows caused by the intensive rains, again the population made cuts in the drains of LBOD system for expediting evacuation of rain water from their fields that increased the flow in Outfall Drain. This caused not only the overflowing and breaches in the LBOD but the breaches and overtopping also occurred in other main drains, branch drains and sub-drains of the LBOD System. Another significant phenomenon that occurred was heading up of water upstream of pipe culverts which have been designed to carry much less discharge than occurs due to heavy rains and cuts made by farmers. This caused breaches in the banks upstream, notable of these was at RD 350 culvert bridge across MMD, which caused breach in the left bank of MMD that threatened Mirpurkhas city. In order to safely pass the flow in the reach RD 245 to RD 500 of Spinal Drain of LBOD System earthen and gunny bag dowels were constructed in emergency.

16. Breach occurred in LBOD Spinal Drain at RD-435 NIP that affected villages; (i) Haji Khalid Bhurgri; (ii) Haji Qasim Bhurgri; (iii) Nawab Younis Talpur. Local people made cuts in the embankment of MMD to obtain relief from flooding, which subsequently converted into breaches at RD-117 IP, RD-151 NIP, RD-152.5 IP, RD-189 IP, RD-202 IP, RD-216 IP & RD-219 NIP affecting the villages Rano Ramdhan. Overtopping in MMD at RD-201 to 208, RD-213 to 217, RD-231 to 236 affected the villages; (i) Chounrow Bhurgri; (ii) Gul sheer Gorchani; (iii) Mirwah Gorchani; (iv); Khalid Leghari; (v) Syed Ali Nawaz Shah; and (vi) Muhammad Khan Banglani. Breach in Mirpurkhas Main Drain MMD at RD-354 caused flooding in the entire area of Taluka Hussain Bux Marri. The District Administration of Mirpurkhas sought the help of Pak Army teams and IPD staff to take remedial measures for repairing washed away embankment of MMD between RD-350 to RD-357 in order to save Mirpurkhas city. The breaches at RD-62 & 63 of Sanghar Main Drain (SMD) affected the village Khuda Bux Rajar and areas surrounding areas Sanghar Sugar Mill. Upward action of Dhoro Puran Outfall Drain seriously affected Aliani village and Roshan Abad near Jhudo.

17. It is pertinent to note that the event of 2006-Flooding did not impact Badin district as severely as it happened during 2003-flooding. This is due to diligent work carried out by Army in filling breaches immediately after the occurrence of 2003-flooding, and later in restoration work carried out by AWBLBC that is still in progress.

Review of Flood Events in 2007

18. During 2007, the cyclone Yemyin 03B threatened to hit the southern coastal areas of Sindh but it diverted and hit the coastal areas of Balochistan on June 23, 2007, causing severe damages in Balochistan and areas in the proximity of Karachi. There were heavy rains in Badin District and adjoining areas but due to the preparedness and rapid response of the GoS, no major damages occurred in Badin. The LBOD system capably handled the water flows in the area. No breach in any of the drain in LBOD system has been reported. No emergent work was required to be carried out.

19. The representatives of NGOs confirmed that there was no noticeable flooding or cyclone event during 2007. Except for the following three communities, no population either was asked or moved, who moved on their own for seeking shelter, and returned to their homes just after one day:

(i) a small population from nearby villages in proximity of Kaden town shifted to Kaden Camp;
(ii) a small population from nearby villages shifted to Seerani town; and
(iii) the residents of Baihdimi village shifted to Golarchi.

D.RESPONSE TO 2003-FLOOD EVENT

General

20. Immediately after the flooding occurred in July 2003, the Federal Government as well as Provincial Governments launched a massive relief operation. International community also provided help in that the Governments of Switzerland (through SDC), Japan and Greece donated cash and relief items to the Government of Pakistan for flood affectees. Several indigenous and international NGOs participated in relief operations during and immediately after the flooding event of 2003.

By GoPakistan

21. The President and the Prime Minister separately visited the affected areas after the occurrence of the flooding in 2003. The Government of Pakistan provided grant of PKR 100 million for undertaking rehabilitation in the flood affected areas. The Government of Punjab provided grant of PKR 50 million for the Sindh province for undertaking rehabilitation in the flood affected areas.

22. National Rural Support Programme (NRSP) provided relief assistance to the affected people belonging to its Community Organizations. It has also provided food rations to 514 households and cooked food in relief camps in Golarchi Taluka to 2,175 persons and medical assistance to affected population.

Response by GoSindh in respect of 2003 Event

23. In view of the devastating damages caused by the flooding in 2003, the Sindh Government declared emergency and established a fund for relief operation contributing 50 million Rs from resources of Sindh Government. A Provincial Relief Committee was constituted to review the losses caused by the heavy rain and floods in the province, especially the damages to life and property in the districts of Badin, Thatta and Tharparkar. The Provincial Relief Committee and

District Coordination offices were made responsible for the relief operations; affected families were provided tents, blankets and various food items, such as flour, pulses, cooking oil, sugar, tea, milk powder, etc. GoSingh arranged evacuation of marooned people by employing various government agencies including the Pakistan Army. The flood-affected victims were provided shelter at relief camps set up at the premises of various schools and other government buildings.

24. Nara Canal AWB and Left Bank Canal AWB provided technical assistance and support to various agencies involved in relief operation. They carried out emergency restoration works for the danaged irrigation and drainage networks in order to clear the floodwater and assured the availability of canal water in the area. Using machinery and equipment available in Lower Sindh Mechanical Division major breaches in irrigation and drainage networks were plugged in order to safeguard the people and valuable property including standing crops, buildings, roads network and others infrastructure.

25. Later on, a detailed assessment of losses and structural damage to LBOD and irrigation networks was prepared in order to restore the damaged infrastructure. Several schemes were prepared and implemented to restore the damaged infrastructure.

26. It was decided by GoSindh that the families of the victims (dead), who were bread-earners, would be given Rs. 100,000 each while other families would be given Rs. 50,000.

By International Community

27. The Government of Switzerland, through SDC, provided US$ 36,700 for rehabilitation work in Dadu and Tharparkar districts. The Government of Japan donated cash grant of US$ 10,000 to the Government of Pakistan, which was in addition to the relief items worth US$ 160,000 handed over to the Sindh Government. The Government of Greece donated relief items worth US$ 57,000 to the Government of Pakistan for flood affectees.

By NGOs

28. In order to meet the immediate needs of the flood-affected population of Badin, Thatta and Dadu districts, the International NGO Forum comprising of Islamic Relief, SCF-UK and OXFAM-GB, Action Aid, Catholic Relief Service, Concern Pakistan and Church World Service jointly contributing funds to provide food and non-food packages in the relief camps and affected people in villages. These packages consisted of essential food items, water purifiers with containers, hygiene kits and cooking utensils. SCF-UK provided food to Tharparkar through Thardeep Rural Development Programme (TRDP) and to Badin through Strengthening Participatory Organization (SPO). Concern Pakistan distributed tents worth EUR 40,000 (US$ 45,610) in Badin through the Church World Service. Focus Humanitarian Assistance provided food assistance to five hundred families for seven days as well as mosquito coils and water purification tablets to these families for ten days.

29. The Pakistan Red Crescent Society (PRCS) provided blankets and medical camps using US$ 50,000 contributed by ICRC. PRCS had allocated US$ 50,000 from its own resources for relief work in Sindh and Balochistan provinces. In addition, PRCS received donations: (i) US$ 50,000 from USAID for emergency food supplies to the affectees in Sindh; and (ii) US$ 50,000 from the Chinese Red Cross. These funds were used to provide food, health and shelter to the affectees in both the provinces.

By UN and its Allied Agencies

30. The UNICEF delivered Jerry Cans of drinking water and water purification tablets worth US$ 40,000. Tents purchased by UNDP from funds allocated by OCHA (US$ 50,000) were distributed to the affectees in Badin. UNDP provided another amount of US$ 50,000 for coordination, monitoring and logistics support of relief activities in Sindh. WFP procured and distributed food supplies (400 tones wheat flour and 100 tones edible oil) worth US$ 200,000 for 240,000 beneficiaries in Thatta, Badin, and Tharparkar districts. Half of the food supplies were distributed in Badin, being the worst affected district. WHO also provided 50,000 water purification tablets and 50,000 packets of ORS worth US$ 15,000.

E. RESPONSE TO 2006-FLOOD EVENT

31. During the event of 2006, GoSindh carried out relief operation in the affected areas similar to the one carried out in response to the event of 2003 flooding. Since the damage during 2006 flooding was relatively on lesser scale than the 2003 event the relief operation was all indigenous effort. GoSingh arranged evacuation of marooned people by employing various government agencies including the Pakistan Army. The flood-affected had to be provided shelter at relief camps set up at the premises of various schools and other government buildings. Affected families were provided tents, various food items, such as flour, pulses, cooking oil, sugar, tea, milk powder, etc.

F. RESPONSE TO 2007-FLOOD EVENT

32. Since there was no significant damage caused by flooding in Badin and Mirpurkas districts there was no need for any response. It is, however, worth mentioning that both the general public and responsible government organizations were ready to tackle any adverse situation. DCO's office informed that for the information about the cyclone Yemyin 03B and later about the rains the population in remote areas was itself proactive and contacted the DCO's office and other organizations. The availability V-Wireless Telephone System introduced by PTCL was of great help in accessing remote areas for early warning. DCO's office used this utility to communicate with remote areas very effectively and efficiently.

G. FLOOD MANAGEMENT PLANS

General

33. Pakistan has had a long history of repeated localized and widespread flooding. Much of Pakistan is a flood prone region, with steep upper catchments and the potential for high intensity rainfall. The flood problem has been exacerbated by the progressive denudation of river catchments and the general deterioration of river channels from significantly reduced flows during non-flood seasons because of increased diversion from the rivers. Despite reservoir construction and major investments in flood protection, there remains a considerable flood hazard. The capacities of the dams to attenuate flooding and regulate river flows are being reduced by siltation.

34. Flooding mainly impacts on three areas of the country:

35. The main riverine areas adjacent to the Indus and its tributaries (the Jhelum, Chenab, Ravi, Sutlej and Kabul) where annual floods are used for irrigation. These areas are heavily populated and suffer catastrophic damage due to high intensity floods;

36. High torrent affected areas where intense local rainfall on steep, largely denuded mountainsides can cause major flash floods. Such floods cause immense damage due to erosion and inundation of agricultural and populated lands and to communications and urban infrastructure. large and sudden deposits of sediment from hill torrents near the confluence with major rivers may change hydraulic and morphological conditions locally in the main river, adversely affecting flooding and erosion conditions; and

37. Areas of poor drainage where water ponds in agricultural and urban areas as a result of heavy summer (monsoon) rainfall;

38. Generally, Pakistan is impacted by the high floods in main riverine areas adjacent to the Indus and its tributaries every year during the Kharif season. These high floods cause severe damage to public infrastructure, private property, human life, crops and livestock, as happened in 1950, 1955, 1957, 1973, 1976, 1978, 1988, 1992 and 1995. Due to expectation of this category of flooding every year, the local administrations of the respective districts and other related departments in the vicinity of riverine areas prepared Flood Management Plans containing Standard Operating Procedures (SOPs) in 1980s to combat these floods. These Flood Management Plans have evolved into effective instruments for providing relief to population affected by a flood event. District Administrations generally deal with the non-structural measures to mitigate the effect of floods while the Irrigation Departments of the concerned areas deal with up-keep of the flood protection infrastructure to avoid or minimize flooding.

39. The flooding that occurred in Badin area during 2003 and Mirpurkhas in 2006 was of the category mentioned under bullet three above. Although the Badin area had witnessed rain water floods in the years 1959, 1961, 1962, 1964, 1967, 1970, 1973, 1976 & 1979 but these were relatively of much less severity than that of 2003 flooding. The flooding in Badin area was not expected to be recurrent event every year, as during the forty years (1959 and 2000) only about a dozen times the noticeable flooding due to rains occurred. The area used to remain under water from 2 to 3 months due to poor drainage.This inundation used to spoil crops in the vastly affected area, sub-merging hundreds of villages and displacing thousands of people. The inundation of area for months was a fact accepted without much of a complaint. Due to the fact that the flooding was an accepted norm and of the magnitude much less than that occurred during 2003, preparation of a Flood Management Plan containing SOPs prior to the 2003 event of flooding had not been considered necessary. The gravity of the situation became noticeable after the 1998 cyclone but the flooding in 2003 due to unprecedented rains prompted preparation of a Plan to combat an emergency. Otherwise, the effects of the floods were mitigated with spurred reaction, as no formal Flood Management Plan existed.

Badin District Contingency Plan to combat Cyclones & Floods

40. District Coordination Officer, Badin prepared a Flood Management Plan after the 2003 flooding event in year 2004 prior to monsoon season to combat situation similar to that occurred in 2003. It was reported to be have been updated every year. The updated version of this document is entitled “Contingency Plan to combat Cyclones & Flood / Rain 2007”. This Flood Management Plan is specific to the requirement of Badin District and was prepared keeping in view the lessons learnt during the 2003 flooding. As explained in para 44, the Contingency Plan prepared for Badin District gives only non-structural measures (flood warning systems, laws and regulations, and readiness for providing the relief measures to the affected population). It was found that the “Contingency Plan to combat Cyclones & Flood / Rain 2007” has been circulated to the key responsible officers of the district. During the meeting with representatives of 4 NGOs on April 20, 2004, the Bank Consultant saw its copy with one of the representatives.

Mirpur Khas District Contingency Plan to combat Cyclones & Floods

41. Mirpurkhas had not prepared a Flood Management Plan as of June 2007 when the district administration (DCO) informed that a Flood Management Plan similar to the one prepared for Badin District would soon be prepared. As happened after the 2003 event, the effects of the flood event of 2006 were mitigated with spurred reaction, as no formal Flood Management Plan existed for the Mirpurkhas District.

H. ASSESSMENT OF FLOOD MANAGEMENT PLAN OF BADIN DISTRICT

42. Damaging effects of flooding are as follow:s

- Loss and damage to public infrastructure;
- Loss of private property;
- Loss of crop or reduction in yields of crop;
- Loss of human life and livestock; and
- Spread of water borne diseases.

43. The purpose of a Flood Management Plan for an area is to prevent and/or minimize the damaging effects of floods. Therefore a good plan should contain preventing measures and mitigation measures prior to and after the damage caused by a flooding. For minimizing the damaging effects of a flood two types of measures are necessary; (i) Structural (flood protection works); and (ii) Non-structural (flood warning systems, laws and regulations, and readiness for providing the relief measures to the affected population). Structural measures are meant to prevent or minimize the damaging effect by keeping the flood water away from the populous areas and safe passage of the flood water to the disposal areas or facilities.

