

GUIDELINES FOR WATER AUDITING

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KEYWORDS

Water audit, water account, irrigation domestic & industrial use, water use efficiency, water losses.

ABSTRACT

The term audit has been commonly associated with collecting information and evaluation of financial accounts of the projects. Concept of audit is now being considered as an effective management tool for conservation, including water conservation. Water Audit is a systematic and scientific scrutiny of water accounts of the projects. Elements of water audit includes record of amount of water supplied, water delivered to the beneficiaries, unaccounted use, losses in the distribution system and suggested measures to address water loss.

With the objective to introduce, standardize and popularize the water audit system for conservation of water in irrigation, domestic and industrial sectors and improve Water Use Efficiency a “ General Guideline for Water Audit “ were prepared by Central Water Commission and debated upon in a National level workshop. The outline of the guidelines, suggested proforma for carrying out water audit and main recommendations of the National Workshop are discussed in the paper.

1.0 INTRODUCTION

On an average, India receives annual precipitation (including snowfall) of 4000 KM³. However nearly 75 percent of this, that is, 3000 KM³ occurs during the monsoon season confined to three to four months (June to September) in a year.

Average annual water resource potential of the country is estimated as 1869 KM³. Although, the average water availability in the country remains more or less fixed, the per capita availability is reducing progressively owing to increasing population. Besides, due to urbanisation and industrialisation, the demand for water from various sectors including irrigation sector is on rise. Some parts of the country are already facing water scarcity condition and situation may deteriorate in years to come. Irrigation sector being largest consumer of developed water resources will have to strive for high level of Water Use Efficiency. The new processes, management tools such as Benchmarking, Water Audit etc. can help transform the irrigation systems for better. Same is true for other sectors of water use also.

2.0 PERFORMANCE EVALUATION & BENCHMARKING OF IRRIGATION PROJECTS

With a view to improve performance of irrigation projects and to increase productivity per drop of water, “Performance Evaluation Studies of Irrigation Projects” were taken up in the country. For this, Performance Indicators for Irrigation Performance Assessment were developed. Beside Performance Evaluation of irrigation projects, Benchmarking of irrigation systems has also been taken up since 2002. Benchmarking provides an effective tool for comparing relative performance of irrigation projects and suggest ameliorative measures for performance improvement. Guidelines for Benchmarking of Irrigation projects in India were prepared and the process is being promoted.

3.0 WATER AUDIT

The term audit has been commonly associated with collecting information and evaluation of financial accounts of the projects. Concept of audit is now being considered as an effective management tool for conservation, including water conservation. Water Audit is a systematic and scientific scrutiny of water accounts of the projects. Elements of water audit includes record of amount of water supplied, water delivered to the beneficiaries, unaccounted use, losses in the distribution system and suggested measures to address water loss.

Though water audit is not a new concept, yet, no guidelines or BIS Code for water audit is available in the country. Keeping this in view, Central Water Commission (CWC) brought out "General Guidelines for Water Audit" to cover broadly three main sectors of water use viz. Irrigation, Domestic and Industrial. The aims and objectives of these guidelines are to introduce, standardize and popularize the water audit process for conservation of water in all sectors of water use and improve the water use efficiency.

Water audit determines the amount of water lost from canal network/distribution system due to seepage, evaporation/leakage and other reasons such as theft, unauthorized or illegal withdrawals from the systems. Water audit improves the knowledge and documentation of the distribution system, and better understanding of what is happening to the water after it leaves the source point. Comprehensive water audit gives a detailed profile of the distribution system and water users, thereby facilitating easier and effective management of the resources with improved reliability. It helps in correct diagnosis of the problems faced in order to suggest optimum solutions. This leads to reduced water losses; improved financial performance; improved reliability of supply system; enhanced knowledge of the distribution; efficient use of existing supplies; better safeguard to public health and property; improved public relations; reduced legal liability and reduced disruption etc thereby improving level of service to customers. It is thus an effective tool for realistic understanding and assessment of the present performance level and efficiency of the service and the adaptability of the system for future expansion & rectification of faults during modernization.

As each project or water management system is unique in character and Hydrology and Hydro dynamics are stochastic in nature, the Departments and the agencies, keeping local and regional perspectives, may formulate state-specific, region-specific and project-specific guidelines, based on conceptual guidelines of CWC.

3.1 WATER AUDIT STEPS

Water Audit includes water supply and usage study, process study, system audit, discharge analysis and preparation of water audit report.

