RAINWATER HARVESTING: AN ECO-FRIENDLY APPROACH TO SUSTAINABLE DEVELOPMENT

Jagadisha Bala
Associate Professor in Commerce
Govt. First Grade College
Haleangadi, Karnataka

Abstract: Declining ground water levels in over-exploited areas need to be arrested by introducing improved technologies of water use, incentivizing efficient water use and encouraging community-based management of aquifers. In addition, artificial recharging projects should be undertaken so that extraction is less than the recharge. This would allow the aquifers to provide base flows to the surface system, and maintain ecology. If groundwater is not recharged, country's massive investment in borewells will be simply washed away.

Key Words: Groundwater, Water Management, Recharging, Sustainable Development, Rainwater Harvesting

Introduction:

Access to fresh water is a pre-requisite for achieving the goal of sustainable development. Large parts of India have already become water stressed (NWP, 2012). Rapid growth in demand for water due to population growth, urbanization and changing lifestyle pose serious challenges to water security. This may increase tensions and disputes over sharing and command of water resources. The emerging scarcity of water has also raised a host of issues related to sustainability of the present form of economic development, environmental sustenance, sustained water supply, equity and social justice, water financing, pricing, governance and management.

India has more than 18% of the world's population, but has only 4% of world's renewable water resources and 2.4% of world's land area (NWP, 2012). There are further limits on utilizable quantities of water owing to uneven distribution over time and space. In addition, there are challenges of frequent floods and droughts in one or the other part of the country. Therefore, Rainwater harvesting is one of the most ancient and easy methods that can be adopted at urban and rural level efficiently to deal with the water crisis.

The Concept of Groundwater:

Contrary to popular belief, groundwater reserves are not in the form of lakes or streams of water inside the ground. Water in the ground is stored in the interstices (inter-particulate spaces) of the soil or rock that forms the earth. It is similar to water being stored in a sponge – it is not visible, but can be 'squeezed' out or drawn out.

The soil or rock formations in the earth that contain water are called groundwater aquifers. Below a certain depth in the ground, the earth is saturated (saturation is a state in which all the free spaces or interstices are filled with water). This level is referred to as the groundwater level. This level may be just below the ground level or many metres below ground level.

Process of Groundwater Formation:

When rain falls on the surface of the earth, some amount of water percolates through the soil and moves downwards under the effect of gravity. When water moves through the soil, it is said to be infiltrating, because it gets filtered in the process of passing through the pores of the soil. Groundwater aquifers are formed over many years, as infiltration from successive rains joins the existing groundwater.

Groundwater Depletion:

Heavy extraction of groundwater leads to imbalance in the groundwater reserves as the withdrawal of water is more than the recharge. This leads to depletion of the groundwater resources. Depth of the water table from the surface increases and wells become dry.

14 districts in the Karnataka were affected by fluoride, nitrate, arsenic or other chemical pollutants - a direct resultant of groundwater depletion (Deccan Herald, 2012).

The Concept of Rainwater Harvesting:

In scientific terms, water harvesting refers to collection and storage of rainwater and also other activities aimed at harvesting surface and groundwater, prevention of losses through evaporation and seepage and all other hydrological studies and engineering interventions, aimed at conservation and efficient utilization of the limited water endowment of physiographic unit such as a watershed (CSE, 2010).

In general, water harvesting is the activity of direct collection of rainwater. The rainwater collected can be stored for direct use or can be recharged into the groundwater.

Rain is the first form of water that we know in the hydrological cycle, hence is a primary source of water for us. Rivers, lakes and groundwater are all secondary sources of water. In present times, we entirely depend on such secondary sources of water. In the process, it is forgotten that rain is the ultimate source that feeds all these secondary sources and remain ignorant of its value. Water harvesting means to understand the value of rain, and to make optimum use of rainwater at the place where it falls.

Need for Rainwater Harvesting:

We get a lot of rain, yet we do not have water. Why this situation? The answer is we have not reflected enough on the value of the raindrop. The annual rainfall over India is computed to be 1,170 mm (46 inches). This is higher compared to the global average of 800 mm (32 inches) (CSE, 2010). However, this rainfall occurs during short spells of heavy rain, most of the rain falling on the surface tends to flow away rapidly, leaving very little for the recharge of groundwater. This makes most parts of India experience lack of water even for domestic uses.

Ironically, Dakshina Kannada which receives about 3,900 mm of rainfall annually experiences shortage of drinking water during summer (Bala, 2012). This is because the rainwater is not conserved and allowed to drain away. Thus it does not matter how much rain we get, if we don't capture or harvest it.

This highlights the need to implement measures to ensure that the rain falling over a region is tapped as fully as possible through water harvesting, either by recharging it into the groundwater aquifers or storing it for direct use.

Rainwater Harvesting as a Disaster Mitigation Strategy:

Rainwater harvesting is a form of source control in which water can be converted into a resource. In recent years, due to urbanisation, groundwater recharge has decreased and the peak runoff from rainfall and consequent flooding has increased. It is therefore, National Disaster Management Guidelines (NDMG), 2010 recommends that rainwater harvesting should be carried out extensively. This will serve the twin purposes of lowering the peak runoff and raising the ground water table. Many municipal corporations in India have already made rainwater harvesting compulsory.

