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**Archives of Applied Science Research, 2015, 7 (6):1-6**
*(http://scholarsresearchlibrary.com/archive.html)*

**ISSN 0975-508X**
**CODEN (USA) AASRC9**

# Application of water quality index method to assess ground water quality in Muktainagar Taluka, District-Jalgaon, Maharashtra, India

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**ABSTRACT**

*The study area under investigation, Muktainagar is located towards eastern part of Jalgaon district in Maharashtra state. The area is lying between 21°03'08" North latitude 76°03'18"East longitudes. In India the water availability, quality and quantity differs. To study the hydrochemical nature of the water used for drinking purpose, a collective 51 samples of ground water were collected during pre monsoon 2012 and post monsoon 2013. Analytical reports were compared with World Health Organization. The qualities of ground water were found to be deteriorated predominantly due to overexploitation and anthropogenic activities. Geochemistry of ground water shows $Ca^{2+}$> $Mg^{2+}$> $Na^{+}$> $K^{+}$ and $HCO_3^{2-}$> $Cl^{-}$ > $SO_4^{2-}$>$CO_3^{2-}$ trend. Most of the ground water samples were observed as $Ca^{2+}$ - $Mg^{2+}$ - $Cl^{-}$ type .*

**Key words:** Ground water, drinking water , salinity, Muktainagar , Jalgaon area , Maharashtra.

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## INTRODUCTION

As we are stepping in 21st century, the crises of scarcity of drinking water continue more vigorously. Almost all the freshwater bodies are being constantly polluted, thus the portability of unpolluted water is decreasing (Dixit et.al 2005). In India, about 70% of the population of urban and rural depend on ground water for various domestic uses. But due to improper waste disposal, faulty well construction, lack of sanitation and lack of water sources protection measures causes contamination of ground water .Such contamination lead to diseases outbreaks. Ground water is also contaminated by use of excessive pesticides, fertilizers, effluents discharged from the industries, sewage and such many more pollutants. Consumption of water with high amount of TDS and nitrate has been reported to cause disorders of alimentary canals, respiratory, nervous and coronary systems (Reddy and Subbarao 2001). Crops irrigated with ground water shows poor seed germination, retardation and slow development of plant. in view of such noticeable changes taking place related to agriculture , industrial & domestic fields, there was a need felt for the monitoring of water quality of ground water . Moreover remedial measures, if required should be applied before consumption of water by human beings. Therefore in the present study area an attempt was made to evaluate the chemical characteristics of ground water in Muktainagar taluka, Jalgaon district, Maharashtra.

## II. DESCRIPTION OF THE STUDY AREA:-

Study area( Figure-1) ,Muktainagar is located towards the eastern part of Jalgaon city covering the a area of 63,392 hectares. It is located at 21°03'08"North latitude and 76°03'18"East longitude. Location map of study area is shown in fig 1. The average annual rainfall is 750 mm / per annum. Rainfall of the study area is predominant in the

monsoon season from June to September. The study area consists of alluvial plain of tapi valley associated with purna river flowing from north to south.

