IMPACT OF AGRICULTURAL PRACTICES ON GROUND WATER QUALITY OF FEW VILLAGES OF LADPURA TEHSIL IN KOTA DISTRICT, RAJASTHAN

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ABSTRACT

To find out impact of agricultural practices on ground water quality, ground water samples were collected from five villages around Ladpura tehsil, situated in Kota district and analyzed during year 2008 to 2010. Some important physicochemical parameters like pH, total dissolved solids, alkalinity, total hardness, sulphate, chloride, nitrate, phosphate were analyzed and results were compared with water quality standards prescribed by WHO and BIS 10500. Data reveals that all the water samples showed not too much higher values which indicates that water is not polluted. The correlation coefficients were calculated. The significance of result is further discussed.

Key words: Ground water, Correlation analysis, Agricultural practices.

INTRODUCTION

The present studies have been initiated to find out impact of agricultural practices on ground water quality of Ladpura tehsil of Kota district area. The main source of income or occupation of most of the people in this area is agriculture/farming. Animal manures are commonly used as fertilizer in agricultural practices; as a result concentration of nitrogen may increase in ground water of the area selected. Our environment consists of various types of substances but water is the fabulous substance on earth. Clean, fresh water is essential for nearly every human endeavor. Perhaps more than any other environmental factor, the availability of water determines the location and activities of human on earth. About 97.2% of water on earth is salty and only 2.8% is present as fresh water from which about 20% constitutes groundwater. Groundwater serves as a major source for drinking, irrigation and industrial use. Water is the most abundant chemical component within the biosphere. Water
is the basic medium of metabolic functioning. The removal and dilution of most natural and
manmade wastes are also accomplished almost entirely by water. Being an important
component of ecosystem, any impurities added to water can create imbalance resulting harm
to whole ecosystem. When water contains enough impurities to make it unfit for an intended
purpose like as drinking, domestic, agricultural, fishing and industrial, then it is called as
polluted. High quality of ground water is essential for the health and welfare of the human
beings. The continuous addition of toxic materials on the land and water bodies reaches to
ground water through seepage and contaminates the ground water\(^2\). Once ground water is
contaminated, its purification hopelessly difficult.

**EXPERIMENTAL**

**Materials and methods**

**Study area**

Kota city is centrally located in Hadoti Region. The district Kota lies between 24°25’
and 25°51’ North latitudes and 75°31’ and 77°26’ East longitudes with total area of 5217 sq
Kms. “Kota City” is located at extreme South of it at 25°11’ North latitude and 75°51’ East
longitude occupying total area of 238.59 sq Kms with average height of 253.30 meters from
mean sea level. The only perennial river “Chambal” originating from the hills of Western
Madhya Pradesh passes through the district. According to 2011 census, total population of
district is 10,01,365. Total male population of Kota district is 5,29,768 and female
population is 4,71,570. Total land area of Ladpura tehsil is 153824 hector in which
agricultural land is 40880, 40788, 40579 hectare and nonagricultural land is 101758, 101803,
101927 hector in year 2008, 2009 and 2010 respectively. In year 2008, 2009 and 2010 the
irrigated agricultural land area was 33564, 33202 and 32380 hectare respectively. In
agricultural practices, various types of agrochemicals are used by farmers. In Ladpura tehsil,
agrochemicals which were used during 2008-2010 are; sulphur, urea, D.A.P., potash (as
fertilizer) and endosulphan (as pesticides). In the study area main source of irrigation is open
well/tube well. In selected location the total number of open well was 226, 234 and 240 in
year 2008, 2009 and 2010, respectively and 39 tube wells were used in irrigation during
these years (Source-Milan Khasara, Land Record Office, Tehsil Ladpura Kota (Rajasthan)
V.S. 2064).

**Sampling locations and techniques**

To find out ground water quality status in Ladpura tehsil, water samples were
collected from twenty different selected sites in winter, spring, per-monsoon and post
monsoon, period of years 2008, 2009 and 2010. Five villages Godlyahedi, Rajpura, Morpa,
Dhara and Kaithodi were selected for study. The open wells/tube wells located in residential, commercial and agricultural area were selected for sampling. The samples were collected as composite samples; at every site, samples were collected from four different points and then mixed together i.e. from five villages locations, samples were collected from twenty different sites. Sample were collected in pre-cleaned good quality narrow mouth screw-capped polypropylene bottles of two-liter capacity and rinsed thrice with the water to be collected and then filled completely to avoid encroachment of any air bubble. Sample bottles were then screw-capped tightly and brought to the laboratory. The samples were procured with traditional methods and preserved in a refrigerator at 4°C. Samples were protected from any outside contamination. The coding of sampling locations are given in Table 1.