Radhakrishna Bhadti S. (2010), analyses– In recent 30 years, Bangalore had five severe droughts and three mild droughts. Water problems in layouts are common in the city. Again people are scared of even small rain as it leads to flood due to improper drainage. For both of these problems, Rainwater harvesting and recharging is the only solution.

A survey conducted by the Centre for Science and Environment (CSE), New Delhi, of several villages facing drought in Gujarat, Western Madhya Pradesh and Rajasthan in December 1999 and March 2000, found that all those villages which had undertaken rainwater harvesting and/or watershed development in earlier years had no drinking water problem whatsoever and even had some water to irrigate their crops. On the other hand, neighbouring villages were desperate for water and planning to migrate when the real summer hit them. This survey revealed that rainwater harvesting can meet even the acid test of a bad drought (Anil Agarwal, et.al., 2001).

Rainwater Harvesting Potential:

The total amount of water that is received in the form of rainfall over an area is called the rainwater endowment of that area. Out of this, the amount that can be effectively harvested is called the water harvesting potential.

Table – 1. Water Harvesting Potential

Area	Rainfall	Volume of water harvested
1 sq. meter	1mm.	1 litre
1 acre	1mm.	4,000 litres

The collection efficiency accounts for the fact that all the rainwater falling over an area cannot be effectively harvested, because of evaporation, spillage, retention on the surface itself, method adopted, etc. The following is an illustrative theoretical calculation that highlights the enormous potential for rainwater harvesting.

Table – 2. Rainwater Collection Efficiency

Area of Plot × Annual Rainfall × Collection efficiency = Volume of Water Harvested
100 sq.m. area × 3,900 mm. rainfall × 75% efficiency = 2,92,500 litres of water collected

Consider a house with a flat terrace area of 100 sq.m. The average annual rain fall in Dakshina Kannada district of Karnataka is around 3,900 mm. Considering 75% collection efficiency, 2,92,500 litres of water can be collected.

National Commission on Urbanisation (1988) recommended that a per capita water supply of 90-100 litres per day is needed to lead a hygienic existence, and emphasised that this level of water supply must be ensured to all citizens (Shaban and Sharma, 2007). Considering the average daily water requirement per person at 100 litres, this volume of water (Table 2) is sufficient for the annual water requirements of 8 member family.

Rainwater Quality:

Rainwater collected from rooftops is free of mineral pollutants like fluoride and calcium salts which are generally found in groundwater (CSE, 2010).

The study conducted by Sinwal Neelima and Dr. Lodha Neeta (2007) in 5 villages of Udaipur Dist., Rajasthan on rainwater quality revealed - "The harvested rooftop rainwater was found to be potable status as per the chemical quality but not the microbiological quality. This does not in itself mean that rainwater is unsafe to drink. Millions of people in rural areas around the world depend on rainwater for drinking and other domestic purposes and very few numbers of cases reported of serious health problems related to rainwater supplies."

Methods of Rainwater Harvesting:

There are two broad approaches to Rainwater Harvesting -

1. Storing water for direct use, and
2. Recharging groundwater aquifers.

1. Storing water for direct use: Rooftop harvesting has been practised since ages, and even today it is practised in many places throughout the world (CSE, 2010). Rainwater can be stored in any commonly used storage containers like RCC, masonry or plastic water tanks. Water is likely to be contaminated with air pollutants and surface contamination like silt, dust, etc. This can be prevented to a large extent by ensuring that runoff from first 10-20 minutes of rainfall is flushed off. Some maintenance measures like cleaning and disinfection are required to ensure the quality of water stored in the container (CSE, 2010; Padre, 2001).

2. Recharging groundwater aquifers: Various kinds of recharge structures are possible which can ensure that rainwater percolates in the ground instead of draining away from the surface. While some structures (like trenches, permeable pavements) promote the percolation of water through soil strata at shallower depth, others (like recharge pits, v-wire injection) carry out water to greater depths from where it joins the groundwater.

Indigenous Models:

Over the centuries, many region-specific water harvesting structures have evolved. While the basic principle of Rainwater Harvesting remains the same, the nomenclature differs from region to region and dialect to dialect. It is the process of collecting and storing rainwater in a scientific and controlled manner for future use (Shivakumar, 2010). To name a few - Johads, Khadin, Kunds, Stepwells (Gujarat, Rajasthan), Ahar pynes (Bihar), Kuls (HP), Zings (Ladakh), Bandharas (Maharashtra), Eris (TN), Kere, Katta (Karnataka) and Surangam (Kerala).

Suggestions and Conclusion:

Declining ground water levels in over-exploited areas need to be arrested by introducing improved technologies of water use, incentivizing efficient water use and encouraging community-based management of aquifers. In addition, artificial recharging projects should be undertaken so that extraction is less than the recharge. This would allow the aquifers to provide base flows to the surface system, and maintain ecology. If groundwater is not recharged, country's massive investment in borewells will be simply washed away.

Considering the existing water stress conditions in India and the likelihood of further worsening situation due to climate change and other factors, eco-friendly rainwater harvesting should be encouraged to increase availability of utilizable water.

Community should be sensitized and encouraged to adapt first to utilization of water as per local availability of waters, before providing water through long distance transfer. Community based water management should be institutionalized and strengthened to ensure sustainable water management.

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