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Review Paper on Design of- Rain Water Harvesting System for Nimshirgaon Village

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Abstract: *In this project we used rain water harvesting techniques for increasing ground water table. It is essential and economical in construction compare to other sources. Now days it is compulsory to each and every design of houses. In our project we are collecting data of nearby village like, Rainfall intensity, runoff, and water demand for per capita per day, number of wells and bore wells, soil data etc. After collecting all the data we are designing rainwater harvesting system for each house of village.*

Keywords: Rain Water Harvesting

I. INTRODUCTION

Water availability is the most important consideration for all areas. Manson (June to September) that provides generally 70% of regional annual precipitation. As the population increases the demand increases for various purposes. For sustainable urban future society move towards the goal of efficient and approximate water conservation technique. Rain water harvesting is technology where surface runoff is effectively collecting during yielding rain periods. Rain water harvesting is technology where surface runoff is effectively collecting of rain water which can be stored for direct use or can be recharged into the ground water.

In this project we used rain water harvesting techniques for increasing ground water table. It is essential and economical in construction compare to other sources. Now days it is compulsory to each and every design of houses. In our project we are collecting data of nearby village like, Rainfall intensity, runoff, water demand for per capita per day, number of wells and bore wells, soil data etc. After collecting all the data we are designing rainwater harvesting system for each house of village.

After the designing we provide group of house a separate storage tank depends upon its catchment area and this collected water is poured into the bore wells and remaining water is utilized for the groundwater aquifers or in surface reservoirs by pumping if need be.

Percolation tank are constructed for increasing ground water depth below the ground surface. So we are designing percolation tank for collecting and storing water from road surface to recharge ground water table.

1.1 Importance

Water and Air are the two elements, which are required for survival of Human. The other element like food and shelter, which are required, can be derived from Natural environment, which in turn require the element of water and air to survival. It is said that water is life because the water is required from birth to death for human being and for survival, for drinking, washing, irrigation and other industrial applications.

Main source of irrigation development are dams and canals. Other option are water harvesting structure such as for ground water development, surface minor irrigation systems, watershed development etc. Rainwater harvesting is usually classified into two types

1. Harvesting for agricultural (Irrigation) needs and
2. Harvesting for domestic and other needs. For irrigation needs the rainwater can be harvested during rainy season by constructing any of the following structures.

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1.Major storage reservoir
2. Medium storage reservoir
3.Minor storage tanks
4. Watershed development structures, like check dams, percolation tanks etc.

1.2 Objectives

1. To study rain water harvesting technique.
2. Increasing ground water table.
3. Reduce Soil Erosion and runoff.

1.3 Methodology

1. .Study of different research paper for data and information collection.
2. Study of various case studies related to RWH.
3. Selection of site for project.
4. Collecting all data for related in rain water harvesting and Percolation Tank design.
5. Study the roof structures of each house in a village and calculate catchment area.
6. Design R.W.H. system for a selected area (village)
7. Site select for the Percolation Tank.
8. To Design the percolation tank.
9. Estimation of Water tank and Percolation tank.

II. LITERATURE REVIEW

Dr. R. Angeline Prabhavathy et al. [1]

As the world population increases, the demand increases for quality drinking water. Surface and groundwater resources are being utilized faster than they can be recharged. Rainwater harvesting is an old practice that is being adopted by many nations as a viable decentralized water source. This paper reviews the methods, design of rainwater harvesting systems, and its impacts adopted in all parts of the world. Efficient management of water resources and education about judicious utilization of water resources along with measures of harnessing, recharging and maintaining the quality of water and water bodies has to be taken up on war footing.

Mohd. Saleem, et al. [2]

Shortage of water for industrial and commercial use and even for drinking purpose is a concern throughout the world especially in developing countries. Rainwater harvesting for groundwater recharge is a best and easiest way to solve the groundwater problem. This can be increased in increase in watershed Development programs, in which rain water harvesting is an important structural component. Understanding the net effect of these development programs is crucial to ensure that net effect on groundwater is positive both locally and within a watershed. This review article is focused on literature survey of design of rain water harvesting and its aquifer modeling.

Estimation of recharge

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Fayez A. Abdulla* & A.W. AI- Shareef [3]

The present study emphasizes the importance of roof rainwater harvesting systems for domestic water supply in Jordan. The objectives of this paper are to (1) evaluate the potential for potable water savings by using rainwater in residential sector of the 12 Jordanian governorates and (2) provide some suggestions and recommendations regarding the improvement of both quality and quantity of rainwater collected. Rainfall harvesting from roads, parking lots and rooftops

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can increase water supply for various domestic uses and help combat the chronic water shortages in the country. Analysis of samples of harvested rainwater from residential roofs indicated that the measured inorganic compounds generally matched the WHO standards for drinking water. On the other hand, fecal coli form, which is an important bacteriological parameter, exceeded the limits for drinking water.

Sameer Shadeed & Jens Lange [4]

In arid and semi-arid regions, the availability of adequate water of appropriate quality has become a limiting factor for development. This paper aims to evaluate the potential for rainwater harvesting in the arid to semi-arid Faria Catchment, in the West Bank, Palestine. Under current conditions, the supply-demand gap is increasing due to the increasing water demands of a growing population with hydrologically limited and uncertain supplies. By 2015, the gap is estimated to reach 4.5 × 106m3. This study used the process-oriented and physically-based TRAIN-ZIN model to evaluate two different rainwater harvesting techniques during two rainfall events. The analysis shows that there is a theoretical potential for harvesting an additional 4 × 106 m3 of surface water over the entire catchment. Thus, it is essential to manage the potential available surface water supplies in the catchment to save water for dry periods when the supply-demand gap is comparatively high. Then a valuable contribution to bridging the supply-demand gap can be made.

