Effects of Changes in the Management System of Lower Chenab Canal

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Abstract

To resolve problems like inadequate maintenance of water conveyance conduits (irrigation channels) and associated hydraulic structures, unauthorized usage of water, and inequitable distribution of water, the Irrigation and Power (I&P) Department of Punjab Government handed over the Lower Chenab Canal System (East Circle), having 119 distributaries with total canal command area of 1.85 million acres, to Farmers Organizations (FOs) as a pilot project. To study the effects of this irrigation management transfer (IMT) on the Lower Chenab Canal System, this study was designed.

To investigate the IMT impacts, the daily head and tail discharge data from 2006 to 2009 were collected from the Project Monitoring and Implementation Unit (PMIU) of the Irrigation & Power Department. Based on this data the Delivery Performance Ratio (DPR), Capacity Factor (CF) and status of supply at tails of channels were determined. Besides that, assessment of impact of supplies at the tails after IMT was made. Relative DPRs for crop seasons of Kharif 2006, Rabi 2006-2007, Kharif 2007, Rabi 2007-2008 and Kharif 2008 were computed as of 0.72, 0.68, 0.87, 0.86 and 0.76 respectively. Results showed that there was an increase in supply at the channels tail during Kharif 2007 and Rabi 2007-2008. The analysis showed that the percentage of tails, in term of average number of channels, which remained dry during Kharif 2006, Kharif 2007, Kharif 2008 and Kharif 2009 season were 18%, 12%, 16% and 5.7% respectively; despite the fact that channels run as per authorized head discharge. The data of Abiana (water revenue) collection for different seasons were collected and impact of IMT on the Abiana collection and assessment was investigated. A general trend of decline in revenue collection was noticed.

This study would be helpful for the understanding of the reforms process and to make the improvements in the management system. It would provide findings how to improve the method of Abiana assessment and collection and to enhance the equitable distribution of supply at the tails of the channels.

Keywords Lower Chenab, Tail, Head, Capacity Factor, DPR

Introduction

Like many other canal systems of Pakistan, Punjab in particular, or many other developing countries in general, Lower Chenab Canal (East) system has also been facing several problems. As stated by PIDA, Punjab Irrigation and Drainage Authority (2005a) [1], these problems were "overall deterioration of system management, shortage of water, inequitable distribution of irrigation water, general lack of agency responsiveness, increasing water theft, inadequate maintenance of the canal system, lack of farmers participation in decision making and management, delay in settlement of water disputes, wrong assessment of water revenue (locally known as Abiana), and lack of awareness among farmers about their water rights". In order to take care of the stated problems, a new reform system was introduced by the province of Punjab.

Under this reform system, the Punjab province started the major institutional reforms, including decentralization and transformation of old irrigation system/practices from purely government control to

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public participatory control to improve the efficiency of the old age system – known to be the world's 2nd biggest irrigation system. The purpose of these reforms was to make improvement in the delivery of Irrigation supplies with respect to quality, quantity and operation/maintenance of irrigation channels. For the overall supervision of the IMT system, Punjab

Irrigation and Drainage Authority (PIDA) was established. Under this Authority a pilot Area Water Board (AWB) for the canal command area of the Lower Chenab Canal System (LCC) was established, along with the Farmers Organizations (FOs) at the distributary levels and Khal Panchayat at water course level to tackle irrigation water supply problems of the farmers. Under these reforms, farmers and other stakeholders have been participating/contributing and making decisions at all levels of irrigation system management. This farmers' based management share the responsibilities according to a legal framework.

