Operation and Maintenance Cost of Drainage System: The Case Study of Bareji Distributary, Mirpurkhas, Sindh, Pakistan

GHULAM MUSTAFA UJJAN* , MASHOOQUE ALI TALPUR** , AND BAKHSHAL KHAN LASHARI***

ABSTRACT

The Bareji Distributary that off takes from Jamrao Canal comes under the command area of Left Bank Outfall Drain (LBOD). The distributary is commanding an area of 13,049 acres cultivated land. The total command area is being drained through thirteen tile drainage units. Each unit has average discharge of about 2.25 cusecs. The observations of water table depth through piezometers (sixty five piezometers) have been made every month and at the same time running hours of sump houses and energy consumed by each sump house have also been recorded. The average running of sump house is calculated as 3.3 hours/day per sump house. The water table depth in the corresponding month is measured that has indicated very small fluctuation in water table depth in the period between August 1999 and July 2000. It means that the inflow due to water losses and outflow due to running of sump houses is almost balanced. On the basis of actual running of tile drainage units the cost of operation and maintenance has been calculated. The future incremental drainage cess for 15 years is recommended following the base line of Rs. 84 per acre as being charged from the beneficiaries today.

1. INTRODUCTION

Operation and maintenance is the regular processes of maintaining/repairing the infrastructure and day- to- day observation of the system performance. Thus irrinage system require maintenance for their proper functioning. Drainage network infrastructure is considered as an important and integral part of the irrigation system. To a great extent the life and durability of the system depends upon the proper maintenance of the system. The neglect of maintenance of the majority of irrigation systems in developing countries is incapable of meeting future food demands. The best operated irrigation systems in the world are managed by farmers, not by government agencies" [1].

The cost required for the maintenance & operation of the system is considered the bases for its long run availability. The idea of institutional reforms in irrigation system imparts shifting of O&M responsibility of secondary irrigation channel and sub drains having discharge less than 15 cusecs from Irrigation and Power Department (IPD) to Farmers Organizations. The FOs are foreseen as the fundamental of this system. The FOs have to carry out Operation and Maintenance of the infrastructure by preparing "Cost Effective Plans of O&M", thus economizing the over head cost of the system.

International Irrigation Management Institute (IIMI), Pakistan has been working on "Farmer Managed-Irrigated Agriculture" for the main purpose to involve the beneficiaries in O&M of irrigation and Drainage system and to reduce the burden of cost on O&M of the system.

* Assistant Engineer, ** Junior Irrigation Engineering and *** Senior Engineer,
International Irrigation Management Institute (IIMI), Pakistan

This paper elaborates the budgeting for an appropriate Operation & Maintenance of drainage infrastructure on the basis of actual operation hours of the system in the command area of the Bareji Distributary. Furthermore, the cost has been calculated following the FOP [2] and IPD Yardstick [3]

2. SALIENT FEATURES OF THE DISTRIBUTARY

Bareji Distributary off takes from Jamrao canal at RD 408 and is about 8 miles long. It is perennial channel with design discharge of 41.5 cusecs. It supplies water to an area of about 13049 acres. The drainage system provided under LBOD stage 1 project in the area consists of surface and subsurface drains, there are 13 tile drainage units having discharges from 1.5 up to 3.0 cusecs with 10-20 hp motors. There are four sub drains having total length of about eight miles covers the whole area of the distributary. To dispose of tile drainage effluent the total length of disposal channels is about 3.5 miles. In addition, the spinal drain is passing by the end of command area i.e. from east (Fig. 1). The total landholders on the command area of distributary are 346. Total 65 piezometers were being installed by IIMI in the command area of distributary, to observe ground water level fluctuation.

3. RESULTS AND DISCUSSION

The water table depth has been observed through sixty-five piezometers installed in the command area of the distributary. Results indicate the water table depth has remained between 3.94 and 4.3 feet (Table 1). It describes the inflow due to water losses from distributary, watercourses and deep percolation in the field and outflow due to drainage is almost equal.

The running hours of all sump houses (thirteen sump house) have been recorded which are shown in Table 1. The average running hours per sump house per day are calculated that has come to 3.3 and the energy consumed by each sump house per hour is about 8 kWh/hour.

