

An Overview on the Ground Water Recharge by Rain Water Harvesting

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Abstract—Every year in Monsoon our nature gives us our life in the form of rainfall but little part of it is stored in the soil, dams, lakes etc. and remaining water gets wasted in rivers. At the time of rainfall we didn't even recognize that running water but when the water level of our well's goes down then we think on it but at that time we can't do anything so we face water scarcity, only mean to say "When the well is dry, we learn the value of water". Now days we are reaching to the heights of development and covering all the earth surface by cement and concrete material but we are forgetting that we are closing the route of water to get entered in the earth's surface and it directly affects on our ground water level and we need face water scarcity. If this condition goes on then our new generation will face a high water problems for drinking and Agriculture purpose. Till about thirty years back, the areas around our homes and offices used to be unpaved and the rain falling on these areas would percolate into the soil and remain there for being drawn through shallow open wells. With the proliferation of flat complexes, not only have these areas been averted and percolation of rainwater into the soil almost totally stopped, the quantity of water drawn from the soil below has increased manifold. Consequently open wells and not - so - deep bore wells started drying up. The reason is that no sincere attempt is made to replenish the ground water table with rainwater during the monsoon. The Rainwater harvesting is the simple collection or storing of water through scientific techniques from the areas where the rain falls. It involves utilization of rain water for the domestic or the agricultural purpose. The method of rain water harvesting has been into practice since ancient times. It is as far the best possible way to conserve water and awaken the society towards the importance of water. The method is simple and cost effective too. It is especially beneficial in the areas, which faces the scarcity of water. People usually make complaints about the lack of water. During the monsoons lots of water goes waste into the gutters. And this is when Rain water Harvesting proves to be the most effective way to conserve water. We can collect the rain water into the tanks and prevent it from flowing into drains and being wasted. It is practiced on the large scale in the metropolitan cities. Rain water harvesting comprises of storage of water and water recharging through the technical process.

1. INTRODUCTION

In ancient times the water cycle was properly going on but due to the interruption of mankind the Ground water level is going down and down. It was difficult to imagine few years before that you will require to buy drinking water but now we need to buy it everywhere we travel. Today Fresh water is a scarce resource, and it is being felt the world over. More than 2000 million people would live under conditions of high water stress by the year 2050, according to the UNEP (United Nations Environment Programme), which warns water could prove to be a limiting factor for development in a number of regions in the world. About one-fifth of the world's population lacks access to safe drinking water and with the present consumption patterns; two out of every three persons on the earth would live in water-stressed conditions by 2025. Around one-third of the world population now lives in countries with moderate to high water stress—where water consumption is more than 10% of the renewable fresh water supply, said the GEO (Global Environment Outlook) 2000, the UNEP's millennium report. Actually water harvesting means a system that collects rainwater from where it falls doesn't allow it to drain out. It may include water that is collected within the boundaries of a property, from roofs, agriculture land and surrounding surfaces. Various ways of harvesting water:

- Capturing run-off from rooftops of Home / Offices.
- Capturing run-off from local catchments
- Capturing seasonal flood water from local streams
- Conserving water through watershed management.

Advantages of rainwater harvesting

Homemade or Cheap material can be used for the construction of Container and Tanks. It has low maintenance costs and requirements also. Collected rainwater can be consumed with proper treatment. It provides supply of safe water close to homes, agricultural field and other areas

Technique of Rain Water Harvesting:

A rainwater harvesting system comprises components of various stages - transporting rainwater through pipes or drains, filtration, and storage in tanks for reuse or recharge.

Roof Rain Water harvesting:

Rain water harvesting involves following components:

Catchment Area / Roof: Surface upon which rain falls it may be Roof, Agriculture field, Ground Surface.

Pipe line/ Gutters: Transport channels from Catchment to Storage. The size of the pipe is depend on the rainfall rate.

| S. N | Diameter of pipe in (mm) | Average rate of rainfall (mm/hr) | | | | | |
|------|--------------------------|----------------------------------|------|------|------|------|------|
| | | 50 | 75 | 100 | 125 | 150 | 200 |
| | | Roof Area (Sq.m.) | | | | | |
| 1. | 50 | 13.4 | 8.9 | 6.6 | 5.3 | 4.4 | 3.3 |
| 2. | 65 | 24.1 | 16.0 | 12.0 | 9.6 | 8.0 | 6.0 |
| 3. | 75 | 40.8 | 27.0 | 20.4 | 16.3 | 13.6 | 10.2 |
| 4. | 100 | 85.4 | 57.0 | 42.7 | 34.2 | 28.5 | 21.3 |
| 5. | 125 | - | - | 80.5 | 64.3 | 53.5 | 40.0 |
| 6. | 150 | - | - | - | - | 83.6 | 62.7 |
| 7. | 50 | 13.4 | 8.9 | 6.6 | 5.3 | 4.4 | 3.3 |

Filters

Charcoal Filter

A proportionate layer of Gravel + Charcoal + Sand + Gravel , are used as filter.

Sand Filter

Easy to construct and inexpensive. Filters can be employed for treatment of water to effectively remove turbidity (suspended particles like silt and clay), colour and microorganisms. In a simple sand filter that can be constructed domestically, the top layer comprises coarse sand followed by a 5-10 mm layer of gravel followed by another 5-25 cm layer of gravel.