M. Burt & B. Keiru[5]

Tearfund is actively seeking to address the global issue of climate change through local action. In light of recent research into the issue of climate change and lowering groundwater table in Darfur (Bromwich 2007), Tearfund has piloted an innovative Rain Water Harvesting (RWH) programe to develop new simple household level rainwater harvesting techniques that can be applied in emergency and past emergency situations, in order to minimize reliance on groundwater resource and contaminated surface water sources, which require expensive treatment measures.

A holistic approach is always needed to address the problem of sustainable access to adequate safe water supply and sanitation. However due to its significant, environmental, social and economic benefits, RWH in its many forms should always be considered as a potential water source to supplement other supplies. This is especially true in emergency and post emergency situation, where RWH in its simplest forms, can become a self help water

III. RWH METHODOLOGY & NEW TECHNIQUES

3.1 Hydrological Analysis

On the basis of experimental evidence, Mr. H. Darcy, a French scientist enunciated in 1865, a law governing the rate of flow (i.e. the discharge) through the soils. According to him, this discharge was directly proportional to head loss (H) and the area of cross-section (A) of the soil, and inversely proportional to the length of the soil sample (L). In other words,

Q =Runoff $$Q \alpha H/L \, . \, A$$

Here, H/L represents the head loss or hydraulic gradient (I), K is the co-efficient of permeability. Hence, finally,

$$Q = K. \, I. \, A$$

Similarly, based on the above principle, water harvesting potential of the catchment area was calculated.

The total amount of water that is received from rainfall over an area is called the rainwater legacy of that area. And the amount that can be effectively harvested is called the water harvesting potential. The formula for calculation for harvesting potential or volume of water received or runoff produced or harvesting capacity is given as:

Harvesting potential or Volume of water Received (m3)

= Area of Catchment (m2) X Amount of rainfall (mm) X Runoff coefficient

Runoff coefficient for any catchment is the ratio of the volume of water that runs off a surface to the volume of rainfall that falls on the surface. Runoff coefficient accounts for losses due to spillage, leakage, infiltration, catchment surface wetting and evaporation, which will all contribute to reducing the amount of runoff. Runoff coefficient varies from 0.5 to 1.0. In present problem statement, runoff coefficient is equal to 1 as the rooftop area is totally impervious. Eco-Climatic

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condition (i.e. Rainfall quantity & Rainfall pattern) and the catchment characteristics are considered to be most important factors affecting rainwater Potential. Given below the table showing the value of runoff coefficient with respect to types of surface areas.

Table: Value of Runoff Coefficient (K)

Sr. no.	Types of area	Value of K		
		Flat land 0-5 % slope	Rolling land 5%-10% slope	Hilly land 10%-30% slope
01.	Urban areas	0.85	0.65	-
02.	Single family residence			0.3
03.	Cultivated Areas	0.5	0.6	0.72
04.	Pastures	0.3	0.36	0.42
05.	Wooden land or forested areas	0.30	0.35	0.50

Chapter Hydrology and runoff computation, Irrigation Engineering & Hydraulic Structure, by Garg, S.K.

Methods For Storage Of Harvested Rainwater In Tank

Finally, we need to store the water which is obtained from the rooftop areas of the different buildings. The volume of tank which stores the harvested water will be directly proportional to the total volume of water harvested.
Technically, there are two types of methods for distributing the harvested rainwater:-

- RATIONING METHOD (RM)
- RAPID DEPLETION METHOD (RDM)

To explain these both methods, let us apply it on the village.The detail calculation is carried out to get the valuable steps and the number of days for consumption of stored water is calculated by using both of these methods and the detail calculation are given below.

Rapid Depletion Method (RDM)

In Rapid Depletion method, there is no restriction on the use of harvested rainwater by consumer. Consumer is allowed to use the preserved rain water up to their maximum requirement, resulting in less number of days of utilization of preserved water. The rainwater tank in this method is considered to be only source of water for the consumer, and alternate source of water has to be used till next rains, if it runs dries. Suppose in this method, the amount of water supplied to student is limited which is equal to say, 135lt/day per capita water demand.

Rationing Method (RM)

The Rationing method (RM) distributes stored rainwater to target public in such a way that the rainwater tank is able to service water requirement to maximum period of time. This can be done by limiting the amount of use of water demand per person.

RL Analysis

The analysis of RLs at different regions in Nimshirgaon is necessary for having idea about surface elevation and surface topology of the ground which is one of the most important part for fixing the position of recharge point. For this we have used the contour map of in Nimshirgaon area which is shown below which gives detail distinct information on the variation in the elevation of different regions of surface giving clear idea on the surface topology. The high contour lines on the digital elevation model denotes surfaces of high altitudes i.e. Mountainous region and low lining contour lines denotes the surfaces with low altitudes such as valley region.

IV. FUTURE SCOPE

- If the village is in hilly area at this time use different methods to maximize storage of water by using Contour bunding, Nala bunding etc.

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- One can estimate the percolation tank.
- Find out cost reduction method for rain water harvesting system.

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