International Journal Of Advancement In Engineering Technology, Management and Applied Science (IJAETMAS)

ISSN: 2349-3224 || www.ijaetmas.com || Volume 04 - Issue 06 || June-2017 || PP. 69-83

ASSESSMENT OF GROUND WATER QUALITY IN DESHMUKHI VILLAGE NALGONDA DISTRICT, TELANGANA

Prof Adusumilli. Adilakshmi[1] ,Prof Alapati Venkateswarlu[2]

1. Professor, Civil Engineering, P.V.P.Siddhartha Institute of Technology, Vijayawada, AP.
2. Professor, Mechanical Engineering,V.R.Siddhartha Engineering College, Vijayawada, AP.

ABSTRACT:

The primary objective of the paper is to assess the groundwater quality of the Deshmukhi village Nalgonda district of Telangana. All together 13 groundwater samples were collected from the existing bore wells, out of which two samples namely, sample nos. 11 and 13 were already filtered and used for drinking purposes. The samples were analyzed by using various physical and chemical methods. The parameters such as PH, TDS, EC are analyzed by using portable instruments whereas major Cations like Sodium, Potassium, Calcium and Magnesium are analyzed by photo spectrometer and Ion chromatography. All the Anions are analyzed in the laboratory by titration methods and chemical analysis of the ground water it is found that as per the Indian standards, only one sample is exceeding the permissible limit of 1000 mg/l for TDS and 2 samples are exceeding the permissible limit of Fluoride. However number of samples is exceeding the desirable limits for many individual ions such as 11samples are exceeding in sodium concentration, 10 samples are exceeding in Calcium and Magnesium concentrations, 11 samples are exceeding in Carbonate concentration, and 9 samples are exceeding in bi- carbonate concentration.

Key Words: TDS, Sodium Absorption Ratio, Residual Sodium Carbonate, Salinity

1. INTRODUCTION

1.1 OVERVIEW :In recent times, there has been a tremendous increase in demand for freshwater and water shortage in semi-arid regions due to population increase, urbanization, industrialization, and intense agricultural activates in many parts of India. Due to inadequate supply of surface waters, most of the people in India are depending mainly on groundwater resources for drinking and domestic, industrial, and irrigation uses. Hence, knowledge on hydrochemistry of freshwater is important to assess the quality of groundwater in any area that influences the suitability of water for domestic, irrigation, and industrial needs. Important hydrogeological factors such as rainfall, mineral weathering, topographic relief, and biological activity in a given area are important for controlling recharge and hydro geochemical reactions responsible for chemical constituents contaminating the groundwater. Water quality has deteriorated due to increased human population, rapid urbanization, and un-scientific disposal of waste and improper water management. Anthropogenic activities like poultry farms, various industries including chemical and pharmaceuticals, sewage release of reactive pollutants by chemical industries are the main cause for the degradation of water and soil quality in the watershed. When groundwater is pumped and used for irrigation, evapotranspiration/evaporation process and percolation plays a crucial role. It increases the concentration of certain element like fluoride which has important negative effects on human health. Thus the contaminated water flows back to the groundwater reservoir and polluting the source. A contamination might also come from pesticides and fertilizers when farmers spread these through their fields during growing periods. Another solution for farmers to maintain yields is to mix wastewater and groundwater or to alternate wastewater and groundwater for irrigation. The impact of this type of irrigation will be one of the objects of this study.

It is with this background the present ground water quality investigations are carried out to know the status of ground water quality in and around Deshmukhi village in pochampallymandal of Nalgonda district

1.2. LOCATION AND DESCRIPTION OF THE STUDY AREA: Deshmukhi village in Pochampallymandal of Nalgonda district is relatively dry for the most of the year except for the monsoon months. The study area (Deshmukhi village) is located about 20 km East of Hyderabad, on the banks of the Musi river a tributary of the Krishna river. The study area is situated between longitudes 780.611-780.641 E and latitudes 170.381-170.411 N (Toposheet No.56 K/11/ SE). It has nearly 2500 population of its own and surrounded by three Engineering colleges namely St. Mary's institutions ,Nizam institutions and vignan institutions .The main occupation is agriculture and also poultry industry. Since there are no surface water bodies, they depend mainly on ground water for irrigation, domestic, as well as drinking purposes.

1.3.1 Geology of the Study Area : Geologically the Deshmukhi Region is covered by granites of archean age and intercalated with quartz veins here and there and is at an altitude of 470 m above mean sea level . The study area is covered with the basement of orthogneissic granite and also known as pink granite composed of granite, quartz and dolerite intrusion. It is characterized by cm-large feldspar chunks and an important amount of biotite that contribute to their generally well-developed weathering profile.

