

A Project Report on Design of Rainwater Harvesting System for Jodhpur Institute of Engineering and Technology (JIET) Campus

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Abstract— At the rate in which India populace is expanding, it is said that India will definitely supplant China from its number 1 position of most thickly populated nation of the world after 20-30. These will prompt high rate of utilization of most profitable regular asset; Water's subsequent in enlargement of weights on the allowed freshwater assets. Old technique for damming waterway and transporting water to urban zone has its own issues of everlasting inconveniences of social and political. Keeping in mind the end goal to save and take care of our day by day demand of water prerequisite, we have to think for elective savvy and generally less demanding mechanical techniques for monitoring water. Rain water reaping is outstanding amongst other techniques satisfying those necessities. The specialized parts of this paper are water gathering gathered from housetop which is thought to be catchment territories from all lodgings and Institutes departmental working at Jodhpur Institute of Engineering and Technology. As a matter of first importance, required information are gathered i.e. catchment zones and hydrological precipitation information. Water gathering potential for the inns and workforce flats is ascertaining, and the tank limit with appropriate plan is to consider.

Keywords— Rainwater, Indian Technique, water collection.

I. INTRODUCTION

Harvesting Rainwater for saving drinking water has gained enormously in significance as modern water saving sanitary technique. This can be used for private and public buildings as well as for many industrial areas. Beyond that rainwater harvesting plays an important role for the rainwater (storm water) management of housing estates. Due to the storage (retention) and the usage of rainwater the water flowing off housing estates in both reduced and delayed.

Rainwater harvesting is a technology used to collect, convey and store rain water for later use from relatively clean surfaces such as a roof, land surface or rock catchment. RWH is the technique of collecting water from roof, Filtering and storing for further uses. Rainwater Harvesting is a simple technique of catching and holding rainwater where it falls. Either, we can store it in tanks for further use or we can use it to recharge groundwater depending upon the situation. RWH system provides sources of soft, high quality water reduces dependence on well and other sources and in many contexts are cost effective. RWH system is economically cheaper in construction compared to other sources, i.e. well, canal, dam, diversion, etc.

II. WHAT IS RAINWATER HARVESTING AND WHY IS IT IMPORTANT?

Water is our most precious natural resource and something that most of us take for granted. We are now increasingly becoming aware of the importance of water to our survival and its limited supply, especially in such a dry desert of Rajasthan. The harvesting of rainwater simply involves the collection of water from surfaces on which rain falls, and subsequently storing this water for later use. Normally water is collected from the roofs of buildings and stored in rainwater tanks. Water can also be collected in dams from rain falling on the ground and producing runoff. Rain water harvesting is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface runoff).

- To meet the increasing demand of water.
- To reduce the run-off which chokes the drains?
- To avoid the flooding of roads.
- To raise the underground water table.
- To reduce groundwater pollution.
- To reduce soils erosion.
- Supplement domestic water needs.
- Enhancing the quality of environment.

III. HISTORY OF RAIN WATER HARVESTING

The capturing and storing of rainwater goes back thousands of years to when we first started to farm the land and needed to find new ways of irrigating crops. In hotter climes, catching that intermittent rainfall often meant the difference between life and death for communities. Whilst the need to conserve water fell away with greater urbanization in the last thousand years, we are once again returning to this ancient and vital part of greener living.

- **Talibs:** Medium to large sized reservoirs that provide irrigation for plants as well as drinking.
- **Johads:** Dams that are used to capture and keep rainwater.
- **Baoris:** Wells dug into the ground that are often still used for drinking.
- **Jhalaras:** Specially constructed tanks that are used for the local community and religious purposes

