BENCHMARKING AS A TOOL FOR IMPROVEMENT OF SYSTEM PERFORMANCE: CASE OF SAMRAT ASHOK SAGAR IRRIGATION PROJECT, MADHYA PRADESH, INDIA

Sanjay S. Phadnis*1 and Mukul Kulsreshta2

1. Madhya Pradesh Water Resources Department, Government of M.P., Maulana Azad National Institute of Technology, Bhopal (INDIA)
2. National Institute of Technology, Maulana Azad National Institute of Technology, Bhopal (INDIA)

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ABSTRACT

Population of India has crossed more than 100 crores and with the rapid increase of growing population, the demand of food and water is also increasing. Irrigated lands contribute significantly to the world agriculture output and food supply. Irrigation is critical to food security and economic growth in contemporary India. Today water scarcity is a Global issue and deteriorating environmental and social conditions due to exploitation of water resources in an unplanned manner are making situation more serious. Water is a critical input for agricultural production. The performance of irrigation systems is of serious concern to farmers who rely on them for their crops and livelihoods and to governments that have invested heavily in their development. Large-scale canal irrigation systems, in particular, are in poor condition: they are not properly maintained, operations are inadequate, water supplies do not reach the end of systems, and the timing of water supply is unreliable. The wide gap between actual and desirable performance threatens the sustainability of irrigated agriculture. In large public irrigation schemes in Asia, the main problems of irrigation service delivery faced by the farmers were usually erratic delivery and inequity between the heads and tail-ends of the canals, resulting in low cropping intensities, in a poor proportion of the systems’ command area being irrigated and poor yields. The study will review the performance of existing Samrat Ashok Sagar major irrigation and drainage project for selected benchmarking indicators on actual past data observed.

Key Words: Benchmarking, Irrigation, Water management, Efficiency, Participatory approach, Water Users Association

INTRODUCTION

Irrigation sector has been fundamental to India’s economic development and poverty alleviation since 25% of India’s Gross Domestic Product (GDP) and 65% of employment is based on agriculture. During the post independence period, the country has invested a huge amount of capital in the major and the medium irrigation projects. Among the states, three have already achieved 70% or more of the ultimate irrigation potential with Tamilnadu recording 100% achievement, followed by Punjab and Rajasthan at 84% and 74% respectively. Six States, i.e., Haryana, Karnataka, Jammu & Kashmir, and West Bengal are in the range of 63% to 71%, whereas in U.P. and Maharashtra, the achievement would be 56% each. The States of Bihar, Gujrat, Orissa, Madhya Pradesh and Assam have achieved less than 50% of the ultimate potential. The ultimate potential under major and medium irrigation in the eastern States (except West Bengal), i.e. Bihar, U.P., M.P. and Orissa put together works out to

*Author for correspondence
about 50% of the total ultimate potential of the country\textsuperscript{1}.

During the last decade, most of the major states of India have undertaken profound reform measures in the irrigation sector to facilitate farmers’ participation in irrigation management either under externally aided irrigation development and agricultural intensification programs or through state government initiatives. These states emphasize decentralization of water management and empowerment of water users by encouraging the farmers to form Water Users Associations (WUAs) to take over the responsibility of operation and maintenance of downstream parts of the irrigation system, distribution of water among water users, and collection of water rates\textsuperscript{2}.

Development of Farmers Organization i.e. Water Users Associations in Madhya Pradesh Water Resources Department has been done in following manner:

- In the year 1984-85, Irrigation Panchayats were constituted under M.P.Irrigation Act,1931 but could not deliver the goods since the functions, duties, powers of Panchayat were not well defined therefore these Panchayats were defunct.

- In the year 1994-95, 65 Farmers Management Committees were formed on pilot basis under Cooperative Society Act but these could not extend their whole hearted interest in Irrigation Management and therefore resulted in defunct.

- In the year 1997-98, it was decided to create a public support at all levels regarding transfer of power to manage the state Irrigation System to their real beneficiaries i.e. farmers.

- In the year 1998-99, Merits of PIM and success stories of Andhra Pradesh PIM Model and achievements of Maharashtra and Gujarat Irrigation Societies were publicized for awareness amongst farmers and politicians.

- In the year 1999-2000, Madhya Pradesh Sinchai Prabandhan Me Krishko ki Bhagidari Adhinium 1999 was enforced by Government of Madhya Pradesh in September 1999.

