Assessment of Physicochemical Properties of Hiran River for Irrigation Purposes

Rohit Kumar[1] Prof. R. K Bhatia[2]
[1]M E Student [2]Associate Professor
[1,2]Department of Civil Engineering
[1,2]Jabalpur Engineering Collage, Jabalpur, India

Abstract— The quality of the available water must be tested to check its fitness prior to use. Irrigation water, whether diverted from streams or pumped from tube wells, contain appreciable quantities of harmful substances in solution those may reduce crop yield and deteriorate soil fertility. The main characteristics to assess the quality of irrigation water are Total Dissolved Solids (TDS), Sodium Absorptions Ratio (SAR), Electrical Conductivity (EC) and Chloride. The quality of water is being deteriorated due to disposal of untreated industrial wastewater and agricultural saline effluents directly to groundwater and canal water. The application of poor quality water for irrigation can cause soil problems such as salinity, sodicity, alkalinity, toxicity and water infiltration rate.

Keywords: EC, SAR, RSC, TDS

I. INTRODUCTION

Water is the most important natural resource not only of a state or a country, but of the entire humanity. Water quality influences its suitability for a particular use, i.e. how well the quality fulfills the requirement of the user. For example, river water having good quality with sediment load can be applied for irrigation successfully but may be objectionable for municipal use without treatment. The evaluation of quality of water resulted to find out the causes, relationship and effects among water constituents and level of acceptability. The possible contamination in water included organic matter, nutrients, suspended solids, heavy metals, pesticides and industrial chemicals. Anthropogenic activities within river basins, erosion, and atmospheric depositions were also the main negative impacts on the water quality of most the reservoirs (Haydar et al., 2009). The salinity of soil is also important factor for the determination of water quality. Soil salinity is developed when soil becomes more salty as a result of water Irrigation Water Quality movement in the soil especially due to irrigation. Irrigation water quality is described by different parameters such as Electrical Conductivity (EC), Total Dissolved Solids (TDS) and Chloride.

A. Sample Collection

Water samples from selected sites were collected during the months of Oct/Nov, 2019. The Samples were collected from the surface water of the River in pre-cleaned polyethylene bottles.

B. Water Quality Indices

The water quality indices /parameters that describe the quality of water which are given below:

C. Total Dissolved Solids (TDS)

The salinity behavior of water is indicated by total dissolved solids (TDS). TDS contain the anions (negatively change ions) and cations (+ve changes ions). Total dissolved solids change the color and properties of water. The relationship between total dissolved solids and EC is:

$$TDS\ (mg/L) = EC\ (dS/m) \times K$$

Where, K = 640 in most cases (for EC: 0.5 -5 dS/m) or
K = 735 for mixed waters or
K = 800 for EC > 5 dS/m

The above relationship in most cases is applied for EC ranging from 0.5 to 5 dS/m and not applicable for wastewater (Kahlown and Khan, 2002). TDS is the measure of the amount of material dissolved in water including carbonate, chloride, bicarbonate, phosphate, sulfate, nitrate, sodium, calcium, magnesium, organic ions etc. The density of the water, can be harmful due to increase in TDS concentrations, determined the flow of water into and out of an organism's cells. Moreover, the high concentrations of TDS may also reduce water clarity, contribute to a decrease in photosynthesis, combine with toxic compounds and heavy metals, and lead to an increase in water temperature. Flat insipid taste because of extremely low TDS level was also unacceptable (Kahlown et al., 2006).

D. Electrical conductivity (EC)

The electrical conductivity (EC) of water is defined as the capacity of water to transmit the electric current. It depends on the dissolved ions in the water and their charge and movement. Because it is a good solvent, water dissolved mineral salts in the form of ions, which hold the electric current due to ionic conduction. When the EC of water is high, it shows that there is high concentration of ions in the water. The EC indicates the number of total solids in water and is dependent on the temperature of water. The electrical conductivity of water also affects the plant growth. The measurement of EC at 25oC temperature is considered as reference.

E. Sodium adsorption ratio (SAR)

Sodium adsorption ratio (SAR) is an easily measured property that gives information on the comparative concentrations of sodium, calcium and magnesium. The SAR can be calculated as

$$SAR = [Na+] / [(Ca2 + Mg2+)/2]1/2$$

A high sodium ion in irrigation water affects the hydraulic conductivity (permeability) of soil and creates water infiltration problems. This is because when sodium present in the soil in exchangeable form replaces calcium and magnesium, adsorbed on the soil clays and causes dispersion of soil particles (i.e. if calcium and magnesium are the predominant cations adsorbed on the soil exchange complex, the soil tends to be easily cultivated and has a permeable and granular structure). Due high value of SAR, the soil becomes hard and compact when dry and resultantly, reduces the infiltration rates of water and air into the soil affecting its

structure. This problem is also related with several factors such as the salinity rate and type of soil. For example, sandy soils may not get damage as easily as other heavier soils when it is irrigated with high SAR water.

