ROOF TOP RAIN WATER HARVESTING IN MEWAR UNIVERSITY, CHITTORGARH REGION

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ABSTRACT: *Shortage of water for industrial and domestic use and even for drinking purpose is a cause of concern throughout the world especially in developing and under developed countries. India is already facing water problems and this problem may turn acute unless preservative measures are taken on a substantial scale. One such method is roof top rain water harvesting. Rajasthan is known as dry state in India.The annual precipitation in India is estimated on an average 1100 mm.Although its distribution in spaceand time is highly variable, most of it is allowed to go waste as run-off water into the sea through the river system. The Government of India is also promotingrainwater harvesting through watershed management programme, artificial recharge of ground water and roof top rain water harvesting under various schemes.The present study finds its usefulness in developing awareness towards use of water and efficient ways to harvest roof top rain water resources at Mewar University. A case study has been carried out for Mewar University Gangrar region, Chittorgarh District in Rajasthan and a model has been proposed for the same.*

Key Words: *Rain Water Harvesting, Roof Top, Artificial Recharge, Catchment Area, Storage Tank.*

I. INTRODUCTION

Rain is the ultimate source of fresh water. With the ground area around houses and buildings being cemented, particularly in cities and towns, rain water which runs off from terraces and roofs, drains into low-lying areas and loses the chance of percolating into the soil. Thereby, precious rainwater is squandered, as it is drained into sea eventually. Groundwater or surface water may be unavailable for drinking water. The groundwater level is too deep and contaminated with minerals and chemicals such as fluoride in Chittorgarh. The good thing about rainwater is that it falls on your own roof, and is almost always of excellent quality. In these cases, rainwater harvesting is effective and low-cost solution. It enables households as well as community buildings, schools and clinics to manage their own water supply for drinking water, domestic use, and income generating activities. It provides the luxury of "water without walking", relieving the burden of water carrying, particularly for women and children. Each 20 liters container of clean water might save a kilometers long walk to the nearest source of clean water generally in Rajasthan. This stored water can be used for various purposes such as household, gardening, irrigation etc. Roof top water harvesting 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 be either stored in a tank or diverted to artificial recharge system. This method is less expansive and very effective and if implemented properly helps in augmenting the ground level of the area.

II. NEED OF RAIN WATER HARVESTING

Due to over population and higher usage levels of water in urban areas, water supply agencies are unable to cope up demand from surface sources like dams, reservoirs, rivers etc. This has led to digging of individual tubewells by house owners. Replenishment of ground water is drastically reduced due to paving of open areas. Indiscriminate exploitation of ground water results in lowering of water table rendering many bore-wells dry. To overcome this situation bore wells are drilled to greater depths. The solution to all these problems is to replenish ground water bodies with rain water by man-made means. The gross area of theMewar University premises is 30 acres, out of which 15 numbers of buildings in the premises constitutes 19000 sqm roof top areas. In present situation the 75 % rainwater from this huge roof top area is drained out of campus to nearby area. This huge roof top area, if used for rain water harvesting, has immense potential for ground water recharging. This will result in rise in ground water table which in turn will increase the yield of the open dug wells and also the duration of their services.

According to Rajasthan state ground water atlas 2013, Gangrar region is in critical categorization on the basis of development of ground water with a depletion of 6 ft.

III. OBJECTIVE OF STUDY

The main objective of roof top rain water harvesting is to make water available for future use.

1. To promote roof top water harvesting system.
2. To reduce the runoff which chokes storm drains & to avoid flooding of roads.
3. To argument the ground water storage and control decline of water level.
4. To reduce ground water pollution & to improve the quality of ground water.
5. To meet the ever increasing demand for water & to reduce the soil erosion.

IV. STUDY AREA

The model project is proposed at Mewar University located in Gangrar Tehsil, District Chittorgarh, Rajasthan. Tehsil Gangrar is situated at 23˚56' N latitude and 75˚41; longitude of Chittorgarh district Rajasthan. Central Ground water board has already declared this 501.7 sq. km area of Gangrar as over exploited and so it has become necessary to use rain water in order to fulfil the irrigation and domestic demand of water in the area. Annual rainfall in this area is 709.7 mm with 43 rainfall days (2016). Because of undulating topography and rocky substrata most of the water drains out of the area. Mewar University campus is an open campus and can act as an effective host for collecting &storing rain water. The university comprises of large building blocks with open roof area of 19000m^2 and hence can be very instrumental in collecting the rain which otherwise gets wasted by either flowing in waste drains or evaporation.

