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Rooftop Rainwater Harvesting – a case study

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Abstract: *The rain water harvesting is a simple and cost effective method of collecting or storing rain water by using scientific techniques. Rains are main source of water, and if Rain water is harvested, the scarcity of water can be eliminated. In this is paper, survey record of 2 different rooftops of buildings in college campus in Asongaon, dist. Thane is considered as a case study. For which annual water demand for whole campus is calculated and rooftop rainwater harvesting technique is applied.*
Keywords: *Rain water harvesting, Cost effective, Rooftop, Annual water demand, etc.*

I. Introduction

Rain water harvesting is one of the most effective methods of water management and water conservation. It is the term used to indicate the collection and storage of rain water used for human, animals and plant needs. It involves collection and storage of rain water at surface or in sub-surface aquifer, before it is lost as surface run off. The augmented resource can be harvested in the time of need.

Artificial recharge to ground water is a process by which the ground water reservoir is augmented at a rate exceeding that under natural conditions of replenishment. The collected water is stored and pumped in a separate pipe distribution. This is a very useful method for a developing country like India in reducing the cost and the demand of treated water and also economizing the treatment plants operation, maintenance and distribution costs.

1.1 Need-

- To overcome the inadequacy of surface water to meet our demands.
- To arrest decline in ground water levels.
- To enhance availability of ground water at specific place and time and utilize rain water for sustainable development.
- To increase infiltration of rain water in the subsoil this has decreased drastically in urban areas due to paving of open area.
- To improve ground water quality by dilution.
- To increase agriculture production.
- Improve ecology of the area by increase in vegetation cover etc.

1.2 Advantages-

- The cost of recharge to sub-surface reservoir is lower than surface reservoirs.
- The aquifer serves as a distribution system also.
- No land is wasted for storage purpose and no population displacement is involved.
- Ground water is not directly exposed to evaporation and pollution.
- Storing water under ground is environment friendly.
- It increases the productivity of aquifer.
- It reduces flood hazards.
- Effects rise in ground water levels.
- Mitigates effects of drought.
- Reduces soil erosion.

II. Science of Water Harvesting

In scientific terms, water harvesting refers to collection and storage of rainwater and also other activities aimed at harvesting surface and groundwater, prevention of losses through evaporation and seepage

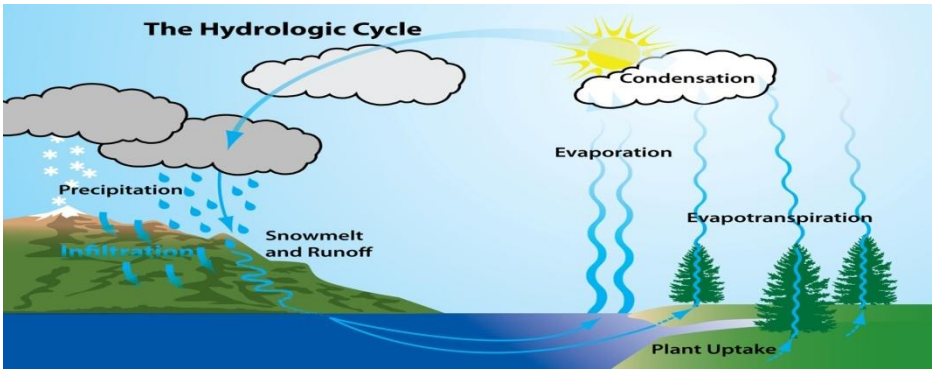
and all other hydrological studies and engineering inventions, aimed at conservation and efficient utilization of the limited water endowment of physiographic unit such as a watershed.

Rain is a primary source of water for all of us. There are two main techniques of rainwater harvesting:

2.1 Storage of rainwater on surface for future use.

- Recharge to groundwater.
- Directly collected rainwater can be stored for direct use or can be recharged into the groundwater.

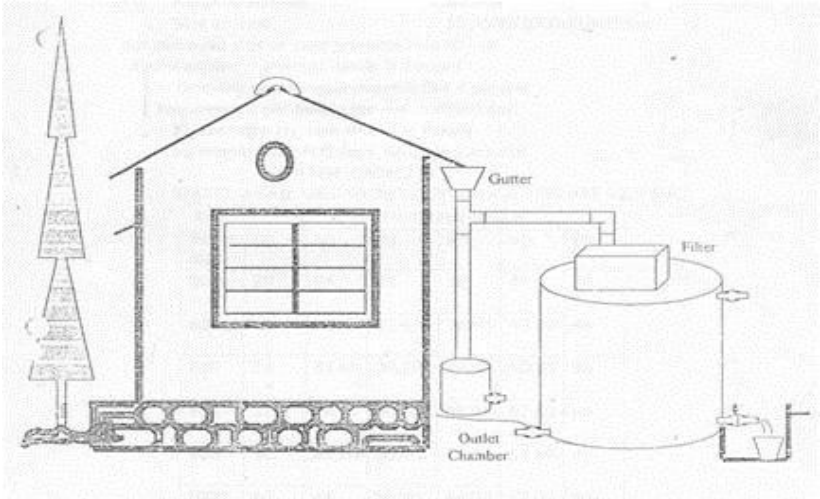
All the secondary sources of water like rivers, lakes and groundwater are entirely dependent on rain as a primary source.