The cost of electricity has been calculated on the basis of actual running hours and electric units consumed. The total cost for that year has come to Rs. 492,590

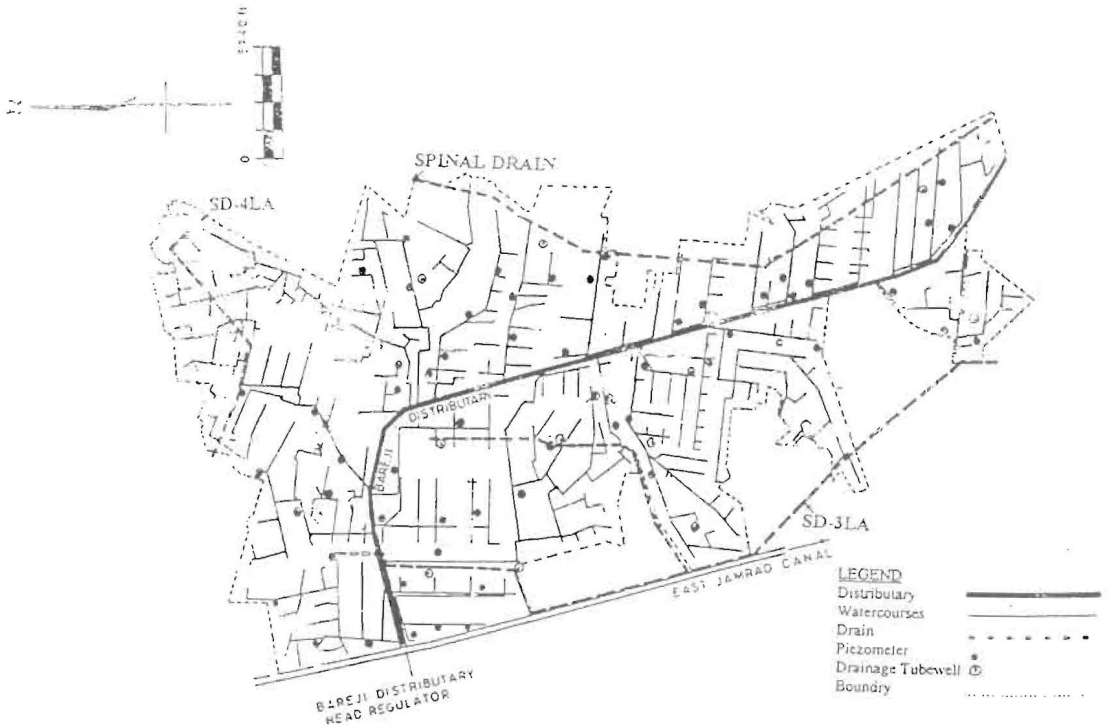

FIG. 1. LAYOUT PLAN OF THE BAREJI DISTRIBUTARY COMMAND AREA

And the O&M cost excluding electricity have come to about Rs. 663,996 per year. (This cost includes eight miles of sub drains, three miles of disposal channel and maintenance of sump house and guarding of sump house). The total cost calculated is Rs. 1,156,590 per year (Table 2).

The O&M cost has been calculated for further fifteen years starting from 2000-2001 by considering average running hours of each sump house 4 hours/day. The cost has come to Rs.1.26 m for the year 2000-2001. Considering the scalation of two percent per year and raise fifteen percent after every three years (FOP 1999), the cost has been calculated up to 2014-2015 (Table 2 and Fig. 2).

The drainage cess has been proposed to be increased by about eight percent per year to balance the O&M expenditure. The datum of drainage cess is fixed Rs. 84 as being now charged from the beneficiaries where drainage is provided.

Figure 1. describes the O&M expenditure estimated by following the recommendation of Future Operation Plan (FOP) and Irrigation and Power Dept. Yardstick. These calculations clearly show that the cost of FOP is 127 percent above than actual and similarly cost calculated by IPD yard stick is 100 above the actual cost required to operate and maintain the drainage system to keep the water level at required level or balance the inflow and outflow.

4. CONCLUSIONS

It is concluded that the running of each sump house for about 4 hours per day, the inflow due to water losses and outflow due to running of tile drainage will be balanced.

The water losses, which are about 25-30 percent, when FO will be given responsibility then can be minimized due to proper water management, lining the watercourses and applying crop water requirement. The running hours of tile units can also be decreased. Therefore energy will be saved and cost can be reduced.

The increment in drainage cess as proposed eight percent per year the expenditure and drainage cess after seven years will be balanced. Then benefit will start from eighth year. If the increment in the drainage cess is considered fifteen percent then benefits will start from the third year.

TABLE 1. COST ESTIMATED FOR THE O&M OF DRAINAGE SYSTEM IN COMMAND AREA OF BAREJI DISTRIBUTARY, MIRPURKHAS.

