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Assessment of Impact of Groundwater Augmentation Structures in Granitic Terrain of Ramsin - Jaswantpura Region of Jalore District, Rajasthan

KEYWORDS: Groundwater, Augmentation, Igneous Rocks

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ABSTRACT *Groundwater is the water located beneath earth's surface in soil and rocks pore spaces and in the joints and fractures of rock formations. Groundwater is the primary source of potable water supply in rural India. Deforestation and the resulting soil erosion hamper the recharging of the groundwater therefore groundwater levels are decreasing country wise in almost entire India. There is severe groundwater depletion problem in Rajasthan state too.*

Hundreds of groundwater augmentation structures have been constructed in last 10-15 years in the Jalore district of Rajasthan by State Watershed Department and other agencies. We have studied only those structures which are in granitic terrain of Ramsin and Jaswantpura region of Jalore district. Our study aims to analyse the significance of water augumentation structures regarding changes in groundwater table of villages Baitarana, Bithan and Punak Khurd of Ramsin region and Rathpura of Jaswantpura region. It is revealed that these structures which were constructed in hard rock or granitic terrain are useful for local villages. They are providing water for their cattle and are also recharging their nearby wells. Therefore, we are of the opinion that the groundwater augmentation structures be preferred in rocky, fractured and jointed igneous terrain to recharge the aquifers.

Introduction

Groundwater is the primary source of potable water supply in rural regions of not only Rajasthan but all over India too. It is not readily available in most parts of India due to hard rock shield, which covers 70% of the country. Central and southern part of the country consists of a peninsular slab where surface water is scarce or seasonal and the groundwater is deep (Ramakrishnen, 1998; Radhakrishna, 2006). The similar situation prevails in Malani igneous and other metamorphic rocks of Rajasthan (Subhajyothi, 2013).

Deforestation and the resulting soil erosion hamper the recharging of the groundwater. Hence, in India groundwater levels are decreasing countary wise. Groundwater levels are further affected in drought- prone regions and in places where there has been over pumping for agricultural or industrial needs, or where there are just too many people using the available water. Although, many states are affected, there is serious groundwater depletion problem in Gujarat, Rajasthan, Uttar Pradesh, Andhra Pradesh and Madhya Pradesh.

Igneous and metamorphic rocks possess negligible primary porosity but attain porosity and permeability due to fracturing and weathering. In metamorphic rocks groundwater yield also depends on the rock type and grade of metamorphism (CGWB, 2006).

In Jalore district, Quaternary age alluvium and wind blown sand cover vast area. Only 5 to 10% of the total district area (10640.00 sq. km) has rock exposures. Ramsin village falls in Bhinmal Tehsil of the district. The granitic aquifers around Ramsin-Jaswantpura region geologically belongs to Erinpura Granite and Malani Group of igneous rocks. These rocks obtain porosity and permeability due to fracturing, jointing and weathering. The water augmenting structures are constructed on near by drainages.

The Study Area - Jalore District:

Jalore district is located between 24^0 37′ and 25^0 49′ North latitude and $71^0$11′ and 73^0 05′ East longitude. As stated above the district has a geographical area of about 10640 sq.km. It is bounded by Barmer district in the north –west, by Pali district in the north- east, by Sirohi district on the south-east, and by Banas- Kantha district of Gujarat state in the south (Fig.1). The district is comprises of seven tehsils viz: Jalore, Ahore, Bhinmal, Sanchore, Raniwara, Sayala and Bagora and also seven blocks viz: Jalore, Ahore, Bhinmal, Sanchore, Raniwara, Sayala and Jaswantpura.

Hydrogeology

Groundwater occurs under unconfined condition in saturated zone of rock formation. Its occurrence is controlled by topography, physiography and structural features of the geological formations. The movement of the groundwater in hard rock areas is governed by size, openness, interconnection and continuity of structural weak planes while in unconsolidated rocks groundwater movement takes places through pore space between grains. (CGWB,2008) Water bearing properties of different aquifers belonging to rocks of Precambrian age are briefly described below.

Granite & Rhyolite: These aquifers occur predominantly in Jalore, Jaswantpura, Bhinmal and Raniwara blocks. Malani rhyolite encompasses small area in Raniwara block. Granite and rhyolite together cover nearly 8% groundwater potential area. Few intrusives are also found which have low permeability. Groundwater is retained in weathered zones, fractures joints etc in these granites & rhyolites. Depth in open wells tapping these aquifer$_3$ ranges from 20 to 50m. Yield of wells varies from 20m^3/day to 188m^3/day. The depth to water level in the area tapping the aquifer ranges from 11m to 31m.

