GROUNDWATER RECHARGE IN THE BASALTIC TERRAIN FOR RAINWATER HARVESTING: EVERYWHERE BUT NOT ANYWHERE

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Abstract

For The last Decade or so one has seen the revival of traditional practices of Rainwater harvesting to meet the ever increasing shortfall of clean drinking water. Rainwater harvesting is being projected as the means of achieving sustainability for meeting the demands of clean water. This is true for all centers of urbanization viz. metros, and big cities. Where, due to constraints of space one cannot think of common large surface reservoirs, which definitely have proven to be unreliable during drought years. Though Rooftop Rainwater Harvesting, is definitely a social responsibility of every citizen, as it ensures that the natural groundwater system is maintained and the groundwater abstraction for daily use is replenished to its maximum during the rainy seasons, which is what normally takes place within the natural Hydrogeological cycle. The Deccan basalts also referred to as “The Deccan Traps”, occupy nearly 90% of area within the state of Maharashtra. From Hydrogeological point of view which takes into account the conditions for the Occurrence and movement of Groundwater, the Traps have been wrongly interpreted as being similar to granites and other hard-rocks. The multilayered aquifer system, which is seen to be commonly occurring within the Trap Terrain are very heterogeneous in nature, both vertically as well as horizontally. This makes the task of exploration for groundwater a very difficult task, which also is the case when it comes to designing systems for achieving the desired Groundwater recharge. The present paper tries to highlight the issues related to the Deccan Basaltic aquifer system which renders the implementation of Rainwater harvesting systems using a pre-defined design and pattern to achieve groundwater recharge non-functional and a shear waste of resources especially in Neo-development areas where, hard rocks are usually exposed on surface.

Keywords: Rainwater harvesting, Groundwater Recharge, Deccan Basaltic Aquifer.

KANIKALALWANI  |  ANIL LALWANI  |  BHARAT MANE

1 Dept of Geology & Petroleum Technology, Nowrosjee Wadia College, Pune 411001, India. Kanika_318@yahoo.com

2 Well & Water Works, 1088/B1-2 Amritiwell Society Model Colony, Pune 411016, , India. info@wellwaterworks.com
Introduction

For the last Decade or so one has seen the revival of traditional practices of Rainwater harvesting, to meet the ever increasing shortfall of clean drinking water. Rainwater harvesting is being projected as the means of achieving sustainability for meeting the demands of clean water. This is true for all centers of urbanization viz. metros, and big cities. Where, due to constraints of space one cannot think of common large surface reservoirs, which definitely have proven to be unreliable during drought years.

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The Deccan basalts also referred to as “The Deccan Traps”, occupy nearly 90% of area within the state of Maharashtra. (Figure 1 A) From Hydrogeological point of view which takes into account the conditions for the Occurrence and movement of Groundwater, the Traps have been wrongly interpreted as being similar to granites and other hard-rocks.

Unlike other hard rocks the Basalts are unique in their Hydrogeological characteristics, and unlike the granites the basalts form multilayered aquifer systems. Groundwater within the basalts are not restricted to fracture zones and joint which cut across the individual flows, but are seen to be flowing along the sheet joints which are developed along flow unit contacts.

The multilayered aquifer system, which is seen to be commonly occurring within the Trap Terrain are very heterogeneous in nature, both vertically as well as horizontally. This makes the task of exploration for groundwater a very difficult task, which also is the case when it comes to designing systems for achieving the desired Groundwater recharge.

The enigmatic nature of the Deccan Basaltic aquifer system renders the implementation of Rainwater harvesting systems using a pre-defined design and pattern to achieve groundwater recharge non-functional and a shear waste of resources especially in Neo- development areas where, hard rocks are usually exposed on surface.

The Deccan basalt aquifer system

According to Deolankar, 1980 The Deccan basalts are hydrogeologically anisotropic and heterogeneous in nature. According to Singhal 1997, Deccan traps behave as a multi-aquifer system, somewhat similar to a sedimentary rock sequence. One can find a potential water bearing horizon (vesicular; amygdaloidal, jointed or weathered basalt), sandwiched between com-
paratively massive basaltic flows, the former behaves as confined aquifer and the latter as Aquifuge or Aquitard. He goes further to highlight the importance of Geophysical investigation, lithological mapping of different flow units, fracture trace, and lineament mapping for higher success of water well drilling in Deccan traps.