44. The Contingency Plan ,prepared by the DCO, for Badin District gave the background of 2003 flooding and informed about the inadequacy of structural measures as those existed. However, it did not include the structural measures but suggested addressing the structural deficiencies. It gave only non-structural measures (flood warning systems, laws and regulations, and readiness for providing the relief measures to the affected population).

45. It mainly focused on preparedness for providing relief measures in the event of a flooding, including flood warning system, evacuation of marooned population and the temporary shelter. The plan contained the narration of the lessons learnt from 2003 Flood Event, which formed the basis of the preparedness plan.

46. It stated that the early warning of cyclones and heavy rains would be communicated through Radio, TV and Police wireless system. The Plan did not mention as to who would be responsible for issuing the Early Warning. It was learnt that NIO carried out research development connected with tides and do publish the reports containing information about the tides. But the Meteorological Department was responsible to track down cyclones and the cloud systems producing heavy rains. Logically, the Meteorological Department should be the one to issue the early warning and they do as per their SOP but it was not mentioned in the Plan. There is a small meteorological station in Badin supervised by a junior official. This station monitors the rain fall as it occurs but is not in a position to issue the early warning. Accordingly, a clear source for receiving the early warning needed to be mentioned in the plan along with the official responsible in the District Administration to communicate the early warning to the remotest possible areas in Badin district i.e. the villages and settlements near the coast line such as; Shaikareyo etc. These

settlements are remote and prone to suffer the most in case of a flooding, and have no TVs or radio receivers. It is time consuming to reach these places. It was learnt 'Tapedars' were the last link to pass on the information that, being revenue collecting staff, are not popular and not considered credible. Therefore, there must be a foolproof way to provide the information to the population in remote areas in time, which is considered credible by them.

47. The mechanism to declare the emergency was stated in the Plan, and establishing control rooms at District level, Taluka level along with the telephone numbers of the concerned officials were given. There was mention of Relief Commissioner's Office in Hyderabad along with his telephone number but the role of the Relief Commissioner was not defined.

48. The duties of the concerned XEN Drainage, Revenue Department, Education Department (for providing school buildings for the relief camps), Health Department, Taluka Muncipal Administration, Agriculture Department, Civil Defense, HESCO, telephone Department, Southern Gas Company, W&S Department, DPO-Badin and EDO (Community Development) were given in the Plan. Also mentioned in the Plan were roles of Edhi Welfare Trust and Pakistan Army. But the roles at union council and/or village level were not indicated.

49. The Contingency Plan included the list of school buildings and number of rooms in them along with their capacities to accommodate displaced persons. It also includes the list of 'DEHs' (villages) and their population, organized taluka-wise along with the names of the concerned 'Tapedars'. But the list of DEHs most vulnerable to flood risks was not prepared.

50. The Flood Management Plan did not indicate details as to where the population of specific '*Dehs'* would be given shelter in case of need.

51. During the 2003 event, the hygienic conditions in schools where shelter was provided became bad, safe drinking water became short in supply and inadequate latrines made overall environmental conditions as intolerable. An officer spending money from the Government Exchequer to provide food during 2003 event was reported to have to face a lot of inquiries and embarrassment after the event in Badin District. For the future, the Secretary Government of Sind Food Department needs to be requested to direct Director Food and Deputy Director to make prior arrangement of supply from Karachi and Hyderabad at the time of need / emergency. But the logistic indicating the quantities of food, safe drinking water, medicines etc., and the budget for the same was not indicated in the Plan.

52. Although the induction of NGOs and other philanthropic was implied in the Flood Management Plan but the detailed mechanism to organize and implement the participation by them was not indicated. It was informed by the representatives of the NGOs that during the 2003 relief operation there was no Disaster management Committee formed, which if had been formed including co-opted representatives from private sector and/or NGOs could have provided better guidance and arrangements particularly towards shortages of food items etc. There was no provision for forming such a committee in the Flood Management Plan.

53. The Flood Management Plan rightly pointed out the need for strict watch on the LBOD drains, which is virtually non-existent even now. This is subject of O&M of LBOD System. SIDA needs to look into it to improve the situation.

I. RECOMMENDATIONS

54. There is need to have a comprehensive Flood Management Plan for Badin and Mirpurkhas districts including structural measures. In this connection, Government of Pakistan has approved a PC-II for an amount of Rs. 41 Million for carrying out the Feasibility Studies by retaining services of consultants to identify and mitigate the problem in LBOD Outfall and Badin Area Drainage System. The TOR for carrying out these Feasibility Studies have been prepared by participation of stakeholders. WAPDA, as the implementing agency of this PC II, has retained the services of the Consultants who have already submitted the Inception Report. The recently approved Project of Water Sector Improvement Program (WSIP), which would be implemented with the World Bank's financial assistance, among other things, "[…]" will support the preparation of a comprehensive flood management plan for the Left Bank of the Indus River in Sindh including the Indus delta and coastal areas. This regional drainage master plan, agreed with local stakeholders during preparation of the national Drainage Master Plan, will encompass both surface drainage, sub-surface drainage, water logging and salinity control and flood risk management, and will include appropriate structural and non-structural options (e.g., flood warning and communications, flood proofing and improved preparedness and response systems). Planning and infrastructure management capacity will be built and the capacity of local authorities will be strengthened. A modern, world-class knowledge base will be developed with appropriate analytical tools and information management systems to support planning, operations and management. The detailed design would be prepared and made ready for implementation of the priority works identified under the master plan under a future investment project that Sindh may undertake with the assistance of its development partners"[…]".The duplication between studies initiated by WAPDA to find a sustainable solution to the flooding problem of surface drainage system of LBOD by determining deficiencies in the existing LBOD Drainage System and finding remedial measures and those envisaged in WSIP, if any, should be sorted out. There should be clear delineation of responsibilities and coordination between WAPDA and SIDA.

55. The Government of Pakistan has formed a National Disaster Management Authority. So far this organization is not known to have involved in disaster management activities related to coastal ares of Sindh Province. It would be appropriate to have participation of this newly formed institution in preparing Flood Management Plan for the Left Bank of the Indus River.

56. WAPDA South must coordinate at appropriate level with GoSindh as well as consult other stakeholders in carrying out the Feasibility Studies through services of consultants to identify and mitigate the problem in LBOD Outfall and Badin Area Drainage System. For preparing a comprehensive DMP there shall be need for stakeholder participation, as has been done in preparing the DMP for Kotri.

57. In the interim the following actions are recommended for improving the existing local government flood risk management systems to reduce flood damage and vulnerability by building capacity and improving flood risk response:

(i) A system for ensuring the communication of early warning that is considered credible and clearly understood by the population prone to adverse effects of flooding needs to be established. A clear methodology should be framed to communicate warnings generated by the Meteorological Department in the shortest possible time, describing the SOPs of the departments, officials involved along with their responsibilities and logistics for implementing the system.

(ii) Routine vigilance through out the year and special vigilance during the Kharif season in respect of all drains in the LBOD System should be incorporated in the Flood Management Plan. This aspect is to be dealt as part of O&M activities to be carried out by the concerned AWBs. SIDA in association with AWBs should prepare Standard Operating Procedures (SOP) for carrying out proper O&M of the surface drains of LBOD System. The O&M Manual (in 5 Volumes) prepared by WAPDA in 1991 and criteria used by IPD for computing M&R yardstick should provide the foundation to prepare the requisite SOP.

(iii) As the schools are used to give shelter, the primary purposes of school buildings to provide education to children is jeopardized due to deterioration using those as residential buildings that require substantial repairs afterwards but generally are not carried out due to limited budget available with W&S Department. Instead of immediately rushing the affected population to school building to provide shelter, which is itself a time consuming process (convincing people to move and to arrange transport and boats) it will be a good option to provide/construct shelters in the vulnerable villages. It is there recommended to provide shelters alternate to school buildings. This alternative could be constructing elevated earthen plate-forms close to each of DEHs so that the affected population can stay near to their properties but at a higher elevation above the expected highest water level of flooding. There would be need, however, for the land to construct these elevated earthen plat-forms. As per the discussions held with the representatives of NGOs met, this can be done with community participation basis (CCB). The community can contribute piece of land while investment may be arrangement from an on-going project. It is considered that area required per person would be of the order of 2.5 m^2 to 3 m^2 per person. The plat-forms would be on the average about 2m high and can have wooden or steel trusses to install temporary covers such as tarpaulin. If constructed on CCB, the up-keep and maintenance can be carried out by the community. During the dry season these plate-forms can be used for community functions such marriage ceremonies etc. A total of 61 villages in 2003 and about 10 villages in 2006 were severely affected. Considering these villages prone to risk of flooding again and adding a few more, a total number of 80 villages would perhaps require these plat-forms. But the number should be determined by consultation with the concerned communities.

(iv) The list of '*Dehs*' most vulnerable to flood risks needs to be prepared, and shown on a map indicating roads to establish evacuation paths. These '*Dehs*' should receive the early warning of an emergent event at the top priority.

(v) The preparedness at village level needs to be reflected. The personnel relating villages can be informed as to where to contact in case of emergency, and also trained to initiate measures to save themselves from a big catastrophe.

(vi) It was learnt that a provision of stockpile edibles, medicines and clean drinking water for three days is maintained but during 2003 it took some 15 days for the affected population to return to their place. Adequate quantum of needed edibles, medicines and clean drinking water are to be determined, and stockpiles maintained as part of the Flood Management Plan. And, adequate budget allocation should be provided for this purpose as part of the Flood Management Plan.

(vii) There should be a provision for forming a Disaster Management Committee, which may include co-opted representatives from private sector and/or NGOs in addition to

the government functionaries for providing better guidance and arrangements in the Flood Management.

J. CONTINGENCY PLANS TO COMBAT CYCLONES & FLOODS – BADIN AND MIRPURKHAS DISTRICTS

58. Building on the Contingency Plan to combat cyclones and floods for Badin and incorporating the above observations an implementable Contingency Plan was prepared, the contents of which were included in Appendix 3 of the report prepared in June 2007. This recommended contingency plan to combat cyclones and floods for Badin was provided to SIDA, DCO's office and NGOs for review and making suggestions to improve it. During the November 2007 mission NGOs provided a further list of vulnerable villages, which has been appended to the Plan. The finalized "Contingency Plan to Combat Cyclones & Floods for Badin District" is given in **Appendix 4.**

59. The Flood Management Plan for Mirpurkhas District had not been prepared as of June 2007. DCO Mirpurkhas promised to prepare one on the same basis as that of recommended FMP for Badin district. In order to facilitate its preparation the Consultant prepared a Draft plan with blanks for the missing information. If those blanks were filled the FMP would have been ready. The District Administration did prepare and provided a FMP prepared by them to the Consultant during the November 2007 Mission. This plan did not use the Draft sent to them prior to the mission and contained some gaps. The missing information was obtained during the November 2007 mission. Using the plan and information provided by DCO's office during the November 2007 mission"Contingency Plan to Combat Cyclones & Floods for Mirpurkhas District" has been prepared, and is given in **Appendix 5.**

60. It is recommended that these contingency plans are used by the respective local governments in future and up-dated every year. It will be necessary to share these plans with all the organizations who have indicated to have a role in combating the cyclones and floods using thes plans. It will be also very helpful if these plans are shared with repted NGOs of both districts.

APPENDICES

Available on Website www.worldbank.org.pk

Annex 5
Food and Agriculture Organization of United Nations

UP-DATED REPORT

ON

ASSESSMENT OF

PRESENT CONDITION OF LBOD AND KPOD AFTER REPAIR

WORKS AND FURTHER WORKS NEEDED

Prepared By:

Muhammad Ehsan, Consultant

November 13, 2007

Islamabad Office

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
AWB	Area Water Board
DCO	District Coordination Officer
DPOD	Dhoro Puran Outfall Drain
EDO	Executive District Officer
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GOP	Government of Pakistan
GOS	Government of Sindh
HANDS	Health and Nutrition Development Society
ICZM	Integrated Coastal Zone Management
IUCN	International Union for Conservation of Nature and Natural Resources
KPOD	Kadhan Pateji Outfall Drain
LBOD	Left Bank Outfall Drain
MAF	Million Acre Feet
M&R	Maintenance and Repairs
MMD	Mirpurkhas Main Drain
NGOs	Non Governmental Organizations
NIO	National Institute of Oceanography
NRSP	National Rural Support Program
OFWM	On Farm Water Management
PEPA	Pakistan Environment Protection Agency
PFF	Pakistan Fisher Folk Forum
PMU	Project Management Unit
RBOD	Right Bank Outfall Drain
SCDRP	Sindh Coastal Rehabilitation Project
SRSP	Sindh Rural Support Program
SUPARCO	Space and Upper Atmospheric Research Organization
TMA	Tehsil Municipal Administration
WAPDA	Water and Power Development Authority
WSIP	Water Sector Improvement Project

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UP-DATED ASSESSMENT OF PRESENT CONDITION OF LBOD AND KPOD AFTER REPAIR WORKS AND FURTHER WORKS NEEDED

A. BACKGROUND

1. On September 10, 2004, the World Bank's Inspection Panel (the Panel) registered a Request for Inspection, submitted by Khadim Talpur, Mohammad Ali Shah, Mustafar Talpur, Munawar Hassan Memon, Iqbal Hyder, Mir Mohammad Buledi, and Najma Junejo on their own behalf and on behalf of "others who live in the area known as District Badin, Sindh Pakistan" in the Indus River Basin (Requesters). Many of the issues raised in the Request related to the LBOD Stage 1 Project, co financed by the Bank with ADB and other donors, which had closed in 1997. Fig. 1 gives the location and components of the LBOD System. The Requesters claimed that the LBOD system was faulty and they had incurred losses because of its poor design. The Requesters claimed that the Bank had failed to observe or had otherwise violated various provisions of its own operational Policies and Procedures. They also voiced concerns that the NDP project would extend the system to serve the entire Indus Basin, adding more effluents from the upper basin, through a National Surface Drainage System (NSDS).

2. The Executive Directors and the President of IDA were notified on September 17, 2004 by the Panel of receipt of the Request. Responding to the claims in the Request the Management authorized an investigation.

3. The Inspection Panel conducted the required investigation. The Panel met with the Requesters, local authorities and stakeholders including fisher folk, and discussed with Government of Sindh (GOS) authorities actions which could be undertaken in the short and medium term to address flood vulnerability and socio-economic and livelihood issues of people living in close proximity to LBOD and in the coastal zone of southern Sindh. The Panel issued its report outlining the findings of the investigation. The Management issued its Response in July 2006.