- Participatory Irrigation Management Programme was launched in whole state.

- In year 2003, Samrat Ashok Sagar Project was considered under Indo Canada Environmental Facility programme to enhance the capacity building of farmer’s organisation with the external support of Non Governmental Organisation (NGOs). Under this programme rehabilitation of existing canal system with active participation of farmers which includes 30% financial contribution in physical improvement was proposed\textsuperscript{3}.

- In year 2004-05, Madhya Pradesh Water Sector Restructuring Project was started for modernization and rehabilitation of deteriorated schemes funded by the World Bank for Rs 1919 crores which includes special programme for Capacity Building of Water Users Associations\textsuperscript{4}.

- MP-Farmer Participation in Irrigation Management (MPFPIM) Act\textsuperscript{5} came into force since 1999 and under this act the structure of participatory model is as below:

  - The WUAs are constituted over a population of 100-1000 water users. WUA has a general body including farmer and wives of male farmers who are members of the general body of the WUAs.

  - It is important to distinguish between the member of the WUA general body including in particular women members and a member of the Management Committee (MC) of the WUA.

  - The demographic area covered by a WUA will be a ‘hydrological boundary’ ranging from 100 to 2000 Ha.

  - The number and the boundary of a WUA are notified by the District Collector in accordance with the President and Territorial Constituency members (ranging from 4 to 10) depending on the WUA.

  - The medium irrigation schemes have a two tier system in which WUA are involved with Project Committees.

  - In the major irrigation schemes, WUAs are involved with a three tier committee consisting of Distributory Committees and Project Committees (PC).
A State level Apex Committee headed by the Minister of WRD consists of representatives of Project Committees across the State. All these committees and WUA Management Committees work in partnership and share different responsibilities. The WUAs are expected to work in close partnership with other stakeholders like WRD, Agriculture and other relevant line departments with Panchayati Raj Institutions (PRIs), for financial and other help.

WUA are involved in identifying and pinpointing the problems and deficiencies in physical system of canal in joint walkthrough process. Their suggestions are taken for understanding background of the problems and its remedies. Consultative and Participatory approach is a process through which stakeholder influence and share control over development initiatives and the decisions and resources that affects them.

Promotion of Participatory Irrigation Management (PIM) under various irrigation systems through creation of Water Users Associations (WUAs) is now actively pursued in various states, for taking over management of the irrigation system within its operational area, maintain and operate the system, so that the irrigation waters are provided to all the farmers in its area in a dependable and equitable way and the overall irrigation use efficiency is improved, productivity is increased and social justice is achieved. The lack of community awareness on sustainable development is leading to the misuse of available resources. To ensure efficient use of water resources, the level of collaboration among all stakeholders involved in the water sector needs to be increased and that people need to be sensitized on the sustainable development. The participation of WUAs and individual farmer of that WUA can minimise the labour deployment for service area.

To analyse the impact of irrigation management transfer, a set of performance indicators was developed by the International Water Management Institute (IWMI), and a set of performance indicators called benchmarking indicators was developed by the International Commission of Irrigation and Drainage to assess the performance of irrigation schemes. IWMI performance indicators have been used for assessment of transferred irrigation schemes in many countries under different conditions.

Many irrigation systems, particularly in developing countries, perform below their potential. Head–tail problems, leaky canals and malfunctioning structures because of improper maintenance, leading to low water-use efficiency and low yields, are some of the commonly expressed problems. A large part of low performance may be due to inadequate water management at system and field level. Performance assessment enables verification of the degree to which targets and objectives are being realized. It also provides different stakeholders (system managers, farmers, and policy makers) with a better understanding of how a system operates. It can help determine problems and identify ways and means of improving system performance...

Therefore it is the need of the hour to initiate benchmarking of irrigation scheme not only at scheme level but also at Water Users Association level where more than one Water User Association are made responsible for operation and maintenance of a major irrigation and drainage project. This will indicate the inefficiencies at individual WUA level as well as create a healthy environment for competition within a project.

STUDY AREA

India is endowed with a rich and vast diversity of natural resources, water being one of them. Its development and management plays a vital role in agriculture production. Integrated water management is vital for poverty reduction, environmental sustenance and sustainable economic development. National Water Policy envisages that the water resources of the country should be developed and managed in an integrated manner.

