DRAFT REPORT

WATER AUDIT STUDY FOR

Doon (PG) College of Agriculture Science & Technology Selaqui, Dehradun, Uttrakhand-248011

CONDUCTED BY:

Association of Energy Conservation
&
Environment Protection

32-B, Bhagirathi Puram, Engineers Enclave, G.M.S Road,

Dehradun, Uttarakhand – 248001

Email: aecep29@gmail.com, Phone: 09456583967

FY -2022-23

Contents

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

A	Ampere
AC	Alternating Current
Avg.	Average
CFL	Compact Fluorescent Lamp
CFM	Cubic feet minute
DTL	Double Tube Light
DG	Diesel Generator
FAD	Free Air Delivery
FTL	Florescent Tube Light
GT	Generator Transformer
DTL	Double Tube Light
KL	Kilo Liter
KV	Kilo Volt
kVA	Kilo Volt Ampere
kW	Kilo Watts
kWh	Kilo Watt Hour
LED	Light Emitting Diode
L	Liters
M or m	Meter
Max.	Maximum
Min.	Minimum
MT	Metric Ton
MW	Mega Watt
No.	Number
OHT	Over Head Tank
PF	Power Factor
STL	Single Tube Light
TR	Ton of Refrigerant
V	Voltage

Acknowledgement

M/s. AECEP, expresses sincere thanks to the Management of **"Doon (PG) College of Agriculture Science & Technology"** for their kind assistance and co-operation for carrying out the Water Audit of their college. The site visits for the Water Audit have been conducted on Sept 25, 2022.

The Study team members of M/s. AECEP would sincerely like to thank all the officials, Department Heads and support staff members of Doon (PG) College of Agriculture Science and Technology, who have rendered their all possible assistance and co-operation and courtesy extended to the water audit team during the entire period of assignment.

This report is an attempt of M/s. AECEP, to provide an overview of the water distribution system and usage of Doon (PG) College of Agriculture Science and Technology, Dehradun. The report also highlights the major water saving opportunities available at the Doon (PG) College of Agriculture Science and Technology, Dehradun, of recommendations which will assist in improving water efficiency has also been highlighted in this report. This report has emerged after a detailed water audit conducted by M/s. AECEP at Doon (PG) College of Agriculture Science and Technology, Dehradun on Sept 25, 2022.

Official from Doon (PG) College of Agriculture Science and Technology, Dehradun

- Ch. Dariyav Singh - Chairman
- Dr. Sanjay Chaudhary - Director
- Dr. Manzoor Ahmed – Dean Academics

Water Audit Team Members

- **Mr. Ashish Vashishth – BEE Certified EA Auditor, President (AECEP)**
- **Mr. Utkarsh Singh – EA & Water Auditor**
- **Mr. Chandramohan Bhandari – Team Member**
- **Mr. Satish Chandra – Team Member**

Association of Energy Conservation & Environment Protection

CHAPTER 1 INTRODUCTION

Water is an essential precondition for life, and according to the UN, it is a human right to have access to clean water. However, in India millions of people are living without direct access to safe water and based on the rapid population growth coupled with the fact that the water reserve is finite, it will be a very valuable and scarce resource within only a few years. In this light, there is an urgent need for decision-makers to act in order to improve the conditions for effective use and supply of water to the Indian people now and in the future.

Under the Indian Constitution and in our federal democratic setup drinking water comes within the domain of the State Governments (Provincial Governments). In fact, the 73rd Constitutional Amendment has gone a step forward. It mandates that responsibility for drinking water and sanitation services should be with Local Governments. The various States in India are at different stages of giving effect to this Constitutional mandate.

The Ministry of Urban Development has formulated Service Level Benchmarks (SLBs) in 2008 and circulated the same to the States for adoption. The SLBs include water conservation and management practices such as continuous water supply, 100% metering of water supply, sustainable tariffs and reduction in leakages to a level of 15% to 20%.

The National Water Policy – 2012 focuses on the need for publishing water accounts and water audit reports indicating leakages and pilferages. The policy recommends systems to evolve benchmarks for water uses for different purposes, i.e., water footprints, and water auditing to ensure efficient use of water.

National Water Mission (NWM) has been established by the Government of India with the objective of "conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water resources development and management".

The Government of India has also launched a Centrally Sponsored Scheme for Repair, Renovation and Restoration (RRR) of water bodies, which has multiple objectives like comprehensive improvement and restoration of water bodies thereby increasing tank storage capacity, improved water use efficiency and increased availability of drinking water.