1.3.2. Ground Water Quality:In general, the ground water in the district found to be suitable for domestic and irrigation purpose. The general range of Electrical conductivity is between 1500 and 2500 micro Seimen/cm at 25º C.

1.4. OBJECTIVES OF THE STUDY:1.To analyse the physical and chemical parameters like Temperature, P^H , Electrical conductivity (EC), Anions, cations and Total dissolved solids(TDS). 2.To know whether the ground water is potable or not, and what is the fluoride concentration ,whether it is with in the permissible limits or not. 3.To study the quality of water for irrigation purposes.

1.5. METHODOLOGY: To determine the concentrations of major cations and anions, standard methods which one mentioned in the theoretical background chapter are followed along with the Ion Chromatography. Spatial distribution maps are developed using ARC GIS 10.1 software to know the spatial distribution of various physical and chemical parameters. Apart from this, ground water is also classified according to standard methods of classification like evaluation of degree of sodium hazard and salinity hazard of ground water on the basis of Sodium Absorption Ratio ,Residual Sodium Carbonate, which are of value in judging its utility for irrigation needs.

2.HYDROCHEMICAL INVESTIGATIONS:

2.1. Sample Collection: In order to evaluate the quality of ground water in the study area, samples are collected in the month of May 2014 and analyzed for the water quality parameters. Sample location map is shown in Fig.1.

ISSN: 2349-3224 || www.ijaetmas.com || Volume 04 - Issue 06 || June-2017 || PP. 69-83

2.2 Collection of Groundwater Samples: Ground water samples are collected for assessment of its quality using major ion chemistry. 13 groundwater samples are collected from bore wells in and around study area namely Deshmukhi village. The water samples are collected in one litre sterilized polythene bottles. Prior to collection the bottles were rinsed 2-3 times with sample water and completely filled to avoid air bubbling. The p^H, EC, TDS are measured immediately on the same day after collection of samples with portable instruments.

3. ANALYTICAL METHODOLOGY AND INSTRUMENTATION:

Ground water samples were analyzed for their physical and chemical parameters. Major ions include cations such as Na^+, K^+, Ca^{+2}, Mg^{+2} and anions namely F^-, Cl^-, So_4^- and $Co3^-$, $HCO3^-$ were analyzed with standard methodsIn general, groundwater contains dissolved solids that range in concentration from less than 100 mg to more than 500000 mg/l (Hem, 1985) The physical analysis includes temperature, colour, turbidity, odour and taste. Bacteriological analysis includes test to detect the presence of coliform bacteria, which indicate the sanitary quality of water for the consumption of human beings. The chemical analysis includes major cations, anions, and trace elements. In the present investigations water quality analysis is made for the parameters such as pH, Turbidity , EC, TDS, sodium, potassium, Magnesium , Calcium, Fluoride, Sulphate, Chloride and Alkalinity and these parameters have been Mapped for their areal extent.

3.1. DETERMINATION OF WATER QUALITY PARAMETERS

Along with the collection of ground water samples their geographical locations were noted down. Sterilized plastic bottles were used to collect the groundwater samples from 13 borewells.

3.2 The following 16 parameters were selected for detailed water quality analysis:

(A)Cation Parameters: 1.sodium 2.potassium 3.Magnessium 4.Calcium

(B)Anion Parameters: 1.Carbonate2.BiCarbonate3.Fluoride4. Sulphate5. Chloride

(C) Other Measured Parameters:1.P^H 2.Turbidity 3. EC 4. TDS

(D)OtherDerivedParameters:1.Sodium Adsorption Ratio 2.% Sodium 3.Residual Sodium Carbonate

3.3. MEASUREMENT OF MAJOR CATIONS

To evaluate the quality of groundwater in the study area the major cations namely Na^+, K^+, Ca^{+2}, Mg^{+2} are analysed and compared with the WHO standards to know the suitability of water for Drinking and irrigation purposes.

3.3.1. Measurement of Sodium and Potassium: The spatial distribution map of Sodium(Fig 1)indicates that most of the area of the basin is having higher concentration than the desirable limits as per the WHO standards. Whereas the West side of the basin is having highest concentration. From the Table 1 it is understood that out of 13 samples, 11 samples are having Sodium concentrations greater than desirable limits.

The spatial distribution map of Potassium(Fig 2) also follows the same trend as that of the Sodium but most of the area of the basin is having desirable concentrations only and the West side is having higher concentration.

ISSN: 2349-3224 || www.ijaetmas.com || Volume 04 - Issue 06 || June-2017 || PP. 69-83

From the Table1 it is observed that 10 samples out of 13 samples are having Potassium concentrations with in the desirable limits and 3 samples are having desirable limits.

