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Rain Water Harvesting - A Case Study

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Abstract: ***Water scarcity is serious problem throughout the world for both urban and rural community. Rainwater harvesting is defined as process of augmenting the natural infiltration of rainwater or surface water into the ground by some artificial methods. 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 recharge pit etc. This method is less expensive and very effective and if implemented properly helps in augmenting the ground water level of the area. The methods of rooftop rainwater harvesting are recharge pit, recharge trenches, storage tanks, abandoned dug wells, bore well. The present study tells us 2,87,536 litres of water harvested per year in four numbers of underground storage tanks.***

Keywords: Catchment, drain pipe, filter, storage tank

1. Introduction

Water scarcity is serious problem throughout the world for both urban and rural community. Urbanization, industrial development and increase in agricultural field and production has resulted in overexploitation of groundwater and surface water resources and resultant deterioration in water quality. Water is required for human being from birth to death i.e. drinking, bathing, washing, irrigation and industrial requirement. Most of our fresh water is obtained from rainfall. Rain replenishes water in pond, lakes, tanks and reservoirs and seeps into the ground and is stored as groundwater.

Rainwater Harvesting

Rainwater harvesting is defined as process of augmenting the natural infiltration of rainwater or surface water into the ground by some artificial methods. To collect and store the rainwater which fall on the rooftop of buildings. The rainwater can be stored in tanks or diverted into dugwell or borewells, recharge pit and recharge well trenches.

2. Objective

1) To overcome the inadequacy of surface water to meet our demands.
2) To arrest decline in ground water levels.
3) To enhance availability of ground water at specific place and time and utilize rain water for sustainable development.
4) To store the water on surface or underground.
5) Assessment of quantity of rainwater harvested in four numbers of underground storage tanks.

3. Study Area

The study is carried out for Deluxe hostel (Girls) of Shri Neminath Bramhacharya Ashram (Jain Gurukul), Neminagar, Chandwad, District Nasik,Maharashtra, which lies north west part of Maharashtra. Chandwad in Maharashtra has historical and religious custom. Chandwad Talika comes under drought prone area. In major parts of the Chandwad town, declining water level trends have been observed in almost entire Chandwad taluka. These areas also coincide with deeper premonsoon water levels in the range of 12 to 20 m below ground level.

Important Statistics

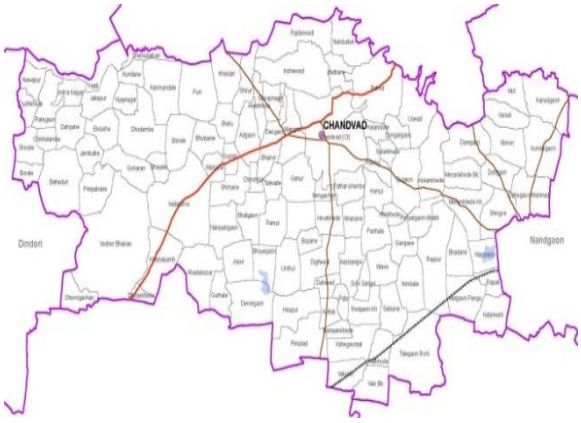
1) Capacity of hostel -750
2) Existing occupancy of hostel-750 students and staff
3) Average annual Rainfall of Chandwad- 518.3mm

Major Groundwater Problems and Issues

The study area comes under drought prone zone. In major parts of the Chandwad taluka, declining water level trends have been observed. These areas also coincide with deeper premonsoon water levels in the range of 9 to 18 m below ground level.

Location of Maharashtra


Location Map of Nasik district



Location Map of Chandwad

Location of 01 underground water storage tank Showing drain pipe

4. Methodology

Components of Rainwater Harvesting System. The system mainly constitutes of following sub components:

1) Catchment
2) Transportation
3) First flush
4) Filter
5) Storage tank

4.1 Catchment

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be a terrace, courtyard, paved or unpaved open ground. The terrace may be flat RCC/stone roof or sloping roof. Therefore the catchment is the area which actually contributes rainwater to the harvesting system.

