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*Original Article*

# Evaluation of surface irrigation water quality in Muktagacha Upazila of Bangladesh

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**Abstract**

A study was conducted to determine the quality of water for irrigation from the surface water of water bodies in Muktagacha Upazila under Mymensingh District. Water samples from 19 different water bodies (river, pond, khal, canal, beel etc.) located all over the upazila were collected and analyzed for chemical composition and properties to classify them according to their suitability for irrigation. All water samples were found excellent to good and normal for irrigation in respect of salinity or Electrical Conductivity (EC) and Sodium Adsorption Ratio (SAR) respectively, and practically neutral to slightly alkaline in respect of pH. Considering boron concentration most of the samples was found to be excellent for all types of crops of the study area. Conventional Classification of water by Piper diagram have been done to show clustering of data points to indicate samples that have similar composition. Geographical Information System (GIS) have been used in mapping, which greatly aided in the understanding of and decision making in water resources management. Any initiative for surface water development for planned irrigation practices is highly encouraged.

**Keywords:** irrigation, water quality, Electrical Conductivity (EC), Sodium Adsorption Ration (SAR), Piper diagram

## 1. Introduction

Irrigated agriculture is dependent on adequate water supply of usable quality. Water quality concerns have often been neglected because good quality water supplies have been plentiful and readily available. For irrigation, the quality of water determines if optimum returns from the soil can be obtained as the quality affects soil, crop and water management. Nearly all water contains dissolved salts and trace elements, many of which result from the natural weathering of the earth's surface. In most irrigation situations, the primary water quality concern is salinity levels, since salts can affect both the soil structure and crop yield. Surface water contributes the major share of irrigation coverage. Low lift pumps of various capacities are used to utilize surface water. Groundwater replenishes surface source during dry period since the underground flow directions are towards rivers, as indicated by different studies. The generally accepted view is that in most parts of Bangladesh, the present levels of surface water abstraction for irrigation during dry season are very close to the accepted maximum limits. Official estimates of area irrigated from surface source, almost certainly exaggerated but indicative of broad trends, show a sharp and rapid increase from about 0.4 m ha in 1960 to 1.35 m ha in 1974-75, remaining thereafter at a similar level until today (Rahman, *et al*., 2000). Irrigated agriculture in Bangladesh has already started showing problems regarding water quality and fertilization (Talukder *et al*., 1989).

The elaboration and implementation of sustainable water use strategies based on detailed data on the seasonal

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variation of the water quality that is strongly related to dilution processes taking place during high-flow periods, and to the loads of soluble compounds carried by the return waters utilized for land washing and irrigation (Crosa, *et al*., 2006). The irrigation practice becomes a matter of great concern if the water quality is not up to the mark. A very few studies were conducted in Bangladesh to determine the quality of surface water for irrigation purposes. Irrigation water quality of surface water catchment in and around the Dhaka-Narayangange- Demra (DND) irrigation project area has been evaluated. The results reveal that except bicarbonate ($HCO_3^-$) and Total Dissolved Solids (TDS) in Kanchpur, Sarolia and the DND project area, all other quality parameters of surface water is safe for irrigation. Boron concentration in most places of the study area is high and is above the recommended limit for irrigation purposes. Higher concentrations of TDS, $HCO_3^-$ and organic matter in Kanchpur waste get dumped into the surrounding water bodies (Shamsad *et al.*, 1999).

Agriculture is now considered to be the dominant source of non-point pollution of surface water (Jones, 1997). Many different sources and processes can be responsible for the contaminants polluting the surface and groundwater. Detailed hydrochemical research is needed to evaluate the different processes and mechanisms involved in polluting water (Helena, *et. al.*, 1999). Conventional classification technique like Piper diagram considers selected major and minor ions in determining the chemical quality of the surface and groundwater of an irrigated area. The objective of the study was to assess the environmental impacts of agricultural practices in the area and also to determine water quality in detail and not just in terms of major and minor ions. Determination of water quality may certainly help better understand of the soil, crop and water management practices of this region.

