ASSESSING POTENTIAL OF FARMER PARTICIPATION IN OPERATION AND MAINTENANCE (O & M) OF IRRIGATION AND DRAINAGE SYSTEM: A CASE STUDY OF LEFT BANK OUTFALL DRAINAGE PROJECT (LBOD) IN SINDH PROVINCE OF PAKISTAN

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Abstract

The paper aims at assessing the potential of farmers participation in managing irrigation and drainage system in the LBOD project area of Sindh province and examining farmers contribution for operating and maintaining (O & M) of the LBOD project, drainage facilities as well as their response in cost recovery in that area.

The Punjab province, where the experience of farmer drainage organizations (FDOs) have remained considerably successful, irrigated agriculture of Sindh province does also have huge potential of farmer participation in managing drainage infrastructure facilities. In this direction, the paper reveals that the declining performance of drainage facilities, including deep tube-wells, scavengers, interceptors and tile drains, has hampered reliability of irrigation supplies and control of salinity and water logging in the LBOD project component area, which has significantly affected crop yields, incomes, and overall quality of life of the farmers in the project area.

As a matter of fact, farmers have a grave concern regarding the operation and maintenance (O & M) of those drainage facilities, which were installed with the aim of reducing salinity and water logging; increasing crop yields, incomes and water supplies; and improving health and the environment. In order to address these problems, the paper suggests that there is need to encourage farmer's participation in managing irrigation as well as drainage network by forming farmer drainage organizations (FDOs) in the LBOD project area. It is suggested that this process of devolution can be implemented in the same way as it was successfully implemented through the introduction of farmer organizations (FOs) by competing authorities like SIDA and WAPDA. In this regard, the paper demonstrates that this process requires number of implementation measures, such as introduction of institutional reforms, participation of farmers from planning to sustained operation, provision of adequate maintenance funds, and training and

motivation of farmers and technical staff, particularly on operation and maintenance of the LBOD drainage facilities.

Introduction

Agriculture is the single largest and driving force of Pakistan economy, with a share of 20.9 percent to the country's GDP (Pakistan Economic Survey, 2007-08). Whereas Sindh's contribution to Pakistan's agriculture GDP is 23 percent with its contribution of major products, including cotton (23 %), sugarcane (31 %), rice (42 %), wheat (15 %) and livestock (28 %). Agricultural development in Sindh province is linked with the supply of irrigation water from the river Indus.

About 68 percent of rural population depends on irrigated agriculture, which employs over 46 percent of labor force and accounts for more than 60 percent of foreign exchange earnings. Pakistan's economic development is therefore directly linked with the progress of irrigated agriculture and sustainable management of water resources.

The sustainable management of water sector is expected to fulfill economic, social and environmental needs. Like many other developing countries, growing water scarcity in Pakistan, exacerbated by rapid population growth and urbanization; increasing demand for water in agriculture, industrial and domestic sectors; mismanagement and misallocation of water resources; and environmental degradation, has become one of the main policy issues in the country. In particular, the Sindh province has been confronting new challenges regarding the sustainability of water resources, which needs new approach towards managing irrigation and drainage system of water sector.

In most of the developing countries, experience has largely demonstrated that water management is complex and multi-level and requires comprehensive framework. A sectorial or sub-sectorial approach needs to be replaced by an integrated approach, which takes account of social, economic and environmental objectives, assesses water resources, evaluates and manages water demand, and seeks stakeholders' (farmers) participation (Azad, 2003).

In Pakistan, the Federal government plays an important role in establishing the overall framework for provincial-level operation in the water sector, and has made attempts at promoting better water allocation, planning and management. In the late 1980s, several factors involved in the declining performance of irrigation and drainage system; such as high cost to government; declining economic efficiency; problems relating to the design, construction and operation and maintenance (O & M); low cost recovery, and the lack of good governance; have made the Government of Pakistan to implement participatory irrigation management (PIM) approach through the involvement of water users/farmers in managing irrigation and drainage system at secondary and tertiary levels (Small and Carruthers, 1991; Pathan, 1999 and 2000).

