The Pakistan Development Review
41 : 1 (Spring 2002) pp. 49–67

Financial Capacity and Willingness of Farmers to Pay for Irrigation Services in the Post-reform Scenario in Pakistan: Two Case Studies

MEHMOOD UL HASSAN

To eliminate the subsidy on the canal irrigation system, the Government of Pakistan has decided to reform the management, intending to make it more efficient, equitable, transparent, and able to take care of the sustainability of the world's largest contiguous irrigation network. The water users are being entrusted with greater role in the management through the formation of Farmers' Organisations (FOs) to operate and maintain secondary canals and pay for full cost of water delivery. Ultimate payer will be the farmer. The economic viability of the reforms, therefore, much depends on farmers' ability and willingness to pay for the cost of irrigation water delivery, which is expected to rise. This paper estimates financial liabilities of the farmers in the post-reform scenario, and assesses their capacity and willingness to pay for liabilities in the provinces of Punjab and Sindh. One distributary in each of the two provinces is studied as the reference distributary, where FOs have already been formed. The cost of desired level of operation and maintenance levels are worked out using secondary data for 1997-98. With these costs, the water users in the Punjab and Sindh provinces need to pay Rs 333 and Rs 373 per ha for their water service, respectively. The estimated O&M costs form about 5.4 and 3 percent of production costs and 3.8 and 3.5 percent of the net income in the Punjab and Sindh provinces respectively. The farmers' net income from crop enterprise is higher than the cost of water. Thus, an average farmer has the potential to pay for water. Recent experience of Hakra 4-R Distributary FO suggests that the farmers are also willing to pay for water service, if they are organised properly.

1. INTRODUCTION

At present, the revenue generated by the canal system is half the amount expended on operation and maintenance (O&M) for the province of Punjab, and the equation is even worse for the other three provinces of Pakistan. The O&M cost of the irrigation system is expected to rise further in future on account of the positive

Mehmood Ul Hassan is the Water Institutions Specialist at the Central Asia Sub-Office of the International Water Management Institute (IWMI), Lahore.

Author's Note: The author wishes to acknowledge the valuable comments on an earlier version of this paper by Randolph Barker, Christopher J. Perry, and S. A. Prathapar, as well as the comments of an anonymous referee of *The Pakistan Development Review*. He also acknowledges with thanks the financial support and permission from the IWMI to carry out and publish this work.

relationship between the age and physical deterioration of the system. Persistently poor cost recovery situation has helped the government to embark on introducing institutional reforms in irrigated agriculture to cope with the rising costs of operation and maintenance (O&M) and decreasing revenue from the irrigation systems. Under these reforms, the Provincial Irrigation Departments (PIDs) have been transformed into financially autonomous entities, as Provincial Irrigation and Drainage Authorities (PIDAs) for their respective provinces. The PIDAs will comprise a number of canal command level Area Water Boards (AWBs). Initially, the PIDAs are establishing pilot AWBs on one selected canal command in each of the four provinces. The pilot AWBs have initiated establishing Farmers' Organisations (FOs) to take over the management responsibilities of the secondary system canals. The FOs will pay their respective O&M shares for the upstream irrigation system as well. The explicit objectives of the reforms are to manage the irrigation and drainage systems efficiently and improve the cost recovery [Punjab (1997); Sindh (1997)].

Though the PIDAs are yet struggling with legal, managerial, and financial frameworks, the reforms ultimately aim to establish a service-client relationship between PIDAs and AWBs, AWBs and FOs, and FOs and individual farmers. The service providers will provide water to the clients on bilaterally agreed terms and assess them for full payment of the costs of water delivery. The clients will be represented at the boards of the service providers. Therefore, the ultimate payer of the service would be the farmer. Paying full cost of water delivery would mean for the farmer much higher water charges than he is paying now [Small (1994)], even if he is not required to pay the capital costs of the system. Therefore, the success of these reforms will be highly dependent on the FOs' ability to make themselves socially acceptable among the members of the farming community, and on being economically viable. Success in establishing FOs will indicate that the community is willing to accept these reforms. The evidence of farmer organisations at the distributary canal level in Pakistan to date suggests that if appropriate social organisational methodologies are followed, organising farmers is not only possible but that farmers also show eagerness to manage their systems [Bandaragoda, *et al.* (1997)]. Recent evidence from southern Punjab [Hamid and Hassan (2001)] conforms to the earlier findings, for example those of Meinzen-Dick, *et al.* (1995), which show that as a matter of fact the farmers manage their system much better than does the state.

Since the farmers evaluate their system performance with regard to adequacy, reliability, and equity of the water service, the FOs can only be sustained by improving the system performance in terms of these indicators. As the total water diversions to canals are rather fixed, the adequacy of the water supply would be beyond an FO's control. To improve equity and reliability of the irrigation water service, there is a need to improve the seriously deteriorated physical condition of the irrigation system, which has been caused by the persistent accumulation of deferred maintenance. For physical improvement, the FOs will need to undertake

optimal investments in O&M of their parts of the system. They also need to pay sufficient money to the AWBs for optimal O&M of the main system that transports water to the distributaries. The financial liabilities of the FOs are expected to be higher than the current water charges being paid by the farmers, considering the full funding of the recurrent O&M as the target to be achieved.

