Groundwater Quality Analysis of Hard Rock Terrain in Bengaluru North Taluk, Karnataka, India.

Nanjundi Prabhu, M.Inayathulla

Abstract: In the present study analysed Groundwater quality of Hard rock terrain in Bengaluru North, Karnataka, India. For the present study areas affected by industrialization were selected to measure the quality of Groundwater for determining its fitness for domestic use. Bore well samples from each part of the study area were analysed for Physio - chemical variations and quality of groundwater. Comparison of Physio - chemical analysis results with Indian Standard drinking water limits shows that all groundwater samples except few are fit for drinking and irrigation purposes. The average value of pH of five villages is 7.5-8.0 which is within desired limit. However, the pH value is increasing so it may be unfit for the future use. About 50% of Water samples containing chloride in excess of 250mg/l are considered undesirable for drinking purposes which may lead to cardiovascular diseases. The concentration of sulphate for each sample of villages is within desirable limit. Also it is found that 25% of samples containing total hardness more than 300 mg/l which is undesirable. In future there may be threat of decrease in groundwater quality. Public awareness must be created among the citizens about the importance of lakes/tanks and give awareness about importance of quality of Groundwater and surface water.

Keywords: Perennial, Physico-Chemical Characteristics, Monthly variation, Biological variations.

I. INTRODUCTION

Groundwater is the most vital source of water for drinking, irrigation and industrial purposes. Growing population and its requirements have led to the decline of surface and sub-surface water. Superiority of groundwater is equally vital to its quantity owing to the fitness of water for various purposes. Water quality analysis is a significant issue in groundwater studies. Difference of groundwater quality in an area is a function of physical and chemical parameters that are greatly influenced by geological formations and anthropogenic activities.

Water Quality is represents the chemical, physical and biological characteristics of water, commonly in respect to its sustain for a chosen use.

The fresh water is of invigorating concern for humanity since it is directly connected to human well being. Groundwater is a precious natural resource of water supply all over the planet. Its use in agriculture, manufacturing and civilized usage proceeds to grow where annual surface water places are absent. The current community, over drafting, rapid urbanisation and increased industrialisation has lead to fast degradation of our society. We all are aware about water has a lot of uses, such as for power generation, drinking, aquaculture, irrigation and domestic purposes.

II. STUDY AREA

The area chosen is Bengaluru North Taluk which spreads in Bengaluru District. The study area geographically lies between 77^0 18' 30'' E and 77^0 46' 0'' E longitude and 12^0 56' 30'' N and 13^0 13' 0'' N with an area of 795.49 sq.km which is covered in Survey of India (SOI) Topo sheet number: 57 G / 12 on 1:50000 scale.
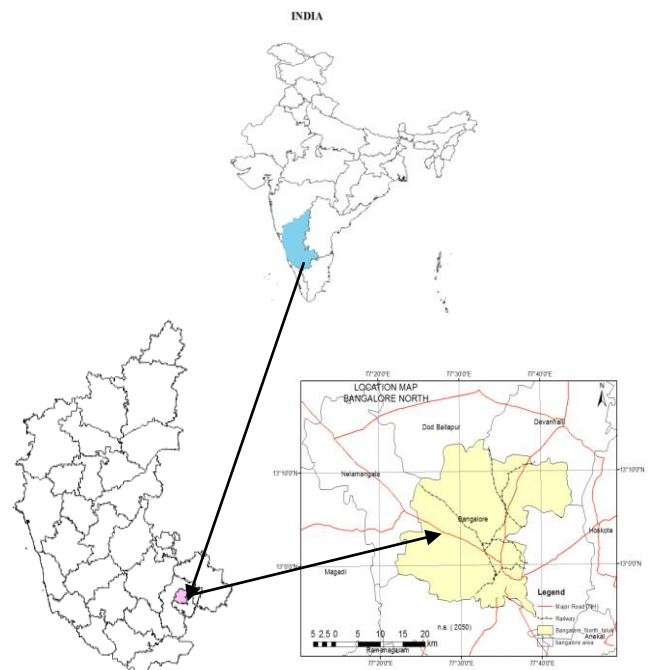

Fig.1 Location map of Bengaluru North Taluk

The maximum length and width of the command is approximately equal to 85.58 km and 114.29 km respectively. The following maps are prepared using GIS Software, Fig.1 shows the location map of the Bengaluru North, Fig.2 shows the Digital Elevation model of Bengaluru North Taluk.

