

Artificial Recharge to Deeper Aquifers by Roof Top Rainwater Harvesting in Kolkata Municipal Corporation Area, A Case Study in South Kolkata

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Before discussing the case study of artificial recharge to ground water, the following points need to be understood.

Concept of Recharge

- Infiltration is the process of recharge.
- Water supply for prolonged periods is required for soil saturation.
- No recharge for water, which is applied only intermittently.
- The hydraulic effects generated by artificial recharge are basically of two types.
- Piezometric effect.
- Volumetric effect.

Basic Requirements

- Availability of non-committed surplus monsoon runoff.
- Identification of suitable hydrogeological conditions and sites.

Scientific Inputs

- Hydrometeorological Studies.
- Hydrological Studies.
- Soil Infiltration Studies.
- Hydrogeological Studies.
- Geophysical Studies.
- Chemical Quality of Source Water and of Ground Water.

Identification of the Area for Artificial Recharge

- Areas where ground water levels are declining on regular basis.
- Areas where substantial amount of aquifer has already been desaturated.
- Areas where availability of ground water is inadequate in lean months.
- Areas where salinity ingress is taking place.
- Areas where ground water is chemically polluted.

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Implementation of Artificial Recharge Schemes

Successful implementation of artificial recharge schemes will essentially involve the following major components

- Assessment of source water
- Quality of Source Water
 - Physical Quality refers to the type and amount of suspended solids, temperature, and the amount of entrapped air.
 - Chemical quality refers to type and concentration of dissolved solids and gases.
 - Biological quality refers to type and concentration of living organisms.
- Planning of recharge structures
- Finalisation of specific techniques and designs
- Monitoring and impact assessment
- Financial and economic evaluation
- Operation and maintenance

Kolkata Municipal Corporation Area

- Area: 187.33 Sq.Km
- Population: 7.1million (Static-4.6 million & Floating-2.5million).
- Daily supply of water: 2293.6 MLD (Surface source-1108 MLD & ground water source- 1185.6 MLD)
- Total consumption: 1171MLD or 427.41MCM (Annually).
- A total of 305.20 million litres per day of ground water is being withdrawn in KMC area.
- June to October is the monsoon period characterised by heavy shower. Over 80% of the total annual rainfall occurs in this period. Normal annual rainfall of KMC area is 1647mm. Normal monsoon rainfall is 1282mm and normal non-monsoon rainfall is 365 mm.
- Due to rapid urbanization the major part of the original geomorphologic units have been obscured.

Hydrogeology of KMC Area

- Quaternary sediments consisting of silt, clay, sands of various grades, gravel and occasional pebbles deposited in deltaic condition by Ganga-Bhagirathi river system.
- In general ground water in KMC area occurs under confined to semi-confined condition under a blanket of clay of 30-40m in thickness. In Ballyganj, Tollyganj, Tiljola, Dhakuria, Kasba, Santoshpur, Garia, Behala, Barish and Thakurpur area and in the levee deposits on the bank of Hugli river ground water occurs under water table condition in shallow aquifer over the top clay blanket.
- The principal productive fresh water aquifer occurs within the depth span of 60-180m bgl in the major part of the area except in the western part. In the western part in Garden Reach-Barisha Sector and around Kashipur west of Dum Dum

brackish water aquifers occur down to depth of 160m bgl and 200 m bgl respectively. These brackish water aquifers are underlain by fresh water aquifers. In Santoshpur area in the extreme south all the aquifers within 300 m bgl are brackish.