With its continuously declining per capita water availability (from about 5,177 m3 in 1951 to 1,654 m3 in 2007), India stands water stressed and is close to being categorized 'water scarce'. Water demand in India is expected to grow annually by 2.8 per cent to reach 1,500 bcm (by 2030) while the current supply is only about half (viz., 744 bcm). The Government of India, in its Intended Nationally Determined Contribution (INDC) submitted to UN Frame work Convention on Climate Change (UNFCCC) in October, 2105, has committed to improve the water use efficiency by 20%, through regulatory mechanisms with differential entitlements and pricing. It further emphasizes the need to focus on integrated water resource management through water conservation, wastewater minimization, etc.

A water audit is an effective management tool for minimizing losses, optimizing various uses and thus enabling considerable conservation of water. Thus, Doon (PG) College of Agriculture Science and Technology, Dehradun, Management has entrusted AECEP for conducting water audit at Doon (PG) College of Agriculture Science and Technology, Dehradun.

This report discusses about the existing water scenario at Doon (PG) College of Agriculture Science and Technology, Dehradun, potential water savings and how the basic water audit approach has been applied to water conservation.

1.1 Rationale for Water Audit

The world's water resources are finite but exist on a planet with a constantly growing population. The development of water resources to man's benefit has been a fundamental factor in the evolution of civilizations throughout history. But, as our populations continue to grow and shift, the availability of quality water resources is in decline. Pollution, climate change and construction of cities in dry regions are some of the factors exacerbating evolving supply/demand imbalances. To account this, it is essential that man utilize existing water resources in the most careful, efficient manner. Water audits provide a rational, scientific framework that categorizes all water use in the system. It is a tool to overcome drought related problem, shortage, leakage and losses.

Water Audit is most effective tool for water management with the help of water audit, we identified and quantify what steps can be taken to reduce water use and losses.

It was with this objective that AECEP was entrusted with the job of conducting Water Audit Doon (PG) College of Agriculture Science and Technology, Dehradun, in line with the requirements of NBC guidelines.

The Management is conscious with regard to its Water Efficiency Levels and they have initiated several measures to reduce the water consumption, which include amongst others the use of water flow meters at process end.

1.2 Steps of Water Audit

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

1.2.1 Water Supply and Usage Study

Water audit comprises of preparation of layout of water sources, distribution network, and 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 and fittings in the water supply system, locations and particulars of flow control devices and history sheets of all measuring and control devices including pipes and fittings etc.

1.2.2 Process Study

Flow measurement devices may be installed at all strategic points so that water losses from various components such as 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. could be assessed at regular intervals.

Water quality of the distribution system needs to be monitored regularly at strategic points to find out the level and nature of contaminants present in the supplied water.

AECEP, has carried out flow measurement of supply line and other lines feeding water to different areas via gravity to understand the quantity of underground water received from the submersible pumps. Accordingly, discharge from various department and estimation of losses was also assessed.

1.2.3 System Audit

The current water usages and systems for water use under various sectors such as buildings, 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.

AECEP has carried out physical inspection of water distribution network/system of Pump House, to get their per day drinking and sanitary water consumption to arrive at per capita water consumption in the Doon (PG) College of Agriculture Science and Technology, Dehradun.

1.2.4 Discharge Analysis

The domestic wastewater, backwash waste, washroom & laboratories etc. need to be studied for conformity to environment standards, possibility of recovery of valuable by-products and the opportunity for recycling of waste water.

At Doon (PG) College of Agriculture Science and Technology, Dehradun, AECEP has carried out detailed study of waste water generation.

1.2.5 Water Audit Report

A water audit can be accomplished on the basis of water allotted for a service and water utilized for that service. After assessing the loss of water and the efficiency of the system, steps needed for utilization of recoverable water loss and reuse may be listed.

An effective water audit report may be purposeful in detection of water losses and improve efficiency of the system. Water audit of the system should be undertaken at regular intervals at least on an annual basis.

The AECEP water audit explains the losses of water in system and various management approaches.

1.3 Scope of Work

AECEP has been entrusted to conduct Water Audit of Doon (PG) College of Agriculture Science and Technology, Dehradun. In determining the water audit scope, AECEP has considered the extent and boundaries of the Installations. Water audit as per defined scope was conducted at the facilities as appended here under:

- Review of present water distribution system, water efficient fixtures, pipelines, water treatment plant, etc.
- Review of Irrigation system
- Review of Water Storage System.

