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EFFECTIVE UTILIZATION , STORAGE & TREATMENT OF RAIN WATER FOR DRINKING PURPOSE AT ADYPU CAMPUS

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Abstract- At the rate in which Indian population is increasing, it is said that India will surely replace China from its number 1 position of most densely populated country of the world after 2030. These will lead to high rate of consumption of most valuable natural resource Water" resulting in augmentation of pressures on the permitted freshwater resources. Ancient method of damming river and transporting water to urban area has its own issues of eternal troubles of social and political. In order to conserve and meet the daily demand of water requirement, Rain water harvesting is one of the best methods fulfilling the requirements. The technical aspects of this project are rainwater harvesting collected from rooftop which is considered to be the catchment area from SOET building of ADYPU campus. First of all, required data are collected that is catchment area & hydrological rainfall data. Water harvesting potential for the SOET building was calculated, and the tank capacity with suitable design is being considered. Volume of tank has been calculated with most appropriate method of estimation. Apt location of tank on the basis of hydrological analysis and Geographic Information System analysis was done in the campus.

Keywords-*Catchment area , Rainwater harvesting, Hydrological rainfall.*

I INTRODUCTION

Though majority of the earth's surface is filled with water, the actual water available for human consumption Is limited. Water is essential to all life forms on earth - human, animal and vegetation. It is therefore important that adequate supplies of water developed to sustain such life. Development of water supplies should, however, be undertaken in such a way as to preserve the hydrological balance and the biological functions of our ecosystems. As land pressure rises, cities are growing vertical and in countryside more forest areas are encroached and being used for agriculture. In India the small farmers depend on Monsoon where rainfall is from June to October and much of the precious water is soon lost as surface runoff. While irrigation may be the most obvious response to drought, it has proved costly and can only benefit a fortunate few. There is now increasing interest in the low cost alternative generally referred to as 'Rain Water Harvesting' (RWH).Water harvesting is the activity of direct collection of rainwater, which can be stored for direct use or can be recharged into the groundwater. Water harvesting is the collection of runoff for productive purposes. Rain is the first form of water that we know in the hydrological cycle, hence is a primary source of water.

1.1 Objective

The objectives of this research can be summarized briefly as follows:

- To study the rainwater harvesting potential of ADYPU campus to conserve, preserve and use rainwater.
- To identify suitable design for harvesting system.
- To use most efficient and effective rooftop rainwater harvesting system at ADYPU campus.
- To study the treatment and filter unit to be applied.
- To augment ground water table and arrest ground water decline.
- To beneficiate water quality in aquifers.

Following IS code will be used for designing of water tank.

- IS 3370(2009)
- IS 456-2000

II. LITERATURE REVIEW

The basic objective of this chapter is to get inside into the previous findings so that it will help to know the gap in earlier studies and to justify the research problem selected by me for the study purpose. The extensive literature review was carried out by referring standard journals, reference books, I.S. Code and conference proceeding. The major work carried out by different researchers is summarized below:

2.1. Water scarcity : A major concern for citizens - Dr Bidyut jyoti gogoi – International journal of civil engineering & technology (IJCIET) – (2019)

The researcher wants to understand the gravity of water scarcity in India with a focus on north east India, the water sources utilized by inhabitants and the groundwater condition. The study is based on secondary research which probes on the literature published by various agencies. The data from the census 2011 is used for analysis and understanding the sources of water used by the people of the north east region.

2.2 "Design of Rooftop Rainwater Harvesting in Nimgaon village - Mr. Chetan Bangale, Mr. Chandradeep Patil – International research journal of engineering & technology (IRJET) (May 2018)

The technical aspect of this project is rainwater harvesting collected from rooftop which is considered to be catchment areas Nimgaon Tarfe Mhalunge, Junnar, Pune. The aim of this project is to collect and store that water and utilize the water by providing proper means of filtration. The project starts by collecting some important researches on rainwater harvesting and studied them.