In this regard, the Government of Pakistan, in 1995, transformed Provincial Irrigation Departments into Provincial Irrigation and Drainage Authorities (PIDAs), among which Sindh Irrigation and Drainage Authority (SIDA) is a well-known. SIDA was established in 1998 with three Area Water Boards (AWBs) on the Nara, Ghotki Feeder and Fuleli (Akram Wah) canals in Sindh province and 1200 Farmer Organizations (FOs) were established in the 14 canal commands/AWBs of these canals in order to manage O & M and to collect water charges. In 2003, 112 more FOs was established under Irrigation and Drainage Management Transfer (IDMT) agreements.

Over the past 10 years, like many other developing countries, including India, Sri Lanka, the Philippines, Turkey and Chile and so on, farmer participation has now become an important and evolving component of irrigation and drainage management in Pakistan (Pradhan, 1998). Out of four provinces of the country, the devolution process of irrigation reforms and management transfer has become significant in Sindh at all levels (Azad, 2003). The experience has demonstrated that farmers are socio-economically benefited through a growing and evolving farmer participation process in the country.

However, certain issues relating mainly to governance in the irrigation and drainage sector in Pakistan pose threats to the viability of farmer participation in irrigation management. As a result, the sector is undergoing a comprehensive institutional reform, which envisions farmer participation and empowerment to

increase accountability, transparency and equity along with an increase in water efficiency (Starkloff and Waheed-uz-Zaman, 1999).

Until recently, the experience of farmer participation in Sindh has remained significant, which suggest that there is also a huge potential for involving stakeholders/farmers in managing vertical (tube-well) irrigation and drainage system as well[1]. Pakistan has one of the largest canal irrigation systems in the world, but seepage from canals and poor irrigation practices has resulted in widespread problems of water logging and salinity, which has been adversely affecting the agricultural productivity, land value, farmer's income and their overall quality of life.

It is only in the recent past that the extent of damages caused by these problems was identified. Large-scale drainage was used as a strategy to control increasing water tables and salinity. For this purpose, different drainage projects were implemented, including Left Bank Outfall Drainage (LBOD) project in Sindh, to address

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[1] Until recently, the experience of farmer participation in managing canal (surface) irrigation network has gained a considerable success in Sindh in comparison to all four provinces of Pakistan. A substantial amount of literature, including mainly that by Pathan, P.A (1999 and 2000), suggests that there is also a huge potential of farmer participation by involving water users associations (WUAs) in managing tube-well (both vertical and sub-surface) irrigation and drainage network at secondary and tertiary levels in Sindh province. Most recently, farmer drainage organizations (FDOs) in Bahawal Nagar, Punjab, are actively involved in planning, designing and construction as well as O & M of drainage facilities.

There are four types of drainage systems in the LBOD project areas, including deep tube-wells, scavenger wells, interceptor drains and tile drains. Deep tube-wells and interceptor drains are located in Nawabshah, Sanghar and Mirpurkhas districts, scavenger wells are located Nawabshah and Sanghar districts. whereas tile drains are only located in Mirpurkhas district of Sindh province.

Deep tube-wells (vertical irrigation system) controls only water logging; interceptor (horizontal) drains, installed along the distributaries and canals, control seepage from distributaries and canals; scavenger (vertical) wells, installed along the canals, drains out sweet and saline water through the deep and shallow pipes respectively; and tile drains, made of brick tiles and triangle-shape, control water logging and work automatically when saline water control cross controlled water-table (SDSC, 1998).

the problem of water logging and salinity in the country. But, poor performance of these projects, mainly due to inadequate operation and maintenance (O & M) and failure of public institutions in handling the drainage structures, could not achieve the envisaged objectives (Pathan, 1999 and 2000). This may therefore need to address the issues related to the sustainable and viable involvement of farmer organizations (FOs) for the overall success of LBOD project from both water equity and sustainability perspectives.

Keeping in view the above aspects of participatory irrigation and drainage management transfer (IDMT) process in Pakistan, this paper therefore aims at (1) assessing potential of farmer participation in managing irrigation and drainage system in the LBOD project area of Sindh province and (2) examining farmer contribution for operating and maintaining of the LBOD project drainage facilities as well as their response in cost recovery in that area. In this regard, the paper also aims at assessing socio-economic benefits derived by the farmers in terms of increased productivity, income, land value and overall quality of life, which on the whole is envisaged to help in achieving self-reliance in agricultural commodities, providing food security and alleviating poverty in Pakistan.

