Socio-economic impact of the groundwater development in the Northern Territory (Australia)

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Abstract: Horticulture is the main industry in the North part of the Northern Territory (N. T.) of Australia. However, there is not sufficient fresh water along the coast for this industry due to saltwater intrusion. Therefore, it was recommended to adopt those industries, which uses saline water only. This idea was executed successfully in the Middle Point area where it has boosted the economy and social life of the region.

Key words: Northern Territory, Australia, Saltwater intrusion, Aquaculture, Wetland

Introduction

The area lies between Longitudes 131° 12' 36" & & 131° 23' 32"and Latitudes -12° 42' 1" & -12° 29' 27", covering about 225 km^2 (Figure 1) and it is accessible all around the year to most of the area by both the sealed and gravel roads. The area is situated in the tropical climate and has two distinct seasons - *dry* (cooler) from May to October and *wet* (rainy) from November to April with temperature ranging from 14.0 to 32.0 °C during the *Dry Season* and from 26 to 35 °C in the *Wet* Season. The annual mean rainfall in this area is about 1600 mm, however the highest recorded was 2000 mm during the 1994-5 season.
The area is surrounded by the black soil coastal and flood plain where experimental farms were established during 1950-60s to grow rice unsuccessfully. About 60 % of the area is wetland. However, the rest of the area is very productive where tropical fruits (mango, banana, popo, etc.) and tropical vegetables are grown commercially. Therefore, the N. T. Government encouraged the farmers to expand horticulture industry in this region. The N. T. is a very fast developing territory in Australia and therefore an additional land and water was needed. A groundwater investigation was carried out in Lambells Lagoon area (Foo & Verma, 1995). It was then followed a groundwater investigation in the adjoining area (Middle Point area) during 1997/98 where only a limited amount of fresh water was found. It was not sufficient for the demand, because the higher pumping rate could lead to the saltwater intrusion. Therefore, it was suggested to farmers and landholders to change over to a salt-water based industry and it was successfully adopted.

Results and Discussion

Geologically, the area lies in the western part of the *Pine Creek Geosyncline* in which the *Lower Proterozoic* carbonate rocks were deposited during 1800 Ma over the Archaean basement (BMR Maps, 1983). The *Lower Cretaceous* sediments during 65 Ma were deposited on top of the carbonate. During a long period of non-deposition and erosion period between 1800 and 65 Ma, a karstic surface was formed on which the Lower Cretaceous sandstone

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was deposited along with the carbonate boulders pebbles, etc. and they created a layer (a maximum of 20 m thickness), which is the main carbonate aquifer (VERMA, 1980). Saline groundwater is being used in fish and crocodile breeding.

