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Application of GPS and GIS for Assessment of Groundwater Flow

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Abstract

Coastal zones are unique. It is a place of high priority interest to people, to commerce, to the military, and to a variety of industries. Because it contains dense populations, undergoes great environmental modification and deterioration through landfill, dredging, and pollution caused by urban, industrial, and agricultural development. A recent assessment in Science (1997) stated that 37% of the world's population lives within 100 km of the coast. Ground water is a major source for all developmental activities, especially for resort based tourism (ICMAM Plan for Chennai). The tremendous increase in population over the coastal area leads to over exploitation of ground water resources causing salt-water intrusion problems in these areas.

When ground water resources are overexploited, more water is used than the aquifer can replenish through infiltration. Without sufficient recharge of the ground water, wells can go dry or "Pull" saltwater from the estuaries into the aquifer (John R, Clark).

Monitoring the ground water level and its quality is essential for the sustainable use of groundwater resources and to prevent saltwater intrusion into the fresh ground water. Presently, ground water levels are monitored independently without reducing to MSL (Mean Sea Level), as the process is labour intensive and expensive. With this method, spatial distribution of flow cannot be assessed. An efficient and fast method was used at Pondicherry to connect all observation wells. Pondicherry region, one of four enclaves, which constitute the Union Territory of Pondicherry (UTP), a former French Colony, is implementing project

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"Tank Rehabilitation Project Pondicherry" (TRPP) to improve the ground water condition. As a part of the project Real Time Kinematic GPS was used to measure the ground level from the mean sea level. The study covering an area 900 km^2 with 240 observatory wells were surveyed using RTKGPS and reduced to MSL. The collected data were processed using ArcView GIS software.

The application of RTKGPS and GIS helped in arriving at the flow condition of groundwater and spatial distribution of levels in the observation wells of Pondicherry. Based on the above study, PWD is working out strategies for identification of recharge area and policy for minimising the over exploitation of ground water among different user groups.

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Strategies to Upkeep the Ecology of the Coastal Regions and to Attain Sustainable Groundwater Development from the Coastal Aquifers of Tamil Nadu - India

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Abstract

Tamil Nadu is underlain by six geological terrains ranging in age from the recent sand dunes to the oldest crystalline rocks of Archaen age. Only 26% area of this State is covered by sedimentary formations. They are located mostly adjacent to the coast. They have appreciable quantity of groundwater. Any damage to the coastal eco-system will affect the potential aquifers of the coast and pollute the groundwater.

The low lying long coast, heavy extraction of groundwater in the sedimentary areas, favourable aquifer properties of the coastal aquifers, seas water intrusion, saline water aquaculture high tide frequent monsoon failures are the major causes deteriorating the costal ecology of this State

Tamil Nadu is a deficit water resources State where the present per capita per year water resource is only 805 cubic metre. Unless effective steps are not being taken up now to increase or save the water resources of this State, the per capital per annum water resources during 2050 AD will be about 435 cubic metre. At that point of time this State is likely to suffer even to meet the domestic demand.

Even now this State is reeling under the severe water scarcity. During 2025 AD this State needs about 2,423 tmcft of water for all the sectoral needs. But the available water resource is 1,674 tmcft. Hence deficit is 749 tmcft that works out

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to 44.74% , if action is not being taken up immediately to increase or save the water resources, the supply and demand of this State during 2050 AD will be 1,499 tmcft that works out to 89.55%.

Out of the total groundwater potential of this State about 50 to 60% is obtained from the sedimentary aquifers located adjacent to the coast. If there is no check to arrest the coastal zone eco system deteriorating agents like, sea water intrusion and the other natural or man made activities it is likely that the entire fresh water aquifer which are located within 80 to 100 km look distance from the coast are likely to be contaminated/deteriorated almost within another 25 years.

While the water resources status of this state is very grim the heavy extraction of groundwater in the coastal aquifers have already started to deteriorate the fresh groundwater not only in Minjur north of Chennai but also in some other areas due to seawater ingress. In Minjur the seawater has already invaded about 16 KM and polluted the inland aquifer. The annual migration rate of the seawater ingress is about 427M.

Now about 17 Million cubic meter (MCM) of fresh groundwater per annum is deteriorated due to the seawater intrusion alone. If there is no check to control the seawater ingress about 40 MCM of fresh groundwater is likely to become saline per year in the 1,000 km coastal length of this State.

The authors would like to suggest the following strategies to prevent the deterioration of the eco-system of the coastal areas of this State.

1. Develop the ground water in such a way to by keeping the groundwater level in the coastal aquifers always one foot above mean sea level.
2. Carry out artificial groundwater techniques like (1) Surface spreading (2) Injection, (3) creation of fresh water ridge (4) development of pumping through (5) Construction of subsurface barrier etc.
3. Adopt all the coastal zone management approaches, including implementation of groundwater norms

The authors feel that only through these approaches it would be possible to upkeep the ecology including the arresting the seawater ingress in the coastal areas of this State. Then only it would be possible to get a sustainable groundwater resource from the coastal as well as in the sedimentary aquifers of the State. Since the groundwater resources of the coastal aquifers are about 60% of the total groundwater potential of this State the above strategies have to be implemented forthwith.