THE STUDY OF ARTIFICIAL GROUNDWATER RECHARGE BY THE ROOF TOP RAIN WATER HARVESTING SYSTEM AT MAHAVEER INSTITUTE OF SCIENCE AND TECHNOLOGY, CHADRAYANGUTTA, HYDERABAD.TELANGANA

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ABSTRACT

The method of rain water harvesting has been into practice since ancient times. The method is simple and cost effective too. 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 /multi-storied buildings. But, with the increasing population (human and animal) and with diseases related to water, it has become incessant practice to provide safe drinking water. In continuation to this above practice, a project on Roof top rain water harvesting structure with a study was implemented to provide safe drinking water to the community and to identify the best possible technology with respect to the specific region. In this paper, it covers the components that can be taken under the rain water harvesting structure, geographical area, availability of the water quantity, its quality and water demand. It also covered about the design parameters in which the flexibility and community management can promote and accordingly the design was modified.

The main conclusion of this paper was the acceptance of the community about the technology, its design considerations and about the promotion of this technology in the water scarcity and pollutant regions. Finally, the study revealed that, it requires awareness about the utilization of direct rain water with a primary filter unit, challenge of social and community acceptance, maintenance and time involvement for effective utilization and the water available at the door step with an amount of Rs. 1.30/- per one liter. This research paper belongs to the site of Mahaveer institute of science and technology, Chadrayangutta, Hyderabad , Telangana. Due to construction of roof top rain water harvesting at study area, there is an increase in static water level in dug well from 8mtrs to 12mtrs and bore well from 40mtrs to 45 mtrs.

Keywords: Artificial ground water recharge, rooftop,rain water harvesting

1. INTRODUCTION

Rainwater harvesting and utilization systems have been in place for centuries. Rainwater harvesting refers to the practice of collecting rainwater from rooftops, land surfaces, or rock catchments and storing it for human use. Water collection vessels are typically located within accessible distances of their place of use. Our case study investigates increase of groundwater recharge .For this analysis we have checked both dugwell and borewell static water level of Mahaveer institute of science and technology of site area of hostel building.

Archaeological evidence of rainwater capture in China suggests that such systems were in place as many as 6,000 years ago. Evidence of roof catchment systems and other technologies demonstrate that in ancient Rome, villas and whole cities were designed to take advantage of rainwater as the principal water source for drinking and domestic purposes. In 2000 BC, tanks to store hillside runoff for domestic and agricultural purposes allowed habitation and cultivation in the Negev desert in Philistine, an area receiving as little as 100mm of rain annually. The earliest evidence of rainwater harvesting technology in Africa comes from northern Egypt, where tanks between 200 and 2,000 m3 have been used for at least 2,000 years—many remain operational today. In Southeast Asia, rainwater collection practices trace back to Thailand, where for 2,000 years small-scale collection from eaves troughs and simple gutters into jars and pots has been commonplace. In South Asia, such practices date back to the 9th or 10th Century, where evidence of rooftop rainwater collection and simple brush dam constructions can be found. The world's largest rainwater tank is likely the Yerebatan Sarayi in Istanbul, Turkey, constructed during the rule of Caesar Justinian (AD 527565). The tank measures 140m x 70m with a capacity of 80,000 m3.

WHY RAINWATER HARVESTING?

According to US EPA the present amounts of available surface and groundwater supplies will not be able to meet future water demand. Water conservation and development of alternative water supplies is necessary to meet our growing demand for fresh water.

Rainwater harvesting is an alternative water supply approach that captures, diverts, and stores rainwater for later use and is available to anyone. Captured rainwater is often used as a potable water source. Another popular use is for attracting and providing water for wildlife, pets, and livestock. Rainwater is also used for landscaping because the water is free of salts and other harmful minerals. Rainwater does not have to be treated with chemicals that have residual influences for most non-potable uses.

Implementing rainwater harvesting techniques directly benefits our country and state by reducing the demand on the municipal and public water supply, along with reducing run-off, erosion, and contamination of surface water (Porter et al., 2008).

According to the United States Environmental Protection Agency (US EPA), 50 to 70 percent of total household water (sanitized water that meets US EPA regulations for Public Drinking Water) is used for landscape irrigation and other outdoor activities (US EPA, 2009). Replacing that water with captured rainwater for landscaping efficiently uses this valuable resource, reduces personal water bills, and decreases the overall demand on public water supplies.

Rainwater harvesting can also help prevent flooding and erosion, turning storm water problems into water supply assets by slowing runoff and allowing it to soak into the ground. This also helps decrease the contamination of surface water with sediments, fertilizers, and pesticides in rainfall runoff.