## 2. Materials and Methods

### 2.1 Location

The study area was the Muktagachha upazila under Mymensingh district of Bangladesh. More irrigation is done here than in any other upazila of the district. The area is located between 24° 36' N to 24° 52' N latitudes and 90° 04' E to 90° 20' E longitudes. Rainfall is the major source of recharge in the area (596 mm out of a total of 2654 mm rain on average) with other sources of return flow from irrigation and deep percolation from surface water bodies. Boro and Transplanted Aman rice are mainly grown in the area as irrigated crops. About 14,343 hectares of cultivated land of the study area is presently provided with irrigation. Irrigation intensity is about 37% of the net cropped area (BADC, 2003). Among surface water sources the river Banar is the only perennial river flowing over the south-western part of the study area. In addition, there are 2,936 usable ponds, a large beel, a few khals and canals to serve as surface water sources for irrigation. Though these surface water sources conserve sufficient water during monsoon, many of them go dry during winter and cannot fulfill the dry season water requirements of the area. The water may contain different elements of varying origins and toxic concentrations disposed from adjoining settlements, urban and industrial areas that degrade its quality for irrigation.

### 2.2 Sample collection

A field investigation was conducted during dry season (January -February 2004) to evaluate the suitability of water in the study area for irrigation. The water samples were collected from different locations of Mukatagacha upazila and prepared for subsequent experiments and analysis. Nineteen water samples were collected grid wise from the water bodies (river, pond, khal, canal, beel). The locations of the sample sites were taken by the GPS (Global Positioning System) meter. The sampling location map of the surface water of the study area is shown in Figure 1. Before sampling from a water body, high-density 1 liter PVC bottle were rinsed thoroughly with the sample water so that the sample was representative of the surface water source. After collecting the water samples, the bottles were kept air tight and labeled properly for identification. Several filtrations of the collected water samples were required during the analysis of different elements.

### 2.3 Chemical analysis

The collected surface water samples were analyzed for pH, electrical conductivity, total dissolved solids, the cations, such as nitrogen, calcium, magnesium, potassium, sodium; the anions, viz., carbonate, bicarbonate, chloride, sulphate, phosphate and borate according to the standard methods and techniques (Jackson, 1967). The water quality determining indices, such as Sodium Adsorption Ratio (SAR), Residual Sodium Bicarbonate (RSBC), Soluble Sodium Percentage (SSP), etc. were calculated by using the following recommended relationships.

Sodium Adsorption Ration (SAR)

$$SAR = \frac{Na^+}{\sqrt{(Ca^{++} + Mg^{++})/2}} \quad (1)$$

Soluble Sodium Percentage (SSP)

$$SSP = \frac{Na^+ + K^+}{Ca^{++} + Mg^{++} + Na^+ + K^+} \times 100 \quad (2)$$

Residual Sodium Bi-carbonate (RSBC)

