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# Review of Literature on Benchmarking of Irrigation Systems

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**ABSTRACT**

The definition adopted by World Bank program; "Benchmarking is a systematic process for securing continual improvement through comparisons with relevant and achievable internal or external norms and standard", Hector Malano and Martin Burton [2001]. Benchmarking is a process to improve the level of irrigation services, increase transparency, accountability of irrigation projects and promote an increased role for water users in irrigation management. It is firmly believed that improvement in the level of service provision to water users is a key factor to increase and sustain agriculture production. [CWC Report, 2002]

**Keywords :** World Bank Program, Benchmarking

## I. INTRODUCTION

Benchmarking is a very powerful management tool for analyzing and improving performance of water resources projects. Therefore the Government of Maharashtra has decided to undertake the Benchmarking exercise in all the projects in the state in a phased manner in such a way that all projects are covered under Benchmarking exercise in a period of about five years. [Maharashtra State Water Policy, 2003]

The amount of water and land available for agriculture is limited in many developing countries like India with the growth of cities and industries, it is shrinking rapidly. Irrigated agriculture worldwide must improve its utilization of these increasingly scares resources. On this premises benchmarking as a tool for measuring the relative performance of irrigationsystems or tracking the performance of individual system help:

- Policy makers 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.
- Irrigation managers to identify long-term trends in performance, to set reasonable overall objectives and to measure progress.
- Researchers to compare irrigation systems and identify factors that lead to better performance.
- Donor agencies, government and NOG's system to assess the impactof interventions in the irrigation sector and to design more affective interventions.

### Benchmarking of Irrigation Systems

### History

Australia is the pioneer of benchmarking in the irrigation and drainage sector. Since 1998, the

Australian National Committee of ICID (ANCID) has benchmarked a number of major irrigation water service providers in Australia. The providers come from the six states of Australia and include
47 water supply systems. The systems were benchmarked using 62 indicators covering four general areas, namely:

- Operational Performance
- Financial Performance
- Environmental Performance
- Business Performance

Benchmarking in the irrigation and drainage sector began recently in other countries, after the launching of the joint (WB/IPTRID/IWMI/ICID/FAO) international initiative in 2000. Mexico joined the benchmarking initiative in 2001, followed by India and China in 2001/2002 and Egypt in 2002. All these countries used performance indicators outlined in the IPTRID guidelines. Mexico, however, had also carried out Rapid Appraisal (RAP) and Report Cards (Social Consultation).India reported the early benchmarking results of five schemes in the Maharashtra State in which both IPTRID and Indian National Benchmarking Indicators were used.In the Montecaseros Pilot Project, Mendoza, in Argentina, diagnosis of a Farmer-Managed Irrigation System performance was carried out, in which more than 40 multidisciplinary performance indicators for irrigation and drainage were tested. However, the procedure did not follow the benchmarking guidelines that are presently under review. Argentina has expressed interest in joining the benchmarking initiative.In France, performance assessment of the Society of the Canal de Provence(SPC), was carried out. SPC had defined its own performance indicators, some of which matched with the external indicators defined in the IPTRID Guidelines.In the United Sates, the Bureau of Reclamation benchmarked three programs, namely, Power Program (1990s), Groundwater Pumping (2001), Resource Stewardship and Dam Safety (2002). Irrigation service provision was not benchmarked.

The average annual flow available in rivers in India is around 1869 BCM. Presently, the national annual average per capita availability is about 1829 cum. per year. However, by the year 2050, the estimated annual per capita availability of 1168 cum. would take the country at the threshold of water scarce conditions. The situation in certain parts of the country is likely to becritical and it is estimated that by the year 2050, 30% of the geographical area and 16% of population in the country will be under absolute water scarcity condition, with water availability of less than 500 cum per year. [INCID 2002]

Estimation of water demand and its implications on water quantity and quality is extremely important. Agriculture has the dominant demand and it will continue to predominate for a long time. However, there isconsiderable scope for rationalization of its demand and optimization of its use. Lower consumption of water in agriculture has a very positive impact on reduction of environmental degradation. For meeting country's need for food grains, the water demand for irrigation for the year 2050 has been estimated by the National Commission for Integrated Water Resources Development Plan (NCIWRDP) to be around 628 MCM for low demand and 807 BCM for high demand. [INCID. 2003]