- Depth to water level in the area varies from 3.34m to 16.32 m bgl in pre monsoon period and from 1.57m to 15.71m bgl in post monsoon period.
- Piezometric surface indicates that water level is deepest around Park Street forming a trough in Central Kolkata around Park Street, Rajabazar, Fort William etc due to excessive withdrawal of ground water as well as due to interference effect of closely spaced tube wells running simultaneously. There is fall of 7 to 11m in ground water level in last 45 years from 1958 to 2003.
- The long-term trend of ground water level in this part indicates a falling trend in both pre and post monsoon period.
- Ground water is mainly of bicarbonate and chloride type. Ground water in the extreme northern, eastern and western part is brackish and marginal to good in the rest of the area.
- There is a good scope for rainwater harvesting in KMC area. A net quantum of 247 million cubic metre of available rainwater may be utilized by both conservation and artificial recharge.

Artificial Recharge to Ground Water

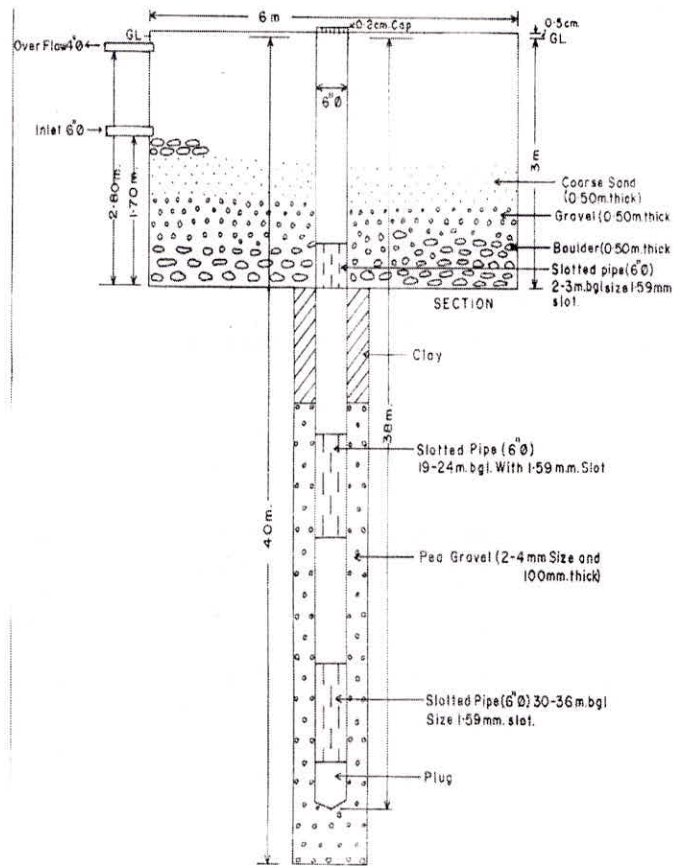
In Kolkata Municipal Corporation area the presence of a thick clay layer at the top of the sedimentary sequence and the metalled and concrete pavement in the surface restrict the rainfall recharge to ground water in the area. Considering hydrogeological set up of KMC area gravity head recharge tube well using the roof top rainwater is the only recharge structure feasible. The roof top rainwater after being filtered through beds of coarse sand (1-2mm size & 50cm thick), gravel (2-5mm size & 50cm thick) and boulder (6-9mm size & 50cm thick) placed successively from the top in the recharge trench will enter recharge well through the slot put against the bottom filtered beds. This water will then disperse into the aquifer to be recharged through the slots put against the aquifer (Fig-1).

The exact depth, dimension of the tube well and position of slots will be decided on the basis of the depth of aquifer to be recharged and the quantum of roof top rainwater available.

Artificial recharge scheme has been taken under Central Sector Scheme at All India Soil & land Use Survey Building having roof area of 676 sq.m.

Two nos of gravity head recharge tube wells of 119.38 mbgl depth have been constructed in a recharge trench (11.57m X 1.65m X 3m) filled with filter materials. Zone tapped 102.61-114.77mbgl. A quantity of 890m³ of rainwater has been recharged annually to ground water. The water level shows a rising trend after the artificial recharge (Fig-2).

Gravity Head Recharge Well



Hydrograph of Baishnabghata Patuli (Kp-1)

