

# IMPROVING OPERATIONAL PERFORMANCE AND MANAGEMENT OF CANAL IRRIGATION SYSTEMS USING HYDRAULIC MODELING



SUBMITTED BY

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## ABSTRACT

Water resources development and management acquired new dimensions in Pakistan. Recently, the Government of Pakistan has taken strategic initiatives and primarily focused on governance, decentralization and participation of the farmers by transforming the Provincial Irrigation Department (PID) to the Frontier Irrigation and Drainage Authority (FIDA). Management responsibilities are decentralized at canal command level to Area Water Boards (AWBs) and most of the existing functions at distributary level are performed by the farmer's organizations (FOs). Recently six distributaries have been handed over to the farmer organizations under the irrigation management transfer (IMT) programme in Swat Canal Area Water Board (SCAWB).

The study was conducted to analyse the operational performance using hydraulic simulation modeling. To assess the impact of IMT on the performance of the irrigation system a database oriented irrigation management information system (IMIS) technique has been developed and utilized. The Simulation of Irrigation Canal (SIC) hydrodynamic model was used to analyse the improved operational scenarios for the irrigation systems operation at distributary level, to provide the system managers and farmers organizations to update the managerial control and plan operational activities through improved understanding of the system. Results of the study revealed that irrigation supplies are in excess of the crop water requirements. The relative water supply (RWS) index varies from 1.66 to 2.02 during summer, whereas in winter it varies from 2.22 to 2.55. The delivery performance ratio (DPR) during summer varies from 0.78 to 0.83 and in winter from 0.63 to 0.73. Irrigation supplies were reliable over the whole growing season. Due to modernization of the irrigation systems and enhanced water allowance, the annual cropping intensity and yield have increased significantly. There is a prominent increase in yield of maize (40 percent), sugarcane (55 percent) and wheat (43 percent) while the cropping intensity has increased by 25 percent.

The Irrigation service fee (ISF) collection analysis indicated that all the FOs performed well during the first year (2004-05) of IMT and recovered 60 percent of the assessed ISF; whereas during the 2005-06 and 2006-07, ISF collected was very low. From these results it is evident that chances of successful cost recovery do not seem to be high.

Operational and regulation aspects of the main system also play a pivotal role in overall irrigation water management aspects. The SIC model was used to evaluate the effectiveness of physical infrastructures of the Chowki Distributary. Open flume outlets along the distributary behave as hyper-proportional irrespective of their position. The head bifurcator outlets are behaving hyper-proportional, whereas middle ones as perfect proportional and tail end as sub-proportional. The trifurcator outlets are behaving as hyper-proportional. The major causes are construction inaccuracies in setting the crest level, which lead the outlets to draw more or less than the design discharge.

To improve the manual operation of the Chowki Distributary irrigation system, different operational strategies were investigated and quantified. From the results of this study, it is suggested to operate the distributary head regulator manually based on fixed frequency operation. It is recommended that from May to July, the distributary should be operated at 90-80 percent of design discharge, 90-75 percent of design discharge from August to October and 75-85 percent of design discharge from December to April to adjust the over delivery due to high water allowance. Hydraulic committees at each of the distributary should be established to operate the distributary according to crop demand. Awareness among the farmers should be created regarding the farm irrigation application methods to avoid over-irrigation and wastage of water.