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GROUND WATER QUALITY AND SPATIAL DISTRIBUTION OF RAMANAGAR TALUK BY USING WATER QUALITY INDEX AND GIS

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ABSTRACT

Assessment and mapping of quality of groundwater is an important quantity, because the physical and chemical characteristics of groundwater determine its suitability for agricultural, industrial and domestic usages.The current review assesses the groundwater nature of Ramnagar taluk with the assessment of water quality file and combined with GIS innovation. Inverse distance weighted (IDW)raster interpolation technique of spatial analyst module in ArcGIS software has been used to generate the spatial distribution of water pollutants constituents.The point of this study is to give an outline of the spatial variety of groundwater quality boundaries,i.e.,PH,Turbidity(NTU), Electrical conductivity(EC), Total dissolved solids(TDS), Alkalinity, chlorine, Total hardness (TH), Calcium hardness(CaH), Magnesium hardness(MaH), Sodium(Na), Potassium(K), Sulphates(SO4), Fluorides(F), Nitrates(NO3), Iron(Fe), in the Ramnagar taluk. Groundwater tests were gatheredfrom 46 areas, tried in the research facility and were broke down utilizing Geographical InformationFrameworks (GIS) methods. Geospatial expert apparatuses were utilized to produce different topicalguides, and introduction procedures were applied to recognize the spatial appropriation of ground-water quality boundaries. Groundwater quality was examined exhaustively and contrasted and , WHO water quality norms

Keywords: Spatial distribution, Ground water quality, Geographical information system(GIS)

1. Introduction

Groundwater is the readily available source of fresh water for living organisms on the earth for their survival. The suitability of groundwater for a particular use depends on its quality. The groundwater quality assessment is necessary to ensure its optimal and sustained safe use. There are various principles of water quality relying upon the kind of water use. Evaluation of groundwater quality is a confounded cycle that relies upon utilization of proper measurable instruments for its evaluation. Groundwater geochemistry has been evaluated by different creators utilizing various systems**.**WQI is a successful strategy for assessing drinking water quality and reasonableness in any space Multiple Linear Regression (MLR) models were additionally applied to foresee the degree of water quality factors utilizing compositional and spatial traits of land cover. fostered a

fluffy various leveled model for the expectation of water quality file in light of fluffy thinking. As per, the awareness examination model demonstrated thatboundaries which reflect relatively lower water quality and huge spatial inconstancy could be planned.Our review region Ramanagara taluk of Karnataka state, South India. In view of the 2011 evaluation this region contains 1,082,636 occupants with 77.51% education rate. It is arranged somewhere in the range of 12.7145 ° N and 12.6003° N, and longitudes 77.2767° E and 77.4702° E. Rapid urbanization and industrialization will directly or indirectly pollute the groundwater. The main objective of the current study is to present the dependency of populated area on a particular water quality class as a new method- ology, and also to analyse and interpret groundwater samples collected from various locations of Ramnagar area to assess the groundwater quality.

2. Methodology

The overall methodology adopted for the present study is presented in the form of flow chart inFigure2

2.1Geo-database

Sampling was carried out during winter seasonfor the year 2022 using GPS survey. A total of forty six(46) water samples were collected from the selected locations throughout the study area (Figure 1). The graticules and altitude values of the selected sampling locations are given in Table 1. The collected samples were preserved by adding appropriate reagents in laboratory to determine the water quality analysis. These samples were analyzed for different parameters (Table 2) following standard methods (APHA, 1998). All the parameters were compared with the guidelinessuggested by Burceau of Indian Standards (BIS, 2012). The obtained water quality data form the attribute database which is used to generate the spatial distribution maps for the present study area.