Retrieval Number: L30881081219/2019©BEIESP
DOI: 10.35940/ijitee.L3088.1081219
Journal Website: www.ijitee.org

1467

Published By:
Blue Eyes Intelligence Engineering
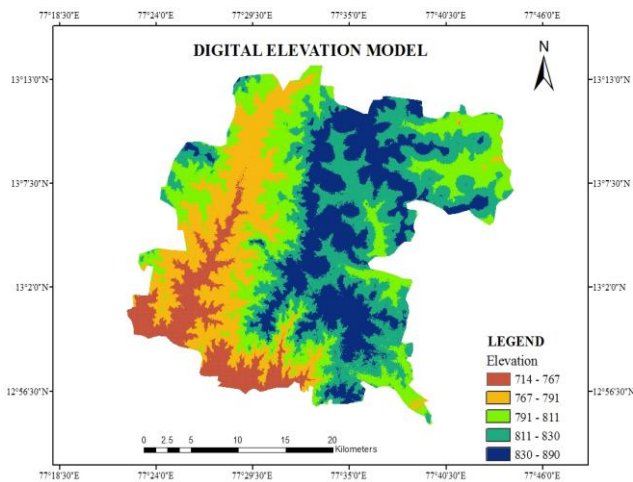*& Sciences Publication*

Fig: 2 Digital Elevation Model of Bengaluru North watershed

III. EXPERIMENTAL METHODS

A. Water Sampling Procedure and Assessment

The water samples were analysed for various parameters in the research lab. chemical and physical features like Temp, pH, Turbidity, TDS , TSS , Electrical Conductivity, Mineral Acidity, Total Hardness, Calcium, Magnesium, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand(COD), Chloride, Iron, Nitrates, Phosphates and Alkalinity have been tracked for the lake water at different points from bore wells.

IV. MATERIALS AND METHODS

The Water Samples collected from different locations .The Water samples were immediately carried to Laboratory for the measurement of various Physical and chemical features like Temperature, pH, Turbidity, TDS, TSS, Electrical Conductivity, Mineral Acidity, Total Hardness, Calcium, Magnesium, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Chloride, Iron, Nitrates, Phosphates and Alkalinity .Water samples were collected from 33 select bore wells located in the study area. As regards the water quality in and around Bengaluru North is suitable for drinking purposes and all the constituents are in confirmative with BIS standards.

Table:1.0 Water quality Standards as per WHO and ISI.

Sl.No.	Parameters with Units	WHO Standards	ISI Standards	
			Acceptable limits	Maximum limits
1.	pH	7.0 – 8.5	6.5 – 8.5	6.5 – 9.2
2.	EC (in µS)	-	400	1000
3.	TDS	500	500	2000
4.	Turbidity	-	10	25
5.	Chlorides	200	250	1000
6.	Total Alkalinity	-	200	600
7.	Total Hardness	100	300	600
8.	Calcium Hardness	75	75	200
9.	Magnesium Hardness	50	30	100
10.	Nitrate	-	45	100
11.	Sodium	-	20	150
12.	Potassium	-	10	12
13.	Sulphate	200	150	400
14.	Fluoride	1.0	0.6 – 1.2	1.5
15.	Iron	0.3	0.3	1.0
16.	Lead	-	0.1	-
17.	Zinc	-	5.0	15
18.	Manganese	0.1	0.1	0.5
19.	Copper	1.0	0.05	1.5

All parameters are in mg/l. Except EC in µS; Turbidity in NTU

Existing bore wells of the study area were considered as the points to draw the samples. 33 bore wells were selected as the sampling points to collect the groundwater samples. The points selected were distributed in the entire area to represent true representative about the quality of groundwater.

A. Sample Collection and Transportation:

Groundwater samples were collected from selected bore wells as per the standard procedure. Two liter pre cleaned PVC (polyvinyl chloride) cans thoroughly rinsed with distilled water were used for collection.

Of samples. The bore well water was released for 3 to 5 minutes before collecting samples into the cans, so as to wash out the local impurities and to empty the water standing in the service pipe. The containers are labelled describing the date of collection, time of collection, sampling location, and conditions under which sampling is done. The collected samples were transported to laboratory and were analyzed.

Table.2.1 Physio – chemical data for Groundwater in the studied area.