IV. RAINWATER HARVESTING AT JIET

JIET JODHPUR is a wide spread educational campus with a vast area of around 9 acres. There are around 2500 students studying in the main campus, whose daily requirement has to be served. Due to this fact there can be a possible water shortage in the future. The nearby water-tables are being exploited daily at a fast pace. And there are fields in the nearby area which require this water. So this creates a situation here of the usage of the rainwater. This huge area can be utilized for the purpose of Rainwater Harvesting. With the annual rainfall of around 333 mm and an intensity of 20mm per hour in this area of Mogra provides good opportunities to harvest the rainwater. The main campus consists of Six buildings namely

1. Co-Ed Campus
2. Faculty Guest House
3. Hostel No.-01
4. Hostel No.-02
5. Hostel No.-03
6. Hostel No.-04
7. Basket ball court

The orientation of each building is such that it maximizes the chances of collection of water. The open area of main playground will serve as the location for the storage Recharge Well for water collected in buildings mentioned above.

V. STUDIES CARRIED OUT IN MOGRA

The campus of this institute is situated at the area of semi Arid zone of Jodhpur city. The institute is surrounded by Industrial & Agricultural area. The total strength of campus including students and staff peoples is more 3000+. Thus, with this present strength and also with the expansion, campus should also increase its facilities and maintenance requirements. Thus water is most natural resource being always in high demands by human beings and is indispensable part of the life. Hence, keeping in view all the above problems and status of campus JIET, JODHPUR, Administrative body should focus on water scarcity problem. Therefore, in this situation, rain water harvesting system can be considered as a best solution for fighting against water scarcity in campus.

The campus of Jodhpur institute of Engineering & Technology (JIET) is situated at 26.1487°N latitudes and 73.0464°E longitudes Mogra Khurd, Jodhpur, Rajasthan 342802. the figure shown by using Geographic Information System (GIS).



VI. OBJECTIVES OF RAINWATER HARVESTING

The main objectives of rainwater harvesting are:

- To meet the increasing demand of water.
- To reduce the run-off which chokes the drains?
- To avoid the flooding of roads.
- To raise the underground water table.
- To reduce groundwater pollution.
- To reduce soils erosion.
- Supplement domestic water needs
- Lessens urban flooding.
- Straightforwardness in building framework in less time.
- Monetarily less expensive in development contrasted with different sources, i.e. dams, redirection, and so on.
- Water collecting is the perfect circumstance for those regions where there is lacking groundwater supply or surface assets.
- Aides in using the essential wellspring of water and keep the overflow from going into sewer or tempest channels, accordingly lessening the heap on treatment plants.
- Reviving water into the aquifers which help in enhancing the nature of existing groundwater through weakening.

VII. METHODS OF RAINWATER HARVESTING

Broadly there are two ways of harvesting rainwater.

- (i) **Surface runoff harvesting**
- (ii) **Roof top rainwater harvesting**

Various methods of rainwater harvesting are described in this section.

1. Surface runoff harvesting

In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

2. Roof Top rainwater harvesting

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the ground water level of the area.

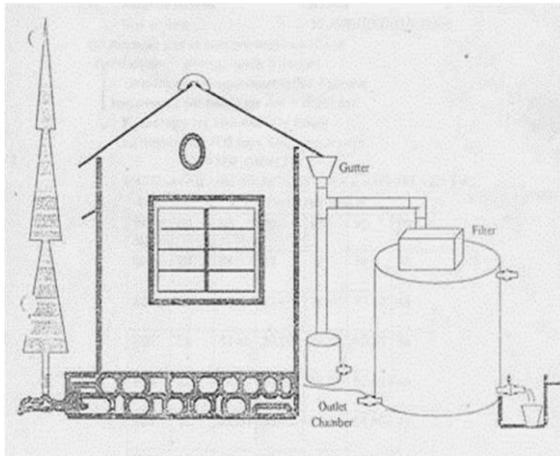
VIII. COMPONENTS OF THE ROOF TOP RAINWATER HARVESTING

The illustrative design of the basic components of roof top rainwater harvesting system is given in the typical schematic diagram.