Table 1: Sampling Locations

<table>
<thead>
<tr>
<th>Sampling Locations</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Godlyahedi (L_1)</td>
<td>Open well/ Tube well</td>
</tr>
<tr>
<td>Rajpura (L_2)</td>
<td>Open well/ Tube well</td>
</tr>
<tr>
<td>Morpa (L_3)</td>
<td>Open well/ Tube well</td>
</tr>
<tr>
<td>Dhara (L_4)</td>
<td>Open well /Tube well</td>
</tr>
<tr>
<td>Kaithodi (L_5)</td>
<td>Open well /Tube well</td>
</tr>
</tbody>
</table>

The physicochemical parameters like pH, total dissolved solids (TDS), alkalinity, total hardness (TH), chloride (Cl⁻), nitrate (NO₃⁻), phosphate, sodium, potassium, calcium and magnesium were analyzed using standard methods\textsuperscript{3-6}. The methods used for estimation of various physicochemical parameters are tabulated in Table 2.

Table 2: Methods used for estimation of physicochemical parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>pH metry</td>
</tr>
<tr>
<td>Conductivity</td>
<td>Laboratory method</td>
</tr>
<tr>
<td>Total dissolved solids</td>
<td>Calculation method</td>
</tr>
<tr>
<td>Total alkalinity</td>
<td>Titration method</td>
</tr>
<tr>
<td>Total Hardness, calcium and magnesium</td>
<td>EDTA titration</td>
</tr>
<tr>
<td>Sodium and Potassium</td>
<td>Flame photometric method</td>
</tr>
</tbody>
</table>

Cont…
Parameters | Methods
--- | ---
Chloride | Silver nitrate method
Nitrate | Ion-selective electrode method
Phosphate | Spectrophotometric method

There are some methods adopted for computation of some important indices, the formulas of the calculated indices are as follows -

**Aggressive index (AI)**

\[
AI = \text{pH} + \log (TA \times TH)
\]

where

- \(\text{pH}\) = Measured water PH
- \(TA\) = total alkalinity in mg/L
- \(TH\) = total hardness in mg/L

**Langlier saturation index (LSI)**

\[
LSI = \text{pH} - \text{pHS}
\]

\[
\text{pHS} = (9.3 + A + B) - (C + D)
\]

where

- \(A = (\log_{10} (\text{TDS}) - 1)/10\)
- \(B = -13.72 \times \log_{10} (^{\circ}\text{C} + 273) + 34.55\)
- \(C = \log_{10} (\text{TH as CaCO}_3) - 0.4\)
- \(D = \log_{10} (\text{A as CaCO}_3)\)

**Ryzner index (RI)**

\[
RI = 2\text{pHS} - \text{pH}
\]

**Percentage sodium (% NA)**

\[
\% \text{Na} = \frac{\text{Na}^+}{(\text{Ca}^{2+} + \text{Mg}^{2+} + \text{K}^+ \cdot \text{Na}^+)} \times 100
\]
Sodium adsorption ratio (SAR)

\[
\text{SAR} = \frac{\text{Na}^+}{\sqrt{\text{(Ca}^{+2} + \text{Mg}^{+2})/2}}
\]

Exchangeable sodium percentage (ESP)

\[
\text{ESP} = \frac{100(-0.0126 + 0.01475 \times \text{SAR})}{1 + (-0.0126 + 0.01475 \times \text{SAR})}
\]

Residual sodium carbonate (RSC)

\[
\text{RSC} = (\text{CO}_3^{2-} + \text{HCO}_3^-) - (\text{Ca}^{+2} + \text{Mg}^{+2})
\]

RESULTS AND DISCUSSION

The average results of the sampling locations (L1, L2, L3, L4, L5) of physicochemical parameters for water samples are presented in Table 3.

Table 3: Average results of the sampling locations (L1, L2, L3, L4, L5) of physico-chemical parameters

<table>
<thead>
<tr>
<th>Year</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Season</td>
<td>Season</td>
<td>Season</td>
</tr>
<tr>
<td></td>
<td>Pre-</td>
<td>Post-</td>
<td>Winter</td>
</tr>
<tr>
<td>Parameters</td>
<td>monsoon</td>
<td>monsoon</td>
<td>Winter</td>
</tr>
<tr>
<td>pH</td>
<td>8.10</td>
<td>7.70</td>
<td>7.80</td>
</tr>
<tr>
<td>Conductivity</td>
<td>400</td>
<td>266</td>
<td>314</td>
</tr>
<tr>
<td>TDS</td>
<td>217</td>
<td>151</td>
<td>172</td>
</tr>
<tr>
<td>Carbonate alkalinity</td>
<td>BDL</td>
<td>BDL</td>
<td>BDL</td>
</tr>
<tr>
<td>Bicarbonate alkalinity</td>
<td>217</td>
<td>151</td>
<td>172</td>
</tr>
</tbody>
</table>