The irrigation professionals in Pakistan usually question farmers' capability to handle O&M of the secondary levels of the irrigation system as they consider that farmers lack the necessary knowledge. However, this question is not relevant, as the FOs can hire professionals from the market for O&M of the distributaries and pay them, if the FOs are able to generate money from irrigation revenue. The real question to be asked is whether these organisations are willing and able to mobilise the required financial resources to undertake the responsibilities for effective O&M of the distributary and minor canals and also meet their obligations to pay for the O&M of the upstream irrigation system. Their ability to mobilise necessary financial resources hinges upon individual farmer's capacity and willingness to pay for irrigation water service.

Since the productivity of irrigated agriculture as well as farmers' returns from agriculture in Pakistan have declined for the past several years, one would wonder whether the farmers could afford to pay for the actual costs of a water service without an increase in their yields. The success of the current irrigation reforms largely depends on the capacity of the farmers to pay for water. Increasing water rates alone, without any consideration for their capacity to pay, would not yield any positive results. If the farmers have no capacity to pay, the FOs are likely to default, as many farmers will not be able to afford paying for water. The farmers' capacity serves as an important social criterion in setting the level and structure of water charges [Chaudhry (1986)]. If there is no capacity to pay, the number of defaulters and the amount of defaulted recoveries will increase, implying that funding for O&M will not be available for future years. Thus, assessing farmers' capacity to pay for water is crucial.

The paper at hand, therefore, attempts to address two crucially important research questions in the context of reforms: What would be the financial liabilities of FOs for operating and maintaining the irrigation system? And will the individual farmers be able to pay for these obligations?

This paper aims to address these two questions by estimating the financial liabilities of the farmers under the reform scenario, and by determining the farmers' capacity to pay for these liabilities. Evidence from one of the pilot projects regarding farmers' willingness to pay under the new set-up is also presented. The situation is analysed by looking into the current O&M spending, on the one hand, and by assessing the maintenance needed for the provincial canal irrigation systems and distributaries, on the other. The potential for financial viability of the farmers' organisation is addressed with reference to farmers' average capacity to pay for the target level O&M of the system.

Section 2 of the paper presents some salient features of the irrigation system. Section 3 illustrates research locale and methodology. Section 4 discusses the arrangements for O&M financing in the pre-reform context, and Section 5 deals with the desired O&M requirements. Section 6 elaborates on farmers' capacity and willingness to pay for water. Section 7 concludes the discussion.

2. IRRIGATION SYSTEM OF PAKISTAN

Pakistan has an arid climate with very high temperatures in the central and southern parts of the country. The weather plays an important role in determining agricultural productivity. The average annual rainfall in the Indus plain and the Peshawar Valley is around 229 mm. Most rainfall is received during the monsoon season, from mid-June to mid-August.

The major sources of irrigation water in the country are under public and private ownership. The private irrigation system constitutes 0.2 million tubewells located in the canal commands and dry land areas. Groundwater pumpage from these tubewells accounts for nearly 80 percent of the country's total groundwater exploitation, about 20 percent of the total irrigation supply at the source, and approximately 30 percent of total irrigation supply at the root zone. The public irrigation system derives irrigation supplies from surface water and public tubewells. The Indus Basin Irrigation System commands 80 percent of the country's irrigated area.

The current Indus Basin Irrigation System (IBIS) comprises the river Indus and its two eastern and four western tributaries. This irrigation system is called the Indus Food Machine for its importance in Pakistan's agriculture. The IBIS provides water for almost all the surface supplies. A small proportion of the surface supplies comes from the 30 small dams located in the hilly areas and the Pothohar Valley. The IBIS comprises of 3 major reservoirs, 19 barrages/headworks, 12 link canals, and 43 canal commands. The length of the link and main canals is around 845 and 63,000 kilometres, respectively. The carrying capacity of the link and main canals is around 3.1 and 7.4 cubic kilometres of irrigation water per second, respectively. These canals provide water to the farmers' fields through a network of approximately 89,000 tertiary channels, or watercourses. The total length of these watercourses is estimated to be over 1.6 million kilometres. The government operates and maintains the canal system; the farmers operate and maintain the watercourses. The culturable area benefiting from this system is estimated to be over 14 million ha, which is irrigated by a network of a number of perennial and non-perennial canals. Out of the total IBIS command area, 5.5 and 8.4 mha are located in the Sindh and Punjab provinces, respectively, where the major part of Pakistan's irrigated agriculture takes place. Thus, intended reforms matter most to these two provinces. The study, therefore, focuses only on these two provinces.

3. RESEARCH LOCALE AND METHODOLOGY

For the analysis related to the FOs' area of operation, one distributary in each of the two provinces was selected, where pilot projects for establishing FOs were in progress. The International Water Management Institute (IWMI), Pakistan, had selected these distributaries for its research on farmers' participation in distributary management. The Hakra 4-R Distributary in the Eastern Sadiqia Canal Command, a medium-scale distributary in the Punjab province, has a design discharge of 5.46 cubic meters per second and a culturable command area of over 17500 ha. The distributary feeds 123 irrigation outlets through its main channel and two minors.[1] There are 5 drop structures across the length of the main distributary, which is around 36 kilometres long and serves around 4700 farms. The farmers of the distributary are a mix of local people, recent settlers, and migrants by origin. The banks of the distributary were rapidly deteriorating due to animal and vehicular traffic. The freeboard has almost disappeared. The major maintenance problems of the distributary included berm-cutting, widened cross-sections, scouring in the head reach and silt deposition in the tail reach, and weak banks. The command area was gradually being converted to waterlogged and saline lands due to unreliable supplies. The farmers tended to grow rice for treating waterlogging and salinity, but usually over-irrigated due to unreliable supplies. The farmers complained about the inequity in the water distribut

ion and wanted to improve the water supply especially with regard to equity and reliability.