The system mainly constitutes of following sub components:

- Catchment
- Transportation
- First flush
- Filter

IX. RAINFALL DETAILING



In Jodhpur brief rainy season starts from Late June to September. (By Koppen BShw) An Average maximum rainfall in Jodhpur is Avg.450 mm in 1899.

Yearly Rainfall in Jodhpur Region from 2010 – 2017
 According to Irrigation Department , Lalsagar , Jodhpur

CATCHMENT AREA & VOLUME OF RAINFALL

LOCATION	CO-ED CAMPUS	FACULTY GUEST HOUSE	HOSTEL (MESS) NO.1	HOSTEL NO.2	HOSTEL NO.3	HOSTEL NO.4
AREA	16396.58 Sq. Meters	476.37 Sq. Meters	510.30 Sq. Meters	432.51 Sq. Meters	432.51 Sq. Meters	432.51 Sq. meters
VOL.	43,68,048. (Cu.Meter) 9	1,26,904.9	1,35,943.9	1,15,220.6	1,15,220.6	1,15,220.6

Calculation of volume by obtained rainfall by average rainfall in jodhpur. (333mm)

volume = area x average rainfall – 20% (transpiration)

Water Collection Potential

Total Rain water collection - 4,97,654.4 liters

Capacity of single tank - 10 x 10 x 6 Cu. m

Number of Tanks - 10 (As per suitable Location)

Runoff coefficient with respect to types of surface areas:-

TYPE OF AREA	RUNOFF COEFFICIENT (C)
Residential	0.3-0.5
Forests	0.5-0.2
Commercial & industrial	0.9
Parks & Farms	0.05-0.3
Asphalt or Concrete Paving	0.85

YEAR	2010	2011	2012	2013	2014	2015	2016	2017
Avg. Rain-Fall (mm)	173.33	185.67	95.76	86.66	107.77	71.96	84.05	333

Runoff Coefficients of Different Surfaces:-

DIFFERENT SURFACES (C)	RUNOFF COEFFICIENT
Roof Conventional	0.7-0.8
Roof Inclined	0.85-0.95
Concrete /Kota paving	0.6-0.7
Gravel	0.5-0.7
Brick Paving	0.7

ANNUAL RAINWATER HARVESTING POTENTIAL

Annual rainwater harvesting potential is given by:-

$$V = C \times I \times A$$

Where,

V=Volume of water that can be harvested annually in m³ .

C = Runoff coefficient

I = Annual rainfall in (mm)

A = Catchment area in (mm)

X. ADVANTAGES OF RAINWATER HARVESTING

1. Easy to Maintain:

Utilizing the rainwater harvesting system provides certain advantages to the community. First of all, harvesting rainwater allows us to better utilize an energy resource. It is important to do so since drinking water is not easily renewable and it helps in reducing wastage. Systems for the collection of rainwater are based on simple technology.

The overall cost of their installation and operation is much lesser than that of water purifying or pumping systems. Maintenance requires little time and energy. The result is the collection of water that can be used in substantial ways even without purification.

2. Reducing Water Bills:

Water collected in the rainwater harvesting system can be put to use for several non-drinking functions as well. For many families and small businesses, this leads to a large reduction in their utilities bill. On an industrial scale, harvesting rainwater can provide the needed amounts of water for many operations to take place smoothly without having to deplete the nearby water sources.

It also lessens the burden of soil erosion in a number of areas, allowing the land to thrive once again. In fact, it can also be stored in cisterns for use during times when water supplies are at an all time low.

3. Suitable for Irrigation:

As such, there is little requirement for building new infrastructure for the rainwater harvesting system. Most rooftops act as a workable catchments area, which can be linked to the harvesting system. This also lessens the impact on the environment by reducing use of fuel based machines.

Rainwater is free from many chemicals found in ground water, making it suitable for irrigation and watering gardens. In fact, storing large reservoirs of harvested water is a great idea for areas where forest fires and bush fires are common during summer months.

