IMPACT OF FINANCIAL REFORMS IN IRRIGATION SECTOR OF PUNJAB, PAKISTAN

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ABSTRACT

Pakistan has the world's largest contiguous irrigation system which was designed to provide uninterrupted supplies of irrigation water during the entire year. It has been observed that system has lost its efficiency over time. In this scenario a comprehensive reform program has been introduced in the irrigation sector. Basic aim of the whole reform program is to delegate the system to the ultimate users so that they can efficiently manage/maintain it and thus ultimately increasing the water productivity and reducing poverty. Present study was aimed to analyze the effectiveness of these reforms, which were carried out in Lower Chanab Canal (East) irrigation circle in Punjab (covering almost 1.8 million hectares of irrigated land) as a pilot project. In order to assess the different relationships between irrigation reforms, cost recovery, improved infrastructure, system efficiency, head-tail equity and ultimately the productivity and income of the farmers, a comprehensive survey of the area was carried out. Data were collected in the study area through comprehensive field survey for the two periods i.e. pre-reform period and post-reform period (year 2002-03 to 2006-07) from the same set of sampling units. Effectiveness of reform process was judged through the comparison of established parameters and econometric analysis of the data. Results of the study were largely supporting the notion of irrigation reforms. It was estimated that irrigation charges recovery has improved with an over all improvement in the O&M of the system. Sustainability indicators and water delivery indicators have also shown improvement in the post reform period thus increasing the productivity level.

Keywords: Impact assessment, Irrigation reforms, IMT, Pakistan.

INTRODUCTION

Agriculture is the largest consumer of water. Ever increasing human and animal population is putting more pressure on the agriculture sector to meet the demands of the increasing population, especially the food requirements. Irrigation water being the single most important input for the agriculture sector is under more stress as compared to other inputs due to its limited supplies. Need for improvement in efficiency and productivity of irrigation water has become one of the key issues for agriculture sector.

Irrigated agriculture has remained the focus of world attention since the last century. Increasing concerns regarding the food security, livelihood conditions, and abundant usage of fresh water sources in irrigated agriculture has put the stress over the shoulders of the policy makers all over the world to make continuous efforts for the betterment of the irrigation sector in terms of efficiency and productivity. International donor agencies have always remained involved in this process especially with developing countries. World Bank alone has increased the financing of irrigation projects from 1 project per year in 1950s to 26 projects per year in 1970s and 1980s. In the year 2007 World Bank has financed 23 projects in the irrigation sector. Out of these, 3 projects were in Pakistan (World Bank, 2007). Irrigated agriculture can rightly be said the life blood of the economy of Pakistan, as more than 75 percent of the cultivated land is irrigated (Anonymous, 2005). Table 1 shows that surface irrigation is the main source of irrigation as alone in Punjab more than 12 Mha of land are being irrigated fully or partially with it.

Table 1: Irrigation sources in Pakistan

	Total (Mha)	Canal (%)	Canal + Tubewell (%)	Tubewells (%)	Wells+Other (%)
Punjab	14.33	28.4	50.5	19.1	2
Sindh	2.34	94.8	–	5.2	–
NWFP	0.92	85.4	–	6.7	7.9
Baluchistan	1.17	41.9	38.7	28.4	11.1

(Source: Anonymous 2006)

Irrigation sector in Pakistan is facing major problems which can be grouped into four categories;
i. Deteriorating infrastructure, ii. Inefficient institutions, iii. Low adaptability of new technology, iv. Financial constraints

These factors ultimately lead to poor water and low agricultural productivity. World experiences on irrigated agriculture have clearly indicated that without integrated approach of water resources that includes irrigation, drainage and environment, the agricultural

productivity and sustainability would not be possible in the developing countries. It has also been observed that the state owned irrigation systems have not been performing well and are deteriorating day by day, especially in developing countries due to financial, managerial and socio-political factors (Haq, 1998). Rent seeking behavior of the officials of public irrigation agency was another reason which had created an atmosphere of mistrust between the users and agency (Rinaudo, 2002).