Phyllite: The aquifer occur predominantly towards Jas-

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wantpura block. Groundwater occurs under water table condition and is mostly tapped by dug wells. Depth of wells ranges from 20m to 30m. The depth to water level ranges from 11m to 18m below ground level. Yield of wells is generally very poor ranges from 30 to 80m^3/day.

Status of Groundwater Augmentation Structures in Ramsin – Jaswantpura area of Jalore district:

Groundwater is a renewable, finite resource, annual recharge is governed by several natural factors. The stored capacity of groundwater reservoirs combined with small flow rates provides a large, extensive distribution of water supply. In order to augment the

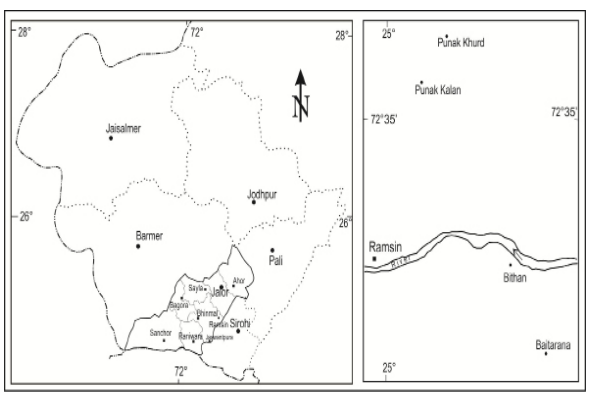

Figure 1: Sketch map of Jalore district with location of study area.

natural groundwater reserve, artificial recharge of groundwater basins/bodies have been attempted. Artificial recharge can be defined as augmenting natural infiltration of precipitation or surface water into underground formations by altering natural conditions of replenishment. In other words, surplus water, which would otherwise flow out of an area is retained for a longer period, thus enabling more infiltration than runoff. (Ministry of Drinking Water and Sanitaion, GOI, 2013) Artificial recharge is attempted in order to:

- Restore supplies to an aquifer depleted from excessive draft or augment supplies to aquifers lacking adequate recharge;
- Store excess surface water underground for future use;
- Improve the quality of the groundwater or prevent its deterioration, or to create a freshwater layer;
- Remove sediment, bacteriological and other impurities from sewage and waste water effluent;
- Store energy in aquifers or obtain cool water of a relatively constant temperature; and
- Arrest or reduce land subsidence by increasing hydrostatic pressure.

Government Initiatives:
The State Department of Watershed Development& Soil Conservation and the Department of Public Works are constructing artificial recharge structures such as anicuts, bunds, khadins, rapats and percolation tanks and devising water spreading methods in order to reduce soil erosion and gulley formations, conserve soil moisture and provide causeways. These activities are being carried out in a sectoral approach. As a result, the effects of these activities on the groundwater regime are limited.

The Groundwater Department (GWD) initiated artificial recharge studies in 1990. The construction of recharge structures have been undertaken by the department with some reservation as there is no provision for comprehensive pre-feasibility or post-construction evaluation studies. The State Government's present effort in watershed development is a major intervention in natural resource regeneration and groundwater recharge. Very few scientifically designed experiments have been done to assess the suitability of various methods for different terrains, soils and rainfall zones. Their impacts on water resources and socio-economic development are less significant.

GWD focused on watershed management, natural resource management, drought mitigation, improving drinking water supply, soil conservation, etc. A range of activities were undertaken to harness rainwater runoff. The structures range from earthen field bunds to cement concrete structures, and from plugging water flow in small streams to structures to harness the flow from whole watersheds or sub-river basins. With all these interventions, the main objective was to check surface runoff, impound water and recharge groundwater.

As groundwater recharge depends on geohydrological parameters, it becomes difficult to assess their actual impact.

Groundwater Augmentation Structures Constructed by State Watershed Department in Igneous Terrain of Ramsin – Jaswantpura region- Critical Analysis of a few selected pockets:

State Watershed Department, Jalore have constructed number of groundwater augmentation structures in parts of Jalore district between the years 1999 to 2014. Masonary dam, Check dam etc. were constructed in both rocky areas and in the soil covered areas. The significance of each such structures constructed is briefly discussed below:

Masonary Dam constructed near village Ramsin Bittan:
At village Ramsin Bittan in tehsil Jaswantpura in Jalore district, a Masonary dam was constructed in the year 2003-04 (WASCO, 2005) The rock on which dam has been constructed is granite.The area is almost flat. In last 10 years,

Photograph 1: Masonary dam at village Bithana near Ramsin town, District Jalore.

