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A CASE STUDY ON ARTIFICIAL RECHARGE OF GROUND WATER

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Abstract: artificial recharge of groundwater is accomplished through placing surface water in basins, furrows, ditches, or different centers wherein it infiltrates into the soil and actions downward to recharge aquifers. synthetic recharge is an increasing number of used for short- or lengthy-term underground garage, where it has several blessings over floor storage, and in water reuse. artificial recharge requires permeable surface soils. in which these are not available, trenches or shafts in the unsaturated sector can be used, or water can be at once injected into aquifers via wells. To design a machine for artificial recharge of groundwater, infiltration rates of the soil have to be determined and the unsaturated area among land floor and the aquifer ought to be checked for good enough permeability and lack of polluted regions. The aquifer should be sufficiently transmissive to keep away from excessive buildup of groundwater mounds. know-how of those conditions calls for area investigations and, if no deadly flaws are detected, check basins to predict machine overall performance.**
Index Terms – Artificial recharge, water reuse.

1. INTRODUCTION

Groundwaterrecharge or deepdrainage or deeppercolation is a hydrologic procedure, wherein water actions downward from surface water to groundwater. Recharge is the number one approach thru which water enters an aquifer. This method commonly takes place within the vadose sector underneath plant roots and, is regularly expressed as a flux to the water table surface. Groundwater is recharged naturally by using rain and snow melt and to a smaller extent by way of floor water (rivers and lakes). Recharge can be impeded incredibly by means of human activities such as paving, improvement, or logging. These activities can result in loss of topsoil resulting in reduced water infiltration, enhanced surface runoff and reduction in recharge. Artificial groundwater recharge is becoming increasingly important in India, where over-pumping of groundwater by farmers has led to underground resources becoming depleted. In 2007, on the recommendations of the International Water Management Institute, the Indian government allocated ₹1,800 crore (equivalent to ₹44 billion or US$610 million in 2019) to fund dug-well recharge projects (a dug-well is a wide, shallow well, often lined with concrete) in 100 districts within seven states where water stored in hard-rock aquifers had been over-exploited. Pollution in stormwater run-off collects in retention basins. Concentrating degradable contaminants can accelerate biodegradation. However, where and when water tables are high this affects appropriate design of detention ponds, retention ponds and rain gardens.

2. LITERATURE REVIEW

2.1 **general :** Groundwater is an important source of water supply for municipalities, agriculture and industry. Therefore the capability to predict the behavior of chemical contaminates in flowing groundwater is of vital importance for a). the reliable assessment of hazardous or risks arising from groundwater contamination problems, and b) the design of efficient and effective techniques to mitigate them. There are several studies reported in this filed. Reliable and quantitative prediction of contaminant movement can be made only if we understand the processes controlling the transport of contaminants. These include a) advection, b) hydrodynamic dispersion and c) physical, chemical and biological reactions that affect their soluble concentrations in groundwater.

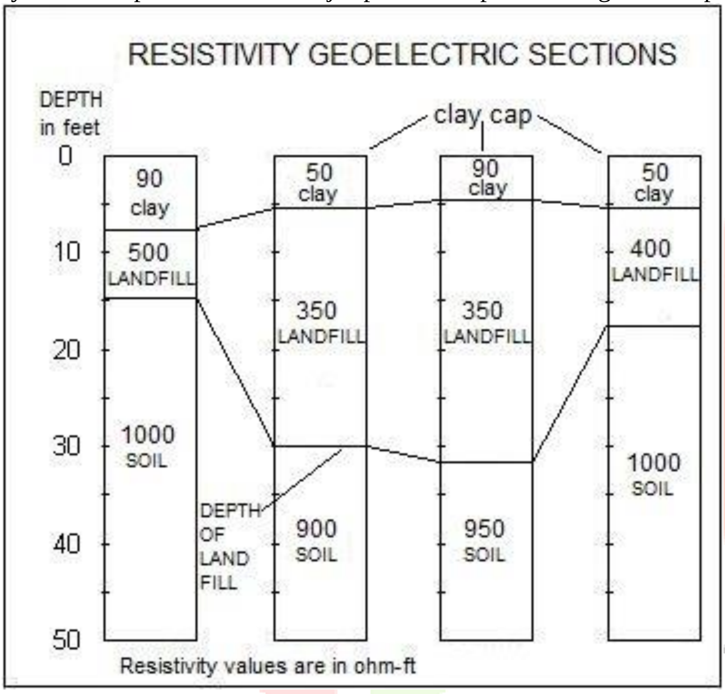
2.2 **groundwater quality modeling study :** The earliest observation of the dispersion phenomena was reported by Slichter (1905) who used an electrolyte as a tracer to study the movement of groundwater. Remarkable studies on related processes in groundwater flow and contamination transport in 1950 and gradually received the increasing attention of researchers. Bachmat et al. (1980) conducted a survey of numerical models mainly related to groundwater management. His report contained a list of 138 flow models and 39 mass transport models in 14 countries. Naymik (1987) presented a systematic review of 44 technically advanced articles on mathematical modeling of solute transport in the subsurface system. His review covers the period 1980-1985 only. Another comprehensive review paper on modeling of solute transport in groundwater was presented by Abriola (1987). She reviewed models reported upto 1986. Many models have been developed to assess traditional surface water loading impacts of NPS pollution. Some include groundwater recharge for baseflow generation purposes, but exclude the detailed vadose zone modeling necessary for assessing potential leaching of agricultural chemicals. Typical models include CREAMS (Krisel etal 1980). HSPF (Donigian et al 52 1983), ANSWERS (Beasley et al 1977), and WLF (Haith and Shoemaker 1987).

