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Evaluation of performance indicators for canal command area of Samrat Ashok Sagar Project Vidisha district M.P.

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■ **ABSTRACT :** The existing irrigation system of right bank canal including the canal water distribution, irrigation supplied, crop yield, water used and water productivity was evaluated on the basis on Nelson's parameters. These indicators was found as Tail end supply ratio: 0.71, delivery timeliness ratio: 0.75 carrying capacity ratio: 0.79 and fee collection performance: 0.35 for Canal Command Area of Samrat Ashok Sagar Project Vidisha district M.P. Tail end ratio value 0.71 indicated that water supply in the head and tail was almost in satisfactory range. It was also observed that tail end water supply was sufficient for 80 days only out of 112 days of canal operation. Delivery timeliness ratio (0.75), carrying capacity ratio (0.79), poor structure ratio (0.00), fee collection(0.35), Manpower numbers ratio (0.003), sustainability of irrigated area ratio (1.16) and area infrastructure ratio (301.62) were calculated tail end supply ratio was not found within the preference range this indicates that amount water reaching to tail end is not satisfactory and requires proper planning. Similarly fee collection ratio was also found poor and needs improvement. The values of other water delivery indicators was found within reference range and hence, declared satisfactory.

■ **KEY WORDS :** Performance indicator, Canal irrigation performance, Water management, Water productivity, Water user association

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With increasing population and demand for food, sustainable production increases from irrigated agriculture must be achieved. With limited freshwater and land resources, and increasing competition for these resources, irrigated agriculture worldwide must improve its utilization of these resources. Few would disagree with these statements, yet we do not have a way of determining the present state of affairs with respect to irrigated agriculture. The question-how is irrigated agriculture performing with limited water and land resourceshas not been satisfactorily answered. This is because we have not been able to compare irrigated land and water use to learn how irrigation systems are performing relative to each other and what the appropriate targets for achievement are. With the many variables that influence performance of irrigated agriculture, including infrastructure design, management, climatic conditions, price and availability of inputs, and socio-economic settings, the task of comparing performance across systems is formidable. However, if we focus on commonalties of irrigated agriculture-water, land, finances and crop production-it should be possible

to see, in a gross sense, how irrigated agriculture is performing within various settings. This report presents IWMI's "comparative" indicators and experience with their use, based on application across several irrigation systems. At this stage, it is hypothesized that through the use of these indicators, we are able to document and compare key performance attributes of irrigation systems. If so, then it should be possible to compare performance across irrigation systems in a number of settings to understand where we presently stand with respect to productive utilization of land and water, to compare relative performance of systems, and to identify where performance can be improved by (Molden *et al.*,1998).

The performance of an irrigation system as a whole should be judged not only by the utilization of the potential created in terms of area irrigated. But also by measuring the increasing in agriculture through superior agronomic practices, choice of crop and cropping pattern in relation to soil condition, water availability and use of other supporting inputsby (Chouhan,2009). Evaluation of Performance indicators are a powerful tool for identifying deficiencies in irrigation district management by (Rodriguez–Diaz *et al.,* 2008). A set of performance indicators was developed by the International Water Management Institute (IWMI) and likewise a new set of performance indicators called benchmarking indicators ''was developed by International Programme Technology and Research in Irrigation and Drainage (IPTRID) to assess the performance of irrigation organizations (Burton *et al.*,2000). In present study the Nelsons parameters were used and evaluated to assess the irrigation performances of right bank canal command area.

METHODOLOGY

The study was conducted for the command area of Right Bank Canal of Samrat Ashok Sagar Irrigation Project located in Vidisha district, Madhya Pradesh (India). The Samrat Ashok Sagar Project is a major irrigation project located in Vidisha district of Madhya Pradesh (India). Its command area falls in parts of Vidisha and Raisen districts. The dam is constructed on the Halaliriver, which is a tributary of Betwa river about 40 km. from Bhopal. Command area of Samrat Ashok Sagar lies between Longitude 77°33' E and Latitude 23°30' N, at an altitude of 426 m respectively. The project is based on catchment and gravity flow. The problems of farmer at tail end canal command area, because optimum water is not available. However, individual farmers use diesel and/or electric pump sets to lift water out of the canals. This project was commenced in year 1977 to irrigate 25091 hectares in *Rabi* season (Anonymous, 2016).

