Investigation of the Effectiveness of Salt Barrages in Jaffna Peninsula

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Introduction

The Jaffna Peninsula which is the northernmost tip of Sri Lanka has its groundwater source in the subsurface limestone layer. Due to over exploitation of groundwater for agricultural needs, most wells in the region have become brackish. Therefore, a supply source to replenish the wells to meet the increasing demand for fresh water is of paramount importance. Converting the two internal saltwater lagoons, Vadamarachchi and Upparu, to fresh water lakes is expected to improve the water resources of the peninsula, both in recharging the underground storage with additional surface storage and desalinating the lands fringing the lagoons. Making these lands suitable for cultivation and fresh water prawn farming in the banks of the lagoon are also expected (Shanmugarajah, 1993).

The Upparu lagoon with surface area of about 26 km^2 has opening to the sea towards the south and is mainly a saltwater lagoon. During the north-east monsoon rain water fills up the lagoon lowering its salinity. Saltwater barrages have been erected in the mid 1900s to convert the lagoon into a fresh water lake (Rajasooriyar *et.al.*, 2002). However, the barrages have not functioned properly and have allowed the salt water to intrude. Repair and replacement of these barrages were completed in October 2009.

Currently the effectiveness and the efficiency of the Ariyalai barrage of Upparru lagoon is monitored by the Irrigation Department by observing the salinity of surface water in five locations every month. This research focuses on evaluating the effectiveness of the Ariyalai barrage by delineating the saltwater intrusion pattern and groundwater flow pattern within the area extending from the fringe of the lagoon into the land for 2 km. The larger area coverage is expected to provide a more realistic picture of the saltwater intrusion patterns and hence a correct assessment of the effectiveness of the barrages.

Materials and Methodology

Existing aquifer types, geology and topography were studied with the help of previous researches and through monitoring carried out in the area. No comprehensive studies have been carried out on groundwater to check the effectiveness of the salt barrages constructed in Jaffna Peninsula. Wells were selected in a profile perpendicular to the fringe of Upparu and Jaffna lagoons. The study area covers parts of Nallur, Kopay and Chavakachcheri Divisional Secretariat Divisions.

Electrical conductivity (EC) values of the groundwater samples drawn from 100 wells were measured in situ. Depth to water level in each well was also recorded. Measurements were taken during January and July to represent dry and wet seasons of the region. The wells, which showed abrupt changes of EC, were selected for further hydrochemical analysis. Thirty such shallow wells were selected for the analysis. EC was measured using calibrated standard conductivity probe. Water samples were analysed to determine chloride, sulphate bicarbonate, sodium, potassium, magnesium and calcium concentrations using titrimetric

and spectrometric methods such as atomic absorption spectroscopy and UV/Visible spectroscopic methods. Spatial distribution of the chemical and physical parameters of the groundwater was interpolated using Inverse Distance Weighted method. DEM was created to delineate the groundwater flow pattern.

Results and Discussion

Chloride concentrations in groundwater are very high in coastal regions. Measured chloride levels in wet season vary between 1.4 mg/L and 8200 mg/L. In dry season they vary between 42 mg/L and 4356 mg/L. EC values increased in dry season when compared to wet season (Figure 1). It is observed that EC values are generally higher downstream of the barrage. During the dry season they further increase. The saltwater movement can be observed during the wet season in the left bank of the lagoon upstream of the barrage. That high conductive flux seems moving in southwest direction during the dry season. Thus, the conductivity distribution appears to be complicated in spatial and temporal dimensions.

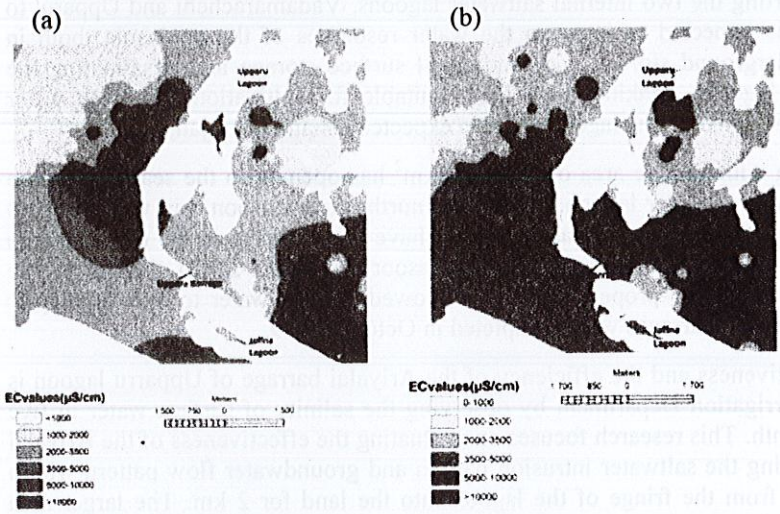

Figure 1: Distribution of EC values during (a) wet season (b) dry season

Conclusion

Groundwater in the fringe of the Upparu lagoon, which is far from the barrage is of good quality compared to the groundwater closer to the barrage in both seasons. If the barrage works properly the groundwater in the fringe of the lagoon should have a near freshwater composition. Therefore, it can be concluded that the effectiveness of the barrage is less during both seasons. However, further continuation of this research would deliver a much better result.

References

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