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Geochemical Study of Groundwater for Drinking Purpose from Kasari Basin, Kolhapur, M.S.

Geochemical Assessment of Groundwater Samples for Drinking Purpose fromKasari River Basin, Kolhapur District, Maharashtra.

Yogita A. Patil[1,] Abhijit J Patil[2],H.S. Patode[3]
1.Department of Geology, G.K.G. College, Kolhapur.
2. Department of Geology, Vivekanand College, Kolhapur.
3. School of Earth Sciences, SRTM University, Nanded

Abstract-
Water scarcity has been a grave problem recently. Proper management and distribution of water have become indispensable to tackle this problem. River basin is a watershed and its management is essential to ensure the quantity and quality of its water. Study area has been underlined by Deccan Basalt lava flows.dug well and bore well samples from different parts of the Kasari River Basin have been collected and different physicochemical parameters have been analyzedto assess drinking quality of groundwater. The analysis of 42 water samples from Kasari river basin was carried for 14 parameters viz., pH, EC, TDS, Cl,TH, Ca, Mg, Na, K, CO_3, NO_3, HCO_3, Cl, and $SO_4$for both seasons pre and post monsoon of the year 2018. All samples have values of different parameters within permissible limit and are fit for drinking purpose.

Key words- *Water, Watershed, drinking quality, groundwater, permissible limit, Deccan Basalt*

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I. Introduction

For drinking as well as irrigation purpose the quality assessment of water is a prerequisite. Various diseases spread through the polluted water. Even irrigation done by poor quality of water; results in improper seed germination and retardation of crop affecting the yield.

Also,the misuse of water and its unequal distribution are main hurdles in water management. As about 70% of Indian water resources and a growing number of its water reserves have been contaminated by biological, organic and inorganic pollutants. Analysis and study of various physicochemical parameters is essential from point of view of water quality for drinking as well as irrigation purpose. Understanding the hydrochemistry of water is vital for its optimal usage for drinking, irrigation, domestic or irrigation purpose. [4,5,11,12]

STUDY AREA-

The study area is Kasari River Basin. Kasari is one of the main tributaries of Panchganga River. Kasari River originates near Gajapur Village (Taluka-Shahuwadi) at Latitude 16° 39’ 51’’ to16° 55’ 13’’ N and Longitude 73° 42’ 51’’ to 74° 42’ 51’’ E. The main stream is wide and receives water from a triangular area lying between watersheds of Vishalgadh in the North and Waghjai in the South. The river receives important Southern tributary called Mangari near Bhogaon village.

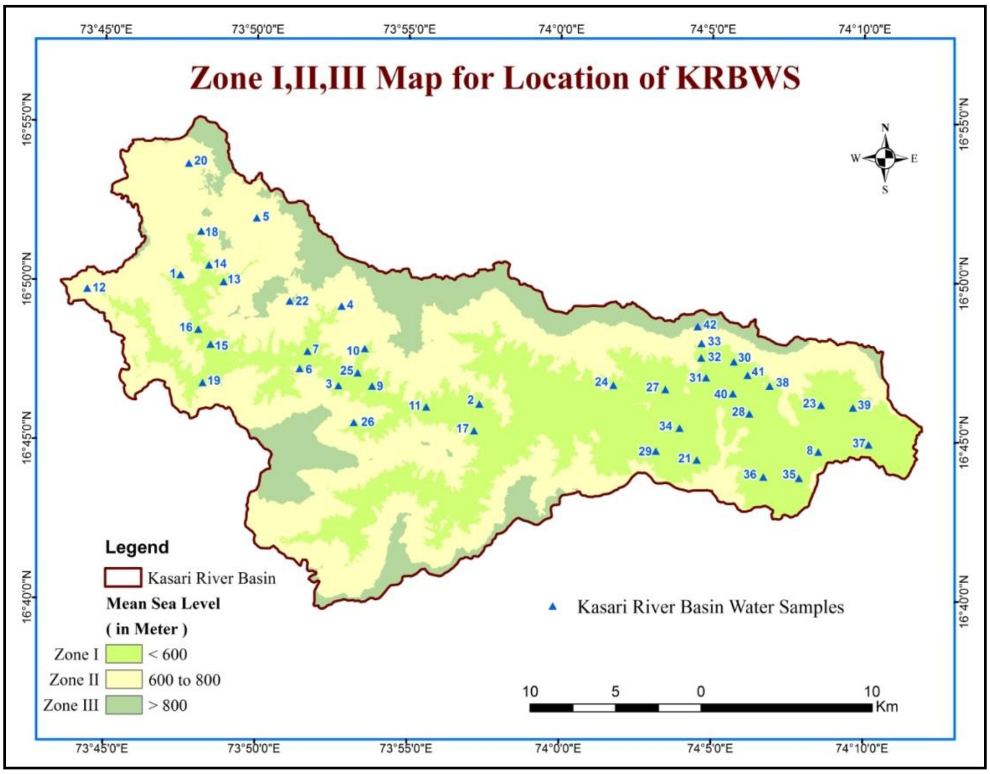

Fig. .1 Kasari River Basin Water Samples (KRBWS 1 to 42) Location Map with Zone I, Zone II and Zone III

In the above map the sampling locations are shown according to the height of the locations from mean sea level. The area is divided into three categories as area <600 msl. (Zone I), area from 600- 800 msl. (Zone II) and area > 800msl. (Zone III). Most of the locations fall under the category I i.e.,<600msl. Few samples fall in second category i.e., from 600-800 msl. and very few samples belong to category III i.e.,>800msl.

PHYSICO-CHEMICAL PARAMETERS-

The analysis of water samples from Kasari river basin was carried for 14 parameters viz., pH, EC, TDS, TH, Ca, Mg, Na, K, CO_3, NO_3, HCO_3, Cl, SO_4 and F.

I. pH

The pH of water is significant in geochemical equilibrium or solubility calculations. (Hem-1991). Most groundwater samples have pH range of 6.0 to 8.5 [3].

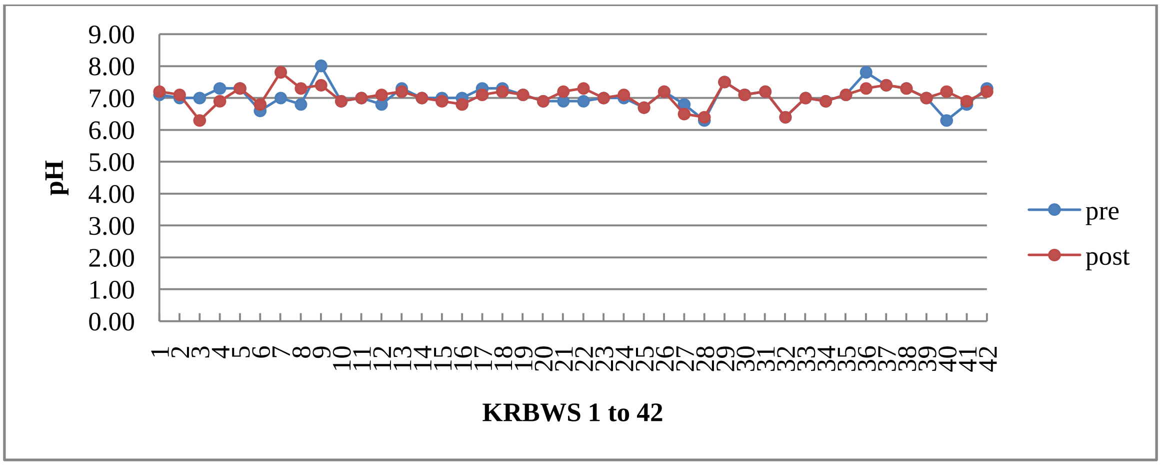

Fig 2- **pH values for pre monsoon and post monsoon season 2018**

In figure no. 2, pH values for the year 2018 during pre and post monsoon season are graphically represented. The minimum of the pH pre monsoon is 6.3 and maximum value of it is 8 which indicate that the pH ranges from acidic to basic. And during post monsoon season the minimum values is 6.3 and maximum value is 6.8 which indicate that the pH is acidic. As compared with standards, like W.H.O., BIS and FSS the values are within range. The pH values of both the season of 2018 have no significant difference; they are almost similar showing no variation according to season.