4. Although the NDP project as originally conceived in the 1997 Staff Appraisal Report (SAR) was to have laid the groundwork for the NSDS, the concept was subsequently rejected as a result of extensive studies and reviews.No extension of the LBOD spinal drain to join a national surface drainage system was done under the NDP project.

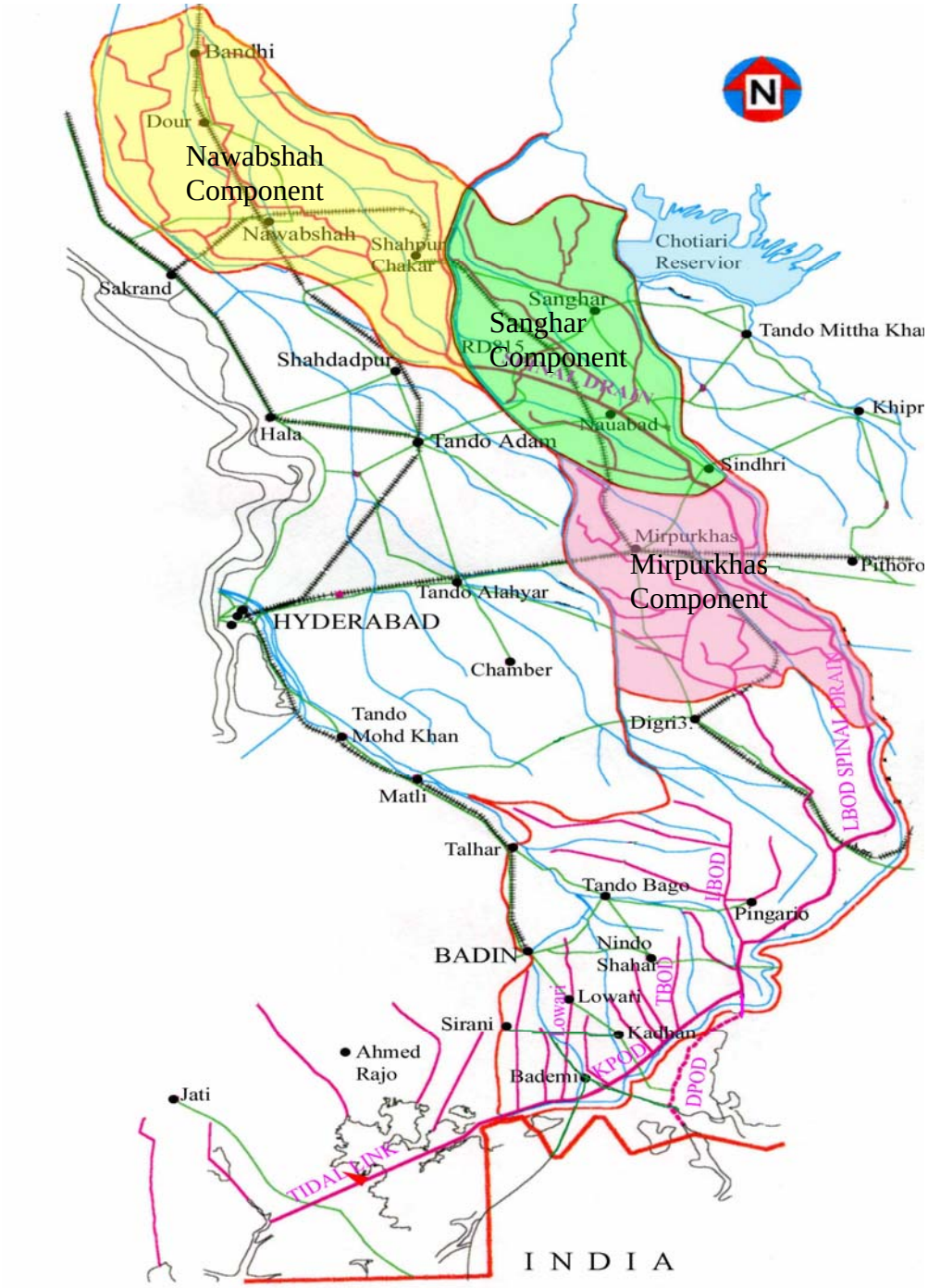
5. In the light of Panel's recommendations the Board of Executive Directors of the Bank approved a Short Term Action Plan, which consists of five activities:

- Implementation of the Coastal Area Development Program (CADP) in southern Sindh
- Rapid assessment of ecological and livelihood conditions in the dhands to identify immediate measures to improve livelihoods and ecological conditions
- Rapid assessment of existing local government flood risk management systems to reduce flood damage and vulnerability by building capacity and improving flood risk response

- Assessment of the condition of the right embankment of the LBOD spinal drain and KPOD and preparation of a detailed maintenance plan

- Processing of the Water Sector Improvement Project (WSIP) in order to ensure a rapid startup of the technical studies to design measures to improve the performance of LBOD and prepare a comprehensive flood and drainage plan for the left bank of the Indus River in southern Sindh.

Fig.1 – Location and Components of LBOD System



B. INTRODUCTION

6. For carrying out activity indicated under bullet point 4 in para 5 above relating to 'Assessment of the condition of the right embankment of the LBOD spinal drain and KPOD and preparation of a detailed maintenance plan' services of a consultant[1], were retained.

7. Starting work on April 09, 2007, the Consultant studied various reports previously prepared[2]. The Consultant undertook a mission to site from April 15, 2007 to April 21, 2007. He visited Karachi, Hyderabad, Mirpurkhas, Badin, Mirpurkhas Main Drain, LBOD, KPOD and starting point of Tidal Link to learn about the project area and see repair works accomplished and/or on-going, and to discuss the issues with government officials, technical staff of the concerned agencies and Institutes, local government officials, and NGOs[3]. It was not possible to inspect the Tidal Link beyond its starting point without a boat due to virtually non-existent IP. Based on the findings of the mission, review of the previous reports and discussions held with the staff and management of the Sindh Irrigation and Drainage Authority (SIDA), the Chief Engineer and Staff of WAPDA's Hyderabad Office, the Director (Left Bank Canals AWB) and the Director (Nara Canal AWB), the Consultant prepared the report entitled " Assessment of Present Condition of LBOD and KPOD after Recent Repair Works and Further Works Needed", and submitted it on June 06, 2007. This report among other things contained a detailed Plan of civil works (Annex 3) needed to restore the damaged and deteriorated surface drainage system of LBOD to its designed parameters and proposed M&R yardstick (Annex 2) for preparing annual budget for carrying out the routine M&R activities to prevent accumulation of maintenance. The report also contained the recommendations for the actions required by Go Sindh, SIDA, AWBs and others.

8. The services of the Consultant[4] have been again retained to up-date the assessment report prepared in June 2007. The Consultant undertook a mission to site from November 06, 2007 to November 11, 2007. He visited Karachi, Hyderabad, Mirpurkhas, Badin, LBOD between RD159 and RD 305 and KPOD between RD 84 and RD 159 to learn about the current status of repair works accomplished and/or on-going, nature of events that took place during monsoon seaon, and to discuss the issues with government officials, technical staff of the concerned agencies and Institutes, local government officials, and NGOs.

9. Like the last mission in April 2007, the government and non-government officials and technical experts were extremely generous with their time and provided data and background information. The staff and management of the Sindh Irrigation and Drainage Authority (SIDA), the Director (Left Bank Canals AWB), the Director (Nara Canal AWB), the Team Leader of the Consultants engaged by WAPDA for carrying out the feasibility studies of various solutions to the problems of LBOD and NGOs[5] provided substantive support to the Consultant. The Consultant is grateful to all these officials and experts for their hospitality and assistance. This report gives the up-dated assessment of present condition of LBOD and KPOD.

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[1] Mr. Muhammad Ehsan
[2] List of documents consulted in preparing this report is given in **Annex 6**
[3] List of organizations and officials met by the consultant is given in **Annex 4**.
[4] Mr. Muhammad Ehsan
[5] List of organizations and officials met by the consultant is given in **Annex 5**

C. FLOODS

1. Review of 2003 – Flood and its effect on LBOD

10. During the month of July 2003, Nawabshah, Mirpurkhas and Badin districts received heavy rainfalls[6]: Nawabshah (304 mm), Mirpurkhas (192 mm) and Badin (292 mm). The run-off produced by the rains in these districts, which includes the catchment area of LBOD System, enters the surface drains of LBOD System and goes to sea through LBOD Outfall system. **Fig. 2** shows the schematic diagram of LBOD System and its outfall. Review of the design of LBOD Outfall system indicates that it has been designed to cater for a drainage rate of 1.5 cfs / sq. mile which is equivalent to surface drainage rate of 42 mm (1.67 inches) in a month. Rainfall received in 25 days of July 2003 was on the average 295 mm, which was 7 times the discharge capacity of LBOD.

11. Considering the envisaged run-off factor of 20%, LBOD system received 0.286 MAF of the total quantity of 1.43 MAF produced by the catchment area of LBOD due to rains. In order to drain out rain water, 2,050 drain inlets, with a capacity of 1.8 cfs each, have been provided in the drains. The design discharge of LBOD Outfall system is thus 4,000 cusecs (7,934 AF/day) but it can accommodate up to 6,000 cusecs (11,900 AF/day) utilizing the freeboard. At this rate it would have taken ordinarily 24 days to evacuate this volume of water. In addition, Badin catchment area of 3.3 million acres received 300 mm rainfall which also entered in LBOD System.

12. For expediting evacuation of rain water from their fields the farmers of Nawab Shah, Sanghar and Mirpurkhas made cuts in the drains of LBOD system that further increased the flow in Outfall Drain. This caused overflowing in the LBOD. The situation further aggravated due to flows from canal escapes and breaches that entered LBOD. It is pertinent to note that I&P Department did not close the inflows to irrigation canals despite the rainfall that worsened the flow condition in LBOD system which had to carry many times more discharge than the capacity of drains. High tide in sea and high level in Shakoor Dhand obstructed the flow, and area in the vicinity of Badin district suffered badly. It was observed on July 25, 2003 that a discharge of about 9,000 cusecs passed through Spinal Drain in the proximity of RD 159+000.

13. The 2003 floods were thus caused by a combination of factors: i) Rainfall in the area; ii) water coming to the area by the canals in the left bank below Kotri (total of more than 40,000 cusecs) iii) Drainage water of the record storm in the month; iv) drainage water coming from the upper Nara basin carried by LBOD; v) the connection of the upper DPOD basin to the LBOD system; v) high sea levels and surge caused by the storm which blocked the direct discharge of the water and raised the levels in the KPOD and LBOD; vi) DPOD emergency flood way did not function as per design. **Plates 1** to **4** show condition of the flow in LBOD and inundation of area during 2003 – Flood.

[6] Meteorological Records of rainfall

Fig.2 – Schematic Diagram of LBOD System

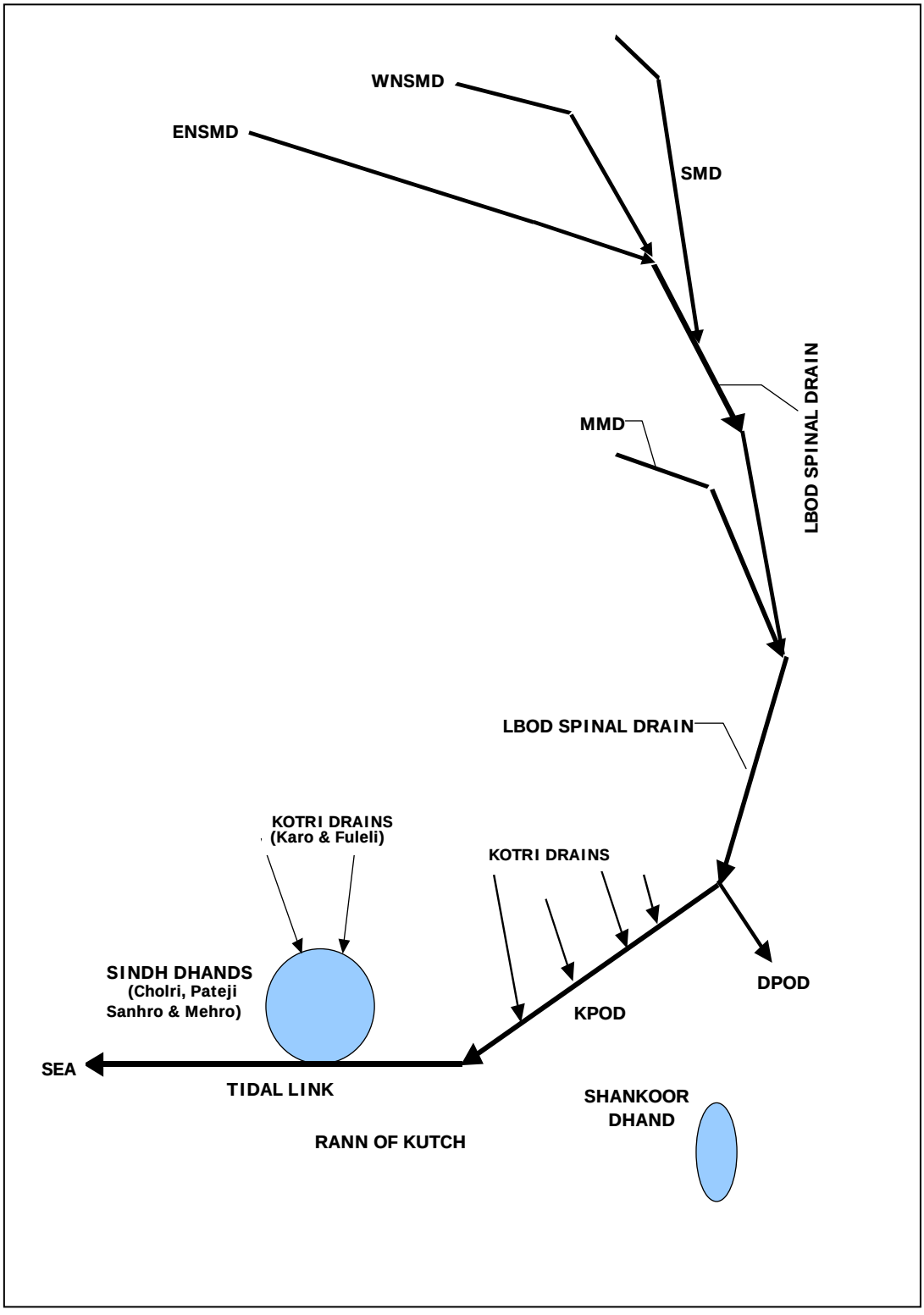

Plate 1: Flow through LBOD at RD-274 during 2003-Flood

Plate 2: View of Berm of KPOD after Receding of Water of 2003-Flood

Plate 3: Inundation caused by 2003-Flood

Plate 4: KPOD at RD 50 after receding of Water, Inundation Visible

14. There were several breaches in the system particularly in LBOD and KPOD. List of breaches that were plugged by SIDA is given in the Table 1.