Sl No.	Lat.	Lon.	Boron	Bicarbonates	Calcium
1	13.04167	77.58333	0.07	160	52
2	13.09167	77.6	0.33	160	36
3	12.94417	77.55833	0.05	98	28
4	12.94417	77.55833	0.3	195	36
5	13.09167	77.6	0.04	134	44
6	13.04167	77.58333	0.15	140	72
7	12.94417	77.55833	0.21	38	33
8	13.09167	77.6	0.07	65	39
9	13.04167	77.58333	0.05	39	27
10	12.99278	77.59611	0.001	116	24
11	13.08194	77.50556	0.06	159	56
12	12.94417	77.55833	0.18	73	8
13	12.94861	77.57194	0.24	177	24
14	12.98194	77.55556	0.12	189	24
15	13.00417	77.5725	0.06	43	24
16	13.13611	77.61944	0.38	220	28
17	13.1875	77.5	0.04	61	20
18	12.98194	77.62917	0.001	37	12
19	12.94889	77.59694	0.02	43	36
20	12.94889	77.59694	0.07	43	36
21	13.09167	77.6	0.2	128	36
22	13.05972	77.57694	0.02	238	32
23	12.9725	77.57667	0.4	116	24
24	13.04167	77.58333	0.08	110	32
25	12.94861	77.57194	0.07	31	30
26	13.1875	77.5	0.21	79	30
27	13.13611	77.61944	0.31	61	30
28	13.05972	77.57694	0.29	61	78
29	13.00417	77.5725	0.07	49	36
30	12.98194	77.55556	0.06	37	70
31	12.98194	77.62917	0.35	61	24
32	12.99278	77.59611	0.26	49	20
33	12.94889	77.59694	0.29	61	20

Table.2.2 Physio – chemical data for Groundwater in the studied area.

Sl. No.	LAT.	LON.	Magnesium	Sodium	Nitrate	Ph
1	13.04167	77.58333	19.51	90	16	8
2	13.09167	77.6	34.08	110	31	8
3	12.94417	77.55833	12.19	60	1	8.4
4	12.94417	77.55833	19	49	12	7.9
5	13.09167	77.6	12	36	12	6.8
6	13.04167	77.58333	27	79	59	7.9
7	12.94417	77.55833	39.1	57	49	8.4
8	13.09167	77.6	55.6	44	34	8.4
9	13.04167	77.58333	8.9	29	88	8.7
10	12.99278	77.59611	17.05	53	19	8.4
11	13.08194	77.50556	29.24	91	1.2	8.23
12	12.94417	77.55833	4.87	70	1.5	8.9
13	12.94861	77.57194	4.89	88	4.2	8.1
14	12.98194	77.55556	58.38	114	4.6	8.6
15	13.00417	77.5725	14.62	53	4.6	8.9
16	13.13611	77.61944	70.54	184	39	7.8
17	13.1875	77.5	24.34	81	76	8.9
18	12.98194	77.62917	4.88	46	2	9.2
19	12.94889	77.59694	4.91	51	19	8.8
20	12.94889	77.59694	4.91	51	19	8.8
21	13.09167	77.6	38.94	45	30	8
22	13.05972	77.57694	126.5	150	96	8
23	12.9725	77.57667	19.48	53	5	8.4
24	13.04167	77.58333	24.35	50	14.5	8.2
25	12.94861	77.57194	18.27	29	9	8.4
26	13.1875	77.5	6.11	40	2	8.6
27	13.13611	77.61944	18.27	45	11	8.6
28	13.05972	77.57694	31.7	59	41	8.5
29	13.00417	77.5725	14.63	35	21	7.6
30	12.98194	77.55556	25.61	120	45	8.4
31	12.98194	77.62917	4.89	21	0.2	8.2
32	12.99278	77.59611	10.97	22	0.4	8.3
33	12.94889	77.59694	17.04	74	20	8.5

Table.2.3 Physio – chemical data for Groundwater in the studied area.