In today's scenario governments are also considering the importance of performance evaluation by benchmarking. It is mentioned in National Water Policy of India (April 2002) that efficiency of utilization should be improves in all the diverse use of water and utilize water up to maximum extent. Planning and implementation of water resources projects involve a number of socio-economic aspects and issues. Common approaches and guidelines are necessary on these matters. The National Commission for Integrated Water Resources Development Plan

(NCIWRDP) in their reportof September 1999 and World Bank Irrigation Sector report in India Sept 1998, it is mentioned that there is need to assess the performance of completed projects with reference to cost and benefits as anticipated at the time of their planning and as experienced now.

In Maharashtra water and irrigation commission report June 1999 7.5.1 it ismentioned that ordinarily, projects are termed old when more than 25 yearsperiod has elapsed since its completion along with canals. Till June 1970 more than 200 projects have been completed in Maharashtra out of which 132 are on Godavari Basin. There has been considerable reduction in irrigation potential on account of old projects consequent up on which total irrigation potential of the state is appreciably affected [MWIC Report, 2002]. Therefore it is high time to initiate action to restore the same by contemplating in this regard.

## Benchmarking Process

Brian Hearn [1999] emphasized on the concept "If you don't measure it, you can't manage it" and explained the application of benchmarking at micro level. He explained that farm efficiencies are important factor for further improvement of the irrigation system. According to his study these basic indicators lead to improvement in agronomic indicators of irrigation system. Study analyses possibility of on-farm assessment of irrigation system in present scenario. The non-availability of data forced to non- application of this parameter in our current study.

Arumugam Kandiah and Tom Brabben [2000] gave in-depth review of many publications related to benchmarking. They proposed structured manner data for indicators and gave the details of basic data which is necessary for individual projects. All the six processes of benchmarking aredescribed in details for ready references. The complete study is a reference to understand the implementation part which is difficult to consider immediately. In our study action, monitoring and its evaluation part is not included as it is solely governed by Irrigation department of Maharashtra.

Charles M Burt [2000] presented different experiences regarding benchmarking in U.S. external indicators which are water inputs and outputs, project economics, agronomic, social, environmental and health.As far as internal indicators are concerned study defines these as a media tochange the process and have impact on external indicators, such as WUA, individual field work, budgets etc. In our work we have considered external indicators and while calculating SGV in some cases internal indicators are also considered.

Seyed J Jebellie [2000] identified the benchmarking indicators for the technical, financial, managerial, social, productivity and environmental problems for Iran. From this report the most important part gets clear that the irrigation benchmarking differs as the country, state or province changes. We thought-out this part in our study and judged every project giving due importance to their location.

Hector Malano and Martin Burton [2001] proposed general set of guidelines to be followed for benchmarking any irrigation projects. These guidelines were developed with the support of IPTRID, WB, IWMI, ICID, CIID and FAO gave a clear description about the process which is to be followed, data collection with its analysis and set of indicators to be followed for better performance evaluation. In the guideline, stress was given on four major classification of indicators namely, service delivery performance, financial performance, productivity efficiency and environmental performance. The most importantly the authors have explained the definition of benchmarking which is considered as the benchmarking definition given by World Bank and other supporting agencies IPTRID, WB, IWMI, ICID and FAO. This guideline is treated as base for designing

methodology of benchmarking of irrigation projects. The complete set of protocols for data collection and processing is given. Further it was analyzed that it is difficult to use all the indicators mentioned in the guidelines due to constrain of data available with Maharashtra Irrigation department. The indicators for our work are selected on the basis of availability of data pertaining to indicators.

Peter Alexander [2001] observed that the objectives and needs were almost same for different benchmarking studies but outcomes were varying as the indicators taken were based on the irrigation water providers. In Maharashtra, the agency that supplies the irrigation water is irrigation department. Thus to evaluate performance one method can be adopted. Even if the same method of benchmarking is adopted but question remains in the mind, whether the method will support all irrigation projects or not? This question became inspiration to develop SGV by the author.

Bill Kingdom and Fernando Gonzalez [2002] explained the benchmarking concept in two classes, metrics and process. Application of benchmarking to urban water and irrigation water supply is explained and similarities are reviewed. The analysis of data and framework design is presented. It is observed that the benchmarking is applicable where the standards for indicators are difficult to decide or calculate. Then achievable standards can either be generated among the most feasible equivalent data of other irrigation projects or decided as per the policy of irrigation water supply agency.