The Dhoro Naro Minor in the Rohri Canal Command was chosen as the reference channel in the Sindh province. This minor serves a command area of about 5350 ha with a design discharge of around 1.46 cubic meters per second and irrigating the lands through its 25 outlets. The minor serves about 421 farms of varying sizes. One of the major characteristics of the command area was a highly skewed distribution of land. The command area of the channel has been provided with a vertical drainage system, with 9 tubewells and a discharge in the range of 0.4 to 0.6 cubic meters per second each and serving blocks of command area of around 130 ha. Along both of these distributaries, farmers have been organised into FOs. The basic purpose of these FOs is to undertake the O&M responsibilities for their respective distributaries.

Methodology

The maintenance costs for the provincial-level systems have been obtained from the maintenance yardsticks of the respective provinces and inflated to the 1997-98 level using the inflation rates. The establishment (or operational) costs have been directly taken from the actual budgets of the PIDs.

[1]The term "minor" is often used in the Sindh province to mean a small distributary.

The projects carried out detailed maintenance assessment surveys to assess the required O&M costs. Socio-economic surveys entailed farmers income from crop production. The project staff prepared draft business plans after wide consultation with the FOs [Pirzada, *et al.* (1998); Hassan and Khatri (1998)]. These data have been used to estimate the O&M costs for the distributary level, as well as the incomes of farmers. The difference in the provincial-level O&M costs and the FO-level costs is treated as O&M costs of the primary irrigation system (barrages, main and branch canals) upstream of the distributaries.

4. PRE-REFORM O&M FINANCING

O&M Costs Defined

The PIDs generally refer to maintenance costs as maintenance and repair (M&R) costs. These include all construction, repair, silt removal, etc., that are not performed by the department's own employees, but are completed by registered (qualified) contractors instead. Maintenance and repair costs can be defined as the direct costs expended on the physical upkeep of the irrigation system. Another category of maintenance costs is referred to as "rehabilitation and improvement" costs. These costs do not form part of the regular maintenance cost allocations but are prepared as development projects and are generally aimed at lining and re-modelling canal systems, as well as extending the existing canal system.

Operational costs include staff salaries, allowances, and other benefits, usually referred to as "establishment charges" by the Irrigation Department. Fuel and lubrication for official vehicles and other office utilities form part of establishment expenditures as well.

O&M Budgeting and Allocation Procedures

The Water and Power Development Authority (WAPDA) operates and maintains the reservoirs. The respective PIDs are responsible for the O&M of the irrigation and drainage infrastructure within respective provinces, as irrigation is a provincial affair. The PIDs estimate annual O&M requirements, prepare budgetary proposals, and forward these to the Finance Department. A "yardstick"[2] serves as the basis to prepare budgetary demands for maintenance and repairs of the irrigation system. The latest yardstick for the Sindh Province was approved in 1986, and similarly, for the Punjab, by the Punjab Finance Department in 1992. Budgets demanded are not always approved [World Bank (1996)] and budgetary allocations

[2]The provincial governments have worked out standard costs of constructing and maintaining civil works in terms of amount of work and the cost of material, labour, etc. This is generally referred to as a "yardstick". PIDs in the Punjab and Sindh revise their yardsticks from time to time, but rather infrequently.

against these demands are usually lower due to cuts on the so-called "non-development" budget.[3] Besides, the yardstick is not adjusted in view of inflation levels. Thus, budget estimates ignore cost escalation after the year the yardstick has been approved. Another limitation in the yardstick approach is that there is no provision for purchase and maintenance of durable goods such as vehicles, equipment, etc., which may necessarily be required for optimal O&M of the system. Consequently, the rigidities in the yardstick approach do not allow capturing the effects of long-run economic and technological changes. Financial allocations based on the yardstick approach do not consider ever-increasing prices for labour and materials, and have considerably limited the quality of maintenance work.

Revenue Assessment and Collection Procedures

At present, the PIDs impose water charges on a per area basis, and these vary with the crops grown in each season. One obvious reason for levying crop-based water charges is that the farmers comprehend this structure easily. Water charges are set *ad hoc*, and there appears to be no systematic procedure for increases. Increases are not linked to inflation but rather to donor pressure. In both absolute and real terms, the result has been a decline in revenue. The variation in water charges among various crops is based on water requirements for those crops. However, the relationship is neither systematic nor directly proportional to the consumptive use of water by various crops [Chaudhry, *et al.* (1993)]. For instance, the water rates for rice and sugarcane should be much higher than those for cotton. In the Eastern Sadiqia Canal Command, the rates for rice are 5 percent lower than those for cotton, and 90 percent higher for sugarcane [Iqbal (1996); Mahmood (1996)]. Neither do water charges have anything to do with income generated by these crops [Chaudhry (1986)]. In current water pricing, the rational agricultural producers tend to maximise water use although it may be highly scarce.

The assessment system consists of detailed written records, whereby every action is double-checked at one stage or another. The underlying assumption, at the time of design, for such a complex water charges system was to eliminate, or lessen, corruption opportunities for the lower cadres of the Revenue and Irrigation Department staff. These complications, nonetheless, have opened ways of corruption [Chaudhry (1986)]. In the current system of water charges assessment, an irrigation assessor, or *patwari*, assesses the water rate based on the condition of the crop. This enables farmers to negotiate an arrangement to under-report the cropped area, or to declare a poorly harvested crop. The irrigation assessor, being a poorly paid official enjoying high social power within his area of jurisdiction of four to five villages, finds it difficult to avoid making money from such arrangements. The result of this assessment procedure is that much of the cropped area is reported fallow.