$$RSBC = HCO_3^- - Ca^{++} \quad (3)$$

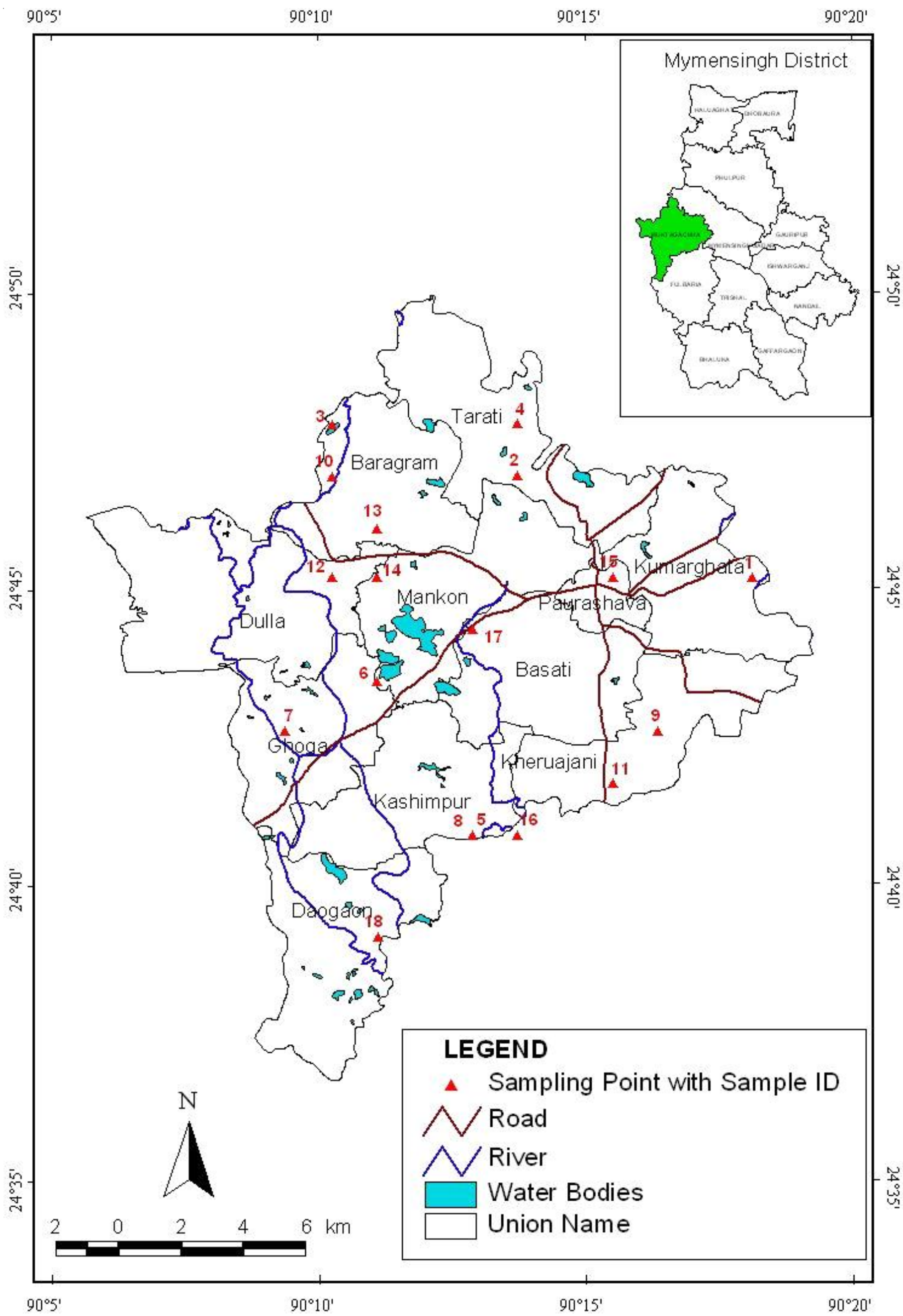


Figure 1. Surface Water Sampling Location Map of Muktagacha Upazila

Permeability Index (PI)

$$PI = \frac{Na^{+} + \sqrt{HCO^{-}_{3}}}{Ca^{++} + Mg^{++} + Na^{+}} \times 100 \qquad (4)$$

Total Hardness (Ht)

$$Ht = (Ca^{++} + Mg^{++}) \ x \ 50 \qquad (5)$$

Where, all the ionic concentrations are expressed in milli-equivalents per litre (meq/l). Although all these indices were evaluated in this study, the SAR is probably the only one in current use and is generally considered an effective evaluation index for most water used in irrigated agriculture (Ayers and Westcot, 1985).