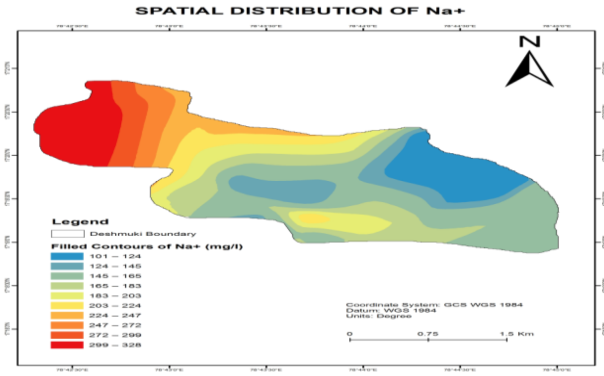

Fig.1:The spatial distribution map of **Sodium**(Na^+)

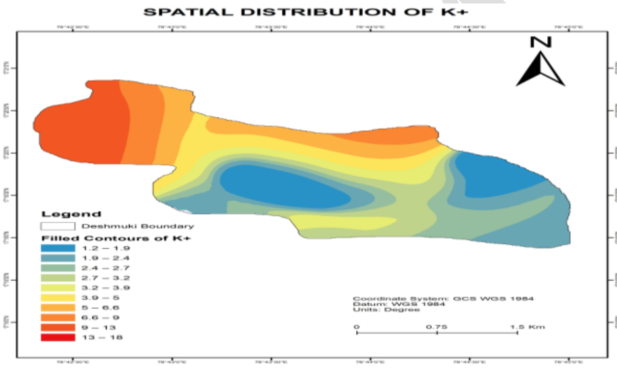

Fig-2:The spatial distribution map of **Potassium**(**K^+**)

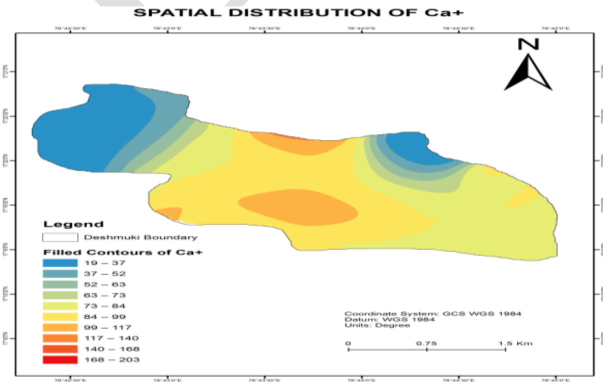

Fig 3:The spatial distribution map of **Calcium** (**Ca^+**)

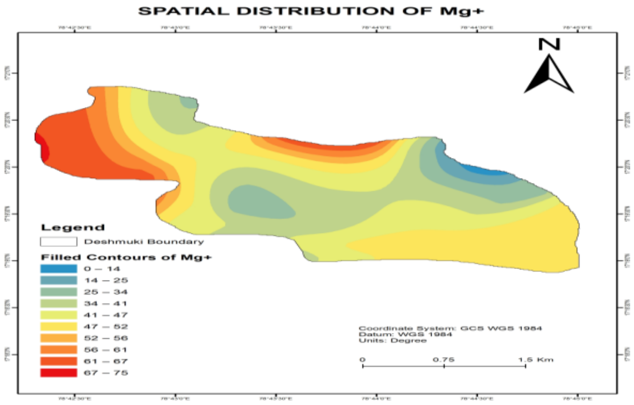

Fig-4:The spatial distribution map of **Magnesium(Mg^{+})**

3.3.2. Measurement of Calcium and Magnesium: In the study area sample nos.1, 11, 13 contains the calcium with in the desirable drinking water standards but in rest, the concentration is reaching the highest desirable limits and in sample no.12 it is exceeding the highest limit. The magnesium concentration ranges from 13.81 - 74.77 mg/l, in drinking water samples (11, 13).It is with in the desirable limits. The concentrations of Ca^{+2}, Mg^{+2} are given in the cations Table 4.4 and the spatial maps are shown in Fig. 4.

Table 1: Major Cation Concentration in the present study in terms of meq.