[3]The budgetary allocations for PID, Punjab, during 1993-94, for instance, were almost 30 percent less than the demand.

O&M Spending and Cost Recovery

O&M Costs: In general, the major part of O&M costs comprises operational costs; more specifically, establishment expenditures incurred for staff salaries and benefits, supplies and services, communication, and utilities. This recurrent expense does not fluctuate very much from one year to the next, unless the government undertakes a major revision of benefits for civil servants. Maintenance costs, except for emergencies like breaches, cuts, flood control, etc., are largely well-known in advance.

Financial constraints, to some extent, inhibit the PID's ability to carry out the required maintenance adequately. For instance, allocations during 1995-96 were 15 percent short of the budget demanded. A brief overview of the operation and maintenance costs incurred on the irrigation infrastructure, in both provinces, is presented in Table 1. The O&M expenditures presented here exclude costs related to public tubewells, assuming that the users bear the O&M costs themselves. The government has already started programmes to turn tubewells over to the users.

Operational expenses are around 70 percent of the total costs, while the remaining 30 percent are expended on maintenance.[4] Average establishment expenditure per hectare of command area is around Rs 159[5] and Rs 203 in the Punjab and Sindh provinces, respectively. Maintenance expenditures were about Rs 68 and Rs 85, respectively, for the Punjab and Sindh provinces. Average total O&M expenses for canal irrigation systems in the Punjab and Sindh provinces, respectively, are around Rs 227 and Rs 288 per ha.

Table 1

Operation and Maintenance Costs of Canal Irrigation Infrastructure in Punjab and Sindh Provinces

(Rs in Millions)

Serial No.	Particulars	Punjab (1995-96)	Sindh (1997-98)
1	Total Establishment Costs	1339.23 (159.43)	873.08 (203.04)
2	Total Maintenance Costs	570.73 (67.94)	363.61(84.56)
3	Total O&M Costs	1909.96 (227.38)	1236.69(287.60)
4	Establishment Costs as Percent of O&M	70	71
5	Maintenance Costs as Percent of O&M	30	29

Source: Irrigation and Power Department, Punjab, and Pirzada, *et al.* (1998).
Note: Figures in parenthesis are average expenditures per hectare of CCA.

[4]This amount, nevertheless, is not necessarily actually spent on maintenance. The findings of Mudasser (1997) showed that irrigation contractors were of the opinion that they had to pay 15–20 percent of the contracted tender value as a commission to gain approval for the tender. Only a few contractors were interviewed, however.

[5]1 US$ = Pak Rs 46.50.

Revenue Collection: The average revenue generated by the collection of water charges during 1995-96 was around Rs 164 and Rs 137 per ha for the Hakra 4-R Distributary in the Punjab and the Bareji Distributary in Sindh, respectively. These revenue figures were obtained by consolidating the PID records for the respective distributaries. According to the results of another sample survey of 117 farmers selected at random from along the Hakra 4-R Distributary [Hassan and Khatri (1998)], all reported that they had paid *abiana* (water charges). Only 1 percent of the sampled farmers had reported crop failure (*kharaba***)** to qualify for a concession of the *abiana*. The general belief is that the secondary-level irrigation systems generate revenues that usually exceed the costs incurred on these systems. This view is rather simplistic, as the cost of water delivery from the source is not considered.

At current collection rates, the canal system's revenue falls short of the desired level of collection. Farmers are paying less than the target level. This subsidy can be met by controlling under-assessment and leakage. The present system of revenue assessment and collection provides many opportunities for farmers to influence the irrigation assessor to reduce water charges. Claiming (falsely) hailstorm damage, or floods and earthquakes, identifying cropped land as fallow or healthy crops as struck by disease, and declaring that seeds completely or partially failed to germinate, is easily possible.[6] Outlet enlargement is another means of misappropriating canal water.

If the target of zero subsidy is to be achieved, users need to pay higher than current water charges, even at the present level of O&M spending, which might be much below the optimal maintenance requirements of the system. Therefore, there is a need to establish the desired O&M financing level, with the farmers' liabilities based on these calculations.

5. DESIRED O&M FINANCING

Maintenance Cost for the Provincial Irrigation Systems

The PIDs use their respective yardsticks to estimate maintenance expenditures for one year. Despite the limitations, the yardstick can be used to estimate desired maintenance expenditures, if the estimates incorporate inflationary adjustments. The yardstick for the Sindh province, on a unit area basis, calculated maintenance expenditures to the tune of Rs 62 per ha for 1986-87 [Sindh (1987)]. The budgetary demands prepared by the PID in the Punjab for the year 1992-93, when the yardstick was revised [Punjab (1992)], are used to calculate the per unit cost of maintenance for the irrigation system. The total PID budgetary demands for the irrigation system, excluding tubewells, were around Rs 101 per ha. These estimates depict the required

[6]For example, the underestimation resulted in an annual financial misappropriation of about Rs 60 million in the Punjab province alone, according to Chaudhry (1986).

maintenance needs for the respective years. After inflationary adjustments, the maintenance cost for 1997 comes to Rs 174 for the Punjab and Rs 170 for the Sindh province.

Average Establishment (Operational) Costs for the Provincial Irrigation Systems

Staffing policies announced by the provincial governments through the PIDA Acts clearly indicate that establishment costs will be reduced over time by the adoption of various measures, but no drastic change is expected initially. Therefore, it is assumed here that the average establishment costs for the irrigation system will not decline immediately, but will remain constant at current levels. Using budgetary allocations for 1997-98, average establishment costs for the provincial irrigation systems are estimated at around Rs 159 and Rs 203 in the Punjab and Sindh provinces, respectively.