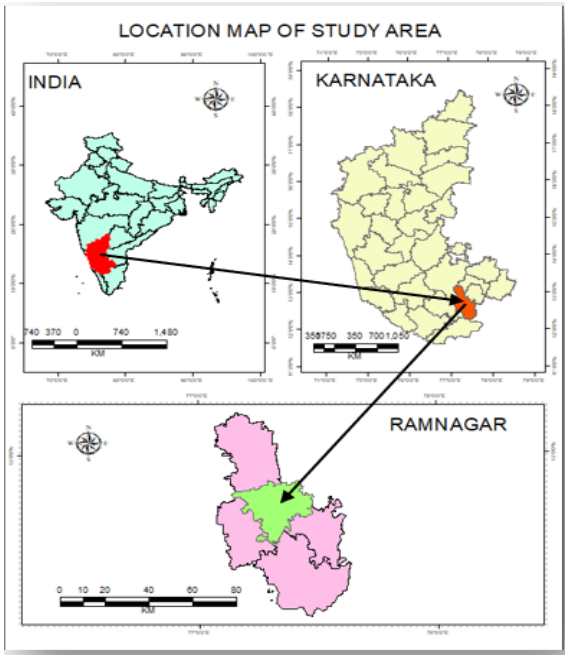


Figure1: Map showing the location of the study area

2.2. Interpolation-GIS model

Inverse distance weighted (IDW) raster interpolation technique of spatial analyst module in ArcGIS (version 5.0) software has been used for the present study to delineate the locational distribution of various water pollutants.The various areas of the inspecting stations were brought into GIS programming through point layer. Each example point was doled out by a novel code and put away in the point property table. The information base document contains upsides of all synthetic boundaries in isolated segments alongside an example code for each testing station. The geo-data set was utilized to create the spatial conveyance guides of chosen water quality boundaries specifically alkalinity, all out disintegrated solids (TDS), complete hardness (TH), chlorides (CI), fluorides (F) and water quality record (WQI).

2.3. Water Quality Index (WQI) Estimation

WOI is computed to reduce the large amount of water quality data to a single numerical value.WQI mirrors the composite impact of various water quality boundaries on the general nature of water. Water quality list was figured by embracing the technique for Tiwari and Mishra (1985), Sinha and Saxena (2006) to decide the appropriateness of the groundwater

$$WQI = \text{Antilog}\left[\sum_{i=1}^{n} w_i \log_{10} q_i\right]$$

Where w_i = weightage factor of i^{th} parameter
q_i = quality rating of i^{th} parameter

w_i is calculated from the following equation,

$$w_i = k/s_n$$

Where $k = \text{constant} = \dfrac{1}{1/vs_1 + 1/vs_2 + \ldots\ldots 1/vs_n}$

s_n = standard value of i^{th} paramete

q_i is calculated from the following equation,

$$q_i = \left(\frac{v_a - v_i}{v_s - v_i}\right) \times 100$$

Where v_a = actual value obtained from laboratory analysis of i^{th} parameter
v_s = standard value of i^{th} parameter
v_i = ideal value
(pH=7 and 0 for all parameters)

X

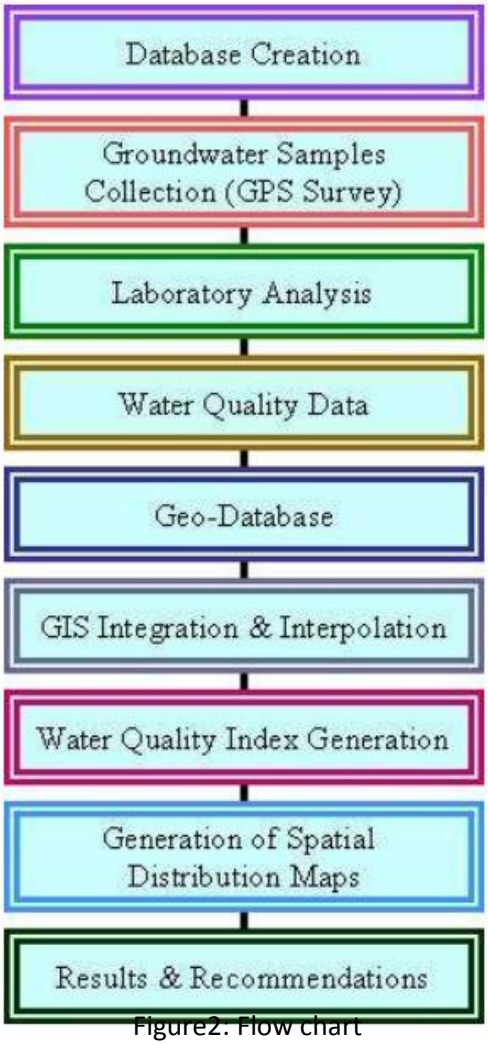


Figure2: Flow chart

Based on the water quality index, the analyzed samples were g
drinking (below 50), moderately polluted (51 to 80) and severely polluted (above 80)