Sl No.	Lat	Lon	Phosphate	Sulphate	Total Hardness	Elect. Conductivity	Fluorides
1	13.04167	77.58333	0.03	14	210	870	1.56
2	13.09167	77.6	0.18	134	230	990	1.63
3	12.94417	77.55833	0.04	29	120	415	1.2
4	12.94417	77.55833	0.07	18	170	570	0.4
5	13.09167	77.6	0.16	28	160	510	0.2
6	13.04167	77.58333	0.06	66	290	960	0.2
7	12.94417	77.55833	0.1	41	189	530	0.18
8	13.09167	77.6	0.17	63	112	920	0.3
9	13.04167	77.58333	0.19	38	335	610	0.44
10	12.99278	77.59611	0.08	20	130	520	0.59
11	13.08194	77.50556	0.1	42	260	950	0.14
12	12.94417	77.55833	1.7	20	40	430	0.49
13	12.94861	77.57194	0.1	14	80	610	0.58
14	12.98194	77.5555	0.1	96	300	1110	0.7
15	13.00417	77.5725	0.05	34	120	470	0.64
16	13.13611	77.61944	0.1	68	360	1540	0.43
17	13.1875	77.5	0.1	52	150	670	0.43
18	12.98194	77.62917	0.1	20	50	380	1.56
19	12.94889	77.59694	0.1	42	110	460	0.34
20	12.94889	77.59694	0.05	42	110	460	0.34
21	13.09167	77.6	0.04	62	250	710	0.3
22	13.05972	77.57694	0.1	202	600	1920	0.38
23	12.9725	77.57667	0.07	62	140	540	0.34
24	13.04167	77.58333	0.1	34	180	610	0.31
25	12.94861	77.57194	0.16	27.4	150	450	0.2
26	13.1875	77.5	0.09	15	100	390	0.7
27	13.13611	77.61944	0.1	20.2	150	520	0.7
28	13.05972	77.57694	0	80	325	1010	0.3
29	13.00417	77.5725	0.1	50	150	470	0.6
30	12.98194	77.55556	0.11	90	280	1220	0.9
31	12.98194	77.62917	0.2	19	80	250	0.4
32	12.99278	77.59611	0.28	15	95	290	0.9
33	12.94889	77.59694	0.18	40	120	600	1.5

V. RESULTS AND DISCUSSION

A. Total hardness:

Total Hardness: In the study area Bengaluru iv is having Lowest value 60 mg/l and highest is Kodigehalli is 600mg/l and the average value is 166.96 mg/l. The variation of Hardness in the study area is shown in the fig.2
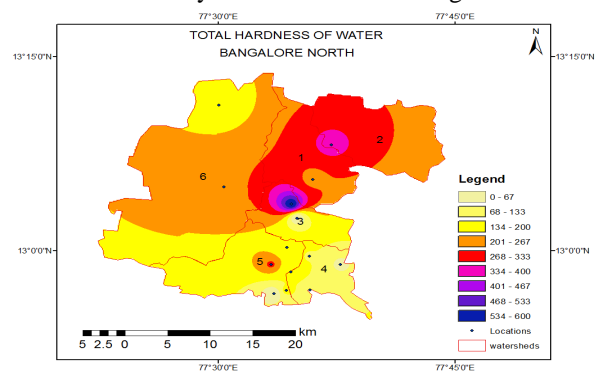

Fig.2 Total Hardness of Water at Bengaluru North Taluk

B. Sulphate:

In the study area Hebbala2 and Basavanagudi having 14mg/l is the lowest value and kodigehalli is having 202 mg/l is the highest value and the average value is 44.01mg/l. The variation of Sulphate in the study area is shown in the fig.3
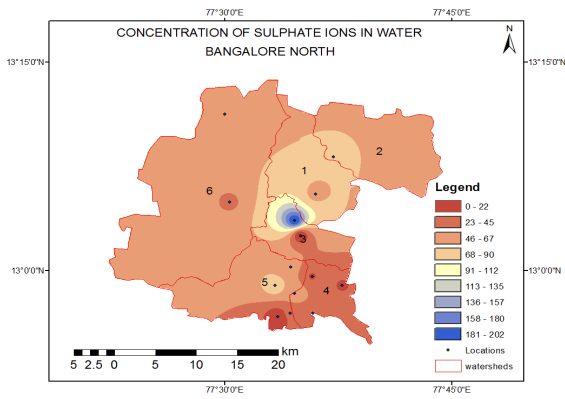
Fig.3 Concentration of Sulphate Ions in Water at Bengaluru North Taluk