Table 1: List of Breaches in LBOD and KPOD (July 2003)

Sr. No.	Location	(RD)	Breach Width (Ft)
1.	Shadi Large (LBOD)	182	35
2.	Kazi Qudus village (LBOD)	165	130
3.	Kazi Qudus village (LBOD)	163	50
4.	Kazi Qudus village (LBOD)	162	100
5.	Shadi large (LBOD)	170	45
6.	Vidhri Chak (KPOD)	158	80
7.	Vidhri Chak (KPOD)	158	30
8.	Vidhri Chak (KPOD)	158	50
9.	Village Mukhtiar (LBOD)	277	40
10.	Village Rahim Notkani (LBOD)	279	55
11	Village Mehrab Chandio (LBOD)	285	50
12	Near VRB (LBOD)	295	25

2. Review of 2006 - Flood and its effect on LBOD

15. Similar to the event of 2003-flood that occurred due to unusual rains during July 2003, there was another flood event in the LBOD project area in April 2006. There were intensive rains in the Lower Sindh as indicated in the Table 2:

Table 2: 2006 Rainfalls

Sr. No.	Taluka	Rainfall (mm)
1.	Badin	298
2.	Matli	231
3.	Talhar	205
4.	S.F. Rahu	110
5.	Tando Bago	144
6.	Mirpurkhas	272
7.	Digri	362
8.	Jhudo	150
9.	Kot Ghulam Muhammad	207
10.	Sindhri	281
11.	H.B.Mari	273

16. Besides sheet flows caused by the intensive rains entering the drainage system, the local farmers again made cuts in the drains of LBOD system for expediting evacuation of rain water

from their fields that increased the flow in the Outfall Drain. This not only caused overflowing and breaches in the LBOD but also breaches and overtopping occurred in other main drains, branch drains and sub-drains of the LBOD System. However, no water came to the area by the canals in the left bank below Kotri during the 2006 Event.

17. It is pertinent to note that the event of 2006-Flooding did not impact Badin district as severely as it happened during 2003-flooding. This is due to diligent work initially carried out by Army in filling breaches immediately after the occurrence of 2003-flooding, and later in restoration work carried out by AWBLBC that is still in progress.

18. Another significant phenomenon, however, that occurred was heading up of water upstream of pipe culvert bridges which had been designed to carry much less discharge than occurs due to heavy rains and cuts made by farmers. This caused breaches in the banks upstream, notable of these was at RD 350 culvert bridge across MMD, which caused breach in the left bank of MMD that threatened Mirpurkhas city. In order to safely pass the flow in the reach RD 245 to RD 500 of Spinal Drain of LBOD System, earthen and gunny bag dowels were constructed in emergency. The major breaches that occurred due to flooding are given Table 3.

Table 3: List of Overtopping and Breaches in LBOD System (April 2006)

Sr. No.	Nature and Location	(RD)	
		NIP	IP
Overtopping in LBOD			
1.	Several Overtopping in the reach	212-235	
2.	Overtopping in LBOD		225
3.	Several Overtopping in the reach		248-296
4.	Several Overtopping in the reach	270-298	
5.	Several Overtopping in the reach		298-300
6.	Several Overtopping in the reach	304-306	304-306
7.	Overtopping in LBOD	362	
8.	Overtopping in LBOD	431	
9.	Overtopping in LBOD	443	
10.	Overtopping in LBOD	449	
11.	Overtopping in LBOD	455	
12.	Overtopping in LBOD	479	
Relief Cuts by people converted to Breaches			
1.	Mirpurkhas Main Drain (MMD)	52	
2.	Mirpurkhas Main Drain (MMD)	117	117
3.	Mirpurkhas Main Drain (MMD)	151	
4.	Mirpurkhas Main Drain (MMD)		152.5

Sr. No.	Nature and Location	(RD)	
		NIP	IP
5.	Mirpurkhas Main Drain (MMD)		189
6.	Mirpurkhas Main Drain (MMD)		202
7.	Mirpurkhas Main Drain (MMD)		216
8.	Mirpurkhas Main Drain (MMD)	219	
9.	Mirpurkhas Main Drain (MMD)		
	Mirpurkhas Main Drain (MMD)		
Breaches and Washing-away of Embankments			
1.	Breach in LBOD	435	
2.	Mirpurkhas Main Drain (MMD)		350-357
3.	Sanghar Main Drain (SMD)	62-63	

3. 2007 - Monsoon and its effect on LBOD

19. During 2007, the cyclone Yemyin 03B threatened to hit the southern coastal areas of Sindh but it diverted and hit the coastal areas of Balochistan on June 23, 2007, causing severe damages in Balochistan and areas in the proximity of Karachi. There were heavy rains in Badin District and adjoining areas but due to the preparedness and rapid response of the GoS, no major damages occurred in Badin. The LBOD system capably handled the water flows in the area. From the gauge records of the KPOD, it was inferred that a maximum flow of 4,000 cusecs passed through KPOD. No breach in any of the drain in LBOD system has been reported. No emergent work was required to be carried out.

20. Due to rains, however, localized erosions (*gharas*) occurred at several locations on the NIP and IP of LBOD and KPOD where the earthwork had been completed to raise the banks by about 5ft.

D. REPAIR WORKS CARRIED OUT AFTER FLOOD EVENTS

1. Repair Works carried out by Pakistan Army after 2003 Flooding

21. After the 2003 floods, Rs.50 million were provided by WAPDA from the balance loan amount of the LBOD project in order to cope with immediate post flood situation. The emergent works to restore functioning of the outfall drains (KPOD and DPOD) were executed during the year 2004-05 in association with 5 Corps Engineers Pakistan Army in the following locations:

- Weir at RD 159 of KPOD: In order to pass more flow in DPOD to reduce passing of flow of the magnitude that passed in July 2003 through KPOD, the weir was slashed so as to lower it by 2 ft.

- KPOD, RD 25 to RD (-) 5: The earthwork has been carried out to restore Inspection Path (IP) in this reach. Also, the stone pitching in the reach RD (-)5 to RD (+) 1.030 has been provided on the outer slope of the embankment to counter the wave action of high water that may be caused by high tides that can come from the direction of Cholri Dhand due to collapse of the Cholri weir. The site was visited on April 17, 2007 and the works were noticed to be in reasonably good condition.

- KPOD, RD 60 to RD 50: The earthwork has been carried out to restore Inspection Path (IP) in this reach. No stone pitching has been provided on the outer slope of the embankment. The site was visited on April 17, 2007 and the work was noticed to be in reasonably good condition.

- KPOD, RD 60 to RD 52: The earthwork has been carried out to restore Non-inspection Path (NIP) in this reach. No stone pitching has been provided on the outer slope of the embankment. The site was visited on April 17, 2007 and the work was noticed to be in reasonably condition.

- Seerani Branch Drain RD.0.0 to RD.16: It was envisaged to restore Seerani Branch Drain. Also planned was the stone pitching along outer slope of IP side. The work has been completed.

- KPOD RD 0 to RD 84 (Both NIP &IP): The repairs to 10 pipe outlets were carried out.

- Repairs to 4 bridges at RD 27, RD 58, RD 77 and RD 84 of KPOD were carried out.

- KPOD RD 0 to RD 84 (Both NIP &IP): 16 new pipe outlets were constructed.

2. Works carried out by Left Bank Canals AWB (2005-07)

22. Left Bank Canals AWB prepared PSDP schemes for execution during the period 2005-07 in order to strengthen both banks of LBOD from RD 204 to RD 159, and KPOD in various reaches. The status of completion as of November 08, 2007 on the awarded contracts, when the Consultant visited site, is given in Table 4.

TABLE 4: Status of Works Carried out by Left Bank Canals AWB (2005-07)

No.	Description of Scheme	Contract Amount (Rs. M)	Expenditure As of End November 2007 (Rs. M)	Status of completion
1.	Earthwork for IP of KPOD RD (-) 5 to RD (-) 10, and stone	13.19	13.19	Work Completed

No.	Description of Scheme	Contract Amount (Rs. M)	Expenditure As of End November 2007 (Rs. M)	Status of completion
	pitching on outer.			
2.	Earthwork for IP of KPOD RD (-) 10 to RD (-) 15, and stone pitching on outer.	13.17	10.50	Work Substantially completed
3.	Earthwork of guide bank KPOD RD 0 - RD 4, and stone pitching on outer and inner sides of the guide bank.	16.03	0.00	Work not yet started due to lack of funds
4.	Earthwork of guide bank KPOD RD 4 - RD 8, and stone pitching on outer and inner sides of the guide bank.	15.24	0.00	Work not yet started due to lack of funds
5.	Earthwork for NIP of KPOD RD 5 - RD 15, and stone pitching on outer.	5.65	5.65	Work Completed
6.	Earthwork for NIP of KPOD RD 5 - RD 0, stone pitching on outer and construction of 5 Nos. Pipe Inlets at: (i) RD 1; (ii) RD 2; (iii) RD12; (iv) RD 20; and (v) RD 24.	11.65	10.60	Work Substantially completed
7.	Earthwork for IP of KPOD RD 25 - 50, RD 60 – 85 and RD 98-108.	13.73	13.73	Work Completed
8.	Earthwork for IP of KPOD RD 115 - 129, RD 146 – 159 and stone pitching at RD 23 opposite outfall bridge of Lowari Branch Drain.	12.18	12.18	Work Completed
9.	Earthwork for NIP of KPOD RD 15 – 52 and RD 60 – 85.	20.70	21.52	Work Completed
10.	Earthwork for NIP of KPOD RD 85 – 159.	22.75	22.75	Work Completed
11.	Earthwork for IP of LBOD Spinal, RD 159 – 204.	12.29	12.76	Work Completed
12.	Earthwork for NIP of LBOD Spinal, RD 159 – 204.	13.12	13.12	Work Completed
13.	Repairs to 2 bridges at RD 109 and RD 122 of KPOD	1.83	1.83	Work Completed

No.	Description of Scheme	Contract Amount (Rs. M)	Expenditure As of End November 2007 (Rs. M)	Status of completion
14.	Repairs to 2 bridges at RD 146 and RD 159 of KPOD	1.70	1.70	Work Completed
15.	Construction of 5 Nos. New Inlet Structures along KPOD	1.46	1.21	Work completed.
16.	Repairs of 15 Nos. Inlet Structures along KPOD	4.45	4.44	Work completed.
17.	Construction of 5 Nos. New Inlet Structures along LBOD	1.46	1.21	Work completed.
18.	Repairs of 8 Nos. Inlet Structures along KPOD	1.73	1.68	Work completed.

23. The Inspection Path (IP) of KPOD and LBOD in the reach RD (-) 15 to RD 204 has been converted into berm by off-setting the IP by at least 20 feet and constructing the new IP 5 feet above this berm. Similarly, the Non Inspection Path (NIP) of KPOD and LBOD in the reach RD (-) 15 to RD 204 has been raised by converting the old NIP into berm by off-setting the new NIP by at least 20 feet and constructing the IP 5 feet above this berm. In this manner the flow carrying capacities of LBOD and KPOD have been increased to cater for unusual flows similar to those that occurred in 2003 and 2006. But this has been done arbitrarily without hydrological analysis and re-visiting operational criteria of drains in the LBOD system to establish the credible maximum discharge, which should be subject of envisaged studies to be carried out by the consultants being engaged by WAPDA. Nevertheless, the aforementioned works which are substantially completed can stand in good stead in case of need to cope with unusual flows. **Plates 5** and **6** show condition of KPOD between RD 84 and RD 159. **Since the earthwork was not compacted using rollers but is consolidated only by the tractor-trolley used to haul material, there have occurred localized erosions (*gharas)* in new IP and NIP embankments during the monsoon season. Obviously, these *'gharas*' need to be repaired.**

Plate 5: View of NIP of KPOD near RD 90 (Nov. 08, 2007)

Plate 6: View of IP and NIP of KPOD looking towards RD 159 from D/S Side (Nov. 08, 2007)

24. The Left Bank Canals AWB also prepared schemes for execution during 2006-07 in order to re-section the prism and strengthen both banks of LBOD Spinal between RD 204 to RD 305.5 and Mirpurkhas Main Drain (MMD) from RD 30 to RD 254. The status of completion as of November 08, 2007 on these schemes, when the Consultant visited site, is given in Table 4.

TABLE 5: PSDP Schemes in Left Bank Canals AWB

No.	Description of Scheme	Estimated Cost (Rs. M)	Status of Completion
1.	Re-sectioning, raising and strengthening IP &NIP of LBOD Spinal, RD 204-220.	8.23	Work Completed
2.	Re-sectioning, raising and strengthening IP &NIP of LBOD Spinal, RD 220 - 255.	8.19	Work Completed
3.	Re-sectioning, raising and strengthening IP &NIP of LBOD Spinal, RD 255-270.	8.14	Work Completed
4.	Re-sectioning, raising and strengthening IP &NIP of LBOD Spinal, RD 270-305.5.	6.74	Work Completed
5.	Re-sectioning, raising and strengthening both banks of MMD, RD 30-60.	8.53	Work Completed
6.	Re-sectioning, raising and strengthening both banks of MMD, RD 60-90.	8.58	Work Completed
7.	Re-sectioning, raising and strengthening both banks of MMD, RD 90 - 120.	8.04	Work Completed
8.	Re-sectioning, raising and strengthening both banks of MMD, RD 120-150.	8.50	Work Completed
9.	Re-sectioning, raising and strengthening both banks of MMD, RD 150-180.	8.85	Work Completed
10.	Re-sectioning, raising and strengthening both banks of MMD, RD 180 -200.	8.58	Work Completed
11.	Re-sectioning, raising and strengthening both banks of MMD, RD 200 - 225.	8.78	Work Completed
12.	Re-sectioning, raising and strengthening both banks of MMD, RD 225 -254.	8.84	Work Completed

25. The Inspection Path (IP) of LBOD in the reach RD 204 to RD 305 has been converted into berm by off-setting the IP by at least 20 feet and constructing the new IP 5 feet above this berm. Similarly, the Non Inspection Path (NIP) of LBOD in the reach RD 204 to RD 305 has been raised by converting the old NIP into berm by off-setting the new NIP by at least 20 feet and constructing the IP 5 feet above this berm. In this manner the flow carrying capacities of LBOD and KPOD have been increased to cater for unusual flows similar to those that occurred in 2003 and 2006. Similar to what has been done on KPOD and LBOD between RD (-)15 and RD 204, this has been done arbitrarily without hydrological analysis and re-visiting operational criteria of drains in the LBOD system to establish the credible maximum discharge, which should be subject of envisaged studies to be carried out by the consultants being engaged by WAPDA. Nevertheless, the aforementioned works which are substantially completed can stand in good stead in case of need to cope with unusual flows. Plates 7 and 8 show condition of LBOD upstream and downstream of RD 305

Plate 7: View of LBOD Downstream of RD 305 (Nov. 08, 2007)

Plate 8: View of LBOD Upstream of RD 305 (Nov. 08, 2007)

3. Works Carried out by Nara Canal AWB

26. After the event of April 2006 flooding in the area, Nara Canal AWB also prepared PSDP schemes in order to re-section the prism and strengthen banks of the drains in its jurisdiction; West Nawab Shah Main Drain (WNSMD) and its sub-systems, East Nawab Shah Main Drain (ENSMD) and its sub-drains, Sanghar Main Drain (SMD) and its sub- drains including Makhi Branch Drain and its two sub-drains, Sinjharo Branch Drain and its sub-drains, Patoyun Branch Drain and its two sub-drains and c. However, except for the scheme relating to Mirpurkhas Main Drain (MMD) and its sub-drains from RD 254 to RD 365 no other scheme was undertaken due to lack of funds.

