A CASE STUDY ON ROOFTOP RAIN WATER HARVESTING SYSTEM

Ahmad Elyas Faizi[1], Mr. Rishabh Mahure[2]

[1]*Student, Department of Civil Engineering-, Noida International University*
[2] *Assistant Professor, Department of Civil Engineering-, Noida International University*

Abstract **--** Our earth is a blue planet and 4/5 part of earth surface is covered by water, around 97 % World water quantity is locked in sea/oceans, only 0.3% is available for human consumption. But today this is getting polluted due to human activities like mining, industrialization and population growth has created shortage of drinking water. Rain water harvesting is one of the most ancient and easiest options that can be adopted at urban and rural level efficiently. The aim of this study is to investigate the possibility of using harvested rainwater as a source of drinking water without causing any health and environmental risks. This can be achieved by suitable storage technique, efficient and economical treatment methods. This research paper describes a collaborative and development of affordable technologies for capturing & retaining runoff, roof tops and groundwater using this as a valuable source of water and this can be helpful as a valuable water source in future.

Keywords— Rain water harvesting, roof catchments, rooftop rain water harvesting, water quality, water management, economic benefits, future water demand, etc.

I. INTRODUCTION

Water is a one of the most important resources for surviving of human being as much as food, air, etc, but few attentions are paid for its economical use of this precious resource, the water table is going down abnormally and if the problem is not given a look, then the future generations may have to face scarcity of water. Rainfall is the best source of water and if rain water is harvested, the scarcity of water can be remove. This is the nest solution to overcome water problems where surface water sources are insufficient and inadequate groundwater supply quantitatively and qualitatively. Rain water harvesting system is the process of collecting and storing water for future use. Rooftop rain water harvesting is the technique through which rain water is captured from the roof catchments and stored in reservoirs. Rooftop rain water harvesting is essential for making water available with the best quality for future use. This method is particularly important in old/new structures, hilly areas, urban and coastal areas. The reasons behind are the increasing demand of water due to the increasing of population and extensive use of water, In fact India is blessed with adequate rainfall as a whole, yet there are wide strip of land, dry, less rain and prone area. In many places the quality of groundwater is not good. In such places rainwater harvesting may provide a good lifeline for survival.

The main objective of rooftop rain water harvesting is to make water available for the future use of consumer, Capturing and storing of rain water for use is more than usual important dry areas, hilly areas, Urban and coastal areas, in alluvial areas energy saving for 1m. rise in ground water level is around 0.04 kilo watt per hour.

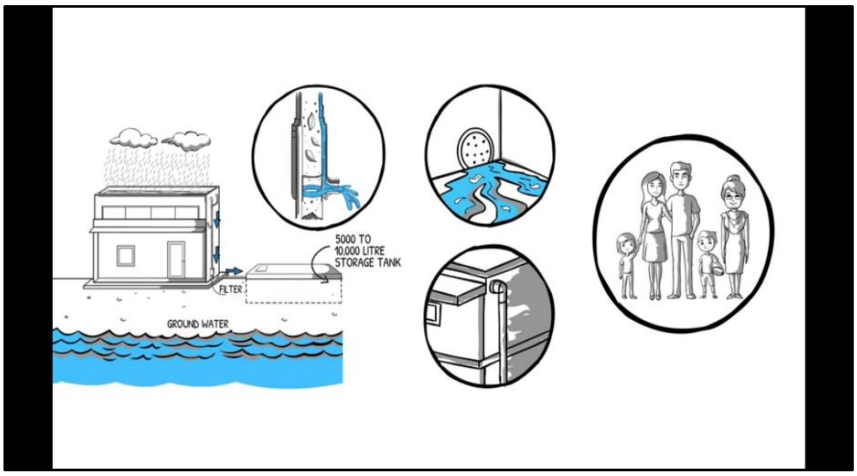

Fig.1 process of harvesting

1.1 NEED FOR RAIN WATER HARVESTING SYSTEM

1. To meet the increasing demand for water.
2. To avoid flooding of roads.
3. To reduce the runoff which chokes storm drains.
4. To augment the ground water storage and control decline of water levels.
5. To reduce ground water pollution.
6. To improve the quality of ground water.
7. To reduce the soil erosion
8. To supplement domestic water requirement during summer.
9. To control the wastage of rain water, etc.

