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Performance evaluation of west Banas irrigation project using maintenance indicators

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Abstract

Maintenance indicators are used to evaluate performance of canal by using Relative Change of Water Level (RCWL), Dependability of Duration (DOD) and Effectiveness of Infrastructure (EOI). RCWL is observed in 10 Percent Right Main Canal showing that water level is decreased in the canal from the designed level. Intended duration of water delivery as per decided in the meeting of water distribution committee was 110 days for West Banas Canal System. In IInd, IIIrd and IVth irrigation ratio obtained between actual and intended duration is 1.07, 1.10 and 1 respectively which shows good DOD attained during II, III and IV irrigation. But in Ist irrigation dependability of duration was 0.88. Effectiveness of infrastructure (EOI) was calculated as 90 per cent indicating almost 10 per cent of structures are either damaged or do not exist.

Keywords: Maintenance Indicators, DOD, Effectiveness of infrastructure, RCWL

1. Introduction

Maintenance performance indicators make it possible to see how well-irrigated agriculture is performing at the system, basin or national scale. As a tool for measuring the relative performance of irrigation systems or tracking the performance of individual systems the IWMI Maintenance indicators help.

Proper maintenance enables the keeping of water control infrastructure in good working condition so that the design water level is maintained. The head loss across structures in irrigation canals is the single most important factor disrupting the intended delivery of irrigation water.

The aim of this study is to determine irrigation performance with Maintenance indicators. No such investigation has been done in the region so far. Therefore, system managers can develop new strategies. Maintenance indicators will provide a chance to policymakers and planners to evaluate how productively land and water resources are being used for agriculture, and to make more informed strategic decisions regarding irrigation and food production. Researchers use these indicators to compare irrigation systems and identify factors that lead to better performance.

2. Description of study area

The Right Main Canal of West Banas Irrigation Project has been considered in this study, Sawrupganj a tehsil headquarter in the district Sirohi. The selected study site is accessible by a 2 km long road from Dhaneri village.

3. Methodology

In the present study comparative indicators are used to evaluate the system performance of Right Main Canal which enables policymakers and planners to see how productive their use of water and land for agriculture is. They help answer important strategic questions, such as: What types of systems are getting the most from limited water and land resources? How much should we invest in irrigated agriculture, and how?

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3.1 Maintenance indicators

Proper maintenance enables the keeping of water control infrastructure in good working condition so that the design water level is maintained. The head loss across structures (water level difference between upstream and downstream of structure) in irrigation canals is the single most important factor disrupting the intended delivery of irrigation water. The following hydraulic performance indicators (Boss, 1997; Kloezen and Garces-Restrepo, 1998.) [8, 2] evaluated the maintenance indicators.

3.1.1 The relative change of water level (RCWL)

It is the ratio of actual water depth from the canal bottom and comparing it with the design water depth at the same position in the main canal, i.e. changes of water depth from the intended level.

$$\text{Relative Change of Water Level} = \frac{\text{Actual depth}}{\text{Design depth}} \dots (3.1)$$

3.1.2 Effectiveness of Infrastructure

It measures the ratio of the number of functioning structures to the total number of structures initially installed.

$$\text{Effectiveness of Infrastructure} = \frac{\text{No.of functioning structures}}{\text{Total no.of structures}} \dots (3.2)$$

3.1.3 Dependability of Duration

It is estimated as the ratio of the actual duration of water delivery compared to the plan as computed by

$$\text{Dependability of Duration} = \frac{\text{Actual duration of water delivery}}{\text{Intended duration of water delivery}} \dots (3.3)$$

4. Results and Discussion

Main purpose of measuring maintenance indicators for the evaluation of irrigation systems is to assure safety related to failure of infrastructure, keep canals in sufficiently good (operational) condition to minimize seepage or clogging, sustain canal water levels and designed head-discharge relationships and keep water control infrastructure in working

condition. Here in this study, condition of canals, duration of water delivery and effectiveness of infrastructure are measured.

4.1 Relative Change of Water Level (RCWL)

Relative Change of Water Level (RCWL) is used to find deterioration in canal structure by weakening of walls, breaches, seepage, siltation etc. Actual depth of three minors located at head, mid and tail sections of the right main canal was considered for analysis. The water levels were measured regularly during entire irrigation cycle, which were then divided by the design values to estimate Relative Change in Water Level. Table 4.25 show results of RCWL indicating a decrease in depth due to inefficient water supply and maintenance. Increase in value of RCWL was observed from head to tail minors for Right Main Canal. Fula bai khera Minor in head section of RMC measured 4 percent relative change in water level with design and actual depth of 0.50 m and 0.48 m respectively.

At middle section, depth has shown 12 per cent value of RCWL causing decrease in water level due to seepage from various parts of canal. About 14 per cent, change in water level was observed at tail section. An average value of RCWL at three locations was measured to be 10 per cent for Right Main Canal. The graphical representation of RCWL for right main canal is given in Fig. 4.26. Head section minor had shown lower RCWL and it increases middle to tail section minor. Hence, tail section of minor not supplying water adequately.