C. Sodium (Na): The sodium concentration in the studied samples ranges from 21 mg/l at ulsoor is the lowest value and 184 mg/l at Gollahalli is the highest value and the average value is 62.09 mg/l. The variation of Sodium in the study area is showing in the fig.4
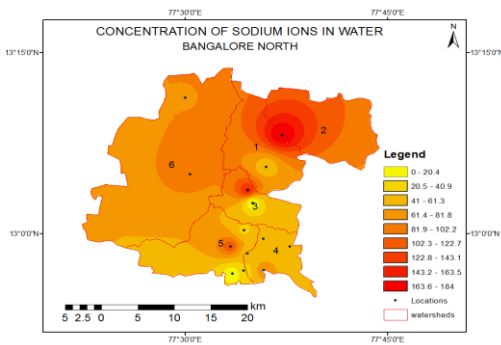

Fig.4 Concentation of Sodium Ions in Water at Bengaluru North Taluk

D. Potassium (K):

Potassium concentration from 2.2 to 28.4 mg/l with an average of about 8.56 mg/l. The variation of Potassium in the study area is showing in the fig.5
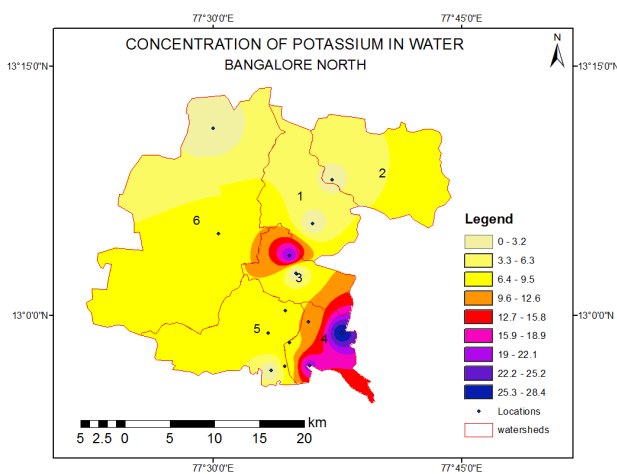
Fig. 5 Concentration of Potassium in Water at Bengaluru North TaluK

E. PHOSPHATES:

 In the study area Hebbala ii is having Lowest value 0.03 mg/l and 1.7 mg/l is the highest at Bengaluru - iv. Average value is

0.125mg/l. The variation of Phosphate in the study area is showing in the fig.6
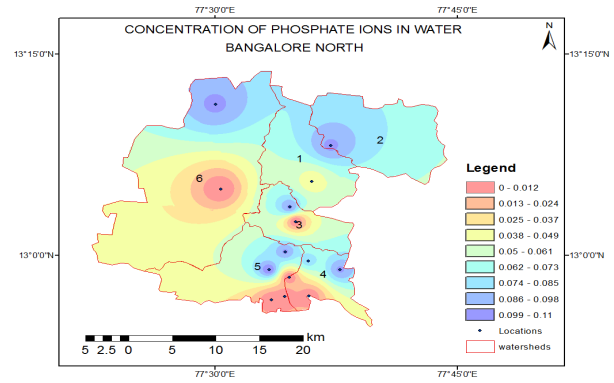
Fig. 6 Concentration of Phosphate Ions in Water at Bengaluru North Taluk

F. pH VALUE

 In the study area Malleswaram is having Lowest value 7.6 mg/l and 9.2 mg/l is the highest at Ulsoor. Average value is 8.32 mg/l. The variation of PH in the study area is showing in the fig.7
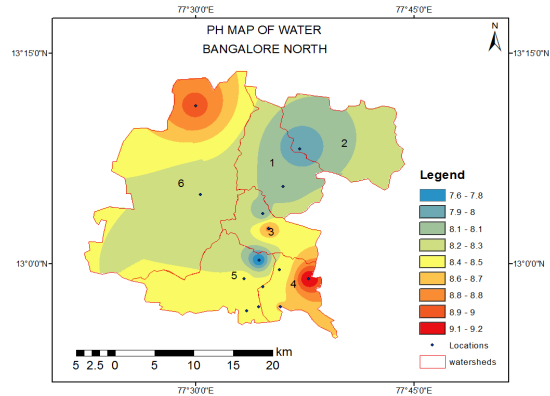

Fig. 7 Concentration of PH Water at Bengaluru North Taluk

G. NITRATES:

In the study area Vasanthnagara is having Lowest value 0.4 mg/l and highest is Kodigehalli is 96 mg/l and the average value is 23.85mg/l. The variation of Nitrates in the study area is showing in the fig.8
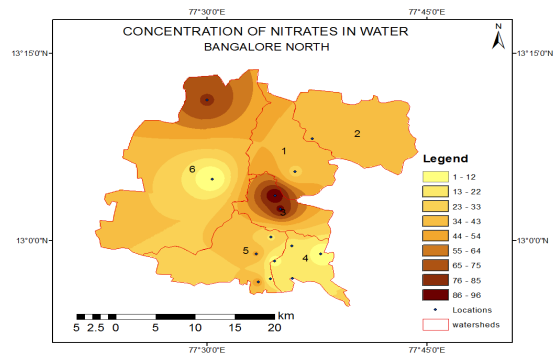