Storage tanks: Storage tank for the Harvested rain water and it is usable in Domestic, Animal and for Gardening purpose. For designing the optimum capacity of the tank following aspect have to be considered:

- Average Annual rainfall
- Size of the catchment
- Drinking water requirements

Suppose the system has to be designed for meeting the meeting drinking water requirement of a 5 member family living in a building with a roof top area of 100 Sqm. Average annual rainfall is 600 mm. Daily drinking & cooking water requirement / person is 10 Liters .

We shall first calculate the maximum amount of rainfall that can be harvested from roof top.

Area of roof top = 100 Sqm.

Average annual rainfall = 600 mm.

Co-efficient for evaporation, spoilage, flush = 0.80 (Constant)

Runoff co-efficient = 0.85 (Constant)

100 sq m roof top= (Area of roof top)x(Annual rainfall in meter)x(Runoff Co-efficient)x(Co-efficient of evaporation)

$$= 100 \times 0.60 \times 0.85 \times 0.80$$

$$= 40.8 \text{ cum}$$

$$= 40,800 \text{ liters}$$

The tank capacity has to be designed for dry period i.e. the period between two consecutive rainy seasons. With monsoon extending over 4 months the dry season is of 245 days has been considered.

Drinking water requirement for family for dry season 245 x 5 x 10 = 12,250 litres.

As a safety factor , the water tank should be built 20 % larger than required i.e. 14700 litres = (1.2 x 12,250)

This tank meet the basic meet drinking & cooking water requirement of a 5member family for the day period.

Over flow connection: There should be a overflow connection for avoiding overflow condition during excess/heavy rainfall. Overflow connection should be opened on a Canal or in a Sloppy region of the particular area.

Cost of installation

Estimated average cost of installing a Water Harvesting System for :

An individual house of average area of 300-500 m2, the average cost will be around Rs. 20,000-25,000. A recharge well will be constructed near the existing bore well. The roof water through PVC pipe will be diverted to recharge well.

An apartment building, the cost will be less since the many people will share the cost. More over in apartments there are separate storm water drains, which join the MCD drains in the main road. Here along with recharge well, recharge trench and percolation pits can be constructed. The cost will be around 60 to 70 thousand

A colony, the cost will be much less. For instance, around 36 recharge wells were installed at the cost of 8 lakh, which is around Rs 500-600 per house. In many colonies storm water drains are present but it is difficult to isolate them from sewage drains because there has been violation of the drainage master plan. Also, these drains are not properly maintained. Hence, care needs to be taken while using storm water for water harvesting. Rooftop harvesting is preferred because the silt load is less. In storm water drain the silt load is high and generally the municipality does not maintain the storm drains properly.

An institution with campus, the cost was around 4 lac. Here two recharge wells and three trenches cum percolation pits were constructed.

Field's Runoff water Harvesting

In rainfall we lose our fertile soil every year with runoff water, that's why Indian soils are losing their productivity day by day. There are few techniques to conserve the fertile layer of soil. In a field the water flows to the direction of slope, as the slope get sloppier the water flows with a high speed but water takes the upper layer of soil along with it. To conserve the soil and water we need to take it in preferred direction by making proper channels. But how???

Now a day's tube well's are getting use a Major source of water in India due to the low cost for implementation bur sometimes it is not able to meet the need of Any Agriculture field , House or any Industry.

Due to the lowering of ground water level a direct effect is shown on tube wells. Tube well's are the Best medium for the "Ground water Recharge" due to their long depth.

Water Harvesting potential = Rainfall (mm) X Collection efficiency

Example

Consider a building with a flat terrace area of 100m². The average annual rainfall in Nagpur is approximately 1,110 mm (44 in) in simple terms; this means if the terrace floor is assumed impermeable, and all the rain that falls on it is retained without evaporation, then, in one year, there will be rainwater on the terrace floor to a height of 1,110mm.

Area of the plot = 100 m²

Height of annual rainfall = 1.11 m {1,110 mm (44 in)}

Volume of rainfall over the plot = Area of plot X Height of rainfall

= 100 m² X 1.11 m

= 111 m³ (1, 11,000 litres)

Assuming that only 50 percent of the total rainfall is effectively harvested,

Volume of water harvested = 55,500 litres

This volume is about twice the annual drinking water requirement of a 5-member family. The

Average daily drinking water requirement per person is 10 litres³.

Case Study:

In thane (Maharashtra) in the year 2003 Rain water Harvesting project was done in VIKAS Complex B wing for five buildings 9 storage each. They had dug 3 bore wells and a pit of 6ft X 4ft pit. So total cost was around Rs. 300000 including the piping. Due to this they have 5000 liters of output in the morning and evening. So total 10000 liters per day. So the total 5 building supply per day was 50000 per day. For instant

from the year 2003 they receive 50000 liters of water nonstop every day.

Conclusion:

Sustaining and recharging the groundwater along with judicious use of the limited fresh water resources is the need of the hour. One of the most logical steps towards this goal would be acknowledging the importance of rainwater harvesting. It can be concluded from above findings that rainwater, if conserved and utilized using the rainwater harvesting technology, can be an effective tool of replenishing ground water resources.

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