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A REVIEW ON RAIN WATER HARVESTING TECHNIQUES

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ABSTRACT

Our most valuable natural resource is water, which most of us take for granted. We are more conscious of the significance of water to our existence, as well as its scarcity. Humans need water for a variety of reasons. Water covers the majority of the earth's surface (about 71 percent). Only 1% of the total volume of water accessible on the earth's surface is fresh but also drinkable water, with 97 percent being salty water, 2% being ice & glaciers, as well as 1% being fresh and potable water. In terms of average annual rainfall, India is one of the world's wealthiest countries. It's hard to believe, but Cherapunji, which receives 11000 mm of yearly rainfall, nevertheless has a severe drinking water deficit. Though India's average annual rainfall is 1170 mm, it may be as low as 100 mm in the deserts of western India. As a result, rainwater collecting techniques must be used to meet the water demand.

KEYWORDS: *Rain Water Harvesting, Filter, Rainfall.*

INTRODUCTION

India is classified as a developing country. Water demand is rising day by day as a result of quicker industrialization or urbanization, as well as a rise in population. India's rainfall is erratic at best. The majority of it is concentrated over a few month of the year, and the majority of it flows away, resulting in inadequate ground water recharge. There is a substantial geographical mismatch in the available water resources and the demand for water. As a result, it is becoming essential to transport water from farther away, increasing the expense of transportation. It's also a frequent observation that the subterranean water table is dwindling as a result of unregulated water extraction. Maharashtra is a state in India that spans 307,713 square kilometers and has a population of 82 million people. Over half of the population lives in rural areas where water scarcity is a concern. Due to decreasing water tables, poor water quality, and expensive operating and maintenance costs, traditional sources such as open wells, bore wells, and piped water supplies have failed. Every year, a large quantity of water that falls on terraces is lost, and it all ends up in storm water drains. Rainwater collecting has the potential to help solve water shortages[1]

Why Collect Rainwater?

1. Rainwater harvesting is the process of collecting rainwater directly from the sky and recharging it in the ground to prevent groundwater levels from falling, or storing it in a surface or subterranean water tank. Because of the following reasons, it is best suited in today's setting.This is the most scientific and cost-effective method for replenishing groundwater and rejuvenating the water table.
2. It improves the quality of water for irrigation and household usage.
3. It produces water that is naturally soft and free of dissolved minerals, salts, arsenic, and other heavy metals.
4. It may be done at both an individual and a communal level. This manner, we may be self-sufficient in terms of household water needs, rather than relying on government or other local bodies to take action.
5. Collecting rainfall as it falls out of the sky seems to be a brilliant idea in places where drinkable water is in short supply. Rainwater has relatively few contaminants, making it one of the cleanest sources of water accessible. Where traditional water delivery systems have failed to satisfy people's requirements, rain water collecting technologies may be used.

Rainwater harvesting is the collection as well as storage of rainwater for reuse on site while preventing runoff. We may collect it in a variety of locations, such as a river or a roof, and divert it to a well, bore well, shaft, reservoir using percolation, aquifer, and so on. Shown in figure 1. We utilize it for garden watering, animal drinking, irrigation, and residential usage after appropriate treatment. It is one of the earliest and most basic ways of home water self-supply[2].