27. During the April 2007 mission, the Consultant visited the site of breach that occurred in MMD between RD 350 and RD 357 due to heading up of water upstream of pipe culvert located at RD 350. It was noted that bed clearance and repairs to banks in the reach RD 350 - 357 was in progress. Although an additional pipe had been added to the original single pipe after the event of 2003 flooding but it did not prevent the breach. The Consultant suggested to the concerned XEN and the AEN to provide further additions to the two existing pipes in order to prevent breach again at upstream of this location during the impending monsoon season to save Mirpurkhas city. During the November 2007 mission, the concerned XEN Drainage informed that scheme relating to Mirpurkhas Main Drain (MMD) and its sub-drains from RD 254 to RD 365 had been completed

E. PRESENT CONDITION OF LBOD

1. LBOD Spinal Drain

28. The repair works between RD 159 to RD 305 of LBOD both on the IP side (Right Bank) and NIP (Let Bank) are substantially completed. The Inspection Path (IP) has been converted into berm by off-setting the IP by at least 20 feet and constructing the new IP 5 feet above this berm. Similarly, the Non Inspection Path (NIP) in this reach has been raised, converting the old NIP into berm by off-setting the new NIP by at least 20 feet, constructing the IP 5 feet above this berm. In this manner the flow carrying capacity of LBOD in this reach (RD 159 to RD 305) has been increased to about 9000 cusecs to cater for the flows similar to those reported to have occurred in 2003 and 2006.

29. There had been breaches and overtopping in the reach RD 305 to RD 480 during the flood event of April 2006. **Thus, there is need to re-section and strengthen banks of Spinal LBOD up to RD 480 and upstream.** But, due to non-provision of funds in the 2007-08 PSDP budget no scheme could be undertaken. Despite the fact the LBC AWB made a request for allocating Rs. 816 million under PSDP the funds were not provided due to the fact all funds were diverted to mitigate the devastating effect of flooding in central Sindh on account of 13 breaches that occurred in FP bund near Shahdad Kot due to heavy rains

2. Kadhan Pateji Outfall Drain (KPOD)

30. The repair works on KPOD, both on the IP side (Right Bank) and NIP (Let Bank) have been completed between RD (-) 5 to RD 159. The Inspection Path (IP) of KPOD in the reach RD (-) 5 to RD 159 has been converted into berm by off-setting the IP by at least 20 feet and constructing the new IP 5 feet above this berm. Similarly, the Non Inspection Path (NIP) has been raised/being raised by converting the old NIP into berm by off-setting the new NIP by at least 20 feet and constructing new NIP 5 feet above this berm. In this manner the flow carrying

capacity of KPOD in the reach between RD (-) 5 to RD 159 has been increased to cater for unusual flows similar to those that occurred in 2003 and 2006 (reportedly maximum of over 8,000 cusecs during 2003). The KPOD is in a reasonably good condition to safely pass flows similar to those occurred in 2003 and 2006. **There is no immediate need to carry out more works on KPOD (except routine maintenance) until such time as the credible maximum discharge is established by hydrological analysis and re-visiting operational criteria of drains in the LBOD system, which studies are on-going by the consultants engaged by WAPDA**.

3. Dhoro Puran Outfall Drain (DPOD)

31. After the 2003 flood event, the weir at RD 159 of KPOD was slashed to lower it by 2 ft in order to pass more flow in DPOD to reduce the flow of the magnitude that passed in July 2003 through KPOD. **Plat 9** shows the lowered weir. No significant repair work has been carried out on DPOD itself, as none was considered emergent after flood events in 2003 and 2006. **There may be need to carry out works on DPOD after the credible maximum discharge expected to flow through it is established by hydrological analysis, re-visiting operational criteria of drains in the LBOD system and the problem of back flows in certain conditions and other flow retarding conditions in DPOD that do exist, which studies are to be carried out by the consultants engaged by WAPDA**.

Plate 9: View of Weir at Head of DPOD looking Downstream (Nov. 08, 2007)

4. Other Main Drains, Branch Drains and Sub-Drains of LBOD System

32. Except for closing breaches no special work is reported to have been carried out on other Main Drains, Branch Drains and Sub-Drains of LBOD System after the flood event of 2003.

After the flood event of April 2006, the banks of MMD were repaired and strengthened both by Nara Canal AWB and Left Bank Canals AWB in the reaches located in their respective jurisdictions. Due to inadequate funds available for M&R, e.g. allocations of only Rs. 4.55 million and Rs. 4.85 million were made during 2005-06 and 2006-07 respectively for surface drains of Nawabshah Division, all drains in this division are expected to be in need of major intervention to address the deferred maintenance to restore their design capacities. The situation in other divisions is not expected to be different than that of Nawabshah Division for the same reason of paucity of funds for carrying out routine maintenance.

F. FURTHER WORKS REQUIRED TO BE DONE FOR SURFACE DRAINS

1. General

33. During the events of flooding in 2003 and 2006, the surface drains of the LBOD Drainage System, for reasons stated in Sections C.1 and C.2 above had to pass discharges much higher than their respective safe carrying capacities. During the 2006 flood the banks of the drains were overtopped due to heading up of water upstream of pipe culvert bridges having lesser capacity than safe carrying capacity of the drain even at lower discharges e.g. at RD 350 of MMD. The flooding caused breaches in the banks, water passed over berms etc. This required not only closing of breaches but raising and strengthening of banks of the drains particularly the Spinal LBOD, KPOD and MMD to cope with the discharges similar in magnitude that occurred in 2003 should those occurred again.

34. Although there had been an investment of over 2,500 million Rupees under NDB but most of it (70%) was incurred on the 'Remodeling of Nara Canal' and Commissioning of Jamrao Twin Canal, 19% on the rehabilitation of drains related to drainage systems all other than those in LBOD System, 7% on lining of some 200 Water Courses and 3% on the procurement of Electrical and Mechanical equipment for LBOD System. Out of the eight performance contracts awarded for O&M of scavenger wells, interceptor drains, subsurface and surface drains of the LBOD Project in Sindh for 5 years, only two performance contracts were for surface drains of Sanghar and Nawabshah systems (total cost Rs. 82 million). Thus, the money spent under NDB on procuring civil works (through Performance Contracts only) for rehabilitation of surface drains in the LBOD System was only nominal. There is deferred maintenance in the prisms of drains. Until such time as the condition surveys are carried out it is not possible to identify the areas that would be more affected when the design parameters are exceeded. It is therefore considered appropriate to restore capacities of all main drains, branch drains and sub-drains as well as their banks to the designed parameters along their entire lengths to insure safe functioning of the System.

35. As was pointed out by the POE, it is emphasized that the monitoring program is essential to have a final LBOD Drainage System and Outfall System that can work according to the identified objectives. Due to complexity of the situation POE recommended an adaptive approach in order to learn at the same time the structures are built. This approach needs to be adopted to determine the nature and extent of long term works by hydrological analysis and re-visiting operational criteria of drains in the LBOD system and the consensus of all stakeholders after consultation. Pursuing this approach there is need to formulate an interim plan (keeping in view as to what has been done so far after 2003 flooding) to carry out the works necessary to ensure a safe function of the system, until such time as the nature and extent of long term works is established by hydrological analysis and re-visiting operational criteria of drains in the

LBOD system and the consensus of all stakeholders after consultation, inventory of the surface drains has been prepared.

36. For preparing this interim plan, an inventory of LBOD surface drains was compiled initially using the information contained in an Index Plan of LBOD provided by Director, Left Bank Canals AWB and "Operation and Maintenance Manual, Volume 3, The Surface Drainage System (December 1991)". The lengths of most of the drains given in the inventory were scaled from the AWB map. Wherever available the design discharges of the drains were indicated but substantial information had to be filled in this inventory relating to respective design discharges. Nevertheless, the information on lengths of the drains was sufficient to prepare the proposed plan of rehabilitation/restoration of LBOD Surface Drainage System, part of which has been implemented and some parts are on-going with the funds provided to SIDA under PSDP. Later, WAPDA's office at Hyderabad was contacted again during the month of May 2007. WAPDA provided the information that has been used to up-date the inventory. The up-dated inventory is given in Annex 1.

37. For estimating the cost of the works required to be implemented, unit rates per RD of each of the three types of the drains have been established using the costs of the completed works and on-going works. In the case of sub-drains it was assessed that those would require 50% of the unit cost for main drains while the branch drains would require 75% of the unit cost of main drains. Due to narrowing of section of spinal LBOD upstream of RD 305, it was assessed that the cost per unit length will be about 60% of the cost incurred on KPOD and LBOD main drains in the downstream reaches. The units rates used are: (i) Rs. 305,400 per RD of LBOD in reach RD 305-815; (ii) Rs. 306,700 per RD of other main drains such as MMD. SMD etc.; (iii) Rs. 230,000 per RD of branch drains; and (iv) Rs. 153,350 per RD of sub-drains. The proposed plan of rehabilitation/restoration of LBOD Surface Drainage System, prepared in June 2007, is given in Annex 2, while the summary is given in Table 6.

TABLE 6: Summary of Proposed Plan of Rehabilitation/Restoration of LBOD Surface Drainage System (June 2007)

Sr. No.	Description	Total Works Required	Phasing of Work						Remarks
			FY 2004- 05	FY 2005-06	FY 2006-07	FY 2007-08	FY 2008-09	Total FY 2004-09	
		Cost (M.Rs)	Cost (M.Rs)	Cost (M.Rs)	Cost (M.Rs)	Cost (M.Rs)	Cost (M.Rs)	Cost (M.Rs)	
1	East Nawab Shah Main Drain System	154.117				154.117		154.117	
2	Gajrah Branch Drain Sub-System	77.668				77.668		77.668	
3	Amurji Branch Drain Sub-System	94.306				94.306		94.306	
4	West Nawab Shah Main Drain	80.509				80.509		80.509	
5	Singhoro Branch Drain Sub-System	64.787					64.787	64.787	
6	Makhi Branch Drain Sub-System	30.822					30.822	30.822	
7	Sanghar Main Drain Sub-System	73.223					73.223	73.223	
8	Patoyun Branch Drain Sub-System	38.872				38.872		38.872	
9	Mirpurkhas Main Drain System	199.662			80.000	119.662		199.662	
10	Left Bank Outfall Branch Drain Sub-System	124.677				124.677		124.677	
11	Left Bank Outfall Spinal Drain	344.268		54.391		184.123	105.754	344.268	
12	KPOD System	275.751	64.402	49.638	73.920	87.791		275.751	
13	DPOD System	26.468				26.468		26.468	
14	Outfall Structures[7]	224.221				100.000	124.221	224.221	
Total LBOD Surface System		**1,809.349**	**64.402**	**104.029**	**153.920**	**1,088.192**	**398.806**	**1,809.349**	

[7] - The Outfall Structure to arrest effect of sea intrusion should be constructed only after comprehensive studies to properly locate it in KPOD.

2. Description of Civil Works needed as per Rehabilitation Plan (June 2007)

38. **DPOD:** No significant repair work has been carried out on DPOD itself, as none was considered emergent after flood events in 2003 and 2006. In order to ensure safe functioning of DPOD there is need to carry out detail condition survey of its banks and cross-sections to frame a scheme for strengthening of banks and adequacy of the prism to carry 2,000 cusecs particularly after the slashing of the weir at RD 159.

39. **KPOD:** All works envisaged for ensuring safe passage of flows through KPOD similar to those occurred in 2003 and 2006 have been either with funds provided under PSDP. For the nature of works carried out see para 23. The scheme (s) for the remaining works that relate to its 4 branch drains need to be prepared and completed by end of year 2007-08.

40. **LBOD:** The works in the reach RD 159 – 305 have been completed. For the nature of works carried out see para 21. There is need to re-section and strengthen banks of Spinal LBOD up to RD 480 and upstream. The accumulated maintenance in the 15 sub-drains and Shadi Bahadur Branch Drain out falling directly in Spinal LBOD is also required to be addressed. The proposed plan includes the works pertaining to these drains.

41. **Other Drains:** The proposed plan includes works for other main drains, branch drains and sub-drains in order to re-section and strengthen banks of these drains.

42. **Improving Outfall System:** In order to formulate a strategy to address the wide range of challenges of dynamic problems of LBOD Outfall System and achieve objective of improving the functioning of Outfall System, POE has indicated several structural alternatives in their report including: (i) "A" - Construction of a regulating structure at the junction of KPOD and the Tidal Link; (ii) "B"&"C" - Construction of two control structures at the bifurcation of the Spinal Drain, one in KPOD and the second in DPOD; (iii) "D"&"E" - Measures to protect the Kotri Drains by diversion of the Kotri drains that enter (or all of them as before) towards Pateji Dhand, and possibly Mehro Dhand; and (iv) "E" - Control of Tidal Link access to the Dhands – the most important but complex situation. Although the construction of outfall control structures to improve functioning of the Outfall System is included in this plan[8], as the construction of these structures is considered necessary to arrest intrusion of sea water and have flexible control over flows into DPOD and KPOD, but the location of the regulating structure at the junction of KPOD and the Tidal Link should be determined after comprehensive and thorough studies.