This report aims at portraying the water audit details and the outcome along with recommendations for Doon (PG) College of Agriculture Science and Technology, Dehradun.

1.4 Approach and Methodology

The following step by step methodology and approach were adopted while carrying out the Water Audit of Doon (PG) College of Agriculture Science and Technology, Dehradun. AECEP team visited Doon (PG) College of Agriculture Science and Technology, Dehradun premises in Sept 2022 for the field measurement and conducting the audit. The broad methodology adopted for the Water Audit at Doon (PG) College of Agriculture Science and Technology, Dehradun is furnished below.

1.4.1 Pre Audit Information

- Preliminary literature review of concepts and methodologies related to water audit for utility, facilities and building.
- Walk through the entire admin building, hostels, Pump House, to understand the nature of water uses and the systems installed in the building.
- Discussion with the administrative officers, pump operators, campus staff, housekeeping and kitchen employees on the various water uses during the day and the source of water.

1.4.2 Base-lining and benchmarking

The water audit for Doon (PG) College of Agriculture Science and Technology, Dehradun included both primary and secondary data collection for various identified water uses. Primary data collection included the following components

- Development of questionnaire format for individual water use, mopping, gardening etc.

- Sample survey of Doon (PG) College of Agriculture Science and Technology, Dehradun office staff to estimate individual water consumption on sanitary and drinking purposes based on questionnaire format
- Flow rate calculation from the taps flow rates and number of all water using fixtures/ equipment was also undertaken.
- Secondary data collection included compilation of number of staff along with their duration of stay.
- Collecting records of water pumped to the overhead tanks and from OHT to end users etc to estimate actual supply.

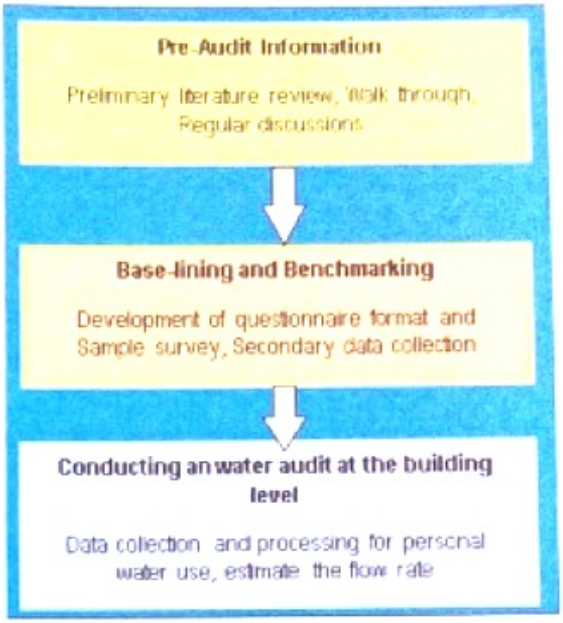

Figure 1 Approach and Methodology

1.4.3 Conducting an water audit at the building Level

- The data collection and processing for personal water use including drinking, flushing and face/ hand washing, mopping, irrigation, utensil washing etc. was done on the basis of actual consumption.
- As part of the survey, staff members recorded the number of daily visits to toilet, flushes in toilets and urinals, along with daily frequency of hand washing and average time of water flow from the taps.
- The data for all the above uses was calculated for varying time period for DCAT staff to calculate per capita use.

1.5 Instrumentation Support

Instruments used for undertaking the audit include the following:

- **3-Phase Power Analyzer:** The Krykard make ALM-31 power analyzer was used to measure the power of the pump motor
- **Ultra-Sonic Flow Meter:** Highly versatile state-of-the-art ultrasonic flow meters, with flow transducers were used to measure the velocity and flow of water in the pipeline.

3-Phase Power Analyzer

UltraSonic Flow Meter

CHAPTER 2 WATER BILL STUDY

2.1 Purchased Water

Doon PG College of Agriculture Science and Technology takes ground water via 4 No's of Borewell pumps (2 HP X2 No's and 5 HP X 2 No's). 2 No's of Pumps (5 Hp x 1 No' and 2 Hp x 1 No') are installed in the main building side and the other 2 No's of Pumps (5 Hp x 1 No' and 2 Hp x 1 No') are installed in the Hostel Building side. The Running of 2 Hp main building pump is 4 Hrs./day, 5 hp main building pump is 1 Hr./day, 2 Hp (Mess) hostel building pump is 4 hrs/day and 5 hp garden pump hostel building is 4 hrs/day.