1.2 Advantages of rain water harvesting

1. Rainwater is clean and free source of water.
2. Rainwater harvesting provides a source of water at the point where it is needed.
3. It is socially acceptable and environmentally responsible.
4. It promotes self-sufficiency and conserves water resources.
5. Rainwater is friendly to landscape plants and gardens.
6. It reduces storm water runoff and non-point source pollution.
7. It uses simple, flexible technologies that are easy to maintain.
8. Offers potential cost savings especially with rising water costs.
9. Provides safe water for human consumption after proper treatment.
10. Rooftop rain water harvesting is less expensive.
11. Rooftop rain water harvesting system is easy to construct, maintain and operate.
12. In desert, rain fall is low, in islands, due to limited fresh water aquifers, rain water harvesting is mostly preferred source of water.
13. Water management.

Fig.2 the rooftop harvesting

II. **Knowledge of Water Harvesting**

In this term, water harvesting refers to collecting and storing of rain water and also othger activities which is aimed at harvesting rain water surface and groundwater, preventing of loses through evaporation system and seepage and all other studies and engineering inventions , rain water is the primery source of water to harvest for us. And there are two techniques of rain water harvesting.

Rainwater harvesting requires at least an annual rainfall of 100-200mm. Its suitable even if the roof is size is small. For example, a 5 x 6 meters (30sq/m) house, with 500 mm annual rainfall, snow, etc. Will save an annual rainfall of 15000 liters on its roof; the sufficient amount of water is enough for a 5 members family.

So why waste when we can harvest the rain water with a good quality for the future use.

2.1 **Storage of rainwater on surface for future use**

1. Directly collecting of rain water can be stored for direct use and also can be recharge into the groumdwater.
2. Recharge to ground water.

All the other secondary sources of water like lakes, rivers and ground water are depends on the rain water sources.

Components of rooftop rain water harvesting system

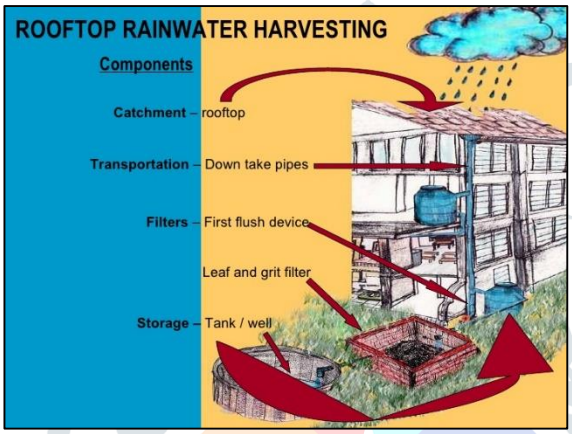

Fig. 3 components of rooftop rain water harvesting system

1. Catchment

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

2. Conveyance (PIPE)

Rainwater from rooftop should be carried through down water pipes to storage or harvesting system. Water pipes should be resistant (ISI HDPE/PVC pipes) of required capacity.

3. First flush

It's a device used to flush off the water received in the first rain shower. The first rains needs to be flushed off to avoid contaminating storable/recharchable water by the probable conitaminents of the atmosphere and the catchment roof. It also can help in cleaning of silt and other material.

