

A Review on Sustainable Development of Rainwater Harvesting System in Urban and Rural Areas

S. Sachin¹, Manohar², Rambirendra³, Hemant⁴, Shyambirendra⁵, Takar⁶

¹Associate Professor, Department of Civil Engineering, Aravali Institute of Technical Studies, Udaipur, India

²Assistant Professor, Department of Civil Engineering, Aravali Institute of Technical Studies, Udaipur, India

^{3,4,5,6}B.Tech Student, Department of Civil Engineering, Aravali Institute of Technical Studies, Udaipur, India

Abstract:- Lack of rain water is serious problem throughout the world for both urban & rural community. The ancient water sources are as well, river and reservoirs, etc. are not effectively fulfilling water demand due to unbalanced rainfall. Therefore Rainwater harvesting system investigates as a new water source. The aim of the Rainwater harvesting system is to fulfill the water demand during the period of scarcity. The rain water harvesting (RWH) system is a alternative source of water. The outcome of the rainwater harvesting system for collecting area such as parking area, workshop area, some of the terrace of the buildings. As per literature survey, it shows that the present status of RWH system is having the storage 53,96,816 liters/year and construction cost of 5 lakh Rupees respectively. This is also reasonably well in comparison with conventional water sources. The developed system satisfies the social requirements and can be implemented in rural areas as well as urban areas by technical methods.

Keywords:- Agriculture, Rain Water Harvesting, Reservoir,

1. INTRODUCTION

Rain water harvesting is one of the useful effective processes of water management and water conservation. It is used to indicate the collection and storage for rain water and also used for human, animals and plant needs.

The agriculture in the region is totally dependent on rain, where the type and amount of rainfall is such that if the vegetation is disturbed, large-scale erosion could ensure.

Rainwater harvesting is a process of collection, conveying and storing of rain water in artificial tanks or reservoir from the rainfall area for lateral use. RWH is the technique of collecting water from roof, Filtering and storing for further use. Either, we can store rain water in tanks for further use or we can use it to recharge groundwater. RWH system provides sources of water which reduces dependent on well and other sources. RWH system is not expensive in construction as compared to other sources, i.e. well, canal, dam, diversion, etc. Artificial recharge to a ground water is a process by which the ground water reservoir is increased. The collected water is stored and pumped in a separate pipe distribution [1].

Now a days rainwater harvesting system is the major collection of rainwater from roofs and other catchment area, the collection of runoff from man-made ground or natural surface catchment areas for domestic, industry, agriculture and environment uses. The systems can be categorized as small, medium and large scale [2].

Water is essential to man, animals and plants. Life on earth would not exist without water. An adequate supply of safe water is a prerequisite for major, socioeconomic development of a community. Despite this, water supply shortages are becoming a problem of global proportion [11].

1.1 Quality of harvested rainwater

Rainwater gets mixed with both soluble and insoluble material from surface on which rain water fall. The contaminant may be organic (plants, fungi, insects) or inorganic such as minerals, metals, chemicals also collected by surface runoff. Although harvested rainwater does not need a high degree of purity for garden and agricultural application. Rainwater which is harvested from unclean surface is notable for drinking and cooking purpose.

1.2 Components of Rainwater Harvesting System

A Rainwater harvesting system includes the following components such as pipes or drains, filtration, and tanks for storage of harvested water.

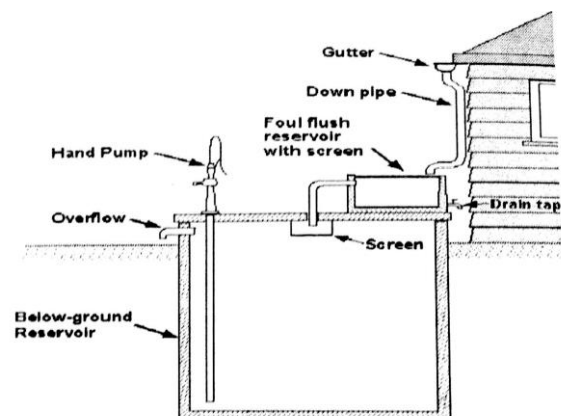


Figure-1: Components of Rainwater Harvesting System

The design and installation of RWH system comprises following:

1. Rainwater Catchment basin and Carriage
2. Rainwater Handling and Reservoir Sizing and
3. Rainwater Purity and Filtration

With above study it is found that the rainwater harvesting system can be developed with effective quality approach. The aim of this paper is to expose the economical benefits of rainwater harvesting system.

The reasons for using rain water harvesting system:

What: Rain water harvesting increases the water supply, food production and maintain food security.