Study Area and Sampling Methods

The Left Bank Outfall Drainage (LBOD) Project, Started in 1988 and financed by the World Bank, Asian development Bank, Islamic Development Bank, DFID, CIDA and the Government of Pakistan, was designed to address the problems of water logging and salinity in the three component areas of Nawabshah, Sanghar and Mirpurkhas districts of Sindh province.

The primary objective of this project was to dispose off saline drainage effluent into the sea, besides pumping saline ground water into a network of drainage canals with installation of tube-wells in those areas where water-table rose to within 1.5 meters or less of the surface (IBRD, 1984 and SDSC, 1998).

Though the installation of tube-wells (both vertical and horizontal sub-surface drainage devices) including deep tube-wells, interceptors and scavengers as well as construction of tile drains, it was recognized that there is a significant increase in the

agricultural productivity due to considerable decline in both the water logging and salinity in the project catchments area. According to WAPDA (2003), the cultivated combined area (CCA), served by all the four types of drainage systems, in the three components of Nawabshah, Sanghar and Mirpurkhas LBOD project is estimated at 1.274 million acres (Table-1).

Table - 1
Distribution of Sub-Surface Drainage by LBOD Project Components

Project Component	CCA (000 Acres)	Tube wells	Scavengers	Interceptors	Tile Drains
Nawabshah	555	273	190	53	--
Sanghar	358	617	180	122	--
Mirpurkhas	361	718	--	75	68
Total	**1274**	**1608**	**370**	**250**	**68**

Source: WAPDA, 2003.

For this study purpose, the sample design is based on multi-staged sampling, with clusters pertaining to drainage type and target farmers at the stages. In this regard, total number of all drains (i.e. deep tube-wells, scavenger wells, interceptor drains and tile drains) has been stratified by their type in the project component areas, including Nawabshah, Sanghar, and Mirpurkhas.

Using sampling methods based on probability proportion to size, weighting technique is used to select scientific sample of drainage in each project component. However, while selecting number of sample drains in each drain type, a careful approach is applied to ensure that representative number is included in the sample. For this, the sample is chosen by using a ratio of approximately 3.6 percent out of total drain types in the LBOD project area.

In this study a total of 21 drains have been selected for the research purpose. Out of 21 sample drains, 9 drains comprise deep tube-wells. Using proportionate size of total saline tube wells in all three-project components 3, 3, and 3 tube-wells have been drawn

from each of the components of Nawabshah, Sanghar, and Mirpurkhas. Similarly, out of all 370-scavenger wells in both Nawabshah and Sanghar, 6 scavenger wells (3 each) from Nawabshah and Sanghar were randomly selected.

Regarding the selection of interceptor drains 3 drains have been drawn for rational generalizations. Besides, 3 tile drains in Mirpurkhas are also chosen using same on random procedures. On the whole, a total sample of 63 farmers has been selected through distribution of sample farmers by drainage type in each of the LBOD project components, whereas 3 farmers have been selected, one each from small, medium and large size of landholdings in each sample drainage type unit. This sample size is quite reasonably taken into account the varying farm-size categories (Table-2).

Table - 2
Sample of Farmers by the Size of Land Holding in LBOD Project Components

Farm-Size (Acres)	Tube wells Nos	Scavengers Nos	Interceptors Nos	Tile Drains Nos	All in Nos.
Nawabshah Component					
Small (1-12)	3	3	3	-	9
Medium (13-50)	3	3	3	-	9
Large (50)	3	3	3	-	9
All	**9**	**9**	**9**	**-**	**27**
Sanghar Component					
Small (1-12)	3	3	-	-	6
Medium (13-50)	3	3	-	-	6
Large (50)	3	3	-	-	6
All	**9**	**9**	**-**	**-**	**18**
Mirpurkhas Component					
Small (1-12)	3	-	-	3	6
Medium (13-50)	3	-	-	3	6
Large (> 50)	3	-	-	3	6
All	**9**	**-**	**-**	**9**	**18**
All Components					
Small (1-12)	9	6	3	3	21
Medium (13-50)	9	6	3	3	21
Large (> 50)	9	6	3	3	21
All	**27**	**18**	**9**	**9**	**63**

Source: Research Survey Data, 2005-06.