The Madhya Pradesh state has created 23 lakhs ha irrigation potential, but performance in potential utilisation is as low as 40%. Production of food grain, adequate power supply and safe drinking water for growing population will be a great challenge for India and worldwide both in near future. Therefore it is the need of the hour to
develop a strategy for equitable and optimal utilization of Canal Irrigation Water for better productivity through Community Participation. It has been widely accepted that promoting community participation through Water Users Association can be the best strategy for long term sustainability of Irrigated agriculture. Madhya Pradesh had implemented Participatory Management Act 1999 to transfer Operation and Management responsibility of all major, medium and minor projects. However, many Water Users Associations are still performing below average. Therefore capacity building programmes and benchmarking for continual monitoring to know the performance at WUA level is important. To start with benchmarking performance evaluation, initially few selected indicators where farmer’s participation can be ensured should be selected.

Vidisha is a historical place. Samrat Ashok Sagar Project (also known as Halali Project) is a major irrigation cum flood protection project constructed across Halali River which is a tributary of Betwa River. The dam site of the project is 40kms away from Bhopal and 16 kms from Salamatpur railway station, which is on Bhopal Delhi main line. It is also connected by road from Vidisha and Raisen (Fig. 1).

Project covers 2 revenue districts in command namely Vidisha and Raisen of Madhya Pradesh, India. This is a Major Multi-purpose Irrigation Project. It caters demand of Drinking Water supply
to Vidisha Township. Irrigation to part area of Vidisha and Raisen District. In addition to this fisheries and Tourism also generates huge revenue. The total gross command area of project is 37419 ha out of which culturable command area are 27924 ha. Net area served is 25091 ha against the annual irrigation of 37636 ha. The intensity of irrigation is thus 135%.

Huge investment is done for creating water resources potential in India. However, due to large gap between the potential created and potential utilized in most of the irrigation projects, the benefits of created infrastructure could not be achieve. Similar to other irrigation projects, Samrat Ashok Sagar Irrigation Project (Halali Project) is also showing same deficiency. Currently irrigation accounts for more than 1/3rd of states’ revenue deficits. In many states, O&M expenditure was just enough for staff salaries with little for works. Low water charges and poor cost recovery resulted in secular decline in funding for maintaining water infrastructure, inefficient water allocation and sharpening conflicts over sharing of water in many regions (Table 1).

A reliable service allows efficient irrigation management within the constraints of the system.

Table 1: Application of conventional benchmarking in irrigation and drainage at WUA level

<table>
<thead>
<tr>
<th>Area of application of Benchmarking</th>
<th>Name of the authors and years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Benchmarking at Water Users Association Level</td>
<td>Charnes A, Cooper WW, Rhodes E. 1978</td>
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| Mamata Swain And Deepak Kumar Das(2008) | Cakmak B., Aysegul Kibaroglu, Berna Kendirli And Zeki Gokalp (2008), Belgin, 2008,
Moreover, if the irrigation delivery is flexible, the farmer can adapt the irrigation schedules to optimum cropping strategies and tactics that can be adjusted as the crop progresses. Therefore, both reliability and flexibility lead to higher irrigation efficiency and crop yield².

**MATERIAL AND METHODS**

Fig. 2 shows the schematic diagram of methodology been used. To begin with benchmarking process, few simple indicators are used in present study as shown in Table 2.

![Diagram](image)

**Fig. 2**: Methodology of benchmarking

**Table 2** : Main Performance indicators for Benchmarking

<table>
<thead>
<tr>
<th>Domain</th>
<th>Performance indicator</th>
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<tr>
<td>I. System Performance</td>
<td>Water delivery capacity Index</td>
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<tr>
<td></td>
<td>Potential Created versus Potential Utilised</td>
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<tr>
<td></td>
<td>Number of Watering provided for Each WUA in different years</td>
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<tr>
<td>II. Agricultural Productivity</td>
<td>Output per unit irrigated area – Rs/ha</td>
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<tr>
<td>III. Financial Aspects</td>
<td>Cost recovery ratio</td>
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<tr>
<td></td>
<td>Total O&amp;M cost per unit area (Rs/ha)</td>
</tr>
<tr>
<td></td>
<td>Total cost per person employed on O&amp;M works (Rs/person)</td>
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<tr>
<td></td>
<td>Maintenance cost to revenue ratio 5.Staff numbers for O&amp;M per unit area (persons/ha)</td>
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</tbody>
</table>
RESULTS AND DISCUSSION

Indicator-by-Indicator measure of performance for water users level benchmarking has been evaluated by dividing the indicators into 3 categories viz. system performance indicators, agriculture production indicators and financial Indicator as given in Table 2.