- **Water Account**

It comprises of preparation of layout of water sources, distribution network, service/delivery points to water users and return flow of waste or excess water. The layout should contain locations and capacities of flow measurement devices installed at key point, sizes of different channels, dimensions of pipes etc. A study of the availability of water from different sources and past consumption patterns for various sectors is necessary to understand the present water utilization and projecting future requirement.

- **Process Study**

Flow measurement devices shall be installed at all strategic points in a canal system so that water discharge from various components such as Head regulator, Cross regulator, Outlet structures etc. can be recorded and estimation of losses in conveyance as well as directly from the structure can be made. Similarly, for a domestic water scheme, flow measurement devices may be installed at raw water source, conveyance system from raw water source to treatment plant, from treatment plant to treated water storage system, treated water storage system to distribution networks, individual users, etc. so that discharge from various components and estimation of losses could be assessed at regular intervals. Such

studies will also prove useful for future extension, renovation and modernization of the system. The water distribution system, leakage assessment etc. will form an integral part of this study.

• **System Audit**

The current water usages and systems for water use under various sectors such as irrigation, domestic water supply, industry and thermal power need to be studied to check their operational efficiency and level of maintenance. The scope for any modification or up-gradation will depend on the status of existing systems. Measurement methodology from the intake point of the system through various sub-systems to the ultimate user points needs to be verified periodically for its suitability, efficiency and accuracy. Bulk metering should be done at the source for zones, districts etc and revenue metering for consumers. This will help in identifying the reaches of undue water wastage. The domestic wastewater, return flows from irrigation and effluents from the industries need to be studied for conformity to environment standards, possibility of recovery of valuable by-products and the opportunity for recycling of waste water.

• **Water Audit Report**

Adequate planning and establishing standard procedure is necessary prior to undertaking the water audit of a system. A water audit can be accomplished on the basis of water allotted for a service and water actually utilized for that service. After assessing the loss of water and the efficiency of the system, steps needed for utilization of recoverable water loss may be listed. A cost-benefit study for optimum recovery of water loss may be performed. A water audit report may, invariably, contain

- amount of water earmarked/made available to the service.
- amount of water utilized, both accounted and unaccounted.
- water loss and efficiency of the system along with reasons for such water losses
- suggested measures to check water loss and improve efficiency.

An effective water audit report may be purposeful in detection of excessive losses from gates, in conveyance system etc. Taking timely action for repair of regulatory structures, restoration of canals, valves etc. in case of Domestic Water Schemes etc. will reduce conveyance losses and improve efficiency of the system. Water audit of the system should be undertaken at regular intervals, at least on an annual basis.

4.0 IRRIGATION SECTOR

As one step ahead of Evaluation studies and Benchmarking of irrigation projects, water audit is required to be made applicable to all irrigation systems. Water accounting is prerequisite for Water Audit as it defines the demand for surface water service. Water demand is region specific depending upon the type of soil, cropping pattern/practices, climatic condition, etc. Irrigation water demand also depends upon the type of conveyance system, water application technique etc. As a first step, Crop Water Requirement (C.W.R) of different crops is required to be computed. Among various methods available for working out C.W.R, Modified Penman Method is considered the most suitable. Next step is to assess the flow to be released at the outlet/off taking head, distributor/branch head, head regulator (Canal head) etc. by adopting judiciously assumed/computed values of field application efficiencies and conveyance efficiencies(losses) in different reaches, moving from tail to head.

The measurement of water is essential for calculation of water losses during conveyance in canal and distribution network and also during application in the field. Some of the simple techniques/measuring devices commonly used for measurement of actual quantity of water delivered are (a) Velocity Area Method, (b) Weir and (c) Flumes. Complete records of water withdrawn from the reservoir or the river

system and of water that flows through the various branches, distributaries and other network channels and at outlets in bulk supply to Water User Association if in place as well as water flowing through escapes are needed to be maintained. Simultaneously, record of rainfall, crops sown, area irrigated and depth of water provided are also required to be maintained. Actual conveyance and field application losses and efficiencies of an irrigation system can be calculated from such records. Any abrupt reduction in flow measurement at a particular location, without any with drawl in the reach upto u/s measuring point will also help in identifying points of unauthorized use. Analysis of the data collected, as outlined in the proforma will give the actual conveyance and field application efficiencies and losses due to unauthorized with drawl. These efficiencies are to be compared with the planned / achievable efficiencies to assess the scope for improvement. The corrective measures need to be taken accordingly.

Various sample proforma for water audit in irrigation system are given at the end.

