Investigation of the Effectiveness of Salt Barrages in Jaffna Peninsula: Phase 2

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Introduction

The Vadamarachchi lagoon and the Upparu lagoon have surface areas of about 77 and 26 km^2 respectively. These lagoons have openings to the sea and are salt water lagoons. However, during the Northeast monsoon, rainwater from their catchment areas also collects in them. The total catchment area of these lagoons is about 50% of the area of the peninsula (Balendran, 1968). Groundwater is the prime source for people in Jaffna peninsula for their drinki ng, domestic and agricultural activities. Even though the households have their own wells, majority of the wells in the study area are affected by salt water intrusion. Thus, as a prevention measure barrages were constructed. The Thondamanaru barrage commenced in 1947, a separation bund between the Vadamarachchi lagoon and Upparu lagoon was constructed along a saddle between the two lagoons. Subsequently Upparu lagoon was incorporated into the scheme by the construction of a semi-circular spill at its outlet at Ariyalai. Thondamanaru barrage was completed in 1953 and Ariyalai barrage in 1955 (Shanmugarajah, 1993). Barrage serves as a salt water exclusion bund to convert the internal salt water lagoon Upparu, to fresh water lake 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 (Balendran et al., 2012).

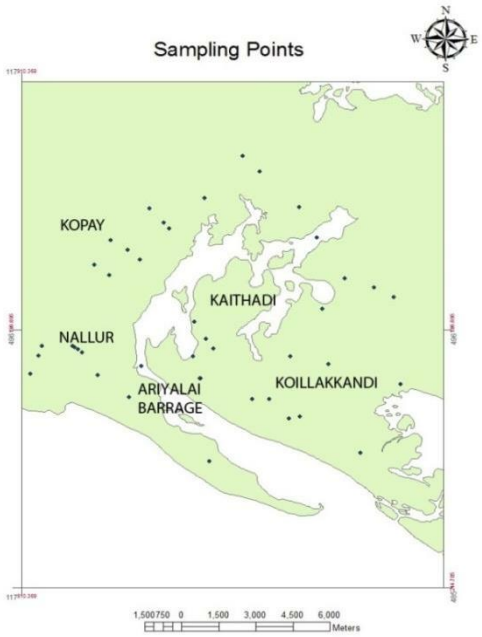

Figure 1: Sampling Locations.

The study focused on the area from the fringe of the lagoon into the land extending for 2 km around the barrage including the downstream to evaluate the effectiveness of the barrage by delineating the salt water intrusion pattern. Area on the west and northwest were included in Phase 2 of the investigation (Figure 1). In the initial stage in 2011-2012, the north, east and south areas of the lagoon were considered.

Methodology

Existing data including salinity, sodium and chloride concentrations aquifer types, geology and topography were the areas of data collection. Wells studied in the initial stage and wells in the downstream of the barrage were sampled. Electrical conductivity (EC) of the groundwater were measured with Thermo Orion 3Star EC meter during wet and dry seasons (November 2012 and April 2013). The wells in which EC shows a sudden change was selected for further hydro chemical analysis (sodium and chloride). 35 shallow well samples were selected for sampling during each wet and dry seasons. Samples were analyzed for Na using Varian SpectrAA 240 AAS facility available at the UvaWellassa University. Chloride was measured with argentometric method. Spatial distribution of the chemical and physical parameters in the groundwater were plotted using Inverse Distance Weighted method aided by ArcGIS 9.3.

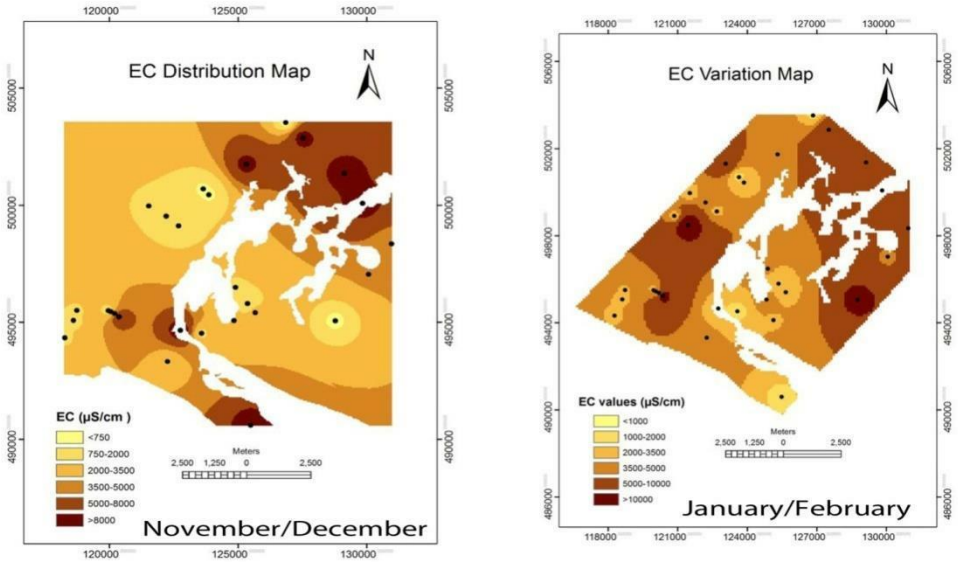

Figure 2. EC variation in the study area during wet season.