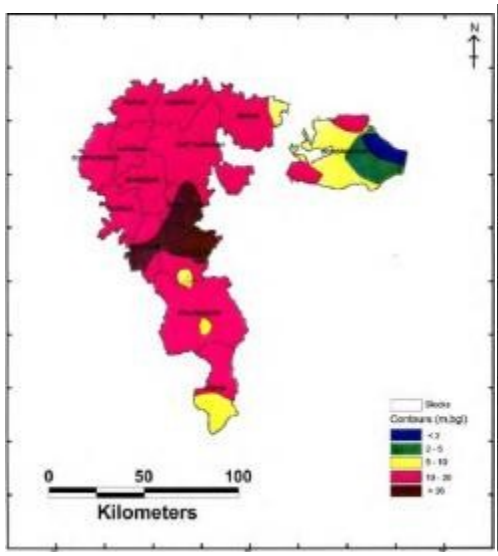

Fig 1: Depth of water in Gangrar (Pre Monsoon)

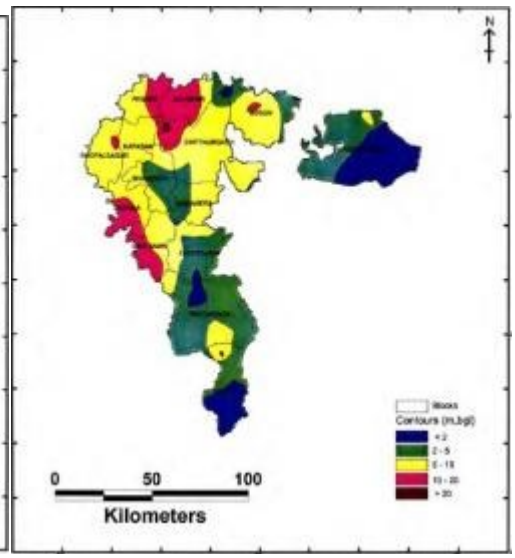

Fig 2: Depth of water in Gangrar (Post Monsoon)

In hydrogeology, the major water bearing formation is of limestone.Depth to water level Pre-monsoon is 5 - 25 mbgl and depth to water level Post-monsoon is 0.5 - 20 mbgl. In ground water quality, presence of chemical constituents are more than permissible limit (EC>1500 mmhos/cm at 25^0 C, F>1.5 mg/l, Nitrate>45.0mg/l) is EC - 800 sq km F – 1500 sq km Nitrate– 4200 sq km. The water is Alkaline in nature. The major ground water problems and issues in this area are redeclining water level low yield of wells and pollution of ground water. According to dynamic ground water resources, the annual replenishable ground water resource is 394.39 mcm. The Net Annual Ground Water Draft is 561.7714 mcm and projected demand for domestic and industrial uses up to 2025 is 65.6317 mcm.The climate of the Chittorgarh district is dry except S-W monsoon season. The cold season is from December to February and is followed by summer from March to June. From mid of September to end of November constitute post monsoon season. The district experiences either mild or normal drought once in two years. Severe type of drought has been recorded very rarely. Most severe type of drought has never occurred in the district.

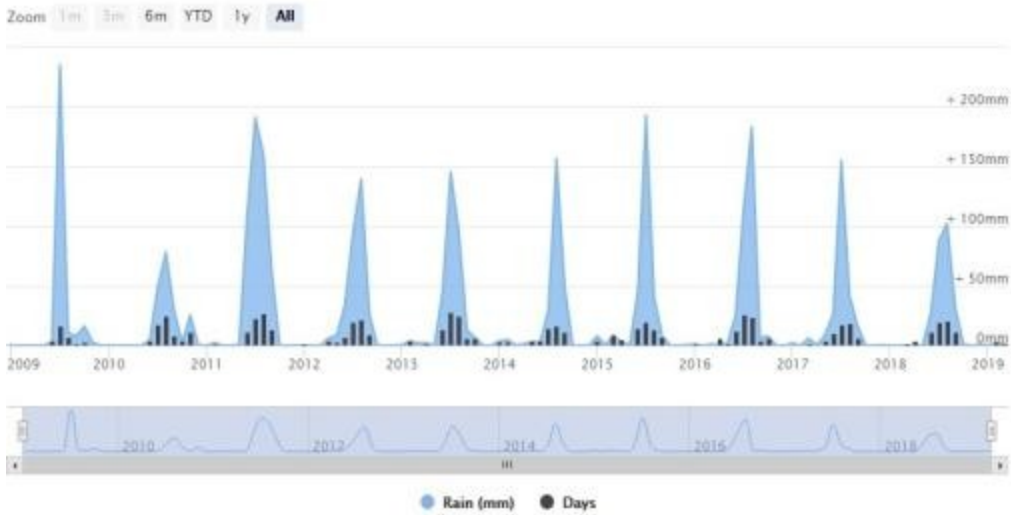

Fig 3: Average rainfall amount (mm) & Rainy days

V. METHODOLOGY

A rainwater harvesting system consists of three elements: the collection system, the conveyance system, and the storage system. A collection system is catchment area where roof water will accumulate. For the conveyance, drain of 70 cm width & 80 cm width is constructed around the university campus to carry the water up to storage tank. For storage, a well of capacity of 463,602Litres has been constructed in the campus..