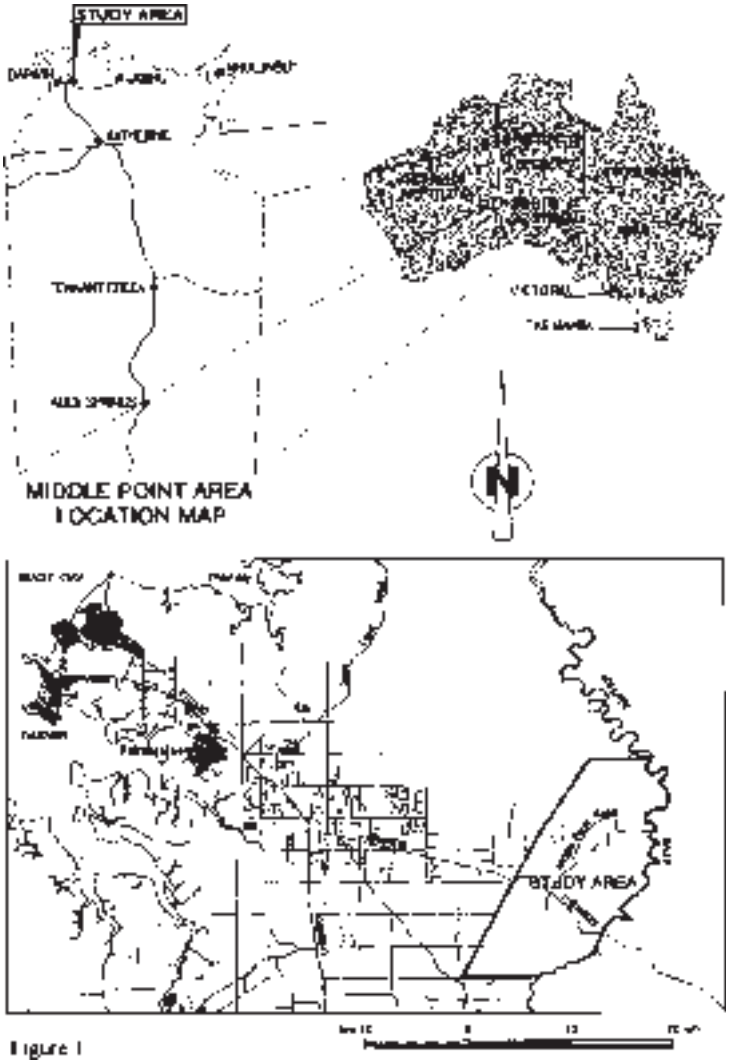

Figure 1

About 30 % of the monsoonal rain recharges the aquifer annually. The average seasonal variation in the standing water level (SWL) is up to 20.0 m (Figure 2). Saltwater intrusion during the Dry season has been observed due to large amount of pumping and decline of SWL (Refer report No 03/1998 D). The investigation established a saltwater gradient with the help of geophysics and chemical analyses and finally a hydrogeological map was produced with a boundary of fresh and saline water. A groundwater modelling was carried out using DEM (digital elevation model) to find the recharge and discharge to establish the amount of the fresh groundwater available for additional pumping without creating saltwater intrusion (the AQUATERRA REPORT, 1999).

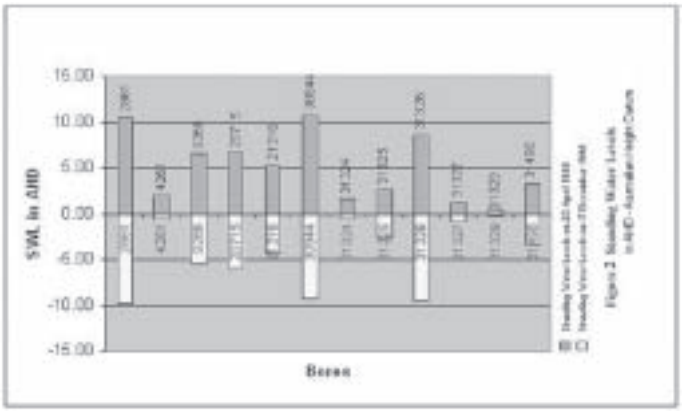

Figure 2. Standing Water Levels on the same day in Bores

The aquifer water is carbonate and hard with TDS (total dissolved solids) around 200 mg/L and bicarbonate (HCO_3) around 250 mg/L. Sodium (Na) and chloride (Cl) are very low. The salinity value depends on the geographic location. Both Chloride and the electric conductivity (EC) were measured over a year (see Figures 3 & 4) and their values were seen to be increasing as the Dry Season progressed. The highest salinity measured in the electric conductivity (EC) was 61,000 mS/cm, which is an appropriate value for the aquaculture farming requisite. The Adelaide River traverses through this area where it is tidal with an annual fluctuation of about 4.0 m. However, it doesn't have any significant effect on groundwater (quality or swl) as seen in a bore within 10 m from the riverbank.

It should be noted that the salinity in this bore (Figures 3 & 4) declines during the Wet Season as the fresh water recharges the aquifer. However, in the event of excess pumping this reversal wouldn't happen because the SWL is at a critical level and any major change might create a problem. Hence any expansion of the horticultural industry in this region is restricted. During the geophysical survey with EM 34 with separation of 40 m (Knapton, 1998), it was observed that the water with the EC value > 80 µS/cm was brackish. The soil type also affects this value. Therefore, these both data were taken into account to establish the saltwater boundary.

Conclusion

The use of the saline water in the aquaculture industry was a success and it has proved that there is no such thing as bad water. There are numerous areas in Australia, which lie along the coast. A large number of traditional Indigenous Australians live along the coast. Therefore, a proper use of water would always save both the economy and social pattern. Use of water must be according to their type (saline, polluted or highly mineralised, etc.). Fresh water should be used for the domestic purposes only. Results of this investigation were incorporated in the Hydrogeology Map of Darwin (Verma, 2002).

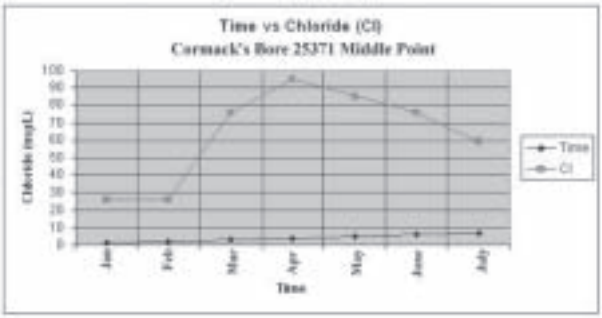

Figure 3. Time vs. Chloride Graph

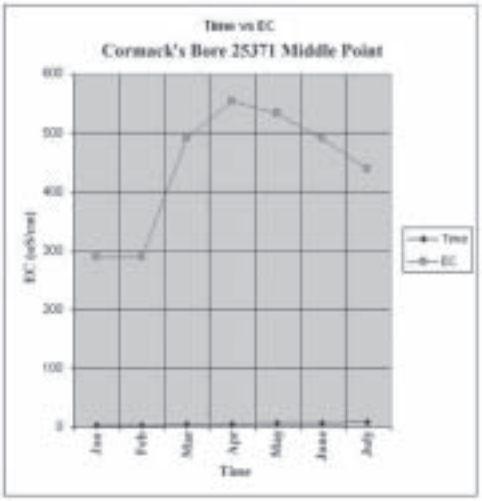

Figure 4. Time vs. EC Graph

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