Study Results

Land Cultivation Patterns by Drainage Types

It is mentioned that variables such as land cultivation patterns, crop use and cropping intensity vary significantly form

Kharif to Rabi[2] seasons of crop cultivation due mainly to inadequate irrigation supply and inoperativeness of drainage tube-wells pertaining to their operational faults and electricity problems. It is highly recognized that inoperativeness of Tube-Wells threatens the sustainability of adequate irrigation supplies as well as the improvement in water logging in the LBOD project area. Study results indicate that a largest size of land is cultivated by the farmers in order to grow different crops in Kharif and Rabi seasons respectively, however, a considerable size of cultivable land is left followed and abandoned (Table-3, Table-4 and Table-5).

Pathan (2002-03) argues that a reliable irrigation supplies as well as decrease in water logging can increase the size of both cultivable land and agricultural output, if canal and tube-well irrigation water is jointly used. This notion supports the study results that sustainable irrigation and drainage network can increase both a reliable irrigation supply and land productivity by facilitating farmers with the increased size of irrigated land and cropping intensity.

This can also support changes in cropping pattern, particularly crops with heavy water demands like rice and sugarcane, or cropping patterns, which allow farmers to optimize their combination of crops in order to gain more financial benefits.

The sample data, analyzing the key variables such as the cropping intensities, cultivation patterns and crop use by types of drainage and seasons, reveals that cropping intensities have remained high in Rabi season compared to Kharif. Wheat in Rabi and cotton in Kharif dominates in terms of area cultivated under these crops.

These crops are further followed by Rice and sugarcane. Data also shows that all three drainage modes have substantially contributed towards cultivations of the crops in the area (Table-6).

[2] Kharif & Rabi are two cropping seasons in Pakistan. Kharif season is from April –May to October –November, and Rabi from November-December to March-April. Rice, Sugarcane, Cotton, Maize, Bajra & Jawar are Kharif crops while Wheat, Grain, Tobacco, Rap seed, Barley, and Mustard are Rabi Crops.

Table - 3

Land Cultivation Patterns by Component and Drainage Type (% in CCA)

Study Area	Land Patterns	Kharif 2006	Rabi 2005-2006
Nawabshah	Crops	76	82.5
	Fallow	10	4.5
	Abandoned	9.9	9.9
	Others	3.1	3.1
	All	**100**	**100**
Sanghar	Crops	70	69.5
	Fallow	6.3	6.2
	Abandoned	23.7	23.3
	Others	---	---
	All	**100**	**100**
Mirpurkhas	Crops	45.7	47
	Fallow	2.8	1.2
	Abandoned	51.5	51.8
	Others	---	---
	All	**100**	**100**

Source: Research Survey Data, 2005-06.

Table - 4

Cropping Pattern in Kharif 2006 and Rabi 2005-06 Seasons

Kharif 2006 Season			Rabi 2005-06 Season		
Crops	**Area (Acres)**	**Percent**	**Crops**	**Area (Acres)**	**Percent**
Cotton	305	51	Wheat	317	51
Rice	76	13	Oilseeds	93	15
Sugar	82	14	Sugarcane	82	13
Vegetables	21	3.5	Vegetables	14	2.5
Orchards	53	8.5	Orchards	53	8.5
Fodder	62	10	Fodder	64	10
All	**599**	**100**	**All**	**623**	**100**

Source: Research Survey Data, 2005-06.

Table - 5
Cropping Intensities by Drainage Type

Drainage Type	Land Cultivation	% in Kharif	% in Rabi	Annual
Nawabshah component				
Tube wells	Cropping Intensity	63	77	140
Scavengers	Cropping Intensity	84	3	87
Interceptor Drains	Cropping Intensity	88	21	109
Sanghar component				
Tube wells	Cropping Intensity	93	93	186
Scavengers	Cropping Intensity	60	59	119
Mirpurkhas component				
Tube wells	Cropping Intensity	28.5	28.6	57.1
Tile Drains	Cropping Intensity	98	72	170

Source: Research Survey Data, 2005-06.

Access to Irrigation Supplies and Un-cultivation of Land by Drainage

It is universally recognized that increased land cultivation and agricultural production heavily relies on reliable and adequate irrigation supplies through out Pakistan and same is the case in the LBOD areas of all three components, including Nawabshah, Sanghar and Mirpurkhas districts. Besides, salinity and water logging and the resulted declining soil fertility are other main reasons for the irrigated land not to be cultivated by the farmers, which constrain farmers from increasing agricultural productivity and income.

