

Effect of the lining of water courses on water losses and conveyance efficiency

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Abstract: Four water courses recorded the loss of water before improvement as 25.58, 13.82, 36.46 and 39.84%, however after improvement these water losses exhibited reduced values i.e. 1.61, 1.36, 1.63, and 1.36, and conveyance efficiency improved by 37.85%. Therefore it is recommended that to obtain maximum conveyance efficiency and reduced water loss risks the lining of water courses should be on top priority.

Key Words: Water course, Lining, Water Losses

Introduction

Irrigated agriculture of Pakistan is as old as the civilization of Moen-Jo-Daro. The development of intensive irrigation network implemented after the construction of barrages in the middle of 20th Century. The importance of irrigation is recognized by the fact that it intensifies the cultivation of land and increase yield of crops, if, the irrigation water is efficiently used. Irrigated agriculture is located largely in the Indus plain. The main water source in the Indus plain is the Indus River and its tributaries. Various investigations have revealed that most of the watercourses are improperly designed, poorly maintained, and carelessly operated, this results in considerably water losses Lauritzen (1963) reported that about one third of the water diverted for irrigation purposes was lost in conveyance and that only one half of the water was left for application and is stored in the rootzone, Corey and Clyma (1975) concluded that the water course conveyance losses occur over 40% in Pakistan. Mashhadi (1993) reported that seepage losses in unlined conveyance system of the different countries in the world varies from 25% to 50% of total diversion. Cory and Clyma (1975) attributed the physical causes for watercourse losses as leaky "nakkas", inadequate hydraulic capacity, thin channel walls, inadequate free board, obstruction such as trees, weeds, debris and sediments, poor alignment and excessive ditch system required to serve many small fields. Rahmat *et al.* (1978) measured conveyance losses of 15 watercourses in NWFP ranged from 25 to 45%. Kkhatk *et al.* (1983) found the average losses of 32.45% from seven water course in NWFP. Evaluation of the improved water courses shows substantial saving of water losses. Khan (1986) reported about 27% increase in delivery efficiency and about 53% reduction in water losses after water course improvement. Shahid *et al.* (1996) reported that the seepage quantities from unlined irrigation channels as quoted from various technical sources ranged from 25% to 50% of transported water. World Bank (1992), proposed that lining work controls excessive seepage, waterlogging and salinity. Bridley (1987), and Patto, (1989). mentioned that seepage losses from irrigation conveyance channels have widely been identified as environmentally critical resulting from ground water accessions and associated drainage problems. Keeping in view the importance of water losses before and after improvement of water course, the present study was carried out in four water courses in three districts of Sindh province.

Materials and Methods

The study was carried-out during 1998 on four water courses, i.e. two water courses were located in district Mirpurkhas, and two in district Sanghar and Nawabshah of Sindh province. These water courses vary in length, design, discharge, commanded area, and other farming conditions (Table 1). These water courses were selected randomly from On-Farm Water Management of LBOD Stage-1 Project Area. The lining was done with bricks of rectangular shapes. Conveyance water losses measurement before and after improvement were made by method described by Hagan, (1989) current meter. Two current meter were installed at inlet and outlet of the water course to ensure that flow of water is steady later-on the discharge was recorded. The water losses percentage in conveying system was calculated as flows:

$$\text{Water loss \%} = \frac{Q_1 - Q_2}{Q_1} \times 100$$

% loss

$$\text{Loss in 1000 ft length} = \frac{\text{Total loss}}{\text{Total length in ft.}} \times 100$$

$$\text{Conveying Efficiency (CE)} = 100 - \text{water loss \%}$$

$$\text{CE} = \frac{Q_2}{Q_1} \times 100$$

Where:

Q_1 = Measured discharge at head.

Q_2 = Measured discharge at tail.

Results and Discussions

Losses computed in the unlined section in per 1000 ft were 4.02, 4.45, 3.70 and 4.50% in water courses 377/2R, 378/1A, 1CR and 2L respectively. Maximum water loss (4.50%) was found in 2L, and minimum (3.70%) was observed in 1CR. The losses in lined portion were 0.98, 1.08, 0.50, and 0.93% in the water courses 377/2R, 378/1A 1CR and 2L respectively. It has been observed that the losses were due to leakage from nakkas, evaporation and seepage losses from bed and banks of unlined portion of water course. From the results it is evident that an average loss in unlined section is almost higher than that of lined portion. The average conveyance efficiency in lined water course was 98% while unlined water course exhibited 71%. The reasons of less conveyance efficiency in unlined portion of water course is due to lack of proposed maintenance of the water courses, presence of vegetation, improper alignment and rodent effect. Thus the conveyance efficiency was improved due

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Table 1: Salient features of water courses

Name of water Course	Crop Cultivated Area (Acres)	Design Discharge (cfs)	Total Length (ft)	Lined Length (ft)	Unlined Length
377/2R Doultpur	355	2.82	8003	1640	6363
378/1A West Jamreo	268	3.60	4362	1253	3109
ICR Toori	692	5.36	13120	3280	9840
2L Punioo	411	4.69	10332	1460	8872

Table 2: Water losses in lined and unlined portion of water courses

Name of water Course	Lined portion on the water courses			
	Discharge at head (Q1) (cfs)	Discharge at tail (Q2) (cfs)	Losses Between Q1 - Q2 (cfs)	Loss Rate in 1000 ft (%)
377/2R	3.10	3.05	0.05	0.98
378/1A	2.20	2.17	0.03	1.08
1CR	5.52	5.43	0.09	0.50
2L	3.69	3.64	0.05	0.09
Unlined portion of the water courses				
377/2R	3.05	2.27	0.78	4.02
378/1A	2.17	1.87	0.30	4.45
1CR	5.43	3.45	1.98	3.70
2L	3.64	2.19	1.45	4.50

Table 3: Water losses and conveyance efficiency of lined and unlined water courses

Name of water Course	Water Losses			Conveyance Efficiency	
	Lined	Unlined	Total	Lined	Unlined
377/2R	1.61	25.58	27.19	98.39	74.42
278/1A	1.36	13.82	15.18	98.35	86.16
1CR	1.63	36.46	38.09	98.36	63.59
2L	1.36	39.84	41.20	98.64	60.08
Average	1.49	28.93	30.42	98.44	71.00

to lining of water courses. These findings are in agreement with Khan (1986) who reported that more number of turn-outs, leakage losses, less cooperation among the water users and less maintenance, reduce the efficiency of water course. These fore it is recommended that water courses must be lined for better effectiveness and sustainable water management.

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