IRRIGATIONAL QUALITIES OF GROUND WATER IN ANDHRA PRADESH

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Abstract : Irrigation is the science of artificial application of water to the land in accordance with the crop requirements throughout the crop period for the full nourishment of the crops. The water resources for irrigation can be divided into two types, 1.Surface water, 2.Ground water. The ground water is twice as efficient in terms of agricultural productivity as surface water. While using ground water resources for irrigation, a thorough knowledge of its chemistry to assess its quality is essential. This could be very useful for a sound agricultural planning, soil and water management. The main criterion that is usually considered in the evaluation of irrigation is total dissolved salts and Sodium content in relation to the other cations. To study this, Ground waters from 10 bore wells in Andhra Pradesh were collected and analyzed for Sodium, Potassium, Carbonates, Bi-carbonates and Chlorides. The analysis is based on Electrical Conductivity (E.C), Total Dissolved Salts (TDS) and pH of the water. Based on Electrical Conductivity, and Total dissolved salts, 90% samples found to be suitable for irrigation.

Index Terms - Ground Water, Irrigation, Electrical conductivity (E.C), Total dissolved salts (TDS), pH

I. INTRODUCTION:

Irrigation is the science of artificial application of water to the land in accordance with the crop requirements throughout the crop period for the full nourishment of the crops. The water resources for irrigation can be divided into two types, 1.Surface water, and 2.Ground water. The ground water is twice as efficient in terms of agricultural productivity as surface water. While using ground water resources for irrigation, a thorough knowledge of its chemistry to assess its quality is essential. This could be very useful for a sound agricultural planning, soil and water management. The main criterion that is usually considered in the evaluation of irrigation is total dissolved salts and Sodium content in relation to the other cations. To study this, Ground waters from 10 bore wells in Andhra Pradesh were collected and analyzed for Sodium, Potassium, Carbonates, Bi-carbonates and Chlorides. The analysis is based on Electrical Conductivity (E.C), Total Dissolved Salts (TDS) and pH of the water. Based on Electrical Conductivity, and Total dissolved salts, 90% samples found to be suitable for irrigation.

MATERIALS AND METHODS:

Systronics Conductivity Bridge, Elico pH meter (model L 1-120), Burette, Pipette, Volumetrical flask, and Indicators materials were used in this analysis. Water samples were collected from 10 different bore wells situated in different places in Andhra Pradesh. Sample of about three liters from each site were collected in polythene cans and were analyzed in the laboratory using standard method.

METHODS OF WATER ANALYSIS:

(i) Electrical Conductivity: The electrical conductivity of water samples were determined by using Systronics Conductivity Bridge and the values were expressed in micro Siemens/cm.

(ii) pH: The pH of the water samples were determined by using Elico pH meter(model L 1-120).

(iii) Total dissolved solids: The values of total dissolved solids (TDS) were calculated from EC in micro Siemens/cm using the below given formula.

TDS=EC*0.64 mg /l

STUDY OF IONS IN GROUND WATER:

(i) Sodium: The Sodium content of the water was determined by using Systronics flame photometer. A standard solution of Sodium Chloride was prepared by dissolving 0.254 gm of Sodium Chloride (AR). Definite quantities of this solution were diluted to get standard solutions of different concentrations.

A standard curve was drawn from the values obtained by using these solutions in the photometer. The water samples were then atomized in the flame photometer and the readings were noted. From these values the concentration of solutions was obtained.

(ii) Potassium: The Potassium content of the water sample was estimated by using Systronics flame photometer. A standard solution was prepared by dissolving 0.1907 gm. of Potassium Chloride (AR). Definite quantities of this solution were diluted to get standard solutions of different concentrations.

A standard curve was drawn from the values obtained by using these solutions in flame photometer .The water samples were then atomized in the flame photometer and the readings were noted. From this value the concentration of potassium was obtained.

(iii) Carbonate and Bicarbonate: The Carbonate content was found absent in 80% of water samples. Though the concentration of Carbonate ions were in traces. The Bicarbonate concentrations were considerable in all the water samples analysed. The Bicarbonate ion concentrations in the waters analysed ranged between 3.2mg per litre and 9.7mg per litre. The average Bicarbonate ion concentration was 6.9mg per liter.

Irrigation waters containing high concentrations of Carbonate and Bicarbonate increase the salinity and Sodium content of the soil. Ildeforiso Pla (1968) observed in Venezula that when waters with very high Carbonate content were used the total salt and Sodium content of the soil increased on the surface soils.

Fullestone et.al., (1975) observed the increase of pH of the soil along with deposition of the Carbonate of Calcium or Magnesium, when the soils were irrigated with Bicarbonate waters. Ground waters with neutral pH values and with Bicarbonate alkalinity exhibit the most frequently encountered iron concentration in the range 1 to 10ppm (Faust 1981). A similar trend is observed in the present study also.

(iv) Chloride: Chloride content of the water sample was estimated by titrating 50ml of the water sample with standard 0.05 N Silver Nitrate solution using Potassium Chromate solution as indicator.