Average O&M expenses to meet the desired standards are estimated around Rs 333 and Rs 373 per ha for the Punjab and Sindh provinces, respectively. Out of these estimates, establishment costs are 52 and 45 percent, respectively, for the Punjab and Sindh provinces.

Desired O&M Financing at the Distributary Canal Level

For the two selected distributaries, a series of engineering and walk-through surveys were undertaken to estimate the extent of necessary maintenance. Based on the results of these surveys, cost estimates were prepared and have been reported separately [Water Users Federation (1997); Pirzada, *et al.* (1998)]. The FOs have also devised their staffing plans. Based on the findings of these studies, the following O&M expenditures have been calculated for the distributary-level O&M.

Table 2 shows that the major maintenance areas that need immediate attention are repairs of banks, berms, and the service roads, etc.; tightening of cross-sections; and filling of scoured bed. Since the costs involved were quite high for the Hakra 4-R Distributary, and as investments for some items generally have a longer life, costs such as repair of cross-sections and strengthening of banks were regarded as capital costs. The FO was unable to undertake these capital investments within a year. These repairs have been phased into a medium-term plan spread over a period of five years. The annual costs of maintenance are thus estimated at around Rs 1 million.

In the case of the Dhoro Naro Minor, major cost items are essential structures maintenance, and repair of the inspection path. However, the expenditures involved are not as high, compared to those of the Hakra 4-R Distributary. Therefore, the FO decided to undertake these activities within the first year.

Table 2

Costs for Optimal O&M at the Distributary Level in the Indus Basin

Cost Item	Hakra 4-R Distributary (Rs/annum)	Dhoro Naro Minor (Rs/annum)
(a) Maintenance	**1,063,400**	**262,362**
Essential Structures Maintenance	–	62,692
Silt and Vegetation Removal	103,400	41,317
Repair of Cross-sections	580,000	36,000
Bank Strengthening	380,000	44,866
Repair of Inspection Path	–	77,487
(b) Establishment Costs	**810,000**	**428,400**
Salaries	660,000	360,000
Supplies and Services	100,000	51,600
Travel (O&M of Transport)	50,000	16,800
(c) Contingencies	**20,000**	**10,000**
(d) Capital Costs (Equipment, Transport and Furniture), for the First Year only	**267,000**	**93,600**
Average Cost (CCA ha)	**124**	**149**
Average Cost without Capital Costs (Rs/ha)	**109**	**131**

Apportionment for the Upstream and Distributary Level Costs

Since FOs will manage the distributary level and pay for the upstream cost of water delivery, one major question is the cost allocation for the maintenance for these tasks. Assuming that the average maintenance expenditure at the provincial level will be incurred in view of the desired maintenance standards as prescribed by the respective yardsticks, and that inflation will be taken care of by escalating the costs, necessary expenses for maintenance of the irrigation infrastructure can be calculated. Another assumption pertains to the establishment. We can assume, as provided in the PIDA Acts, that there will be no initial change in the staffing of the PIDs and that the establishment expenditure will remain at the current level. Once we ascertain the O&M expenses at the provincial level, expenditure for the upstream system can be calculated as the difference between the overall average and expenditure on the distributary. The desired O&M spending, per hectare, on the distributary canal and for the canal system of the entire province is presented in Table 3 below.

The estimated annual contribution by farmers along these two distributaries to the upstream maintenance is around Rs 113 and Rs 121 per ha for the Punjab and Sindh provinces, respectively. Likewise, the contribution for the upstream establishment is estimated at around Rs 111 and Rs 121 per ha, respectively, for the

Table 3

Desired O&M Spending on the Canal System by the Management Mode in Pakistan

(Rs/ha)

Cost Category	Provincial Average for Canal System		Distributary and Below		Above Distributary	
	Punjab	Sindh	Punjab	Sindh	Punjab	Sindh
Establishment	159	203	48	82	111	121
Maintenance and Repairs	174	170	61	49	113	121
Total	**333**	**373**	**109**	**131**	**224**	**242**

two provinces. Thus, farmers in the Sindh province will need to pay a total amount of Rs 373 for water services per hectare per annum. Of this amount, the FO will retain Rs 109, and Rs 242 will be paid to the AWB for upstream maintenance. Similarly, the water users in the Punjab province need to pay Rs 333 per ha for water services. The FO will spend Rs 109 per ha on distributary maintenance, and pay the AWB Rs 224 per ha for upstream maintenance.

6. FARMERS' CAPACITY AND WILLINGNESS TO PAY FOR DESIRED O&M

The capacity to pay for water depends directly on farmers' incomes, especially from crop enterprises. According to the economic theory, a farmer will be willing to apply water to the crops as long as it generates more income than its per unit cost. If the marginal income from a crop by application of an additional unit of irrigation water is less than the water charge for that crop, the farmer is not able to pay for water. The net income criterion generally serves as a good approximation of farmers' ability to pay for water charges. Net farm income,[7] as a measure to assess the average paying capacity of the water users from both reference channels, is discussed in the following paragraphs.

Average Net Farm Income at Hakra 4-R Distributary

A socio-economic survey, encompassing 367 randomly-selected farms along the Hakra 4-R Distributary, was carried out in 1995 to assess, *inter alia*, farmers' productivity and income from crops. The results showed that the major crops included cotton, fodder, and sugarcane in the summer, and wheat and fodder in the winter. The cropping intensity of the sample was estimated to be around 140 percent.

[7] The net farm income includes returns to family labour, land, and capital.