Fig. 8 Concentration of Nitrates in Water at Bengaluru North Taluk

H. MAGNESIUM

In the study area Bengaluru iv is having Lowest value 4.7 mg/l and highest is Kodigehalli is 126.5 mg/l and the average value is 23.74 mg/l. The variation of Magnesium in the study area is showing in the fig.9
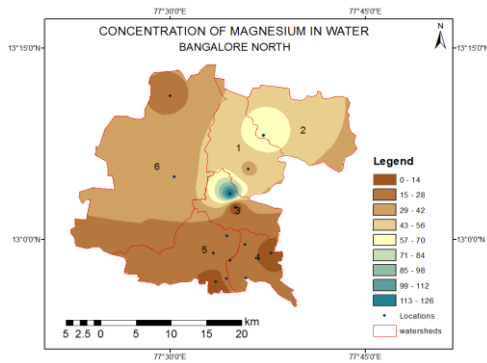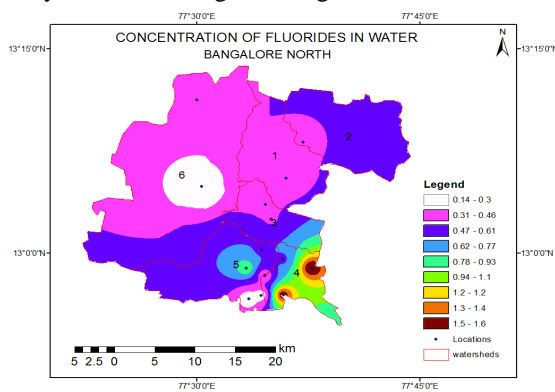

Fig.9 Concentration of Magnesium in Water at Bengaluru North Taluk

I. Fluoride

In the study area Chikkabanavara is having Lowest value 0.14 mg/l and highest is Yelahanka1 is 1.63 mg/l and the average value is 0.602 mg/l The variation of Fluoride in the study area is showing in the fig.10

Fig. 10 Concentration of Fluorides in Water at Bengaluru North Taluk

J. ELECTRICAL CONDUCTIVITY

In the study area Ulsoor is having Lowest value 250 umhos/cm and highest is Kodigehalli is 1920 umhos/cm and the average value is 695.60 umhos/cm. The variation of Electrical Conductivity in the study area is showing in the fig.11
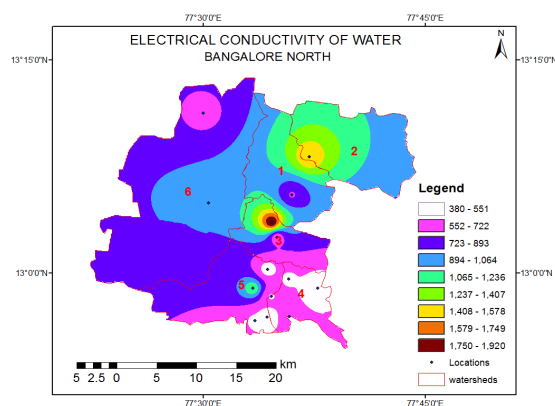

Fig. 11 Electrical Conductivity of Water at Bengaluru North Taluk

K. CHLORIDES

In the study area Vasanthnagara is having Lowest value 36 mg/l and highest is Gollahalli is 341mg/l and the average value is 117.78 mg/l The variation of Chlorides in the study area is showing in the fig.12
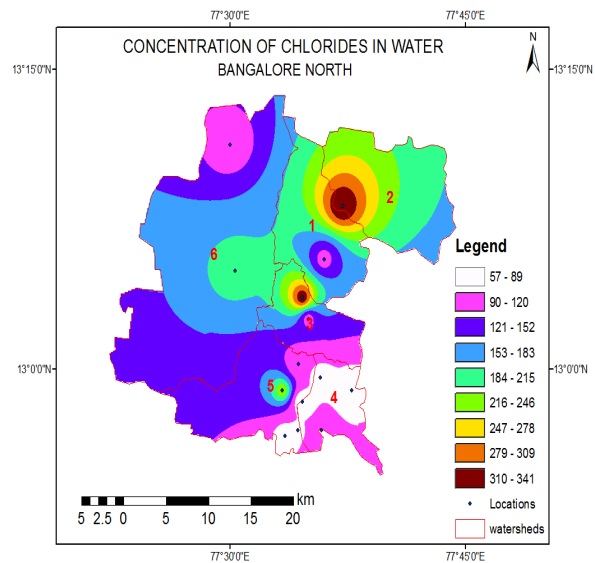