2.3 **groundwater quality modeling study using mudflow :** John Doherty (2001) reported that use of USGS ground water flow model MODFLOW is often hampered by the occurrence of 'dry cells'. While MODFLOW allows such cells to 'rewet' in the course of a simulation, stability of the heads solution process is often problematical with rewetting functionality operative. In many case of practical interest (particularly in mining applications), MODFLOW simply fails to converge. However by making a number of adjustments to the MODFLOW block-centered flow package, it is possible to overcome this problem in many instances of 86 MODFLOW development. These adjustments are such as to allow a layer to transmit water, albeit with vastly reduced transmissivity, even if the water level in that layer is below its base. With these alterations MODFLOW cells can remain active even if they lie within the unsaturated zone. Contaminant transport models often use a velocity field derived from a MODFLOW flow field. Consequently, the accuracy of MODFLOW in representing a ground water flow filed determines in part the accuracy of the transport predictions, particularly when advective transport is dominant. Henk Haitjema et al (2001) compared MODFLOW ground water flow rates and MODPATH particle traces (advective transport) for a variety of conceptual models and different grid spacing to exact or approximate analytic solutions. All of the numerical experiments concerned flow in a single confined or semi confined aquifer. While MODFLOW appeared robust in terms of both local and global water balance, they found that ground water flow rates, particle traces, and associated ground water travel times are accurate only when sufficiently small cells are used. For instance, a minimum of four or five cells are required to accurately model total ground water inflow in tributaries or other narrow surface water bodies that end inside the model domain. Also, about 50 cells are needed to represent zones of differing transmisivities or an incorrect flow filed and (locally) inaccurate ground water travel times may result. Due to the discharge of untreated sewage water into the small tank the water has become unsuitable for irrigation. The contaminated water will also infiltrate to the groundwater and affect the water quality in the surrounding wells. The Sulur watershed hence faces a problem of both quantity and quality of water. Groundwater flow and pollutant transport can be assessed through modeling. The groundwater flow pattern of Sulur watershed has been established using the flow model MODFLOW. The spatial distribution of the contaminants from the Small tank has been assessed with the transport simulation programme MODPATH. The effects of the constructed percolation ponds have also been examined during the modeling session. Water samples were taken in the two tanks and in the surrounding wells in order to assess the general water quality in the watershed and the potential influence of the Small tank. The results from the modeling show that the flow pattern in the Sulur watershed is generally from south to north. The modeling results clearly show the influence of pumping wells on the flow pattern. In the northeastern part of the watershed, a large density of wells creates an unnatural discharge area. This is mainly the result of the poor availability of water in combination with the un sustainability high withdrawal rates. The results show that under the prevailing conditions, the water level will continue to decline unless measures are taken. However, the results show that the water level can be increased by the introduction of percolation ponds, which gives verification to the Government project of construction of ponds and consequently gives great importance to this study. Model simulations demonstrate that the proposed model operated in a parallel computing environment can result in considerable savings in computer run times (between 50% and 80%) compared with conventional modeling approaches and may be used to simulate grid discretizations that were formerly intractable. Scott Painter et al (2008) stated that dewatered or dry cells in the USGS groundwater modeling software MODFLOW may cause non physical artifacts, trigger convergence failures, or interfere with parameter estimation.

3. CASE STUDY

3.1 **introduction :** Overexploitation of groundwater resources and as a consequence decline in water table are the causes of serious concern in some parts of Haryana, Gujarat, Rajasthan, Tamilnadu, Andhra Pradesh, Maharashtra and Punjab1 . In the state of Haryana, present availability of water is 2 M ha m, which includes 1.1 M ha m surfacr water and 0.9 M ha m groundwater. Yearly fluctuations of water table depths in the North-East region of the state indicate the declining trends of fresh groundwater resources. In the districts of Ambala, Kurukshetra and Karnal the groundwater, withdrawal, mainly from fresh water zone, is at the rate of 192%, 158% and 725% of annual recharge, respectively2. The exploited groundwater along with canal water supply is used to meet water requirements of wheat and one or two rice crops grown under intensive agriculture. The paddy fields and unlined canals also contribute to the groundwater. However, these contributions are not sufficient to keep groundwater balance in favourable condition for depleting groundwater areas.