5.0 DOMESTIC SECTOR

Domestic water is a basic need for human as well as livestock. For sustainability, the planning may be required at national level as a whole for policies and subsequently at state or region or at community levels. The quantity of water required for domestic purposes depends mainly on habits, social status, climatic conditions and customs of the people. Over and above the demand, 15% losses may be allowed for determining the quantity of raw water required. However actual losses in the distribution system are much higher on account of leakages and poor maintenance in addition to lack of efforts towards conservation. It is estimated that about 30 to 50% of the water produced and supplied in the cities goes as waste through leakages in the distribution system. For the purpose of water audit, bulk metering system is to be devised zone-wise, including group-consumer-wise in a system or a sub-system. This will facilitate identification of the reaches where actually the wastage of water is taking place. For metered water use, per capita per day consumption is to be obtained by dividing water usage by the number of days in the billing period and also by the number of residents of household. If water use is not metered, consumption can be worked out based on average domestic (metered) consumption per capita per day for consumers having similar water use habits plus an allowance for unmetered commercial consumption. Water audit helps in determining the amount of water lost from a distribution system due to leakages etc. Water audit compares the amount of water supplied with the amount billed and unbilled accounts for the water loss.

6.0 INDUSTRY SECTOR

Growing population and rising standard of living of people are pushing up demand for quality industrial products at phenomenal pace. Thus the industrial requirement for water is increasing day by day. As one of the large users of this precious resource, industry has an important responsibility to practice water audit. Industries can realize many benefits from the practice of water audit. By reducing consumption of water, industries will not only effect saving, but also protect the environment. Industries need to adopt technologies for efficient use of water for cooling purposes and set benchmarks for water use for different types of industries. Complete record of raw water with drawl from the source; water used in township/horticulture; quantity of recycled water used; effluent discharged in water bodies etc. has to be maintained as part of water audit.

WORKSHOP ON WATER AUDIT

Draft 'Guidelines for Water Audit', prepared by Central Water Commission were deliberated upon in a National Level Workshop organized at New Delhi in January, 2004, jointly by Central Water Commission and Central Ground Water Board. Recommendations emerged in the seminar are:

- Water audit is an important management tool for effective conservation of water. Broadly water audit should be conducted categorically in two systems, resource audit or supply side audit and the other one as consumption or demand side audit. All efforts should be made for improvement of not only water use efficiency and distribution system, but also on the efficient development and management of the source of water.
- It was strongly advocated that the water audit system needs to be framed and incorporated in every significant water resources project as a routine exercise during operation and maintenance of the project by the project authorities.
- The periodicity of water audit and its report may be determined in advance at the commencement of commissioning the project by the project authority and the concerned Governments and appropriate provision of fund may be made for its implementation. In general, it may be carried out annually.
- A systematic comprehensive water audit of irrigation projects will be very useful in bringing out the trend of changes on demand and supply scenario which will help in deciding the methodology for improving the efficiency of the system by adopting conjunctive use of surface and ground water, application of modern irrigation techniques including drip and sprinkler irrigation wherever feasible and other improvised agricultural devices in addition to development of wasteland and waterlogged areas.
- There is general apathy towards conjunctive use of ground water and surface water. Specific water audit needs to be conducted on regular basis for realistic assessment of ground realities and initiating remedial measures under the umbrella of holistic approach.
- Pollution level of fresh surface water and ground water resources are alarmingly increasing due to excessive use of pesticides and fertilizers in agriculture and discharge of untreated waste by industries and sewage disposal leading to health hazards and scarcity of fresh water. Water audit from this angle needs to be conducted strategically and periodically. The existing laws regarding pollution control need to be strictly observed by not only imposing penalties but also restricting the polluters.
- To identify water loss due to leakage, the approach of bulk metering system should be installed at various well defined macro and micro systems like various zones, districts, towns, colonies and even large group-consumers to single unit consumers so that water audit can be effectively conducted.

Various proformae for carrying out Water Audit in Irrigation Sector

Proforma	Description
I	Water Demand
II	Water Indent
III	Daily Discharge Drawn by Various Sections
IV	Discharge Drawn at Various locations of canal
V	Water Used and Area Irrigated (Sub-division)
VI	Water Used and Area Irrigated (Section)
VII	Discharge letout through scouring sluices or escapes (Sub-division)
VIII	Discharge letout through scouring sluices or escapes (Section)
IX	Rainfall/Evaporation (Sub-division)
X	Rainfall/Evaporation (Section)
XI	Annual Water Account for Major and Medium Projects
XII	Annual Water Account for Minor Irrigation Projects
XIII	Water Auditing

Some of the above proformae are reproduced for reference.