Table 4.1: Calculation of relative change in water level

| Name of Minor | Design Depth (m) | Measured Depth (m) | RCWL (%) |
|----------------------|------------------|--------------------|----------|
| Fula Bai Khera minor | 0.50 | 0.48 | 4 |
| Achpura minor | 0.50 | 0.44 | 12 |
| Kyaria minor | 0.50 | 0.43 | 14 |
| Average | | | 10 |

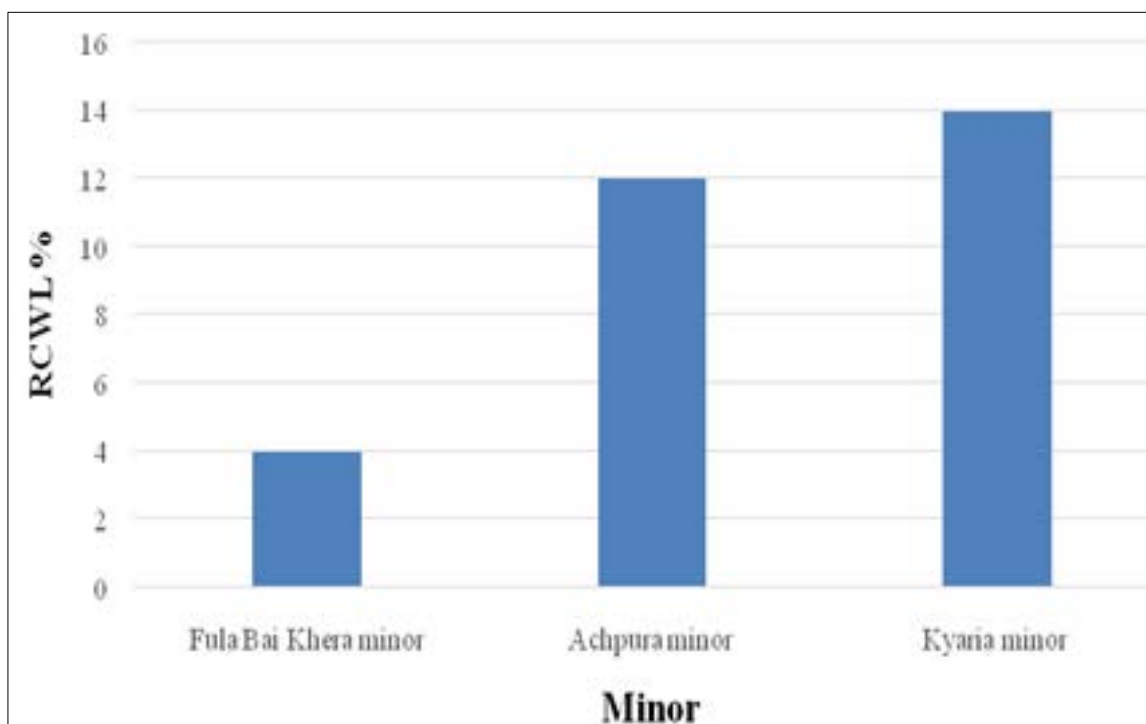


Fig 4.1: Relative Change of Water Level for Right Main Canal

4.2 Dependability of duration (DOD)

For year 2017-18, intended duration of water delivery was approved as 110 days in the meeting of water distribution committee held at Irrigation Department of West Bans, Sirohi. The first irrigation was given in the month of November. The dependability of duration was attained value 1 in IV irrigation

whereas 0.88, 1.07 and 1.10 during I, II and III irrigation respectively. The dependability of duration value 1 indicates that water was supplied as per schedule whereas a value lower than 1 indicates that water was not supplied as per schedule. The canals were closed in March.

Table 4.2: Dependability of Duration for West Banas Canal System

| Canal | Duration | I st Irrigation | II nd Irrigation | III rd Irrigation | IV th Irrigation |
|------------------|-------------------|----------------------------|-----------------------------|------------------------------|-----------------------------|
| Right Main Canal | Actual Duration | 23 | 30 | 31 | 28 |
| | Intended Duration | 26 | 28 | 28 | 28 |
| DOD | AD / ID | 0.88 | 1.07 | 1.10 | 1.00 |

4.3 Effectiveness of infrastructure (EOI)

Effectiveness of Infrastructure (EOI) values help in assessment of the performance of the canal operation. As per the design document, the total number of different structures constructed was 70, but only 63 of them were functional at present. As a result, the value of Effectiveness of

Infrastructure was obtained to be 90 per cent for year 2017-18. Nearly 10 per cent of the structures had been damaged. Several disfigurements of water control structures were found as their iron bars not in proper shape reported. Effectiveness of infrastructure for the Right Main Canal was found as 0.90 shown in Table 4.27.

Table 4.3: Effectiveness of Infrastructure

| Canal | Total no. of Structures | No. of Functioning Structures | Effectiveness of Structures |
|------------------|-------------------------|-------------------------------|-----------------------------|
| Right Main Canal | 70 | 63 | 0.90 |

5. Conclusions

- RCWL is observed at 10 Per cent Right Main Canal showing that water level is decreased in the canal from the designed level.
- Intended duration of water delivery as per decided in the meeting of water distribution committee was 110 days for West Banas Canal System. In IInd, IIIrd and IVth irrigation ratio obtained between actual and intended duration is 1.07, 1.10 and 1 respectively which shows good DOD attained during II, III and IV irrigation.
- In Ist irrigation dependability of duration was 0.88.
- Effectiveness of infrastructure (EOI) was calculated as 90 per cent indicating almost 10 per cent structures are either damaged or do not exist.

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6. Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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