Who: Harvested rain water is generally gives the benefit to the households and individuals in the rural area.

How: since the rain water harvesting provide water supply which leads to the food security, this will contributes to the income from the crop yield.

RWH is done for the purpose:

1. To increase the ground water recharge.
2. To reduce surface runoff from rainfall area.
3. To reduce seawater ingress in coastal areas.
4. To use the storage water for drinking and agricultural purpose during scarcity period.

1.3 Needs

1. To mitigate the inadequacy of surface water.
2. To increase availability of ground water at specific place and time.
3. To improve the ground water quality.
4. To improve agricultural yielding.
5. To improve ecosystem of the area by plantation.

2. WATER RESOURCES

Agriculture is the major trade of the people of almost all the states of India. Therefore, the rain water is essential for yielding of crops and various agriculture products. Shortage of water for irrigation purposes is the major problem of the cultivation in Himalayan and plains regions of the states. Water resources are limited and highly variable. The judicious use of these resources is essential [3].

2.1 Techniques

1. Ground water recharge in rural area

- [a] Gully plug
- [b] Contour bund
- [c] Gabion structure
- [d] Percolation tank
- [e] Recharge shaft
- [f] Nalla Bunds
- [g] Ground water dams
- [h] Dugwell recharge

[a] Gully plug:- Gully plugs are built using local stone, clay and bushes across small gully and stream. Gully plug helps in conservation of soil and moisture.

[b] Contour bund:- Contour bunds are effective methods to conserve soil and moisture in watershed for long duration. These are suitable in low rainfall area where monsoon runoff can be impounded by constructing bunds on sloping grounds.

[c] Gabion structure:- The height such structure is around 0.5meter and is normal used in the stream with width less 10meters.

2. Ground water recharge in Urban area.

- [a] Recharge pit
- [b] Tube wells
- [c] Recharge trench
- [d] Trench with recharge well

[a] **Recharge Pit**:- this technique is suitable for building having a roof area of 100 square meter. They are may be of any size are generally constructed 1 to 2 meter wide and 2 to 3 meter deep.

[b] **Recharge Trench**:- Recharge trench are suitable for building having a roof area of 200-300 square meter and where permeable strata is available at shallow depth.

[c] Trench may be 0.5 to 1 meter wide and 1 to 1.5 meter deep and 10 to 20 long.

3. RWH IN DIFFERENT STATES OF INDIA

1. **Tamil Nadu**:- It was the first state to make rainwater harvesting compulsory for every building to avoid groundwater depletion. The scheme was launched in 2001 and has been implemented in all rural areas of

Tamil Nadu. Since its implementation, Chennai had a 50% rise in water level in five years and the water quality significantly improved [4].

2. Karnataka :- In Bangalore, adoption of rainwater harvesting is mandatory for every owner or the occupier of a building having the site area measuring 60 ft × 40 ft and above and for newly constructed building measuring 30 ft × 40 ft and above dimensions. In this regard, Bangalore Water Supply and sewerage board has initiated and constructed “Rain Water Harvesting Theme Park” in the name of Sir M. Visversvaraya in 1.2 acres (4,900 m²) of land situated at Jayanagar, Bangalore. In this park, 26 different type of water conservation tips. The auditorium on the first floor is set up with a “green” air conditioning system and will be used to arrange the meeting and showing of a video clip about the rainwater harvesting to students and general public [5]. An attempt has been made at the Department of Chemical Engineering, Indian Institute of Science, Bangalore to harvest rainwater using upper surface of a solar still, which was used for water distillation [6].

3. Rajasthan:- In rainwater harvesting has traditionally been practiced by the people of the Thar desert. Many ancient water harvesting systems in Rajasthan have now been revived [7]. Water harvesting systems are widely used in other areas of Rajasthan, as well, for example the chauka system from the Jaipur district [8].

4. Maharashtra :- At present, in Pune, rain water harvesting is compulsory for any new housing society to be registered.

In Mumbai, Maharashtra, rainwater harvesting is being considered as a good solution to solve the water crisis.

The Mumbai City council is planning to make rainwater harvesting mandatory for large societies [9].

4. TREATMENT FOR RWH

1. Chlorine Treatment: This method is widely use when treated water to be stored for later use and in general industrial use.

2. Ultraviolet Light Treatment: This is another method for treatment of water. It reduces risk to industrial applications to reduce the corrosion.