## 3. Results and Discussion

The average temperature of the water samples of the study area was approximately 18.9°C. The chemical compositions of the collected surface water samples are presented in Table 1. The results of the water quality parameters are

Table 1. Chemical composition of surface water samples in the study area

| Sample ID | pH | EC | TDS | Cation Contents | | | | | Anion Contents | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $Na^+$ | $K^+$ | $Ca^{2+}$ | $Mg^{2+}$ | $NH_4^+$ | $Cl^-$ | $CO_3^{2-}$ | $HCO_3^-$ | $NO_3^-$ | $SO_4^{2-}$ | $PO_4^{3-}$ | $BO_3^{3-}$ |
| 1 | 2 | 3 µS $cm^{-1}$ | 4 mg $l^{-1}$ | 5 | 6 | 7 | 8 | 9 meq $l^{-1}$ | 10 | 11 | 12 | 13 | 14 | 15 mg $l^-$ | 16 |
| 1 | 7.560 | 211 | 135 | 0.564 | 0.054 | 1.764 | 0.784 | 0.044 | 0.450 | 0.000 | 2.030 | 0.176 | 2.257 | 0.065 | 0.232 |
| 2 | 7.760 | 192 | 123 | 0.768 | 0.084 | 0.980 | 1.372 | 0.044 | 0.450 | 0.000 | 1.580 | 0.066 | 3.633 | 0.022 | 0.074 |
| 3 | 7.680 | 151 | 096 | 0.541 | 0.073 | 0.980 | 0.784 | 0.088 | 0.900 | 0.000 | 1.350 | 0.044 | 3.908 | 0.127 | 0.013 |
| 4 | 7.470 | 151 | 097 | 1.221 | 0.227 | 0.980 | 0.980 | 0.044 | 0.900 | 0.000 | 1.350 | 0.044 | 4.459 | 0.018 | 0.110 |
| 5 | 7.480 | 181 | 142 | 1.334 | 0.046 | 1.568 | 0.784 | 0.000 | 0.450 | 0.000 | 2.030 | 0.044 | 5.009 | 0.076 | 0.025 |
| 6 | 7.300 | 200 | 136 | 0.564 | 0.161 | 2.156 | 0.392 | 0.088 | 0.900 | 0.000 | 1.350 | 0.000 | 3.817 | 0.112 | 0.062 |
| 7 | 7.410 | 163 | 113 | 0.949 | 0.108 | 1.372 | 0.196 | 0.088 | 0.450 | 0.000 | 1.130 | 0.000 | 3.266 | 0.026 | 0.013 |
| 8 | 7.800 | 312 | 204 | 1.357 | 0.307 | 2.744 | 0.392 | 0.088 | 1.350 | 0.000 | 3.150 | 0.000 | 5.560 | 0.011 | 0.086 |
| 9 | 7.640 | 203 | 135 | 0.677 | 0.158 | 1.372 | 0.980 | 0.044 | 0.450 | 0.000 | 2.030 | 0.000 | 3.450 | 0.105 | 0.038 |
| 10 | 7.560 | 161 | 116 | 0.428 | 0.057 | 1.568 | 0.392 | 0.044 | 0.450 | 0.000 | 1.800 | 0.000 | 2.899 | 0.011 | 0.062 |
| 11 | 7.340 | 292 | 201 | 1.958 | 0.749 | 1.568 | 0.392 | 0.220 | 1.350 | 0.000 | 1.580 | 0.000 | 4.734 | 0.272 | 0.147 |
| 12 | 7.190 | 061 | 059 | 0.089 | 0.034 | 1.372 | 0.392 | 0.088 | 0.900 | 0.000 | 0.000 | 0.000 | 3.541 | 0.015 | 0.062 |
| 13 | 7.490 | 182 | 128 | 0.768 | 0.204 | 1.568 | 0.294 | 0.132 | 0.900 | 0.000 | 1.350 | 0.000 | 1.798 | 0.018 | 0.086 |
| 14 | 7.200 | 123 | 088 | 0.360 | 0.134 | 2.352 | 0.000 | 0.132 | 0.450 | 0.000 | 0.900 | 0.000 | 5.651 | 0.079 | 0.025 |
| 15 | 7.450 | 070 | 054 | 0.111 | 0.019 | 1.568 | 0.588 | 0.044 | 0.900 | 0.000 | 0.450 | 0.022 | 5.595 | 0.050 | 0.038 |
| 16 | 7.580 | 161 | 130 | 0.587 | 0.057 | 1.764 | 0.784 | 0.088 | 0.900 | 0.000 | 1.350 | 0.000 | 8.571 | 0.050 | 0.050 |
| 17 | 7.720 | 272 | 179 | 1.447 | 0.268 | 1.960 | 0.588 | 0.044 | 1.350 | 0.000 | 2.250 | 0.176 | 8.214 | 0.079 | 0.147 |
| 18 | 7.140 | 031 | 048 | 0.00 | 0.023 | 2.352 | 0.000 | 0.132 | 0.450 | 0.000 | 0.230 | 0.000 | 5.714 | 0.063 | 0.000 |
| 19 | 7.610 | 152 | 109 | 0.858 | 0.231 | 1.372 | 0.196 | 0.044 | 0.900 | 0.000 | 0.900 | 0.000 | 6.548 | 0.092 | 0.025 |
| Average | 7.490 | 172 | 123 | 0.767 | 0.158 | 1.651 | 0.542 | 0.079 | 0.780 | 0.000 | 1.410 | 0.030 | 4.664 | 0.068 | 0.068 |
| Max | 7.800 | 312 | 204 | 1.958 | 0.749 | 2.744 | 1.372 | 0.220 | 1.350 | 0.000 | 3.150 | 0.180 | 8.570 | 0.270 | 0.230 |
| Min | 7.140 | 031 | 048 | 0.000 | 0.019 | 0.980 | 0.000 | 0.000 | 0.450 | 0.000 | 0.000 | 0.000 | 1.800 | 0.010 | 0.000 |
| SD | 0.190 | 072 | 043 | 0.513 | 0.168 | 0.486 | 0.358 | 0.049 | 0.330 | 0.000 | 0.750 | 0.060 | 1.820 | 0.060 | 0.060 |

