



Study on quality of irrigation water of vijapur taluka of mehsana District, Gujarat (India)

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ABSTRACT

In arid and semi arid area, irrigation is very essential for successful agriculture. Quality of irrigation water is an important factor of crop production. Whatever may be the source of irrigation water, some soluble salts are always dissolved there in these are mostly sodium, calcium, magnesium and some time potassium as cations and chloride, carbonate, and bi-carbonate as anions. Salinity hazard which is associated with high soluble salts in water and measured in terms of electrical conductivity (EC), water having an EC value of more than 2.25mhos/cm² is always unsafe for irrigation use. The alkali hazard is related to the development of alkalinity in the soil and is expressed as SAR Residual Sodium Carbonate is an indirect expression of CO₃²⁻ and HCO₃¹⁻ of Na⁺ in ground water. Based on the RSC value the irrigation water are classified in conclusion.

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Introduction

Water is one of the most indispensable resources and is the elixir of life. About 97.2% of water on earth is salty and only 2.8% is present as fresh water from which about 20% constitutes ground water. Ground water is highly valued because of certain properties not possessed by surface water¹. Assessment of water quality is very important for knowing the suitability for various purposes². Water quality index (WQI) is regarded as one of the most effective way to communicate water quality³⁻⁵.

In arid and semi arid areas, irrigation is very essential for successful agriculture. Quality of irrigation water is an important factor of crop production. In India, the irrigated area is about 60.40 million hectares of which 41 percent is covered by canals, 26 percent by open wells, 7.7 percent by tube wells, 16.7 percent by tanks and 8.5 percent by other sources. In Gujarat total irrigated area is about 2.1 million hectares of which 80 percent area is covered by ground water. So ground water is an important source of irrigation in Gujarat. Whatever may be the sources of irrigation water, some soluble salts are always dissolved therein (TDS). These are mostly sodium, calcium, magnesium and some times potassium as cation and chloride. Carbonate and bi-carbonate as anions.

When high TDS ground water is used for irrigation, it creates problems of either salinity and /or alkalinity in the soil due to dissolved salts⁶⁻⁷.

Classification showing various hazardous categories

- Salinity hazard
- Sodicity (alkali) hazard
- Bi-carbonate hazard etc.

Salinity hazard which is associated with high soluble salts in water and measured in terms of electrical conductivity (EC), water having an EC value of more than 2.25 mhos/cm² is always unsafe for irrigation use.

The alkali hazard is related to the development of alkalinity in the soil and is expressed as SAR (sodium adsorption ratio).

Residual sodium carbonate (RSC) is an indirect expression of CO₃²⁻ and HCO₃¹⁻ of Na⁺ in ground water. Based on the RSC value the irrigation waters are classified in to three categories viz. probably safe, Marginal and Unsafe.

The study area:

The northern part of Gujarat state may be classified as a semi arid region. The mean annual temperature of the area is 26.0°C. The maximum temperature in May being 42.0°C. The average annual rainfall of the area is 25-303mm. There being fairly wide variations from year to year. There is no any permanent river in this region. The ground water is also very deep.

The Mehsana district is situated in the northern part of the Gujarat State. It lies between 23° and 24° – 10' North latitudes and 72° 0' and 72° 80' East longitudes spreading over 4376.38 sq. km. It is bonded by Banaskantha district in North, Sabarkantha district in East, Patan district in West and Ahmedabad district in South.

The area is a semi arid region. The Vijapur taluka is between latitude 23° 34' 0" N and longitude 72° 45' 0" E. The major water resources of the area are well and tube-wells. During the year 2010 -2011 about 11 ground water samples were collected during pre-monsoon 2010, 11 samples during post monsoon 2010.

Material and Methods

The samples collected from the wells were analyzed for major ion chemistry, employing the standard water quality procedures APHA^{8,9}. pH and electrical conductance were measured using pH and EC meter, Total dissolved solids were computed by TDS meter. Na and K were calculated by Flame photometrically. Total hardness as CaCO₃ was measured by using standard EDTA solution. Mg was calculated by Versenate method¹⁰. Studies on quality of irrigation water of Mehsana District, Gujarat (India).

Total hardness and Calcium, Chloride was determined volumetric method using standard AgNO_3 solution¹¹. Sulphate was estimated through titration against standard Barium chloride solution. The parameters present in the water sample can be calculated by using various methods¹².