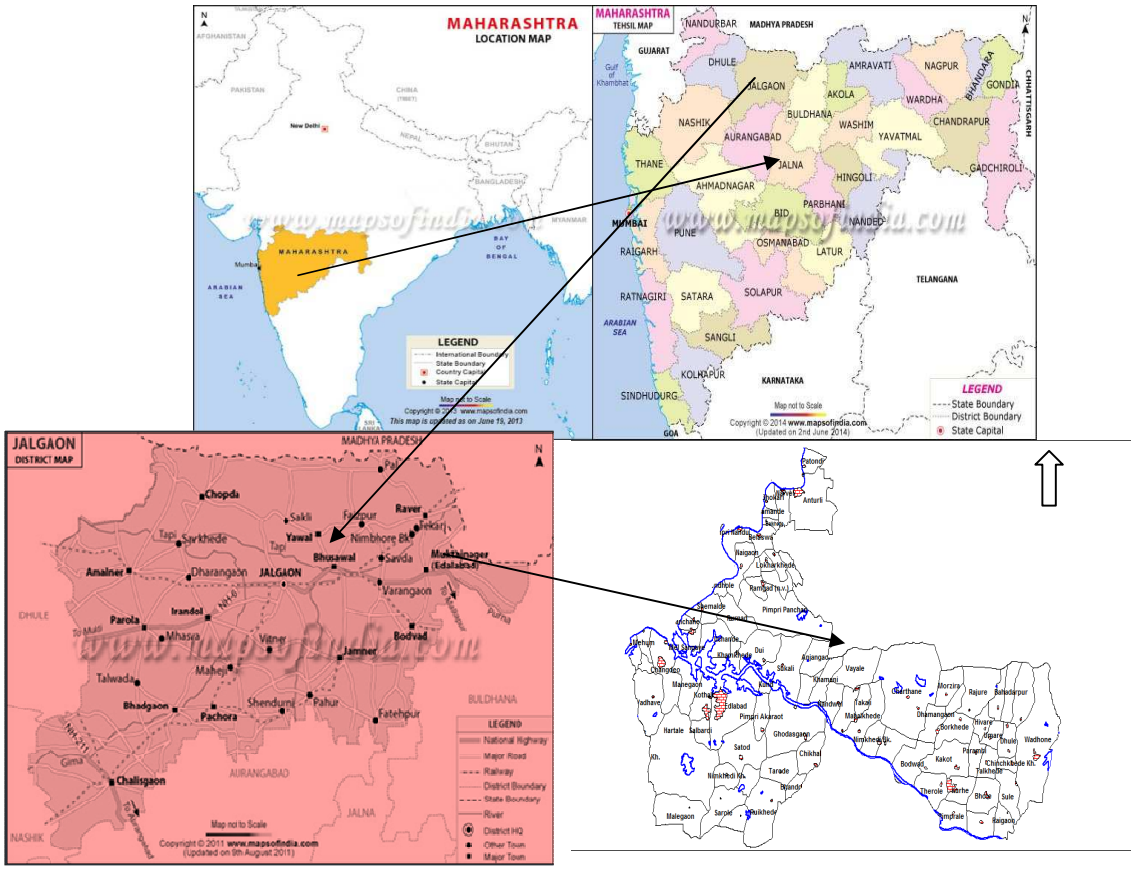



**Fig 1: Location map**

## MATERIALS AND METHODS

A total of 51 water samples were collected from Muktainagar area Jalgaon district during the post monsoon 2012 and pre monsoon 2013. The water samples were collected in pre-cleaned polyethylene one litre bottles. The sample bottles were labeled, sealed and transported to the laboratory for further hydro chemical analysis. The analytical procedure and techniques followed by APHA( 1995).

On digital water analysis kit pH, EC and TDS were measured. The sodium and potassium were determined by using Flame photometer, by titration methods calcium, chloride, total alkalinity , carbonate, bicarbonate, total hardness was estimated while sulphate, phosphate, nitrate were analysis by Spectrophotometer or digital calorimeter. The total dissolved solids were obtained by using Hem's factor. The results were obtained in ppm, It was converted into equivalent per million (epm), by dividing it with respective equivalent weight of parameter .

Based on the physicochemical analysis, irrigation quality parameters like sodium absorption ratio (SAR), Kelley's ratio (KR), sodium percentage (Na %), residual sodium carbonate (RSC), Magnesium ratio(Mg%), corrosivity ratio, chloro alkaline indices is calculated. The correlation of the analytical data has been attempted by plotting different graphical representation such Piper trilinear diagram (1994), Wilcox diagram (1970), US Salinity diagram was used to study the classification and suitability of groundwater .

## RESULTS AND DISCUSSION

Statistical summary report of ground water quality parameters along with BIS drinking water standards are tabularized below in table 1. Hydrochemical variations of ground water in Muktainagar Taluka of Jalgaon District.