discussed below:

### 3.1 pH, EC, TDS

The range of the pH value of the surface water is 7.140 to 7.800 with the average value of 7.490, which are within the permissible limit (Table 2) for irrigated agriculture (DOE, 1997 and UCCC, 1974). The Electrical Conductivity (EC) value of the surface water samples of the study area varied from 031 to 312 mS $cm^{-1}$ with an average value of 172.05 mS $cm^{-1}$, which are according to Wilcox, 1955 irrigation water quality classification 'excellent to good' for irrigation. The Total Dissolved Solids (TDS) value of surface water samples of the study area ranged from 048 to 204 mg $l^{-1}$ with an average value of 123 mg $l^{-1}$.

### 3.2 Cation content

The sodium ($Na^+$) content of the surface water samples ranged from 0.000 (not detected) to 1.958 meq $l^{-1}$ with an average value of 0.767 meq $l^{-1}$. It is evident that all the values of $Na^+$ are far below the recommended limits (Table 2) for irrigation use (DOE, 1997, WHO, 1983 and UCCC, 1974). The potassium ($K^+$) content of the surface water samples ranged from 0.019 to 0.749 meq $l^{-1}$ with an average value of 0.158 meq $l^{-1}$ The calcium ($Ca^{2+}$) content of the study area ranges from 0.980 to 2.744 meq $l^{-1}$ with an average value of 1.651 meq $l^{-1}$. The magnesium ($Mg^{2+}$) content ranges from 0.000 (not detected) to 1.372 meq $l^{-1}$ with an average value of 0.542 meq $l^{-1}$. It is evident that all the values of $Mg^{2+}$ in the surface water of the study area are much lower (Table 2) than the recommended limits (DOE, 1997 and WHO, 1983) and can be used without restrictions. The ammonium ($NH_4^+$) content of the surface water samples ranged from 0.000 (not detected) to 0.220 meq $l^{-1}$ with an average value of 0.079 meq $l^{-1}$. The higher $NH_4^+$ concentration in some collected irrigation water samples may have been due to the impact of settlement and anthropogenic effects.