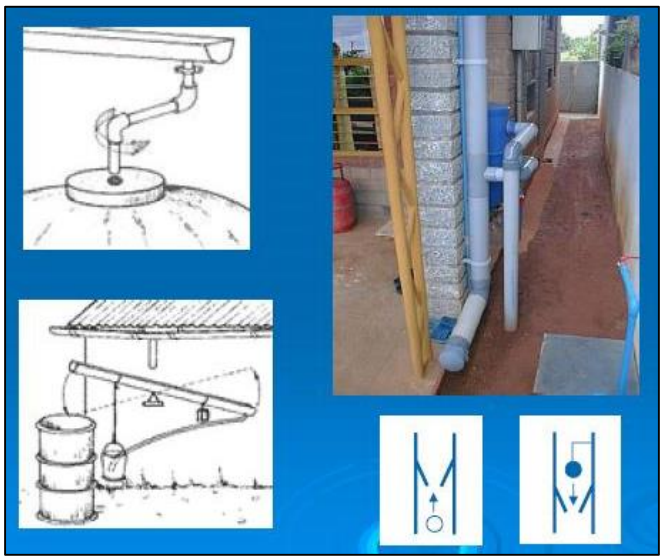

Fig. 4 First Flush

4. Filter

Filters are used for treatment of water to effectively remove turbidity. After first flushing of rainfall, water should pass through filters or directly stored in tank and filter before use. A gravel, sand and 'netlon' mesh, Pressure filter is designed and placed on top of the storage tank or near the tank depending upon the use.

5. **Coarse Mesh-** To provide passage for debris at the roof.
6. **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.

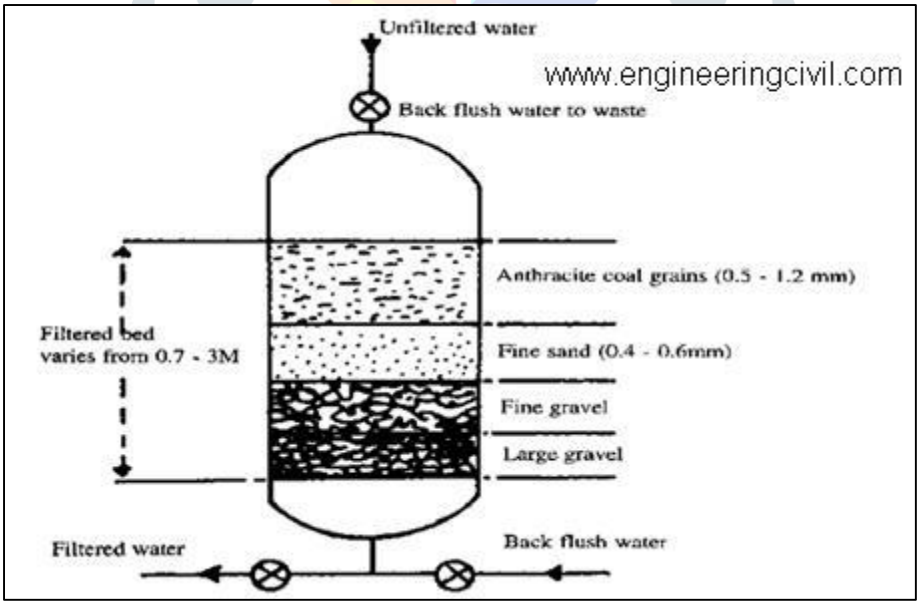

Fig. 5 PRESSURE SAND FILTER

III. METHODOLOGY

Following methodology have been adopted to achieve the main objective.

1. First of all various places considered to observe the readings of various parameters like pH value, chloride content, fluoride content, hardness etc.

2. Test were conducted on groundwater before and after harvesting system and then it allowed to passed into the ground through perforated pipe into the borewell, and hence it recharged the ground water and improved quality of water we got at the end.

Case Study

Study area (Lajpat Nagar)

Ground water analysis (march and may)

TABLE: 1 (Kasturba niketan society)

S.NO.	PARAMETERS	PERMISSIBLE VALUES	OBSERVED VALUES (MARCH)	OBSERVED VALUES (MAY)
1.	PH	6.5-8.5	6.9	7.4
2.	NITRATE (ppm)	10.0	6.5	7.5
3.	CHLORIDE (ppm)	250	160	175
4.	HARDNESS (ppm)	200	130	160
5.	FLUORIDE (ppm)	1.0-1.9	1.3	1.6

TABLE: 2 (Vikram vihar)