According to the reforms process, the Provincial Irrigation Department would control main regulation and provide technical support in policy making. On the other hand PIDA being an autonomous body would be responsible for the improvement of irrigation performance, optimizing water use efficiency, introducing the concept of participatory management, undertaking measures to improve assessment and collection of Abiana, and making the authority self sustaining. PIDA would perform its' responsibility through the Area Water Board at canal command level. It would devise such programs that will promote the formation and enhancement of FOs, which would be responsible for the operation and management of the distributaries in their command along with the maintenance and repair of canals and associated structures. Other responsibilities of these FOs would be to get water from the major canals and then distribute it to farmers on equitable basis. Beside these responsibilities, they would also take care of water disputes among the farmers, assess and collect Abiana (PIDA 2007) [2].

The aim of this part of the research work (and paper) was to study the impact of Irrigation Management Transfer to Farmers Organizations on the Lower Chenab Canal System (East). It mainly deals with the estimation of delivery performance ratio at heads and tails of the channels, development of equations, estimation of relative delivery performance ratio for the assessment of equitable distribution of irrigation water, computation of capacity factor for canal system, effect of farmers participation in decision making, assessment and collection of Abiana, and performance of FOs and their impact on water supply of irrigation channels.

Brief Description of Study Area

The main focus of this study is of Lower Chenab Canal (East) Circle, Faisalabad area. This partly covers areas of district Sheikhupura, Toba Tek Singh, Hafizabad, Jhang and Faisalabad. There are four branch canals in LCC (East) Circle, Faisalabad. These branch canals are Burala branch, Mian Ali branch, Lower Gugera branch and Upper Gugera branch. The LCC was constructed in 1892 and it is off taking from Head Khanki at the Chenab river in the Gujrat district. The LCC (and the associated Area Water Board, AWB) consists of total area of 2.262 million acres with grass command area (GCA) of 2.122 million acres and canal command area (CCA) of 1.85 million acres. The proposed discharge is 11229 cusecs and existing discharge is 8249 cusecs. Length of the main canals and branch canals is 297 miles. The numbers of distributaries in LCC are 119 and the Farmers Organizations (FOs) are 85. The major crops in study area are cotton, maize, sugarcane, rice, wheat, oilseed and fodder (PIDA 2005b) [3]. The index plan of LCC (East) is shown in Figure 1.



Figure 1. The index plans of LCC (East) [adopted from PIDA 2005b] [3].

Delivery Performance Ratio (DPR) and Relative Delivery Performance Ratio (RDPR)

Delivery Performance Ratio. Delivery Performance Ratio, DPR (ratio of actual discharge to designed discharge) of a channel is a very important hydraulic performance indicator to judge the performance of channels in an irrigation system as that of LCC (East). For this system two types of DPRs were computed i.e. Tail DPR (ratio of actual tail discharge to authorized tail discharge) and Head DPR (ratio of actual head discharge) for five different crop seasons including Kharif 2006, Rabi 2006-2007, Kharif 2007, Rabi 2007-2008 and Kharif 2008. A specimen table (Table 1), as given below, shows the computed values of Tail and Head DPRs for 13 different channels of LCC for Karif 2006 and Kharif 2007 seasons.

Name of Channel		Kharif 2006	1		Kharif 2007	7
	DPR at Head	DPR at Tail	Relative DPR	DPR at Head	DPR at Tai	l Relative DPR
High Level Disty	0.135	0.173	1.280	0.293	0.000	0.000
Alipur Minor	0.442	0.449	1.017	0.532	0.304	0.571
Ram Nagar Minor	0.374	0.232	0.621	0.497	0.018	0.035
Kot Hara Sub Minor	0.381	0.032	0.085	0.264	0.077	0.292
Manchar Disty	0.340	0.226	0.665	0.534	0.292	0.547
1-R Minor	0.411	0.365	0.887	0.386	0.508	1.315
Fateh Pur Disty	0.000	0.000		0.629	0.015	0.024
Vanike Disty	0.473	0.233	0.492	0.633	0.304	0.480
Dhilwan Minor	0.525	0.410	0.782	0.487	0.486	0.996
Chak Ghazi Minor	0.572	0.394	0.689	0.587	0.617	1.052
Ramke Minor	0.564	0.395	0.701	0.635	0.681	1.072
Kharak Sun Minor	0.407	0.318	0.782	0.509	0.277	0.544
Mehdiabad Minor	0.587	0.227	0.387	0.625	0.597	0.956

 Table 1. Delivery Performance Ratios (DPR) at heads and tails for thirteen channels of LCC (East) for two Kharif seasons.

