

Rain Water Harvesting Analysis : A Review

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Abstract - Rain water harvesting is a method of collection and storage of rainwater. This rain water which is harvested can be further utilized for various activities such as drinking, gardening, groundwater recharge, etc. depending upon the rain water harvesting potential. This paper gives an overview of rain water harvesting, components of rain water harvesting systems, advantages and disadvantages of rain water harvesting, methods of rain water harvesting and the need for rain water harvesting systems.

Key Keywords - Rain water harvesting, components of RWH, need for RWH, advantages and disadvantages of RWH.

1. INTRODUCTION

The world population is growing at an astonishing rate and so is the demand for water. To meet these increasing water demands, groundwater is being used on a large scale all over the world. Due to utilization of groundwater at greater extent, the groundwater is depleting at a faster pace than the rate at which it can be naturally recharged. As a result of this exploitation, many groundwater tables are various places around the world have already been exhausted or are on the verge of exhaustion. Cities and villages are growing and so there is increase in agricultural activities. To meet the water demands for these agricultural activities again groundwater sources such as wells, tube wells, etc. are being used.

Water harvesting is not a new concept; rather it has been into practice since ancient times. Various water harvesting techniques and methods have been developed and improved from time to time to increase the efficiency of these systems. Though rain water harvesting is not a new concept, yet it is not being implemented in a large scale, as it should have been.

During monsoon season, majority of rainwater gets wasted due to surface runoff; the water from rooftops go directly into sewer and the water from storm water runoff also goes to the sewer and ultimately goes to waste. To tackle all of these issues rain water harvesting is an environmentally sound solution. By implementation of

rain water harvesting systems, the water can be collected, stored and used at later stage. This can ensure that not all rain water gets wasted and that the water is available for an extended period of time and not only in monsoons.

2. RAIN WATER HARVESTING & COMPONENTS

Rain Water Harvesting

Rain water harvesting is the collection of rainwater and its storage. The stored rain water can be used for various activities as well as for groundwater recharge. The basic components of rain water harvesting include catchment area, filters, storage and groundwater recharge structures, etc.

Methods of Rain Water Harvesting

Rain water harvesting can be done by following methods:

a. Surface Runoff Harvesting

Surface runoff is the flow of water that occurs when excess storm water, rain water, etc. flows over the earth's surface. The rain water surface runoff occurs when the soil is saturated to full capacity and the intensity of rainfall is more than the soil can absorb. The collection and storage of this surface runoff water is termed as surface runoff harvesting.

b. Rooftop Rain Water Harvesting

The rain water which is flowing off from rooftops of residential, institutional, industrial and various other buildings is collected and stored for further use is termed as rooftop rain water harvesting.

Components of Rain Water Harvesting

Rain water harvesting systems basically constitutes of following components:

a. Catchment

Catchments are the surface area that receives water. It may be terrace, porches, courtyards, etc. The quantity of rain water to be harvested depends majorly upon the catchment area of that rain water harvesting system.

b. Conveyance

The rain water collected from catchments is then conveyed or transported with the help of water pipes. These pipes should be UV resistant of required capacity. The mouth of each drain pipe should have a wire mesh to avoid entrainment of floating materials.

c. First Flush

The first shower of rains wash off various impurities present on the catchments and it is important to avoid this water to enter the system and storage tanks. Thus first flush devices are installed to flush off the water received in first shower.

d. Filters

Filters are provided for the treatment of water to effectively remove turbidity, colour and micro-organisms. There are various types of filters available which include sand gravel filter, charcoal filter, PVC pipe filter, sponge filter, etc.

e. Storage Structures

Storage structures are provided to store the filtered rain water for various activities. This stored rain water can also be used for recharging groundwater.

f. Groundwater Recharge Structures

Groundwater recharge structures are the structures which are provided in order to replenish the groundwater table. The rain water harvested is conveyed to these structures and then groundwater is recharged.

Advantages of Rain Water Harvesting

- Reduction of water wastage due to surface runoff and storm water runoff.
- Reduction in urban floods and soil erosion.
- Reduction in water bills.
- Reduced load on ground water sources.
- Availability of water for extended period of time.
- Used to artificially recharge groundwater table.
- Environmentally attractive solution particularly in water scarce regions.

Disadvantages of Rain Water Harvesting

- Rain water harvesting in regions with no or very less rainfall may not seem as a feasible option.
 - Rain water harvesting during construction phase can be less expensive, but rain water harvesting for already existing structures has a high installation cost.
 - Regular maintenance is required so that the system does not get clogged.
 - Storage limits can be caused due to area, type of equipment, rainfall and inadequate storage spaces.
- Need for Rain Water Harvesting
- As the water sources are depleting at a faster pace, it is needed to fulfill the water demands as well as to replenish the groundwater table and hence rain water can be used for groundwater recharge.