Masonary Dam constructed near village Baitarna:
This is another masonary dam constructed at village Baitarna (DDP 2/11 Project) near village Ramsin in block Jaswantpura in Jalore district. From the photograph no.-2 it is quite evident that sufficient water is stored in th catchment area. Even the migrating birds are freqvently staying

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in the reservior for the reproduction.The area is occupied by granite. Granite exposers are well exposed in a nearby well of Shree Shivnath Singh.Water in this well is full i.e. up to the surface.This structure was also constructed during the year 2004 and in last 10 years there is enough water avalibilty in this structure. The water of the structure is used by local cattle population and the near by wells of the villagers are also being recharged annualy water retains in it during the leap period. The water quality is fairly potable although during summer levels become slightly high (up to 1.68 ppm).

Photograph 2. Masonary dam constructed at village Baitarana near village Ramsin.

3. Masonary Dam constructed near village Ratpura:
At village Ratpura in block Jaswantpura in Jalore district, a Masonary dam was constructed in the year 2011-12. The rock on which dam has been constructed is granite.The area is almost flat. In last two years, this dam has restored large quantity of water and has considerably recharged the near by wells. Moreover in the close vicinity of dam, community land is there which has dense bushes and grass which are automatically grown every year and is used as fodder by local villagers for their cattles.Water quality is potable too.

4. Sub-surface barrier constructed in the river near village Rathpura
Sub-surface barrier constructed in the river near village Rathpura so as to store the flowing water during the monsoon period and subsequently use it during post monsoon season. Water quality is suitable for drinking purpose.

5. Few wells constructed in the Granite Terrain:
Author has visited and collected and analysed the groundwater data of five local wells. Data have been tabulated (Table-1). Well wise inferences are:

Well of Mr. Bhanwar Singh:
We have visited the well of Bhanwar Singh near village Punak Khurd (Fig.1) which is constructed in granite terrain. Nearly this well, a Groundwater Augmentation structure has been constructed in the year 2007-08. Authors have collected the well data from the State Watershed Department and analysed. Details have been mentioned in Table-1. From the table, it is evident that the total depth of Shree Bhanwar Singh's well is approximately 90 ft and during the year 2008, it retained water averaging 33.25 ft. This thickness of groundwater has considerably increased 77.79 ft. average in the year 2009. Furthermore, recharge of groundwater remained quite high between the year 2010 to 2014. Water is also suitable for drinking purpose.

(ii) to (v) Wells of Mr. Chell Singh, Mr. Mall Singh, Mr. Ranjit Singh and Mr. Dunger Singh:
Similar is the situation with other four wells of Mr. Chell Singh, Mr. Mall Singh, Mr. Ranjit Singh and Dunger Singh which is also well evident from Table 1. The water quality is fairly potable.

Table 1: Groundwater thickness recorded in few wells of village Punak Khurd.

Name of well owner	Depth of wells in feet	Year 2008	Year 2009	Year 2010	Year 2011	Year 2012	Year 2013	Year 2014
Sh. Bhanwar Singh	90	33.25	77.97	68.06	70.61	59.04	75.09	77.13
Sh. Chell Singh	82	31.75	75.56	62.85	62.07	57.73	72.30	70.97
Sh. Mal Singh	86	31.64	74.45	66.76	63.59	52.56	68.88	70.12
Sh. Ranjeet Singh	84	27.5	73.16	64.58	65.76	54.54	69.13	72.34
Sh. Dungar Singh	80	26.37	68.9525	64.32	60.45	54.75	65.88	71.5

Concluding Observation:
As mentioned above authors have collected both secondary and primary data and analysed the data after frequently field visits. The concluding observation are:

From the above discussion it is quite clear that in Jalore district the groundwater augmentation structures which have constructed in last one decade by State Watershed Department and others NGOs in granite terrain proved benificial to the local population as there is considerable recharge of groundwater in such structures.

The wells dug in granitic terrain have sufficient water during leap period of the year too.

Therfore, it may be concluded that in Jalore district, groundwater augmentation structures should be constructed in the Malani igneous suit rock terrain for considerable recharge of near by wells and for more agricultural productivity.

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