The agriculture in Pakistan is dependent on irrigation and state owned irrigation system was performing poorly (Vermillion, 1997). The deterioration of the irrigation system was considered as the main cause of stagnant agriculture (World Bank, 1994). Various studies have been conducted to identify the main problems faced by the irrigation sector in Pakistan, especially Punjab. By and large these studies have indicated that the low irrigation and water use efficiency, increasing inequality in the water distribution across the system, poor cost recovery from the users, deteriorating infrastructure and institutions and lack of user participation in the irrigation management process were the root causes of the problem. There has been chronic inequity with the upstream water users receiving more water than their due share, while those at the tail reaches of the canal command receiving less. The system is steadily deteriorating and performing far below user's expectations; and there is a great mistrust between the irrigation department and the users (Haq, 1998, Hussain, 2003, Latif and Pomee, 2003, World Bank, 2004).

So the need for improving irrigation management has been laddered up on the agenda of most national and international agencies in the recent past. This was prompted by the dilapidated irrigation performance despite sizeable investments in the rehabilitation of irrigation infrastructure. Thus learning from the international experience, Government of Pakistan soon recognized that the existing irrigation management setup should be reformed by shifting the responsibility of management from government managed agency i.e. Provincial Irrigation Department (PID) to the farmers. Considering the situation, the Government introduced institutional reforms in the irrigation sector of the Punjab in 1997. One important aspect of the reforms is irrigation management transfer (IMT) by user's participation in the management of the system called "Participatory Irrigation Management" (PIM).

The World Bank in the early '90s proposed commercialization and privatizations of the irrigation system as the only choice for rehabilitation. However after a series of negotiations with the World Bank, the government of Pakistan agreed upon institutional reforms in water sector of the Punjab. Consequently, in 1997, Pakistan's provincial assemblies passed bills to implement institutional reforms in the country's irrigation sector (Nakashima, 1998). In the province of Punjab, the institutional reforms were introduced through the Punjab Irrigation and Drainage (PIDA) Act 1997.

Structure of newly formed institutions: Newly formed institutions were organized in three tiers: 1. Punjab Irrigation and Drainage Authority (PIDA); 2. Area Water Boards (AWB); 3. Farmers Organizations (FOs) and Khal Punchayat (KP)

PIDA is controlling the process of institutional reforms in the irrigation sector in the province of Punjab, headed by the provincial minister for irrigation while Secretary, Irrigation department (who was responsible for irrigation sector previously) is acting as Managing Director PIDA is comprised of 11 members (Among these six are farmer representatives being nominated by the provincial government while the rest five are government representatives). Area Water Boards (AWB) are being formed at canal command level. In all, nine AWBs will be formed in the Punjab province. But up till now, only one AWB on Lower Chanab Canal East (LCC East) has been formed as reforms have been implemented only in this area in the whole province. AWB will be consisted of nineteen members including ten elected members (from respective farmer organizations) and nine members from allied government departments.

Farmer Organization (FO) is the third link of the chain of the new institutions formed under the process of reforms in the irrigation sector. FO is constituted at the distributary level of the canal system and consisted of the presidents of all the Water User Organizations (WUAs) called 'Khal Punchayats' in local system. All the presidents of WUAs formed the general body of FO while nine members are being elected out of general body as the members of 'Managing Committee'. FO is responsible for running the affairs of the irrigation system at the distributary level. It performs all the major functions like assessment and collection of water charges, operation and maintenance (O&M) of the distributary and dispute settlement among the farmers etc. Till now the process of Irrigation Management Transfer (IMT) has been carried out only in the pilot project area which is the LCC east area and eighty six FOs have been formed in this area in three phases. The process of IMT was started in March 2005 when first batch of twenty FOs have been given the rights of irrigation management and the process completed in December 2005 when third batch of sixteen FOs were awarded rights of irrigation management by the PIDA.

Fourth and last link of the chain is 'Khal Punchayat' or WUA (Water User Organization) which is being established at water course level of each distributary. Each WUA is consisted of five members including one president of the WUA. These members have been elected from the registered farmers at that water course. WUA is responsible for the collection of water charges and water distribution related aspects.