II. Electrical Conductivity (EC)

The ability of groundwater to conduct an electrical current is called as electrical conductivity which is a function of temperature, types of ions present and concentration of various ions [10].

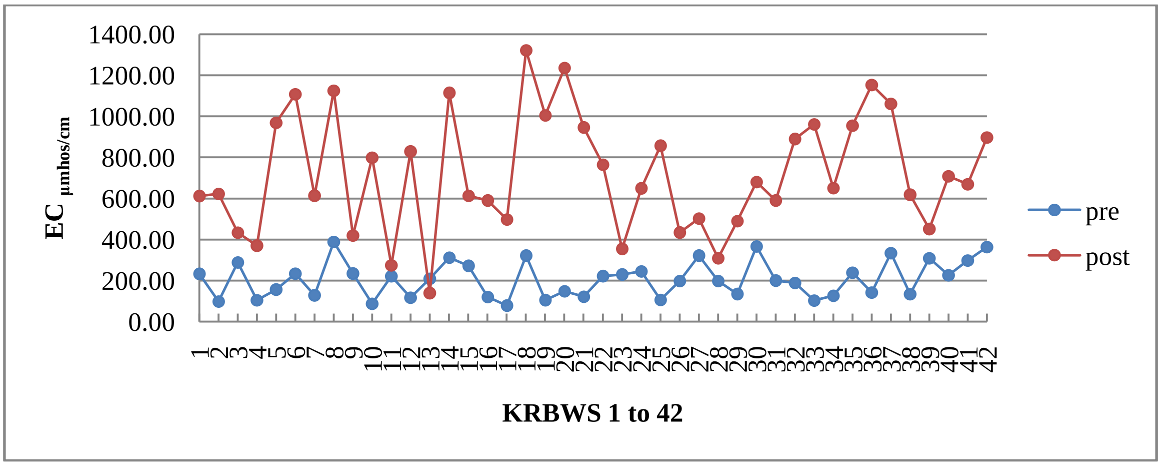

Fig. 3 EC of KRB for pre monsoon and post monsoon season 2018

In the fig. 3 Electrical Conductivity values for the year 2018 during pre and post monsoon season are represented graphically. The minimum of the EC during pre-monsoon is 77.89 and maximum value is 389.34. During post monsoon season the minimum values is 89.83 and maximum value is 376.90. However as compared with standards all the values are within range. The EC values for both seasons of 2018 show variation for the both the seasons. They are slightly higher for the post monsoon season.

III. TOTAL DISSOLVED SOLIDS (TDS)

Total dissolved solids (TDS) are direct measure of all the dissolved, organic and inorganic particles present in water. TDS in water samples include dissociated and undissociated substances, excluding suspended matter, colloids or dissolved gases.

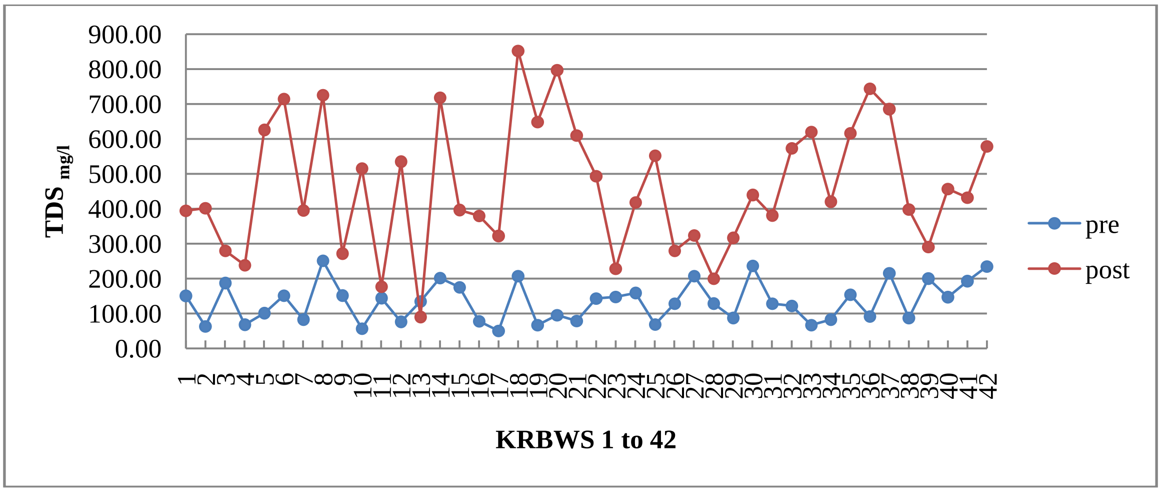

Fig. 4 TDS of KRB for pre monsoon and post monsoon season 2018

In the figure no. 5.6.1, TDS values of the year 2018 for both the seasons are shown graphically. The minimum and maximum values for pre monsoon season are 50.24 and 251.12 respectively. The minimum value for post monsoon season is 57.94 and maximum value is 243.10. All values are within range as compared with standard. The values for post monsoon are higher than that of pre monsoon season.

IV. CHLORIDE (Cl)

Chloride is one of the important major anions to be found in water due to weathering, intrusion of salt water, leaching of sedimentary rocks and soils, domestic and industrial wastes [3].

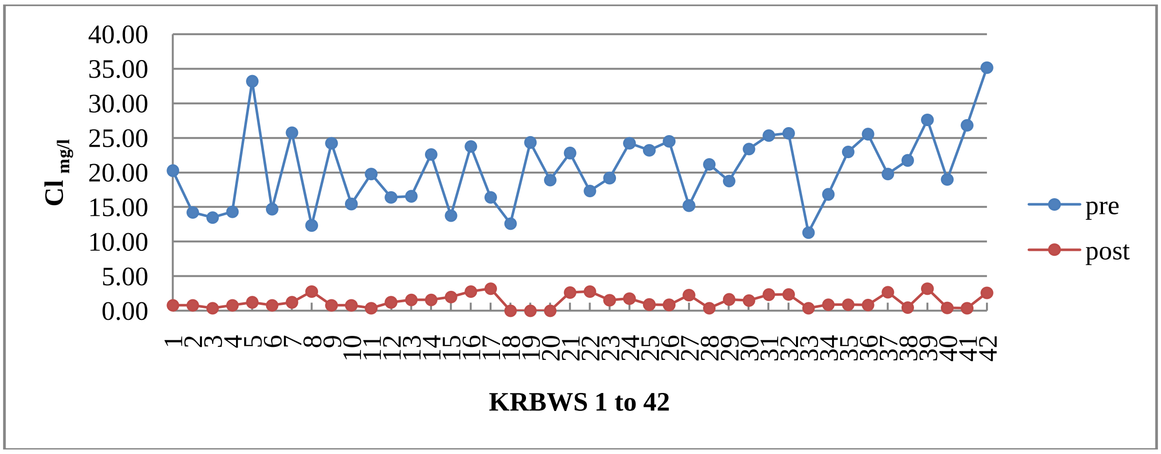

Fig. 5 Cl of KRB for pre monsoon and post monsoon season 2018

In figure no. 5, the Cl values of the year 2018 are shown graphically for both pre and post monsoon seasons. The pre monsoon minimum and maximum values are 11.33 and 35.18 respectively. For post monsoon season the values are 10.23 minimum and 31.23 maximum. As compared with standard the values are much lower. The post monsoon Cl values are lower than the pre monsoon values.

V. HARDNESS (TH)

Hardness is generally expressed in terms of calcium carbonate concentration, which is generally caused by calcium and magnesium ions present in water.