Performance indicators:

Performance indicators as proposed by Nelson were used for evaluating the irrigation project commanded by WUA. These indicators were grouped into four categories namely, Water deliveries, Maintenance, Financial and Sustainability indicator (Nelson, 2000). Water users were surveyed in right bank canal of SAS project. Information was collected on gross command area, cultivable command area, total number of structures, total number of damaged structures, water charges collection, expected water charges collection, total length of canal, total number of day water available in canal, total number of staff working, canal irrigated area and tube well irrigated area. This information was tabulated and analyzed to characterize the WUA. All the information was collected with the help of questionnaire.

Water deliveries status:

Quality of water deliveries is evaluated in terms of tail-end supply ratio, area uniformity and delivery timeliness ratio.

Tail-end supply ratio (TSR):

The simplest indicator of water delivery performance is whether adequate water is reaching the farmers at the end of the canal system. The Tail-end supply ratio is the number of days that sufficient water reaches the end of the canal system, divided by the total number of days. Ideally, this ratio should be close to one. TSR is simple and inexpensive, but is only a qualitative indicator. It is based on the common situation that irrigators at the end of the canal are usually the ones shorted.

Tail - end supply ratio = Ns/Nt

where,

Ns = The number of days that sufficient water reached the end of the canal system

Nt = The total number of days the canal system

was delivering water.

This information of canal running days and number of days of sufficient supply to tail end was collected through performa.

Delivery timeliness ratio (DTR):

If water is delivered on request, an analysis of timeliness may be possible from the individual water order records. The delivery timeliness ratio is the number of orders where water was delivered within the target time of the requested date, divided by the total number of orders. Ideally, this ratio would equal one. If there is a difference in DTR between the upper part of the canal system and the lower end or DTR is low, or lower than normal, this may be occur due to reasons like, if demand exceed the canal capacities, if demand exceed the available water supply, or the water supply itself mismanaged or it could also be caused by poor maintenance or management of the diversion dam, pump stations, or canals.

Delivery timeliness ratio = Nt/NT

where,

Nt = Number of orders where water was delivered within the target time. It was assumed that all the farmers have ordered for three irrigation in wheat, one in gram etc.

NT = Total number of orders (from the individual water order records).180 farmers were considered for total number of orders.

Maintenance status:

Maintenance work in WUA is evaluated through carrying capacity ratio and poor structure ratio.

Carrying capacity ratio (CCR):

Canal capacity can indicate problems related to sediment deposits, erosion, vegetation, or possibly inadequate capacity of some structures. The carrying capacity ratio is the actual capacity for the selected canal, divided by its designed capacity. The ideal ratio would be one. In applying this indicator, flow is measured at the designed water level or head.

Carrying capacity ratio = Ca/Cd

where,

Ca = Actual canal capacity for the selected canal during observations.

Cd = Designed canal capacity for the selected canal.

Poor structure ratio (PSR):

The poor structure ratio is the number of structures in poor condition, divided by the total number of structures. Poor can be defined as a structure not functioning adequately, or at risk of failing during the coming year. Ideally, this ratio should be zero.

Poor structure ratio = Np/Nt

where,

NP = Number of structures in poor condition (not functioning adequately or at risk of failure) as per observation during survey.

NT = Total number of structures on the system.

Financial status:

Financial indicators namely, fee collection performance was used to evaluate financial status of WUA.

Fee collection performance:

Fee collection performance is the annual irrigation fees collected, divided by the total annual fees assessed. This indicates the effectiveness of the collection programme, but it can also be affected by the economic condition of the irrigators and the degree to which the irrigators feel the system is worth supporting. Values greater than 1 are possible if some delinquent assessments from previous years are collected.

Fee collection performance = Fc /Fa

where,

Fc = Annual amount of water charges collected as per WUA records

Fa = Annual amount of water charges assessed as per WUA records.

Manpower number ratio:

The manpower number ratio, which is the number of staff (full time equivalent), divided by the total irrigated area. The optimum value for this indicator may vary widely among different regions of the world, because of differences in labour productivity and irrigation intensity.

Manpower number ratio = Ns/At

where,

Ns = Is number of staff (full time equivalent)

At = Is total irrigated area.

Sustainability:

Sustainability of irrigated area:

Sustainability of irrigated area is the current

irrigated area divided by the initial irrigated area when the system was first fully developed. A trend towards reduced area generally indicates that the system is not sustainable (for water supply, environmental, or economic reasons). If area has increased significantly from the designed area, it may indicate the water supply is now distributed over too much land, or delivery capacities are being exceeded.

Sustainability of irrigated area = Ac/Ai

where,

Ac = Is current total irrigated area

At = Is total irrigated area when the system developed was completed.

Area/infrastructure ratio:

A key variable affecting the economic sustainability of a system is the area/infrastructure ratio which can be roughly defined as the irrigated area divided by the total length of canals and laterals. The critical value for this variable is determined by the economics of the region.