Fig. 12 Concentration of Chlorides in Water at Bengaluru North Taluk

L. Carbonate (CO3) and Bicarbonate (HCO3):

The concentration of the carbonate in the studied samples ranges from 9 to 36 mg/l with an average concentration of about 17.09 mg/l, while bicarbonate ranges from 31 mg/l to 238 mg/l with an average concentration of about 94.81 mg/l. The variation of Carbonates and Bicarbonates in the study area is showing in the fig.13 and fig.14.
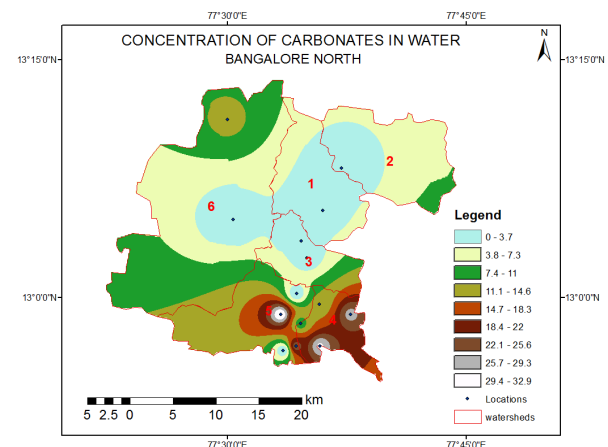

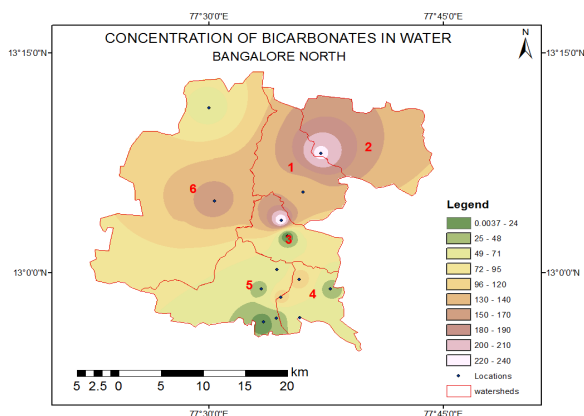**Fig.13 Concentration of Carbonates in Water at Bengaluru North Taluk**

Fig. 14 Concentration of Bicarbonates in Water at Bengaluru North Taluk

M. CALCIUM (ca)

The calcium content of the studied samples, ranging from about 8 to 78 mg/l with an average of about 30.96 mg/l, are well within the permissible limit and suitable for drinking purposes as per BIS .The variation of Calcium in the study area is showing in the fig.15
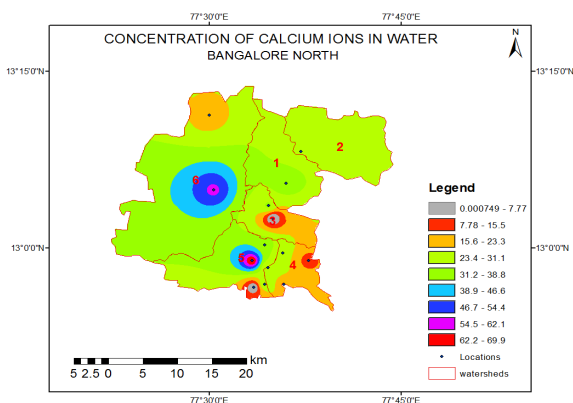

Fig. 15 Concentration of of Calcium Ions in Water at Bengaluru North Taluk

VI. CONCLUSIONS

From the results of this study it has been concluded that: The physico – chemical analysis of the study revealed that. All the groundwater samples collected were having the concentrations of many parameters are within the standard limits and few samples are above the permissible limits. The quality of groundwater is objectionable in few samples and most of the samples are good for domestic uses.