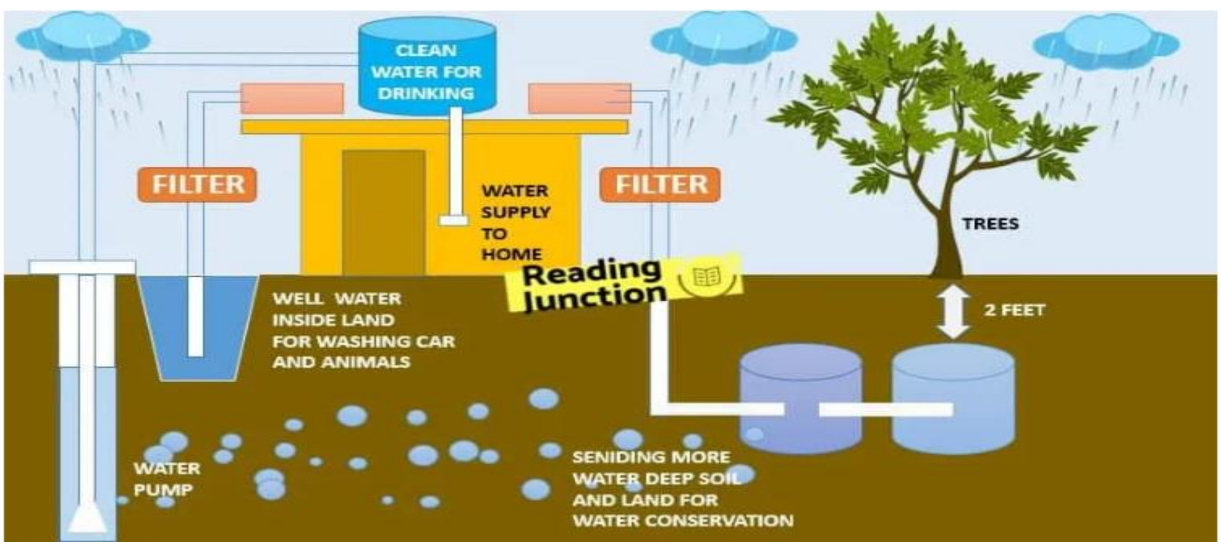

Figure 1: Illustrate Diagram Showing The How We Utilize The Rain Water[3]**.**

Rainwater Harvesting Structure Components:

There will be three fundamental components to all rainwater collecting structures:

1. The catchment area, or the surface area used to collect rainfall.

2. A collection device for collecting or retaining water, such as tanks, cisterns, or percolation pits.

3. Conveyance system, which is a network of pipelines or percolation pits that transports water from a catchment region to a collecting device.

Rainwater Harvesting Methods:

Rainwater harvesting may be accomplished in a variety of ways. In the following paragraphs, some of the most significant techniques will be described one by one.

1. Rainwater harvesting for the Dewas Roof Water Filter:

The city of Dewas is situated in the state of Madhya Pradesh. This roof water filter was originally used in Dewas, which is why it is known as the Dewas roof water filter. Figure 1 depicts the Dewar roof water filter in detail. Sand pebbles of various sizes may be used to make it. T1 and T2 are the two caps included in this set. Always keep caps T1 and T2 closed. T2 is for backwashing the filter on a regular basis, while T1 is for backwash drainage. Rainwater enters via little stones about 6 mm in size. Cap T2 is used to provide medication for water purification. For the first two days of the rainy season, do not recharge rainwater. Maintain a clean roof at all times, particularly during the rainy season, to ensure that the quality of rainwater dropping on the roof does not degrade. This roof filter costs about Rs 800 without the connecting pipe. This filter can percolate approximately 50 m^3 of water from a 100 square meter roof area in Maharashtra under normal conditions[4].

2. Rainwater harvesting for recharging:

Pit Total rainwater falling on the open plot may be recharged by digging a recharge pit if there is no well or bore well in the home. This hole may be used to collect water that runs off the plot. This pit may be filled 10 to 15 times in a single monsoon, recharging up to 200 m3 of water. This technique works well in areas where the soil permeability is high. The pit's capacity may be increased to 10 m3. Water percolation on the order of 200 m3 per year is feasible via this hole. The price of this construction is estimated to be about Rs. 7000.

Rainwater is directed to a 6 m × 6 m x 1.5 m water collecting tank near the well, and a tiny filter pit of 1.5 m x 1.5 m x 0.6 m is dug at the bottom of the main pit. Otherwise, depending on the availability of space around the well, an appropriate pit may be dug. the intricacies of agricultural runoff recharging an open well. The filter pit is filled in three equal layers with sand, pebbles bigger than 20 mm, and pebbles/boulders larger than 75 mm pebbles, and is linked to the well via a 150 mm diameter PVC pipe that extends 0.5 to 1.0 m into the well. The water tank's volume is estimated to be about 50 m3. This structure allows for the percolation of 400 to 1000 m3 of water per year[5].

