WATER QUALITY ASSESSMENT BY USING AN INDEX AT CITY LEVEL -
A CASE STUDY

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ABSTRACT

Water Quality Index (WQI) is one of the most effective way to assess the
groundwater quality in relation to domestic use in Azamgarh district of Uttar Pradesh. The analysed of the physico-chemical
properties and computed WQI are grouped groundwater of the study area in moderate to good quality zone and suitable for
drinking and domestic usage. The WQI of the current study will be of much use for the planners in the management and
monitoring of water resources.

KEYWORDS: Ground Water, Physico-Chemical Analysis, Azamgarh City, Water Quality, Index

Ground water is an important source of water supply throughout the world. It is the major source of
drinking water supply for urban and rural areas. The evaluation of groundwater quality is an important as its
quantity, since the physical and chemical characteristics of groundwater determines its suitability for agricultural,
industrial and domestic uses. Water Quality Index (WQI) has been regarded as one of the most effective way to assess
the quality of water and is communicated on the basis of calculate water quality indices (Pradhan et al., 2001). The
present study area Azamgarh is located on the East. The aim of the present study is to investigate the state of groundwater
quality of the wells using WQI studies.

MATERIAL AND METHODS

A total number of thirteen samples were collected
from bore wells (Hand pump) in the study area during
month of October, 2012. TDS was estimated indirectly by
making use of following formula : $64 \times \text{EC}$ in ms/cm
(Raghunath, 2003). All water quality analysis were carried
out as per APHA, 1998 and Kotaiah and Kumar Swamy,
1994).

Computation of Water Quality Index

Water Quality Index (WQI) denoting the
intergrated effect of the various parameters that are relevant
and significant to a particular use that is proposed to express
the water quality for different uses. It is one of the most
effective ways to communicate information on water
quality trends to policy makers, to shape sound public
policy and implement the water quality improvement
programmes efficiently. Water Quality Index (WQI) was
computed by weighted index method to determine the
suitability of groundwater for drinking purpose
(Padmanabha and Belagali, 2005). The estimated
qualitative values of water quality parameters and their
standards (BIS, 1991) are used for the calculation of water
quality indices. WQI has been computed using the formula
given in equation number 1

\begin{equation}
\text{WQI} = \sum_{i=1}^{\eta} w_i q_i
\end{equation}

Where, $w_i$ = weightage factor of $i^{th}$ parameter
$q_i$ = quality rating of $i^{th}$ parameter

\begin{equation}
\frac{k}{w_i} = \frac{1}{I/vs_1} + \frac{1}{I/vs_2} + \cdots + \frac{1}{I/vs_h}
\end{equation}

Where, $k$ = constant
$s_i$ = standard value of $i^{th}$ parameter

\begin{equation}
q_i = \frac{V_a - V_i}{V_s - V_i} \times 100
\end{equation}

Where,

$V_a$ = actual value obtained from laboratory
analysis of $i^{th}$ parameter
$V_s$ = standard value of $i^{th}$ parameter
$V_i$ = ideal value (pH = 7 and 0 for all parameter)

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<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Location</th>
<th>pH</th>
<th>Alkalinity</th>
<th>EC</th>
<th>TDS</th>
<th>TH</th>
<th>CaH</th>
<th>MgH</th>
<th>Cl</th>
<th>SO₄</th>
<th>NO₃</th>
<th>PO₄</th>
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<tbody>
<tr>
<td>S1</td>
<td>D.A.V. Degree College</td>
<td>7.95</td>
<td>180</td>
<td>1400</td>
<td>896</td>
<td>278</td>
<td>202</td>
<td>76</td>
<td>158.4</td>
<td>78</td>
<td>2.06</td>
<td>0.9</td>
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<tr>
<td>S2</td>
<td>Bus Station</td>
<td>7.52</td>
<td>138</td>
<td>800</td>
<td>512</td>
<td>64</td>
<td>56</td>
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<td>16.2</td>
<td>4.68</td>
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<tr>
<td>S3</td>
<td>Rahul Nagar</td>
<td>7.86</td>
<td>142</td>
<td>700</td>
<td>448</td>
<td>212</td>
<td>186</td>
<td>26</td>
<td>68.2</td>
<td>10.8</td>
<td>0.8</td>
<td>1.4</td>
</tr>
<tr>
<td>S4</td>
<td>Raidopur Colony</td>
<td>7.03</td>
<td>96</td>
<td>800</td>
<td>512</td>
<td>168</td>
<td>142</td>
<td>26</td>
<td>112.8</td>
<td>22</td>
<td>4.11</td>
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<td>S5</td>
<td>G.I.C.</td>
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<td>120</td>
<td>900</td>
<td>576</td>
<td>88</td>
<td>72</td>
<td>16</td>
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<td>96</td>
<td>800</td>
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<td>112</td>
<td>84</td>
<td>28</td>
<td>102.4</td>
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<td>7.08</td>
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<td>94</td>
<td>70</td>
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<td>700</td>
<td>448</td>
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<td>108</td>
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<td>186</td>
<td>1500</td>
<td>960</td>
<td>284</td>
<td>224</td>
<td>60</td>
<td>188.2</td>
<td>112</td>
<td>1.35</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Table 1: Physico-Chemical Properties of Groundwater Samples in the Study Area
Using the water quality index, all the samples were categorized into five classes as excellent (0 to 25), good (26 to 50), moderately polluted (51 to 75), severely polluted (76 to 100) and unfit (above 100) based on their suitability for human consumption.