Moreover, lack of farmers' access to money, credit, labor and technology are some other reasons being associated with farmers' decision making regarding land cultivation (Table 6). As a result, the current performance of drainage facilities, including deep tube-wells, scavengers, interceptors and tile drains, becomes increasingly questionable so far as reliability of irrigation supplies and control of salinity and water logging objectives of the LBOD project are concerned.

Ghassemi (1995) explains that drainage is as necessary as irrigation for land cultivation, control of salinity and water logging, and soil fertility. Thus, application of drainage techniques for

controlling salinity and water logging as well as maintaining irrigation supplies through sub-surface and vertical (tube-well) drainage types are necessary to address number of issues, such as water-table, depth control, ground water quality, soil improvement and crop yields enhancement.

Faruqee (1995) argues that the management of water resources is poor and damage to soil resources is considerable. The land available for cropping is being reduced due to variety of reasons, including lack of water, salinity and water logging and soil fertility.

The problem of inadequate drainage facilities was substantially addressed by the implementation of LBOD project, however, poor performance of drainage facilities in the area still seems to be the main reason behind addressing the problems as mentioned above. For that reason, farmers have no option other than land is not to be cultivated (Table-6).

Table – 6

Reasons for Land Not Cultivated by Drainage

10	Reasons for Land Not Cultivated	Area (Acres)	Percent (%)
	Kharif 2006 Season		
Tube-wells	Lack of Water	2994	76
	Salinity and Water logging	423	10.6
	Soil Fertility	413	10.5
	Other (Lack of money/labor)	115	2.9
	All	**3945**	**100**
Scavengers	Lack of Water	291	51.1
	Salinity and Water logging	142	25
	Soil Fertility	111	19.5
	Other (Lack of money/labor)	25	4.4
	All	**569**	**100**
Interceptors	Lack of Water	270	72.4
	Salinity and Water logging	33	8.85
	Soil Fertility	66	17.7
	Other (Lack of money/labor)	4	1.05
	All	**373**	**100**

Tile Drains	Lack of Water	548	63
	Salinity and Water logging	199	22.88
	Soil Fertility	115	13.2
	Other (Lack of money/labor)	8	0.92
	All	**870**	**100**
Total		**5757**	
Rabi 2005-06 Season			
Tube-wells	Lack of Water	2994	76
	Salinity and Water logging	423	10.7
	Soil Fertility	413	10.5
	Other (Lack of money/labor)	107	2.72
	All	**3937**	**100**
Scavengers	Lack of Water	291	58.7
	Salinity and Water logging	142	28.6
	Soil Fertility	38	7.67
	Other (Lack of money/labor)	25	5.03
	All	**496**	**100**
Interceptors	Lack of Water	270	86
	Salinity and Water logging	33	10.5
	Soil Fertility	7	2.23
	Other (Lack of money/labor)	4	1.27
	All	**314**	**100**
Tile Drains	Lack of Water	495	69
	Salinity and Water logging	135	25.1
	Soil Fertility	89	4.89
	Other (Lack of money/labor)	8	1.01
	All	**727**	**100**
Total		**5474**	

Source: Research Survey Data, 2005-06.

Crop Incomes

It is mentioned that the lack of water, salinity and water logging and soil fertility have adversely affected the land

cultivation patterns, cropping intensity, cropping output and so the cropping incomes earned by the farmers. On the whole, crop production in the LBOD area is badly affected by those factors, mentioned above. For example, the average yield of rice (i.e. metric/ hectare) is about 38 percent less to that of the province as whole. Similarly the yields of wheat and cotton (i.e. metric/hectare) are about 35 and 34% respectively below the provincial averages (Pathan, 2000).

The field observations revealed that the majority of farmer's source of income is crop production, although some household members of farming communities were also involved in different income generating activities including livestock, poultry, manual labor etc. Research experience in estimating crop incomes in similar studies indicates that crop incomes are one of the most difficult indicators to estimate.

According to Pathan (2002-03), the complexities, such as land tenure, subsistence and marketed crop production, and the lack of farm records contribute to this difficulty, even when great care is taken in collecting the primary data. Likewise, there was a widespread tendency among the respondents to under report outputs and incomes, because they suspect that either the collected information would be used to tax them in some way or will bring no particular benefits to them. Also, there was tendency among the farmers to over-report outputs and incomes so that they could get higher price of land if it gets sold or leased. The same kind of factors may affect the following data regarding crop output and net income (Table-7).