Cont…
Table 4: Correlation analysis between various physicochemical parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>pH</th>
<th>Alkalinity</th>
<th>TDS</th>
<th>Hardness</th>
<th>Calcium</th>
<th>Magnesium</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>1</td>
<td>0.9027</td>
<td>0.9643</td>
<td>0.9694</td>
<td>0.9655</td>
<td>0.9661</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>1</td>
<td>0.8954</td>
<td>0.9508</td>
<td>0.9350</td>
<td>0.9570</td>
<td>0.9570</td>
</tr>
<tr>
<td>TDS</td>
<td>1</td>
<td>0.9597</td>
<td>0.9687</td>
<td>0.9463</td>
<td>0.9463</td>
<td>0.9463</td>
</tr>
<tr>
<td>Hardness</td>
<td></td>
<td></td>
<td>0.9953</td>
<td>0.9971</td>
<td>0.9851</td>
<td>0.9851</td>
</tr>
<tr>
<td>Calcium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>0.9851</td>
</tr>
<tr>
<td>Magnesium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

### pH

The lower values of pH may cause corrosion in containers and pipeline, while the higher values may produce sediment, deposit and difficulties in chlorination for disinfection of water\(^7\). In the present studies the pH values in all ground water samples varied from 7.6 to 8.2 which are within the maximum limit. As the pH ranges within limits, so it cannot produce any harmful effect.
Table 5: Average result of calculated indices of sampling locations (L₁, L₂, L₃, L₄ and L₅)

<table>
<thead>
<tr>
<th>Cation-anion</th>
<th>% Na</th>
<th>SAR</th>
<th>ESP</th>
<th>RSC</th>
<th>AI</th>
<th>LSI</th>
<th>RI</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.0410</td>
<td>31.7164</td>
<td>1.4068</td>
<td>3.2274</td>
<td>0.1200</td>
<td>12.7877</td>
<td>0.8123</td>
<td>6.4755</td>
</tr>
<tr>
<td>-0.0573</td>
<td>34.8579</td>
<td>1.2818</td>
<td>3.0544</td>
<td>0.3600</td>
<td>11.8700</td>
<td>0.0721</td>
<td>7.5559</td>
</tr>
<tr>
<td>-0.0550</td>
<td>34.7195</td>
<td>1.3709</td>
<td>3.1777</td>
<td>0.3800</td>
<td>12.1662</td>
<td>0.2822</td>
<td>7.2355</td>
</tr>
<tr>
<td>-0.0314</td>
<td>33.2361</td>
<td>1.3726</td>
<td>3.1801</td>
<td>0.2600</td>
<td>12.4972</td>
<td>0.5844</td>
<td>6.8312</td>
</tr>
<tr>
<td>0.0497</td>
<td>32.2901</td>
<td>1.4072</td>
<td>3.2279</td>
<td>-0.1800</td>
<td>12.8807</td>
<td>0.8403</td>
<td>6.5194</td>
</tr>
<tr>
<td>0.0540</td>
<td>31.4963</td>
<td>1.1103</td>
<td>2.8161</td>
<td>0.0400</td>
<td>11.9407</td>
<td>0.0519</td>
<td>7.5961</td>
</tr>
<tr>
<td>0.0276</td>
<td>30.8280</td>
<td>1.1614</td>
<td>2.8873</td>
<td>0.0000</td>
<td>12.3875</td>
<td>0.3790</td>
<td>7.1419</td>
</tr>
<tr>
<td>0.0430</td>
<td>32.0772</td>
<td>1.2999</td>
<td>3.0795</td>
<td>-0.0600</td>
<td>12.6991</td>
<td>0.5530</td>
<td>6.8939</td>
</tr>
<tr>
<td>0.0639</td>
<td>33.1914</td>
<td>1.4772</td>
<td>3.3245</td>
<td>0.0200</td>
<td>13.0489</td>
<td>0.8856</td>
<td>6.4288</td>
</tr>
<tr>
<td>-0.0314</td>
<td>36.6752</td>
<td>1.3728</td>
<td>3.1804</td>
<td>0.3400</td>
<td>11.7202</td>
<td>-0.0531</td>
<td>7.7062</td>
</tr>
<tr>
<td>-0.0607</td>
<td>35.5752</td>
<td>1.4318</td>
<td>3.2620</td>
<td>0.3200</td>
<td>12.2732</td>
<td>0.3810</td>
<td>7.1380</td>
</tr>
<tr>
<td>-0.0156</td>
<td>33.1946</td>
<td>1.3820</td>
<td>3.1932</td>
<td>0.0400</td>
<td>12.7668</td>
<td>0.5822</td>
<td>6.8355</td>
</tr>
</tbody>
</table>
Conductivity

Conductance is not too harmful but water with higher conductance is not suitable for drinking, irrigational and other purposes. The values of conductivity varied between 415 to 690 µS, which is also within the limit.