A. Possible Remedial Measures:

The sewage must be de linked with the water body and passed only through sewer systems. Clean up weeds in the lake and use it as compost and raw material to produce biogas. The water already present must be completely drained before any restoration work is implemented. Disposing of domestic/industrial wastes and carcasses must be stopped. Public awareness must be created among the citizens about the importance of lakes/tanks and suitability of groundwater for drinking purpose.

REFERENCES

1. AtulKotiya, DevendraDohare and ShriramDeshpande, "Analysis of GroundWater Quality Parameters: A Review" Research Journal of Engineering Sciences ISSN 2278 – 9472, Vol. 3(5), 26-31, May 2014.
2. Cristina Rosu, IoanaPistea, MihaelaCalugar,IldikaMartonos, Ozunu, "Assessment of Groundwater Quality Status by using water quality index (WQI) Method" inTureni Village , 2012.
3. DhiviyaaPranavam TS, VenkatesaRao T, Punithavathi L, Karunanithi S and Bhaskaran A "Groundwater pollution in the Palar Riverbed near Vellore, Tamil Nadu, India". Indian J. Sci. Technol. 4 (1), 19-21.Domain site: http://www.indjst.org, 2011.
4. G. Achuthan Nair, Jalal Ahmed Bohjuari, Muftah A. ALMariami, Fathi Ali Atia and Fatma F. EI-Toumi, carried out "Groundwater quality status by water quality index"at North –East Libya,oct, 27(4), 695-700, 2006
5. Gupta N. and et.al., Physico-Chemical Analysis of Drinking Water Quality from 32 locations in Delhi, Journal of Indian Water Works Association, 2010.
6. J. Sirajudeen Arul Manikandan and V. Manivel, "Water Quality Index of Groundwater around Ampikapuram area near Uyyakondan channel Tiruchirappalli Tamil Nadu" Archives of Applied Science Research, 5(3), 21-26,2013.
7. Rajankar P. and et al."Assessment of Groundwater Quality using water qualityindex(WQI) in Wardha Maharashtra" Journal of Environmental Science and Sustainability, NEERI, 1(2), 49-54 , 2013.
8. Jairaj, C., Prathap Kumar, M.T. & Raghunandan, M.E. "Compaction characteristics and strength of BC soil reinforced with untreated and treated coir fibers" Innov. Infrastruct. Solut. (2018) 3: 21. https://doi.org/10.1007/s41062-017-0123-2.
9. Jairaj & Prathap Kumar, M.T. "Long-term Performance Studies on Strength Characteristics of Black Cotton Soil Reinforced with Untreated and Treated Coir Fibre" Int. J. of Geosynth. and Ground Eng. (2018) 4: 25. https://doi.org/10.1007/s40891-018-0143-9.
10. C. Jairaj, M.T. Prathap Kumar, H. Muralidhara "Shear Strength of BC-Soil Admixed with Lime and Bio-Enzyme", Materials Science Forum, Vol. 969, pp. 327-334, 2019.
11. *Nanjundi P, M.Inayathulla," Runoff Estimation by SCS Curve Number Method for Bangalore North Taluk, Karnataka, India" Jour of Adv Research in Dynamical & Control Systems, Vol. 11, No. 1, 2019.*

AUTHORS PROFILE

Nanjundi Prabhu is a life member of Indian Water Resources Society (IWRS), MIAE, MISTE. Born in Karnataka, Obtained his BE in Civil Engineering in the year 2006-2010 from JNNCE, Shimoga and M.E with specialization on Water Resources Engineering during 2010-2012 from UVCE, Bangalore University and Pursuing Ph.D from Bangalore University. Presently working as Assistant Professor at NMIT, Bangalore, India. And has 7 years of teaching experience. Till date, has presented and published several technical papers in many National and International seminars and conferences.

Dr.M.Inayathulla is a life member of Environmental and Water Resources Engineering (EWRI), ASCE, WWI, ASTEE, ASFPM. Born in Karnataka, Obtained his BE in Civil Engineering in the year 1987-1991 from UBDT, Davanagere and M.E with specialisation on Water Resources Engineering during 1992-1994 from UVCE, Bangalore University and got Doctorate from Bangalore University in the year 1990-1995. Presently working as Professor at UVCE, Bangalore University, India. And has more than 25 years of teaching experience. Till date, has presented and published several technical papers in many National and International seminars and conferences.