

Quantifying Amount of Water Available for Groundwater Recharge from Haveli Fields

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In most of the areas of the country, the availability of utilizable surface water is so low that people have to depend largely on ground water for agriculture and domestic use which in turn resulting to depletion of ground water aquifers. In order to improve the ground water situation, it is necessary to artificially recharge the depleted ground water aquifers. 'Haveli' is a system of collecting water within the periphery of field boundaries in heavy to very heavy soils of central part of Madhya Pradesh. The 'Haveli' is the old age practice, though declining, due to cultivation of *kharif* crops like soybean. Haveli system of cultivation is an excellent system of participatory rainwater management. The system facilitates not only conservation of soil moisture but also enhances ground water. In addition to these, it controls weeds, improves soil fertility, reduces energy requirement and provides prolonged working period for seeding of *rabi* crops (Rajput *et al.*, 2004).

The study area is the Shahpura block of Jabalpur district covering an area of 800 sq. km lies between North latitudes 22°55'30" and 23°16'30" and East longitudes 79°21'00" and 79°49'30" falling on the parts of survey of India toposheet No. 55 M/8, 55 M/9, 55 M/11, 55 M/12, 55 M/13. The surveyed area falls on Patan revenue tehsil and the principal towns in the area are Shahpura, the block head quarter, Belkheda, Sahajpur and Chargawan. The Itarsi-Jabalpur main railway line of central railways passes through the central part of the block. The main road passing through the area is Jabalpur road. This block is bounded by Damoh district in the North-East, Narsinghpur district in the South Patan and Bargi blocks in the North and East, respectively. The total geographical area of Shahpura block was 80,000 ha and alluvium area was 52,000 ha while the total potential Haveli area was estimated as 34,533 ha.

Traditional Haveli system of cultivation was found to be prospective for ground water recharge to a larger extent. Water is stored in Haveli fields during rainy season and allowed percolation in the field itself. Remaining water is let out after rainy season and residual moisture is utilized for *rabi* cultivation.

The daily rainfall data for 10 years (2001-2010) along with average evaporation data were collected from the block office of Shahpura, Jabalpur (M.P). The entire northern portion of the area is occupied by alluvium, except some of the North eastern portion which is covered by Vindhyan sandstone. The southern part of the block is occupied by rocks of igneous and metamorphic origin. Igneous group includes basalts, whereas metamorphic includes marble schist and Quartzite. Towards the south of Narmada river are exposures of dolomitic marble, which is in contact with schist and as it extends further southwards,

it comes in contact with basalt. The contact can be observed nearby villages, namely Andia, Dungaria, etc.

Measuring infiltration rate

For determination of infiltration rate of the soil, tests were conducted in eight different locations in the study area namely Imaliya, Kheri, Heerapur Bandha, Bilkhirwa, Shahpura, Barkheda, Jamunia and Khoka by using co-centric cylindrical infiltrometer. Locations selected for infiltration test were same as selected for soil texture. Water was added to the cylinder to a certain level. While adding water, care was taken to undisturb the soil so that the suspended particles may not block the soil pores. At frequent intervals, measurements were made to determine the amount of water, which has infiltrated during the time interval and at this time additional water was added to maintain constant infiltration head. Buffer pond surrounding the cylinder was used to minimize the radial flow of water. The buffer was constructed by driving into the soil a larger diameter cylinder concentric to the intake cylinder.

Data obtained from the test were plotted and curves for infiltration rate Vs elapsed time and also cumulative infiltration Vs elapsed time were derived. It was found that Kostiaikov's equation was found best fit to denote the infiltration characteristics of soil. The equation states that

$$Y = Kt^n$$

Where,

Y = cumulative infiltration, cm

t = elapsed time, min

K,n = constant, 0 > n < 1.

Infiltration, the process of water movement of ground surface into soil is an important process in hydrological cycle. Surface runoff and groundwater recharge can be linked with infiltration (Benjamin *et al.*, 2007).

Availability of Haveli storage for direct recharge

The depth of water which remains in the field just before the breaking of the tubes was considered for direct recharge. The depth of storage is also governed by the heights of the bunds prevailing in the area. A reconnaissance survey was made to get the average height of the bund which comes out to be 0.9 m. Baghel (2008) estimated block wise potential Haveli areas in clay soils of Kynmore plateau and Satpura hill agro-climatic zone. However, the quantum of water available for recharge is to be estimated by multiplying the total potential Haveli area in Shahpura block with the average height of the bunds.

The results of the equation wherein, cumulative infiltration as dependent variable and elapsed time as independent variable at eight locations of Shahpura block of Jabalpur district are shown in the Table 1 below.

Table 1 : Cumulative infiltration and elapsed time for the soil at different locations of Shahpura block of Jabalpur district

Selected locations	Estimated equation
Imaliya	$Y = 0.5823 t^{0.6089}$
Kheri	$Y = 0.6988 t^{0.4550}$
Heerapur	$Y = 0.5829 t^{0.6080}$
Bilkhirwa	$Y = 0.3874 t^{0.7115}$
Shahpura	$Y = 1.6657 t^{0.4285}$
Barkheda	$Y = 1.3784 t^{0.5159}$
Jamunia	$Y = 8.9268 t^{0.3278}$

Table 1 showed that both the cumulative infiltration and elapsed time for the soil have been correlated at the eight selected locations.

The basic infiltration rates were ranged between 0.39 cm/hr at Bilkhirwa and 8.93 cm/hr in Jamunia indicating existence of clay soil in the study area. However, the quantity of water available for recharging ground water in addition to Haveli area in Shahpura block was estimated as 31079.9 ha-m. The study helps the planners and policy-makers for planning annual cropping programme successfully to augment production, productivity and income squarely.

References

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