



Hydrogeological evaluation of an over-exploited aquifer in Dhaka, Bangladesh towards the implementation of groundwater artificial recharge

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The population of Dhaka City is presently about 12 million and according to present trends in population growth, that number will most likely increase to 17.2 million by the year 2025. A serious water crisis is expected due to the extremely limited quality and quantity of water resources in the region. Previous studies have shown that the current trend in groundwater resource development is non-sustainable due to over-exploitation of the regional aquifer system, resulting in rapidly decreasing groundwater levels of about 2 to 3 meters per year. Today, annual groundwater extraction clearly exceeds natural groundwater recharge. New water management strategies are needed to guarantee future generations of Dhaka City a secured and sustained water supply as well as sustainable development of the city. The implementation of groundwater artificial recharge (AR) is one potential measure. As the first step towards a new water management strategy for Dhaka City, the authors report on the hydrogeological conditions of the greater Dhaka region and from this are able to present the location of potential recharge sites and identify appropriate recharge technologies for AR implementation.

The aquifers of greater Dhaka can be grouped in three major categories: Holocene Deposit, Pleistocene Deposit and Plio-Pleistocene Deposit. The aquifers are generally thick and multilayered with relatively high transmissivity and storage coefficients. AR is considered feasible due to the fact these aquifers are alluvium deposit aquifers which characteristically have moderate to high hydraulic conductivity. Low costs for recovery of recharged water and large recharge volume capacity are generally associated with aquifers of unconsolidated sediments. Spatial analysis of the region has shown that Karaniganj, Kotoali, Savar, Dhamrai, Singair upazila, which are situated in greater Dhaka region and close to Dhaka City, could serve as recharge sites to the subsurface by pond infiltration technique. A study involving the use of a 3-D mathematical model shows that the abstraction or recharge in the area within and around Dhaka City does not affect the groundwater level below the city. Therefore, in order to improve the groundwater level, artificial groundwater recharge directly at the city area would be mostly appropriate. As the thickness of the surface impermeable layer varies from 5 m to 45 m, the combination of infiltration and injection technology would be a proper choice. Detailed studies are required using the most appropriate state of the art spatial analysis to support the final selection and ranking of suitable locations for the AR facilities, according to flood risk, urbanization, underground characteristics, water sources, AR technology and later use of the recovered water.

Groundwater quality data reveal that the upper aquifer below Dhaka City contains relatively high concentrations of dissolved ions, quite variable in space. The ground water is predominantly of Ca-Mg-HCO₃ type. Cation exchange and oxidation may enhance the biogeochemical processes in the aquifer under the existing prevailing conditions. Many reports conclude that the groundwater chemistry of the upper aquifer has been influenced by various anthropogenic processes, showing wide variations of groundwater quality depending on the area, which would complicate the implementation of AR projects.

The preliminary evaluation of the potential for AR implementation, considering environmental and social impacts, as well as the available water sources for infiltration and injection (conventional or non-conventional),

AR may be considered a viable response measure with regards to the problems Dhaka City is facing. Without the implementation of groundwater artificial recharge or similar measures, groundwater availability and groundwater quality will further decrease and serious water crisis are to be expected. Measures to avoid groundwater contamination must also be taken to complement the benefits provided by AR implementation.