The analysis is carried out for all major and minor crops during each cultivation season (i.e. Kharif and Rabi seasons). The details of crop output, costs (i.e. crop production/variable and fixed costs) and crop incomes (i.e. gross and net incomes) are provided at all levels, including sample of farmers in each project component and bifurcation of crops grown in each location of all four types of drainage (Table 7). These are used here because they significantly explain the difference in crop incomes as a response to lack of irrigation supplies, salinity and water logging and soil fertility in the area.

This analysis mainly focuses on varying crop output and incomes achieved by the farmers in correspondence to the area

served by each drainage type. For the major inputs (e.g. fertilizers, pesticides, etc.) on which this analysis is focused, valuation has been conducted on the basis of market prices of these inputs. A selective number of crop inputs were used in estimating the cost of production mainly because of their direct relation with the crop incomes of the sample farmers. Thus, cost of total output is divided into two groups (i.e. fixed production/variable costs), mainly because of their nature and effects on the production incomes, including gross and net incomes which vary in terms of time period.

The gross income is the income earned from total crop output of sample farmers less production/variable costs, whereas net income is the income earned from total crop output less sum of both the production/variable and fixed costs. It is mentioned that overall performance of these drainage types has considerable impact on varying crop output and incomes. For example, Table 7 highlights the net income earned from cotton crops by the farmers is significantly higher in the areas served by deep tube-wells and tile drains to that of area served by scavengers and interceptors. Similarly, net income earned from water-demanding crop like sugarcane is

Significantly higher in the areas served by tube-wells and tile drains. These findings therefore confirm that reliability of irrigation supplies (i.e. joint use of canal and tube-well water) and the better performance of drainage system (e.g. tile drains) can significantly contribute to increased crop output and incomes.

Table – 7

Average Gross and Net Crop Incomes in the LBOD Area by Drainage Type (Rabi 2005-06 and Kharif 2006 Seasons)

Crop	Output Maunds	Rs. per Acre					
		Price/ Maund	Total Output	Production Costs	Gross Income	Fixed Costs	Net Income
Tube-wells							
Cotton	20	1200	24000	9090	14910	368	14542
Rice	39	400	15600	3610	11990	319	11671
Sugarcane	782	40	31280	14094	17186	457	16729
Wheat	33	350	11550	6827	4723	93.3	4629.7
Scavengers							
Cotton	18	1200	21600	9090	12510	368	12142
Rice	42	400	16800	3610	13190	319	12871
Sugarcane	639	40	25560	14094	11466	457	11009
Wheat	38	350	13300	6827	6473	93.3	6379.7
Interceptors							
Cotton	17	1200	20400	9090	11310	368	10942
Rice	38	400	15200	3610	11590	319	11271
Sugarcane	746	40	29840	14094	15746	457	15289
Wheat	41	350	14350	6827	7523	93.3	7429.7
Tile Drains							
Cotton	26	1200	31200	9090	22110	368	21742
Sugarcane	845	40	33800	14094	19706	457	19249
Wheat	33	350	11550	6827	4723	93.3	4629.7

Source: Research Survey Data, 2005-06.

Farmers' Perception about Drainage Performance

A substantial amount of international literature on farmers' participation in managing irrigation and drainage system around the world, including Pakistan, has gained an increasing attention with specific reference to operation and maintenance (O & M) of irrigation and drainage infrastructure.

In case of Sindh province of Pakistan, LBOD project was rated as positive with respect to reducing water logging and salinity, reducing damage to infrastructures, increasing yield, income and water supplies and improving health and the environment. In general, the project helped sustainable agriculture and enhanced rural livelihoods (Alam, 2000). But, despite all these

facts, the long-term sustainable management of LBOD drainage infrastructure remains highly questionable, specifically with reference to its poor performance that is largely affected by financial and institutional constraints.

A study, undertaken by Chaudhry and Bhutta (2000), assessed the performance of the Fourth Drainage Project (FDP) in Punjab, Pakistan. Their study revealed that in addition to finding constraints, major O & M problems were associated with periods of pump breakdown and un serviceability, electrical and civil work failures, poor maintenance, inadequate surface drain capacity, lack of beneficiary involvement and insecurity of facilities.

