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Water Quality of Shallow Groundwater in Parts of Betwa River Command Area

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ABSTRACT

The paper published the preliminary results of Groundwater Quality Studies in a Betwa Command Area in Vidisha District. Water quality varies seasonally, some wells showing increase in salinity as water level in the post monsoon period. Water quality is identified based on various geochemical classifications. Water samples collected from different wells were analysed using standard laboratory techniques. Modified stiff, piper trilinear diagrams and trend surface maps were constructed to identify the chemical character of the shallow groundwater. Groundwater has been analysed and found suitable for general domestic and irrigation purposed except some which are intensively irrigated.

INTRODUCTION

The study area located in Vidisha District covered by Betwa For the last two decades continued irrigation has lead to accumulation of salts from fertilizers and pesticides in groundwater in this area. Groundwater is being used for irrigation and domestic purpose in the study area. Further the increase of total dissolved solids in this area can be attributed to the evaporation from shallow waters especially in the water logged areas.

METHODOLOGY & MATERIAL USED

Sampling Technique

Sample were collected and stored in 500 ml plastic during the dry seasons. Sample bottles were carefully cleaned with concentric HCI then rinsed strongly with tap water finally with distilled water bottle were further rinsed with the water to be sampled, before sample collection. A total number of twenty nine sample in pre-monsoon and seventy in post-monsoon were collected from different wells of study area.

Analysis of Shallow Groundwater Samples

Samples collected were analysed by using standard techniques in the laboratory. To understand the water quality water samples were analysed by using volumetric, flame photometric techniques for various chemical elements.

The physical characteristics : The twenty nine pre-monsoon and seventy post-mansoon

samples are analysed for Ca, Mg, Na, K, HCO3, Cl, TDS, pH, Electrical conductance etc., and the results are summarized below:

1. Hydrogen ion concentration : The pH of groundwater varies from 6.7 to 8.2 This indicates slight alkalinity of groundwater in this area.
2. Specific electrical conductance : The conductance values are in the range of 321 to 2740 mhos/cum at temperature C. In most of the samples the value falls in the permissible zone except observation wells at Ghat area, Paper Mill and Salamatpur Village.
3. Hardness : It ranges from 54 to 832 ppm as CaCO3. Thus it falls in categories of hard and very hard although it temporary in nature.
4. Alkaline Earths: The Ca and Mg ranges from 10 to 152 ppm ersoectively.
5. Alkalies: The concentration of sodium and potassium ions are very low in the majority of groundwater samples.
6. Carbonates and Bi-carbonates: The value of carbonates and bi-carbonates are in the water permissible range except some stations. Residual sodium carbonate was calculated to see the effect of this anions on the quality of groundwater samples. R.S.C. value have been increased for post-monsoon.
7. Chloride: Chloride values for groundwater samples in pre-monsoon are found to be within the permissible limit except in sample from Ghat area, Paper Mill and Salamatpur observations.
8. TDS : There is an increment in the value of total dissolved solids in groundwater in post-monsoon as compared pre-monsoon seasons. In general the TDS should decrease after monsoon due to increase in storage, but in the study Area it is observed that the water quality deteriorates after Mansoon (Table. 2). This clearly indicates the dissolution salts present in the soil zone with rain water. The accumulation of salts are largely due to extensive evaportion from shallow ground water table (characteristic of water logged areas) and usage of fertilizers in abundance in the study area.

Table. 1. Results of Water Quality Analysis in the Study Area.

Overall Quality Deteriorates In Post – Monsoon Based on pre & post monsoon samples
Water Quality

The water quality of the study area irrigation is determined by the concentration of certain soluble salts and nutrients and area as follows:

Sodium Absorption Ration (SAR) and Salinity hazards.
Residual Sodium Carbonate (RSC)
Soluble Sodium Percentage (SSP)
Kelley's Ration

Sodium Absorption Ration (SAR) and Salinity hazards

SAR is relative proportion of sodium to calcium plus magnesium, which effects permeability of the soil, SAR and salinity hazard of samples

Table 1:Chemical Analysis of Ground Water Samples

PARAMETER	OBSERVATION	INFERENCE
PH	6.7 to 8.3	Slightly Alkaline
Specific Electrical	441 to 4260	Increasing problem
Conductance	(micromhs/cm)	For Irrigation
Hardness	54 – 832	Increasing
Alkaline Earths	Ca 1-12 ppm	Permissible
	Mg 1 –14 ppm	Problematic
(Bi-) Carbonates	2-16 cpm	Permissible
Chloride	1 – 22 ppm	Permissible
Total Dissolved Solids	187 – 2398 ppm	Problematic

collected in pre-monsoon and post-monsoon seasons indicate that most of the water samples of pre-monsoon show low sodium alkali hazards and medium to high salinity hazards thus falls in the category of S1, C2, to C1C3 type on the scale made my US soil salinity laboratory. Riverside, California where as in post-monsoon season water quality falls in S1C2, S1C3, S1C4 type. S1 C2 and S1C3 is within the permissible limit and can be used for any type of crop and soil but S2C3 and S1C4 type of water can be used with saline tolerant plant along with gypsum.

Residual Sodium Carbone (RSC)

The excess of carbonate plus bicarbonate over Magnesium plus Calcium all expressed in ppm is called Residual Sodium Carbonate. It affects adversely the quality of water. Based on Wilcox's classification the quality of the groundwater samples of the study area is found within permissible range i.e. 1.25 to 2.5 ppm except some stations i.e. Ghat area, Paper Mill and Salamatpur Village in pre-monsoon period.

Soluble Sodium Percentage

Soluble Sodium Percentage for pre-monsoon and post-monsoon were computed and it was found that the water quality is good in pre-monsoon seasons which deteriorates in post-monsoon samples due to increased solubility of sodium salts.

Kelley's Ration

Kelley's Ratio is the ration of sodium to calcium and magnesium which should be less than unity. Based on Kellye's ration it has been found that the Kelley's ration is greater than one in some i.e. Ghat area, Paper Mill and Salamatpur village etc. thus water deteriorates in post-monsoon.

Table 2: Water Quality

Sodium Absorption Ration	SIC2 – S1C4	Problematic
Soluble Sodium %	Problematic in	Post – monsson
Kelly's Ratio	> 1 at places	Problematic
Residual Sodium Carbonate	1.25 - 2.5 ppm	Permissible

CONCLUSIONS

This study reveals the irrigation practice by local farmers is leading to environmental disaster. The usage of excess water from river is causing the water logging situation on one hand and on the other hand presence of excess standing water in the agricultural field demands more fertilizer to gain good crop output. Thereby increase in salt concentration in the soil zone is contributed by evaporation from shallow ground water and excessive usage of fertilizers. This would lead to salinity hazard in very near future leaving the present agricultural lands either as swampy lands or as barren waste lands.

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