| N=51 | | | Post 2012 | | | | Pre2013 | | | | Classification | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S.ro** | **Category** | **Parameters** | **Max** | **Min** | **Avg** | **S.D.** | **Max** | **Min** | **Avg** | **S.D.** | **Highest desirable limit** | **Permissible limit** |
| 1 | General | pH | 8.3 | 7.0 | 7.5 | 0.34 | 8.6 | 7.1 | 7.8 | 0.35 | 6.5-8.5 | ------ |
| | | EC | 3910 | 295.3 | 1194.2 | 711.3 | 3820 | 122 | 0.3 | 848.2 | 1400 | ------- |
| | | TDS | 2768 | 235.5 | 764.1 | 472.05 | 2144 | 168 | 713.2 | 458.9 | 500 | 2000 |
| | | TH | 1224 | 140 | 382.6 | 227.8 | 1407.6 | 57 | 356.9 | 252.84 | 300 | 600 |
| | | TA | 1087 | 19.3 | 367.8 | 197.5 | 1149.5 | 28.5 | 337.2 | 181.13 | 200 | 600 |
| 2 | Cations | Ca | 312.6 | 19.3 | 72 | 55.29 | 258.4 | 6.09 | 61 | 45.66 | 75 | 200 |
| | | Mg | 158.4 | 3.9 | 51.2 | 33.22 | 185.3 | 2.76 | 50.4 | 40.10 | 30 | 100 |
| | | Na | 456.1 | 19.8 | 100.6 | 92.44 | 372.1 | 18 | 81.5 | 74.11 | NA | NA |
| | | K | 159.9 | 0.0 | 4.6 | 22.22 | 3.3 | 0.1 | 1 | 0.85 | 10 | 10 |
| 3 | Anions | $HCO_3^-$ | 1065.7 | 42.1 | 417.4 | 200.78 | 1307.4 | 60.3 | 379.3 | 203.23 | NA | NA |
| | | $CO_3^{2-}$ | 156.2 | 0.0 | 41.6 | 36.13 | 95.8 | 0 | 37.3 | 20.26 | NA | NA |
| | | $SO_4^{2-}$ | 146.3 | 4.4 | 49.8 | 37.53 | 99.2 | 5.6 | 41.8 | 25.22 | 200 | 400 |
| | | $Cl^-$ | 471.8 | 2.0 | 126.7 | 110.2 | 575.7 | 25.7 | 130.2 | 116.40 | 250 | 1000 |
| | | $NO_3$ | 109.7 | 14.2 | 44.2 | 23.57 | 219.2 | 14.2 | 44.1 | 23.53 | 45 | NA |
| | | $PO_4$ | 11.4 | 0.0 | 1.6 | 1.87 | 3.3 | 0.0 | 0.3 | 0.47 | NA | NA |

*(all the parameters are expressed in ppm. Except EC in µs/cm and pH. Here N= number of ground water samples, NA not available.)*

**IV. A. Drinking water quality aspects:-**

pH of the ground water sample are alkaline and within limits. According to BIS, the total hardness under desirable limits of is 49% & 52% of post monsoon & of pre monsoon. Only 8% in post monsoon and 13% in pre monsoon are above permissible limits. According to Durfor and Becker's classification of hard water, 90% in post monsoon and 80 % in pre monsoon are very hard.

TDS in the water originates from natural sources, sewage, urban and agricultural runoff and industrial waste water. As per BIS limit, TDS of post monsoon & pre monsoon are 72% and 54% under permissible limits. In the present study only one sample from both the season in unfit for drinking and agricultural purposes. The classification of the water samples as nature of salinity depending on the TDS value (by Rabinove et.al. 1958) are as non saline in both the seasons (41 samples) and rest samples are slightly saline. 95% of total alkalinity concentration are within the permissible limits in both the season.

Calcium ion concentration exceeds in pre monsoon season than post monsoon season which indicates the over exploitation of ground water in summer season. The total Ca % lies as 64% in post monsoon and 74% in pre monsoon under desirable conditions described by BIS. Only one sample has exceeded the permissible limit. In case of magnesium nearly 30% lies under desirable limit in both the season. Sodium concentration is insignificant in all water samples of both the season. Potassium ion concentration is within the desirable limits in both the season.

In case of Chloride concentration, maximum the water samples are within desirable limits i.e.. 250ppm. If the chloride ion concentration exceeds 200 ppm, then it is not safe for drinking and may create gastrointestinal problems. In present study are 11 ground water sample for post monsoon and 8 ground water samples are not fit for drinking purpose. Chloride can enter into resources due to natural and anthropogenic activities such as runoff, use of inorganic fertilizers, septic tank effluents and irrigation drainage. Bicarbonate concentration varies 34 to 156 ppm in post monsoon and 0 to 95ppm in case of pre monsoon season.