F. Residual sodium carbonates (RSC)

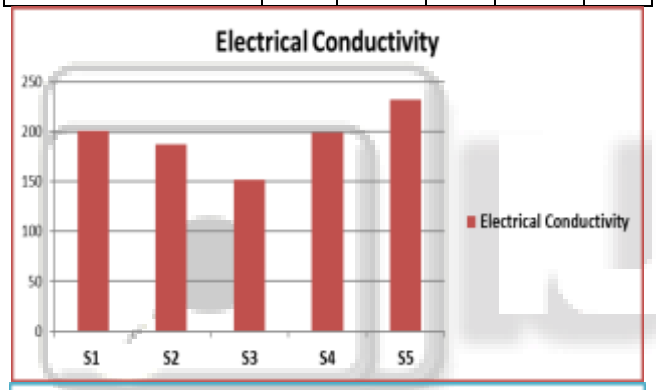
It is used to predict the additional sodium hazard associated with CaCO3 precipitation involve calculation of the residual sodium carbonate. RSC is another alternative measure of the sodium content in relation with calcium and magnesium. This can be calculated as:

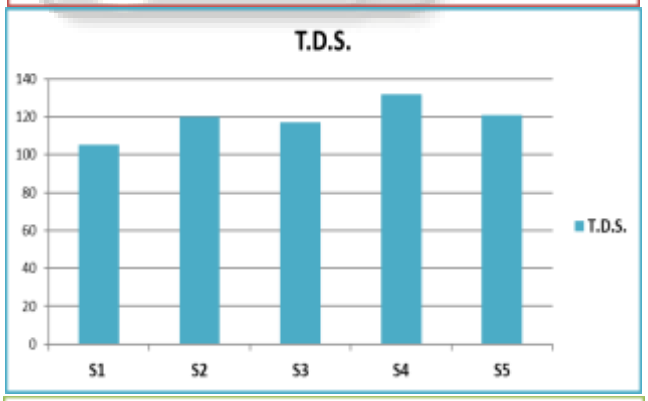
$$RSC = (CO_3^{2-} + HCO_3^{-}) - (Ca^{2+} + Mg^{+2})$$

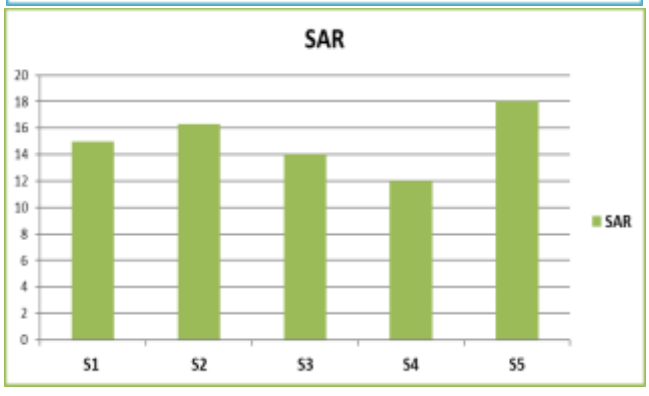
Where, all concentration is in meq/L.

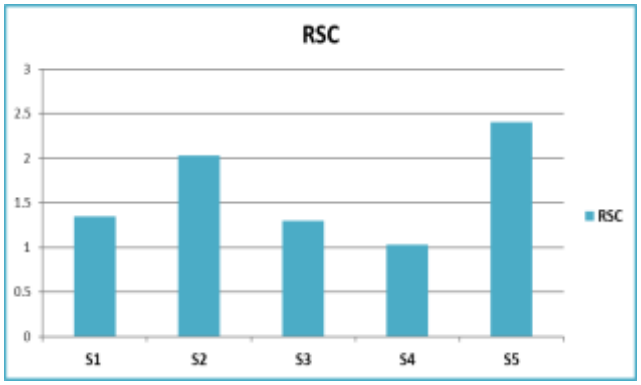
II. Results & Discussion

Parameters	S1	S2	S3	S4	S5
Electrical Conductivity	201	187.5	152	198.7	232
T.D.S.	105	120	117	132	121
Sodium Adsorption Ratio	15	16.3	14	12	18
Residual Sodium Carbonates	1.35	2.03	1.3	1.025	2.4









III. Conclusion

This study assessed the physicochemical properties of Hiran River water from five different locations (viz. Bhagraji, Majhgawan, Lal Patthar, Sihora Rail Patthar, Kundam) of Sihora city, during the months of Oct-Nov. The analysis was carried out by taking certain important parameters like electrical conductivity, total dissolved solids, SAR, RSC.

The electrical conductivity (EC) and sodium adsorption ratio (SAR) values were suitable for irrigation. The high EC and high alkalinity values indicate that water is not that much suitable for agriculture purpose and hence has to be used with caution. Spatial changes in EC were in narrow range, which may be due to high rate of evaporation. The trace elements concentrations were well within the permissible limits for agricultural irrigation. The values were compared permissible range.

IV. References

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[9] AlineBaggio (Delft University of Technology – The Netherlands)A.Baggio@ewi.tudelft.nl.published at journal magazine of Delft University of Technology.