VI. INFRASRUCTRE REQUIRED

a) Catchment Area: The site already possesses enormous catchment area of 19000 m^2 primarily having brick or concrete tops. The existing roof tops are of cement finish and tile cover to gather more fraction of rain water.

S. No	Building Name	Catchment Area (m^2)
1	Guest House	232
2	Meera Girls Hostel	615
3	PannaDhai Girls Hostel	615
4	Faculty Quarter (Block A)	430
5	Faculty Quarter (Block B)	430
6	Faculty Quarter 2BHK	620
7	Mess	640
8	Sports Club	330
9	International Hostel	745
10	Sanga Hostel	745
11	Kumbha Hostel	630
12	Pratap Hostel	630
13	WorkshopBuilding	1620
14	Law Building	1480
15	Main Building	9800

Table 1: Catchment Area in Mewar University

b) Gutters: Semi-circular or rectangular components can be installed all along the border of catchment using materials like plain galvanized iron sheets and PVC pipes. In Mewar campus, all the catchments are of plain roof. The water can be down directly through down pipe.

c) Downpipe: PVC or GI pipes with thickness 50 mm to 100 mm are the most preferred option as downpipe. In the Mewar campus, already downpipe of 100 mm to all catchments are attached.

d) First Flushing System: Proper down pipe to carry the roof water is available which disposes in to drain of dimension 70 cm width and 80 cm depth, constructed around the campus.
e) Filters: The filter unit is a chamber with filter media such as coarse sand, charcoal, coconut fiber, pebbles and gravels to remove the debris and dirt from water that enters the tank. The filter unit is available in the campus.
f) Storage Tank: The location already offers large water storage well of capacity 463, 602Liters. Using pump, water is drawn from well for domestic purpose.
g) Recharge Structure: Here in Mewar University, large quantity of roof water is available in rainy days. There is no recharge structure.Very soon, trench will be made 1.5-3 m wide and 30-50 m length depending upon water availability. Wells of 150-300 mm diameter and 5-10 m deep (below pervious layer) will be constructed in the trench to recharge the ground water table.

Fig: 3 Components of Infra Structure of Rain Water Harvesting

VII. STATISTICAL DATA & CALCULATION

Annual average rainfall in this area is 709.7 mm (A) with 43 rainfall days (2016). The total catchment area(B) is 19000 m^2. The runoff coefficient (C) for concrete type catchment is 0.8.

Rain Water harvesting potential = Amount of Rainfall x area of catchment x Runoff coefficient

Annual water harvesting potential of University Campus is = A x B x C

= 0.709 x 19000 x 0.8

= 10776.800 cum

= 1, 07, 76, 800 Liters

The capacity of well to store rain water is 463,602 Liters with free board of 1.7 meter.

The University is planning to make more wells to preserve this water for future use and remaining to recharge ground water table using recharge structure.

VIII. CONCLUSION

The concept and application of rain water harvesting is a revolution in the form of water preservation and reuse especially for urban areas and in drought area like Rajasthan. Mewar University has huge potential of rain water harvesting. There is enough quantity of rain water, which can be harvested from the play grounds, paved and semipaved circulation area and the garden area of the institute premises. These areas are around 3 – 4 times the rooftop area in the institute's premises. The University administration has encouraged this concept in order to recharge the depleting level of ground water and to make effective use of rain water being wasted otherwise.

REFERENCES

1. Indian Standard Roof top Rainwater Harvesting – Guidelines, 2008, BIS, New Delhi, PP-10-13.
2. Government of Rajasthan, Water resource department, Monsoon 2016.
3. District ground water brochure, Central ground water board, Ministry of water resources, Government of India.
4. Dr. SumanPanigrahi. Int. Journal of Engineering Research and Application www.ijera.com ISSN: 2248-9622, Vol. 7, Issue 1, (Part -1) January 2017, pp.111-115
5. Dr. Arun Kumar Dwivedi, Virendra B. Patil&Amol B. Karankal Global Journal of Researches in Engineering Civil And Structural Engineering Volume 13 Issue 1 Version 1.0 Year 2013

6. Jacob (2008), "Rooftop Rainwater Harvesting for Rural Schools in Karnataka – Experiences", Solution Exchange for the Water Community Consolidated Reply Query : Compiled by Nitya Jacob, Resource Person and RamyaGopalan, Research Associate, 9 May 2008.
7. MOWR (2002), "Thirty Fourth Report Ministry of Water Resources Demands For Grants 2002 – 2003", Ministry of Water Resources Government of India, New Delhi, 2002.
8. CGWB (1999), "Activities and Achievements of Central Ground Water Board on Rain Water Harvesting and Artificial Recharge", Central Ground Water Board, Ministry of Water Resources, Government of India, New Delhi, 1999.
9. Manual on Roof top Rainwater Harvesting systems in Schools", www.arghyam.org.