Hydrological Cycle

The term water harvesting is understood to encompass a wide range of concerns, including rainwater collection with both rooftop and surface runoff catchment, rainwater storage in small tanks and large-scale artificial reservoirs, groundwater recharge, and also protection of water sources against pollution.

The objective of water harvesting in India differs between urban and rural areas. In urban areas, emphasis is put on increasing groundwater recharge and managing storm water. On the other hand, in rural areas securing water is more crucial. There the aim is to provide water for drinking and farming, especially for life-saving irrigation, and to increase groundwater recharge.



Components of Rainwater harvesting

The system mainly constitutes of following sub components:

1. Catchments- The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be terrace, courtyard, or paved or unpaved open ground.

2. Transportation- Rainwater from rooftop should be carried through down take water pipes or drains to harvesting system.

3. Coarse Mesh- To provide passage for debris at the roof.

4. Gutters- All around the edge of a sloping roof Channels are provided to collect and transport rainwater to the storage tank. Gutters need to be supported so they do not sag or fall off when loaded with water. The way in

which gutters are fixed depends on the construction of the house; it is possible to fix iron or timber brackets into the walls, but for houses having wider eaves, some method of attachment to the rafters is necessary.

5. Conduits-Conduits are pipelines or drains that carry rainwater from the catchment or rooftop area to the harvesting system.

6. First Flush-First flush is a device used to flush off the water received in first shower. The first shower of rains needs to be flushed-off to avoid contaminating storable/rechargeable water by the probable contaminants of the atmosphere and the catchment roof.

7. Filter-There is always some skepticism regarding Roof Top Rainwater harvesting since doubts are raised that rainwater may contaminate groundwater.

III. Case Study

To apply the concept of rain water harvesting to existing building, we have selected the campus of SHIVAJIRAO S. JONDHALE COLLEGE OF ENGINEERING AND TECHNOLOGY, Asangaon, Dist. Thane. In this campus there are total 4 buildings, in which two buildings having two wings and rest of are single wings. For this buildings Water demand calculations and quantity of Rain water harvesting is calculated only for two building by considering working days, holidays, population, and terrace areas of each building.

3.1 Water demand calculation.

Table no.1 Engineering Degree Building (Wing-A & Wing-B)

SRNO	ITEMS	AVAILABLE POPULA-TION	TOTAL WORKING DURATION (DAY'S)	NON WORKING DURATION (DAY'S)	NET WORKING DURATION (DAY'S)	WATER DEMAND LITRES/ HEAD/ DAY	TOTAL WATER DEMAND LITRES/ HEAD/ DAY
1	Semester (lectures)	1600	210	56	154	25	6160000
2	Examina-tion	1600	90	24	66	5	528000
3	Vacations (For students)	160	60	16	44	5	35200
Total water demand for Engg. degree building in one academic year (In liters)							6723200
Total water demand for Engg. degree building per week (In liters)							129292
Total water demand for Engg. degree building per day (In liters)							18420

Table No. 2- Polytechnic Building (Wing-A & Wing-B)

SRNO	ITEMS	AVAILABLE POPULA-TION	TOTAL WORKING DURATION (DAY'S)	NON WORKING DURATION (DAY'S)	NET WORKING DURATION (DAY'S)	WATER DEMAND LITRES/ HEAD/ DAY	TOTAL WATER DEMAND LITRES/ HEAD/ DAY
1	Semester (lectures)	1984	210	56	154	25	7638400
2	Examina-tion	1984	90	24	66	5	654720
3	Vacations (For students)	60	60	16	44	5	13200
Total water demand for Polytechnic building in one academic year (In liters) =							8306320
Total water demand for Polytechnic building per week (In liters) =							159737
Total water demand for Polytechnic building per day(In liters) =							22757

As per above water demand calculations,
Total water demand for a academic year = **15029520 Liters**
Total water demand for per week = **289029 Litres**
Total water demand for per day = **41177 Liters**

Table no.3 Calculations for Water Harvesting Potential-

SR.NO	BUILDING DESCRIPTION	CATCHMENT (TERRECE) AREA (SQ.M)	AVARAGE HEIGHT OF RAINFALL (M)	RUNOFF COFFI-CIENT	COLLECTED VOLUME OF RAINFALL (CU.M)	COLLECTED VOLUME OF RAINFALL (LITRES)
1	Engineering Degree Building (Wing-A & Wing-B)	6780.25	2.2	0.9	13424.9	13424895
2	Polytechnic Building (Wing-A & Wing-B)	2784.01	2.2	0.9	5512.3	5512340

As per above water potential calculations,
Total collected volume of rainfall in year=**18937235 Liters**

Assuming 20% losses in collection=**3787447itres**
Total water available for harvesting in year =**15149788Litres**

IV. Conclusions

As per the calculation, we can save more water than demand.
Cost of installation- An individual house of an average area of 300-500sq. m having average cost 30,000/-35,000/-in apartment this cost will be less, as it is divided.

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