WUA make recommendations for approval to the 'Management Committee' of the FO for final approval. A brief comparison of activities of the existing system (after IMT) and the previous system which was operated by Provincial Irrigation Department (PID) is presented in the table 2.

Table 2: Review of traditional system and reform process in Punjab

Activity	Traditional System	Reforms
Fixation of water charges	PID	PID
Assessment of water charges	Staff of PID	FO
Collection of water charges	Staff of Revenue dept	FO through WUA
O&M expenditure assessment at Dist. and below	PID	FO
Responsibility of O&M	PID	FO
Incentive system	No	Yes but moderate
Dispute settlement	PID	WUA & FO
Penalties on late payment	Complicated	Yet to be implemented

As discussed above, the new model of reforms have been implemented in the pilot project area (LCC east canal command area) partially since March 2005 and completely from December 2005. Results of the pilot project area will make the way for onward implementation of reform process in whole province and it will also reflect the weak linkages and strong dimensions of the existing reform model. This study has been carried out to make an early assessment of the whole process so that expansion of these reforms can be designed/implemented keeping in view the findings /suggestions /recommendations of this study.

MATERIALS AND METHODS

Sampling Framework: LCC (East) canal command area was selected as the study area as it was the only canal command where irrigation reforms have been implemented till the year 2007 when the data collection for the study was carried out. LCC (East) canal command is a vast area covering about 1.8 million hectares of irrigated land (Anonymous, 2006). The area is spread in the two cropping zones i.e. Rice-Wheat cropping zone and Mixed cropping zone.

Sampling Scheme: A multistage sampling procedure was adopted in selecting the sample. Study area was initially selected purposively on the ground that irrigation management was transferred in the area of LCC (East). At the second stage, study area was stratified based on the following criteria;

1. First batch of the distributaries, where irrigation management was transferred in March 2005, was included in the sample.
2. Second batch of the distributaries, where irrigation management was transferred in June 2005, was included in the sample.
3. Third batch of the distributaries, where irrigation management was transferred in December 2005, was not included in the sample because the rights of the IMT were transferred to third batch were delayed.

By using Simple Random technique, fifteen distributaries were selected from the first and second batch of the distributaries making a sample of thirty distributaries in the reform area. First level analysis was carried out on the data collected from these distributaries. Out of these thirty distributaries, ten distributaries were selected by using Purposive Random technique on the basis of homogeneous characteristics and their location in the LCC (east) canal command. The sampled distributaries represented head, middle and tail of the command area. Out of the ten selected distributaries, six watercourses per distributary (two each from head, middle and tail of the distributary) were selected through Stratified Random Sampling giving a sum of sixty watercourses. From these sixty watercourses, six farm household were randomly selected. A sample size of three hundred and sixty farmers was collected for second level analysis.

Data Collection: Data were collected from secondary as well as primary sources. Secondary data were collected through the office record of FOs, PID regional offices and from their respective representatives using a well structured and comprehensive questionnaire. Data from the primary sources were collected using an elaborative and comprehensive questionnaire. A 'Before and After' approach has been used for the purpose of analysis. The data were also collected for two periods, Pre-reform period and Post-reform period. Secondary data for the pre-reform period were taken for two years (year 2003-04 and 2004-05) while for post-reform period it was comprised of two years (year 2005-06 and 2006-07). While primary data were collected for two years (year 2004-05) for pre-reform period and year 2005-06 for post-reform period).

Analytical frame work: Two types of analysis were used in the study

- Comparison of indicators
- Econometric analysis

Comparison of indicators: Well established set of indicators have been used for comparison of two situations based on the work of Kloezen *et al*. (1997),

Husain and Biltonian (2001) and Cornish (2005) and are presented in table 3 which is given below

Table 3: Broader Category of Indicators Used in the Study

Indicator's Category	Indicators
Productivity indicators	Cropping intensity, Productivity of major crops, Gross Value Product (GVP) of major crops
Socio-economic indicators	Cost of production of major crops, Ground water irrigation cost, Income of the farmers
Sustainability Indicators	O&M expenditure, water charges collection, Gross Margin to COP ratio
Socio-economic Indicators	Age, Education, income level, Dispute settlement.
Equity	Delivery Performance Ratio, Head-Tail equity
Water availability	Increase in number of days water remain available to farmers