CHAPTER 3 ASSESSMENT OF WATER DISTRIBUTION SYSTEM

3.1 Overview of Doon (PG) College of Agriculture Science and Technology

Doon (P G) College of Agriculture Science & Technology (DCAT) is part of the Doon Group of Colleges Society. The College is located in Dehradun, Uttarakhand. It is affiliated with the Hemwati Nandan Bahuguna (H N B) Garhwal University, Srinagar Garhwal (Uttarakhand) since 2001.

It was on 25th December, 2001 that the Hon'ble Shri Ajit Singh ji, the then Union Minister of Agriculture, inaugurated a new block namely Louis Pasteur in Doon (P.G.) Paramedical College & Hospital and a new building for Doon (P.G.) College of Agriculture Science and Technology in Selakui, Dehra Dun. In December, 2002, a State of Art Biotechnology Laboratory and a new block "Har Govind Khurana Bio-tech Block" were inaugurated by the Hon'ble Vice-Chancellor of the H.N.B. Garhwal University.

Institute has the following amenities:

- Admin Building
- Hostel Room
- Canteen
- Class Rooms
- Library
- Laboratory
- Sports Facilities

AECEP has visited all water consuming areas during water audit to understand the philosophy of water consumption in these areas. Each area at the campus consumes water for various purposes such as cleaning, domestic purpose, drinking, Lab, etc.

The key fact about the DCAT is provided in below table:

Table 1 General Details & Key Facts

Contact Details		
Brief description of Assignment	:	Water Audit at Doon (PG) College of Agriculture Science & Technology
Name & Address of the Building	:	Doon (PG) College of Agriculture Science & Technology Selaqui, Dehradun, Uttrakhand-248011
Operational Days	:	250 Days per annum
Contact Officer	:	Dr. Manzoor Ahmed – Dean Academics
Key Facts		
Main Water Sources	:	Ground Water
Over Head Tank Details	:	New Building – 4000 L X 2 No's & 1000 L X 1 No' Chima – 1000 L X 3 No's Dean Office – 4000 L X 1 No' Hostel – 10,000 L X 2 No's & 500 L X 2 No' Solar - 2000 L X 1 No' & 1000 L X 1 No'
Source of Water Supply (Ground water)	:	⇨ Main Building – 2HP and 5 HP ⇨ Hostel Building – 2 HP and 5 HP
Total staff strength	:	60 No's
No of Students (Hosteler)	:	200 No's
No of Students (Day Scholar)	:	1800 No's

3.2 Water Source and Water Storage System

3.2.1 Sources of Water:

At DCAT, water is supplied to the PVC storage tank at building top of Different buildings via four submersible pumps. From these PVC tanks, water is used for drinking and Gardening.

3.2.2 Storage Tanks at DCAT:

At DCAT, there are total 13 No's of PVC tank. The water at the entire campus is supplied from these storage tank.

Table 2 Under Ground Storage tanks

Identification	Type	No's	Capacity of OHT (Lts)	Total Capacity (Lts)
New Building	PVC	2	4000	8,000
Chima	PVC	1	1000	1,000
Dean Office	PVC	3	1000	3,000
Hostel	PVC	1	4000	4,000
Solar	PVC	2	10,000	21,000
		2	500	
		1	2,000	
		1	1,000	3,000
Total		13		40,000

3.3 Water Usage Area in DCAT:

From Submersible pump water is supplied to the PVC Tank. From these PVC tanks water is supplied to New Building, Chima, Dean Office, Hostel, Solar etc. The water is used for both drinking and gardening purposes.

3.4 Pumping Station at DCAT

At DCAT, 4 No's of submersible pump for raw water supply, the details of pumps are mentioned below: -

- **Submersible Pump**

4 No's of Borewell pumps (2 HP X2 No's and 5 HP X 2 No's). 2 No's of Pumps (5 Hp x 1 No' and 2 Hp x 1 No') are installed in the main building side and the other 2 No's of Pumps (5 Hp x 1 No' and 2 Hp x 1 No') are installed in the Hostel Building side. The Running of 2 Hp main building pump is 4 Hrs./day, 5 hp main building pump is 1 Hr./day, 2 Hp (Mess) hostel building pump is 4 hrs/day and 5 hp garden pump hostel building is 4 hrs/day.