- Soil erosion from runoff needs to be controlled and rain water harvesting can help in this aspect.
- Rain water helps in decreasing load on water sources and water supply systems.
- To reduce water bills by using harvested rain water for various purposes rather than using metered water supply.
- Rain water harvesting can help greatly in reducing urban floods.

3. PAST WORK REVIEW

Various review and research work related to rain water harvesting systems were reviewed and are summarized below-

1. Abhijeet Keskar, et al (2016) have studied rain water harvesting a campus study at campus of Government College of Engineering located in Aurangabad, Maharashtra, India. In this they studied various areas of the campus and developed a rain water harvesting system. They also studied various technical aspects of the system, social requirements and implementation in rural areas. Also they have done the calculation and designing of this rain water harvesting system.

2. J.R.Julius, Dr.R.Angeline Prabhavathy, Dr. G.Ravikumar (2013) have studied rainwater harvesting (RWH) done at various locations all around the world. They have studies advantages, disadvantages, methods and need for rainwater harvesting systems. Along with rainwater harvesting studies around the world, they have also studied rainwater harvesting systems in India.

3. Santosh P. Mane, Amol S. Shinde (2014) have studied the changing of the rainwater harvesting management in India. They discuss the concept of rainwater harvesting, its significance and the different methods of rainwater harvesting in India. It discusses the primitive and modern methods of rainwater harvesting. It also gives overview on type, capacity and location of the structures. Also legislations regarding rainwater harvesting at central level and Maharashtra state level are given.

4. Sumedh R Kashiwar, et al. (2016) have studied an overview on the ground water recharge by Rain water harvesting. They present the concept of rainwater harvesting, its advantages and different techniques adopted for rainwater harvesting. It also discusses how the rainwater can be used to recharge groundwater. Details about filters, calculation and cost of installation are also discussed. An example of a building is also taken in which its rainwater harvesting potential is calculated. Also a case study is given of VIKAS Complex B wing, Thane, Maharashtra where rainwater harvesting is setup and how they have successfully harvested rainwater.

5. Mohanty R.R., Dalai A., Singh K.N., Das A., Dalai B (2018) have studied a new way for roof top rainwater harvesting management technique and have presented a case study. They present a case study conducted in a household at Marjita village of Tirtol block in Jagatsinghpur district, Odisha, which lies between 20°20' 54"N latitude and 86°22' 9" E longitude. The Geographical area of Jagatsinghpur district is 1668 Km² and the annual average rainfall is 1436 mm. The gross groundwater draft for domestic and industrial water supply was estimated as 339.57 Ha-m. The results from the case study showed that the rooftop rain water harvesting was able to meet the 80 % of the total water required in that household on daily basis. In view of this case study, it may be possible to replicate this in different households to achieve similar results.

6. Debu Mukherjee, et al. (2016) have carried a study on artificial ground water recharge in India. This study discusses various issues involved in the artificial recharge of groundwater. It presents an overview on artificial groundwater recharge in India. Paper discusses artificial groundwater recharge and different methods for groundwater recharge. Various methodology for artificial recharge programmes and schemes are also presented. This paper also presents various issues regarding artificial groundwater recharge in India, technology used, effectiveness of the technology, advantages and disadvantages of artificial ground water recharge and its operation & maintenance.

7. Naveen Lasiyal, et al. (2016) studied the scenario regarding rain water harvesting system in Jaipur city at residential and industrial buildings. They have carefully selected the study area and studied rain water harvesting and its various aspects. They also presented the calculation and design of rain water harvesting system and also gave cost analysis.

8. N. Balamurugan and B. Anuradha (2013) have studied the artificial ground water recharge with the help of surplus water. This study was conducted in Chidambaram Taluk. In this study they presented an approach to replenish the decreasing ground water level by using surplus water via artificial recharging. Design and calculations are done and on based on that various recommendations were made by them.

9. Anant D. Patel, et al. (2015) have presented a case study on rainwater harvesting in Amba Township in Gandhinagar. In this case study they studied thoroughly the components of rain water harvesting, advantages and disadvantages, the need for rainwater harvesting systems and various methods by which rainwater harvesting can be implemented. Design, calculations and various recommendations were also made.

10. Miss. Shweta Bisht, Dr. Sanjeev Gill (2018) have carried a study on rainwater harvesting. In this study they presented the various components and aspects related to rainwater harvesting. They presented concept behind rainwater harvesting, methods of rainwater harvesting and potential areas where these rainwater harvesting techniques can be implemented.

4. CONCLUSION

Population is increasing rapidly and so are the water demands. To meet these demands rain water harvesting is an environmentally sound solution. In highly populated country like India, water crisis is a serious problem and so the water resources should be managed carefully. Rain water harvesting helps to meet water demands, replenish groundwater, reduce water bills and improves environmental health.

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