To estimate the gross value of the product, average yields for various crops were multiplied by the average farm-gate prices received by the respondents. Net farm income was calculated by subtracting the average gross production costs from the gross value of production for all the crops. Average net production value per hectare was estimated by multiplying average net production values of various crops with the proportion of area sown for that crop, then finding the sum of the product. The costs and returns for various crops sown by the farmers are presented in Table 4.

Table 4

Net Farm Income Calculations for Hakra 4-R Distributary in 1997-98 (for a Representative ha of Land)

Crops	Percent of Area Under Crop	Yield (kg/ha)	Price (Rs/kg)	Gross Value of Product (Rs/ha)	Gross Produc-tion Cost (Rs/ ha)	Average *Abiana* Paid (Rs/ ha)	Net Value Product (Rs/ha)	Weighted Net Value of Product (Rs/ha)
1	**2**	**3**	**4**	**5 (3x4)**	**6**	**7**	**8 (5-6)**	**9 (8x2)**
Cotton	0.4700	688	20.04	13787	6405		7382	3469.0
Rice	0.0400	2503	4.09	10237	4480		5757	230.3
Sugarcane	0.0400	39937	0.39	15575	5991		9584	383.4
Gur	0.0500	3148	4.96	15614	4344		11270	564.0
Sorghum[(a)] (Fodder)	0.0100			4442	1959		2483	24.8
Kharif Fodder[(a)]	0.1400			6663	1852		4811	673.6
Oilseeds[(b)]	0.0025	869	17.22	14964	896		14068	21.0
Vegetables	0.0050			7317	4327		2990	14.9
Total Kharif	**0.7575**			**9674**	**3947**	**121.00**		**5381.0**
Wheat	0.5500	2125	3.84	8160	3602		4558	2506.9
Rabi Fodder[(a)]	0.0700			12230	2523		9707	679.5
Oilseed[(b)]	0.0200	599	13.44	8051	1202		6849	137.0
Vegetables	0.0050			24483	4500		19983	99.9
Total Rabi	**0.6450**			**5627**	**2204**	**81.10**		**3423.3**
G. Total	**1.4025**					**202.10**		**8804.3**

Source: Author's calculations based on [Hassan and Khatri (1998)].

Notes: (a) The fodder is sold on the basis of the area and not the weight. Therefore, instead of yields and prices, average gross value of product is directly calculated.

(b) There are many oilseed crops. However, for the purposes of the current study, the prices and yields have been averaged together as these are assessed together for charging for water. Besides, the area under such crops is almost negligible.

Crop yields for major crops for 1995-96, for the Punjab province, are quite comparable to the data used in this study [Pakistan (1997)]. The cropping intensity for the entire province during 1995-96 (131 percent) was, however, slightly lower than that reported for the Hakra 4-R Distributary. Nevertheless, accounting for non-irrigated areas, the difference in the cropping intensity does not affect the findings significantly. Therefore, the net farm income calculations can be assumed as applicable to all irrigated areas of the province.

Calculations yielded that the average annual net value of the product is around Rs 8800 per hectare, of which about Rs 5400 and Rs 3400 were realised in the summer and winter crops, respectively. Average water charges paid by farmers were estimated at around Rs 121 and Rs 81 per hectare in the summer and winter, respectively. Thus, the total water charges paid were estimated to be to the tune of Rs 202 per ha per annum. Water charges paid formed around 3 percent of the average production costs and around 2 percent of the net income per hectare.

If farmers have to pay the full cost of O&M, they need to pay Rs 333 per hectare. The target level of water charges forms about 5.4 percent of production costs and 3.8 percent of the net income. Given the scarcity and importance of irrigation water for crops, farmers have the capacity to pay for the proposed water charges. The proposed water rates will reduce their net income from the crop enterprise by less than 2 percent, even if the farm productivity does not much improve as a result of the provision of a more equitable and reliable water service. While there are no significant negative financial implications of the reforms for farmers, there is more likelihood of increased returns for farmers as a result of improvements in the efficiency of irrigation systems.

Average Net Farm Income at the Dhoro Naro Minor

A detailed crop survey was undertaken during 1997 in the Dhoro Naro Minor command area, primarily to verify the cropping intensity and crop production in preparation of the business plan for the FO. The findings are reported in Pirzada, *et al.* (1998). Besides the business plan, useful information on agricultural income from crops was also produced. The following information, pertaining to the calculation of the net income, is extracted from that document. (See Table 5.)

The cropping intensity at the minor was around 114 percent, which is almost double the average cropping intensity reported for the Sindh province [Pakistan (1997)]. However, the cropping intensities at the Rohri Canal command area, which feeds this distributary, were recorded to be around 120 percent [World Bank (1997)]. Crop yields more or less compare to provincial averages. Almost half of the total cropped area in the minor is planted during each of the two cropping seasons. The gross costs form almost half of the gross value product. Taxes form around 6.5 percent of the total production costs, while water charges at present form less than 1 percent of both the total cost of production and the net farm income. The calculated water rates for full O&M funding form around 3 percent of the total production costs, and 3.5 percent of the net farm income.

Table 5

Net Farm Income at the Dhoro Naro Minor in the Sindh Province in 1997-98

S. No.	Particulars (Unit)	Quantity
1	Cropping Intensity (Percent)	113.67
	Kharif	59.98
	Rabi	53.69
2	Gross Value of Product (Rs/ha)	21,996
3	Gross Costs (Rs/ha)	10,696
4	Total Taxes (Rs/ha)	751
	Water Rates	77
5	Total Cost of Production (Rs/ha)	11,447
6	Net Farm Income (Rs/ha)	10,549

Source: Author's calculations, based on Table 39 of Pirzada, *et al.* (1998).

