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Assessment of groundwater quality for irrigation of Buxa block, Jaunpur district

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Abstract

The knowledge of quality of groundwater in various region of Jaunpur district is necessary for its judicious use and management in agriculture. Therefore characterization of ground water in Buxa Block of Jaunpur district was undertaken during 2009. The water samples were randomly collected from different villages of the block and analyzed for EC, pH, Na, Ca, Mg, CO^{--}_3, HCO^{-}_3, SAR (sodium absorption ratio), R.S.C.(residual sodium carbonate), and Mg:Ca ratio were analyzed. Moderate level of salinity (C_1- salinity class) in irrigation water samples was observed. The water samples were the neutral to slightly alkaline in reaction. The carbonate was observed in 74 % water samples but bicarbonate content ranged from 183.0 to 732.0 mg L^{-1}. Calcium and Magnesium content in irrigation water samples ranged from 20 to 60 mgL^{-1} and from 49.4 to 377.4 mgL^{-1}respectively. Most of groundwater of Buxa block comes under C_1S_1 class and had moderate salinity and low alkalinity. Considering sufficient rainfall received in this area salinity, alkalinity and residual sodium should not be the problem. Irrigation quality of all samples of water is very good and suitable for the irrigation.

Keywords- EC, pH, SAR and RSC, water quality

Introduction

The concentration and composition of dissolved constituents in water determine its quality for irrigation use. Quality of water is an important consideration in any appraisal of salinity or alkali conditions of an irrigated area. All irrigation waters contain some salts, but the concentration and nature of salt vary. The quality of irrigation water depends primarily on the total amount of the salt present and the proportion of Na^+ to other cations and certain other parameters. Irrigation water consists of (a) surface water and (b) ground water**.** Whatever may be source of irrigation water, viz. river canal, tank, open well, or tube well or hand pump, some soluble salts are always dissolved in it. However, the nature and quantity of dissolved salts depend upon the source of water and its course before use. The main soluble constituents in water are calcium, magnesium, sodium and sometimes potassium as cations and chloride, sulphate, bicarbonate and sometimes carbonates as anions. Among the soluble constituents calcium

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magnesium, sodium, chloride, sulphate, bicarbonate and boron are of prime importance in determining the quality of irrigation water and its suitability for irrigation purposes. However, other factors as texture, structure of the soil, its drainage characteristics, and nature of the crop grown and climatologically conditions are equally important in determining the suitability of irrigation water in agriculture. The suitability of water for irrigation will be determined by the amount and kind of salts present. With poor water quality various soil and cropping problems can be expected to develop. There is scanty information about quality of irrigation water in Buxa Block, Jaunpur District. Therefore, present study was undertaken to analysis the different quality parameter of irrigation water

Materials and methods

The present investigation was carried out during 2009 at Department of Geography, T.D.P.G. College Jaunpur. Fifty sites were selected for irrigation water sampling situated around the Buxa Block, Jaunpur district. Jaunpur lies on 25^0 46' N latitude and 82^0 40' E longitudes and altitude is 30 MSL. Irrigation water samples were collected from 50 villages/sites around the Buxa Block, Jaunpur. The fresh samples were taken in 500 ml polythene bottles (stoppered). The tube-wells are continuous discharge for about 10 to 20 minute prior to sampling in the bottles. Water samples were protected against microbial growth by adding 2 drops of pure toluene. The pH of irrigation water samples were determined by digital pH meter using glass electrode in water samples (Jackson, 1973). All E.C. measurements of irrigation water samples were made with digital E.C. meter using conductivity cell (Jackson, 1973).Carbonate and bicarbonate in irrigation water samples were determined by titration the water samples with standard sulphuric acid (0.1N. H_2SO_4) using phenolphthalein and later on methyl red as indicators (Jackson, 1973).Calcium and magnesium of water sample were determined in by the versenate method (EDTA) AND Na^+ & K^+ concentration in water samples were determined by flame photometer (Jackson, 1973).

Results and discussion

It was observed that pH of irrigation water samples (Table 1) ranged from 7.2 to 8.2 and with mean value of 7.6. The data revealed that most of irrigation water samples were neutral to slightly alkaline in nature. The 10 per cent of irrigation water samples were very slightly alkaline in reaction while 74 per cent of irrigation water samples were slightly alkaline in reaction only 16 per cent samples were alkaline in reaction. Electrical conductivity (EC) is the most convenient way of measuring water salinity. E.C. of irrigation water samples ranged from 0.47 dSm-^{1} to 2.0 dSm^{-1} with mean value 0.9 dSm^{-1} at the 25^0C. It means that all the irrigation water comes under C_1 low salinity class and it was safe for irrigation with very low no salinity hazards. Low salinity water can be used for irrigation for the most of the crops (Chabra, 2000).