Month	Average water table depth (ft)	Average running (hrs)	Electric units consumed (kWh)	Cost of Electricity (Rs 4.0/unit)	O&M cost excluding Electricity (Rs.)	O&M cost excluding Electricity (Rs.)
Aug 99	3.94	40.4	4205.3	16821	55333	72154
Sep 99	3.89	53.6	5590.4	22361	55333	77695
Oct 99	3.89	152.7	15879.1	63516	55333	118850
Nov 99	3.62	116.5	12119.6	48478	55333	103812
Dec 99	3.04	196.3	20418.0	81672	55333	137005
Jan 00	3.07	109.0	11330.8	45323	55333	100657
Feb 00	3.93	57.4	5970.8	23883	55333	79217
Mar 00	3.94	97.9	10181.3	40725	55333	96059
Apr 00	4.25	85.7	8911.58	356646	55333	900980
May 00	4.34	164.9	17143.9	68572	55333	123909
Jun 00	4.35	73.6	7652.9	30612	55333	85945
Jul 00	4.08	36	3744.0	14976	55333	70309

TABLE 2. COMPARISON OF O&M COST IN THE COMMAND AREA OF BAREJI DISTRIBUTARY, MIRPURKHAS.

Year	Operation and Maintenance cost (Rs M)			Proposed Incremental Drainage Cess (Rs M)	
	Future Operation Plan (FOP)	Irrigation & Power Dept. Yard stick (IPD)	Actual	15% per year (FOP)	8% per year (actual basis)
2000-01	2.87	2.54	1.26	1.00	1.00
2001-02	2.93	2.59	1.29	1.15	1.08
2002-03	2.99	2.64	1.31	1.32	1.17
2003-04	3.44	3.04	1.51	1.52	1.26
2004-05	3.51	3.10	1.54	1.75	1.36
2005-06	3.58	3.16	1.57	2.01	1.47
2006-07	4.11	3.23	1.60	2.32	1.59
2007-08	4.20	3.29	1.64	2.66	1.72
2008-09	4.28	3.36	1.67	3.06	1.85
2009-10	4.92	3.86	1.92	3.52	2.00
2010-11	5.02	3.94	1.96	4.05	2.16
2011-12	5.12	4.01	2.00	4.66	2.34
2012-13	5.89	4.62	2.30	5.36	2.52
2013-14	6.01	4.71	2.34	6.16	2.72
2014-15	6.13	4.80	2.39	7.09	2.94

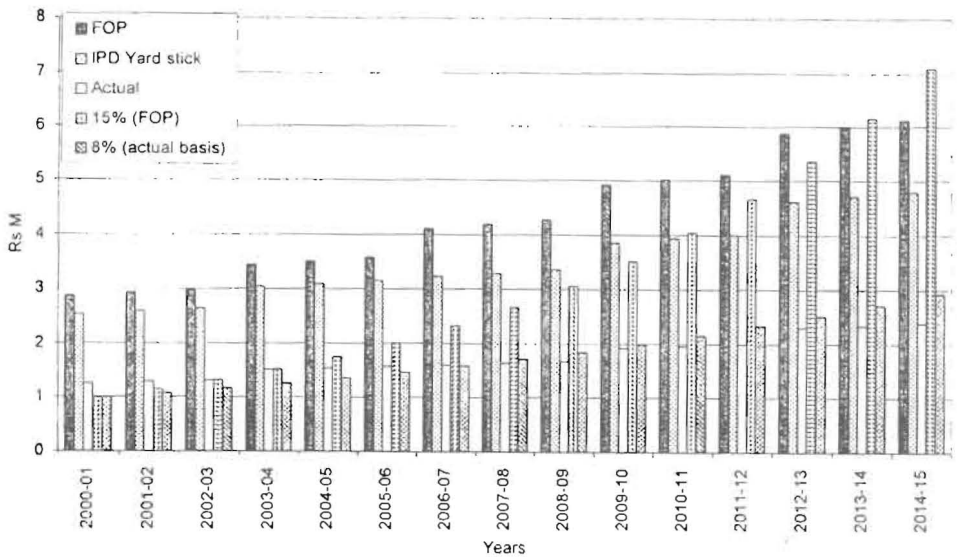

FIG. 2. COMPARISON OF O&M COST OF DRAINAGE SYSTEM AND PROPOSED CESS IN COMMAND AREA OF BAREJI DISTRIBUTARY, MIRPURKHAS

REFERENCES

[1] Skogerboe, G.V and Merkley, G.P, "Irrigation Maintenance & Operation Learning Process", Water Resources Publications, LLC, 1996.

[2] Pakistan Drainage Consultants, "Future Operational P... (FOP)", LBOD Stage–I, Pakistan Drainage Consult... Sindh, 1999.

[3] Irrigation & Power Department, "Operation... Maintenance Manual", Government of Sindh, 1993.