### 3.3 Anionic content

The bicarbonate ($HCO_3^-$) content of the surface water samples ranged from 0.000 (not detected) to 3.150 meq $l^{-1}$ with an average value of 1.410 meq $l^{-1}$. Although some of the

Table 2. The National and International Recommended Guidelines for Irrigation Water Quality

| Parameters | Sources | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | DOE (1997)* | BWPCB (1976)* | WHO (1983)$^{\Delta}$ | UCCC (1974)$^{\Delta}$ | Wilcox (1955)$^{\Delta}$ | Richards (1954)$^{\Delta}$ | Ayres and Westcot (1985)$^{\Delta}$ | Average Values in the study area (surface water) |
| Temperature (°C) | 20-30 | | - | | | | | 18.9 |
| pH 6.5-8.5 | 6.5-9.2 | 6.5-8.5 | 6.5-8.4 | | | 6.0-8.5 | 7.490 | |
| EC (mS $cm^{-1}$) | - | | - | 700-3000 | 250-2000 | 0-3000 | | 172 |
| TDS (mg $l^{-1}$) | 0-1000 | 0-1500 | 0-1000 | 450-2000 | | | 0-2000 | 123 |
| Ht (mg $l^{-1}$) | 200-500 | | 500 | | | | | 109.61 |
| SAR - | | - | 0-3 | | 0-18 | 0-15 | 0.740 | |
| SSP (%) | | | | | 0-60 | | | 27.300 |
| RSBC (meq $l^{-1}$) | | | | | | | | 0.190 |
| Kelley's Ratio | | | | | | | | 0.360 |
| $Na^+$ (meq $l^{-1}$) | 8.70 | | 8.70 | 2.96-8.87 | | | 0-40 | 0.767 |
| $K^+$ (meq $l^{-1}$) | 0.308 | | - | | | | 0-0.051 | 0.158 |
| $Ca^{2+}$ (meq $l^{-1}$) | 3.75 | | 10 | | | 0-20 | | 1.651 |
| $Mg^{2+}$ (meq $l^{-1}$) | 2.5-2.95 | | 4.17 | | | | 0-5 | 0.542 |
| $NH_4^+$ (meq $l^{-1}$) | - | | 0.028 | | | | 0-278 | 0.079 |
| $HCO_3^-$ (meq $l^{-1}$) | - | | - | 1.49 | | | 0-10 | 1.410 |
| $CO_3^{2-}$ (meq $l^{-1}$) | - | | - | | | | 0-1 | 0.000 |
| $Cl^-$ (meq $l^{-1}$) | 4.23-6.90 | 16.90 | 7.04 | 3.75 | | | 0-30 | 0.780 |
| $NO_3^-$ (meq $l^{-1}$) | 0.161 | 0.726 | 0.161 | 0.081 | | | 0-0.161 | 0.030 |
| $SO_4^{2-}$ (mg $l^{-1}$) | 400 | 400 | 400 | | | | 0-20 | 4.664 |
| $PO_4^{3-}$ (mg $l^{-1}$) | 6 | | - | | | | 0-0.063 | 0.068 |
| $BO_3^{3-}$ (mg $l^{-1}$) | 1.0 | | - | 0.7 | 0.3-1.0 | | 0-2 | 0.068 |

Note: * National Guidelines $^{\Delta}$International Guidelines

samples showed a high trace amount of carbonate ($CO_3^{2-}$), but the maximum showed not detected value. All the estimated values of $CO_3^{2-}$ concentrations in the study area are in keeping with the recommended limits (Table 2). The chloride ($Cl^-$) content of the surface water samples ranged from 0.450 to 1.350 meq $l^{-1}$ with an average value of 0.780 meq $l^{-1}$. The range of $Cl^-$ content of the irrigation water sample was far below (Table 2) the recommended limits (DOE, 1997) as well as injurious for plant growth. The nitrate ($NO_3^-$) content ranged from 0.000 (not detected) to 0.180 meq $l^{-1}$ with an average value of 0.030 meq $l^{-1}$. Higher concentration of $NO_3^-$ in the surface water may be due to the discharge of untreated industrial, domestic and municipal waste at these locations. In some situations $NO_3^-$ that enters the ground water systems originates as $NO_3^-$ in wastes of fertilizers applied to the land surface. The sulfate ($SO_4^{2-}$) content of the surface water samples ranged from 1.800 to 8.570 mg $l^{-1}$ with an average value of 4.660 mg $l^{-1}$. Although the $SO_4^{2-}$ concentrations in the study area vary considerably, all the $SO_4^{2-}$ values fall within acceptable limits (DOE, 1997, BWPCB, 1976 and WHO, 1983). The phosphate ($PO_4^{3-}$) content ranges from 0.010 to 0.270 mg $l^{-1}$ with an average value of 0.068 mg $l^{-1}$. The values obtained from all the water samples of surface waterfall were within acceptable limits (DOE, 1997). The concentration of boron ($BO_3^{3-}$) in surface water samples ranged from 0.000 (not detected) to 0.230 mg $l^{-1}$ with an average value of 0.070 mg $l^{-1}$. The results were within the permissible limits of irrigation water (DOE, 1997, UCCC, 1974 and Wilcox, 1955).