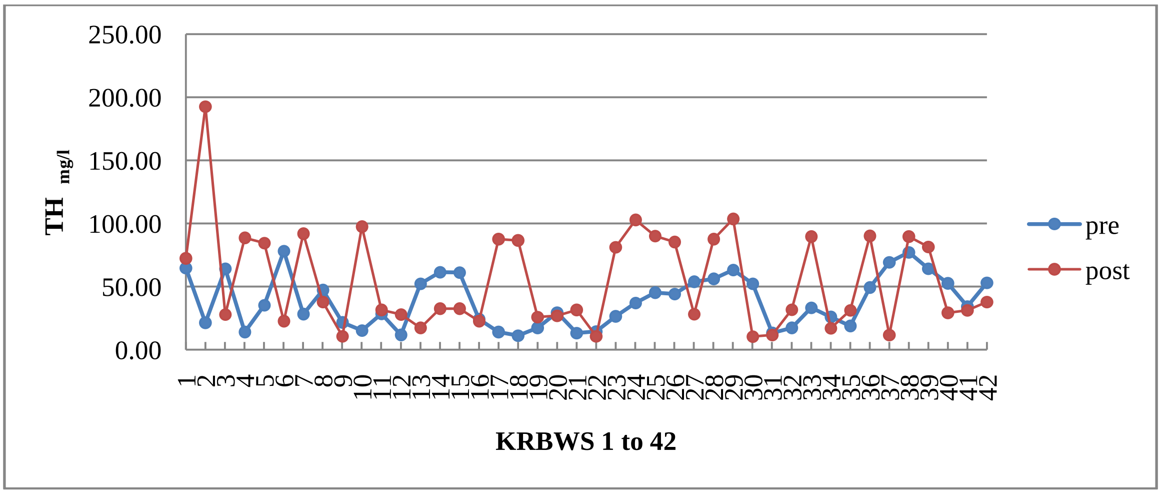

Fig. 6 TH of KRB for pre monsoon and post monsoon season 2018

In figure 6, total hardness values of pre and post monsoon season of year 2018 are shown in the graph. During pre-monsoon season the minimum value is 11.24 and a maximum value is 78.21. During post monsoon season the minimum value is 9.98 and maximum value is 87.45. The values are much lower than the standard value. There is no much deviation in the values of pre and post season. The post monsoon values are higher than that of the pre monsoon values except for sample no. 13, 15, 34, 37, 40, 41 and 42.

VI. TOTAL ALKALINITY (TA) –

Alkalinity is primarily a function of carbonate, bicarbonate, and hydroxide contents and is taken as an indication of the concentration of these constituents. The capacity of a solution for neutralizing the acids at the equivalence point of carbonate or bicarbonate is referred to as the alkalinity.

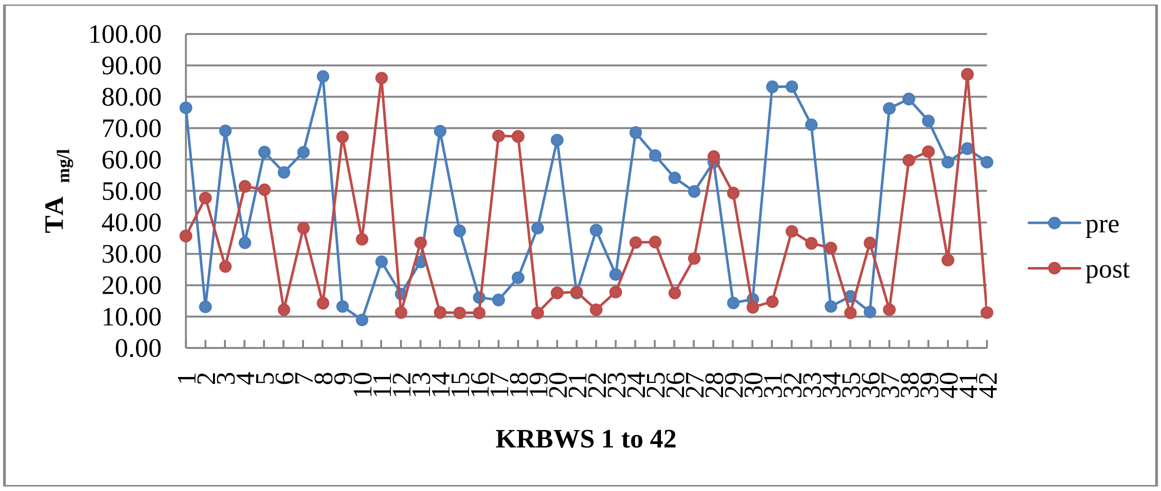

Fig. 7 T.A. of KRB for pre monsoon and post monsoon season 2018

In figure7, total alkalinity values of pre and post monsoon seasons of year 2018 are shown in the graph. During pre-monsoon season the minimum value is 8.95 and maximum value is 86.54. During post monsoon season the minimum value is 4.65 and maximum value is 85.43. The values are much lower than the standard value. There is deviation in the values of pre and post season.

VII. CARBONATE (CO_3)

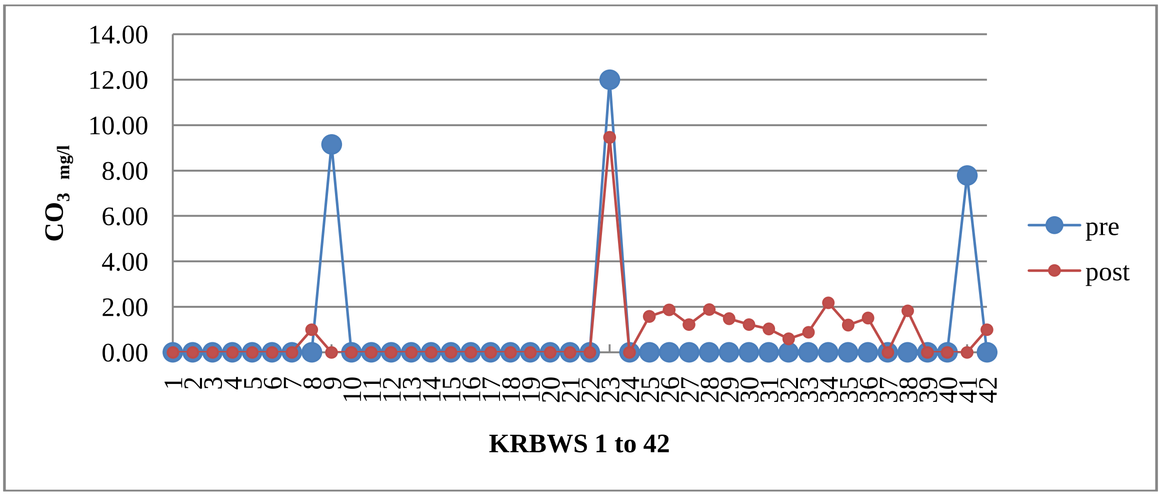

Fig. 8 CO_3 of KRB for pre monsoon and post monsoon season 2018

In figure 8, CO_3 values of pre and post monsoon seasons of year 2018 are shown in the graph. During pre-monsoon season the minimum value is 0 and maximum value is 12. During post monsoon season the minimum value is 0 and maximum value is 9.45. The values are much lower than the standard value. There is no much deviation in the values of pre and post season except for sample no. 9, 23 and 41.

VIII. BICARBONATES (HCO_3)

Bicarbonates and carbonates may originate from sources such as atmospheric CO_2; solution of carbonate minerals and rocks such as calcite and dolomites; weathering of feldspar by carbonic acid; and the reaction of NO_3^- and SO_4 by organic matter (Awadh and Ahmed, 2013).