The principal ground water resources of the vijapur region are wells and tube wells. In all about 22 samples of ground water were analyzed for various cations and anions. pH and electrical conductivity of water was also determined. The data of chemical analysis for some representative samples are presented in Table I. It gives information about the quality of waters from various points.

Table II and III give information about the quality of water in relation to their sodium absorption ratio (SAR) and RSC Value.

Results and Discussion

As per experimental data, the water of Vijapur taluka of Mehsana District has high to very high salinity (EC of 0.52 to 2.28) and low sodium hazard (2 to 7.83 SAR Value) and probably safe to unsafe limits of RSC (-7.5 to 3.1). Only 9.09% as doubt to unsafe (unsuitable) for irrigation. Unsuitable irrigation water not only reduces the crop growth but also affects the chemical characteristics of the soil in which the crop is growing.

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Table I Quality of irrigation water of Vijapur taluka of Mehsana District. No. of Samples: 22, Year of Study: 2010 onwards

| Sr.No | Analysis | Range | Mean |
|-------|--|------------------|------|
| 1 | pH | 7.08 to 8.04 | 7.44 |
| 2 | EC in m.moh/cm ² at 25 ⁰ C | 0.52 to 2.28 | 1.36 |
| 3 | Ca ⁺² +Mg ⁺² mg/L | 4.7 to 13.4 | 7.46 |
| 5 | HCO ₃ ⁻¹ mg/L | 4.2 to 9.4 | 7.1 |
| 6 | CL ⁻¹ mg/L | 4 to 18 | 8.4 |
| 7 | Na ⁺ mg/L | 3.25 to 12 | 6.94 |
| 8 | K ⁺ mg/L | 0.0006 to 0.0083 | 0.01 |

Table II Quality of irrigation water of Vijapur Taluka of Mehsana District No. of Samples: 20

| Sr No. | Analysis | Range | Mean |
|--------|---|--------------|------|
| 1 | RSC mg/L (Residual Sodium Carbonate) (CO ₃ ⁻² +H CO ₃ ⁻¹)-(Ca ⁺² +Mg ⁺²) | -7.5 to 3.1 | 0.23 |
| 2 | SAR (Sodium adsorption ratio) | 2 to 7.83 | 3.69 |
| 3 | EC (Electrical conductivity) | 0.52 to 2.28 | 1.36 |

**Table III Quality of irrigation water of Vijapur Taluka of Mehsana District
No. of Samples: 20, Location: Different Wells and tube wells from Vijapur Taluka Year
of Study: 2010 on wards**

| Analysis | Value | Samples | Percent | Categories |
|---|----------------|---------|---------|---------------|
| EC (Electrical conductivity) | 1.0 to 0.250 | 00 | 0.00% | Low |
| | 0.250 to 0.750 | 01 | 04.55% | Medium |
| | 0.750 to 2.250 | 21 | 95.45% | High |
| | >2.250 | 00 | 0.00% | Very High |
| RSC mg/L (Residual Sodium Carbonate) | 1.0 to 1.25 | 13 | 59.09% | Probably safe |
| | 1.25 to 2.50 | 07 | 31.82% | Marginal |
| | >2.50 | 02 | 09.09% | Unsafe |
| SAR (Sodium adsorption ratio) | 1.0 to 10.0 | 22 | 100.00% | Low |
| | 10.0 to 18.0 | 00 | 0.00% | Medium |
| | 18.0 to 26.0 | 00 | 0.00% | High |
| | >26.0 | 00 | 0.00% | Very High |

Table IV Rating of different Criterias

| Sr.No | Analysis | Value | Categories |
|-------|---|----------------|---------------|
| 1 | EC (Electrical conductivity) | 0.0 to 0.250 | Low |
| | | 0.250 to 0.750 | Medium |
| | | 0.750 to 2.250 | High |
| | | >2.250 | Very High |
| 2 | SAR (Sodium adsorption ratio) | 0.0 to 10.0 | Low |
| | | 10.0 to 18.0 | Medium |
| | | 18.0 to 26.0 | High |
| | | >26.0 | Very High |
| 3 | RSC mg/L (Residual Sodium Carbonate) | 0.0 to 1.25 | Probably safe |
| | | 1.25 to 2.50 | Marginal |
| | | >2.50 | Unsafe |