2.3 "Roof - Top rainwater harvesting system for official / multistoried building with reference to malda districts, WB - Dr. Suman Panigrahi – International journal of engineering research & application (IJERA) (January 2017)

The rain water harvesting is the simple collection or storing of water for the domestic or the agriculture purpose. The method of rain water harvesting has been into practice since ancient times. The method is simple and cost effective too. Malda district of West Bengal is badly affected by Arsenic contamination in ground water. The present study finds its usefulness in developing awareness towards judicious use of water among masses and efficient ways to harvest roof top rain water resources at institutional / multistoried buildings in Malda district. A total of 10 residential building, 10 school building,7 official building and 10 multistoried building (including flat) covering English bazar Municipality, Kaliachak, Gazole and Ratua block were selected to evaluate the potential towards rooftop rainwater harvesting.

III. PROBLEM STATEMENT

- There is scarcity of water in all state of India due to increased need for water results in lower ground water tables . Many piped water supply systems fail. The use of rainwater is a useful alternative.
- If all the rainwater from the roof is collected and given necessary treatment can be utilized for various purpose as per our convience.
- Due to water obtained from the rainfall, It reduces the load from local water distribution system.
- So we decided to use rainwater for drinking only.

IV. METHODOLOGY

The primary data was taken from a Literature survey targeted by web searches and review of e-books, manuals, codes and -journal papers. After review the problem statement is defined and the selected frame models are taken up for detail study and analysis purposes.

There are two method of rainwater harvesting-

- Surface runoff harvesting
- Roof top rainwater harvesting

We have adopted roof top rainwater harvesting

4.1. Roof top rainwater harvesting

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the groundwater level of the area.

- Data collection (measurement of catchment area, average rainfall in pune, no of students in college, water drunk by each person averagely)
- Data analysis (Analysis of the collected data)
- Design of water tank & treatment method used in it. Calculation of water tank & other things (each and everything is calculated and fixed)
- Measurement sheet is written to finalise all the item. Rate analysis of listed items
- Conclusion of project. Limitation of design project Future scope of design project.

4.1.1. Components of roof top rainwater harvesting

1. **Delivery system gutters**: Channels all around the edge of a sloping roof to collect and transport rainwater to the storage tank. Gutters can semi-circular or rectangular. Gutters are made up of locally available material plain galvanized iron sheet. Semi-circular gutters of PVC material can be readily prepared by cutting those pipes into two equal semi-circular channels. The size of the gutter should be according to the flow during the highest intensity rain. The way in which gutters are fixed depends on the house; it is possible to fix iron or timber into the walls, but for houses having wider eaves, some methods of attachment to the rafter is necessary.

- **Conduits:** Conduits are pipelines or drains that carry rainwater from the catchment or rooftop area to the harvesting system. Conduits can be of any material like polyvinyl chloride (PVC) or galvanized iron (GI), materials that are commonly available.

2. Filtration methods

- Charcoal water filter : A simple charcoal filter can be made in a drum or an earthen pot. The filter is made of gravel, sand and charcoal, all of which are easily available.
- Sand filter : Sand filter have commonly available sand as filter media. Sand filter are easy and inexpensive to construct. These filter can be employed for the treatment of water to effectively remove turbidity (suspended particles like silt and clay), colour and microorganisms.