System performance

The analysis stage compares the critical success indicators and identifies the performance gap(s) between the Water Users Associations and the Water Users Association against which it is being benchmarked. Measurements of discharges at WUA level are more important than other indicators. These data commonly used for performance indicators such as the irrigation ratio, irrigation efficiency etc.

(a) Water delivery capacity Index

Water delivery capacity index indicates adequacy of canal discharge capacity to meet irrigation. In Samrat Ashok Sagar Project, carrying capacity of canal is much less than required as given in Fig. 3. The inefficiencies in entire distribution system are visible ranges 56.2 % to 85.28 % in water delivery capacity index. Due to less carrying capacity of canal, reliability of system is low. Water deliveries at field with respect to irrigation schedule are delayed between head to tail reach of canal. Such situations are causing stress on entire canal system and creating conflicts among farmers.

In Fig. 4, irrigation potential created versus irrigation potential utilized at WUA level is shown for Rabi crop. Similarly, irrigation potential created versus irrigation potential utilized at WUA level for annual crop area versus actual irrigated crop is shown in Fig. 5. It is clearly visible that Water User Associations like Sunpura, Medki are much below the expected performance. Despite overall project area covered under Rabi irrigation is very close to potential created in most of the years but, few WUAs within the study area are left partially dry due to incomplete infrastructure. The demand for Kharif is nil in study area therefore annual performance is highly unsatisfactory. However it is observed that water balances status shows that excess water is consumed in Rabi season itself result a serious concern for project designers.

Experience has shown that there are certain conditions which prevent the optimal development of schemes e.g. it is impossible to provide satisfactory service to individual farmers, because of the poor and deteriorated infrastructure, and vague and inadequate operation and maintenance procedures. The situation is further complicated because of interference of large number of water users with varying extents of landholdings and having different socio economic interests. The RBC system feeds water supply to Vidisha Township through running canal during Rabi season also causing additional stress on system.

![Fig. 3: Water delivery capacity index](image-url)
Fig. 4: WUA wise irrigation potential created versus irrigation potential utilised in Rabi season

Fig. 5: WUA wise irrigation potential created versus annual irrigation potential utilised

Fig. 6: Number of watering provided for each WUA in different years
From the Fig. 6 it is clearly visible that number of watering in each WUA shows inequity. The reliability of an irrigation service is the degree to which the irrigation system and its water deliveries conform to the expectations of the users. The situation is critical in the tail portion where water is reaching delayed and inadequate.

I. Agriculture production performance

Indicators of output per unit command area; output per unit irrigated area was used to evaluate the production performance. Output per unit irrigation supply and output per unit water consumed are not used because of non-availability of reliable data.

(a) Output per unit irrigated area (Rs/ha)

It is defined as a ratio of total annual value of agricultural production received by the producers to the total irrigated area cropped during area.

From the Fig. 7, it is evident that output per unit irrigated area and output per unit command area for year 2007-08 is higher than the output in year 2003-04, however, it is due to price escalation in margin of four years. It cannot be linked with increase in crop production as the canal carrying capacity of entire system shows high degree of inefficiencies at individual canal head and inequities are seen in number of watering in individual WUA.

Financial performance

Irrigation ratios, cost recovery ratio and maintenance costs are the most commonly used performance indicators for the assessment of operational success of the schemes.

(a) Cost recovery

It is defined as total revenue collected from the producers towards irrigation water charges per annum to total Management, Operation and Maintenance (MOM) cost towards providing irrigation and drainage services. The MOM cost does not include capital expenditure and depreciation/renewals of main components.