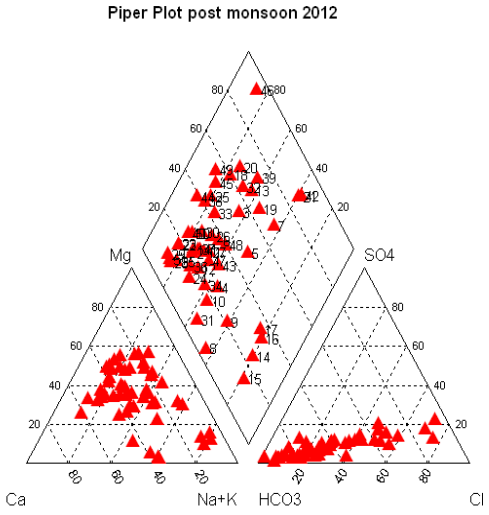
Only 43% of water samples of nitrate ion exceeds the permissible limit i.e.. is 45ppm (BIS 2003) in both the season . Higher level of nitrate in the ground water sample may be due to extreme use of nitrogen fertilizers, human and animal wastes contribution (Janardhana et.al. 2009). Jalgaon district acquires third position in using chemical fertilizers among India. Higher nitrate concentration in drinking water may cause methaenoglobinaemia in infants widely known as Blue Baby disease.

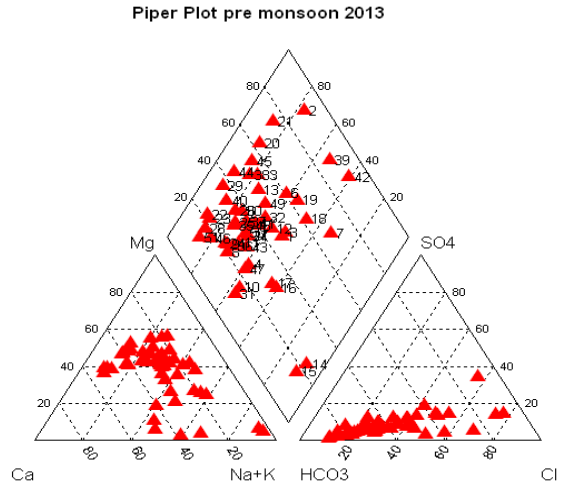
Sulphate concentration varies from 13 to 146ppm in post monsoon and in pre monsoon season it varies from 6 to 99 ppm. According to James (1982) the sulphate concentration in water sample are doubtful and unsuitable for drinking purpose. But as per BIS all the water samples of both the season are within desirable limits. Phosphorus present in small quantity may result in the growth of algae and aquatic vegetation which lead to eutrophication of aquatic system (Handa ,1990).Many minerals also contain phosphorus (Hamilton, 1992). In present study area all the ground water samples for phosphorous are under permissible limits.

**IV. B.Graphical representations:-**

**Piper diagram :-**

The Hill – Piper diagram helps us to identify and understand the hydrogeochemical nature of ground water (Piper 1953). The trilinear diagram was created to study the relevant chemical nature of the different samples of the study area.