43. The cost of total interim plan of rehabilitation/restoration is of the order of Rs. 1,809 million (June 2007). An amount of Rs. 64 million were provided by WAPDA (Rs. 50 million out of the remaining loan amount available with them); and source of balance amount of Rs. 14 million is not known. The Government of Sindh committed Rs. 692 million under PSDP. Thus the total funds committed so far are Rs. 756 million. The balance amount of Rs. 1,053 million has to be ear marked from some other source. The information about availability of funds in GoSindh's future budgets is not known. As of end of FY 2006-07, the cumulative expenditure of Rs. 289 million was incurred, with the maximum spending of about Rs. 123 million during FY 2006-07. It is pertinent to mention that the amount required during the FY 2007-08 was Rs. 1,088 million. The envisaged expenditure of Rs. 1,088 million during FY 2007-08 seemed a large target but could be met with proper spade work i.e. preparation of annual work plans, immediate condition survey of the drains by respective Drainage Divisions of the two concerned AWBs,

[8] Item 14 in Table 6.

preparation of schemes, timely award of contracts and allocation of required amount in the budget.

44. No work has been carried out during the current FY 2007-08 due to non availability of funds. Request for special allocation and release of Rs 816 million was made to the Federal Government. There was devastating damage in the central Sindh due to 13 breaches in FP Bund near Shahdad Kot. Federal Government allocated Rs. 1,500 million for repairing FP bund and mitigating damage caused elsewhere due to these breaches. Federal Government stated that no further allocation was available beyond Rs. 1,500 million during the FY 2007-08 for Sindh Province. As such, the request for Rs. 816 million for spending on the LBOD system was turned down. CM, Sindh Dr. Arbab Rahim visited Golarchi, Badin and Tando Bago on August 27, 2007 and instructed desilting of branch and tributary drains of LBOD System in these areas. A special allocation of Rs. 138 million in this regard was made (Rs. 80 million for LBC AWB and Rs. 58 million for AWB Nara canal). However, no money has been reported released so far.

45. As a result of not carrying out restoration works as envisaged in the interim plan, there will be need to re-visit this plan and revise scheduling of the planned works.

G. ACTIVITIES FOR SUSTAINABLE SOLUTION TO THE PROBLEM OF FLOODING

46. The activities that need to be carried out to determine sustainable solution to the problem of flooding of surface drainage system of LBOD involve the following:

- Determine deficiencies in the existing LBOD Drainage System and find remedial measures;
- Carry out studies to determine the preferred revised design of the outfall system, considering the alternative proposals identified by the World Bank POE to reduce the flood risk problems and the impact of the discharge of saline effluent; and
- Establish an effective O&M program for the surface drains and outfall system of LBOD;

1. Studies Initiated

47. Government of Pakistan approved a PC-II for an amount of Rs. 41 million for carrying out the Feasibility Studies by retaining services of consultants to identify and mitigate the problem in LBOD Outfall and Badin Area Drainage System. WAPDA has been given the responsibility to procure and supervise these consulting services. WAPDA has retained the services of a joint venture of consulting firms to carry out the requisite studies, as per TOR described in para 48.

48. WAPDA prepared the TOR and sent those to SIDA and IPD for consultation. IPD arranged a meeting on January 11, 2007, attended by the following, to discuss and finalize these TOR:

(i) Rais Khair Muhammad Burgari (Chairman NC AWB Mirpurkhas);
(ii) Muhammad Hashim Dal (Chairman LBCAWB Badin);
(iii) Mr. Khair Muhammad Junejo (Notable Agriculturist);
(iv) Major (R) Omer Farooq Ahmed Khan (member LBC-AWB Badin);
(v) Muhammad Moosa Mehndhro (UC Nazim Bhugra Memon);
(vi) Mr. Noor Ahmed Bhurgri, Taluka Nazim KGM;

(vii) Syed Mumtaz Ali Shah, DCO Mirpurkhas;
(viii) Mr. Allah Dito Shar, DCO Sanghar;
(ix) Mr. Agha Aijaz Ahmed Khan, Managing Director SIDA Hyderabad;
(x) Mr. Atta Muhammad Soomro, Chief Engineer, Right Bank Sukkur; and
(xi) Mr. Ghulam Mustafa Dahri, Director Nara Canal AWB Mipurkhas.

49. The above mentioned participants suggested changes in the TOR circulated by WAPDA. The scope of work included in the approved TOR, also endorsed by participant of the above meeting (para 48), is as follows:

(i) To undertake a comprehensive study, conforming to the international standards, of LBOD System, must cover the following aspects.

- To examine the existing and required surface and subsurface water drainage capacity of the present system of LBOD outfall drains and its collector drains.

- The system needs to be enhanced in order to carry out taking saline and storm water in the event of maximum rains.

- Estimation for upcoming maximum saline effluent and storm water to be handled under worst scenario (historical rainfall intensity /over 300 mm rainfall) and evacuation of storm water should be possible within a maximum period of three to five/three days.

- To determine the deficiencies in the system in relation to the desired capacity of the system.

- The other options for disposal of the drainage effluent/ surface runoff through an outfall aligned in a North-south direction may also be considered, because one reason for failure of the tidal link is its alignment in an East-West direction.

- To suggest the appropriate structure at suitable place and related items of work necessitated to stop further scoring / intrusion of sea water in between RD.0 to RD.(-)22 of KPOD.

- Analysis of the present lines/ alignments of outfall drains and study of pre-inception of LBOD and natural drains/Dhoras and subject the best option to carry the storm/saline effluent smoothly into sea.

- Analytically determine parameters for redesigning of the entire LBOD Stage-I system and maximum permissible effluent and run-off recommended to be handled by the system.

- Analyse financial effects of various options highlighting the recommended option in relation to benefits.

(ii) Re-design entire LBOD System, including outfall drains, to provide for the following:

- Rainfall intensity of 75 mm with a return period of 50 years.

- Rainfall intensity of 150 mm with a return period of 50 years.
- Historical rainfall/ more than 300 mm.

(iii) Prepare the PC-1 Pro-forma [as modified by the Planning Commission] incorporating each one of the above mentioned options for approval and implementation.

(iv) Suggestions of stake holders may also be considered before finalizing the study for redesign of LBOD system.

(v) Assess the damages caused to the entire LBOD system and people of the area etc, due to alleged defective designing of LBOD system.

(vi) The environmental aspects of entire project may also be assessed and mitigation measures may be suggested.

(vii) The study of disposal of storm water into sea through Dhoro Puran Drain and activation of other natural drains as source of smooth transportation may also be conducted.

50. The studies have been started. The consultants have already submitted the Inception Report. The Mid Term is planned for submission in January 2008 while the studies to determine the preferred solution are planned for completion by end of June 2008.

2. Studies Envisaged in WSIP

51. The recently approved Project of Water Sector Improvement Program (WSIP), which would be implemented with the World Bank's financial assistance, among other things, "[…]" will support the preparation of a comprehensive flood management plan for the Left Bank of the Indus River in Sindh including the Indus delta and coastal areas. This regional drainage master plan, agreed with local stakeholders during preparation of the national Drainage Master Plan, will encompass both surface drainage, sub-surface drainage, water logging and salinity control and flood risk management, and will include appropriate structural and non-structural options (e.g., flood warning and communications, flood proofing and improved preparedness and response systems). Planning and infrastructure management capacity will be built and the capacity of local authorities will be strengthened. A modern, world-class knowledge base will be developed with appropriate analytical tools and information management systems to support planning, operations and management. The detailed design would be prepared and made ready for implementation of the priority works identified under the master plan under a future investment project that Sindh may undertake with the assistance of its development partners"[…]".

3. Need for Coordinating Studies

52. **The SIDA** would be the primary project implementing agency for WISP. As per PAD of WSIP, "[…]"SIDA would also be responsible for preparation of the master plan for flood and drainage management on the left bank of the Indus river and plans for delta area and costal zone (Component C2) in coordination with other concerned provincial and federal agencies, and collaborate in future project preparation (Component E2) and technical assistance, training and strategic studies (component E3) "[…]". There is thus need to establish coordination between

WAPDA and SIDA to streamline the modality of undertaking required studies so that: (i) there is no duplication of the activities among various agencies involved in studies; (ii) all studies are coordinated at a proper level; and (iii) the solutions found are acceptable to all stake holders.

H. O&M OF LBOD

1. General

53. O&M of the surface drains in LBOD system has been below par mainly due to two reasons; (i) inadequate funding; and (ii) un-smooth handing over of the system to GoSindh – handed over by WAPDA in 1993-94, returned to WAPDA in 1994 and again handed over to Go Sindh in 2002 which accepted it with reservations. Immediately after the take-over by GoSindh, there was an unusual flooding event in 2003. From that time onwards instead of routine O&M activities repairs and strengthening of drain embankments are being carried out with O&M funds as well as special budgeting provided by Federal Government and GoSindh. There has been no standard operating procedure (SOP) in vogue for carrying out O&M activities.

2. WAPDA Produced Manuals

54. The Consultants of WAPDA on LBOD Stage I Project produced procedures for O&M of LBOD System in five (5) volumes of the document entitled “Operation and Maintenance Manual”, Volume 3 pertains to the Surface Drainage System, which gives organization, operation procedures, maintenance needs, equipment provide by the Project for O&M activities (presumably also handed over to IPD, Sindh) and reporting Forms. No annual budget estimate or yardsticks have been included/suggested in this Manual. The list of equipment available for O&M activities, was supposed to be located at designated places indicated in Volume 5 of the Manual entitled “Equipment and Workshop”. Most of this equipment is now reported to be out of order.

3. Criteria for O&M of Drains

55. The procedure contained in Volume 3 of WAPDA produced O&M Manual, however, is different from the IPD procedure indicated by the criteria of the yardsticks for O&M of surface drains prepared by IPD in November 1988, which is as described below.

(i) 1" surgrassing of IP of main and branch drains in a year;

(ii) Excavation by Dragline considering that Branch Drain required bed clearance after every fifth year;

(iii) Excavation by Excavator considering that Sub Drains will require bed clearance in alternate year;

(iv) Weed clearance (branch & sub-drains) considering that all categories of drain require weed clearance every year as weed grows with flourish;

(v) Bankworks (all categories) manually by tractors considering wear and tear of 0.5 ft every fifth year;

(vi) Repair to structures @ Rs: 500/structures (VRB, DRB, VRC, RC, WCA, Siphon, SWI);

(vii) R&M of Vehicle considering 3 vehicles running 1500 KMS (1000 miles) per month at Rs. 3/- per KMS inclusive of major and minor repair; and

(viii) Rs. 30,000 for miscellaneous items of works.

56. Based on the above criteria the yardstick of Rs. 7,585/mile, Rs. 11,378/mile and Rs. 15,170/mile of main drain, branch drain and sub-drain respectively had been computed on the basis of the then Schedule of Rates (1988). The mile in this context means 5 RDs (5000ft). It is pertinent to note that this yardstick does not include the supervision charges i.e. salaries and allowances of XENs, AENs, SENs and regular vigilance staff (Baildars, etc) required through out the year. Also not included in this yardstick is the special additional temporary vigilance staff required in Kharif (Monsoon) season. This is perhaps the reason for engaging 'Abklani' labour reported to be hired at the rate of Rs. 1,250 per month, which is below par the minimum wages of Government for Grade 1 employees.

4. Current Budget Allocations

57. The annual budget allocations are made without regard to any yardstick and inflation, and are grossly inadequate. A total amount of Rs. 9.301 million has been allocated in FY 2007-08 for M&R of the entire LBOD system, out of which small amounts of Rs. 2.3 million and Rs. 1.3 million for LBC AWB and Nara Canal AWB respectively have been released to-date. The budget allocations for M&R need to be made realistic based on the prevailing Schedule of Rates and logical requirement for carrying out proper O&M activities.

5. Recommended Practice of O&M

58. There is need to develop improved and cost effective Standard Operating Procedures (SOP) for O&M of surface drains of LBOD System in the interim period till such time as the LBOD System is revamped after detailed studies. This should take in to account operating procedures so as to keep the flows in drains to as low as possible.

59. In addition, the criteria for routine maintenance should be made realistic so as to keep the drains in reasonably safe conditions to withstand effects of possible high flows.

60. Before the beginning of the fiscal year, in consultation with the beneficiaries (FOs, District Governments, etc.) the annual work plans for M&R should be prepared by the XEN concerned of the Drainage Division using the information provided by the concerned sub-engineer/AEN. These should be based on the unit works assumed in the approved Yardsticks or any inspection made to establish need for special/emergent repairs. The concerned Director, AWB should approve these annual work plans. The work plans should not be only in the form of lists of works but should have objective of carrying out M&R activities as envisaged by the unit works on which the Yardsticks are based. This will avoid possibility of accumulation of M&R works in case the funds are adequately provided.

61. For procurement of M&R works through contracting, there in need for timely preparation of bidding documents and award of contracts.

62. The key player in supervising M&R works during execution by the contractors is the concerned sub-engineer. In order to enable the sub-engineer to frequently supervise several M&R works simultaneously on-going (normally the case) official transport to the sub-engineer

(motorcycle) to visit remotely located sites should be available. AENs and XENs should also make codal checks on the implementation of M&R works.

6. Need for Updating O&M Yardsticks

63. Without changing the existing criteria for computing the O&M yardstick, as an interim step to provide for effective O&M activities, it is necessary to immediately up-date the financial costs of O&M works taking into account the inflation. At the rate of 10%/year, the up-dated yardstick works out to be Rs. 42,170 /mile, Rs. 63,260 /mile and Rs. 84,340 /mile of main drain, branch drain and sub-drain respectively. It is important to point out that administratively 6.5% inflation per year is allowed but the realistic inflation works to be 10% to match the market prices. Based on the aforementioned yardstick the annual budget requirement for each of the surface drain has been computed, which are given in **Annex 3**. **There shall, however, be need to revise the criteria for computing the yardstick to include the missing items such as the cost of routine vigilance through out the year and special vigilance during the Kharif season, and also taking into consideration prevailing market rates to make it realistic.**

I. CONCLUSIONS

64. Following conclusions are made in respect of assessment of present condition of LBOD and KPOD after recent repair works, further works needed and preparation of a detailed maintenance plan.

(i) The emergent works to restore functioning of the outfall drains (KPOD and DPOD) were executed during the year 2004-05 in association with 5 Corps Engineers Pakistan Army.

(ii) The strengthening of both banks of LBOD from RD 159 to RD 305, and KPOD from RD (-) 22 to RD 159 was found to have been completed.

(iii) The re-sectioning and strengthening of banks of Mirpurkhas Main Drain (MMD) from RD 254 to RD 365 have been completed.

(iv) The requisite re-sectioning and strengthening of remaining length (RD 305 to RD 815) of LBOD Spinal and all other main drains, branch drains and sub-drains remains to be undertaken.