(Source: As quoted in above text)

Econometric Analysis of Data: Econometric analysis was carried on primary data collected for three hundred and twenty farmers from the study area. Since the LCC (East) area has been spread in two cropping zones (Rice-Wheat cropping zone and Mixed cropping zone), wheat was the single common crop grown by almost all the farmers in both periods (pre-reform period and post-reform period). Therefore, econometric analysis was carried out only for the wheat crop in the present study. Cobb-Douglas production function was estimated due to its certain advantages for use in the agriculture sector. Following production function was estimated for wheat crop independently to capture the impact of irrigation reforms on GVP of the wheat crop in the study area[1].

$$lnwagvp = \beta0 + \beta1\ lnwareaij + \beta2\ lnwscstij + \beta3\ lnwfcstij + \beta4\ lnwsicstij + \beta5\ lnwticstij + \beta6\ lnwmcstij + \beta7\ lnwlcstij + \beta8\ lneduij + \beta9\ D1 + \beta10\ D2 + \beta11\ D1\ D2 + vij \quad (1)$$

Econometric model used for assessing the impact of irrigation reforms on wheat productivity is as given as eq (2).

$$lnay = \beta0 + \beta1\ lnwareaij + \beta2\ lnwscstij + \beta3\ lnwfcstij + \beta4\ lnwsicstij + \beta5\ lnwticstij + \beta6\ lnwmcstij + \beta7\ lnwlcstij + \beta8\ lneduij + \beta9\ D1 + \beta10\ D2 + \beta11\ D1D2 + \mu ij \quad (2)$$

Where

$\beta0$ = Constant

lnwagvp = Average real GVP2 of wheat crop of the i-th farm expressed in rupees per acre.

Lnay = Average yield of wheat crop of the i-th farm (kgs/acre).

$lnwarea_i$ = Area of i-th farm under the wheat crop

$lnwscst_i$ = Average seed cost of the i-th farm for wheat crop.

$lnwfcst_i$ = Fertilizer cost of the i-th farm for wheat crop (rupees per acre).

$Lnwsicst_i$ = Surface irrigation cost of the i-th farm (rupees per acre).

$Lnwticst_i$ = Tube-well irrigation cost of the i-th farm (rupees per acre).

$Lnwmcst_i$ = Cost of mechanized operations of the i-th farm (rupees per acre).

$Lnwlcst_i$ = Cost of labour operations of the i-th farm (rupees per acre).

$Lnedu_i$ = Years of schooling of the i-th farm for wheat crop .

D_1 = Dummy variable for location of outlet of specific farm. If D1= 1 then it represents location at tail of the distributary otherwise head or middle of the distributary.

D_2 = Dummy variable for taking into account the implementation of reform process. If D2 = 1 then it represents post-reform other wise D2=0

D_1D_2 = Interaction variable of two dummies i.e. D1D2 was used to capture the impact of reform process on the farms located at the tail of the distributary.

vij, uij = Error terms

RESULTS AND DISCUSSION

Results of the study can be divided into two sub-sections. First section represents the comparison of indicators discussed in section 2 while second section represents the results of econometric analysis carried out using data obtained from three hundred and sixty farmers across the LCC (east) system the area from head to tail.

Comparison of indicators: Table 4 summarizes the indicators estimated using the secondary data for two periods (pre-reform period and post-reform period). It is well evident from the table 4 that almost all the indicators have performed better in the post-reform period. Although the increase in GVP of the crop was less than that of the increase in cost of production but it was due to

[1] All the variables except the dummy variables were entered in the model by taking their natural log.