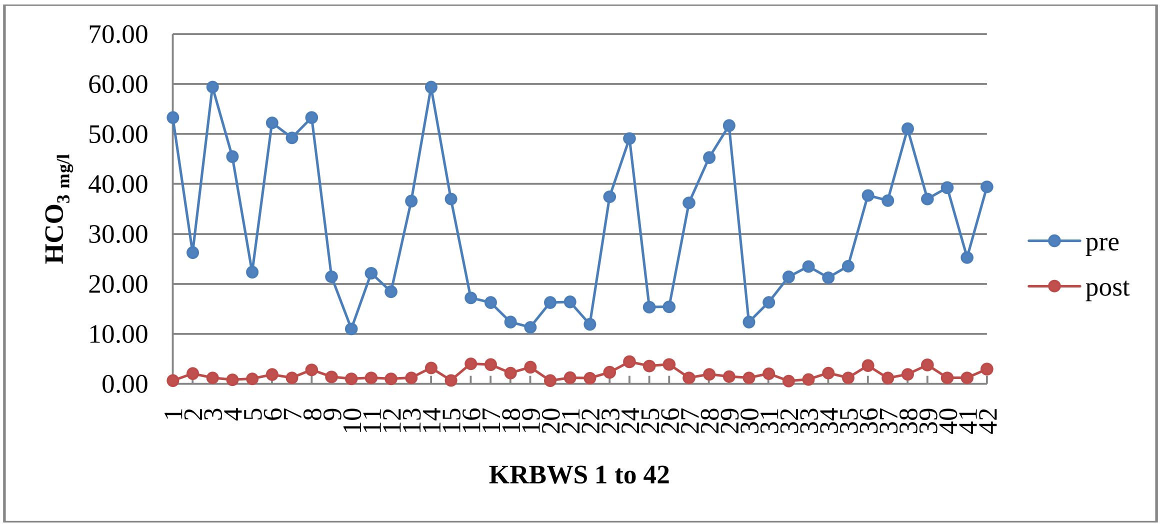

Fig. 9 HCO3of KRB for pre monsoon and post monsoon season 2018

In figure9, HCO_3 values of pre and post monsoon season of year 2018 are shown in the graph. During pre-monsoon season the minimum value is 11.59 and maximum value is 11.43. During post monsoon season the minimum value is 11.32 and maximum value is 67.02. The values are much lower than the standard value. There is no much deviation in the values of pre and post season except for sample no. 19, 22 and 24.

IX. SULPHATE (SO_4)

Sulphate originates naturally in water from gypsum and other common minerals. The presence of sulphate in water is usually very less in amount but when it crosses its limit (>400 mg/l), it causes a laxative effect on human digestive system.

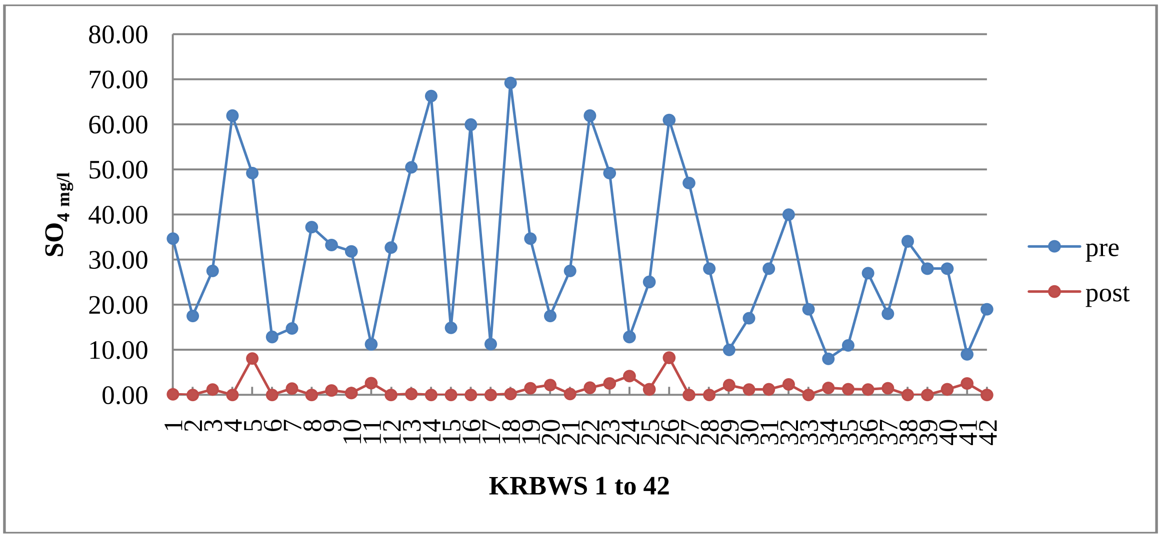

Fig 10 SO_4 of KRB for pre monsoon and post monsoon season 2018

In figure10, SO_4 values of pre and post monsoon seasons of year 2018 are shown in the graph. During pre-monsoon season the minimum value is 8 and maximum value is 69.22. During post monsoon season the minimum value is 10 and maximum value is 51. The values are much lower than the standard value. The values of pre monsoon season are higher than that of post monsoon season.

X. NITRATE (NO_3)

Nitrate is a very minor constituent of the rocks, but is a major constituent of the atmosphere. It is the end product of oxidation process of nitrogen, and is highly soluble and very mobile.

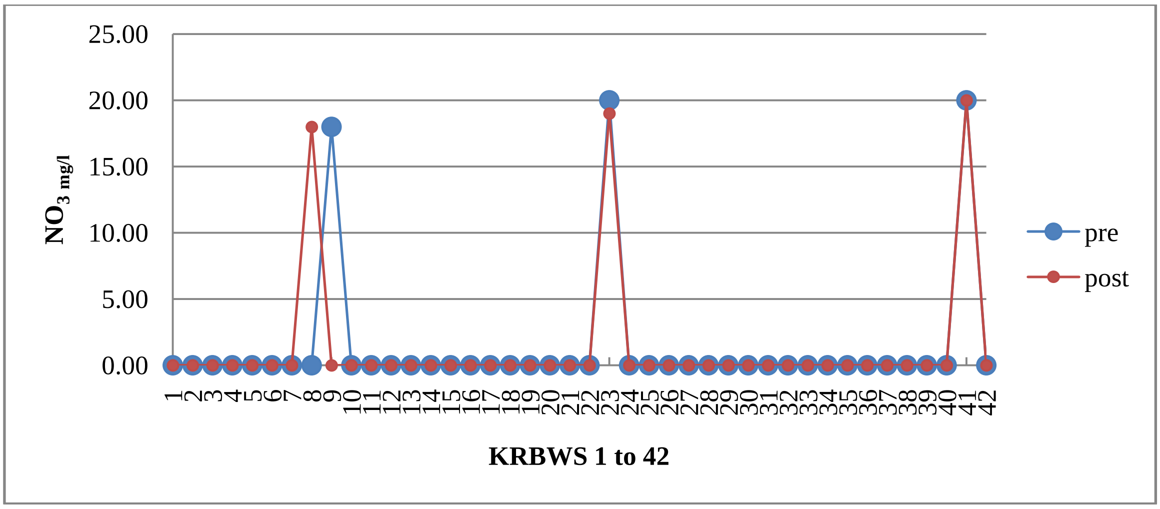

Fig. 11 NO_3 of KRB for pre monsoon and post monsoon season 2018

In the figure11, NO_3 values of the pre and post monsoon samples of the year 2018 are shown. The lowest value for pre monsoon season is 0 and highest value is 20. For post monsoon season the lowest value is 0 and highest value is 20. The values are lower than the standard value. Sample nos. 8, 9, 23 and 41 shows; deviations in NO_3 values for both the season. Other values are almost same.

XI. CALCIUM (Ca)

Calcium is one of the most abundant elements in natural water. It is formed due to leaching of calcium rich rocks such as limestone or due to mineralization of organic matter by bacteria.