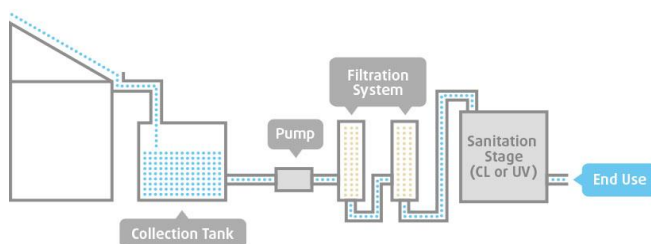


Figure-2 : Filtration of Harvested Water

3. Filtration: In the first step removal of particle and sediments is done.

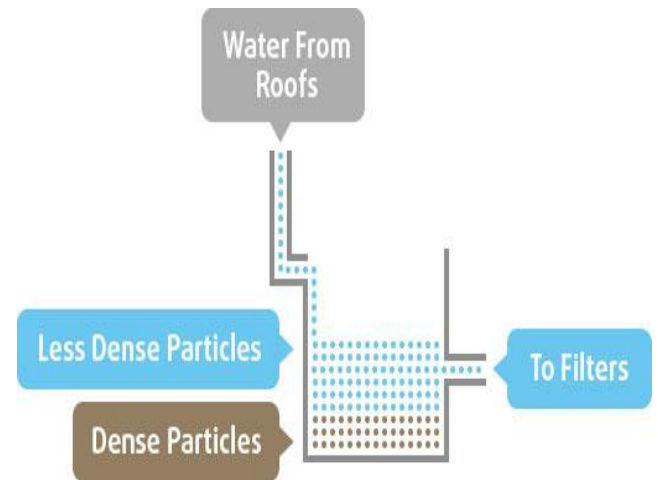


Figure-3: Filtration

Rainwater harvested from roofs and stored in a tank or pit. Dense sediment will settle under the action of gravity force at the bottom of the tank. A float switch triggers the operation of the system to commence pumping or a pressure drop inline indicates the need to treat and transfer water instantaneously. In filtration 1-5 micron solids to be removed, screen and sand filter is to be used for removal of fine particles and solids. Filters also have the option to be self cleaning [10].

5. ADVANTAGES OF RWH

1. Provides self sufficiency to water supply.
2. Reduce the cost for pumping of groundwater.
3. Provides high quality water.
4. Improves the quality of ground water.
5. Reduces soil erosion from rainfall area.
6. Rooftop rainwater harvesting is economical.
7. Structure for rain water harvesting systems are easy to construct, operate and maintain.
8. Rainwater harvesting system controls the flood at same time.
9. Reduces the several effects of drought.

6. CONCLUSION

Recharge of the ground water is a time consuming process, it take sufficient time to recharge ground water table. We cannot suddenly increase the ground water table after constructing any type of recharge structures. RWH is very beneficial concept in rural and urban areas, so we can prefer RWH system. This will help to recreate

the source for depleting ground water resources. Also help to save the little amount of rain water which used to drain away from many years. Rain water harvesting is essential for humans and animals as well as for ground water depletion.

REFERENCES

1. Arora, S., and Hadda, M.S., "Indigenous Technical Knowledge for soil and water conservation and soil fertility restoration in foothill region of the Himalayas in North-West", Proceedings of 14th International Soil Conservation Organization Conference. Water management and soil conservation in semi-arid environments, Marrakech, Morocco, May 14-19, 2006.
2. Gould, "Contributions Relating to Rainwater Harvesting" The World Commission on Dams Secretariat (WCD), Vol IV, No. 3, 1999.
3. Choudhary and Aneja, "Impact of greenrevolution on long term sustainability of land and water resources in Haryana", Indian Journal Agriculture and Economics, Vol. 46, No. 3, pp- 430-431, 1991.
4. "Tamil Nadu praised role model for rainwater harvesting", Hindu.com. 2011.
5. "Rainwater harvesting BWSSB-Bangalore water supply and sewerage board", bwssb.gov.in.
6. Anjaneyulu, L., E. Arun, Sankannavar, Ravi, Rao, K. Kesava, "Defluoridation of Drinking water and rainwater harvesting using a solar still", Industrial & Engineering Chemistry Research Vol. 51, No. 23, pp 8040-8048. 2012.
7. "Ancient water harvesting systems in Rajasthan". Rainwaterharvesting.org. Retrieved 2012.
8. "Chauka system", Rainwaterharvesting.org, Centre for Science and Environment, 2013.
9. "BMC to make rainwater harvesting mandatory for large societies".
10. <https://cleanwater.com.au/information-centre/guide-to-rainwater-harvesting-and-treatment>
11. Preston HH, "Mysteries of Water and the Future of a Scarce Resource", 2008.