Area/infrastructure ratio = At/Lc

where,

At = Is the total irrigated area.

Ac = Is the total length of canals and laterals on the system.

RESULTS AND DISCUSSION

The study was undertaken in right bank canal command area of Samrat Ashok Sagar Irrigation Project of Vidisha district Madhya Pradesh for evaluating the performance of right bank canal command area of Samrat Ashok Sagar Project and to plan improvements for enhancing water productivity and cropping intensity of the project by optimizing surface and pressurized irrigation system.

Performance evaluation:

The existing irrigation system including the canal water distribution, irrigation supplied, crop yield, water used and water productivity was evaluated on the basis on Nelson parameters (Nelson, 2000). The Nelson parameters include water delivery, maintenance of canal and financial indicators as described in methods and materials section. The performance indicators calculated were tail-end supply ratio, area uniformity ratio and delivery timeliness ratio to identify the problem in water delivery and were presented in Table 1. Performance of water user associations was evaluated using performance indicators *i.e.* physical indicators, bio- economic indicators and social indicators in head, middle and tail reaches. Water users were surveyed in the RBC command. Information was collected on gross command area, cultivable command area,total number of structures, total number of damaged structures, water charges collection, expected water charges collection, total length of canal, total number of day water available in canal, total number of staff working, irrigated area and tube well irrigated area. This information was tabulated and analyzed to characterize the WUA. All the information was collected with the help of questionnaire.

The performance indicators calculated were tail-end supply ratio, delivery timeliness ratio, carrying capacity ratio, poor structure ratio, fee collection performance, manpower numbers ratio, sustainability of irrigated area and area infrastructure ratio to identify the problem in water delivery and have been presented in Table 1. Performance of water user associations was evaluated using performance indicators *i.e.* physical indicators, bio- economic indicators and social indicators in head, middle and tail reaches.

Tail end ratio value 0.714 indicated that water supply in the head and tail is almost in satisfactory range and

Table 1 : Water delivery indicators for RBC command of SAS irrigation project

Parameters	Performance indicator	Basic input	Input value	Value	Reference range
Water Deliveries	Tail-end supply ratio	Ns/Nt	80/112	0.714	0.50-0.70
	Delivery timeliness ratio	Nt/NT	3/4	0.750	0.70-0.90
Maintenance	Carrying capacity ratio	Ca/Cd	5.097/6.4	0.796	0.60-1.26
	Poor structure ratio	Np/Nt	0/9	0	0.01-0.20
Financial	Fee collection performance	Fc/Fa	3427513531/ 1199629736	0.350	0.62-1.0
	Manpower numbers ratio	Ns/At	33/9503	0.003	0.0004-0.001
	Sustainability of irrigated area	Ac/Ai	27924/24000	1.16	0.5-1.0
Sustainability	Area infrastructure ratio	At/Lc	7067/23.34	301.62	350

only requires adoption of border irrigation and sprinkler irrigation system. It was also observed that tail end gets water for 80 days only out of 112 days of canal operation which was found sufficient for wheat crop. Similarly delivery timeliness ratio (0.75), carrying capacity ratio (0.79), poor structure ratio (0.00), fee collection (0.35), manpower numbers ratio (.003), sustainability of irrigated area ratio (1.16) and area infrastructure ratio (301.62) were calculated. Slightly higher value of Tail end supply ratio indicates that amount water reaching to tail end requires proper planning. Similarly fee collection ratio was also found poor and needs improvement. The values of other water delivery indicators was found within reference range and hence declared satisfactory. The result indicates that the study of feasibility required for adoption of improved surface irrigation methods and pressurized irrigation methods to enhance the water productivity and cropping intensity. The save water by adopting the improved irrigation methods can be used for bringing additional area under secure irrigation (Chouhan, 2009).

Conclusion :

The study was conducted in Samrat Ashok Sagar Project of Vidisha district Madhya Pradesh to evaluate the performance indicators in right bank canal command. It concluded that the values of tail end supply ratio (0.71), delivery timeliness ratio (0.75), carrying capacity ratio (0.79), poor structure ratio (0.00), fee collection (0.35), manpower numbers ratio (.003), sustainability of irrigated area ratio (1.16) and area infrastructure ratio (301.62) was found within permissible limit which clearly indicated that study of feasibility is required for adoption of improved surface irrigation methods and pressurized irrigation methods to enhance the water productivity and cropping intensity, so that additional area can be brought under irrigation. This will help in doubling the income of farmers of right bank canal command area.

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