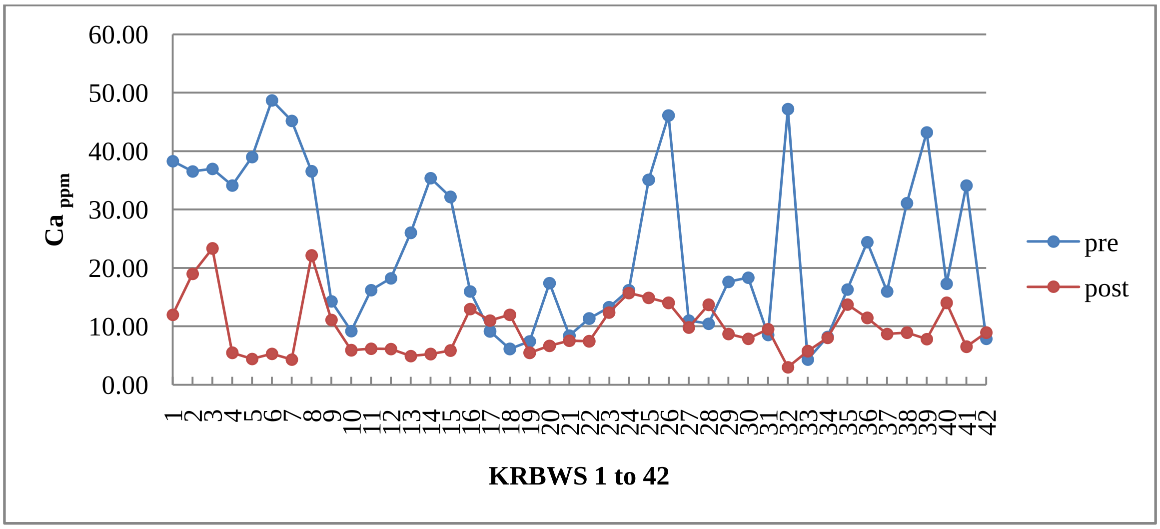

Fig. 12 Caof KRB for pre monsoon and post monsoon season 2018

In the fig.12, Ca values of the pre and post monsoon samples of the year 2018 are shown. The lowest value for pre monsoon season is 4.34 and highest value is 48.71. For post monsoon season the lowest value is 5.23 and highest value is 49. The values are lower than the standard value. The pre monsoon values are higher than that of post monsoon values.

XII. MAGNESIUM (Mg)

Magnesium occurs in all types of natural waters along with calcium, but the concentration of magnesium generally remains lower than calcium. But sometimes magnesium ions exceed calcium ions which can be attributed to anthropogenic activities [3].

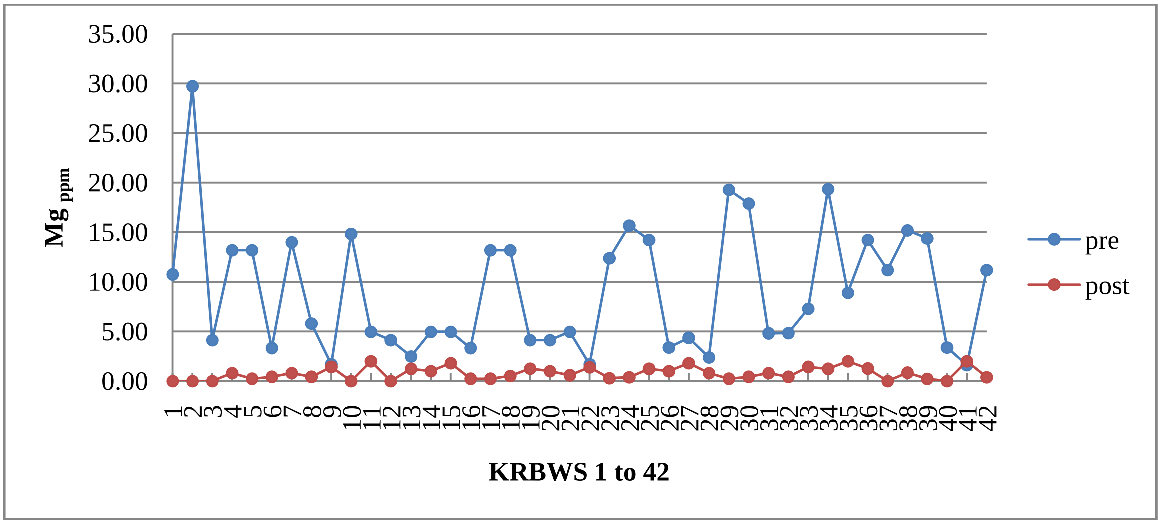

Fig 13 Mgof KRB for pre monsoon and post monsoon season 2018

In figure 13, Mg values of pre and post monsoon seasons of year 2018 are shown in the graph. During pre-monsoon season the minimum value is 1.61 and maximum value is 29.69. During post monsoon season the minimum value is 1.24 and maximum value is 19.88. The values are much lower than the standard value. The pre monsoon values are higher than that of post monsoon season.

XIII. SODIUM (Na)

Sodium is highly soluble and naturally found in groundwater. The sodium bearing minerals which give rise to soluble sodium includes- albite, nepheline, sodalite, glaucophane etc.

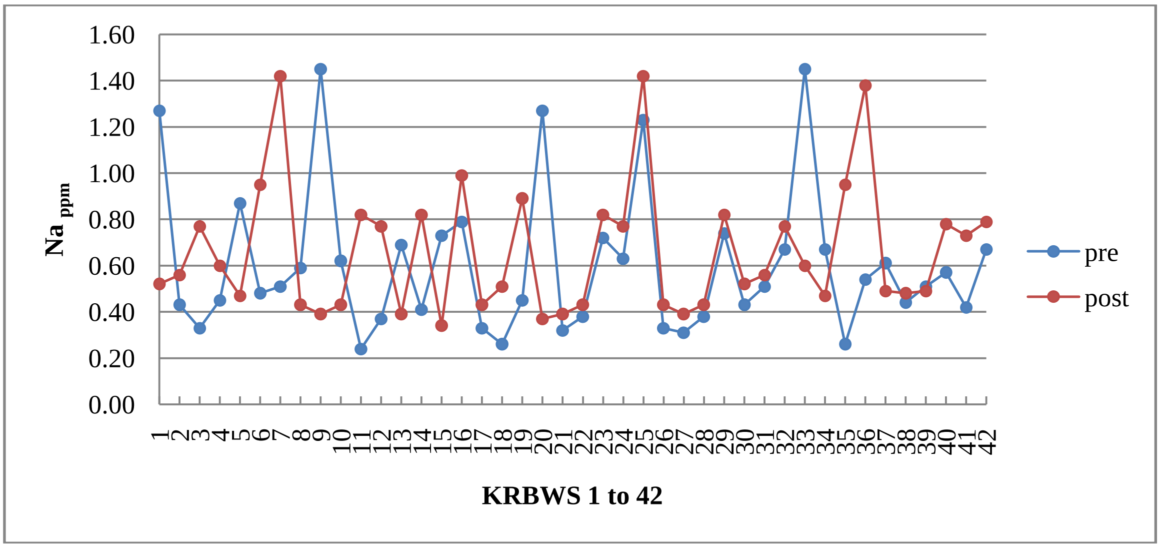

Fig.14 Naof KRB for pre monsoon and post monsoon season 2018

In fig.14, Na values of pre and post monsoon seasons of year 2018 are shown in the graph. During pre-monsoon season the minimum value is 0.24 and maximum value is 1.45. During post monsoon season the minimum value is 0.34 and maximum value is 1.42. The values are much lower than the standard value. There is no much difference in the values of all samples except sample no. 7 and 9.

XIV. POTASSIUM (K)

The main sources of potassium in groundwater include rain water, weathering of potash silicate minerals, use of potash fertilizers and use of surface water for irrigation.