Relationship Between DPRs at Tails and Heads of Channels: In order to find relationship between Delivery Performance Ratio at channel tails (DPR_T) and Delivery Performance Ratio at channel heads (DPR_H) different equations, given below, were developed for Kharif seasons of 2006-2009 for channels of Lower Chenab Canal (East) System. Plots in this regard may be seen in Figure 2.

- a)- Kharif 2006: $DPR_T = 0.81 DPR_H 0.053$
- b)- Kharif 2007: $DPR_T = 0.53 DPR_H 0.226$
- c)- Kharif 2008: $DPR_T = 0.8 DPR_H 0.012$

d)- Kharif 2009: $DPR_T = 0.91 DPR_H - 0.005$



Figure 2. Relationship between Head DPR and Tail DPR for Kharif seasons of LCC (East).

Relative Delivery Performance Ratio. Relative Delivery Performance Ratio, LDPR (ratio of Tail DPR to Head DPR), which is used to measure Equity Performance Indicator, were computed by using the computed Tail DPRs and Head DPRs for all the channels in the LCC (east). A set of specimen LDPR values for eighteen channels of LCC (East) are given in Table 2. Afterwards, average of all the LDPRs for all channels was computed for all the five seasons. An ideal value of LDPR was one, which means that every changed flow condition at a sub-system head are proportion-ately distributed among the shareholders regardless of their location along the distributaries.

The summary of the average relative delivery performance ratio calculated for Lower Chenab Canal (East) System is shown in Table 3 and its variation is depicted in Figure 3.

Channel Name	RDPR Kharif 2006	RDPR Rabi 2006- 2007	RDPR Kharif 2007	RDPR Rabi 2007- 2008	RDPR Kharif 2008
Ramke Minor	0.33	0.62	1.14	0.62	0.96
Sagar Disty - I	1.00	0.92	0.86	0.74	0.87
Sagar Disty - II	1.89	0.94	0.88	0.87	0.84
Shah Jamal Distrobutory - I	0.83	0.35	0.81	0.59	0.98
Shah Jamal Distrobutory -I	0.09	0.38	0.72	0.28	0.42
Vanike Disty	0.81	0.51	0.35	0.00	0.58
Wazira Minor	0.52	0.78	0.75	0.50	0.82
Bassi Minor	0.22	0.03	0.40	0.00	0.00
Bath Disty	0.48	0.00	0.00	0.30	0.34
Bijwana Sub Minor	0.54	0.04	0.26	0.15	0.00
Chukeri Minor	0.29	0.57	0.43	0.28	0.11
Chutala Sub Minor	0.60	0.87	0.95	0.84	0.80
Dangali Disty	0.59	0.61	0.57	0.38	0.92
Gajjiana disty	0.36	0.11	0.19	0.29	0.33
Ghour Dour Disty	0.01	0.04	0.79	0.09	0.09
Haripur Minor	0.93	0.51	0.92	0.97	1.00
High Level Channel Disty	0.03	0.13	0.12	0.00	0.22
Innuana Disty	0.62	0.92	0.88	1.01	0.97

 Table 2. Relative Delivery Performance Ratio (LDPR) for eighteen channels of LCC (East) for five different seasons.

Table 3. Summary of the Average Relative DPR Values.

Sr. No.	Name of System	Crop/Flow Season					
	LCC	Kharif	Rabi	Kharif	Rabi	Kharif	
	East	2006	2006-2007	2007	2007-2008	2008	
1		0.72	0.68	0.87	0.87	0.77	



Figure 3. Variation of the Relative DPRs for LLC (East) channel system for five different Kharif seasons.