Sno	B W	Na^{+}	K^{+}	Mg^{+}	Ca+
1	BW-1	5.22	0.46	4.13	1.54
2	BW-2	5.68	0.166	6.014	4.116
3	BW-3	7.16	0.060	4.109	4.047
4	BW-4	5.58	0.302	5.44	5.037
5	BW-5	5.91	0.128	4.0126	3.488
6	BW-6	6.10	0.061	2.905	4.690
7	BW-7	7.91	0.105	3.890	4.547
8	BW-8	5.38	0.0297	4.330	5.298
9	BW-9	4.69	0.072	1.67	8.41
10	BW-10	4.55	0.046	4.814	3.013

ISSN: 2349-3224 || www.ijaetmas.com || Volume 04 - Issue 06 || June-2017 || PP. 69-83

11	DW	3.28	0.041	1.13	0.74
12	BW-11	9.54	0.081	6.151	10.146
13	DW	3.21	0.029	1.25	0.87

From the spatial distribution map of Calcium it is understood that most of the area is having high concentration than the desirable limits except the West side which shows lowest concentration. From the Table 4.5, 10 samples out of 13 samples are having exceeding concentrations.

The spatial distribution map of Magnesium indicates that most of the area of the basin is having high concentration than the desirable limits. However the West side is having highest concentrations. From the Table 4.5, 10 samples out of 13 samples are having exceeding concentrations of Magnesium.

3.4. MEASUREMENT OF MAJOR ANIONS IN THE GROUNDWATER SAMPLES:

Major anions like Cl^- , F^- ,SO_4^- ,CO_3^- ,HCO_3^- ,NO_3^- are analyzed in the present study to understand the groundwater quality.

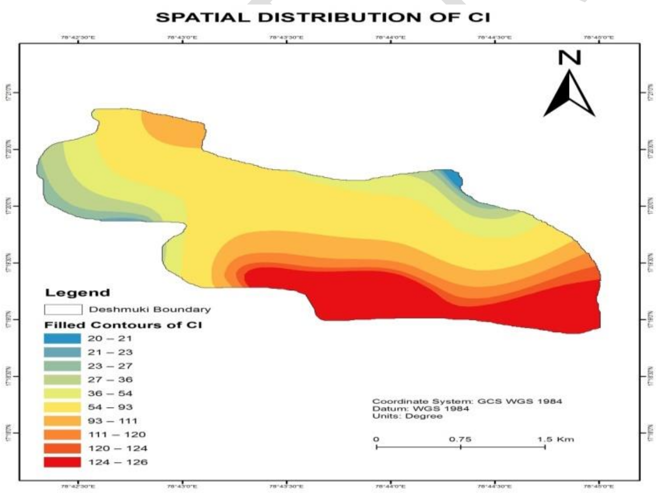

Fig 5:The spatial distribution map of **Chloride (Cl^-)**

ISSN: 2349-3224 || www.ijaetmas.com || Volume 04 - Issue 06 || June-2017 || PP. 69-83

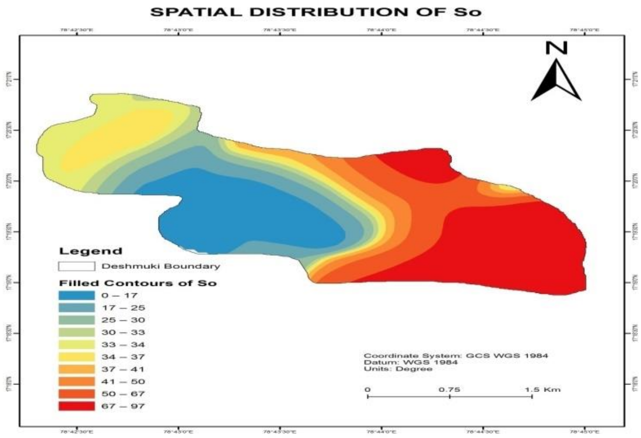

Fig-6:The spatial distribution map of **Sulphate (SO_4^-)**

3.4.1. Measurement of Chloride: In the entire water samples the Chloride concentration is within the desirable limits, and it ranges from 20 – 126 mg/l with an average value 73.46 mg/l and the values are tabulated in the Table 2, the spatial distribution map is shown in Fig.5 and it indicatesthat the southern portion of the basin is having some what higher values of Chloride, but with in the desirable limits only. In the drinking water samples (11, 13) the Chloride concentrations are 20 mg/l and 25mg/respectively