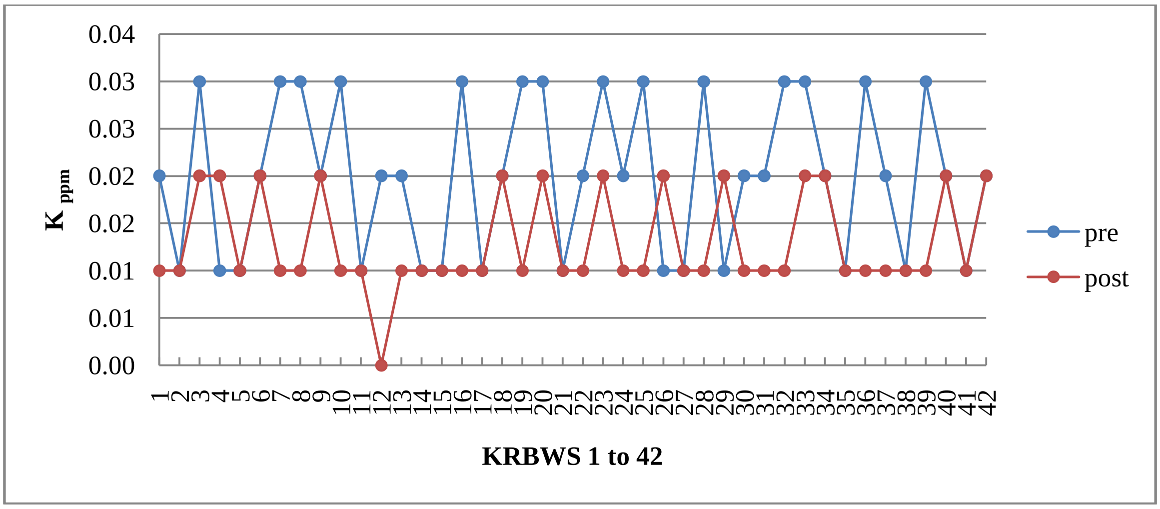

Fig.15 Kof KRB for pre monsoon and post monsoon season 2018

In fig. 15, K values of pre and post monsoon seasons of year 2018 are shown in the graph. During pre-monsoon season the minimum values is 0.01 and maximum value is 0.03. During post monsoon season the minimum value is 0.00 and maximum value is 0.02. The values are much lower than the standard value. There is no much difference in the values of all samples.

ANALYSIS with-

1. PIPER DIAGRAM

The concentration of major cations and anions are plotted in piper diagram to check the geochemistry of ground water. The relative concentration of major cations and anions are plotted on 2 separate trilinear plots while in central diamond plot the points from 2 trilinear plots are projected. [6,7]

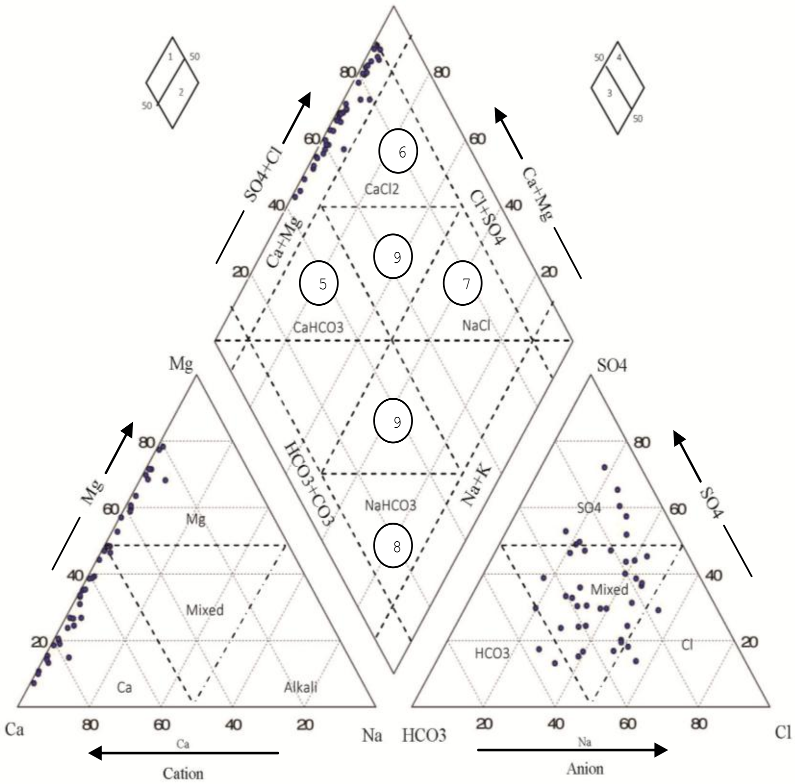

Fig.16 Piper Trilinear Diagram showing water types for KRBWS (Pre-Monsoon 2018)

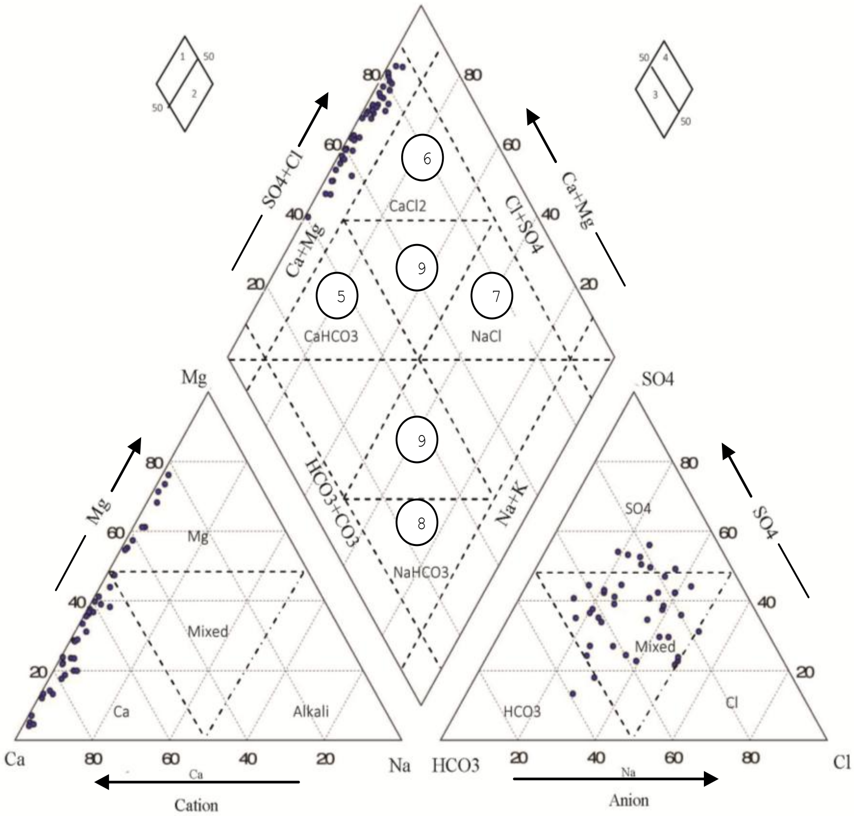

Fig.17 Piper Trilinear Diagram showing water types for KRBWS (Post-Monsoon 2018)

For pre monsoon season 2018 from the Piper Trilinear Diagram it is seen that all the samples fall in area 1 of the diamond shaped field belonging to Ca+ Mgindicating the dominance of alkaline earth over alkali (viz. Ca+Mg>Na+K) and strong acidic anions over weak acidic anions i.e. ($Cl+SO_4 > HCO_3+CO_3$)

For post monsoon season 2018 from the Piper Trilinear Diagram, it is seen that all the samples fall in area 1 of the diamond shaped field belonging to Ca+ Mgindicating the dominance of alkaline earth over alkali (viz. Ca+Mg>Na+K) and strong acidic anions over weak acidic anions i.e. ($Cl+SO_4 > HCO_3+CO_3$).