It is obvious from the drill time observations, that all the depths at which the water is encountered represent the upper and lower contact zones between the Amygdaloidal basaltic flow unit and the Compact basaltic flow unit. These zones are termed as INTER UNIT ZONE - IUZ (Kulkarni, 1987; Kulkarni and Deolankar, 1995, Lalwani 1993) (Figure 1B).

These zones are characterized by a large percentage of amygdales and also by the presence of sub-horizontal interconnected sheet joints. Such a sheet jointed Inter Unit Zone in Amygdaloidal basaltic flow units acts as inflow zones within wells. Photographs of such sheet joints exposed in a dug well and also encountered in borewell have been shown (Photos 1 and 2).

According to, Kulkarni et. al. 1997, Lalwani 2000, borewells in close proximity do not necessary tap the same aquifer nor do they have the same yield, this fact confirms that Deccan basaltic flow units forming aquifers are extremely Heterogeneous in nature and extreme caution has to be adhered while dealing with them. A completely dry borewell near high yielding borewells could be a case of very poorly developed or improper connections with the aquifer. Lalwani (1994).

Rainwater Harvesting In Basalts

The multilayered aquifer system commonly seen to be occurring within the Trap Terrain are very heterogeneous in nature, both vertically as well as horizontally. This makes the task of exploration for groundwater a very difficult task, which also is the case when it comes to designing systems for achieving the desired Groundwater recharge.

As recommended by CGWB, 2000, CPWD 2002; Gupta, 2006, to achieve artificial recharge in hard rock areas one needs to tap the aquifers by means of drilling of borewell.

Kulkarni (1987) has shown the lithological controls on the development of trasmissive sheet joints within the Amygdaloidal basaltic flow units. According to Lalwani 1994, it is very difficult to predict such lithological controls with the help of resistivity data and the limited Hydrogeological data collected at different sites.
The recharge of the ground water system within the trap terrain needs to be done keeping in mind the heterogenous nature of the Deccan basaltic Aquifer and also the possibility of the borewells drilled not being connected to the aquifers. Hence making it essential to properly identify locations where in the recharging borewells need to be in hydraulic continuity with the Aquifer system and the connections of the transmissive Inter unit zones need to be well developed to achieve the desired recharge. (Photo 3)

Conclusion

Designing a rainwater harvesting system within the Basaltic where in groundwater needs to be recharged is a difficult task, Groundwater Recharge in the Basaltic Terrain for Rainwater Harvesting is possible Everywhere But Not Anywhere. Any attempt to recharge groundwater should be restricted to locations where the recharging structure is well connected to the Aquifer system via the transmissive inter unit zones providing an avenue for the recharging water to enter into the Aquifer system. To achieve ground water recharge in the hard rock areas within the basaltic the borewells drilled need to have successfully encountered prolific aquifer system. Where the recharge borewells are drilled only based on alignment and positions of building and the locations of the down take pipes from terrace, there is a high probability that the desired ground water recharge will not take place.

Trying to achieve Groundwater recharging in to the deeper basaltic aquifers, large number of recharge structures, systematically placed all around the building or within a cluster of building probably would not achieve the desired results as compared to a few properly identified & strategically located recharge structures that are in hydraulic continuity with the Aquifer system.

Dry borewells, which have not encountered any water while drilling indicates that the borewell is not connected to the aquifer via the transmissive Inter Unit Zones and any attempt to utilize such borewells for recharging purpose would be a shear waste of resources. As the surface waters need to be directly connected to the Groundwater systems precautionary measures needs to be taken to ensure that the recharging water is free of contaminants before it gets diverted for recharge in to the subsurface.

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TERRE Policy Centre

Field Address:
Pandit Ajgaokar Scheme,
Khandobacha Mal, Bhugaon,
Pune - 411042, Maharashtra (India)

Office Address:
22 Budhwar Peth,
Pune 411002, Maharashtra (India)