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PERFORMANCE ASSESSMENT OF OUTLETS OPERATION IN THE UPPER CHENAB CANAL SYSTEM

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A field survey was carried out for the assessment of outlets operation in the Upper Chenab canal system. Discharge measurement of 65 outlets was carried out in the selected channels, 13 outlets from each channel of different type. The results indicated that majority of the outlets are tampered. Sanctioned discharge for the outlets was not reaching the outlets located near the tails of distributaries and minors. The distribution of water is done on the basis of stage-discharge relationship. The sedimentation in the channel is creating a change in the surface elevation.

Key words: outlets, performance assessment, Upper Chenab canal

INTRODUCTION

Water is a basic input for crop production. Currently most developing countries have the common goal to accelerate the production of agricultural crops to meet the food requirements of a swelling population through explo.itation and better management of their water resources. The technology for using available water supplies most efficiently is either lacking or not adapted to the available resources in many countries. Pakistan is also facing the same dilemma like many other countries. Being predominantly an agricultural country, about 70% of its population comprises agriculturists and farmers (Akhtar, 1980).

Irrigation in Pakistan began with the Mohanjodaro civilization more than 5,000 years ago. Summer flood was diverted to cover lands adjacent to the rivers to grow crops. A modern conveyance system was constructed by the British in the late 18th century. Today it is the greatest single irrigation system in the world (Fukuda, 1976). The mean annual river runoff available in the system is around 172 billion cubic meter.. There are three major reservoirs in the system, having a combined live storage capacity equal to 10% of the mean annual river flow. There are 15 barrages and 45 main canals withdrawing, on average, 130 billion cubic meter of river water annually. In addition, there is a network of inter-river link canals for transferring water from one river to another (Anonymous, 1999),

The purpose of an irrigation system is to deliver water of appropriate quality in the required quantity and at the most opportune time and place for optimising agricultural production in a given area, therefore considerable emphasis must be placed on measurement and control of water in transit through the system. Akhtar (1980) conducted a study on the factors affecting irrigation efficiencies and concluded that the most significant variable in explaining conveyance efficiencies were field inlet discharge. An accurate measurement of water from storage or diversion to delivery is necessary for successful irrigation management to meet legal obligation to ensure equitable distribution of water to those served, and to establish and maintain a cordial relationship between the Irrigation Department's staff and the water user.. The day-to-day management of water requires that daily water use be known and compared against flow reserves and demands. This can only be accomplished by knowing with reasonable accuracy the amount of water being diverted and delivered. Good water measurement creates confidence in the development and can go a long way towards eliminating waste and harmful irrigation practices that may lead to a variety of drainage related, problems such as salinization of soil., restricted rootzone, excessive leaching and eventually complete waterlogging. The main objective of the study was to compare the observed results with the designed parameters and to investigate the variation of discharge of irrigation canal outlets which are directly inflowed by the method of canal regulation.

METHODOLOGY

A survey was carried out for the assessment of operation of the outlets in the Upper Chenab canal.. The study was based on various types of data collection keeping in view the required parameters. A total of five distributaries and minors in the districts of Gujranwala and Sheikhupura were selected. Designed parameters of the selected channels were collected from the Irrigation and Power Department of Punjab. At site discharge measurement of 65 outlets was carried out of the selected channels, measuring 13 outlets of each channel of the following types: open flume. adjustable proportional module, open flume with roof block. pipe or barrel and scratchley type. The other data were concerned with actual discharge observations of the canal outlets by Cut-Throat Flume for discharge up to 2 cusecs and beyond this discharge current meter was used.

RESULTS AND DISCUSSION

The discharge observations taken at site were tabulated and analyzed. The observations of two minors i.e. Mukta and Khutiali minor are presented in Tables I and 2 respectively. Comparison of discharge outlets is given in Figures I and 2. which clearly showed that the designed discharge was not reaching the outlets located near the tails of distributaries/minors and tail clusters. Only two outlets (No. 8+900 and No. 27+800) of Khutiali minor were drawing their designed discharge. The majority of the outlets were found drawing excess discharge than the designed one.

Table 1. Comparison and variation of discharge from outlets of Mukta minor

Sr. No.	Outlet RD	Type of outlet	Discharge Cfs		%age variation of discharge
			Designed	Observed	
1	2+323	APM	0.97	1.26	29.90
2	2+333	APM	1.33	2.50	87.97
3	5+185	APM	0.64	1.89	195.31
4	5+964	APM	1.05	1.74	65.71
5	13+982	APM	1.75	2.67	52.57
6	13+982	O.F	1.75	3.33	90.29
7	14+396	APM	1.68	2.44	45.24
8	17+057	OFBR	1.57	1.58	00.64
9	19+038	OFBR	0.95	0.97	02.10
10	21+214	Scr.	2.90	1.93	-33.45
11	48+400	O.F	1.68	0.77	-54.17
12	48+400	O.F	1.83	1.16	-36.61
13	48+400	O.F	1.56	0.95	-39.10