### 3.4 Irrigation water quality

In Water Class for irrigation, Sodium Adsorption Ratio (SAR) is an important parameter in determining the suitability of irrigation water, which was found "normal" according to Raghunath, 1990. These results showed that there was a good proportion of $Ca^{2+}$ and $Mg^{2+}$ in the study area that is favorable for good structural and tilth conditions of the soil indicating no permeability problem. Water class for irrigation was also determined considering the combined effects of SSP, EC and boron contents. According to these criteria, 17 samples of surface water were found to be "excellent to good" and only 2 samples were classified as "permissible" (Raghunath, 1990 and Wilcox, 1955). However, these permissible waters were "normal" and "satisfactory" when categorized using SAR and RSBC values, respectively

(Raghunath, 1990 and Gupta and Gupta, 1987). The water classes were "fresh", "good" and "moderately hard" in respect of the classification of TDS, Permeability Index (PI) and Total Hardness (Ht) (Freeze and Cherry, 1979), except for 8 samples that were "slightly hard" in respect of Ht (Raghunath, 1990). The classification range of pH was found slightly alkaline to practically neutral (Michael, 1992).

To determine how the interaction of the various ions affect the suitability of the water for crop irrigation, the SAR has been plotted with the conductivity measurement on the classical U.S. Salinity Laboratory Classification diagram (Wilcox, 1955) in Figure 2. This diagram uses SAR and EC values for classifying irrigation water quality. As seen in the figure, the majority of the water samples analysed belong to the C1-S1 class (low salinity and low sodium content class), which is suitable for irrigation on almost all soil types, which is in broad agreement with the guidelines by Ayers and Westcot (1985). Three samples (Sample ID no 8, 11 and 17) belong to the C2-S1 (medium salinity and low sodium content class); however, water belonging to this class is also suitable for most plants provided moderate amount of leaching takes place or for plants with moderate salinity tolerance without considerable practices for salinity control (Shaki and Adeloye, 2006).

### 3.5 Conventional classification of water: Piper diagram

Piper diagrams, also called trilinear diagrams (Piper, 1953), are drawn by plotting the proportions (in equivalents) of the major cations ($Ca^{2+}$, $Mg^{2+}$, ($Na^{+}$ + $K^{+}$)) on one triangular diagram, the proportions of the major anions (Alkalinity ($CO_3^{2-}$ + $HCO_3^{-}$), $Cl^{-}$, $SO_4^{2-}$) on another, and combining the information from the two triangles on a quadrilateral. The position of this plotting indicates the relative composition of a groundwater in terms of the cation-anion pairs that correspond to four vertices of the field. The Piper diagram not only shows graphically the nature of a given water sample, but also dictates the relationship to other samples (Hussain, *et.al.*, 2008). For example, by classifying samples on the Piper diagram, we can identify geologic units with chemically similar water, and define the evaluation in water chemistry along the flow path.