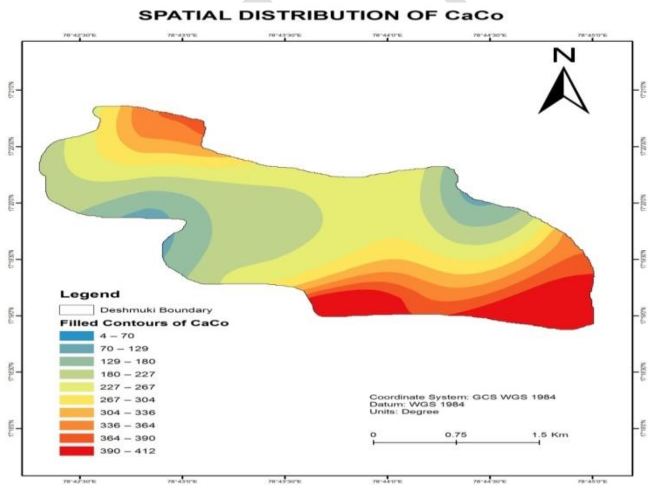

Fig. 7:The spatial distribution map of **Carbonate ($CACO_3^{2-}$)**

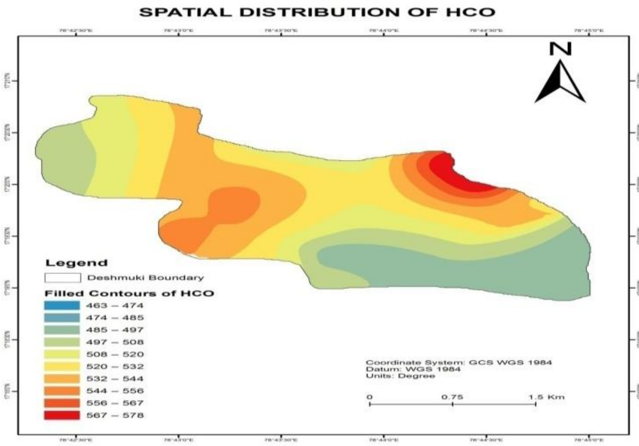

Fig-8:The spatial distribution map of **Bicarbonate (HCO_3^{2-})**

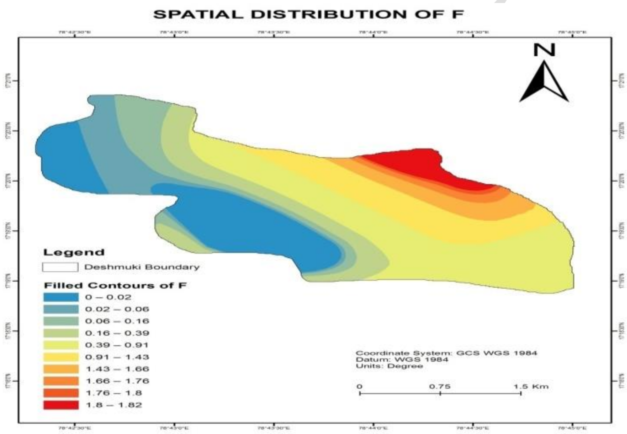

Fig 9: The spatial distribution map of **Fluoride (F^-)**

.**3.4.2. Measurement of Sulphate:** In all the water samples the Sulphate concentration is within the desirable limits, and it ranges from 0.1 – 97.14 mg/l and the values are tabulated in the Table 2, the spatial distribution map is also shown in Fig.6 which indicates that South – East and North – East corners of the basin are having some what higher values but all the values are with in the desirable limits.

3.4.3. Measurement of Carbonate and Bicarbonate: In all the water samples except drinking water sample the total hardness is exceeding the desirable limits. The values are tabulated in the major anions of Table 2, and the spatial distribution maps for both carbonates and bicarbonates are also produced in Fig.7 and 8. From the map it is observed that most of the area of the basin is having high carbonate concentration and the South – East is having very high carbonate concentration. Where as in the spatial distribution map of HCO_3^- ,most of the area is having high concentration except for the South – East corner of the basin which is having some what lower values than the desirable limits.

3.4.4. Measurement of Fluoride: The spatial distribution map of Fluoride (Fig.8) shows most of the basin area is having desirable limits of Fluoride concentration i.e., 1.5 mg/l. The North – East corner is showing some what

ISSN: 2349-3224 || www.ijaetmas.com || Volume 04 - Issue 06 || June-2017 || PP. 69-83

higher values that to in extended limits only. The water from the bore wells 1 and 3 goes for filtration units and it will be supplied for drinking purposes.

3.5.Other Measured Parameters:

3.5.1. Measurement of P^H Value

In the study area out of 13 water samples, p^H>7.1 is observed in seven samples, in six samples p^H< 7.1 is observed. All the measured pH values are given in the Table 3 and the spatial distribution map is shown in the Fig.11 which indicates that the eastern and western portions of the basin is more alkaline compared to central portion of the basin.