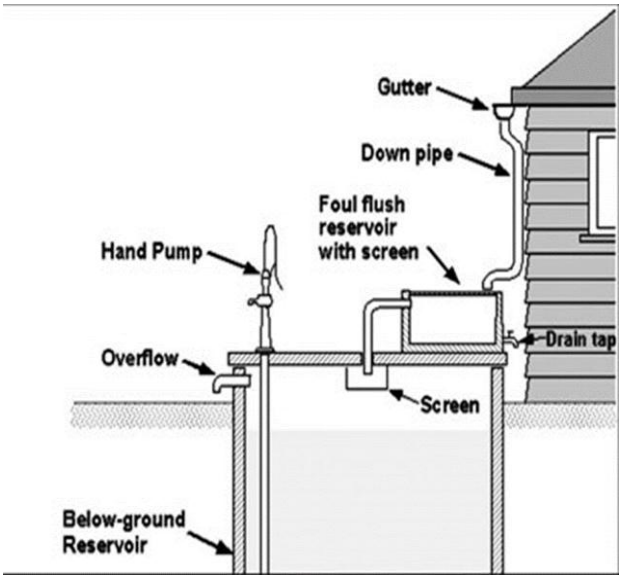

Fig1.,COMPONENT IN RWH

4.2.Study area

In this paper design of RWH System for the proposed location at ADYPU campus. Therefore as much as possible we have included and considered SOET terrace only.

4.3. RAINFALL DATA COLLECTION

The latitude of Pune, Maharashtra, India is 18.516726, and the longitude is 73.856255. Pune, Maharashtra, India is located at India country in the Cities place category with the gps coordinates of 18° 31' 0.2136" N and 73° 51' 22.5180" E.

Rainfall/ Precipitation in Pune, India

- Pune accepts on average 741 mm (29.2 in) of rainfall per year, or 61.8 mm (2.4 in) per month.
- The driest weather is in January when an average of 0 mm (0 in) of rainfall (precipitation) occurs.
- The wettest weather is in July when an average of 163 mm (6.4 in) of rainfall (precipitation) occurs.

Precipitation Table

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Precipitation mm (in)	0 (0)	3 (0.1)	2 (0.1)	11 (0.4)	40 (1.6)	138 (5.4)	163 (6.4)	129 (5.1)	155 (6.1)	68 (2.7)	28 (1.1)	4 (0.2)	741 (29.2)
Precipitation Litres/m² (Gallons/ft²)	0 (0)	3 (0.07)	2 (0.05)	11 (0.27)	40 (0.98)	138 (3.38)	163 (4)	129 (3.16)	155 (3.8)	68 (1.67)	28 (0.69)	4 (0.1)	741 (18.17)

The Pune lies on 562m above sea level Pune is influenced by the local steppe climate. In Pune, there is little rainfall throughout the year. According to Köppen and Geiger, this climate is classified as BSh. The average annual temperature in Pune is 25.0 °C | 77.0 °F. The annual rainfall is 741 mm | 29.2 inch.

4.4.DIMENSION FIXATION

- I have considered water drunk by one student is 3 liters per day
- Catchment Area of our terrace is - 10,000 sq. feet means 929.3-meter sq. = 1000 meter sq.
- Number of students I have considered is - 2000 no's
- Total water required per day – 3 x 2000 = 6000 liters

After FOS the tank should have 20% more than required water, therefore total water required per day is = 7200 liters/day

- Rainfall in Pune - 100 mm max i.e. - 59 mm 18 mm mini (take average)
- 59 mm average rainfall per month, therefore (59 x 12= 708 mm per year - 0.708m)
- Runoff coefficient hilly land 10 - 30 % (0.72 coefficient)
- Now apply formula – Q = C x I x A (C – constant, I – intensity, A – area)
- Therefore Q = 0.72 X 708 X 1000 = 1.6030794E-5 m3/s
- Now convert m3/s to liter /hour
- So 1.6030794E-5 m3/s = 57.7108584 litre/hour
- So 57.70 liters/hour = 60 liters /hour
- Tank capacity based on rainy season therefore June to September but sometimes it starts earlier and ends late. so I considered rainy season of 5 months.
- 30 X 5 = 150 DAYS
- 10 hours taken into consideration for one day discontinuously rain is falling therefore, 60 X 10 = 600 liters/day
- 600 X 150 = 90,000 liters assume add 30% FOS in main quantity than1,17,000 liters approx. 1,50,000 liters.
- Total water can be stored but it is average amount it can be increase if intensity if rain increase.
- Working days of college = 252 days
- 7200 X 252 = 18,14,400 liters
- 1,50,000/18,14,400 X 100 = 10%
- So 10 % of drinking water can be generated by rain water.
- Tank size – I have decide = (5 x 5 x 3) m
- 5 x 5 x 3 = 75 meter cube = 75,000 liters ,
- I will make 3 tanks of same size so it can store 2,25,000 liters totally .Percolation pit – (60 liters /hour) water runoff is calculated
- Therefore (0.75 x 0.75 x 1.5) m = 0.8437-meter cube = 843.7 liters capacity of percolation tank.