Results and discussion

The EC of the groundwater in the study area varies between 881µS/cm and 21,500µS/cm and it varies between 798µS/cm and 13,660µS/cm in wet and dry seasons (Figure 2). In accordance with the investigations of Department of Irrigation, salinity of Upparu lagoon water decreases in wet season and increases in dry season. This is due to the dilution of the saltwater with rain overland flow and excessive evaporation and irrigation during the dry period. The salinity is lower than 20 dS/m in December in most localities of the lagoon. Far from the barrage, lower the salinity. Furthermore, the salinity has become less over the years since 2010, when the barrage was reconstructed.

Chloride concentrations vary between 71 mg/L and 447.3 mg/L in November/December in 2012 and it varies between 28.4 mg/L and 163.3 mg/L in January/February in 2013. Further dilution during the wet season was the main reason for this variation. Sodium values vary between 35.8 mg/L and 930.2 mg/L in November/December in 2012 (Figure 3). This trend can be observed at all localities of the lagoon. Behaviour of the parameters are different during the dry season. EC vary between 798 µS/cm and 13,660µS/cm in general.

Chloride concentration varies from 14.2 mg/L and 362.10 mg/L. evaporation leaves lagoon water more concentrated with chloride and additionally, excessive irrigation extracts would facilitate saltwater intrusion. However, in terms of preventing underground intrusions, the barrage has not been succeeded.

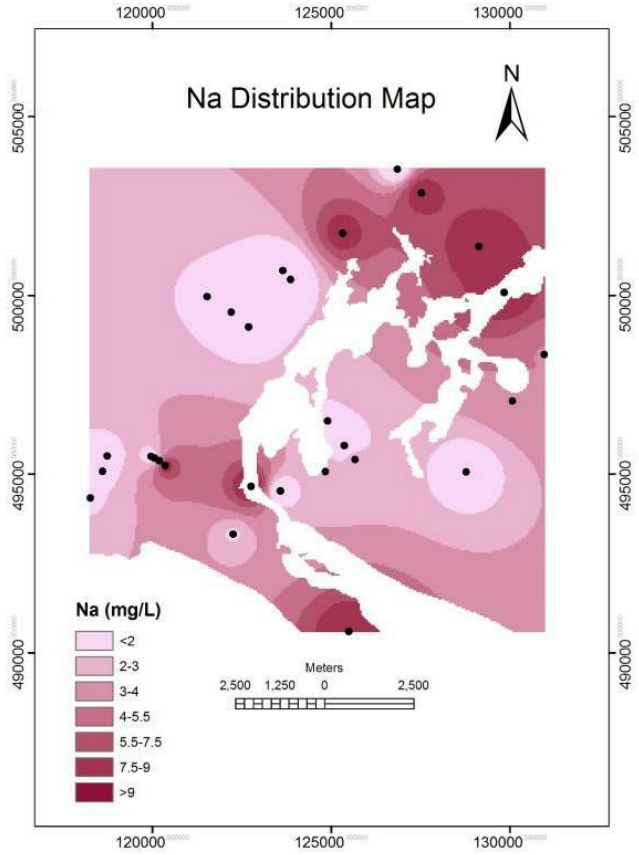

Figure 3. Na concentration in the study area during wet season

The Upparu lagoon receives water from the seasonal rainfall which is the northeast monsoon and drainage from the catchment areas. Due to the high irrigational activities and rapid extraction of water are the reason for seawater intrusion in to the aquifers. However, the wet seasons rain water infiltrate and percolate into the groundwater. Because of this, salt intrusion and seepage through the underground formation will be reducing towards the land. The parallel area next to the fringe of the lagoon has high EC. However, EC declines from lagoon towards the land from SE to NW directions, because of the rainwater infiltration. A well at Chemmani area shows high EC in both wet and dry seasons. However, in proximity wells sho w normal EC. In general, EC in wet seasons are 21,500µS/cm, 16,610µS/cm and 11,650µS/cm in dry season.

Conclusions

2012 and 2013 sodium and chloride concentrations indicate that groundwater in the fringe of the Upparu lagoon which is far from the barrage has good quality water than the ground water closer to the barrage in both seasons. However, compared to previous data, water quality is better in the Phase 2 of the study. Further continuation of this research would deliver a better result than this.

References

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