Summary of the relative DPR shows that there was some improvement in the water supply for Kharif 2007 and Rabi 2007-08 seasons. For both of the seasons the Relative DPR is same as of 0.87, which is higher than the other crop seasons with an average relative DPR value of 0.72 for Kharif 2006, 0.68 for Rabi 2006-07 and 0.77 for Kharif 2008.

Capacity Factor for LCC (East) System

Average of Capacity Factor (ratio of sum of actual head discharges to sum of designed discharge) was computed for the Kharif seasons between years 2006-2009 for this Canal System. The values of average capacity factor for these seasons are given in Table 4. It showed improvement in supplies at the head of the channels of LCC (East) system for year 2007 and 2009, as compared to supply position in 2006 and 2008 respectively. This improvement is not sufficient enough and it is based upon a short span of time. To make some finding based on such a short time span would be a hasty conclusion. The variation of the average Capacity Factor for the Canal System is depicted in Figure 4.

Table 4.	Summary of the	Average	Capacity Factor	for all chann	els of LCC (East).
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Sr. No.	Name of System	Kharif 2006	Kharif 2007	Kharif 2008	Kharif 2009
1	LCC East	0.86	0.91	0.87	0.91



Figure 4. Variation of the Capacity Factors for LCC (East) channel system for different Kharif seasons.

Status of Water Supply at Tails

The daily head and tail water supply data of all channels of LCC (East) for the Kharif seasons for years 2006-2009 were obtained from the Project Management Investigation Unit (PMIU) of I&P Department. The collected data were evaluated on monthly basis to find average water supply status at the tails. It was found that the percentage of tails, in term of average number of channels, that remained dry for Kharif 2006, Kharif 2007, Kharif 2008 and Kharif 2009 was 18, 12, 16 and 5.7, respectively; despite the fact that channels were running as per Authorized Head Discharge during these seasons which showed inequity of supply. This showed that there was some improvement in the dry tail status for Kharif 2007 than Kharif 2008, dry channels were 4% more than the Kharif 2007. For Kharif 2008 season there were 5.7% tails remained dry which were 10% less as compared to dry tails for Kharif 2008. The criterion used for defining tail status is given in Table 5 whereas the data summary/analysis is given in Table-6. On the other hand the tail status variations are depicted in Figure 5.

 Table 5. Criterion used for defining the type of tail status for LCC (East) system.

Authorized Head	95% of Authorized Head Discharge
Dry Tail	Less than or equals 30% of Authorized Tail Discharge
Short Tail	Greater than 30% and Less than 90% of Authorized Tail Discharge
Authorized Tail	Greater or equals 90% of Authorized Tail Discharge & Less than
	115% of Authorized Tail Discharge
Excessive Tail	Greater than 115% of Authorized Tail Discharge

		Average No. of Channels				
Head Status	Tail Status	Kharif 2006	Kharif 2007	Kharif 2008	Kharif 2009	
Channel	Excessive Tail	6	13	15	4	
Run as per	Authorized Tail	74	77	71	140	
Authorized	Short Tail	28	28	35	21	
Head	Dry Tail	24	16	23	10	
Closed Channels		55	59	42	38	

Table 6. Water supply position for Kharif seasons for years 2006-0)9.
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Figure 5. Status of water supply at tails during the Kharif seasons of 2006-09.

Status of Abiana (Water Charges) Collection

The assembled data for different crop seasons showed that the highest percentage of Abiana collected was 87% for Rabi 2004-05 and the second highest value was 84% for Rabi 2006-07. On the other hand, for Rabi 2008-09 Abiana collection was only 31% which showed a significant drop. The cropwise progress of FOs regarding assessment and collection of Abiana until the end of October 2009 is given in Table 7. The variation in Abiana collection over the period is depicted in Figure 6.