Farmers' Willingness to Pay for Desired O&M

To secure the adequacy and reliability of irrigation water, farmers make illegal payments to irrigation officials which are often the same size as that of the payment for water [Mudasser (1997)]. If services improve as a result of better AWB and FO management, farmers would be willing to pay higher charges because the farmers believe that the service they get is more valuable than the charges they pay for it. The purchase of groundwater by farmers at much higher rates in the absence, or during insufficient supply, of canal water indicates their willingness to pay for water.[8]

Another reason for farmers' being willing to pay would be that they know that if they do not pay, they will be worse off than if they do pay. In the present system of irrigation management, the farmers who do not pay do not suffer due to weak accountability mechanisms and enforcement of law. In that sense, an important aspect of these reforms is that the pressures to pay are brought to the local level. Under the FO rules in Sindh, for example, the FOs can refuse to supply water to those who do not pay for water. The Hakra 4-R FO has already imposed a 1 percent daily surcharge on late payments.

Unfortunately, the PID in Sindh had not transferred the distributary to the FO of the Dhoro Naro Minor till the finalisation of this paper. But the Punjab PIDA has transferred the Hakra 4-R distributary during the year 2000. The FO of Hakra 4-R Distributary took over the management of the distributary system from May 2000. During the initial period, it was able to improve equity as compared to the time when

[8]An interesting example of farmers' willingness to pay for water comes from the yet under-construction areas of the Chashma Right Bank Canal. The farmers are allowed to pump and transport water from the main canal in areas where the secondary canals have not been constructed yet. Some watercourses run 2 to 3 kilometres to farm locations, and farmers pay as much as 25 percent of their produce to the pump operators.

PID managed the distributary [Hassan, *et al.* (2000)]. For the first crop season of Kharif 2000, it was able to record a more than 10 percent increase in the area assessed, as well as an increase in *abiana* assessment. Likewise, the FO was able to collect 95 percent of the dues against *abiana* within one month of the issuance of the bills [Hamid and Hassan (2001)]. This experience demonstrates the willingness of the farmers to manage their irrigation system and to pay for water. However, it needs to be seen if all of the FOs, which are being organised following different social mobilisation methodologies, can achieve similar results.

7. CONCLUSIONS

The analysis reveals that in order to meet the O&M requirements of the canal irrigation system, users in the Punjab and Sindh provinces need to pay, respectively, 65 percent and 384 percent more than what they are paying at present as a water charge for each hectare of land. Since the desired O&M costs form only a very small proportion of the net income, and only a small decline is expected in the net income due to the proposed increase in water rates, the average water users of both the pilot distributaries have the capacity to fully fund the O&M costs. The farmers' net income from crop enterprise (even though the productivity is substantially below the potential) is higher than the cost of water. Besides, there might be some real sources of cost reductions for some of the farmers who are currently forced to pay bribes. Thus, an average farmer has the potential to pay for water. The institutional reforms under way, therefore, can be regarded as financially viable. Since water charges form a small fraction of the production costs, increased water charges do not have the potential to induce efficient use of water or a change in the cropping patterns, as the level of water charges is too low to influence farmers' decision to invest in water conservation technologies. Recent developments in the farmer-managed Hakra 4-R distributary with regard to assessment and collection of water charges indicate that the farmers are actually willing to pay for water, as they consider it to be a valuable service. The proposed reforms in the irrigation system, therefore, to be seem financially viable for the Punjab and Sindh provinces, the major targets and beneficiaries of the reforms.

To deliver a reliable and efficient water service to FOs, the PIDAs also need to rehabilitate the upstream irrigation system in a phased programme, as is being planned by the two FOs for their respective distributaries. A gradual rehabilitation programme would be more prudent as it will not disrupt the water supplies to farmers. An unnatural expectation would be for farmers to pay higher water charges without a corresponding improvement in the water service. The success of the reforms, therefore, will also depend on the ability of the AWBs and the PIDAs to undertake efficient operation, maintenance, and management of the upstream irrigation system.

Once the irrigation systems are in the paper condition to deliver water more reliably and equitably—and the FOs and the AWBs are able to resolve deferred maintenance during initial years, the maintenance expenditures may decline on account of the absence of deferred maintenance. This implies that water charges may also decrease after a few years. However, the inflationary cost escalations will need to be tackled at all levels.

Removing the subsidy altogether within the first year may have social implications for the FOs and the government. Therefore, a gradual approach towards eliminating the subsidy would be more useful. The PIDA Acts for both provinces have also envisaged a gradual reduction in the subsidy, and require the FOs to be self-sufficient and pay the full cost for canal irrigation water in seven years' time. The AWBs have to be self-sufficient in ten years' time. Following a gradual approach in increasing water charges—and gradual increases in productivity levels anticipated as an outcome of improved irrigation services, the adverse effects on farm income due to rises in water charges could be minimised further.

The amount of subsidy will increase initially because the government will be required to increase its maintenance expenditures, on the higher levels of the irrigation system being managed by the AWBs or the PIDAs. This is necessary, as there will be no incentive for the FOs otherwise to take over a deteriorated system in need of rehabilitation, which they would have to pay for.