| Sample ID | EC (mmhos/cm) | SAR |
|---|---|---|
| 1 | 211 | 0.50 |
| 2 | 192 | 0.71 |
| 3 | 151 | 0.58 |
| 4 | 151 | 1.23 |
| 5 | 181 | 1.23 |
| 6 | 200 | 0.50 |
| 7 | 163 | 1.07 |
| 8 | 312 | 1.08 |
| 9 | 203 | 0.62 |
| 10 | 161 | 0.43 |
| 11 | 292 | 1.98 |
| 12 | 61 | 0.09 |
| 13 | 182 | 0.80 |
| 14 | 123 | 0.33 |
| 15 | 70 | 0.11 |
| 16 | 161 | 0.52 |
| 17 | 272 | 1.28 |
| 18 | 31 | 0.00 |
| 19 | 152 | 0.97 |

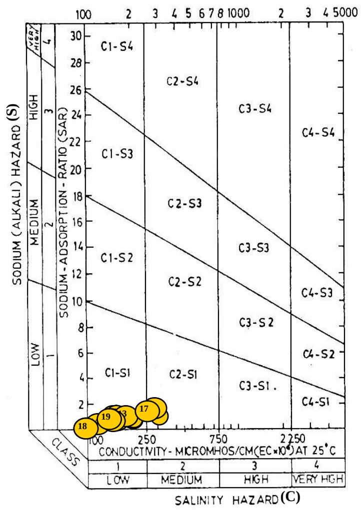


Figure 2. Salinity Classification of Surface Irrigation Water Samples

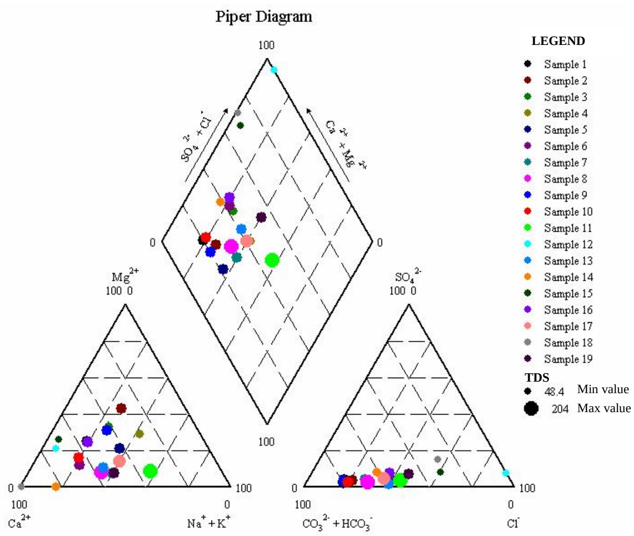


Figure 3. Piper Diagram for Surface Irrigation Water Samples of the Study Area

GW_Chart is a program for creating specialized graphs used in groundwater as well as surface water studies. Piper Diagram is one of the major type of graphs created with GW_Chart (Winston, R.B., 2000). All the water samples collected from surface water sources were plotted on a Piper diagram (Figure 3). The ion concentrations and total dissolved solids for multiple samples showed that the waters in the study area are both major cations and anions dominated.

## 4. Conclusion

From the study results and discussions it may be concluded that the surface water in the study area has no salinity or toxicity problem. On the basis of SAR, SSP and RSBC values, no infiltration problem exists in the selected locations and water management in the area can be done with a desirable limit of SAR. Some locations have high $NO_3^-$ concentration; consequently, irrigation with this type of surface water should be practiced with caution. Conventional Classification of water by Piper diagram shows clustering of data points to indicate samples that have similar composition. A monitoring program is also necessary in order to update the GIS maps for better and updated decision-making. Finally, the surface water of the study area is suitable or almost excellent for being used for irrigation and this quality investigation may be a useful guide to the quality of water in that area.

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**List of Abbreviation**

EC = Electrical Conductivity
GIS = Geographical Information System
GPS = Global Positioning System
Ht = Total Hardness
nd = Not Detected Value
PI = Permeability Index
PVC = Polyvinyl Chloride
RSBC = Residual Sodium Bi-carbonate
SAR = Sodium Adsorption Ratio
SSP = Soluble Sodium Percentage
TDS = Total Dissolved Solids