Bore well recharging with rainwater:

Around the bore well casing pipe, a six-meter-diameter collection pit with a 1.5-meter depth is dug. At the bottom of the big pit, a small hole of 1.5 m × 1.5 m x 0.6 m depth is dug and filled with filter material. After the initial layer of 75 mm stones, a 75 mm diameter PVC pipe is attached to the bore well casing pipe. The pipe is linked to an inverted elbow[6].

Recharging Trench with Roof Water

The collected roof water may be replenished using a recharge trench. Throughout the year, water may be replenished by utilizing spent water or rainfall. This recharge trench may be filled many times depending on the amount of utilized or rain water available. This technique works well in areas where the soil permeability is high. The trench's capacity may be increased to 20 m3. Water percolation on the order of 100 to 200 m3 per year is feasible via this hole. The cost of this construction may be in the region of Rs. 5000.

Recharging Tube Wells with Surface Rainwater

Depleted aquifers are immediately replenished with surface rainfall through a recharge tube well, resulting in rapid recharge and minimal evaporation and transit losses. The following is a diagram of a typical recharge tube well:

- A 50 cm diameter borehole is bored to the required depth.
- A 20 cm diameter casing, i.e. the bore well's outer pipe, is constructed with slotted perforated portions to protect against aquifers.
- The recharge tube well should be about 30 meters below the water table in the region.
- A compressor is used to fill the annular area between the borehole and the pipe with excellent gravel and develop it until it produces clear water. A filter mechanism is supplied at the top to prevent suspended particles from entering the recharge tube well.
- Small spherical boulders, stone chips, and sand are layered in this pit, with boulders at the bottom & sand at the top.
- In this hole, the top one meter of the casing component is filled with sand. To prevent suspended debris from entering the well, the top of the casing pipe is fitted with a cover that is approximately 600 mm below the sand bed.
- The air vent is supplied via a 75 mm diameter pipe linked to the recharge tube well inside the top 600 mm using a reducer tee of dimensions 200 mm x 75 mm in order to escape the air present in the casing component during the percolation process of floodwater. After that, the air releasing pipe is extended to one of the banks, where the vent is built.

The majority of suspended contaminants are filtered out of flood water when it passes through the sand. The second sand filter, which surrounds the well's slotted portion at the top, keeps any residual suspended material out. Before water enters the well, a coir covering serves as a last protective filter. Due to the placement of a slit at the top, the rate progressively drops. After the wet season, approximately one meter of sandy in the filter bed must be changed every year. Because the level of water is shallow soon after the monsoon as well as development is effective, the well is developed with a compressors once a year, right after the properly stored become empty. When the water is clear during pumping, it may be let on the filtered bed to remove the slit that has collected in the filter bed and into the well that is being built. During the infiltration process, the whole filter bed is cleaned of silt using this technique.

Using Roof Water to collect and Store Water: Tanks Rainwater from the roof surface is drained into storage tanks through gutters. There is a hand moveable gutter connector that may be manually moved to redirect the water out to avoid pollution and dust from flowing into the storage tanks. The rooftop is utilized to gather the trash. Rainwater is transported from the roof top to the storage tanks through guttering, which is often constructed of PVC.

Rain Water Harvesting For Building In Urban and Village Area: A Case Study

For research purposes, a rainwater harvesting system for the annexure building of the Govt. Engineering College, Aurangabad is being explored.

The Government Engineering College is situated in Maharashtra's area. Aurangabad receives about 700 mm of rain each year on average. The city has a population of more than ten lakh people. The town is now supplied with water by the Municipal Corporation of Aurangabad. Water is delivered to the town on alternate days due to the capacity of the water treatment facility. The institution requires approximately 350 m3 of water each day. The town's ground water level has been reduced in recent years. Rainwater must be conserved not only in the city but also in the outlying regions of Aurangabad. The significance of rainwater collecting cannot be overstated. It is recommended that each community collect roof water from at least 10 hoses. It is also planned to collect rainwater from the roof of this institute's Annex building. All civil engineering students from this institution would have a role model if this roof top rain water collecting system is built. These students will witness the system and be inspired to build roof water collecting systems elsewhere in the future. The following is a preliminary estimate[7].

