GROUNDWATER SALINITY IN COASTAL AQUIFERS

The Indian peninsula has a long coastline of about 7000 km. Water resources in these coastal regions have a special meaning since any developmental activity largely depends upon the availability of freshwater to meet the industrial, agricultural and domestic requirements. Groundwater is an important natural resource of fresh water for human consumption in these areas and is increasingly being used to meet the major bulk of water supply demands. However, coastal aquifers are vulnerable to contamination from saline water. Major sources of groundwater salinity in a coastal aquifer may be either one or a combination of the following:

- Intrusion of saltwater from sea due to extensive lowering of water table
- Seawater present in aquifers from past geologic times
- Presence of salt domes in geologic formations
- Salts in water concentrated by evaporation in tidal lagoons, playas or other enclosures (e.g. aquaculture tanks)

As more and more coastal areas are developed and groundwater withdrawals increase, the heavier saltwater intrudes further into a freshwater aquifer and renders the saline water unfit for human use. Once the freshwater aquifer turns saline, it becomes extremely difficult to reclaim the much-needed freshwater. In India, most of the states lying along the coast are facing this threatening scenario. In order to avoid the costly and irreversible loss of these precious freshwater reservoirs, there is an imperative need to plan a sustainable groundwater development of coastal aquifers. Such groundwater development calls for a planned pumping policy, keeping in view the salinity source and appropriate measures to control saltwater intrusion in coastal aquifers.

TECHNOLOGY

To combat the problem of saltwater encroachment, following preventive/ remedial strategies may be employed:

- Artificial recharge
- Controlled extraction pattern
- Injection/extraction hydraulic barriers
- Physical subsurface barriers

In order to plan an optimal pumping/recharge policy in accordance with above strategies, it is essential to have prior information about the behavior of freshwater-saltwater interface in response to various possible pumping/

recharge policies. In such cases, mathematical models, that can simulate the behavior of a coastal aquifer in response to a given hydrologic scenario, prove to be indispensable tools in formulating a sound management policy. As an example, a study carried out by the National Institute of Hydrology, Roorkee in collaboration with the Ground Water Department, Andhra Pradesh on Freshwater - Saltwater Interaction in the Coastal Aquifer System in Krishna Delta, A.P. is briefly described here. The project was taken up on account of numerous reports made by farmers of an increase in groundwater salinity in areas that were previously yielding fresh groundwater.

Krishna Delta is an agricultural area, well known for its rich paddy yields. Lately, due to dwindling supply of canal water for irrigation, groundwater is being tapped on a larger scale. The triangular-shaped study area in Krishna Delta

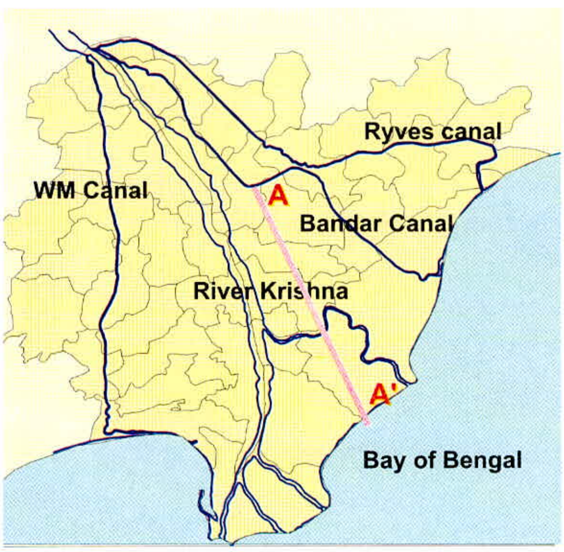

Figure – 1 A coastal area of Krishna delta

(shown in Figure-1) consisted of the region bounded by WM Canal in western delta, Ryves Canal in eastern delta, and Bay of Bengal on the seaward side. The ultimate goals of the project were to gain an understanding of the hydrogeology of aquifer system in Krishna Delta, analyze reasons for water salinity in the area, develop numerical model of groundwater aquifer system and devise possible remedial measures in the area.

To achieve the project goals, extensive groundwater monitoring and field investigations were conducted. Hydro-geologic investigations showed that the aquifer system consists of three aquifer zones, which are interconnected at places. The fourth deep-seated aquifer is largely isolated from the other aquifer zones. Hydro-chemical and isotopic analyses of groundwater samples from the study area revealed that the existing salinity (which ranges from slight to moderately brackish in shallow and middle aquifer zones and highly brackish to saline in deeper zones) is mainly due to the migration of coastline over the geologic time scale. Freshwater recharge arising from Prakasam reservoir and canal irrigation, besides rainfall, has lead to freshening of previously saline groundwater.

Numerical modeling of saltwater transport along section AA' (refer to Figure-1) revealed that a decrease in freshwater recharge to the aquifer system would slowly but eventually lead to encroachment of saltwater from the existing saltwater zones into the adjacent freshwater zones in the shallow and middle aquifers. Already, the flow in River Krishna and discharge of water into the canal system has declined on account of increasing upstream usage, which in turn has reduced the groundwater recharge arising from canal seepage and irrigation return flow.

To test the effectiveness of artificial recharge through recharge wells, a complex of 5 recharge well structures (shown in Figure-2) were constructed at Ayodhya village in Mopidevi mandal. These wells were located in three outfall drains which discharge significant quantities of water into the river when the canals are operational. Analyses of groundwater samples from observation wells in the area revealed a decrease in groundwater salinity in the surrounding area within a radius of 500 m, as a result of artificial recharge.

ENVIRONMENTAL IMPACT

It will not have any adverse impact on the environment.

Figure – 2 Recharge well at Mopidevi

ECONOMICS

This technique helps in managing the groundwater resources in coastal areas. Therefore, it will have tangible and intangible benefits.

BENEFICIARIES

Central and State Groundwater Development Agencies including farmers and the local population of the region.

INTELLECTUAL PROPERTY RIGHTS

No Intellectual Property Rights is involved in the use of this technology.