Another issue that may affect these reforms is the current methods of water charge assessment. The current crop-based method of water charge assessment and collection is extremely complicated, and inappropriate for the newly-created FOs as it involves a high cost of assessment and collection. It does not correspond to the water allocation principles either, as water is allocated on a flat, area-based rate. Therefore, the water charges also need to be based on a flat rate regardless of the crop grown; those which are believed to be more suited for the farmer's management of distributaries in Pakistan, as well as for the PIDAs [Prathapar, *et al.* (2001)]. Flat rate cost-sharing in the canal system can serve as a close proxy for the volumetric charging system, if water rights of the FOs and the AWBs are clearly defined and adhered to, using the principles of proportionality. However, the decision of "how to assess and collect water charges" should be left to the respective FOs. The primary principles followed by the PIDAs, the AWBs, and the FOs should be equity, transparency, and simplicity in procedures, for which the current FOs are struggling.

REFERENCES

Bandaragoda, D. J., G. V. Skogerboe, and Yameen Memon (1997) Prospects for Farmer-managed Irrigated Agriculture in the Sindh Province of Pakistan. Final Report. Pakistan National Programme. International Irrigation Management Institute, Lahore. December. (Research Report No. R-42.)

Chaudhry, M. A. (1986) Irrigation Water Charges and Recurrent Cost Recovery, Pakistan. Expert Consultation on Irrigation Water Charges, FAO, Rome, 22-26 September.

Chaudhry, M. G., S. A. Majid, and G. M. Chaudhry (1993) The Policy of Irrigation Water Pricing in Pakistan: Aims, Assessment and Needed Redirections. *The Pakistan Development Review* 32:4, 809–821.

Hamid, A., and M. U. Hassan (2001) Need for a well Structured Social Organisation Methodology for Reforming Irrigation Management: Lessons from Hakra 4-R Distributary in Southern Punjab, Pakistan. Proceedings of the Drainage Seminar held on April 20-21, at Agricultural University, Faislabad. National Drainage Programme. Pakistan

Hassan, M. U., and M. Khatri (1998) Preliminary Business Plan for the Water Users Federation of Hakra 4-R Distributary. Report R-69. Lahore, Pakistan. International Water Management Institute. November.

Hassan, M. U., A. Hamid, K. Mahmood, and S. Mahmood (2000) Farmer Organisation's Potential for Reducing Waterlogging and Salinity through Improved Equity and Reliability of Irrigation Water : Evidence from Hakra 4-R Distributary in Southern Punjab. Proceedings of the Drainage Seminar held on August 16-18, at Mehran University, Jamshoro. National Drainage Programme.

Iqbal, A. (1996) Hydraulic Characteristics of Chishtian Sub-division, Fordwah Canal Division. IIMI-Pakistan, National Programme, Lahore. (Research Report No. 16.)

Mahmood, K. (1996) Hydraulic Characteristics of Irrigation Channels in the Malik Sub-division, Sadiqia Division, Fordwah Eastern Sadiqia Irrigation and Drainage Project. IIMI-Pakistan, National Programme, Lahore. (Research Report No. 17.)

Mudasser, M. (1997) Abiana and O&M Expenses of Hakra 4-R Distributary: A Case Study. M.Sc. Thesis. Department of Agricultural Economics. University of Agriculture, Faisalabad, Pakistan.

Meinzen-Dick, R., R. Reidinger, and A. Manzardo (1995) Participation in Irrigation. Environment Department Papers, Participation Series. The World Bank, Washington, D. C. February, (Paper No. 3.)

Punjab, Government of (1992) Yard Stick for the Maintenance and Repairs Grant. Finance Department, Letter No. 6(18)87-D-III/FD, Lahore, October.

Punjab, Government of (1997) The Punjab Irrigation and Drainage Authority Act, 1997. Punjab Act XI of 1997, Provincial Assembly of Punjab. Notification No. Legis-2(10)/97/91. The Punjab Gazette, Lahore, July 2, 1997, Law and Parliamentary Affairs Department.

Pakistan, Government of (1997) Agricultural Statistics of Pakistan 1995-96. Economic Wing. Ministry of Food, Agriculture and Livestock. Islamabad.

Prathapar, S. A., M. U. Hassan, Z. I. Mirza, and Z. Tahir (2001) Constraints on Enforcement of Water Policies: Selected Cases from South Asia. A Paper

presented at the Water Policy Workshop organised by Australian Council of International Agricultural Research in Bangkok, Thailand, June 8.

Sindh, Government of (1997) The Sindh Irrigation and Drainage Authority Act, 1997. Provincial Assembly of Sindh Notification No. PAS/Legisl-B-8/97. September 15. Karachi.

Sindh, Government of (1987) Reasonable O&M Requirements. Sindh Irrigation and Power Department. Government of Sindh.

Pirzada, P. A., M. Khatri, and S. D. Haider (1998) Preliminary Business Plan for Dhoro Naro Minor. Pakistan National Programme, International Irrigation Management Institute. Pakistan, Lahore. December. (Research Report No. R-41.1.)

Small, L. E. (1994) Reforming Irrigation Water Charges in Pakistan. *Agricultural Policy Notes*. Washington, D. C. l 3: 4, November.

Water Users Federation, Hakra 4-R Distributary (1997) Proposal of the Water Users Federation, Hakra 4-R Distributary for Joint Management Agreement of the Distributary. Photocopy. Letter No. IIMI/ Pak/ 586/97. August.

World Bank (1996) Fordwah Eastern Sadiqia (South) Project (Cr 2410-PAK) Supervision Mission Draft Aide Memoire, Photocopy. International Bank for Reconstruction and Development, International Development Association, Washington, D. C. November.

World Bank (1997) Project Concept Document: Fourth On-farm Water Management Project. Table 1(b). Photocopy. Washington, D. C. December.