RESULTS AND DISCUSSION:

Water samples were drawn from 10 bore wells in different places of Andhra Pradesh. The main source of recharge of these wells is infiltration rain water. However some of these bore wells adjacent to rivers and cannels and considerable amount of recharge through seepage of river water is also possible. But no definite relationship could be established between the geological deposit and the water composition as the relative amount of the recharge through rain water infiltration or seepage from cannel are not known. Therefore, present study mainly deals the results on the chemical composition of the bore well waters and relevance to certain quality indices.

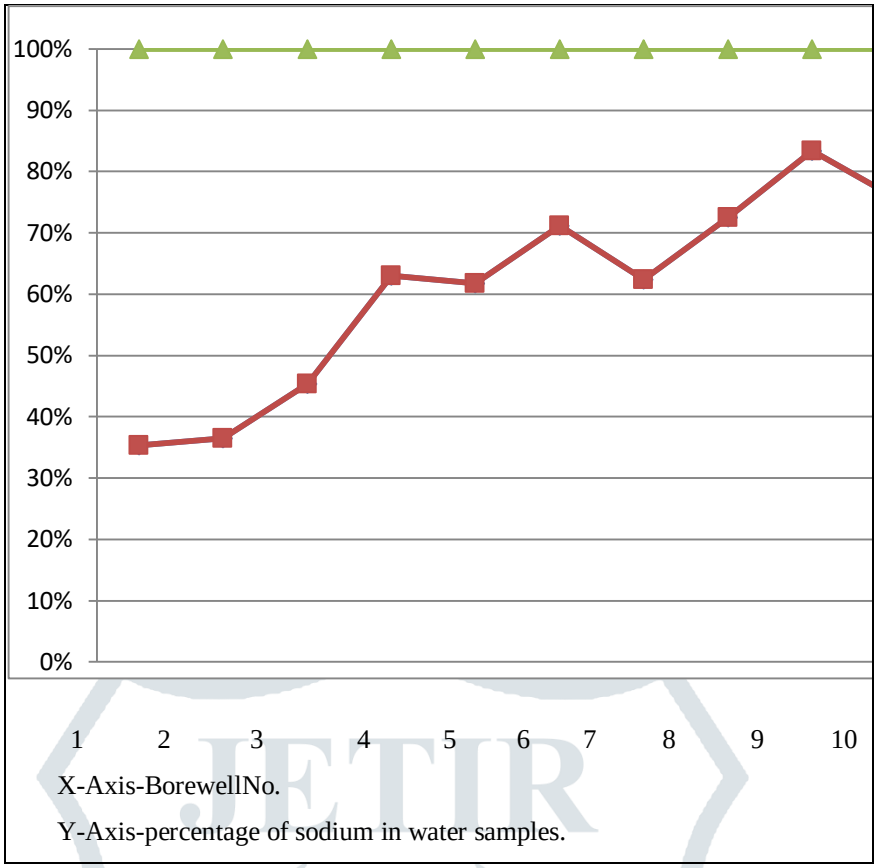
(i) **Electrical Conductivity:** The electrical conductivity of the ground water is varied from 146µ/cm to 1625µ/cm. The wide range in the EC values of the water samples indicate that the dissolved contents of these waters were varied. The water sample with higher EC values shows the contamination level of ground water.

PHYSICO CHEMICAL ANALYSIS

Bore well No	EC	pH	TDS	Na	K
1	470	7.8	300.8	1.83	0.07
2	1063	7.8	680.3	3.48	0.01
3	1190	7.4	761.6	3.61	0.00
4	1160	7.6	742.4	2.35	0.11
5	978	7.6	625.9	3.09	0.13
6	621	8.2	397.4	2.43	0.07
7	146	7.3	93.4	4.22	0.03
8	560	8.0	358.4	3.04	0.00
9	595	7.7	380.8	1.80	0.38
10	1652	7.3	1057.3	3.22	0.88

(ii) **pH:** The pH of the ground water ranged from 7.3 to 8.2 and the mean value was 7.7. Almost 80% of water samples were found to be in the pH range less than 8. All the samples are almost in the neutral range.

Sodium Content in Water Samples: The minimum and maximum of sodium content of water samples analyzed were found to be 1.80 mg/l and 4.22 mg/l. The average value was 2.91 mg/l. Almost all the natural waters contain Sodium cations but in concentration less than calcium and magnesium. This is reversed however in saline and brackish waters. Sodium ions tend to remain in solution and very seldom enter into precipitation reaction that would control its solubility. Clay mineral surfaces absorb sodium ions from solution where ion exchange reaction occurs.