4.4.1. MEASUREMENT OF PERCOLATION TANK

All detailed measurement of percolation tank are explained below :

4.4.2.MEASUREMENT OF WATER TANK

All detailed measurement of water tank are explained below

SR NO	DISCRIPTION	QUANTITY
1.	Excavation	480.76 m3
2.	Pcc work all over the trench (80 mm – 3inch thickness) Cement – 4204 kg (50kg bags – 85 nos) Sand – 4.186 m3 Gravel – 8.37 m3	10.988 m3
3.	Shuttering	4000 sq feet
4.	Steel fixation 20mm - 1420.8 m - 3508.08 kg 10 mm - 5928.0 m - 3659 kg 8 mm - 2499,8 m - 987.48 kg 12mm - 3094.56 m – 2750.64 kg	10905.24 kg Total steel required
5.	Rcc work 16 - 17 vehicles required (1 rmc vehicle carry 7 - 8.5 m3)	111.09 m3
6.	Internal plaster	180 m2
7.	Water proofing coat 15-20 mm thick with mortor	3.1 m3

4.4.3. Total quantities

All detailed total quantity are explained below :

SR NO	DISCRIPTION	QUANTITY
1.	Total work excavation work (3.5 m height deep)	480.76 m3
2.	Shuttering work	4015 sq feet
3.	Total steel required 10905.24 + 15% FOS (wastage)	13,000 kg
4.	Pcc work	11.078 m3
2.	Rcc work (M 20 concrete used) I consider 7m3 in one vehicle so ill required 16 – 17 vehicles	111.09 m3
6.	Plaster work	189 m2

V. RESULTS & DISCUSSION

Total cost of project	
1. Material cost	15,34,064.75/-
2. Labour cost	6,90,329.137 /-
3. Miscellaneous work cost	1,00,000/-
Total cost required for the project	23,24,393.887 /-

5.1. Results

- Total cost required for the project is 23,24,394 ≈ 23,50,000/-
- Capacity of each tank is = 75,000 litres
- I made 3 tank therefore = 2,25,000 litres total storage capacity
- Minimum life of project is 50 years
- Size of each tank is 5 x 5 x 3 m
- Size of percolation tank is 0.75 x 0.75 x 1.5 m
- Under ground water tank pit size is 20.2 x 6.8 m & 3.5 m height of trench
- No of students in college is 2000 nos .
- Terrace catchment area considered is 1000 m2

VI. CONCLUSION

- The rain water will comes at terrace frist (catchment area)
- From terrace (catchment area) water will pass from multiple mess . By this water will get filtered .
- Then at ground floor water is passed from percolation tank .
- There all germs and bacteria will killed and water will be pured . Percolation tank will act as sand filter .
- After that water will pass to store in different tanks .
- As per requirement water is again sent at terrace by pumping, at terrace there is one more clean water tank from that tank the water is sent to coolers at each floor, and at every water cooler there is separate RO filter by this process not a single bacterium will sustain in water.
- The final product now is ready for drinking purpose and it can pass highly configure tests which are used to rate water quality commercially.
- This project life calculated that is least 50 years & its construction cost can recover in less than 1 month of span, the main benefit of this project is it will be workable for whole years because our college is in pune, here rain occur in nov – dec also rather than rainy season.

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