(v) A total investment of the order of Rs. 1,809 million (June 2007) is needed for rehabilitation/restoration of surface drains of LBOD System. So far the total funds committed are Rs. 756 million consisting of an amount of Rs. 64 million provided for emergent works in year 2004-05 that included Rs. 50 million out of the remaining LBOD loan and Rs. 14 million, source unknown) and Rs. 692 under PSDP of GoSindh. The balance amount of Rs. 1,053 Million has to be ear marked from some source. As of end of FY 2006-07, the cumulative expenditure of Rs. 289 million was incurred, with the maximum spending of about Rs. 123 million during FY 2006-07. It is pertinent to mention that the amount required during the FY 2007-08 was Rs. 1,088 million. The envisaged expenditure of Rs. 1,088 million during FY 2007-08 seemed a large target but could be met with proper spade work.

(vi) As the construction of an outfall control structure across KPOD is considered necessary to arrest intrusion of sea water, its construction is included in this plan. In view of the huge investment involved and experience of failure of Cholri Weir it is necessary to determine its location after comprehensive and thorough studies.

(vii) There is a need to find a sustainable solution to the flooding problem of surface drainage system of LBOD by determining deficiencies in the existing LBOD Drainage System and finding remedial measures.

(viii) No Standard Operating Procedures (SOP) are in vogue for carrying out proper O&M of the surface drains of LBOD System. As a result, there is damage to drains during monsoon season and ad hock allocation of meager budget for O&M activities compounds the problem. There is thus need to establish a professional O&M program for the surface drains and outfall system of LBOD that should be fully funded.

J. RECOMMENDATIONS

65. Following actions are recommended for: (i) ensuring safe functioning of the system; until such time as the nature and extent of sustainable solution to flooding problem of surface drainage system of LBOD is established, (ii) proper O&M of the surface drains of LBOD system; and (iii) find the nature and extent of sustainable solution to flooding problem of surface drainage system of LBOD.

(i) Since the earthwork in the reach RD (-) 22 to RD 159 of KPOD and the reach RD 305 to RD 159 of LBOD has not been compacted using rollers but is consolidated only by the tractor-trolley used to haul material, rain-cuts (‘gharas’) and other deformation in the strengthened banks need to be repaired.

(ii) GoSindh needs to ensure that adequate funds are allocated in the budget during FY 2007-08 and 2008-09 for implementing the schemes to re-section and strengthen remaining length (RD 305 to RD 815) of LBOD Spinal drain and all other main drains, branch drains and sub-drains.

(iii) In order to carry out re-sectioning and strengthening of remaining length (RD 305 to RD 815) of LBOD Spinal drain and all other main drains, branch drains and sub-drains, responsible Drainage Divisions of the two concerned AWBs should start undertaking condition survey of the drains, prepare schemes and tender documents for award of contracts as soon as the funds are provided to them.

(iv) The duplication between studies initiated by WAPDA to find a sustainable solution to the flooding problem of surface drainage system of LBOD by determining deficiencies in the existing LBOD Drainage System and finding remedial measures and those envisaged in WSIP should be sorted out. There should be clear delineation of responsibilities and coordination of WAPDA and SIDA.

(v) SIDA in association with AWBs should prepare Standard Operating Procedures (SOP) for carrying out proper O&M of the surface drains of LBOD System. The O&M Manual (in 5 Volumes) prepared by WAPDA in 1991 and criteria used by IPD for computing M&R yardstick should provide the foundation to prepare the requisite SOP and corresponding realistic yardstick.

(vi) Due to ad hock allocation of meager budget for O&M activities the problem of damage to drains during monsoon season is compounded. There is thus need to establish a professional O&M program for the surface drains and outfall system of LBOD that should be fully funded.

(vii) It is necessary to immediately up-date the financial costs of O&M works taking into account the inflation. At the rate of 10%,/year, the up-dated yardstick works out to be Rs. 42,170 /mile, Rs. 63,260 /mile and Rs. 84,340 /mile of main drain, branch drain and sub-drain respectively as compared to the present yardsticks of Rs. 7,585/mile, Rs. 11,378/mile and Rs. 15,170/mile of main drain, branch drain and sub-drain respectively.

ANNEXURES

Available on website www.worldbank.org.pk

Annex 6

World Bank Response Letter to IRN

The World Bank
INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
INTERNATIONAL DEVELOPMENT ASSOCIATION

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Washington, D.C. 20433
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November 2, 2007

Mr. Ghulam Talpur
H # 10 St. 17, F-8/3
GPO Box No 2943
Islamabad
PAKISTAN

Ms Ann-Katherin Schneider
International Rivers Network (IRN)
1847 Berkley Way
Berkley CA 94702
U.S.A.

Dear Mr. Talpur and Ms. Schneider,

Subject: Pakistan National Drainage Program

Thank you for taking the time to meet with the me and my colleagues in Washington on October 18th, and for the frank discussion on the follow up that the Requesters and IRN are conducting of the Bank's Action Plan in response to the National Drainage Program (NDP) Inspection Panel case. We welcome the role that you can play in monitoring progress on the ground in the implementation of the Action Plan and would like to maintain open channels of communication with you.

We would like to provide some clarifications with regard to the issues discussed in the meeting, many of which were also raised in the brochure, "*Shattered Life, Broken Promises*", which you provided to us when we met, and which we understand has been circulated to selected parties within the Bank and members of the Board.

1. ***"The Action Plan does not address the root causes of the disaster in Sindh, which is the faulty design of the Left Bank Outfall Drain (LBOD) drainage disposal system"***

We understand that you are concerned that while the Action Plan includes a number of actions that will benefit the communities and address some of their concerns, until such time as the fundamental structure of the Left Bank Outfall Drain (LBOD) drainage system is addressed, the people in the area will be at risk of flooding, and that you do not see any actions to address this fundamental issue.

The LBOD project was implemented from 1984 to 1997. Internationally and locally recognized engineering and consultancy firms were hired to study irrigation and drainage problems affecting the area and make recommendations on how to address these issues. At that time, the LBOD/Tidal Link arrangement was determined by the relevant authorities in Pakistan to be the most appropriate solution. As a result, millions of people benefited from reclaiming and cultivating formerly barren land. It is also clear that poverty and environmental issues cover a wide entire coastal area. This is a large, highly complex and interrelated physical system with long-standing social and environmental issues.

In this context, it is prudent to resist going for quick fixes or acting on the basis of anecdotal evidence. There are a number of engineering solutions that have been suggested for the longer term drainage issues in LBOD. As you agreed in the meeting, it would be unwise for the authorities to prematurely implement any one of the solutions without adequate study and consultation. One of the benefits from NDP was the development of a new more participatory and integrated approach to the planning of drainage solutions.

The Acton Plan includes (funded through the Sindh Water Sector Improvement Project -WSIP) a careful review of complex hydrological, environmental, and social aspects as a basis for decision-making going forward. It would be premature to include in the Action Plan at this stage any specific solution to this issue. It is our expectation that after the relevant studies have been completed, and the various stakeholders consulted, the relevant Pakistani authorities will decide on a suitable arrangement for the long term drainage needs for the Left Bank.

In the interim, the Action Plan includes short term measures to mitigate flooding risks and their impact in the area, as discussed below.

2. ***"The vulnerability of the villagers in the LBOD affected areas has not been reduced"***

Vulnerability is a chronic problem in this flood-prone area and cannot be eliminated in the short term. A number of measures have however been completed under the Action Plan, which are already having an impact in reducing the level of vulnerability: These include:

- The Badin Local Government has developed a Flood Management scheme and a Contingency Plan. This mainly comprises "soft" flood management and information actions to warn people of pending floods and to mitigate their impact;
- The breaches in the drainage system caused by cyclones (in 2003 and 2006) have been repaired;
- The flow capacity of the outfall drains has been significantly enhanced from 4,400 cusecs to 9,000 cusecs by widening the drain, and strengthening and raising its banks, and the Government is continuously working on strengthening the banks to avoid flooding in the vicinity of drains; and
- The management responsibilities with respect to the monitoring and operation of the irrigation and diversion system has been agreed between SIDA, Government of Sindh and WAPDA.

3. ***"The livelihood program of the Action Plan does not target the affected villages and they received only one-third of the total financial assistance offered"***

The livelihoods component is not limited to any specific area, but has been designed to address livelihood issues in the coastal area where poverty is pervasive and severe. One of the positive outcomes from the Inspection Panel process was to increase awareness of the extreme poverty and difficult living conditions along the whole of the coastal area. Hence the broad design of this program. However, we have also committed to ensure that an appropriate amount of resources from this program goes to the villages in close proximity to the LBOD infrastructure and to the Dhands. Of the 336 projects that have been approved by the Poverty Alleviation Fund (PAF), about 113 are located in the villages of the Tehsils of Badin, Golarchi, Tando Bago and Diplo surrounding the Dhands, the Tidal Link and the KPOD area, consistent with the overall approach being pursued by the program. A map showing approximate locations of projects is attached. A list of these projects, with the village name and the partner NGO, is also attached.

4. ***"The ecological component of the project, the dhand study, is inadequate and has not been completed"***

The Dhand Study is about two months behind schedule. Initial delays were incurred in an effort to have consultations on the Terms of Reference (TOR) with the various partners and in putting in place contractual arrangements. The field work is now completed and the report for the study is due end of November 2007. The purpose of the study is to better understand the socio-ecological dynamics of the area and how it fits in the overall scheme of the functioning of the drainage and tidal system. As noted below, this work has been conducted with strong participation of the people living close to these dhands. You noted in our meeting that this was just the study, and asked why we did not include engineering solutions to alter the water flows and return the fresh water balance back to the dhands. For similar reasons as set out above, it would be imprudent to commit to a particular engineering solution absent these background studies and the overall view of the drainage of the Left Bank.

5. "The Action Plan was not prepared in consultation with the Requesters"

In addition to numerous visits to the area by both Management and the Task Team, all of which included discussions with affected communities, a specific meeting was organized on September 20, 2006 in Karachi to discuss the main elements of the Action Plan and gather comments with the Requesters. The meeting was chaired by the Additional Chief Secretary Government of Sindh. Mr. Talpur was invited to the meeting but as he noted when we met, he was not able to attend. Since the Inspection Panel Report had not been discussed by our Board, and the Action Plan thus had not yet been approved, the Bank had no authority to disclose or formally discuss either document at that stage. Nevertheless, the meeting constructively discussed the main issues and the areas of possible intervention.

6. "The Action Plan is not being implemented in consultation with the affected people"

One of the important elements of the Action Plan is the livelihoods component, which is being implemented through the PAF. The PAF works through Partner Organizations (mostly NGOs) with an established methodology that builds on social mobilization and Community Driven Development. Partner Organizations work in direct consultation with the various communities to develop and implement projects.Another important component of the Action Plan is the Dhand Study. In conducting the underlying ecological and livelihood assessments, 13 workshops were carried out between July and September 2007 in some 57 villages located in the vicinity of the Dhands with 553 registered participants. As noted above, the background studies for the long term drainage needs of the Left Bank also have a significant participatory component.

7. "The WSIP project has a different focus than the LBOD/NDP project and targets different issues"

The WSIP project was designed to have a broader focus on water management issues in Sindh and not solely to address LBOD or Tidal Link related drainage issues. However, since the project was being prepared at the same time as the Action Plan, it was agreed to include in the WSIP the studies needed to prepare a master plan for the area on the Left Bank of the Indus, the delta and the coastal zone which would help in examining structural and non-structural options to address drainage issues. The project has now been approved by the Board in line with what was agreed under the Action Plan.

We intend to report back to our Board on progress in implementing the Action Plan in late November or early December of this year. After discussion with the Board, our status report will be posted on the Bank's Pakistan Sindh Water website.

We remain available for further clarifications and discussions concerning implementation of the Board approved Action Plan. For your information we are also posting this letter on our web site, with a link to our report. In view of its interest in this matter, we are also copying this letter to the Chair of the Inspection Panel, and will be copying members of our Board on a case by case basis, should they have any questions about the issues raised in your report.

Sincerely,

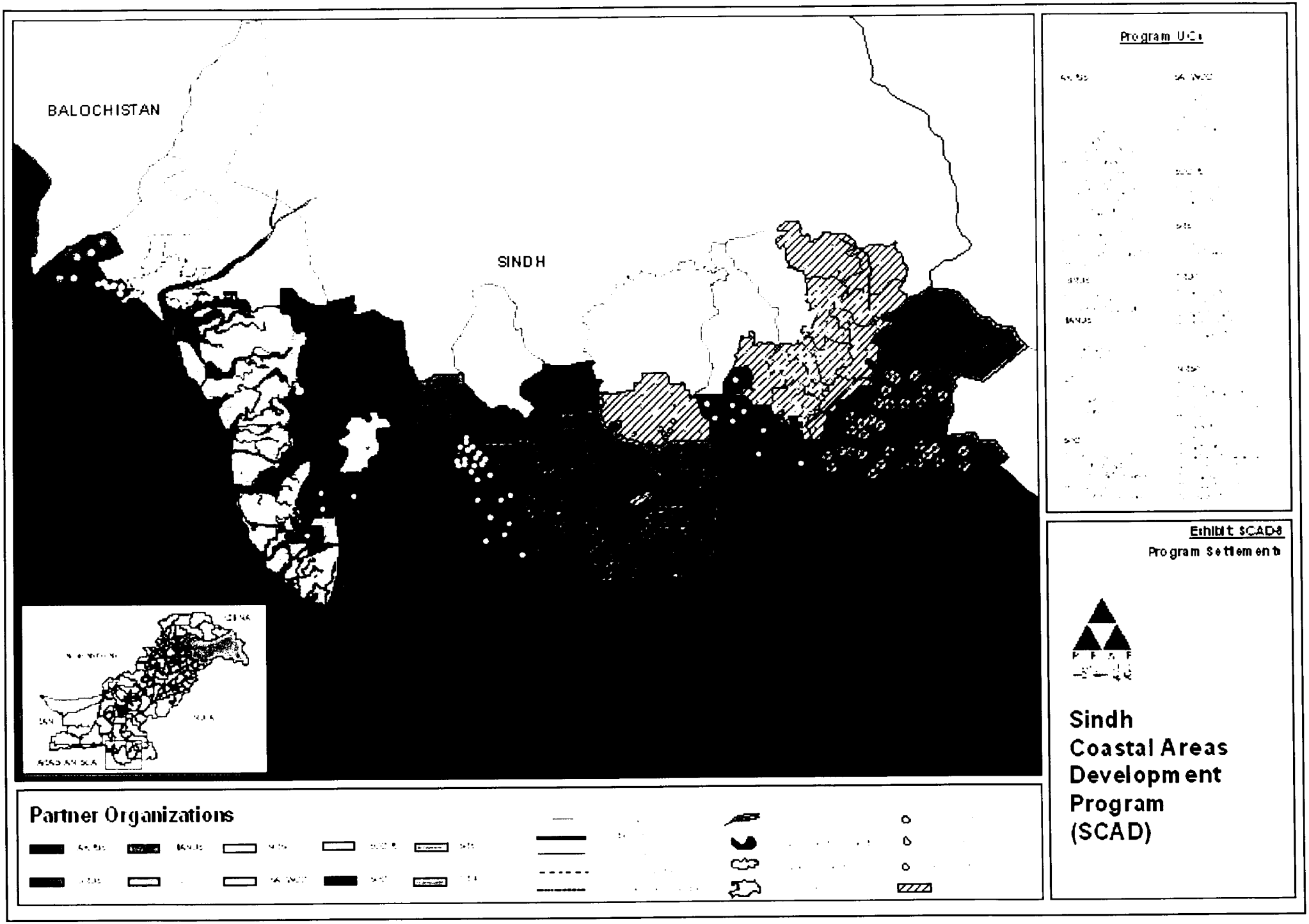
John Roome
Operations Director
South Asia Region

cc: Werner Kiene, Chairperson, Inspection Panel
Shuja Shah, World Bank Executive Director for Pakistan