4. Reduces Demand on Ground Water:

With increase in population, the demand for water is also continuously increasing. The end result is that many residential colonies and industries are extracting ground water to fulfill their daily demands. This has led to depletion of ground water which has gone to significant low level in some areas where there is huge water scarcity.

5. Reduces Floods and Soil Erosion:

During rainy season, rainwater is collected in large storage tanks which also help in reducing floods in some low lying areas. Apart from this, it also helps in reducing soil erosion and contamination of surface water with pesticides and fertilizers from rainwater run-off which results in cleaner lakes and ponds.

6. Can be Used for Several Non-drinking Purposes:

Rainwater when collected can be used for several non-drinking functions including flushing toilets, washing clothes, watering the garden, washing cars etc. It is unnecessary to use pure drinking water if all we need to use it for some other purpose rather than drinking.

XI. DISADVANTAGES OF RAINWATER HARVESTING

1. Unpredictable Rainfall:

Rainfall is hard to predict and sometimes little or no rainfall can limit the supply of rainwater. It is not advisable to depend on rainwater alone for all your water needs in areas where there is limited rainfall. Rainwater harvesting is suitable in those areas that receive plenty of rainfall.

2. Initial High Cost:

Depending on the system's size and technology level, a rainwater harvesting system may cost anywhere between \$200 to \$2000 and benefit from it cannot be derived until it is ready for use. Like solar panels, the cost can be recovered in 10-15 years which again depends on the amount of rainfall and sophistication of the system.

3. Regular Maintenance:

Rainwater harvesting systems require regular maintenance as they may get prone to rodents, mosquitoes, algae growth, insects and lizards. They can become as breeding grounds for many animals if they are not properly maintained.

4. Certain Roof Types may Seep Chemicals or Animal Droppings:

Certain types of roofs may seep chemicals, insects, dirt or animals droppings that can harm plants if it is used for watering the plants.

5. Storage Limits:

The collection and storage facilities may also impose some kind of restrictions as to how much rainwater you can use. During the heavy downpour, the collection systems may not be able to hold all rainwater which ends in going to drains and rivers. Rainwater harvesting is a system that is gaining speed over time. Areas that experience high amounts of rainfall will benefit the most from the system and will be able to distribute water to dry lands with ease. However, the beneficial environmental impact of the system is what drives it further as of now.

CONCLUDING REMARK

Recharge of ground water table is a gradual process, we cannot suddenly increase the ground water table after constructing recharge structures, by constructing any type of recharge structure, and we can give our contribution in aquifer recharge. This will help to rejuvenate the depleting ground water resources. Also help to save the little amount of rain water which used to drain away from many years. Thus it is concluded that implementation of RWH system of JIET JODHPUR campus would result in the form of the best approach to deal with present scenario of water scarcity and storing huge quantity of 4,97,654.4 liters in a year in college campus.

REFERENCES

- [1] Irrigation Department, Lalsagar.
- [2] Civil Engineering Department, JIET Jodhpur.
- [3] Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India.
- [4] The Mahatma Gandhi National Rural Employment Guarantee Act, 2005
- [5] Rainwater Harvesting , Parisara, Envis Newsletter, Vol.26, January, 2012.
- [6] "Advances in rainwater harvesting & soil water conservation techniques for crop production in arid & semi-arid areas" by Alvin.
- [7] •"Rainwater Harvesting & use: understand the basics of rainwater harvesting " by Anthony Zagelow.
- [8] www.rainwaterharvesting.org/rural/traditional1.htm
- [9] Rainwater harvesting by fresh water flooded forests.
- [10] Irrigation & Water Resources Engineering- G.L.Asawa
- [11] "Rain Water Harvesting BWSSB.
- [12] "Ancient water harvesting systems in Rajasthan".Rainwaterharvesting.org.
- [13] [www.Chauka System".rainwaterharvesting.org](http://www.Chauka System)
- [14] "Water Harvesting, Conservation & Irrigation in Mewar" by B.L.Bhadani
- [15] Centre for Science and Environment.