### RESULTS AND DISCUSSION

The collected water samples were analyzed for physico-chemical parameters and these are listed in Table 1. The potability of drinking water is judged based on Indian standard drinking water specification of Bureau of Indian Standards (Table 2).

In the present study, pH values of groundwater were found in the range of 7.03 to 8.01. All the water samples were slightly alkaline in nature. The constituents of alkalinity in natural waters mainly include carbonate, bicarbonate and hydroxide which are resultants of dissolves mineral substance in soil and atmosphere. In the study area alkalinity in water samples range between 96 to 186 mg/L and these are below the acceptable limits.

The EC groundwater at Azamgarh City varied between 700 and 1500 mS/cm. The concentration of total dissolved solids in all the samples in the study area ranges from 448 to 960 mg/L. According to BIS, the acceptable limit for TDS in groundwater is 500 mg/L. The total samples were fall in excessive limits of BIS standards, except S3 S8. The excess solids may be due to insoluble organic matter in the domestic waste water and open ground sewage disposal. High concentrations may be attributed to small scale industrial activities in that area. Variations of TDS concentrations of all the samples.

In the present study, total hardness of the samples ranged from 64 to 284 mg/L and classified (Todd, 2001) the samples in the range of moderately hard to hard. Calcium present in excessive limits of standards in 70 percent of the total samples. The Mg hardness concentrations of all well waters are within the permissible limits, except S3 S8.

In this area, chloride ranges between 58 and 188.2 mg/L and the concentration of chloride in all the samples of study area is below the limit. In most natural waters, sulphate is found in smaller concentrations than chloride.
(Powell, 1964). The sulfate content in the area varies from 2 to 112 mg/L. The result explain that the values of sulphate concentrations in all the samples are well below the premissible limits.

Nitrites and phosphates are essential nutrients for plant growth. Excessive concentrations of nitrate in drinking water may cause methemoglobinemia in small children. Concentrations in excess of 10 mg/L as N, equivalent to 44 mg/L of NO3 evidently present this hazard (Hem, 1985). The concentration of nitrate in the study area ranges from 0.8 to 4.68 mg/L. Phosphorus is fairly abundant in sediments, but concentrations present in solution in natural water are normally not more than a few tenths of a milligram per liter. It is component of sewage, as the element is essential in metabolism, and it is always present in animal metabolic waste. The concentrations of phosphate of the water samples varied from 0.1 to 2.8 mg/L.

Estimated water quality index values and its graphical representation of all sampling stations are given in Table 2. The water quality index of areas like Raidopur Colony (S4), Kunwar Singh Park (S6), Baradev (S7), Matberganj (S8), Narauli Stand (S9) and Sidhari (S11) are well below 25 and are absolutely fit for human consumption. Four samples such as S2, S5, S10 and S12 are in good condition as per WQI rating. Areas like D.A.V. Degree College (S1), Bus Station (S3), are in poor condition and Harbunspur (S13) is very poor condition, this may be due to industrial domestic sewage effluents and runoff from agricultural fields through fertilizers.

CONCLUSION

Hydrochemical analysis of the study clearly indicates that most of the areas fall in under moderate to good water quality zones. The water quality studies explained that certain parameters like pH, alkalinity, total hardness, chloride, nitrates, phosphates and sulphates were within permissible limits prescribed by Bureau of Indian Standards. However, total dissolved solids and calcium hardness were exceeding the standards in some locations. WQI study reveals that three samples were fall in polluted zone in the area.

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