Table 2. Comparison and variation of discharge from outlets of Khutiali minor

Sr. No.	Outlet RD	Type of outlet	Discharge Cfs		%age variation of discharge
			Designed	Observed	
1	8+900	OFRB	1.57	1.57	00.00
2	10+300	OFRB	1.45	1.46	00.69
3	10+300	APM	0.80	0.67	-16.25
4	11+405	APM	0.40	0.36	-10.00
5	13+700	APM	0.91	0.96	05.49
6	17+000	O.F	1.03	0.93	-9.71
7	26+300	APM	1.39	1.72	23.74
8	27+800	Pipe	1.34	1.34	00.00
9	32+800	Pipe	2.20	2.22	00.91
10	77+900	O.F	0.73	0.46	-36.98
11	87+700	O.F	1.74	1.26	-27.58
12	87+700	O.F	1.65	1.19	-27.88
13	87+700	O.F	1.74	1.23	-29.31

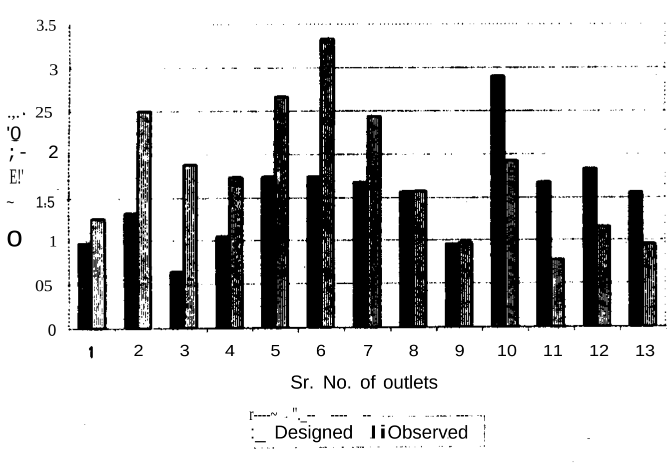

Fig. I. Comparison of discharge from outlets of Mukta minor

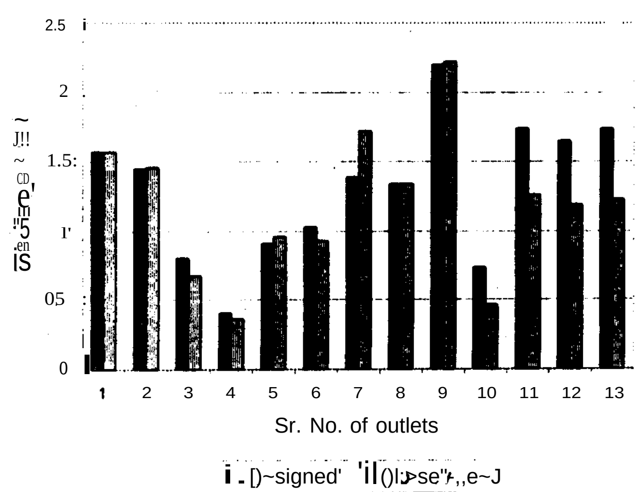

Fig. 2. Comparison of discharge from outlets of Khutiali minor

Operation and Water Measurement: The operational objective of an irrigation system is to provide equitable distribution of the available water resource to all watercourses served by the system. This is accomplished by scheduling, which is a simple method of planning the delivery of water. In practice, the delivery of water is complicated. About 90% of the time of the authority is consumed in solving users problems and 10% for technical problems. The operation of an irrigation system normally requires a detailed knowledge of crop water requirements because water is usually delivered to meet peak irrigation demands.

Operational Problems: The primary problems which were assessed resultant to this study were that the sanctioned flow was not reaching the outlets located near the tails of distributaries and minors. There are so many reasons why water was not reaching the tail, such as i) tampering of outlets, ii) inaccurate inflow estimates, iii) improper setting of outlets, iv) sedimentation and resulting change in water surface levels, v) overdesilting of minors in certain areas, vi) the system is not properly calibrated and adjusted, vii) limited desilting, and viii) socio-political pressures.

In an attempt to overcome the problems, the Irrigation Department has increased the discharge in channels by increasing the water levels in the parent channel. Although the increase in discharge results in higher initial water levels, it also causes upstream outlets to receive disproportionately higher discharge, transfers greater sediment load into tail channels. These operational problems can be overcome by resetting of the outlets for sanctioned discharges and by adding sediment traps and control structures to maintain water levels for designed discharge.

Regulation of Water Control Structures: Canal failures are usually due to inadequate operation and maintenance procedures. The misoperation of canal cross-regulators is sometimes the cause of failure and is due to non-attention to the free board conditions and backwater effects. Canal structures seldom fail except for piping failures. They become non-operative due to a lack of maintenance. Embankment failure is often due to erosion. The level of maintenance on canal structures has decreased. Therefore, a large emphasis is required on preventive maintenance of the water control structures within the system on the smaller canals. A bit of effort made when problem first starts can save considerable effort and cost at a later stage.

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