LITURATURE REVIEW

Water shortage is a significant issue in many developing nations, according to B. Helmreich et al. Rainwater may be used as a source of drinking water depending on the amount of precipitation. Furthermore, effective management may help alleviate water and food shortages in some of these areas. Rainwater harvesting (RWH) is a technique for efficiently collecting surface runoff during rainy seasons. RWH systems should be based on local skills, materials, and equipment to support such technologies. Rainwater harvesting may then be utilized for rain fed agriculture or domestic water supply. Rainwater, however, may be contaminated with germs and dangerous substances, necessitating treatment before to use. Pollution may be reduced using slow sand filtering and solar technologies. Membrane technology may potentially be used to disinfect drinking water to make it safe to drink[8].

Olanike Olowoiya Aladenola and colleagues investigated Rainwater collecting is one of the most promising methods for augmenting limited surface and subsurface water resources in places where the current water delivery infrastructure is insufficient to satisfy demand. Rainwater collecting is one of the measures that may be taken to mitigate the effects of climate change on water supply. Rainwater collection is excellent in Abeokuta due to the city's average annual rainfall of 1,156 mm. The intra-annual range was 0.7 to 1.0, whereas the inter-annual variability was 0.2. Each home may collect 74.0 m3 of rainwater each year. Annual water consumption for flushing, washing, and flushing was estimated to be 21.6, 29.4, and 21.6 m3 correspondingly.

Except in November, December, January, and February, harvested rainwater in Abeokuta can meet family monthly water needs for WC flushing and washing. If there is enough storage, the extra rainfall saved in September and October will enough to replace the short fall in the dry months. The opportunity for water conservation is greatest between June and September, which are the two rainiest months in Southwest Nigeria[9].

F.A. Memon and colleagues investigated the Rainwater collection is becoming a more important component of the toolbox for sustainable water management. Despite a slew of research examining the viability of deploying rainwater harvesting (RWH) systems in specific situations, there is still a substantial vacuum in information in terms of comprehensive empirical performance evaluations. Domestic networks have been studied in the literature to a limited extent, notably in the United Kingdom, but there are few contemporary longitudinal studies of larger non-domestic systems. There are very few research that compare estimated and actual performance. The findings of a longitudinal empirical performance evaluation of a nondomestic RWH system in a UK office building are presented in this article. It also compares actual performance to predicted performance using two British Standards Institute-recommended methods: The Intermediate (basic calculations) and Detailed (simulation-based) Approaches. The real over-sized tank and the smaller optimized tank had capital payback times of 11 and 6 years, respectively, based on estimated cost reductions. To conduct whole-life cost assessments, however, additional comprehensive cost data on maintenance and operation is needed. These results suggest that office-scale RWH systems may save significant amounts of water and money. They also stress the significance of data monitoring and the need for a shift to Detailed Approaches (especially in the UK) to (a) reduce storage tank oversizing and (b) increase confidence in RWH system performance[10].

DISCUSSION

Our most valuable natural resource is water, which most of us take for granted. We are more conscious of the significance of water to our existence, as well as its scarcity. Humans need water for a variety of reasons. Water covers the majority of the earth's crust (about 71 percent). Only 1% of the total amount of water accessible on the earth's surface is fresh and drinkable water, with 97 percent being salty water, 2% being ice and glaciers, and 1% being fresh and potable water. It is the duty of both government and individuals to collect every drop of water that falls on the earth's surface. To do so, each individual must collect raindrops that fall on his roof, plot, or farm as well as recharge them underground. In this research, two examples of roof top water collecting for urban and rural areas were examined. Rainwater harvesting on the roofs of other buildings may be done in the same way. In reality, rainwater collecting methods can satisfy the basic drinking and cooking requirements of every village or hamlet in India.

CONCLUSION

Water is a necessary component of life. Everyone understands that if we do not harness existing water sources and utilize them wisely and with care, water scarcity will become a major issue. Regardless of rapid advancements in all areas of science, there is no replacement for water. As a result, different water collection methods are required. It is the duty of both government and individuals to collect every drop of water that falls on the earth's surface. To do so, each individual must collect raindrops that fall on his roof, plot, or farm and recharge them underground. In this research, two examples of roof top water collecting for urban and rural areas were examined. Rainwater harvesting on the roofs of other buildings may be done in the same way. In reality, rainwater collecting methods can satisfy the basic drinking and cooking requirements of every village or hamlet in India**.**

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