It was observed from the data that CO_3^{--} content of irrigation water samples ranged from 60-180 mgL^{-1} with mean value 68.4 mgL^{-1}. The presence of CO_3^{--} was observed in only 37 water samples. HCO_3^- content of irrigation water samples ranged from 183.0 mgL^{-1} to 450.0 mgL^{-1} with mean value 305.0 mgL^{-1}. Irrigation waters richen bicarbonate content tend to precipitate in soluble calcium and magnesium in soil as their carbonate. The bicarbonate anion is an important in irrigation water as calcium and to a lesser degree also of magnesium as their carbonates in the soil. This brings about a change in the soluble sodium percentage in the irrigation water and therefore, an increase of the

sodium hazard (Das, 2004). The Ca^{++} + Mg^{++} content of irrigation water samples ranged from 109.4 mgL^{-1} to 431.4 mgL^{-1}. Ca^{++} content of irrigation water samples ranged from 30.0 mgL^{-1} to 80.0 mgL^{-1} with mean value 42.2 mgL^{-1}.

Table 1 Chemical properties of irrigation water

S.N.	Parameters	Range	Mean
1	pH	7.2-8.2	7.6
2	E.C. (dSm^{-1} at 25^0C)	0.47-2.0	0.9
3	CO_3^{--} (mgL^{-1})	60.00-180.00	68.4
4	HCO_3^- (mgL^{-1})	183.0-450.0	305.0
5	Ca^{++}(mgL^{-1})	30.0 - 80.0	42.2
6	Mg^{++}(mgL^{-1})	59.40 – 104.0	82.30
7	R.S.C. (meq L^{-1})	0.54 – 0.62	0.50
8	K^+ (mgL^{-1})	3.00-11.0	6.70
9	Na^+ (mgL^{-1})	1.00 - 5.0	2.12
10	S.A.R.	0.09 -0.54	0.22

If the calcium concentration is greater than 35 per cent of the total cations than water is fit irrigation (Chabra, 2000). Mg^{++} content of irrigation water samples ranged from 59.40 mgL^{-1} to 104.0 mgL^{-1} with mean value 82.30 mgL^{-1}. The saline ground water contains magnesium higher than Ca^{++}, the mean Mg^{++}: Ca^{2+} ratio of the water lies between 1 to 9, while a few samples have even higher Mg^{++}: Ca^{++} ratio. With increase in Mg^{++}: Ca^{++} ratio and SAR of the leaching water, the degree of soil dispersion increased significantly. (Chabra, 2000).

The RSC is the measure in mill equivalents per litre (me L-1) of the excess of carbonates and bicarbonates over magnesium (Mg) and Ca. With high RSC (>1.25) there is a tendency for Ca and Mg to precipitate in the soil, thus increasing the proportion of Na and increasing the SAR of the soil solution.It was observed that R.S.C. of irrigation water samples ranged from 0.54 mgL^{-1} to 0.62 mgL^{-1} with mean value 0.50 mgL^{-1}. The range of RSC in water samples was observed less than 1.25; it shows that irrigation water is safe .The Mg^{++}/Ca^{++} content of irrigation water samples ranged from 0.82 to 10.76 with mean value 3.72. It is more important that if the Mg: Ca ratio in irrigation water happen to be more than 4.The perusal of data indicates that K^+ content of irrigation water samples ranged from 3.0mgL^{-1} to 11.0 mgL^{-1} with mean value 6.70mgL^{-1}. Water containing a high concentration K^+ is considered good because K^+ alleviates to some extent the harmful effect of exchangeable sodium (Michael, 1978).

Na^+ content of irrigation water samples ranged from 1.0 mgL^{-1} to 5.0 mgL^{-1} with mean value 2.12 mgL^{-1}. Most of irrigation water samples were low sodium hazard in nature. It means that all the irrigation water samples were suitable for the irrigation. SAR is a measure of the tendency of the irrigation water to cause the replacement of calcium (Ca) ions attached to the soil clay minerals with sodium ions (Na). Any increase in the S.A.R. of irrigation water it will be increases the SAR of the soil solution. SAR of irrigation water samples ranged from 0.09 to 0.54 with mean value 0.22. All of irrigation water comes under S_1 sodicity class with low sodicity hazards (Singh *et. al*., 2012).

Most of irrigation water samples had low sodicity hazard. It means that all the irrigation water comes under C_1S_I water quality class and is suitable for the irrigation. It can be used for irrigation to all soils and on almost crops but leaching is required in case of extremely low permeability.

Conclusion

All the irrigation water comes under C_1S_1 water quality class. It may be concluded that irrigation quality of all samples water was very good and suitable for the irrigation for all the soils and crops.

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