[2] GVP and all the costs used in the study have been calculated with real prices (base 2001-02) using GDP deflator available at www.sbp.org.pk

the fact that real price of the year 2004. It was also remarkable that cost of ground water application has been

Table 4: Comparison of selected performance indicators

Indicators	Pre-reform period	Post-reform period
Indicators from primary data		
Average yield (kg/acre)	1296	1420 (10%)
Average GVP of the wheat crop (Rs.)	12148	12816 (5.5%)
Cost of production (COP)	5152	5684 (10%)
Cost of ground water application	808	750 (-7%)
Ratio of GM to COP	1.35	1.25
Cropping Intensity	163	182 (12%)
Farmer's perception on physical improvement	27 %	62 %
Indicators from secondary data		
Water charges assessment (000 Rs.)	170635	168483
Water charges collection (000 Rs.)	73517	104270
Percentage water charges collection	41.6 %	61.8 %
O&M expenditures (Rs /acre) range across the LCC (East)	17 to 61	17 to 33
O&M expenditures as percentage of water charges collection (range across the system)	15.5 % to 74.3 %	12.2 % to 20.5 %
Av. DPR at Head across the system	0.59 to 0.68	0.58 to 0.68
Av DPR at tail across the system	0.1 to 0.34	0.21 to 0.46

Note: Figures in parenthesis are percentage changes

decreased since the availability of the surface irrigation water has been better wheat3 has been decreased in the year 2006 as compared off in the post-reform scenario. The same fact is evident from the comparison of the DPR at tail which has gone up in the post-reform scenario. Water charges collection has improved from 41.6 percent to 61.8 percent which was a major improvement. But results also showed that the collection percentage has declined to some extent in the second year (year 2006-07) of post reform period as compared to the first year (year 2005-06). One major reason for the decline was absence of any incentive system for early payers and penalties for late payers. O&M of the system has also been improved and variations in O&M expenditures have reduced. Decisions for incurring O&M expenditures which were influenced by political pressures in the pre-reform era were minimized in the new system as each FO in the post-reform era was making decisions for O&M at its own depending upon the collection of water charges of each FO. Comparison of DPR has shown that water availability to tail clusters have increased although the water supplies at head were more or less similar (evident from DPR at head).

[3] Real price of wheat (based on GDP deflator for the year 2001-02) was Rs. 9.34/kg in the year 2004 and Rs. 8.86/kg in year 2006

Table 5: Estimated parameter of the regression models

Variable	Model 1		Model 2	
	Parameter	Sig. level		
Constant	8.34 (19.05)	0.00**	2.42 (5.53)	0.08*
lnwarea	-0.002 (-0.195)	0.84ns	-0.005 (-0.197)	0.84 ns
lnwscost	0.07 (1.20)	0.22 ns	0.17 (1.55)	0.121
lnwfcost	0.073 (2.52)	0.01**	0.083 (2.61)	0.01**
lnwsicost	-0.018 (-0.40)	0.68 ns	-0.02 (-0.40)	0.68 ns
lnwticost	0.006 (1.06)	0.28 ns	0.006 (1.06)	0.28 ns
lnwmcost	0.017 (0.68)	0.49 ns	0.017 (0.68)	0.49 ns
lnwlcost	0.017 (4.25)	0.00**	0.011 (4.25)	0.00**
lnedu	0.005 (2.06)	0.03**	0.006 (2.06)	0.03**
D1	-0.053 (-1.76)	0.08*	-0.063 (-2.06)	0.03**
D2	0.068 (1.36)	0.17 ns	0.084 (3.036)	0.00**
D1D2	0.026 (1.01)	0.31 ns	0.026 (1.01)	0.31 ns
R2	0.19		0.22	
F- Value	3.7	0.00**	7.08	0.00**

* Significant at 10 percent level,** Significant at 5 percent level, ns non significant, figures in parenthesis are the t-statistics

Results of econometric analysis: Results of the econometric analysis are presented in table 5. Cobb-Douglas production function was estimated by applying OLS procedures. R^2 values and F-statistics showed that model was appropriately specified and explained the variations in the data. Tests for the presence of autocorrelation, heteroscedasticity and multicollinearity showed that the model was free from these potential problems.

