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RESEARCH ARTICLE

WATER AUDIT OF KCAET CAMPUS

Deepthi S Nair[1*], Chris Irene[2], Praneet Garg[2], Shafeela Jasmine[2] and Anu Varughese[2]

[1]PG Scholar, Soil and Water Conservation Engineering Department, Kelappaji College of AgriculturalEngineering and Technology, Kerala 679573, India

[2]Assistant professor, Department of Irrigation and Drainage Engineering, Kelappaji College of Agricultural Engineering and Technology, Kerala 679573,India

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Corresponding author:
Deepthi S Nair

ABSTRACT

Water audit aims to counter the depleting water resources and ill usage of water by identification of the problems, leak points, losses, wastage and giving suggestions to minimize the same. For this purpose water meters were installed at different locations. Water meter indicates the measured value of water usage at that particular location. At the same time estimated value of water usage is calculated by using the standards specified by WHO. A comparison of the measured and estimated values was done to get the losses. The results depicted a bulk of water wasted by leaks or real losses and over usage of water at most of the distribution points. Methods like inspection, replacement and repairs of corroded pipes and ill fittings were suggested. Generating awareness to limit wastage of water at households and hostels were also suggested.

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INTRODUCTION

Water audit is an effective management tool for minimizing losses, optimizing various uses and thus enabling considerable conservation of water not in irrigation sector alone but in other sectors of water use such as domestic, power industrial etc. Water audit determines the amount of water lost from a distribution system due to leakage and other reasons such as theft, unauthorized or illegal withdrawals from the systems and the cost of such losses to the utility. Comprehensive audits can give the utility a detailed profile of the water supply system and water users, allowing easier management of resources and improved reliability. It is an important step towards water conservation and, if linked with a leak detection plan, can save the utility a significant amount of money and time. Conducting a water audit in a campus of an agricultural institute is of extreme importance and use, where proper and efficient use of natural resources like soil and water are of prime importance.

A water audit in the campus of Kelappaji College of Agricultural Engineering and Technology shall help prevent unnecessary wastage of water in the campus premises, ensure efficient use of the source, which is the precious ground water and provide a good knowledge of water supply system in the campus. The location of college is in Tavanur, Kerala. Though being one of the highest rainfall receiving states of India (about 3000 mm), Kerala still faces per capita acute shortage of water due to reasons like high population rise, inefficient use of surface water, water contamination and over usage of groundwater.

Thus, it becomes extremely helpful and useful to conduct a water audit in the college campus, to generate effective results. The campus relies on groundwater usage as primary source of water. Thus a water audit will help conserve the groundwater by effectively using the amount available and analyze the wastage and the cause of wastage in the staff and student dormitories and the academic building and other uses.

MATERIALS AND METHODS

Source evaluation: It involves analyzing the differenttypes of sources of water available and the amount of supply, these sources are giving to the distribution line. For the college campus, there are a total of four wells available which supply water across the distribution line. There is an open well which operates throughout the year in all seasons, and three bore-wells, which primarily operate only during the summer season and remains inactive for most of the year.

Measurement of source discharge: The open well water was pumped directly into the big overhead tank near the ladies' hostel. The discharge was found out with the help of float in the tank attached to a rope, the level difference was measured with the help of a scale which indicates the loss or gain in the level of water in the tank. The area of the water tank was found out from the records in the Engineering Divisionof the college. The level difference was noted down for a particular time period for afew days during pumping and no pumping, which indicated the supply and usage, and only during usage respectively.

Analysis of the distribution system: The main receivers in the distribution system were canteen, ladies' hostel, men's hostel, Krishi Vigyan Kendra (KVK), the Precision Farming Development Centre (PFDC), polyhouses in farm, staff quarters and other residential quarters. The locations were selected on the basis of; Ease of meter installation, Maximization of distribution area covered by the meter, Alterations in water pressure caused by installation, Non feasibility of other methods than metering.

Metering of the selected distribution points: Metering of the selected distribution points served as an effective discharge measuring system. There were a total of six 15mm, single jet meters installed.

Calculation of the actual water supply and use: The main supply was calculated by measuring the fluctuations in supply of the main overhead tank during times of pumping and no pumping. The difference between the two gave the discharge of main pump into the overhead tank. The calculation of actual amount of water used at various distribution points was done with the help of meter readings, depth calculation method or by estimation of water usage with reference to the meter readings and compatibility of locations and conditions. The meter readings were taken at the interval of 24 hours, at 5 pm for one month. The ratio between the consecutive day readings and the duration .i.e. 24 hours gave the value of discharge.