Table 3 List of Pump Installed

Description	Location of Pump	kW Of Pump
Submersible Pump	Main Building	2 HP
	Main Building	5 HP
	Hostel Building	2 HP
	Hostel Building	5 HP

3.5 Waste Water Recycling System

Overall Aim for Water Conservation: On the Way Forward With the 3-R Concept

"Water conservation is defined as any action that reduces the amount of water withdrawn from water supply sources, reduces consumptive use, reduces the loss or waste of water, improves the efficiency of water use, increases recycling and reuse of water, or prevents the pollution of water"

3.5.1 Reduce

- Reduction at Source
- Better operating controls such as arresting leakages
- Installation of water saving devices such as water tank alarm at all overhead tanks
- Change of device/ equipment such as replacement of water pumps and motor with energy efficient pumps and motors
- Process modification such as use of sprinklers for watering plants and garden

3.5.2 Recycle & Reuse

- Use of treated water in toilets flushing, gardening, fountains, equipment's
- Using storm water & sanitary water as fire water after treatment
- Reduction of Fresh Water usage supplemented through wastewater treatment
- Direct use of Rainwater Harvesting through storage tanks

3.5.3 Recharge

- Installation of recharge wells / rainwater harvesting pits for recharging ground water tables
- Total recharging capacity (during rain time) to be estimated in m^3/hr.
- Rainwater Harvesting and conservation.

3.5.4 Rain Water Harvesting at DCAT

As per discussion with the concerned officials, **Rain Water Harvesting Pits are under installation**

3.5.5 Sewage Treatment Plant at DCAT

As per discussion with the concerned officials, **5 KLD STP is installed.**

CHAPTER 4 MEASURMENT OF WATER FLOW IN DISTRIBUTION NETWORK

4.1 Distribution of Water (KL per day) at Various Location

In order to understand the current water consumption of the institution, it is mandatory to perform detailed water audit, which is comprised of water flow measurement, assessment of leakages & Losses as well as water quality assessment. During the audit, the Flow Measurements were taken for the entire water supply and distribution network.

4.1.1 Overall Water Consumption

Overall daily average water supply and consumption pattern in different segment is given below

Table 4 Overall water consumption

Area Feeding	Flow	Running Hours	Total Supply (KLD)
From Submersible Pump			
2 Hp Pump (Main Building)	3.87	4	15.48
5 Hp Pump (Main Building)	14.4	1	14.4
2 Hp Pump (Hostel Building)	3.45	4	13.8
5 Hp Garden Pump (Hostel Building)	2.2	4	8.8
Total			**52.48**
2 Hp Pump (Main Building)			
Garden	3.87	4	15.48
5 Hp Pump (Main Building)			
Fish Tank	10.1	1	10.12
Food Court	3.98	1	3.98
5 Hp Garden Pump (Hostel Building)			
Chima	2	0.5	1.00
Deam office	2.1	0.5	1.05
Hostel	2.2	2.5	5.50
HM Building	1.8	0.5	0.90
2 Hp Pump (Hostel Building)			
Mess	3.45	4	13.80
Total			**51.83**
Summary			
Total Water Drawn			52.48
Total Water Consumption			51.83
Transmission Losses			0.44
Uncounted Water			0.21

CHAPTER 5 WATER BALANCE & QUANTIFICATION OF WATER LOSS

5.1 Water Balancing at DCAT

The assessment team has reviewed the water supply and consumption as well as the losses in the water distribution network at DCAT. The water balance diagram of the system is given below

Table 5 Water Balance at Institute

Area Feeding	Total Supply (KLD)	% Share
From Submersible Pump		
2 Hp Pump (Main Building)	15.48	29.50%
5 Hp Pump (Main Building)	14.4	27.44%
2 Hp Pump (Hostel Building)	13.8	26.30%
5 Hp Garden Pump (Hostel Building)	8.8	16.77%
Total	**52.48**	**100%**
2 Hp Pump (Main Building)		
Garden	15.48	29.50%
5 Hp Pump (Main Building)		
Fish Tank	10.12	19.28%
Food Court	3.98	7.58%
5 Hp Garden Pump (Hostel Building)		
Chima	1.00	1.91%
Deam office	1.05	2.00%
Hostel	5.50	10.48%
HM Building	0.90	1.71%
2 Hp Pump (Hostel Building)		
Mess	13.80	26.30%
Total	**51.83**	**98.76%**
Summary		
Total Water Drawn	52.48	100.00%
Total Water Consumption	51.83	98.76%
Transmission Losses	0.44	0.84%
Uncounted Water	0.21	0.40%