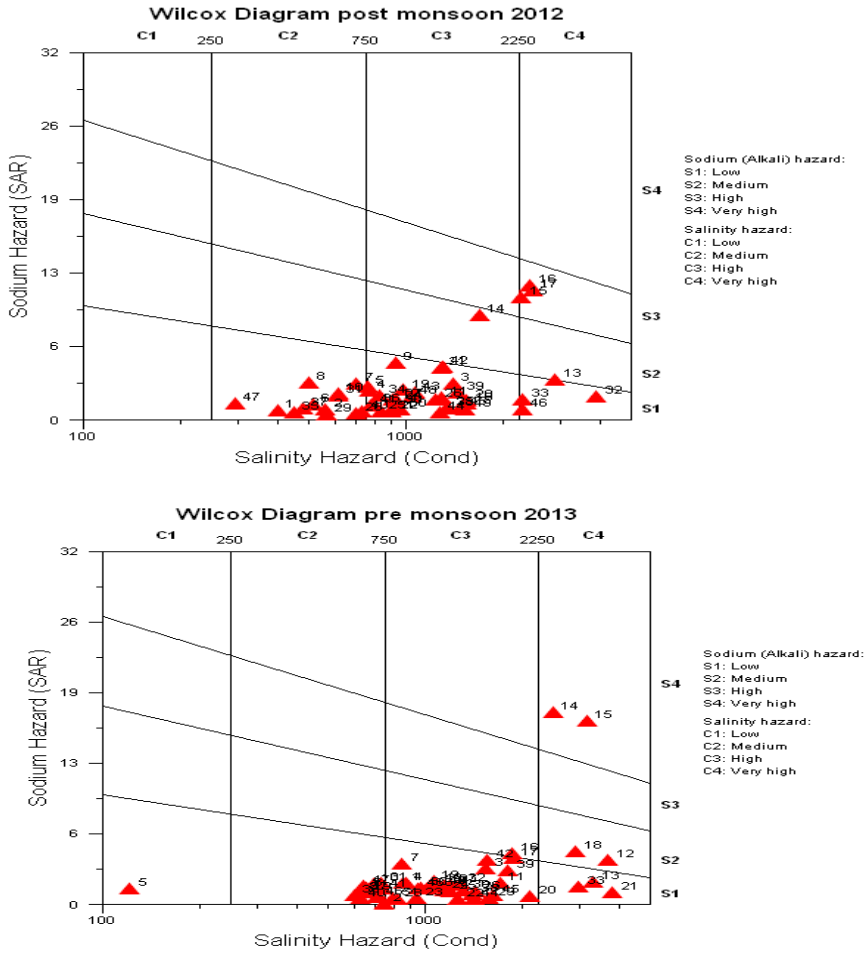




According to trilinear diagram of both the season the water sample falls in the field of mixed $Ca^{2+}$ - $Mg^{2+}$ - $Cl^-$ type and $Ca^{2+}$ - $HCO_3^-$ water types. This shows that alkaline earth metals cations ($Mg^{2+}$ ) exceeds than alkali metals cations($Na^+ + K^+$ ) and weak acid anions ($CO_3^{2-}$+ $HCO_3^-$) exceeds than strong acid anions ($Cl^-$+$SO_4^{2-}$).

**US Salinity Hazard Wilcox Diagram:-**

Kumaresan and Riyazuddin (2006) have discussed their results using Wilcox diagram. Wilcox plot by SAR values versus electrical conductivity of ground water . According to the diagram in post monsoon maximum samples lies in $C_2S_1$ (medium salinity with low sodium) and $C_3S_1$ (high salinity with low sodium) ranges. Few samples lay in

$C_4S_1$, $C_3S_2$, $C_4S_3$ ranges. 4 samples sows $C_4S_1$ i.e.. very high salinity with low sodium . 3samples shows $C_4S_3$ i.e.. very high salinity with high sodium and 1sample shows $C_3S_2$ i.e.. high salinity with medium sodium.




In case of pre monsoon, Wilcox plots shows one sample of low salinity & low sodium hazards $C_1S_1$ , 6 sample shows medium salinity & low sodium hazard ($C_2S_1$) , Nearly 35 samples showing high salinity and low sodium hazards ($C_3S_1$) , 3 samples showing very high salinity & medium sodium hazards ($C_4S_2$) and two samples shows very high salinity &very high sodium hazards ($C_4S_4$).

## CONCLUSION

The main emphasis to analysis the water samples in the study area is to do the first attempt to highlight the level of pollution. The result obtained shows that major samples can be used for domestic uses except some, which are in doubtful conditions according to BIS. Those samples exceeds the TDS (>2000ppm), total alkalinity (>1000ppm), EC (>1400µS/cm), total hardness (>1000ppm), $Ca^{2+}$(>200), $Mg^{2+}$(100) showing water is too hard for drinking. If the water samples are used directly can cause health hazard problem in future. No medical report was found under the survey. But for future remedial measures, the area should be launched with good ground water management practices to set an eco - healthy environment.

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