Calculation of per capita and total water requirement: The per capita water requirement was calculated with the help of set standards by WHO, for domestic use and using estimated values for irrigation purposes and dairy. The total water requirements were obtained by multiplying the number of people in the distribution point, with the per capita water requirement for domestic purposes. For irrigation purposes, the total water requirement was obtained by multiplying the area of irrigation with the water requirement per area of the distribution point. Average amount of water required for irrigation by drip systems in rain shelters and shade housewas found out to be 1.5 mm per day on an average.

For garden use, it was taken as 2 mm per day. For the farm dairy, average water requirement per animal was found out to be 135 liters per day, including the drinking and washing purpose. Thus, the ideal water requirementfor the campus was found out and acomparison was made between the actualwater usage, ideal water requirement and the amount of water supplied.

RESULTS AND DISCUSSION

Calculation of the main supply: Average level difference in the Overheadtank between 11 pm and 4.30 am (in 5.5 hours) = 60 cm
Average level difference in the OH tank in 1 hr = 10.9 cm

Radius of the tank = 3.3 m
Hence the discharge from the tank = Leveldifference x Area of tank $= 0.109 \times 3.14 \times 3.3^2$
$= 3.73 m^3/hr = 3727.0$ *l*/hr

Hence the discharge from the tank in 5.5 hrs (11 pm to 4.30 am) = 20500 *l* From 11 pm to 4.30 am there will be less usage, so 70-80% of 20500 lpd canbe accounted as losses from the OH tank. If this loss occurs throughout the day = 89448 lpd x 0.75 = 67086 *l* will be lost.

OH tank level reading at 7.30 am (when pumping was stopped) = 22 cm

OH tank level reading at 9 am (just before the next pumping was started) = 60 cm Level difference in 1.5 hr = 38 cm

Therefore level difference in 1 hr = 25.33 cm

Hence usage from the tank in 1 hr = 0.25 x 3.14 x 3.32= 8.5486 m^3/hr. If this usage occurs for 18 hrs a day, the water used per day = 153875 *l*/day

Calculation of discharge in men's hostel water tanks

No. of tanks= 4
Radius of the tank = 65cm
Area of the tank = 3.14 x 0.652 =1.327m2
Depth difference in first tank in1hr = (56-8) = 48 cm

Hence the discharge from the tank in 1 hr = 0. 63696 m3/hr = 636.96 l/hr
Depth difference in second tank in 1 hr =(60-10) = 50 cm
Discharge from the second tank in 1 hr = 1.327 x 0.50 =663.5 l/hr
Depth difference in third tank in 1 hr = (55-9) = 46 cm
Discharge from the third tank = 610.42 l/hr
Depth difference in fourth tank = (62-14) =48 cm
Discharge from the fourth tank in 1 hr= 636.96 *l*/hr
Total discharge from 4 tanks in one day = 2,547.84 x 24 = 61148.16 *l*/day.

Estimation of water requirement

Number of Inmates of Men's Hostel = 101
Total Average Water Requirement in litre per day for Men's Hostel = 101 x 114= 11514 *l*

Table 3.1 Per capita water requirement as per WHO

Litre per capita per day (lpcd) minimum, maximum and averagewaterrequirement as per World Health Organization (WHO) -			
Type of Usage	Minimum waterrequirement (lpcd)	Maximum waterrequirement (lpcd)	Average waterrequirement (lpcd)
Drinking	2	8	5
Cooking	2	6	4
Bathing	8	32	20
Sanitation	30	50	40
Washing of clothes	10	30	20
Washing of utensils	15	35	25
Average Per Capita Water Requirement Per Day (lpcd)			114
Minimum Per Capita Water Requirement Per Day (lpcd)			67
Maximum Per Capita Water Requirement Per Day (lpcd)			161

Table 3.2 Water meter readings taken from different locations

Date	Canteen	Duplex	Quarters	Farm Nursery	PFDC	KVK
28-Dec	23783	4556	347	19712	10898	45324
29-Dec	25927	5441	1056	22305	11663	45328
30-Dec	27428	6780	1356	24704	12961	52672
31-Dec	29768	7596	2119	26841	14589	54100
01-Jan	33111	10961	2295	30509	16325	55051
02-Jan	33235	13897	2807	33147	16910	59000
03-Jan	36214	16280	3538	36701	17400	62564
04-Jan	38181	18290	3927	40362	19174	67394
05-Jan	43479	20143	4220	42303	19765	77965
06-Jan	45470	23152	4510	45850	21325	79904
07-Jan	49131	25074	4780	48350	22441	79915
08-Jan	50163	27497	5240	49456	22600	85445
09-Jan	51426	30145	5526	50420	23045	89564
10-Jan	53790	32501	5856	55237	23777	92585
11-Jan	58164	34924	6203	59874	24676	96442
12-Jan	59832	35469	6685	62584	25369	98457
13-Jan	61112	36485	6954	64935	26800	99468
14-Jan	62178	38678	7124	66789	28058	108081
15-Jan	64582	40123	7356	69874	29784	109569
16-Jan	67032	41820	7756	72896	30189	112894
17-Jan	71367	42362	8123	74659	30985	116594
18-Jan	75968	43659	8457	78819	31418	119865
19-Jan	78820	45365	8745	81459	32164	121524
20-Jan	80457	49875	9023	84562	33896	131456
21-Jan	82850	53663	9375	l88915	35032	139420
22-Jan	87340	56367	9734	91199	35613	139427
23-Jan	92111	58284	10187	94567	36258	149242
24-Jan	97636	60252	10492	97935	36917	150862