OBJECTIVES OF THE STUDY

Develop design guidelines of rooftop water harvesting systems Increase the use of rainwater harvesting from rooftops

Reduce the stress on groundwater by providing alternative rooftop water harvesting methods as renewable water resource

Increasing of urbanization, modern agricultural practices three crops for year is causing lot of stress on ground water

Because of pavements, roads, construction areas ground water is un able to sink, because of this roof top rain water harvesting system plays major role in ground water recharge.

SCOPE OF WORK

1. Estimate the total rainfall in the study area (where rooftop or rainwater harvesting is needed) based on past records; maximize rainwater conservation using landscape and rooftop water harvesting measures; use water for direct applications and groundwater recharge to meet the overall water requirements of the area/utilities.

2. Study the behaviour of existing rainfall discharge capacity, flooding, and water availability in the lean/off-season at the site of water harvesting system and its surrounding environment.

3. Establish water resource planning/water cycle balance, designing appropriate piping systems to collect rooftop water; create a storage facility and establish a recharge process in houses and college hostel building.

(A) Water Spreading and Longitudinal Trenches:

In buildings with large open areas, rooftop runoff can be diverted to soil or garden patches on the premises or into a longitudinal trench/pond without disturbing the beauty of the area. The study team and/or consultants should provide structure designs and cost estimates based on international best practices.

Groundwater recharge through shafts is recommended for steep slopes and deep areas. The consultant should design and produce costs estimate for the shafts.

2.ROOF CATCHMENT

The roof of a hostel building of Mahaveer institute of science and technology is an obvious choice for a catchment installation. To accommodate additional capacity, one can build an open-sided barn—called a rain barn or a pole barn. Barns can be used to store water tanks, pumps, filters, as well as vehicles and tools. Rooftop rainwater systems are popular at the household and community level, as the water can be readily used for domestic purposes. An added advantage is that users own, maintain, and control their systems, reducing reliance on other community members. (See figure (2.2)) Water quality in these systems is related to the roof material, climatic conditions, and the surrounding environmental conditions.

Figure 2 : Roof catchment surface

3. QUALITY OF RAINWATER HARVESTING

ROOFS

Roofs are made from a variety of materials, most of which are suitable as rainwater catchment surfaces, e.g., concrete, concrete tiles, metal sheets, ceramic tiles, rock slate, and Ferro-cement. Roofs made from grass/ reed and potentially toxic materials are unsuitable catchment surfaces. Metal sheet roofs are smooth and are less likely to retain contamination than rougher, concrete tile roofs. In Yemen, concrete, cement mortar, and corrugated galvanized steel sheets are the most common forms of roofing. High levels of metals such as zinc, copper, and lead can be found in rainwater that has come into contact with metal roofs (galvanized with zinc compounds to prevent corrosion) or fittings (lead and copper flashings). Fortunately, zinc has low toxicity, and runoff water from galvanized steel roofs rarely exceeds WHO-permitted zinc levels. However, where metal roofs have been painted, toxic compound leaching can occur. Therefore, paint should be checked for suitability in advance; acrylic-based paints designed for exteriors and roofs in the tropics are recommended. Paints containing lead, chromate, tar/ bitumen, fungicides, or other toxins should be avoided, as they create health risks. After repainting a roof, runoff water from the first rainfall should be prevented from entering the storage tank.

4 .HYDROLOGICAL DATA ANALYSIS

Rainfall quantity (mm/year): The amount of water available to the consumer is a product of the total available rainfall and the catchment surface area. A loss coefficient is often included to allow for evaporation and other losses. The mean annual rainfall data tells us how much rain falls in an average year.

Rainfall is likely the first meteorological element measured by humans. There is evidence that rainfall measurements were taken and records maintained in the fourth century (probably in India).

The following difficulties are encountered in the accurate measurement of rainfall:

- Any suitable device for use as rain gauge extends above the surface of the earth and creates eddy currents, which affect the amount of the catch.
- Wind affects the amount of the catch, and relatively few sites are sufficiently sheltered from wind to minimize the wind effects while remaining sufficiently clear of obstructions to make the site typical of the surrounding area for storms from all directions.
- A measurement of rainfall is never subject to verification by repetition and seldom by duplication.
- The samples constituting the measurements are small compared to the total rainfall over the are

COMPUTATION OF AVERAGE RAINFALL OVER A BASIN

To compute the average rainfall over a catchment area of basin, rainfall is measured with a number of gauges and measuring devices. Hydrologists rely on their experience and knowledge to determine the number of gauges required to measure rainfall in a particular area. Hydrologists also refer to World Meteorological Organization requirements.