Dan Howes and Dr. Stuart Styles [2002] analyzed data to determine the degree of water delivery flexibility provided to farmers and the existing as well as planned district modernization. The study effectively explained the area of service delivery performance considering all the dimensions of flexible water delivery parameters. The present state of water delivery flexibility must be improved in order to reduce the volume of groundwater pumping that supplies on-farm irrigation methods such as micro irrigation.

Indian National Committee on Irrigation and Drainage [2002] proposed the guidelines for Benchmarking irrigation systems in India. The guidelines are developed considering the Indian scenario of irrigation systems. The proposed guidelines consist of 20 indicators, with four major classifications. Data collection details are explained with the help of tabular formats. Definition of performance indicators are proposed along with the formula and procedure of data collections.

Ministry of Water Resource, India [2002] explained scenario of Benchmarking of irrigation systems in India. Importance of benchmarking was predominantly discussed in the workshop by eminent personalities from World Bank, CWC, INCID and Irrigation Department. The summary of the experiences which the members had during benchmarking of irrigation projects in their respective countries are explained so that acommon effort can be made to improve the method of Benchmarking. The case study comprising 13 irrigation projects from all over India were taken for benchmarking and were represented. This is a study with broad spectrum which helps for performance evaluation at national level butdifficult to apply at state or region. The report also projects the future applications and implications of benchmarking.

Australian Committee of Irrigation and Drainage (ANCID) [2003] carried out benchmarking of irrigation water providers in Australia. ANCID is performing benchmarking process from 1998 and is continuously assessing the performance of irrigation water providers. The primary objective of the investment was to develop measures and processes to benchmark all aspects of irrigation water supply. Secondary objectives were to build benchmarking skills and a culture of continuous improvement among the participating irrigation water providers. The study

explains that water is saved due to improved decision making.

Fernando Gonzalez and Arumugam Kandiah [2003] explained the benchmarking process by analyzing irrigation systems from different countries. The benchmarking process presented became a pioneer for considering irrigation systems at international level. Eight externalperformance indicators are considered. The comparative analysis representsthat the indicators used are selected after considering the background and data of irrigation systems. The process evolved defines how to select the indicators with different constraints.

Pathak R. S. [2003] stated that Benchmarking is a useful management tool and provides valuable reference to project authority. The measures to be benchmarked and how this data should be collected must be reviewed each year to ensure that the issues that are current and relevant to be reported. The major issues facing the project authority are water use efficiency, cost recovery and consumer's satisfaction. There is need to strengthen mechanism for data collection compilation and analysis of benchmarking data. In current study analysis of data facilitates the authority to take precise decision with maximum dimensional analysis.

Charles M. Burt and Stuart W. Styles [2004] developed Rabid Appraisal Process (RAP) in addition to Benchmarking. Conceptualizing irrigation project modernization through Benchmarking and RAP was reported with the help of external and internal indicators. The three aspects on benchmarking such as evaluation of technical indicators (both external and internal); appraisal of the system processes; and an evaluation of service to users and their satisfaction with that service is defined.

Perez L et al [2004] carried out detailed analysis of indicators using IGRA software application for 37 indicators. The study was carried out for Andalusia, Southern Spain. In this study they have considered only four irrigation systems and generated structured data for benchmarking. The software considered for the data takes care of all the minute information about irrigation system. The complete analysis and report generation is done by IGRA. The best part of the study is continuous benchmarking process representation. With the reference to this we have suggested the three dimensional analysis of the indicators to see the implementation of the suggestions after benchmarking.

## Performance Indicators

The comparative performance indicators enable policy makers and plannersto see how productive their use of water and land for agriculture is. They help to get answer of 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? At the same time, they provide a cost-effective means of tracking performance in individual systems.

Three major studies on performance evaluation have been published are:

- IWMI - Indicators for comparing performance of irrigated agriculturalsystems.
- Bos - Performance indicators for irrigation and drainage
- World Bank-IPTRID-FAO Publication - Modern Water control andManagement Practices (C.Burt and S.Styles from Calpoly, CA)

Many authors have proposed indicators to measure irrigation system performance as summarized by Rao (1993) and have given examples of their use at particular irrigation systems (Bos and Nugteren 1974; Levine 1982; Abernethy 1986; Seckler, Sampath, and Raheja 1988; Mao Zhi 1989;Molden and Gates 1990; Sakthivadivel, Merrey, and Fernando 1993; Bos etal.