Table 2: Major Anion Concentrations in mg/l in the present study:

S no	B W	F^-	Cl^-	No_3^-	SO_4^-	$CACO_3^{2-}$	HCO_3^{2-}
1	BW-1	1	118	13.2	94.9	412	578.2
2	BW-2	1	118	12.2	95.2	410	568.6
3	BW-3	0.7	126	10.7	97.1	400	493.4
4	BW-4	1	26	6.33	33.9	192	505.6
5	BW-5	0.2	124	19.3	31.4	376	539.2
6	BW-6	0.6	124	9.13	24	388	522.2
7	BW-7	0.7	94	5.97	36	204	492.9
8	BW-8	1	92	7.66	42	196	522.2
9	BW-9	1.6	36	15	38.2	180	555.7
10	BW-10	1.7	20	20.1	41.8	176	509.9
11	DW	1.8	20	15.0	25.4	116	463.2
12	BW-11	1.7	32	6.32	21.2	180	479.5
13	DW	ND	2.5	1.45	<0.1	4	555.4

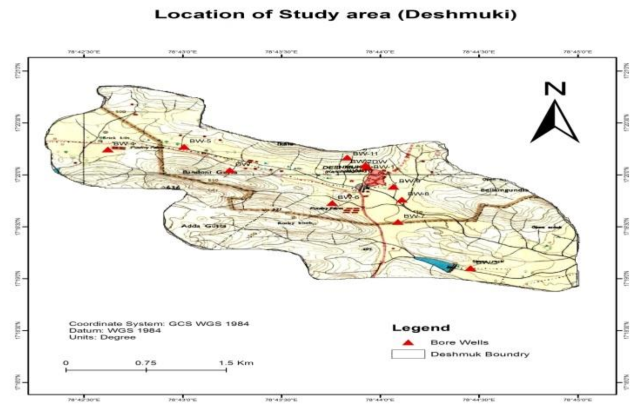

Fig.10: Location Map of study area

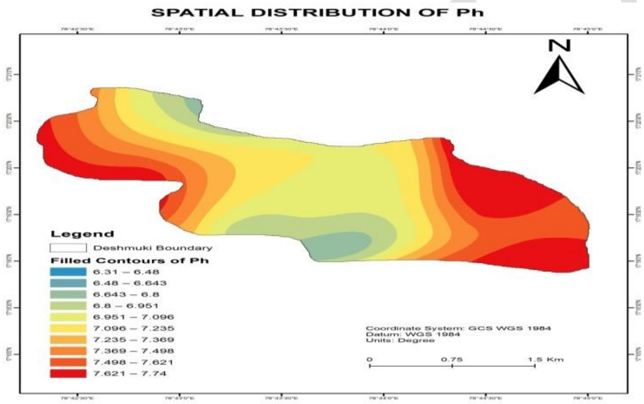

Fig 11:The spatial distribution map ofP^H

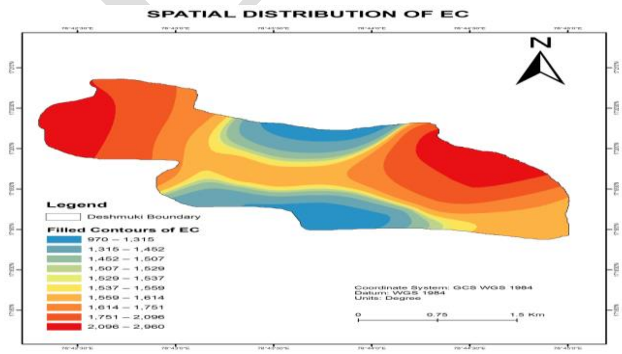

Fig 12: Spatial distribution of EC

ISSN: 2349-3224 || www.ijaetmas.com || Volume 04 - Issue 06 || June-2017 || PP. 69-83

Table 3: P^H, TDS, EC and Temperature values of ground water samples.

Sno	BW	P^H	EC(M S)	TDS	Tin^{O}c
1	BW-1	7.17	1135	681	29.3
2	BW-2	7.74	1598	958	29.8
3	BW-3	7.62	1538	922	29.8
4	BW-4	7.67	1635	981	29
5	BW-5	6.73	1353	812	28
6	BW-6	6.61	1375	825	29.8
7	BW-7	6.89	1645	987	29.8
8	BW-8	7.10	1503	902	27.5
9	BW-9	6.99	1413	848	29
10	BW-10	6.77	1242	745	29.3
11	DW	7.45	520	254	29.3
12	BW-11	6.31	2592	1555	29.6
13	DW	7.73	538	263	29

3.5.2.Measurement of EC: The EC value of the study area, its distribution and variation is