4.2 Transportation

Rainwater from rooftop should be carried through water pipes or drains to storage/harvesting system. Water pipes should be UV resistant PVC pipes of required capacity. Water from sloping roofs could be caught through gutters and down take pipe. At terraces, mouth of the each drain should have wire mesh to restrict floating material.

4.3 First Two Flush

First two flush is a device used to flush off the water received in first shower. The first two 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. It will also help in cleaning of silt and other material deposited on roof during dry seasons.

4.3 Filter

Filters are used for treatment of water to effectively remove turbidity, colour and microorganisms. After first two flushing of rainfall, water should pass through filters. There are different types of filters in practice, but basic function is to purify water.

Types of Filters:

4.3.1 Sand gravel filter

These are commonly used filters, constructed by brick masonry and filleted by pebbles, gravel, and sand. Each layer should be separated by wire mesh.

4.3.2 Charcoal Filter

Charcoal filter can be made in-situ or in a drum. Pebbles, gravel, sand and charcoal should fill in the drum or chamber. Each layer should be separated by wire mesh. Thin layer of charcoal is used to absorb odor if any.

4.3.3 PVC- Pipe filter

This filter can be made by PVC pipe of 1 to 1.20 m length; diameter of pipe depends on the area of roof. Six inches diameter pipe is enough for a 1500 sq. ft. roof and 8 inches diameter pipe should be used for roofs more than 1500 sq. ft. Pipe is divided into three compartments by wire mesh. Each compartment should be filled with gravel and sand alternatively. A layer of charcoal could also be inserted between two layers. Both ends of filter should have reduce of required size to connect inlet and outlet. This filter could be placed horizontally or vertically in the system.

4.3.4 Sponge Filter

It is a simple filter made from PVC drum having a layer of sponge in the middle of drum. It is the easiest and cheapest form filter, suitable for residential units.

5. Methods of Roof top Rainwater Harvesting

1) Storage tanks
2) Recharge trenches
3) Trench with Recharge Well
4) Recharge pit
5) Abandoned Dug wells
6) Bore well

a) Proposed Storage Tank

The four numbers of underground storage tanks are to be constructed at Deluxe hostel(Girls). The dimension of storage tank is length10.0m, breadth- 5.0m. and height 1.50 m.

Table 1.1: Information about Proposed Rainwater harvesting

S. No.	Roof top(terrace) area of Building	Assessment of Reliable Annual Rainfall [It is 80% of avg. annual Rainfall]	Runoff coefficient of Building in Central India
1	1277.43m^2	0.41464 mm	0.95

Table 1.2: Dimensions of proposed storage tank

Sr. No.	Length [m]	Breadth [m]	Height [m]	Remark
1	10.0	5.0	1.5	Epoxy coating will be provided on all 06 sides of each tank

Table1.3: The Cost of underground water tank and other information

S. No.	Total nos. of tanks	Cost of each tank Rs. including 18% G.S.T.	Cost of Total 04 nos. of tanks	Cost of constn. Per litre
1	04	7,13,192/-	28,52,768/-	9.51/-

6. Discussion

There are 07 number of drain pipes identified having diameter of 6 inches.

Water demand per day = Quantity of water required X No. of students including staff
= 135 X 750
= 1,01,250. Litres

Water demand in a year
= 1,01,250 X 304
= 3,07,80,000 litres.

Assessment of Quantity of rainwater harvested
Quantity of water available on terrace = Runoff coefficient X Reliable annual Rainfall X Roof top area
= 0.95 X 0.41464 X 1277.43m²
= 503.1898964m³
= 503.1898964 X 1000
= 5,03,189.89 litres
Quantity of water available on terrace is 5,03,189.89 litres / 7 nos. of drain pipes.
The quantity of water available from 01 drain pipe for 1 storage tank in a year = 71,884.27 litres.
The total quantity of water to be stored in 4 numbers of tanks = 71884.27 X 4 = 2,87,537.08 litres.

7. Conclusion

1) The 71,884.27 litres of rainwater to be stored in 1 underground tank.
2) The total 2,87,537.08 litres of rainwater to be stored in 4 numbers of underground storage tanks.
3) The total cost of 1 tank is estimated Rs. 7,13,192/-only .
4) The total cost of 4 numbers of underground storage tanks are estimated Rs. 28,52,768/-.

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