2. DUROV DIAGRAM

Durov diagram is a composite plot consisting of 2 ternary diagrams where the milliequivalents percentages of the cations of interest were plotted against that of anions of interest sides form a central rectangular, binary plot of total cation vs. total anion concentrations.[1]

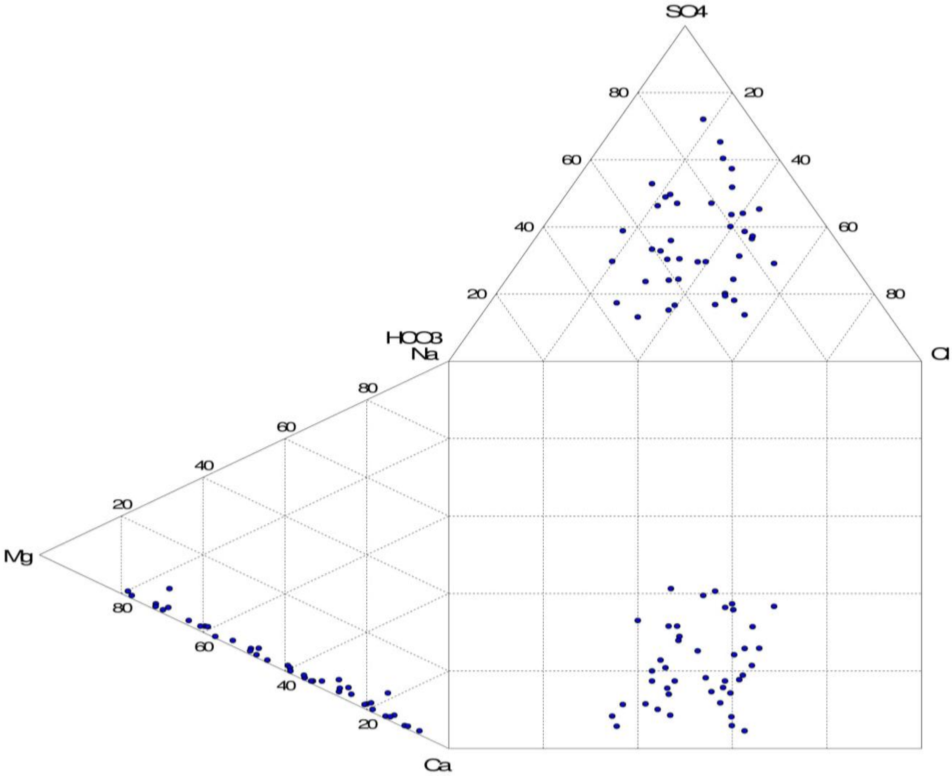

Fig .18 Durov diagram classifying hydrochemical facies for KRBWS (Pre-Monsoon 2018)

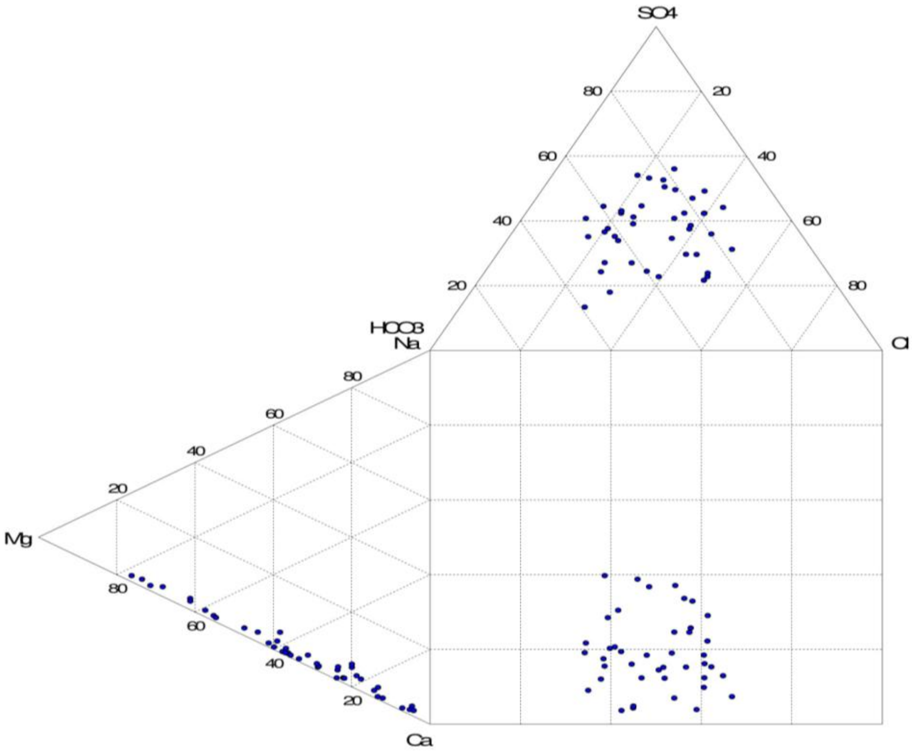

Fig.19 Durov diagram classifying hydrochemical facies for KRBWS (Post Monsoon 2018)

From the Durov diagram of pre monsoon 2018 it is evident that all samples are fall in the Durov plot in the field of Reverse ion exchange. Here Ca and Mg have been replaced by Na at favorable exchange sites. This process causes the dominance of Ca and Mg ions over Na ions.

From the Durov diagram of post monsoon 2018 it is evident that all samples are fall in the Durov plot in the field of Reverse ion exchange. Here Ca and Mg have been replaced by Na at favorable exchange sites. This process causes the dominance of Ca and Mg ions over Na ions.

3. SHOELLOER DIAGRAM-

H. Schoeller in 1961 devised a semi-logarithmic diagram which is widely used in Europe and termed as Schoeller diagram. The main ionic concentrations (as equivalent per million) are plotted on six equally spaced logarithmic scale and the points so plotted are then jointed by straight lines. [8,9]

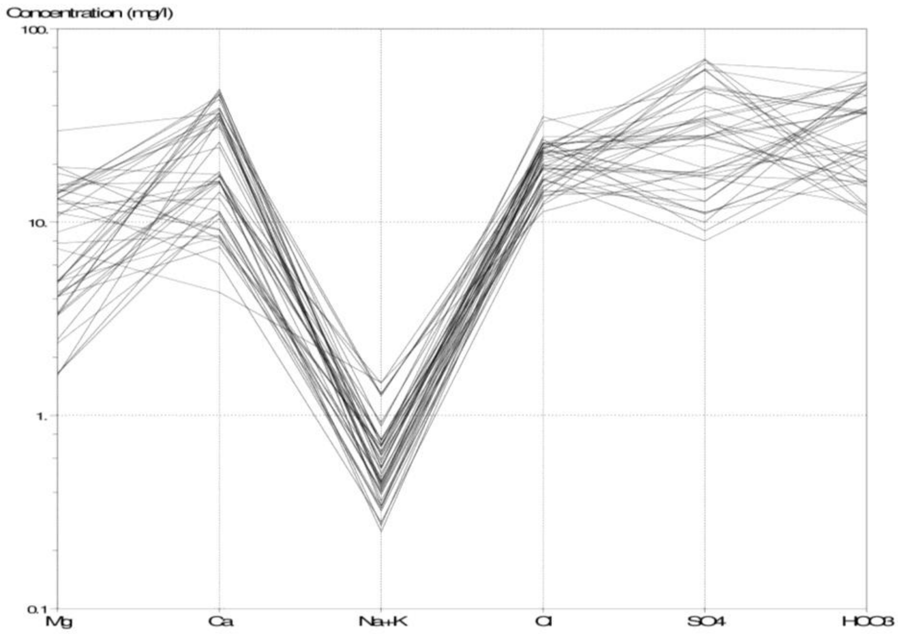

Fig .20 Schoeller diagram for KRBWS (Pre-Monsoon 2018)