Table 3.3 Comparison of measured and estimated values at different locations

LOCATION	MEASURED VALUE (lpd)	ESTIMATEDVALUE (lpd)
CANTEEN	3487.00	3400.00
DUPLEX	16138.93	6840.00
APARTMENT	6744.85	6156.00
FARM NURSERY	3377.40	3212.95
PFDC NURSERY	1318.46	685.00
KVK	5387.92	1412.47

Table 3.5 Comparison of discharge of water from overhead tank and its usage at different locations

SOURCE	DISCHARGE (lpd)	DISTRIBUTIONPOINTS (lpd)	DISCHARGE (lpd)
OverheadTank	153875	CANTEEN	3487.00
		DUPLEX	16138.00
		APARTMENT	6744.85
		FARM NURSERY	3377.40
		PFDC NURSERY	1318.46
		MH	61148.40
		KVK	5387.92
		ACADEMICBLOCK	8055.00
TOTAL	153875	TOTAL	105656.63

Calculation of discharge in ladies hostel water tanks

No. of tanks= 2

Area of tank= 22.5 m^2

Depth difference in first tank in 1 hr = (110-88) = 22 cm

Discharge from the tank in 1 hr = 22.5 x 0.22 = 4.95m^3/hr = 4950 *l*/hr

Depth difference in second tank in 1 hr= (108-84) =24 cm

Discharge from the tank in 1 hr = 5400 *l*/hr

Total discharge from the 2 tanks in one day = (4950 x 24) + (5400 x 24) = 248400 lpd

Estimation of water requirement

No. of inmates in LH = 198
Average per capita water requirement per day = 114 *l*
Total Average Water Requirement in litre per day for Ladies' Hostel = 198 x 114= 22572 *l*

In canteen, the measured value from water meter reading is 3487 *l*/day but estimated is 3400 *l*/day. Therefore there is an excess usage or loss 87 *l*/day from the canteen. Whereas in the staff duplex, a large variation around 9298.93 *l*/day is seen. This implies that there is a greater loss of water or more usage than what is estimated in the duplex. In the case of apartment, not much of a difference is found and there is only a difference of588.85 *l*/day. But in farm nursery, the water wastage is 164.45 *l*/day. In PFDC nursery and KVK the water loss were 633.46 and 3975.45 *l*/day respectively when compared to the estimated water requirement.

Academic Block: Average water supply to the academic block based on per capita water requirement. Average water requirement per day per person according to WHO = 22.5 *l*

No. of people utilizing the academic block water supply per day= 350. Average estimated water requirement in the academic block per day = 22.5 x 350 = 7,875 *l*.

No. of Engg. Division staff = 8

Average estimated water requirement at Engg. Division per day = 22.5 x 8 = 180 *l*

Total water requirement = 7875+180 = 8055 lpd

COMPARISON AND SUGGESTIONS

This implies that a huge quantity of water is being lost every day or is unauthorized utilized by people for different purposes. Suggestions for minimizing water loss include Inspection of complete water distribution system to detect leakage, replacement of old fittings and joints., replacement of corroded pipes, Close the outflow valves of the OH tank during the night time, recycling the waste water for further use and spread awareness among workers, staff and students.

CONCLUSION

The difference between the supply from overhead tank and sum of the usages at the distribution points, which amounted to 50000 *l* for one day, approximately. The comparison between the water required and the actual water used was also made at every distribution point. The water used was more in every distribution point. The canteen used about 100 *l* of more water per day. The water supplied to quarters exceeded the requirement by a whopping 9000 *l*. The apartments used an extra water of 600 *l* per day. The farm supply exceeded the requirement by 150 *l*, while the excess was 600 *l* and 4000 *l* for PFDC and KVK respectively. The results depicted a bulk of water wasted by leaks or real losses and over usage of water at most of the distribution points. Methods like inspection, replacement and repairs of corroded pipes and ill fittings were suggested.

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