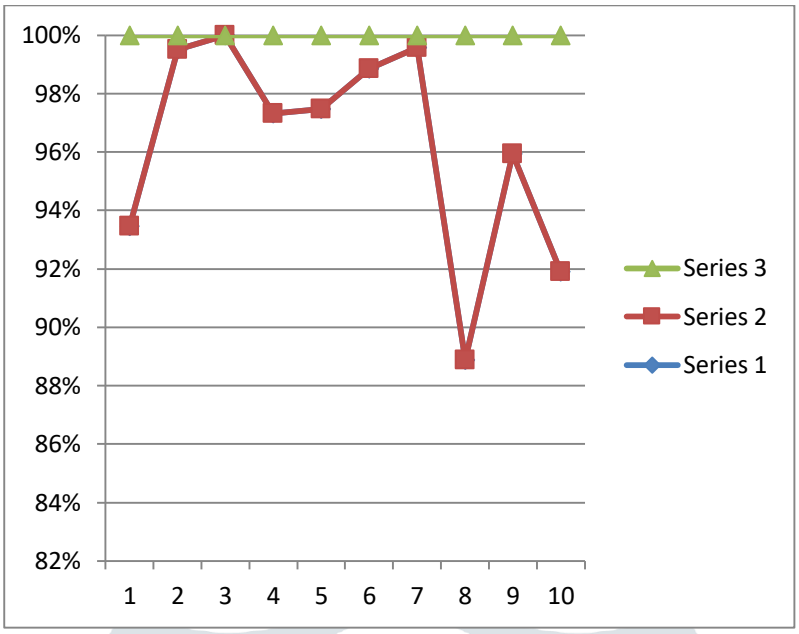


The Feldspar of igneous rocks is good source of Sodium when weathered. Albite ($NaAlSi_3O_8$) is chemically weathered to yield sodium ions and Kaolinite, among other things such as NaCl and Na2SO4 yield Sodium ions on dissolution.

Handa (1967) investigated ground water in association with Caddalore sand stones and showed that the ground waters had Na to Ca ratio 0.4 to 2.3.The Na/Ca ratio of ground water tend to decrease from east to west which indicate the influence of sea water intrusion rather than the geology of the sites where the wells are located (Elampooram, 1983). According to Palanisamy and Dhanabalan Mosi (1973) high proportion of sodium in irrigation waters increased the sodium content of soil exchange complex.

Potassium Content in Water Samples: The average Potassium content of water samples analyzed was 0.17 mg/l with a maximum 0.88 mg/l and minimum 0.0 mg/l Potassium was found absent in 20% water samples. The potassium content of natural water is usually less than that of Sodium, Calcium and Magnesium. The water chemistry of potassium is similar to that of sodium because it seldom enters into precipitation reactions but undergoes ion exchange reactions. Potassium is slightly less common than sodium in igneous rocks but is more abundant in sedimentary rocks. The potassium content of natural fresh waters seldom exceeds the sodium content and rarely if ever is the principle cation. Frequently, the potassium and sodium contents have been reported together as Sodium.

POTASSIUM CONTENT



X-Axis: Bore well no.
Y-Axis: Percentage of Potassium in water

Kanwar and Deo (1969) observed that the exchangeable sodium was less in the presence of Calcium ion in the irrigation water and that the exchangeable Calcium and Magnesium decreased with increasing Potassium content in irrigation water.

Carbonate and Bicarbonate Content in Water Samples: The carbonate content was found absent in 80% of water samples. Though the concentrations of carbonate ions were in traces, the bi-carbonate concentrations were considerable in all water samples analyzed. The Bicarbonate ion concentrations in the waters analyzed ranged between 3.2 mg/l and 9.7 mg/l. The average bicarbonate ion concentration was 6.9 mg/l. Irrigation waters containing high concentrations of carbonate and bicarbonate increases the salinity and sodium content of the soil. Ildeforiso Pla (1968) observed in Venezula that when waters with very high Bicarbonate content were used the total salt and Sodium content of the soil increased on the surface soil.

Physicochemical Analysis

Bore well No	CO3	HCO3	C l
1	0.0	3.2	1.5
2	0.1	8.6	2.2
3	0.0	*8.4*	2.7
4	0.0	6.5	4.3
5	0.1	9.2	1.7
6	0.5	5.7	1.2
7	0.1	9.7	4.0
8	0.1	4.1	0.8
9	0.2	5.9	1.0
10	0.1	7.3	5.8

Table:2

Chloride Content in Water Samples: The minimum Chloride content of water samples analyzed was found to be 0.8 mg/l and the maximum value 5.8 mg/l and the average value was 2.52 mg/l. The most

natural non polluted fresh waters, the chloride ion is relatively unimportant. According to the findings of Gupta (1975), the Chloride content of the ground water is mostly due to sea water intrusion. Chloride may be one of the reduction products from the use of chlorine as disinfectant and oxidant of water and waste water treatment.

In the present study this possibility is ruled out as the water samples are taken mostly from rural areas where protected water supply or waste treatments are not common. Ploegman (1973) reported that water of average chloride content when applied to clay and sandy soil increased the Chloride content of the soil water

CONCLUSION: Irrigation waters from 10 bore wells in Andhra Pradesh were collected and analyzed for their chemical composition and certain irrigation quality parameters. With the exception of 20%of water samples were recorded pH values less than 8. The electrical conductivity of the ground waters varied from 146µS/cm to 1652µS/cm. The mean value was 844µS/cm. Based on the EC value 90% of the samples were found to be suitable for irrigation. Based on the results the usage of fertilizers may be optimized to avoid further addition of salts in the ground water.

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