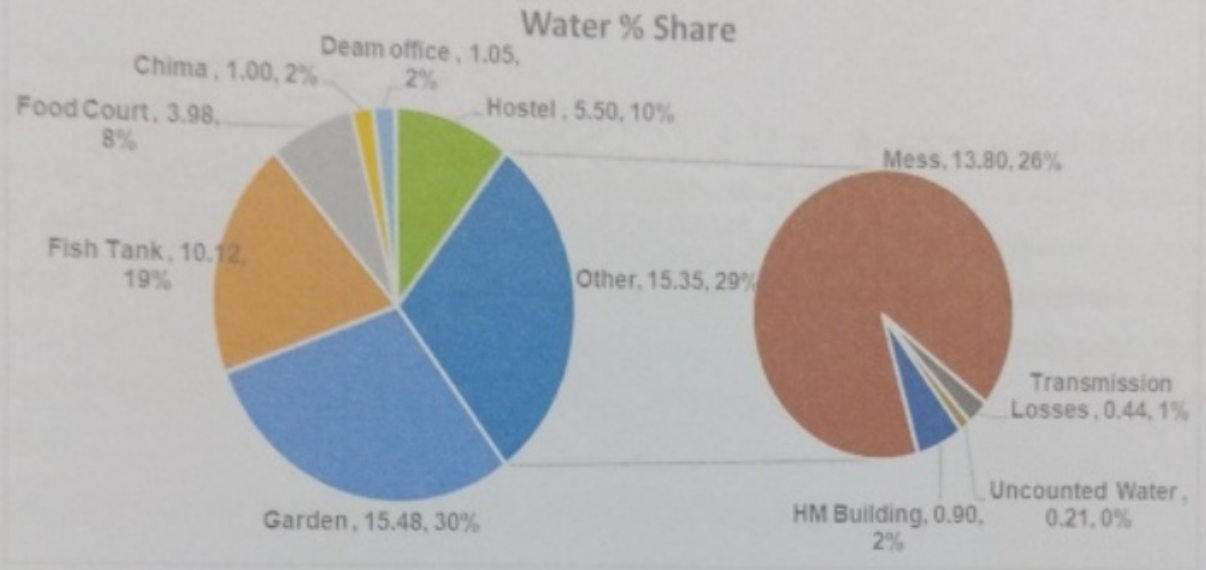

Figure 2 Water % Share

CHAPTER 6 RAIN WATER HARVESTING PITS

6.1 Rain Water Harvesting Scope for DCAT

Rainwater harvesting is a type of harvest in which the raindrops are collected and stored for the future use, rather than allowing it to run off. Rainwater can be collected from terrace or roofs and redirected to a deep pit (well, shaft, or borehole), aquifer, a reservoir with percolation, or collected from dew or fog with nets or other tools. Its uses include water for gardens, livestock, irrigation, domestic use with proper treatment, indoor heating for houses, etc. The harvested water can also be used as drinking water, longer-term storage, and for other purposes such as groundwater recharge.

At DCAT, Rain Water Harvesting Pits are under installation process.

CHAPTER 7 WATER SAVING POTENTIAL / BEST MANAGEMENT PRACTICES DATA AND RECOMMENDATIONS FOR EFFICIENT WATER MANAGEMENT

7.1 Water Saving Potentials / Best Management Practices Data:

Best management practices (BMPs) are a set of hands-on recommendations that help to identify opportunities and implement programs to save water DCAT. BMPs are developed for the various water-use categories in the office buildings and for monitoring and operational procedures. They are grouped according to indoor water use, outdoor water use, and monitoring and operational procedures. We can tailor water-saving program by using part or all the BMPs depending on budget and environmental requirements. Tips and information are provided on water saving amounts and cost recovery to help in prioritizing measures and make the most knock for buck.

Based on the information collected and observations, the following can be recommended to reduce water use and increase its efficiency

7.1.1 Faucets Aerators:

It is recommended to install about 134 No's of Aerator Faucets in the entire campus.

Faucets flows can easily be reduced without affecting the comfort of the water user by using appropriate flow regulator technology for these fixtures. This will result in impressive savings of around 50 percent of faucets water use. Flow regulators, especially the aerators are inexpensive and are easy to install and maintain. This is why they are often considered as the low hanging fruits of water saving programs.

Figure 3 Latest Technology Faucets

Here are the recommended best management practices for achieving water savings for faucets at office building.

- Use pressure compensating and tamper proof aerators that can only be removed with a 'special' tool to reduce vandalism and theft.

