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Title	:	*A Study on Artificial Recharge and its Effects on South Chennai Coastal Aquifer*
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Background:

Groundwater, a renewable source of water had the remarkable distinction of being a highly dependable and safe source for mankind. But the dependence on groundwater is on a rapid increase in many regions because of limited surface water resources. Hence the use of ground water has now become the main source in most regions. This has laid stress on ground water leading to over exploitation to meet the demands. The major consequences of over-exploitation are depletion of water table, seawater intrusion (in coastal areas), groundwater pollution, land subsidence etc.

The increasing demand for water has brought the realization that the underground reservoirs formed by the aquifers constitute valuable water supply sources as well as natural water storage facilities. The planned augmentation of water storage in the groundwater reservoirs by suitable recharge techniques will be useful for reducing overdraft conserving surface runoff and increasing available groundwater supplies. A natural resource, it is increasingly being viewed as a commodity that has to be used rationally, priced appropriately, managed, sources recharged and reused as much as possible and wherever possible.

Artificial groundwater recharge reduces or even reverses the declining levels of groundwater, protects freshwater in coastal aquifers against seawater intrusion and stores surplus surface water, including monsoon run-off for future use. Since long distance transport of water is difficult and expensive, emphasis is being given to in-situ harvesting and recharge.

1. Objectives

The South Chennai Coastal aquifer which is subjected to stress in recent days on account of urbanization was taken up for study and aimed

(i) To assess the magnitude of ground water depletion and quality deterioration since 1988

(ii) To identify the hot spots, (in terms of quality) its causes and impacts.

(iii) To find ways and means to utilize the flood waters for artificial recharge. Based on the previous work done by various researchers in relevant field that come within the scope of the present study methodology was suitably framed for the present study towards the attainment of objectives.

Methodology:

The present study aimed at determining the temporal and spatial variation in the coastal aquifer and addressed the following questions

- How did the monthly water levels in the South Chennai Coastal Aquifer vary over the period of record since 1988? - Temporal variation and
- How do the observed changes, differ from location to location? - Spatial variation

For determining the temporal variation, the monthly changes in the water level, ? L calculated as the difference in the water level of the following month and the current month was determined for all the months from which the net (annual) ? L was calculated. The ? L obtained for each month and the net (annual) ? L was plotted against time (1988-2007) from which a number of striking trends were noticed. The rate of change of the net (annual) ? L found to be varying attributed to various factors such as monsoon rainfall during a particular year, urbanization etc. If rain fall had been sufficient but not reflected in the water level, the reason could be the clear case of urbanization (i.e.) more pumping to cater the needs of increased population and reduced natural infiltration of rain water in to the ground resulting in rain water getting wasted as run-off, even before the sub surface is fully saturated with water. This was substantiated by finding out monthly water level anomalies L*(for any particular year) as the difference between the water level in that particular month and the annual mean water level of that particular year. The plot of the water anomalies were compared in a gap of 5 year period, to examine the reflection of water level with the rainfall received during that period.

To look in to the spatial variations in water level, three years - one year with normal rainfall, another year with deficit rainfall than normal and the third one with surplus rainfall than normal was taken up for analysis.

By developing Water Quality Indices (based on weightage factor and quality rating), the water quality changes were assessed. Later, through the Spatial Interpolation technique of the Geographic Information System, maps were generated showing the ground water quality for the entire region of study based on the index developed.

1. Research findings

The results of the analysis revealed that the temporal variation of the water levels from 1988 - 2007 shows an overall decreasing trend (with the maximum at Palavakkam a highly urbanized area) at most of the locations in the study area. Since Chennai city is more under the influence of North East monsoon, the groundwater level usually show a seasonal fluctuation with a rise in the water level during the monsoon period.

Considering the spatial variation, it was found that water level at Palavakkam was very low which is a highly urbanized area compared to Muttukadu where water levels were found to be high.

The secondary data on water quality when analyzed over a period of time did not follow any pattern. It was found that water quality in general related to quantum of rainfall received. It tends to be good during a year of good rainfall and vice versa. The improvement in ground water quality after rainfall may be due to the dilution of the salts.

Thus the reason for both - decline in water table and quality were attributed to urbanization. This has resulted in certain inconveniences to the community people by way of additional expenditure for purchasing water mainly for drinking purpose.

Also since pumping cannot be controlled by way of monitoring even inspite of the existing legislations, the option of utilizing the flood waters which have several benefits such as enhanced storage to meet the additional demands, improvement in quality and the most important one – controlling the movement of seawater inward due to increased pumping need to be thought of for meeting the increased demands. With this perspective, the model was forecasted to see the effect in the water level with additional recharge at the rate of 25% of the pumped quantity. An increase in the head of 2.98 m over an area of 0.018 sq km and in the head of 3.98 m over an area of 0.0049 sq km was obtained indicating additional storage. This goes to show that the aquifer can be used successfully to recharge water to improve the ground water level.

Discussion:

As revealed from the results of the model study the water table could be improved by artificially recharging the aquifer with the flood waters. Even by recharging 25% of the extracted quantity a significant rise in water level can be achieved. The quantum of water for recharge in constructed areas could be got from planned roof top harvesting. Since part of the study area near the coast is still either of farms or vacant land, the surface runoff could be collected by providing a general slope and let into dug wells in the fields.

The successful ground water recharge scheme through existing dug wells in the agricultural fields already in the action plan of the Government, for improving the sustainability of wells and its quality, during the lean period may be considered for implementation in the study area taking into account the availability of farm and vacant lands, along the South Chennai coastal aquifer.