**Total dissolved solids (TDS)**

Higher concentration of TDS causes gastrointestinal irritation. TDS is an important parameter for drinking water and water to be used for other purposes. The values of TDS varied between 265 to 440 mg/L, which is also within the limit.

**Alkalinity**

The presence of carbonates, bicarbonates and hydroxides are the main source of alkalinity in natural waters. In large quantities, alkalinity imparts a bitter taste of water. The value of alkalinity for water samples varied from 145 to 220 mg/L, which were all within limit.

**Hardness**

Higher values of hardness are responsible for incrustation and scaling in pipe lines. Hardness of water mainly depends upon the amount of calcium and magnesium salt or both. Hardness was found in the range of 130 to 211 mg/L, which were all in the limit.

**Calcium and magnesium (Ca²⁺, Mg²⁺):** Water with high calcium content is undesirable for household uses such as washing, bathing and laundering because of consumption of more soap and other cleaning agents. In the present investigation, calcium concentration ranged from 60 mg/L to 100 mg/L and at high concentration, magnesium salts have a laxative effect particularly when present as magnesium sulphate. Magnesium content in the investigated water samples was varied from 67 mg/L to 115 mg/L and found above prescribed limit.

**Sodium (Na⁺):** Excessive amount of sodium in drinking water is harmful to person suffering from cardiac, renal and circulatory diseases. Sodium concentration in the present analysis was found from 30 mg/L to 47 mg/L and was within the prescribed limit.

**Potassium (K⁺):** Potassium is an essential nutrition element but in excessive amounts, it act as cathartic. Potassium content in the water samples varied from 2 mg/L to 7 mg/L.

**Chloride (Cl⁻):** Chloride in drinking water is relatively harmless; however, high chloride contents in water bodies are harmful for metallic pipes and agricultural crops. Chloride
contents in fresh water are generally influenced by evaporation and precipitation\(^\text{10}\). Chloride contents varied from 20 to 37 mg/L in all the samples, which were all within the limit.

**Sulphate** (SO\(_4^{2-}\)): Sulfates can be more troublesome than chloride because they generally occur in greater concentrations. Higher value of sulphate may cause intestinal disorder. Sulphate values ranged in ground water samples from 18 to 36 mg/L, which were all within the limit.

**Nitrate** (NO\(_3^{-}\)): Nitrate (NO\(_3^{-}\)) is the highest oxidized from nitrogen. Nitrate in water supply in concentration over 100 mg/L causes methamoglobinemia or blue baby disease, particularly in infants up to 6 month of age. Nitrate Forms nitrosamine in stomach which causes gastric cancer. The nitrate concentration in the samples varied from 16 to 34 mg/L, which were all within the limit.

**Phosphate** (PO\(_4^{3-}\)): Occurrence of phosphate in groundwater is due to domestic sewage, detergents, agricultural effluents with fertilizers and industrial waste water. The phosphate concentration in ground water samples varied from 0.08 to 0.15 mg/L which all were within the limit.

**Seasonal trends**

Usual seasonal trends in values of different parameters i.e. dilution effect from pre-monsoon to post-monsoon period and conducting effect from post-monsoon to winter, spring are observed within study period.

**Correlation analysis**

Correlation is a mutual relationship between two variables. Direct correlation exists when increase or decrease in the value of one parameter is associated with a corresponding increase or decrease in the value of other parameter\(^\text{11}\). The average result of correlation analysis of sampling locations (L\(_1\), L\(_2\), L\(_3\), L\(_4\), L\(_5\)) between various physicochemical parameters are tabulated in Table 4.

**Calculated indices**

In the study Millie equivalents (Cation-Anion), Percentage Sodium (%Na), Sodium Adsorption Ratio (SAR), Exchangeable Sodium Percentage (ESP), Residual Sodium Carbonate (RSC), Aggressive Index (AI), Langlier Saturation Index (LSI), Ryzner Index (RI) were calculated. The values indicated that there is no specific impact of agricultural practices on ground water quality of study area during study period. The average result of calculated indices of sampling locations (L\(_1\), L\(_2\), L\(_3\), L\(_4\), and L\(_5\)) tabulated in Table 5.
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REFERENCES


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