They made recommendations based on their observations and reviews of previous research, including introduction of institutional reforms, participation of farmers from planning to sustained operation, provision of adequate maintenance funds and training and motivation of farmers and technical staff, particularly on O & M of drainage facilities.

The study further recommended that the implementing agency should maintain the system until it can be placed on a sound operational footing involving local funds and facilities without dependence on imported technologies. Also, coordination between the construction and operating agencies must be guaranteed, and maintenance of surface drains should be given priority to enhance subsurface drainage. Likewise almost same is the case of the LBOD drainage facilities so far as their overall performance is concerned.

The sample data reveals that the majority of farmers were not found to be satisfied with the overall performance of LBOD drainage infrastructure, including deep tube-wells, scavengers, interceptors and tile drains. When farmers were asked to give reasons for increase in the price of land, 71.42 percent of sample farmers indicated that decrease in salinity and water logging is the main reason (Table 8 and 9).

This indicates that farmers, who are beneficiaries in terms of increased crop production and incomes as well as increased price of their land, are found to be highly concerned with the overall performance of drainage infrastructure that controls salinity and water logging in the project area. In addition, Table 10 further

confirms that a majority of farmers have complains regarding O&M of drainage facilities and electricity failures.

Keeping in view farmers' perception in particular and those recommendations made by Chaudhry and Bhutta (2000) in general, as mentioned above, there is huge potential of farmers' participation in operation and maintenance (O & M) of LBOD drainage facilities both at secondary and tertiary levels of irrigation and drainage infrastructure in the project area.

Table – 8

Reasons for Increase in the Price of Land

Reasons	Cases	Percent (%)
Decreased Salinity & Water logging	15	71.42
Road Construction & close to City	6	28.58
All	**21**	**100**

Source: Research Survey Data, 2005-06.

Table – 9

Farmers' Perceptions on Performance of LBOD Drainage Facilities

Drainage Type	Cases	Percent (%)
Tube-wells	141	49
Scavengers	64	22
Interceptors	55	19
Tile Drains	28	10
All	288	100

Source: Research Survey Data, 2005-06.

Table - 10

Farmers' Perceptions on Improved Quality of Water due to LBOD Drainage Facilities (Rabi 2005-06 and Kharif 2006 (Seasons)

Perceptions	Cases	(%)
Operational Fault	99	33
Lack of Adequate Supervision	10	3.3
Electricity Problem	92	31
Theft & stealing of parts	8	2.7
Theft of Electricity Installations	4	1.3
Lack of Interest by the Farmers	49	16
Lack of Training to Farmers to operate	3	1
Inadequate to willingness to own facility	13	4.3
Too much dependent on public initiatives	8	2.7
Other	14	4.7
Total	**300**	**100**

Source: Research Survey Data, 2005-06.

Conclusion

This paper reveals that the declining performance of drainage facilities, including deep tube-wells, scavengers, interceptors and tile drains, has hampered reliability of irrigation supplies and control of salinity and water logging in the LBOD project component area. As a result, farmers are left with land which could not be cultivated due to a variety reasons, including lack of water, rising salinity and water logging, declining soil fertility and lack of their access to money, credit and technology. Due to these reasons, it is concluded that the declining performance of the LBOD drainage facilities have significantly affected crop yields, incomes, and overall quality of life of the farmers in the project area.

As a matter of fact, farmers have a grave concern regarding the operation and maintenance (O & M) of those drainage facilities, which were installed with the aim of reducing salinity and water logging; increasing crop yields, incomes and water supplies; and improving health and the environment. In order to address the problem, there is a need to encourage farmer's participation in managing irrigation as well as drainage network by

forming farmer drainage organizations (FDOs) in the LBOD project area.

This process of devolution can be implemented in the same way as it was successfully implemented through the introduction of farmer organizations (FOs) by competing authorities like SIDA and WAPDA. In this regard, the paper demonstrates that this process requires to take a number measures, such as introduction of institutional reforms, participation of farmers from planning to sustained operation, provision of adequate maintenance funds, and training and motivation of farmers and technical staff, particularly on operation and maintenance (O & M) of the LBOD drainage facilities.

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