1994). But, there are very few examples of cross-system comparisons or analyses (Bos and Nugteren 1974; Murray Rust and Snellen 1993; Merrey, Valera, and Dassenaike 1994) Recent studies have attempted to standardize these indicators to allow for better comparison across systems (Bos et al. 1994). The indicators selected for present study are based on the guidelines of Irrigation Department of Maharashtra and availability of data.

Charles M. Burt and Stuart W. Styles [1999] gave performance indicators for international projects. They gave indicators for RAP and classified external and internal indicators. The classification of indicators helps to identify the process of benchmarking.

R. Sakthivadivl and David J. Molden [1999] illustrated the purpose of water accounting and a financial indicator, which is to evaluate the present status of water use and productivity, and to provide an indication of where gains can be made. Water accounting can be a part of benchmarking as some indicators are common and useful for comparison.

Roderick T. MacLean et al. [1999] accessed the effect of accurate flow measurement of an irrigated block over delivery performance indicators. The process yielded two key results: the development of the Irrigation District Model (IDM) of water supply and demand, and the establishment of irrigation block studies of operations and on-farm practices. The results were used to determine potential water savings from efficiency and management improvement scenarios. The study includes only one parameter and detailed analysis of flow measurement effect is studied at district level. This becomes cumbersome when the benchmarking is to be carried out at state level and for more performance indicators.

Samad Sanaee-Jahromi and Jan Feyen [1999] explained the main components of the water balance, applied to an irrigation scheme are the canal water supply, rainfall and crop evapotranspiration. Canal water supply and rainfall are inputs to the system while the most significant output of the system is evapotranspiration. The results reveal that the water balance performance indicators over a time period not only reflect the role of the system management with respect to the efficient use of rainfall, but also demonstrate adequacy, reliability and equity in delivery. The values of the indicators provide information on the quality of the management with respect to variations in cropping pattern and rainfall. This indicates the important part that all the irrigation systems have different cropping pattern and while considering delivery performance indicators other parameters which influence the indicators must be integrated.

## SGV of Indicators

External Indicators have limited value in comparing one project with another – unless the crops, weather, water supply, soil, etc. are the same. How can one compare the economics of a rice project against a project that supplies vegetables for export? External indicators can be very useful in examining the conditions before and after in a project, as a result of an intervention. Charles M. Burt [2000]. In practical it is not possible to get the same background of any irrigation system. Thus in this study we have tried to develop SGV for maximum indicators so that decision maker or authorities need not to go back and study the details of each indicators.

Brouwer C and Meibloem M [1986] gave the guidelines on “Irrigation water management: Irrigation water need” they explained the detailed procedure for finding out crop water requirement for multi cropping system. The procedure was studied and analyzed for calculating the crop water demand. The report was useful to get the in-depth knowledge and to understand the “irrigation water demand” indicator.

Hatcho N. et al [1992] described the Scheme irrigation water need and supply for FAO. The guidelines

provide a systematic calculation procedure for irrigation water need for any irrigation system. The season wise calculation of water demand is also stated with multi-cropping. It is functional to find the peak consumptive demand of any command area. The process was studied for calculating the irrigation water demand for a complete year. Based on this, the area was multiplied by water demand fora particular crop and the demand of catchment is calculated. The parameters affecting the water demand (mainly cropping pattern) are analyzed to calculate SGV of indicator in our study.

David Molden et al [1998], presented use of nine sets of indicators with focus on production, finance and water delivery capacity. The conceptual report, with world wide data of some irrigation systems, indicates mainly the development of SGVP (Standardized Gross Value of Production) whichis the base of our study for developing SGV for indicators. The concept of SGV given in this research report brings the production cost to a standard value which is either at State, National or International level.

Jack Keller et al [1999] defined that hydronomic zones, identifies various conditions that may occur within zones and then reviewed basin development concepts pertinent to performance assessment. Water balance considerations are described relevant to zones, and generic means of improving performance within zones are presented. To illustrate, an example of hydronomic zones from Sri Lanka are presented. The study considers the background of the Service delivery performance and presents it as new indicator for comparison.

