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ANALYTICAL STUDIES ON IRRIGATION WATER AT KALUTHAWALAI IN THE BATTICALOA DISTRICT

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Abstract

An analytical study was carried to determine the suitability of ground water for irrigation. Chemical analysis of sodium, calcium and magnesium were carried out and electrical conductivity was measured during December 1998 to March 1999. The results elucidate that the ground water is suitable for irrigation, however special management practices are essential.

keywords: :Electrical conductivity, Ground water, Saline water intrusion, Sodium absorption ratio

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1 Introduction

Batticaloa district is located in the East cost of Sri Lanka. It covers a land area of approximately 2463.63 *square Km* and internal waterway of 229.2 *square Km*. The district accounts for 3.8% of the country's total area. The boundaries of Batticaloa district are Polanaruwa district in the west, Verugal Aru and Trincomalee in the north, Ampara district in the south and Bay of Bengal in the east. The physical feature of the district is flat not exceeding 7.62 *m* in height above the sea level. The east cost of the district is sandy soil and the west is clay soil. The land boarding the lagoon is alluvial.

Batticaloa district is located in the dry zone . Its climate is influenced by the Northeast and Southwest monsoons. The total annual rainfall is 1704.7 mm concentrated between the month of November and January. The annual mean maximum and minimum temperatures are 35^oC to 25^oC. Relative humidity ranges between 62 and 81 during the day and 76 and 83 during the night[4].
Water resources of the district are the rivers, lagoons and ground water. There are no natural springs in the district. Major portion of the population is engaged in agriculture while fishing occupies the second place in the social structure. Major part of the land is used for paddy cultivation. Other subsidiary food crops are also cultivated in the district. Almost all the farmers use organic fertilizers and most of the farmers use inorganic fertilizers above the recommended level.
Kaluthawalai is situated on the south of Batticaloa district and it is an area where intensive agriculture is becoming increasingly important. The soil, which is extremely permeable and is ideal for intensive irrigated agriculture. Ground water is used for irrigation in Kaluthawalai.

2 Materials and Methods

Four wells were randomly selected from agricultural area of Kaluthawalai. Distance between each well was about 300m.One well was selected from a non-agricultural area of Kaluthawalai for comparison. Three water samples in different points were collected from each well in separate plastic bottles and sampling was done at monthly intervals from December 1998 to March 1999. The methods for analysis were followed as prescribed in American Public Health Association APHA (1992)[1]. Sodium was determined using flame photometer and calcium and magnesium were determined titrimetrically. Electrical conductivity (EC) was determined by Griffin model conductivity meter. The relative proportion of sodium to other cations was determined by the sodium absorption ratio (SAR),

$$\text{SAR}=Na/\sqrt{(Ca+Mg)/2}$$

where the concentrations of the constituents are expressed in milli equivalents per litre[2]

3 Results and Discussion

Figure 1 shows the monthly variation of SAR of the ground water sample. The highest SAR value (4.69) was observed at sampling station 4 (which is near to the sea) during December and the lowest SAR value (0.06) was observed at sampling station 2 (which is close to the main road and about 1.5km far from sea) during February. It was observed that heavy rain fall leads to a decrease of SAR value

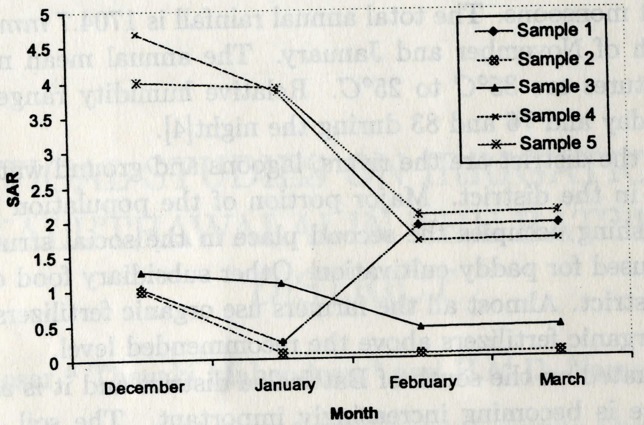

Figure 1: Monthly variation of SAR of the well water in Kaluthawalai

during January. During February and March SAR did not vary considerably. This is an indication that there is a general build up of SAR in the soil solution[3]. According to the classification of irrigation water based on SAR (Table 1) ground water in the selected wells can be used for irrigation with little danger of development of harmful levels of exchangeable sodium. Sodium concentration is important in classifying irrigation water because sodium disintegrate the soil aggregate and reduce its permeability and also affect the plant growth.