- Regularly clean faucets as sediments may accumulate and reduce the flow

Table 6 Recommended flow rate for different type of use

Recommend flow rate for different type of uses	
Public hand-washing faucet	≤ 4.5 liters /min
or self-closing faucet	≤ 1.0 liters /cycle
Restroom faucet	≤ 4.5 liters /min
Kitchen faucet	≤ 8.3 liters/min

Flow per minutes could be set to 2 or 3 or 6 Liters or more as per the requirement. The Flow Control aerator generates thin streams (like shower aerator) of water to cover wider area for rinse, when compared to conventional aerators. This results in lesser-run time of faucet and easiness for user and ultimately water saving. Flow Control Aerator can easily be installed in existing faucets.

7.1.2 Urinals:

a) **Low water use urinals:** In some of the standard systems, water is applied automatically through a continuous drip-feeding system or by automated flushing at a set frequency, 24x7, regardless of whether or not the urinal has been used. Water consumption varies with the system model at an average of 4 liters per flush. Water-efficient urinals use 2.8 liters per flush and in recent times smart flush systems using 0.8 liters per flush have also been launched.

b) **Waterless urinals:** There are various technologies available for waterless urinals. In oil barrier technology, the urinals operate through the use of an oil wall between the urine and the atmosphere, preventing odor from escaping. In another technology, the barrier has been replaced by a seal with a collapsible silicone tube that closes after the fluid has passed through it, to prevent gases from flowing into room. A third system uses biological blocks which include microbial spores and surfactants which can be placed into any urinal, thus eliminating water use. By breaking down the urine into components, buildup of sludge and crystals which causes blockages are prevented.

Figure 4 Waterless Urinals

Bidets and urinals water use accounts for 3 percent of office buildings water use. These standards shown in the table offer a good water-saving opportunity for water saving in office buildings.

7.1.3 Toilet Flush:

a) Dual Flush Toilets

A dual-flush toilet is a variation of the flush toilet that uses two buttons or handles to flush different levels of water. A significant way to save water in buildings is to replace single-flush toilets with dual flush toilets. The standard dual-flush toilets use six liters of water on full and three liters on a half-flush.

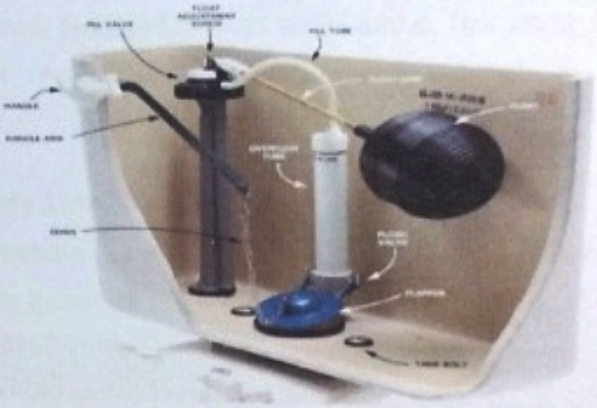

Figure 5 Dual Flush Toilets

Replacing old toilets will result to a reduction of 35 percent of toilet water. More cost-effective results can be achieved by replacing only the toilet trim system.

b) Toilet Tank Bank

It is recommended to install about 86 No's of Toilet tank bank in the flush tanks of DCAT.

With economical, maintenance free 'Green Toilet Bank' it is very easy to save water on toilet flushing, it helps to save 3 liters water on every flushing, with no sacrifice on performance. Toilet Bank filled with water is hanged inside the toilet flushing tank or reservoir. It will displace an amount of water equivalent to 3 Liters in the tank, which means every flush we will save water, thus saving you money. Less the water you use, the less you need to recycle.

Figure 6 Green Toilet Banks

7.1.4 Regular Maintenance of toilet system and use of water efficient fixtures

Regular maintenance of the toilets should be carried out. Test for leaks and make necessary repairs promptly. Keep the toilet in working order by periodically inspecting and replacing flappers and other defective parts. Water efficient fixtures such as aerator and water efficient taps need to be used to reduce water consumption in toilets, bathing area and washroom etc.

7.1.5 Water tank overflow Alarm system at Over Head Tank

It is noticed that no alarm as well as level sensor bell was provided to PVC water tanks. The water alarm system should be installed at PVC OH tanks situated at the roof top. This will help in reduction of wastage of water as well as electricity.

7.1.6 Implementation of Pressure Gauge in Delivery Line.

During the audit, it was observed that there was no pressure gauge installed at the delivery side of the pump. Hence, it is recommended to install pressure gauge at the delivery side of each pump in order to observe the head of the pump.