Kenneth H. Solomon and Baryohay Davidoff [1999] explained that on- farm irrigation evaluations may yield different numerical values than district-wise or region-wise evaluations, leading to confusion for the general public, and at times, perhaps even water policy decision makers. The quantitative relationships between irrigation performance parameters, the extent of water reuse practiced and the geographic scale of the assessments should be developed. In current research work majorparameters which affect the indicators are investigated and are quantified.

Hoekstra A.Y. et al. [2000] has shown that the value-flow concept offers the possibility of accounting for the cyclic nature of water when estimating its value. According to this study it is important to provide a better empirical basis for the demand and supply curves used. For the sectors where water demand can be seen as a 'derived' demand, it is necessary to study more thoroughly what contribution water actually makes to the production of the final product and thus which value can be attributed to water. The delivery performance of irrigation system also depends up on the inflow in the reservoir or maximum storage available in reservoir which further depends up on above concept.

Barbara Van Koppen [2002] developed The Gender Performance Indicators for Irrigation (GPII) to compensate for the lack of conceptual tools and methods that are needed to translate gender-sensitive policy intentions at all levels into action. Study represents generic, quantitative insight on diverse realities that are of direct relevance to irrigation agencies and leaders. The applications of the GPII described that there is a critical need to apply the tool because implications for irrigation and other agencies vary significantly. The study has changed the primary data into indicators and then analyzed its effect on major indicator or performance of irrigation systems.

## Concluding Remarks

Review on different aspects on Benchmarking of irrigation projects helps in pinpointing the shortcomings in the field of performance evaluation of irrigation systems as well the thrust for current research. The review also helps in selection of

appropriate methodology for present study. Following conclusions are drawn from this review.

Many studies attempted to generalize the guidelines for benchmarking at international grid. However field conditions are highly variable in space and time for any irrigation system even at regional level. Therefore it is not possible to adopt same guidelines for all irrigation systems. Generalized objectives can be constituted instead of procedure to perform benchmarking. As the benchmarking process is lengthy and requires organizational setup therefore very few agencies have actually performed the benchmarking of irrigation systems. The Rapid Appraisal Process definitely reduces the time but it also requires massive database. It isobserved that different sets of indicators are considered for above said agencies or countries.Benchmarking is also classified as process and metrics. It is observed that every consecutive year on the basis of experiences, new indicators are introduced or targets are changed. In metrics benchmarking only performance gaps are identified and actions to fill the gaps or reasons of thegaps are not suggested. Studies are also carried out for continuous benchmarking process but they have considered very less (4 or 5) projects which are not suitable for Indian conditions more specifically for Maharashtra where there are more than 2700 major, medium and minor projects. It is observed that in-depth indicator analysis is done for very few indicators or for few irrigation systems. This is due to system environment or data availability.

The Standardised Gross Value is developed only for productivity performance indicators. This is not developed for delivery performance, financial performance and environmental performance indicators. In some studies the SGVP is developed at international level. This can be reduced tonational or state level. The variability is not limited up to the extent of cropping pattern but it is spread all over the performance indicators parameters. Studies have proved that indicators are influenced by different parameters but in the review it is observed that no relations have been established between them.

More distinctively for benchmarking of irrigation systems in Maharashtra itis observed that the targets decided for the indicators are based on last five years average value of respective indicators. For an instance if the system isperforming very poor for last five years then for sixth year it will be fine as it will achieve the target value (average of poor performance). Due to enormous difference in indicator value for some projects, it becomes difficult to compare or even present it graphically. As per the direction of Central Water Commission (Government of India) projects eligible for benchmarking must have experienced five years after completion of projects. Some projects selected for benchmarking have not even completed two or three years after achieving full reservoir level. An effortis made to classify the projects on availability of water on the basis of rainfall, but this is only one parameter which is considered.

The research direction of the present study is aimed at practical aspects of benchmarking which is developed by considering parameters which influence the indicators. The SGV of indicator are evaluated for the causeof comparison and this can be done at regional, state, national and international level. Therefore the SGV can be evaluated considering almostall the aspects or parameters at any level. Decision makers identify only those projects where performance gaps are very high.After investigating background the results or conclusion changes.

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