3.2 materials and methods : The old Sirsa branch canal, a branch of Western Yamuna canal, passes through the fresh groundwater depleting area of North-East Haryana and primarily runs during rainy season to carry excess runoff. It is found that the static ground water level in the area generally varies between 6 m to 14 m. It is shallow near the canal and the seasonal fluctuations of water table are around 1m to 3 m. Figure 1. It was assessed that top layer of very fine to fine sand was present, which varied in thickness from 10 m to 30 m, approximately. At location N1, silty clay/ clayey sand was present at 30 m depth. This layer was absent at all other points. At location N2, silty sand was assessed at a depth of 17 m from the ground surface, which was a localized formation. At all other locations, medium sand to coarse sand was present beneath the fine sand layer, which promised good prospects for the groundwater recharge. Considering the results of resistivity survey, points N4 , and N5 were selected as locations for installation of recharge tube wells. The recharge tube wells were installed at a distance of 50 m between the points N4 and N5 in bed of the old Sirsa branch canal to recharge groundwater artificially. The rotary drilling was used to bore hole of 50 cm diameter to the depth of 45 m. The soil samples collected during drilling operation from the recharge tube well locations verified the results of resistivity survey, as generally sand was present for the major part of the profile. At greater depths gravel was also reported.



Presence of gravel provided good possibility of recharge. The slotted PVC pipes of 20 cm diameter were lowered in the bore hole as conduit for recharging water. The slots (3 mm × 75 mm) on the PVC pipes were provided throughout the pipe length. Annular space between the bore hole and the pipe was filled with gravel of 9 mm to 12 mm in diameter through which the most of water should percolate down to the aquifer.

3.3 results and discussion : Water Table Fluctuations

Effectiveness of recharge tube wells was understood by comparing water table fluctuations in the observation well (A1) located in front of recharge tube well A with water table fluctuations in the observation well (O1) located at the same distance (ie, at 16 m) from canal but towards upstream side (Figure 4). The water table elevation at observations well A1 and O1 with time are shown in Figure 5(a). Higher water table elevations at obversations well A1 clearly indicated the enhancement of recharge due to recharge tube well. Also, water table fluctuations at observation wells A2 and A3 were compared with water table fluctuations at observation wells O2 and O3 , respectively. Similar results were observed as in earlier case. It suggested that there was an increase in recharge rate due to recharge tube well.

Table 1 Electrical conductivity and dissolved Na+ concentration at observation wells

Date	Electrical Conductivity, dS/m				Dissolved Na+ Concentration, meq/l			
	Canal	A1	B2	O1	Canal	A1	B1	O1
First Year								
August 06, 1998	0.204	0.352	0.417	0.686	4.66	5.92	0.70	10.70
August 13, 1998	0.250	0.409	0.429	0.699	4.90	5.29	6.57	11.44
August 20, 1998	0.246	0.425	0.411	0.686	5.29	6.90	7.56	10.34
Second Year								
August 02, 1999	0.218	0.326	0.498	0.677	4.75	6.75	7.05	13.08
August 13, 1999	0.221	0.368	0.372	0.694	4.12	5.36	7.16	14.56
August 24, 1999	0.232	0.406	0.549	0.656	2.55	5.26	6.50	9.88
September 10, 1999	0.248	0.365	0.380	0.631	4.05	4.60	6.20	10..60

3.4 conclusion : Artificial groundwater recharge is possible in the depleting water table areas of Indo-Gangetic plains using recharge tube wells. Estimation of availability of rechargeable water is very important before planning any groundwater recharge project. The geo-electrical resistivity survey may be effectively used to search suitable sites for recharge. Provision of silt basin and suitable filter can ensure long life for recharge tube well. The recharge tube well performed well continuously for two monsoon seasons. The average recharge rate of 10.5 l/s was estimated due to one recharge tube well, which was reasonably good. Radius of influence of recharge tube well was 100 m approximately. Hence, the distance between two recharge tube wells should be more than 100 m for recharge studies in the North-East Haryana. Information and technology generated through this scientific endeavour may help a lot in planning of artificial ground water recharge projects, which may be expected in near future.

4. CONCLUSION

artificial recharge the use of source waters of impaired quality is a legitimate alternative wherein recharge in intended to govern saltwater intrusion, lessen land subsidence, maintain flow baseflows, or comparable in-ground functions. it's far specially nicely acceptable for nonpotable functions, including panorama irrigation, because fitness risks are minimum and public popularity is excessive. where the recharged water is to be used for potable purposes, the health risks and uncertainties are more.