S.NO.	PARAMETERS	PERMISSIBLE VALUES	OBSERVED VALUES (MARCH)	OBSERVED VALUES (MAY)
1.	PH	6.5-8.5	7.1	7.3
2.	NITRATE (ppm)	10.0	6.4	7.6
3.	CHLORIDE (ppm)	250	167	185
4.	HARDNESS (ppm)	200	164	169
5.	FLUORIDE (ppm)	1.0-1.9	1.1	1.4

TABLE: 3 (Vinobha puri society)

S.NO.	PARAMETERS	PERMISSIBLE VALUES	OBSERVED VALUES (MARCH)	OBSERVED VALUES (MAY)
1.	PH	6.5-8.5	7.0	7.8
2.	NITRATE (ppm)	10.0	6.9	8.3
3.	CHLORIDE (ppm)	250	148	176
4.	HARDNESS (ppm)	200	120	146
5.	FLUORIDE (ppm)	1.0-1.9	0.8	1.2

IV. CONCLUSIONS

This method for collecting of rainwater is very easy and economic. Harvested Rainwater samples were collected and analyzed between the month of **MARCH and MAY 2019** without much variation in chemical properties (pH, nitrate, chloride content, hardness etc). Physiochemical properties (DO, COD, BOD TDS etc.) of collected rainwater samples were very much comparable to the limit of drinking water. All the adopted methods were suggested that highly effective in dropping the microbiological contamination and also feasible both at rural and urban areas. At last, it can be concluded that harvested rainwater and its analysis are affordable by individuals and it will be greatly helpful in drought prone rural as well as urban areas.

REFERENCES

1. Domastic Rooftop Water Harvesting- A Case Study Arun Kumar Dwivediand Sudhir Singh Bhadauria.VOL.4, NO. 6, (August 2009)
2. Rain Water harvesting at National Institute of Technology, Rourkela, By Ranjitkumar Sharma. (2010)
3. A rooftop rainwater Haevesting (RRWH) At SPSV Campus, Visnagar,Gujrat - A case study. Utsav R. Patel1, Vikrant A. Patel, Manjurali I. Balya, Harshad M. Rajgor, Volume: 03 Issue: 04 | Apr-2014, Available @ http://www.ijret.org
4. Evaluation of Rainwater Harvesting Methods and Structures Using Analytical Hierarchy Process for a Large Scale Industrial Area. V. Jothiprakashi, Mandar V. sathe. Published Online December 2009 (http://www.scirp.org/journal/jwarp)
5. Shubhra P. Dagwal1, R Mahadeva Swami2, and Dr. Yashvant Patil, "Rooftop Rainwater Harvesting – a case study", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 13, Issue 3 Ver. VII, PP 73-76, May- Jun 2016.
6. Water Conservation and Rainwater Harvesting S.P. Deolalkar (3 September 2015).
7. Rain Water Harvesting System for College of Engineering, TeerthankerMahaveer ,University, Moradabad., S Rehan Ali, R K Jain,Vol. 3, Issue 8, August 2014
8. Gauhar Mahmood and Ms. Ghazala Ishrat, "Rainwater Harvesting an Instrument to Improve Ground Water Quality and Quantitative Potential: The Case Study of Dwarka Sub-City, Delhi, IOSR Journal of Business and Management (IOSRJBM),ISSN: 2278-487X Volume 2, Issue 2, PP 06-13, July-Aug. 2012.
9. Rainwater Harvesting: Grab hold of Water where it Falls! Mrs. S.D. Khandagale, Mrs. V.A. Joshi V.P.M's Polytechni, Thane, MS, India (june 2011)
10. Arun Kumar Dwivedi and Sudhir Singh Bhadauria, " Domestic roof top water harvesting - A case study", ARPN Journal of Engineering and Applied Sciences, VOL. 4, NO. 6, ISSN 1819- 6608, Aug 2009.
11. Patricia H. Waterfall, "Harvesting Rainwater for Landscape Use", University of Arizona Cooperative Extension, 2006.
12. Bureau of Indian Standards (BIS), "Artificial recharge to ground water - Guidelines", IS 15792, 2008.
13. CPWD, "CPWD - Rain Water Harvesting and Conservation Manual", Govt. of India, 2002.