In this area we applied Arithmetic average method to compute the average rainfall .

Arithmetic average method

Station No.	Precipitation in mm	Average precipitation [mm]
1	15	
2	19	
3	20	
4	16.6	
5	22	
6	28	P = 120.6/6 = 20.1

Because rain gauges are uniformly distributed over an area and rainfall varies in a regular manner, results of the arithmetic average method are typically satisfactory and in line with the results of other methods. This method is used to measure storm rainfall, and monthly and annual rainfall. Table (5.1) lists the results of rainfall data from six stations using this method, resulting in an average of 20.1mm

RESULTS OF ANALYSIS: - checked static water level of both dug well and bore well with water level indicator.

May – June 2018

Location of bore well	Type of well	Depth of the well	Static water level
Mahaveer institute of science and technology	Dug well	15 m	8m
Mahaveer institute of science and technology	Bore well	150 m	40 m

July– August 2018

Location of bore well	Type of well	Depth of the well	Static water level
Mahaveer institute of science and technology	Dug well	15 m	12m
Mahaveer institute of science and technology	Bore well	150 m	45 m

This case study reveals increase of ground water table in both dug well and bore well in the month of July-August. Due to construction of roof top rain water harvesting, there is increase in static water level of dug well and bore well .

CONCLUSION

Now-a-days, people have been depended on the government system of water supply for getting water for their every need. The present scenario of water management and distribution in the cities has been centralized by the government which has brought a big

gap of community responsibility in water management. It has slowly but regularly finished the old traditional water harvesting system.

Rainwater harvesting is again a new but old and effective technique of collecting rain water during rainy season for future usage purpose. It is being frequently used in various places of India to overcome the problems of lack of water. Rain water harvesting is the good source of ground water recharge in natural way. However, the ground water level is getting less day by day because of the rapid urbanization and cities development at huge level as well as reduction in percolation of the rainwater to the ground. Rainwater harvesting is the way to reduce the use of ground water as well as maintain its level forever in the future. It is of more importance to the drought regions of India and other countries to supply the demands of water for various purposes. Following are mentioned points proving the fact why to harvest rainwater:

It helps in reducing the water supply bills especially to the mahaveer institute of science and technology.

Rainwater recharged to the ground positively affects groundwater quality by diluting fluorides, nitrates and its salinity.

It contains almost neutral pH and zero hardness which makes it more able to be used in homes, industries, institutions and other commercial establishments.

It may reduce the stress of public water supply sources.

Recharge of rainwater to the ground prevents sea-water immersion into the fresh water bodies in the coastal areas.

It helps in controlling urban flooding if people do rainwater harvesting from rooftops

REFRENCES

- Banks, Suzy and Richard Heineken. Rainwater Collection For the Mechanically Challenged, USA.
- Texas Water Development Board in Cooperation with the Center for Maximum Potential Building Systems (1997). Texas Guide to Rainwater Harvesting, 2nd ed., Austin Texas.
- Safe Drinking Water Act (SDWA), Public Law No.93-523, effective Dec. 16, 1974.] Centre for Science and Environment, 2005, “Rainwater Harvesting and Utilization”. An Introductory Guide for Decision-Makers, Tughlakabad Institutional area, New Delhi - 110062, India.
- Ministry of Rural Development, 2004, “Water Harvesting and Artificial Recharge”. Department of Drinking Water Supply, New Delhi, India.
- Dolman, B., Lundquist, k., 2009, “Roof water harvesting for Low Impact Water Supply” featuring the Brazilian Ball Pre-filter system: A case Study for the Water Institute.
- Mosley, L., 2005, “Water Quality of Rainwater Harvesting Systems”. SOPAC, Miscellaneous Report 579.
- Martinson D. B., and Thomas, T.H., 2005, “Quantifying the First-Flush Phenomenon:
- Effects of First-Flush on Water Yield and Quality”, 12th IRCSA conference, New Delhi, India.
- Kishangarh, Vansant Kunj “Technology Profile: Rooftop Rain Water Harvesting Systems”. Development Alternatives, New Delhi, India.
- Ministry of Water Resources, 2000, “A Guide on Artificial Recharge to Groundwater” Central Ground water Board, Ministry of Water Resources,, New Delhi, India
- [14] Ministry of Water Resources 2003 “Rain water Harvesting Techniques to Augment Ground Water”, Central Ground Water Board, Faridabad, India