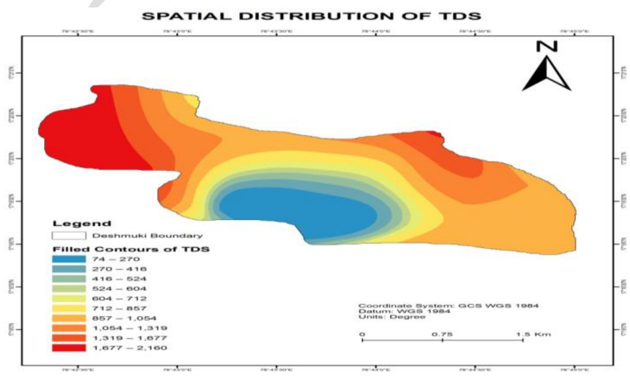

Fig 13: Spatial distribution of TDS

ISSN: 2349-3224 || www.ijaetmas.com || Volume 04 - Issue 06 || June-2017 || PP. 69-83

more or less following the TDS way i.e. the eastern and western portions of the basins is having higher conductivity as it is having more dissolved salts compared to the central portion of the basin. According to the map (Fig.12) the central portion of the basin is having low values of EC, whereas the North - East and North – West corners of the basin are showing high EC values.

3.5.3.Measurement of TDS: Maximum TDS concentration of 500 mg/l is allowed for drinking water, In all samples the TDS is < 1000 except in the sample no 12 in which it is >1000. The highest value is 1555. In the study area the TDS value of the drinking water samples 11 and 13 is within the desirable limits .All the values of the TDS are tabulated in the Table 3 and the spatial distribution map of the TDS (Fig.13) indicates the same trend as the EC map..

Table 4: Table showing suitability of ground water for drinking purposes

parameters	**No.of samples with in standards**	**No. of samples having > desirable limits**	**WHO standards**
p^H	13	----	6.5-8.5
TDS	12	1	1000
EC	8	5	1500
Sodium	2	11	100
Potassium	10	3	10
Calcium	3	10	50
Megnisium	3	10	30
Chlorides	13	-----	250
Fluorides	11	2	1.5
Sulphates	13	-----	200
Nitrates	13	-----	45
Carbonates	2	11	120
Bi Carbonates	4	9	500

ISSN: 2349-3224 || www.ijaetmas.com || Volume 04 - Issue 06 || June-2017 || PP. 69-83

4. PROCESSING AND ANALYSIS OF HYDROCHEMICAL DATA FOR IRRIGATION PURPOSES

In order to gain an insight into the hydro-geochemical characteristics for irrigation suitability, the following parameters are calculated.

1. Percentage sodium: To identify the suitability of water for irrigation.
2. Sodium Absorption Ratio for plotting USSL graphical analysis (Wilcox diagram): for assessing the degree of suitability of ground water for irrigation.
3. Residual Sodium Carbonate: To identify suitability of water for irrigation.

To calculate the above parameters all the values of various cations are converted into milli equivalents per litre (meq) and is shown in Table 4.

4.1.Sodium Percent

Sodium percent is calculated by making use of the formula

% of Na^+= ((Na^+ + K^+) / (Na^+ + K^+ + Mg^+ + Ca^+)) X100

All values in the above equation are in meq

Using above formula, when Na% is taken into consideration, sample nos. 4, 8, 9, 10, 12 are having Na% ranging from 20-40% and the water is categorized as medium salinity water and designated as C2 class and suitable for irrigation.

Sample nos.1, 2, 3, 5, 6, 7, are having Na % ranging from 40-60% and the water is categorized as high salinity water and designated as C3 class and not suitable for irrigation in the areas with restricted drainage facility and salt tolerant crops can be grown. In case of adequate drainage and leeching the water can be used for irrigation.

4.2. Sodium Absorption Ratio(SAR): The Sodium absorption ratio can be calculated by using the formula as given below:

SAR (S A R) = **Na/** $\sqrt{(\square\square + \square\square)/\square}$

Where the ionic concentrations are expressed in meq

Using above formula and calculated the SAR .The interpretation according to Wilcox diagram shows that most of the samples are with low sodium hazard where as all samples are with high and very high salinity hazard.

Low sodium water (S1) can be used for irrigation on all most all soils, with little danger of the development of harmful levels of exchangeable sodium. However some sodium sensitive fruit crops are found to accumulate injurious concentrations of sodium..

High salinity water (C3) cannot be used in soils with restricted drainage. Even with adequate drainage, special salinity control measures are required and plants with good salt tolerance should be selected.

Very high salinity water (C4) is not suitable for irrigation under ordinary conditions. It may be resorted to under very special circumstances. The soils must be permeable, drainage adequate, irrigation water applied in excess to provide considerable leaching and very salt tolerant crops selected.