As evident from Figure 6, for the first year of the project the revenue collection was at its highest level for Rabi 2004-05 season. Afterwards, there was a general trend of decline in Abiana collection with an exception of Rabi 2006-07 season (fifth year of project). It showed that the collection of Abiana was continuously falling with the passage of time and reached at its lowest value for Rabi 2008-09 season, when it dropped to 31%. Apparent reasons for the decline in Abiana collection could be that: a)- some of the Khal Panchayat Chairmen did not deposit the collected amount of Abiana to the FOs; b)- non-implementation of revenue laws for the collection of Abiana; c)- some of the farmers did not pay Abiana with reason of not getting their due share of water; d)-inadequate incentive for the Khal Panchayt Chairmen, which made them disinterested; and e)- lack of technical training of FOs representatives, which is required for better management.

 Table 7. Status of Abiana collection upto 31st October 2009.

Sr. No.	Cropping Seasons	Assessed Abiana	Remission given for relief	Net Assessed Abiana	Collected Abiana	% age of collect
		Rs.	Rs.	Rs.	Rs.	- ion
1	Rabi 2004-05	51,742,962	3,307,972	48,434,990	42,252,654	87.24
2	Kharif 2005	123,641,577	7,667,009	115,974,568	91,810,112	79.16
3	Rabi 2005-06	68,082,076	5,106,922	62,975,154	48,184,778	76.51
4	Kharif 2006	123,575,997	8,708,331	114,867,666	76,528,977	66.62
5	Rabi 2006-07	68,179,753	4,439,251	63,740,502	53,503,714	83.94
6	Kharif 2007	123,224,393	11,685,643	111,538,750	70,676,739	63.37
7	Rabi 2007-08	67,927,291	7,672,354	60,254,937	34,015,794	56.45
8	Kharif 2008	125,813,476	11,730,830	114,082,646	61,930,712	54.29
9	Rabi 2008-09	69,285,696	-	69,285,696	21,271,527	30.70
	Sub Total	821,473,221	60,318,312	761,154,909	500,17500,7	65.71



Figure 6. Percentage of Abiana collection for different crop seasons for LCC (east).

Further, as mentioned in PIDA (2008), [4] report under the social survey of FOs functioning and AWB, the farmers (end users) were not very much satisfied with the performance of the pilot project and their

dissatisfaction has been increasing with the passage of time. It has also been reported under the overall performance ranking that only 23% of the FOs' performance was good, 33% satisfactory, 27% adequate and 17% poor.

Some of the proposals regarding improvement in Abiana collection could be a development of realization in farmers that the sustainability of the Irrigation System and its equitable service delivery depends largely on the funds generated through their water charges, therefore, timely Abiana payments in this regard are necessary. Also, Abina collection system, which involves Khal Panchayt Chairmen, FAOs etc., should be improved.

Conclusions

The following specific conclusions may be drawn from this study.

- The computed values of relative DPR showed some improvement in the water supply for Kharif 2007 and Rabi 2007-08 seasons. Little improvement was found in the dry tail status during Kharif 2006, Rabi 2006-2007 and Kharif 2008 seasons. On the average basis, the results were not encouraging and no consistent pattern of improvement was recorded.
- A random type variation was recorded in the average Capacity Factor for different Kharif seasons from 2006 to 2009 and it ranged from 0.86 (for Kharif 2006) to 0.91 (for Kharif 2007 & 2009). It did not show a consistent pattern of improvement in supplies.
- A general trend of decline in Abiana collection was recorded, starting from Rabi 2004-05 season to Rabi 2008-09 season, with an exception of Rabi 2006-2007 season. This decline in revenue collection was excessive and it dropped two-third over the study period which showed decreasing efficiency of FOs.
- In general, based upon this LCC (East) study results and the data available till now, the reform program introduced by the Irrigation and Power Department of Government of Punjab through PIDA (which involved AWB, FOs, Khal Panchayt and its Chairmen etc) has not been doing well as it was initially anticipated. Thus it needs extensive review.

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