As per Fig. 8, the cost recovery is relatively higher in Water Users Associations of LBC system like Khamkheda, Kararia, Laskerpur, Chirkhed, Jiwajipur, Billori, Sankalkheda, Duparia and Chitoria WUAs than of RBC Water Users Associations. Cost recovery is 7% in certain cases which is a major concern. Revenue recovery is one of the areas where some innovative ideas like responsibility of revenue collection to WUAs with the decision to collect water rates as decided by their General Body should be implemented on Gujrat Model. Responsibility of revenue collection must be given to WUAs. Progressive policies like Govt. of Maharashtra passed Resolution to back up WUAs up to 90% of water charges collected by WUAs. Theoretically the cost recovery ratio should be at least equal to one.
Maintenance cost to revenue ratio which is defined as ratio of total expenditure on system maintenances to the total revenue collected during the year from the farmers towards irrigation water charges is again more than 1. Maintenance cost to revenue ratio is below expected as shown in Fig. 9. Gujarat Government is one step ahead. They have given responsibility of irrigation fees collection to WUAs in plot area with freedom to collect revenue as decided by WUAs so that balance money can be retained by WUAs for their management of canal. Generally, the O and M cost per unit area should be as minimum as possible.

Total cost per person employed per year on water delivery (Rs/person/annum)
providing irrigation and drainage services is shown in Fig. 10.

Maximum per ha staff was deployed in Neemkhera WUA between years 2003-04 and 2007-08. The higher value of such indicator at Neemkhera WUA is due to area irrigated in said WUA is much less than potential created.

Total O&M cost per unit area for period of 2003-04 and 2007-08

Total O & M cost per unit area is the ratio of total O & M cost incurred for management of the system and area irrigated during the year. The total O & M cost includes cost of maintenance as well as establishment charges.

The annual maintenance cost incurred does not include cost of modernisation. Establishment charges include salary paid to staff working for management of irrigation like sub-engineer, amin and chaukidar. Government of Maharashtra has prescribed yearly O & M norms per ha, excluding establishment cost. The staff engaged in management of irrigation system and it is permanent. The expenditure on them is chargeable to the project, irrespective of whether there is irrigation or otherwise.

The results of Upper Wardha Project of Maharashtra State (1997-98 to 2001-02) shows Total O&M cost per unit area is Rs.500.59 Per ha and for year 2002-03, it is Rs 453.75 Per ha (Dhingra, 2006). The O & M cost per unit area always increases when there is less irrigation in particular year. Therefore results shows that Total O&M cost per unit area in Neemkhera shows theoretical value of Rs. 2594 per ha in 2003-04 and Rs. 2549 per ha in 2007-08 in Research Area (Fig. 11). These O&M per ha include salaries of permanent staff. However in line with Maharshtra State MPWRD also provide grant to WUA's of Rs. 60 per ha per year. The results of Upper Wardha Project (1997-98 to 2001-02) shows Total O & M cost per unit area is Rs.500.59 Per ha and for year 2002-03, it is Rs 453.75 Per ha (Dhingra, 2006).

CONCLUSION

The results of this study are focused on performance evaluation of a major irrigation project both at water user’s level working within project. It is concluded in the study that

- Water Users Association-wise number of watering shows that two watering are provided in some Water users association as against others are provided for watering.
- The basic problem identified in the system is low water carrying capacity of canal. Carrying capacity of actual discharge of right bank canal is 56.49% and left bank canal is 77.35%. The situation is more complex at distributor and minor level. Thus, distribution of water at water user’s association level is
more critical and ultimately in-proportionate water distribution at tail reaches water users associations within project. The reason of these inefficiencies is environmentally deteriorated system, low participation of water users and shortage of O&M funds etc.

- Another observation of poor management practices shows that potential created versus potential utilised in Rabi season is in proportionate when they compared at water user’s association level within project area, which shows inequities and poor management at individual WUA’s level in addressing deficiencies during remedial measures taken. This is a matter of serious concern.

- Madhya Pradesh Water Resources department provide grant of Rs. 100/- per ha for irrigated area and Rs. 50/- per ha for un-irrigated area despite 11th finance planning commission to 13th finance planning commission recommended this grant from Rs. 450 per ha to Rs. 1150 per ha. The reason of poor irrigation infrastructure may is due to fewer funds available for operation and maintenance. Cost recovery is very poor and minimum recover found 7% in Sunpura WUA. Thus financial sustainability is far behind its objective.

- It is seen that these inadequate funds put extra pressure on small water users association as grant is allocated on area basis irrespective of large medium and small size. Unless financial sustainability is ensured and responsibility of revenue recover transferred to WUA, the mitigative measures will not sustained for long time. However, it is concluded that above deficiencies at individual Water Users association level are more important to assess rather than at project level.

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