SCAD PROGRAM SETTLEMENTS : LBOD BACKWASH REGION(LBR)

COMPLETED PROJECTS

Sr. No.	PO	Tehsil	UC	Village	Latitude Degree	Latitude Minute	Latitude Second	Longitude Degree	Longitude Minute	Longitude Second	Type of Intervention(s)	Estimated Cost (Rs.) (PPAF Share)
1	NRSP	BADIN	Abdullah shah	Haji Saleh Nohrio	24.000	34.000	26.200	68.000	55.000	52.400	Lift Irrigation	2,654,112
2	NRSP	BADIN		Haji Urus Soomro	24.000	38.000	35.700	68.000	55.000	33.400	Culverts	
3	NRSP	BADIN		Peroze Khan Jamali	24.000	33.000	22.900	69.000	2.000	38.100	Culverts	
4	NRSP	BADIN		Sallah Nohrio	24.000	36.000	11.900	68.000	55.000	34.200	DWSS	
5	NRSP	BADIN		Sallah Nohrio	24.000	36.000	16.800	68.000	55.000	20.200	Culverts	
6	NRSP	BADIN		Ishaque Soomro	24.000	37.000	23.200	68.000	55.000	44.500	Culverts	
7	NRSP	BADIN		Ishaque Soomro	24.000	37.000	20.400	68.000	55.000	29.600	DWSS	
8	NRSP	BADIN		Ibrahim Nohrio	24.000	37.000	25.600	68.000	56.000	46.000	Link Road	
9	NRSP	BADIN		Abdul Raheem Mehran Pota	24.000	35.000	25.700	68.000	55.000	58.100	Hand Pumps	
10	NRSP	BADIN		Haji Mohammad Soomro	24.000	37.000	43.500	68.000	54.000	56.700	DWSS	
11	NRSP	BADIN		Mohammad Khan Jamali	24.000	34.000	6.500	68.000	57.000	54.100	DWSS	
12	NRSP	BADIN		Obhayo Panhwer	24.000	34.000	23.900	69.000	0.000	56.600	DWSS	
13	NRSP	GOLARCHI	Ahmed Raju	Chak-10	29.000	30.000	22.800	68.000	38.000	43.900	DWSS	2,939,971
14	NRSP	GOLARCHI		Chak-15	24.000	28.000	55.600	68.000	40.000	15.700	DWSS	
15	NRSP	GOLARCHI		Chak-30	24.000	34.000	55.500	68.000	34.000	33.600	Link Road	
16	NRSP	GOLARCHI		[redacted]								
17	NRSP	GOLARCHI		Dawood Nohrio	24.000	32.000	24.100	68.000	38.000	9.000	Culverts	
18	NRSP	GOLARCHI		Chak-15	24.000	28.000	59.800	68.000	40.000	15.800	Culverts	
19	NRSP	GOLARCHI		Chak-10	24.000	30.000	23.700	68.000	38.000	37.500	Culverts	
20	NRSP	GOLARCHI		Chak-15	24.000	28.000	59.800	68.000	40.000	18.600	Culverts	
21	NRSP	GOLARCHI		Chak-10	24.000	29.000	52.200	68.000	38.000	37.500	Culverts	
22	NRSP	TANDO BAGO	Dadah	Bajhi Khaskheli	24.000	56.000	41.500	69.000	8.000	10.200	DWSS	1,007,000
23	NRSP	TANDO BAGO		Ghulam Nabi Jarwar	24.000	58.000	4.700	69.000	6.000	41.100	DWSS	
24	NRSP	TANDO BAGO		Pir Bux Khoso	24.000	56.000	29.900	69.000	5.000	4.800	Link Road	
25	NRSP	TANDO BAGO		Haji Noor M Jarwar	24.000	58.000	44.000	69.000	7.000	34.400	DWSS	
26	NRSP	TANDO BAGO	Dei Jurkus	Mohammad Khoso	24.000	39.000	46.800	69.000	13.000	49.400	DWSS	1,589,546
27	NRSP	TANDO BAGO		Mohammad Yousif Bhoot	24.000	35.000	7.000	69.000	9.000	28.500	DWSS	
28	NRSP	TANDO BAGO		Haji Sallar Soomro	24.000	36.000	56.400	69.000	7.000	29.800	Street Pavement	
29	NRSP	TANDO BAGO		Mohammad Ishaque Bhaunrio	24.000	45.000	35.800	69.000	10.000	6.000	Hand Pumps	
30	NRSP	TANDO BAGO		Janjwa Farm	24.000	37.000	49.200	69.000	12.000	4.100	Link Road	
31	NRSP	BADIN	Kadhan	Menghwar Muhalla	24.000	28.000	42.700	68.000	59.000	4.200	Street Pavement	2,896,434
32	NRSP	BADIN		Suleman Notiar	24.000	30.000	58.400	68.000	59.000	52.300	Link Road	
33	NRSP	BADIN		Natho Khan Bajeer	24.000	27.000	54.500	68.000	57.000	20.900	Link Road	
34	NRSP	BADIN		Tahir Bajeer	24.000	28.000	9.700	68.000	56.000	8.500	Link Road	
35	NRSP	BADIN		Jumoo Subero	24.000	29.000	24.300	68.000	59.000	48.400	Hand Pumps	
36	NRSP	BADIN		Allah Dino Bajeer	24.000	29.000	0.020	68.000	56.000	5.200	Hand Pumps	
37	NRSP	BADIN		Mohammad Rafique Dal	24.000	27.000	33.600	68.000	59.000	25.400	Street Pavement	
38	NRSP	BADIN		Qasim Jamali	24.000	28.000	47.600	68.000	59.000	27.200	Street Pavement	
39	NRSP	BADIN		Adam Bajeer	24.000	28.000	16.100	68.000	57.000	9.800	Street Pavement	
40	NRSP	BADIN		Ali Muhammad Jamali	24.000	28.000	34.000	68.000	59.000	20.000	Street Pavement	
41	NRSP	TANDO BAGO	Khalifo Qasim	Khabhar Bhoot	24.000	38.000	43.500	69.000	5.000	39.600	DWSS	2,914,112
42	NRSP	TANDO BAGO		Haji Ahmed Samoon	24.000	41.000	19.100	69.000	4.000	27.400	DWSS	
43	NRSP	TANDO BAGO		Ahmed kathai	24.000	38.000	52.800	69.000	5.000	39.000	DWSS	
44	NRSP	TANDO BAGO		ALi Mohammad Nohrio	24.000	40.000	39.600	69.000	6.000	51.900	DWSS	
45	NRSP	TANDO BAGO		Dilawar Khan Ahmedani	24.000	41.000	9.500	69.000	7.000	31.600	Link Road	
46	NRSP	TANDO BAGO		Haji Ahmed Samoon	24.000	41.000	22.300	69.000	4.000	27.200	Street Pavement	
47	NRSP	TANDO BAGO		Khabhar Bhoot	24.000	38.000	43.500	69.000	5.000	39.600	Street Pavement	
48	NRSP	TANDO BAGO		Khalifo Abdul Latif Daris	24.000	45.000	3.500	69.000	6.000	30.800	Hand Pumps	
49	NRSP	TANDO BAGO		Mohammad Hanif Dal	24.000	46.000	48.100	69.000	7.000	26.500	Hand Pumps	
50	NRSP	TANDO BAGO		Abdullah Khan Junejo	24.000	41.000	59.100	69.000	3.000	22.500	DWSS	
51	NRSP	TANDO BAGO	Khoski	Ghanwar Junejo	24.000	35.000	41.900	69.000	4.000	17.500	DWSS	3,091,631
52	NRSP	TANDO BAGO		Aleem Daris	24.000	36.000	51.700	69.000	4.000	53.600	DWSS	
53	NRSP	TANDO BAGO		Qaiser Ahmedani	24.000	34.000	33.700	69.000	6.000	4.500	DWSS	
54	NRSP	TANDO BAGO		Haji Mohammad Yousif Bhurghari	24.000	38.000	42.500	69.000	2.000	39.600	Link Road	
55	NRSP	TANDO BAGO		Mohammad Siddique Bhoot	24.000	40.000	38.300	69.000	6.000	38.500	DWSS	
56	NRSP	TANDO BAGO		Haji Khameeso Chalgiri	24.000	37.000	19.900	69.000	3.000	28.300	DWSS	
57	NRSP	TANDO BAGO		Chak FFR	24.000	37.000	7.400	69.000	11.000	6.700	Link Road	
58	NRSP	TANDO BAGO		Mohammad Hashim Lakhatio	24.000	38.000	17.000	69.000	3.000	32.300	Hand Pumps	
59	NRSP	TANDO BAGO		Qaiser Khan Khoso	24.000	38.000	14.400	69.000	0.400	21.100	Cross Drainage Structure	
60	NRSP	TANDO BAGO		Punhoon Rebari	24.000	40.000	12.000	69.000	8.000	59.700	Hand Pumps	
61	NRSP	TANDO BAGO		Talib Khoso	24.000	38.000	14.400	69.000	4.000	3.900	Street Pavement	
62	NRSP	BADIN	Lunwari sharif	Mohammad Juman Dasiro	24.000	33.000	12.800	68.000	50.000	59.000	Bridge	843,000
63	NRSP	BADIN		Noor Mohammad Dasiro	24.000	33.000	7.100	68.000	51.000	35.900	Link Road	
64	NRSP	BADIN	Mithi-III	Eidu Nohrio	24.000	31.000	26.000	69.000	5.000	20.500	Street Pavement	554,000
65	NRSP	BADIN	Nindo	Budhal Punhwer	24.000	38.000	38.600	68.000	58.000	47.600	DWSS	2,117,408
66	NRSP	BADIN		Haji Umer Soomro	24.000	40.000	22.300	68.000	58.000	37.200	DWSS	
67	NRSP	BADIN		Haji Umer Soomro	24.000	42.000	25.300	68.000	59.300	39.100	Bridge/Culverts	
68	NRSP	BADIN		Fazal Mohammad Shah	24.000	38.000	17.000	68.000	58.000	31.100	DWSS	
69	NRSP	BADIN		Fazal Mohammad Shah	24.000	38.000	10.300	68.000	58.000	25.300	Link Road	
70	NRSP	BADIN		Mohammad Arab Bhoot	24.000	38.000	56.600	68.000	59.000	38.500	DWSS	
71	NRSP	BADIN		Jummu Gudaro	24.000	39.000	58.500	68.000	58.000	4.600	Hand Pumps	
72	NRSP	BADIN		Mohammad Soomar Panhwar	24.000	38.000	8.100	68.000	59.000	1.800	Bridge	
73	NRSP	BADIN		Juman Shah	24.000	39.000	51.200	68.000	59.000	35.500	DWSS	
74	NRSP	BADIN		Ali Mohammad Jamali	24.000	34.000	49.500	69.000	1.000	36.600	DWSS	
75	NRSP	BADIN		Allah Rakhio Bhurghari	24.000	35.000	13.600	69.000	2.000	13.800	Street Pavement	
76	TRDP	Diplo	Bolhari	Padhrio	24.000	44.000	18.800	69.000	29.000	33.900	DWSS	280,710
77	TRDP	Diplo		Charail	24.000	41.000	15.540	69.000	27.000	20.570	DWSS	
78	TRDP	Diplo		Khoi Moora	24.000	41.000	56.200	69.000	28.000	32.900	Hand Pumps	
79	TRDP	Diplo		Senhar Khoi	24.000	19.000	15.880	69.000	29.000	2.090	Hand Pumps	
80	TRDP	Diplo		Dakan	24.000	23.000	1.740	69.000	27.000	30.700	DWSS	
81	TRDP	Diplo	Dabhro	Deermoon	24.000	17.000	51.820	69.000	31.000	55.750	DWSS	721,558
82	TRDP	Diplo		[redacted]								
83	TRDP	Diplo		[redacted]								
84	TRDP	Diplo		Khatho Nohri	24.000	17.000	40.790	69.000	22.000	33.310	Hand Pumps	
85	TRDP	Diplo		[redacted]								
86	TRDP	Diplo		[redacted]								
87	TRDP	Diplo		Sakri	24.000	22.000	52.800	69.000	25.000	33.900	Hand Pumps	
88	TRDP	Diplo		[redacted]								
89	TRDP	Diplo		[redacted]								
90	TRDP	Diplo		Sakri Juneja	24.000	22.000	52.800	69.000	25.000	33.900	Hand Pumps	
91	TRDP	Diplo		[redacted]								
92	TRDP	Diplo		[redacted]								
93	TRDP	Diplo		[redacted]								
94	TRDP	Diplo		Sakri Juneja	24.000	22.000	57.320	69.000	25.000	45.000	Hand Pumps	
95	TRDP	Diplo		[redacted]								
96	TRDP	Diplo		Bitri	24.000	21.000	2.690	69.000	28.000	32.100	Hand Pumps	
97	TRDP	Diplo		Kheenrohi	24.000	20.000	2.460	69.000	27.500	38.200	Hand Pumps	
98	TRDP	Diplo		Karivari	24.000	17.000	48.280	69.000	28.000	40.320	Hand Pumps	
99	TRDP	Diplo		[redacted]								
100	TRDP	Diplo		Sandooque	24.000	26.000	9.840	69.000	26.000	4.320	Hand Pumps	
101	TRDP	Diplo	Kaloi	Kaloi	24.000	39.000	11.300	69.000	17.000	19.900	Hand Pumps	96,000


BALOCHISTAN
SINDH
Program UCs
Exhibit SCAD-8
Program Settlements
Sindh
Coastal Areas
Development
Program
(SCAD)
Partner Organizations