Table 1: Classification of irrigation water based on SAR[2]

SAR	Water Type
0 - 10	Low sodium water
10 - 18	Medium sodium water
18 - 26	High sodium water
> 26	Very high sodium water

Figure 2 illustrates variations in the monthly mean values of sodium in Kaluthawalai area. Water samples collected in Kaluthawalai at sampling station 4 and 5 (near to the sea) showed high sodium concentration than the others. Saline water intrusion may be the reason for these higher observed values.
According to US salinity diagram [2] for classification of irrigation waters sodium hazard is low in all the sampling stations at Kaluthawalai and salinity hazard is high in sampling stations 1,3,4 and 5.

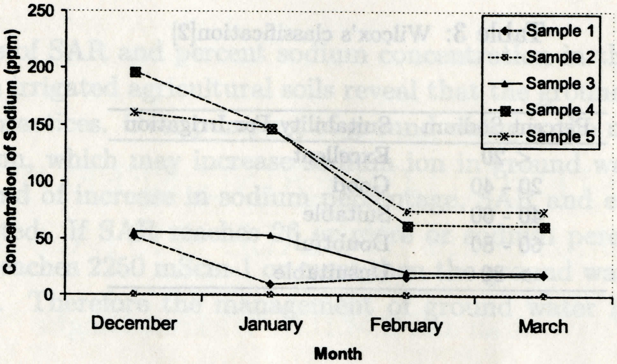

Figure 2: Variations in the monthly mean values of Sodium

Table 2: Percent sodium concentration of well water in Kaluthawalai

Sample Number	Average Percent sodium concentration
S1	14.21
S2	6.88
S3	18.97
S4	47.81
S5	49.56

Table 2 shows that the water sampled from the well in non agricultural area at Kaluthawalai (S2) has the lowest sodium percentage (6.88) and water from sampling station 5 has the highest sodium percentage (49.56).

According to Wilcox's classification[3] (Table 3) water from the sampling station 2 (S2) is excellent for irrigation and others are permissible for irrigation. Figure 3 illustrates the monthly variations of electrical conductivity (EC) of the ground water samples. The electrical conductivity varied from 112.26 μScm^{-1} to 1301.3 μScm^{-1}. While EC of ground water collected from the non-agricultural area remained more or less the same over the periods concerned, EC of ground water collected from agricultural area showed higher values. This indicates a gradual build up of ionized substances in the ground water due to the application of fertilizers and agrochemicals.

According to the classification of irrigation water based on EC (Table 4) water sampled from non-agricultural area is low salinity water and can be used for irrigation for most soils. Water sampled from agricultural area can not be used on soils with

Table 3: Wilçox's classification[2]

Percent Sodium	Suitability For Irrigation
< 20	Excellent
20 - 40	Good
40 - 60	Suitable
60 - 80	Doubtful
> 80	Unsuitable

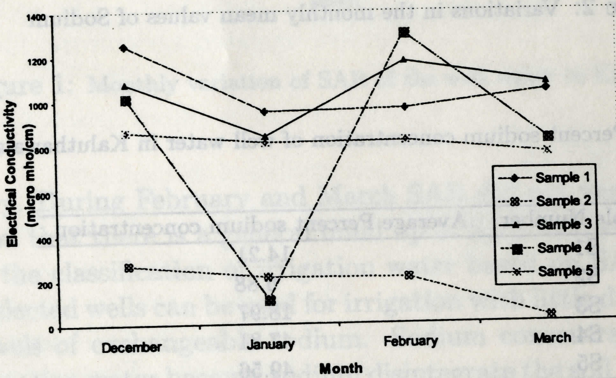

Figure 3: Monthly variation of EC (mScm-1) of well water in Kaluthawalai

Table 4: Classification of irrigation water based on electrical conductivity[2]

EC (μScm^{-1})	Water Type
100 - 250	Low salinity water
250 - 750	Medium salinity water
750 - 2250	High salinity water
> 2250	Very high salinity water

restricted drainage. Special management practices are required along with adequate drainage for salinity control.

4 Conclusion

Higher values of SAR and percent sodium concentration in the ground water from wells beneath irrigated agricultural soils reveal that the ground water is polluted by agricultural practices. Over pumping of ground water is the major cause for saline water intrusion, which may increase sodium ion in ground water. In the long run a gradual trend of increase in sodium percentage, SAR and electrical conductivity can be expected. If SAR reaches 26 or more or sodium percentage reaches 80 or more or EC reaches 2250 mScm-1 or more then the ground water will be unsuitable for irrigation. Therefore the management of ground water is very important for irrigation.

Acknowledgement

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