7.1.7 Capacity building of Staff Involved in Water Distribution

The Management of institution may arrange capacity building and awareness programs for the staff engaged in water distribution network on regular basis.

7.1.8 Leakage Intimation and Response System

During the field visits water leakages wastages was observed in the toilets & urinals. Such situations need to be brought to the notice of the concerned officials as soon as possible so that timely corrective action is taken.

One of the methods is to have better leakage intimation & response system and this can be done by installing adequate display board or stickers with contact details of the concerned authorities or persons who can attend the leakage. The on-site staff or any conscious person who finds the

leakage, can intimate the same to the concerned person so that necessary & timely action is taken.

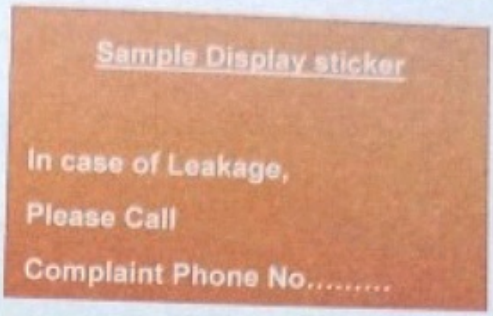

Figure 7 Sample Display Sticker

The hidden water leaks can cause loss of considerable water and energy without anyone being aware of it. The establishment of a leak detection and repair program would be a most cost-effective way to save money and water in the workshop building. Following are some best practices to identify and fixing leaks:

The Management must be committed for providing the staff and resources needed to maintain plumbing fixtures and equipment on a regular basis and assuring prompt identification and repair of leaks.

- Repair staff is given the tools needed and is trained to make leak repair a priority activity.
- Staffs are taught to report leaks and other water-using equipment malfunctions promptly.
- Staffs are rewarded for success.
- Rooftop tank overflow or leakage water should flow to rainwater gutter system not to sewage system to allow detection of rooftop water loss.
- Records of the type, location, number, and repair of leaks are kept in a central location.

7.1.9 Awareness about water use

Need to create awareness among the users through posters & display stickers about water conservation. These stickers should be installed at each water cooler and washroom. Hence, approx. 20-30 No's of posters are required to be installed at different water coolers and washroom.

Figure 8 Sample Display Save Water

CHAPTER 8 SUMMARY

8.1 Points of Appreciation

1. The supervisory maintenance staff of DCAT is quite aware about importance of water use and water conservation.
2. All urinal are very well maintained with no leakage.
3. Proper Maintenance of RO Systems.
4. There is automatic filling of water tanks through controlled float valves.
5. All toilet plumbing and sanitary fixtures are maintained well.
6. 5 KL STP plant is installed for recycling of waste water

8.2 Points Of Concern

1. Sprinklers should be used for irrigation purposes
2. Pumps should be in automatic mode.
3. Rain water harvesting pits under installation process
4. The flow-rate of fixtures is very high ranging from 8 to 14 liters per minute. These need to be replaced with water efficient fixtures with flow rate of 2 Liters per minute.
5. Poster and display stickers about water conservation should by available. Awareness of users towards water savings and conservation is low. There is no program for conducting training regarding awareness for water savings to students and other users. There should be a schedule of periodical training to sensitize users for importance of reduction of water use and its conservation.
6. There should be periodical inspection of all water pipes to check any evident leakages and records should be maintained for inspection.
7. Water Tank Overflow alarm system should be installed.
8. The capacity of cisterns should be reduced by installing tank banks in the cisterns. Also, dual flush tanks should be used.

8.3 Cumulative Water Saving Potentials

Table 7 Cumulative Water Saving Potentials

Observation	Scope (Quantity)	Cost (Rs.)
Tamper Proof Aerators/Faucets	134 No's @ Rs. 300 per item	40,200
Toilet Flush a) Toilet Tank Bank	86 No's @ Rs. 200 per item	17,200
Total		**57,400**

ANNEXURE – Inventory List

Location	Taps	Urinals	Toilet Cisterns	Water Cooler
New Building	30	15	25	3
Office	4	2	4	1
Academic Building				
Outside Store	5	4	10	
Outside Hostel	4	2	6	
Foresting Building	3		6	
First Floor	3		5	
Chima	4	2	6	
Lab, Chima, HM Lab	40			
Hostel	41		24	
Total	**134**	**25**	**86**	**4**