4.3.USSL Graphical Analysis (USSL diagram)

The staff of US Salinity Laboratory (Richards, 1954) has developed a diagram for classification of irrigation water with sodium adsorption ratio (SAR) as an index for sodium hazard and Electrical conductance as an in index of salinity hazard. It is a semi-log paper plotting with EC in micro-mhos/cm on x-axis, SAR on y-axis which is essentially a ratio of sodium to calcium - magnesium concentrations which is defined as follows.

From the USSL diagram it is observed that all the samples belong to C_3S_1category except sample no 12, which belongs to C_4S_1 category. C_3S_1 indicates that water is having "**low sodium hazard and high salinity hazard"**.

4.4. Residual Sodium Carbonate (RSC)

In waters having high concentration of bicarbonate, there is a tendency for calcium and magnesium to precipitate as the water in the soil becomes more concentrated. As a result, the relative proportion of sodium in the water is increased in the form of sodium carbonate. RSC is calculated using the following equation.

$RSC = (HCO_3^{-2} + CO_3^{-2}) - (Ca^{+2} + Mg^{2+})$

Where all ionic concentrations are expressed in epm

According to the US Department of Agriculture, water having more than 2.5 epm of RSC not suitable for irrigation purposes. RSC in between 1.25- 2.5 epm moderate for irrigation and below 1.25 epm it is safe for irrigation.

Excess sodium in water produces undesirable effects of changing soil properties and reducing soil permeability. Hence the assessment of sodium concentration while considering the suitability of irrigation water, the degree to which the irrigation water tends to enter into cation exchange reactions in soil can be indicated by sodium absorption ratio. Sodium replacing absorbed calcium and magnesium is a hazard as it causes damage to the soil structure. It becomes compact and impervious.

5. CONCLUSIONS

(1) As per Indian standards, only one sample is exceeding the permissible limit of 1000 mg/l for TDS and 2 samples are exceeding the permissible limit of Fluoride. However number of samples are exceeding the desirable limits for many individual ions such as 11samples are exceeding in sodium concentration, 10 samples are exceeding in Calcium and Magnesium concentrations, 11 samples are exceeding in the total hardness concentration, and 9 samples are exceeding in bi- carbonate concentration. Therefore it is better to drink ground water after some treatment only. Overall central portion of the basin is somewhat good for drinking water after treatment.

(2) When Residual Sodium Carbonate (RSC) is taken into consideration only 3 samples are within the limit, 5 samples are having RSC values less than 10 and the rest of 5 samples are having greater than 10, indicating that

the water is not suitable for irrigation. Addition of Gypsum, leeching and growth of salt tolerant crops can be adopted.

(3) According to Sodium Absorption Ratio (SAR) all samples are belonging to S_1 category but RSC values are exceeding the desirable limits, indicating that the water is having low sodium and high salinity hazard. Water is not suitable for irrigation in the areas with restricted drainage facility. Therefore salt tolerant crops can be grown. In case of adequate drainage and leeching the water can be used for irrigation.

(4) As per Sodium percentage Five samples belong to C_2 class (Medium salinity water) which are suitable for irrigation, six sample belongs to C_3 class (high Salinity water) which are not suitable for irrigation in areas with restricted drainage. Therefore salt tolerant crops can be grown.

6.REFERENCES:

Aditya Swamy (2004) "water quality of Hazaria region – influence of salinity on ground water". Proceedings ofthe 11th National symposium on Hydrology, National Institute of Hydrology, Roorkee.

APHA (1995) "Standard methods for the examination of water and waste water", 19thedn.,

American Publication Health Association, Washington DC.

Barbar (2000) "Impacts of Industrial waste in ground water and soil conservation at Tuppa area, Maharashtra, India" proc. of international conference on hydrology and watershed management, JNTU, Hyderabad.

Bureau of Indian Standards (BIS IS 10500(1991)) Drinking water –Specification (p.8) (6th reprint,2004). New Delhi: BIS, R.M.Bhardwaj, water Quality monitoring in India –Achievements and constraints, Central Pollution control Board, India.

Bjorn FRENGSTAD, David Banks(2003) "Ground water chemistry related to depth of shallocrystalline bedrock boreholes in Norway." Proc..of int.. conf..on ground water in fractured rocks .Prague

Chourasia L.P (2002) "Hydrochemistry of ground water in alluvial plains of Northern Madhya Pradesh, India".proc of international conference on hydrology and watershed management"JNTUH, India.

Karanth K.R (1999). "Groundwater Assessment, Development and Management" (pp381).New Delhi: Tata McGraw Hill.

Handa B (1981) "Hydro geochemistry water quality and water pollution in U.P". Tech. Report, CGWB, Min. of Iraig. P.317.

Indian Standard Specification for Drinking Water ISI IS 10500 (1983). New Delhi: ISI, 22pp.