Results of the regression models also supported the evidence presented in table 4. Coefficients of the dummy variables and interaction term were having signs according to the a priori expectations. Although

interaction term was non-significant but having positive sign so it could be perceived that although reforms have positive impact on the respondents of the tail clusters yet was not enough to have significant positive impact. It should also be noted here that the coefficient of location dummy (i.e. D1 is negative and significant). The coefficient of reform dummy was positive and significant in both models showing that reforms have positive impact not only on wheat production but also on the GVP of the wheat crop.

Conclusion: The process of the institutional reform implementation, which was started back in 1997 was delayed and the first IMT at FO level was took place in March 2005, has the potential to address the problems of the irrigation sector substantially. The existing process although based on well defined principles yet these has to be tuned further in order to make the process a success story. There is an immediate need for the introduction of a penalty and incentive system for the in time and late payers. Formation of the management committee of FO should also be based on certain pre-defined criteria like the education, time devotion, and agricultural knowledge etc of the office bearers of the FO. Strength of the management committee can prove vital for the sustainability of FO. Although institutional reforms were designed to be tilted towards the tail end farmers yet problems of these farmers have to be addressed further. In nut shell, institutional reforms in Pakistan had a good start but committed efforts need to be incorporated to make it a real success experience.

REFERENCES

Anonymous (2005). Reforms in irrigation sector: Vision, strategy, implementation, strategy. Provincial Irrigation Development Authority (PIDA) report, Lahore, Pakistan

Anonymous (2006). Agricultural statistics of Pakistan. Economic advisor wing, Ministry of Food, Agriculture and Livestock (MinFAL), Islamabad, Pakistan,

Cornish, G. A. (2005). Performance bench marking in the irrigation and drainage sector: experiences to date and conclusions. Report OD 155, Release 1.0, H.R. Wallingford and DFID,

Haq, A. U. (1998). Managing irrigation for environmentally sustainable agriculture in Pakistan. A Case study of the Punjab Irrigation Department. Report No. C-12, Pakistan National Programme, International Irrigation Management Institute, Lahore, Pakistan,

Hussain, I. and E. Biltonen (2001). Pro-poor intervention strategies in irrigated agriculture in Asia: Issues and Options. International Water Management Institute, Colombo, Sri Lanka.

Hussain, I. (2003). Pro-poor intervention strategies in irrigated agriculture in Asia. Poverty in irrigated agriculture: Issues and options, Pakistan. International Water Management Institute, Colombo, Sri Lanka.

Kloezen, W. H., C. Garcés-Restrepo, and S. H. Johnson III (1997). Impact assessment of irrigation management transfer in the Alto Rio Lerma Irrigation District, Mexico. Research Report 15. International Irrigation Management Institute, Colombo, Sri Lanka.

Latif, M. and M. S. Pomee (2003). Impacts of institutional reforms on irrigated awqwqqh tytwaa agriculture in Pakistan. Research report, Centre of Excellence in Water Resource Engineering, University of Engineering and Technology, Lahore, Pakistan.

Nakashima, M. (1998). Water Users organization for institutional reform in Pakistan's irrigation sector. Faculty of international studies, Hiroshima City University, Hiroshima, Japan.

Rinaudo, J. D. (2002). Corruption and allocation of water: The case of public irrigation in Pakistan. Water Policy 4 (5): 405-422.

Vermillion, D.L. (1997). Impact of Irrigation management transfer: A review of the Evidence. Research Report No 11. International Irrigation Management Institute, Colombo, Sri Lanka.

World Bank (1994). Pakistan Irrigation and Drainage: Issues and Options. Agriculture Operations Division (Afghanistan Maldives, Pakistan and Sri Lanka Department, South Asia Region). Report No 11884, Washington, D.C., U.S.A.

World Bank (2004). PAKISTAN: Public Expenditure Management Accelerated Development of Water Resources and Irrigated Agriculture. Report No. 25665-PK VOLUME II, Washington, D. C., U.S.A.

World Bank (2007). Projects and Operations. Web site link http: // web. World bank. Org / external / projects / main? Page PK = 217672 & piPK = 95916 & the Site PK = 40941 & menu PK = 223665 & category = sector & sector = AI & pagenumber=1&pagesize=50&totalrecords=687 &sortby=BOARDSORTDATE&sortorder=DES C,