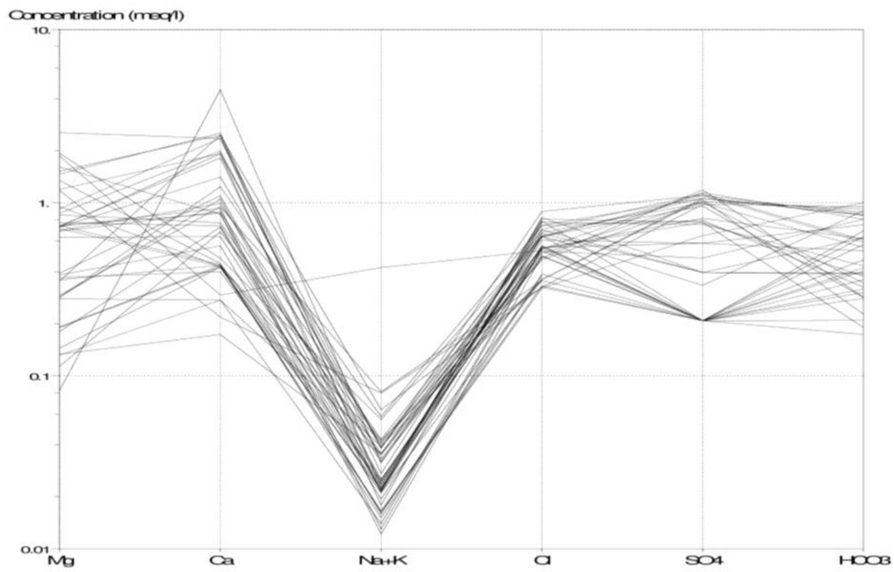

Fig.21 Schoeller diagram for KRBWS (Post Monsoon 2018)

After the studying the plot of Schoeller diagram for year 2018 pre monsoon season it is seen that the value of Mg is greater than Na and K and value of Na is greater than that of K also the value of HCO_3 is greater than Cl and that of Cl is greater than $SO_{4.,}$

For the year 2018 post monsoon season also the values of K is lesser than that of Na and Na has less value than that of Mg. Mg has higher value than Na and K. Also, SO_4 has least value and Cl and HCO_3 have greater values in ascending order.

1. GIBBS DIAGRAM

Gibbs (1970) proposed a diagram to understand the relationship of the chemical components of water from their respective aquifer lithology. The Gibbs diagrams suggest that chemical weathering of the rock forming minerals and evaporation are the main processes which contribute the ions to the water.[2]

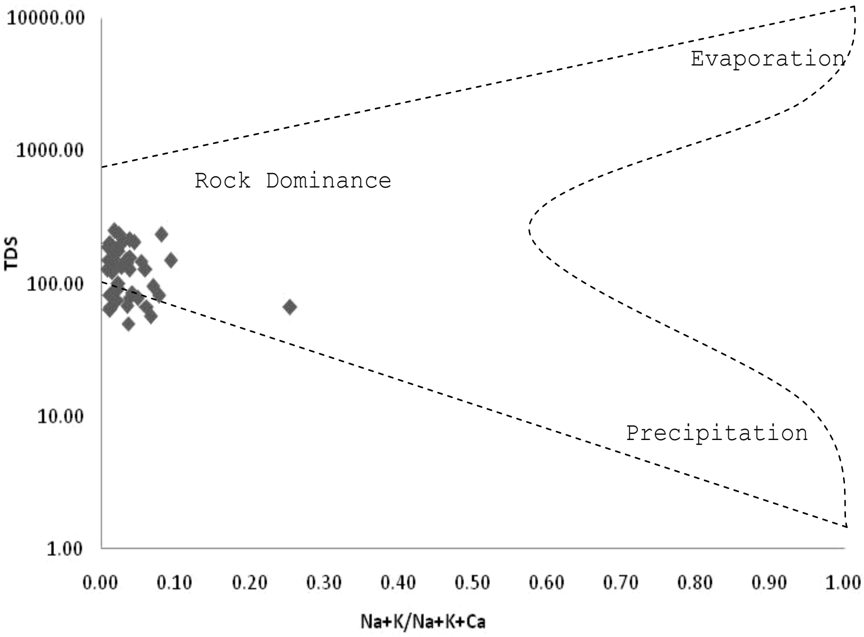

Fig .22 Mechanism controlling the groundwater chemistry Anions-Gibbs for KRBWS (Pre-Monsoon 2018)

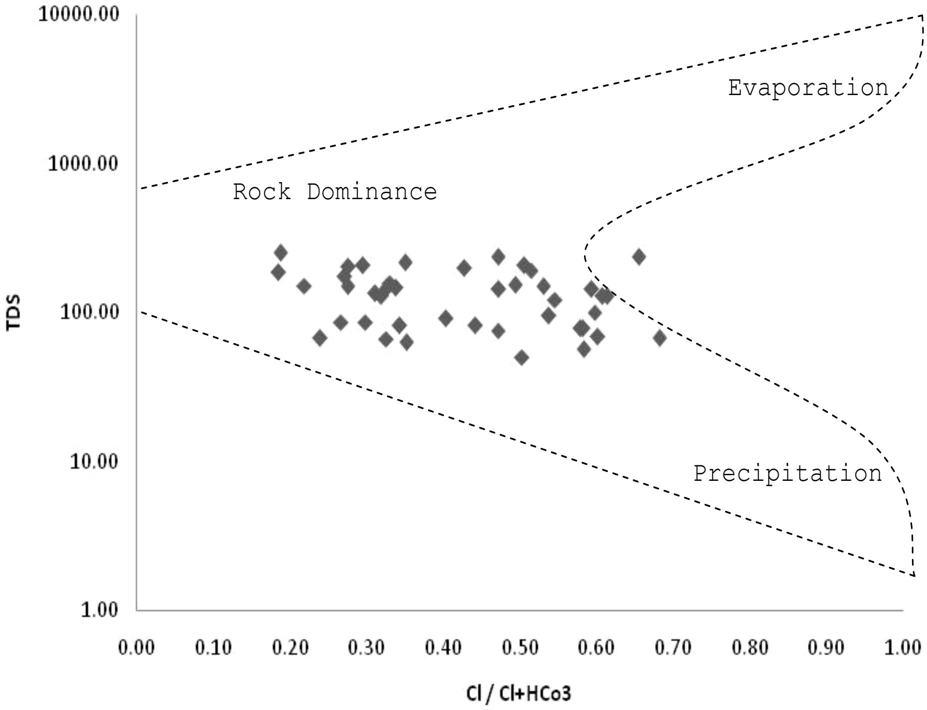

Fig.23Mechanism controlling the groundwater chemistry Cations-Gibbs for KRBWS (Pre-Monsoon 2018).

The samples are distributed in Gibb's diagram for pre monsoon 2018 indicating the chemical weathering of rock forming minerals is the main cause behind the evolution of chemical composition of ground water occurring in all lithological domains of study area. After analysis the ratio is (Na+K / Na+K+Ca) and (Cl+HCO3) are spread to rock dominance.

The samples are distributed in Gibb's diagram for post monsoon 2018 indicating the chemical weathering of rock forming minerals is the main cause behind the evolution of chemical composition of ground water occurring in all lithological domains of study area. After analysis the ratio is (Na+K / Na+K+Ca) and (Cl+HCO3) are spread to rock dominance.

XV. Conclusion

The water samples from bore and dug wells are analyzed for to find out drinking quality, for both pre and post monsoon seasons. The results are compared with standards provided by W.H.O. (World Health Organization). P^H, Electrical conductivity, Total dissolved solids, Cl, Total hardness, Total alkalinity, CO3, HCO3, SO4, NO3, Ca and Mg are the parameters analyzed. It is found that all the parameters for all the samples of for both the periods are within permissible limits and hence are suitable for drinking. After analysis using Piper diagram it is found that there is dominance of alkaline earth over alkali (viz. Ca+Mg>Na+K) and strong acidic anions over weak acidic anions i.e. ($Cl+SO_4$> HCO_3+CO_3) for both periods. (Pre and post monsoon).

From Durov diagram it is seen that for both periods there is dominance of Ca and Mg ions over Na ions. After plotting samples on Scholler's diagram it is evident that concentration of Mg is higher among anions and HCO_3 among cations. From study of Gibb's diagram, it is found that rock dominance is the reason behind the contribution of ions in groundwater samples from study area.

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