Table 1: Details of sampling locations of the study area

SL No	Sampling station	Lat. Dms	Long. dms	SL no	Sampling station	Lat. dms	Long. dms
1	Mayaganahalli	12.76994	77.33523	24	Guddadahalli	12.83478	77.34276
2	Lakkanadoddi	12.78892	77.34138	25	Avaragere-colony	12.81333	77.37938
3	Hegdegere	12.76247	77.37673	26	Kotipura	12.71982	77.28952
4	Manchengowdanapaly	12.72242	77.38051	27	Thumbenahalli	12.71018	77.33565
5	Annalli	12.69978	77.38527	28	Koonagal	12.68651	77.31523
6	Gopalli	12.72893	77.39502	29	Gollaradoddi	12.61173	77.34316
7	Karenahalli	12.78222	77.46769	30	Gunnoor	12.65884	77.34707
8	Shyanumangala	12.79485	77.4316	31	Awerahalli	12.64917	77.33796
9	Channegowdanadoddi	12.80743	77.42936	32	Ammanapura	12.63335	77.32272
10	Bhimenahalli	12.82021	77.41327	33	Nanjapura	12.62962	77.29348
11	Mednahalli	12.78938	77.39856	34	Bannikupe	12.66247	77.2891
12	Ittamadu	12.75750	77.40466	35	Thimmaiahnadoddi	12.66546	77.25488
13	Byramangala	12.74760	77.42711	36	Chikkenahalli	12.69974	77.27212
14	H Gollahalli	12.75368	77.45204	37	Achaludoddi	12.69863	77.29252
15	Hejjla	12.85404	77.42533	38	Rayaradoddi	12.73475	77.27532
16	Banikuppe	12.85610	77.3867	39	Budivadera palya	12.77874	77.45719
17	Ganakallu	12.85142	77.3573	40	Kempashetty doddi	12.74378	77.42955
18	Hagalahalli	12.85046	77.33103	41	Putturammana doddi	12.73962	77.37668
19	Lakshmipura	12,83428	77.299	42	Kenjigarahalli	12.74465	77.34658
20	Chikka-sulikere	12.84854	77.30223	43	Kempegowdana doddi	12.74052	77.27892
21	Kempa Vaderahalli	12.84818	77.28805	44	Padarahalli	12.77122	77.28147
22	Ankanahalli	12.82570	77.25165	45	Madarasana doddi	12.77204	77.2959
23	Katuandoddi	12.82239	77.32207	46	Shivannagowdana doddi	12.76364	77.32031

Table 2: Analytical methods adopted for physico-chemical analysis

Analysis	**Method/instrument**
pH	Digital pH meter
Alkalinity	Titrimetry
Electrical conductivity (EC)	Digital conductivity meter
Total dissolved solids (TDS)	Indirect method (Raghunath, 2003) $0.64\times EC\,\mu S/cm$
Total hardness (TH) & calcium hardness (CaH)	EDTA-Titrimetry
Magnesium hardness (MgH)	Indirect method (Todd, 2001) $[TH-(2.5\times CaH)]/4.1$
Sodium (Na) & Potassium (K)	Flame photometer
Iron (Fe)	1,10 phenanthroline-Spectrophotometry
Bicarbonates (HCO_3) + carbonates (CO_3)	Indirect method (Hem, 1985) 1.31×Alkalinity
Chlorides (Cl)	Mohr's-Titrimetry
Sulphates (SO_4)	Spectrophotometry
Phosphates (PO_4)	Ammonium molybdate method-Spectrophotometry
Fluorides (F)	Selective ion meter

3. Results and Discussion

3.1. Groundwater quality variation

The results obtained from the physico-chemical analysis are presented in Tables 3 to 6.

3.1.1 PH

The pH of a solution is the negative logarithm of hydrogen ion concentration in moles per litre. In the water samples, the pH varies from 6.37 to 9.79indicating non permissible limit.

3.1.2 Electrical conductivity (EC) and Total Dissolved solids (TDS)

Electrical conductivity demonstrates the limit of electrical momentum that went through the water, which thus is connected with centralization of ionized substances present in it. Most broke down inorganic substances present in the water are in ionized structure and add to electrical conductivity. In the study area , electrical conductivity varies from 530 to 1678µS/cm for the water samples.

Electrical conductivity of water is viewed as a sign of the complete broke up salt substance (Hem. 1985). A fast assessment of complete disintegrated solids content in water is gotten by EC. The mean values of TDS are varied from 345 to 1091mg/l of the water samples.

Table 3: The analytical results showing quality of ground water in the study area

S.no	pH	Alkalinity	EC	TDS	TH	CaH	MaH	Na	k	Fe
1.	9.18	180	1430	930	460	62.52	73.87	101.4	107.2	0.92
2.	8.48	260	1236	803	512	73.75	79.70	84.0	11.2	0.68
3.	9.05	252	570	371	312	59.32	39.85	33.0	5.0	0.26
4.	8.96	116	1160	754	428	75.35	58.32	90.6	27.6	0.20
5.	9.79	224	675	439	320	49.70	47.63	65.4	6.6	0.54
6.	9.51	188	823	535	300	40.08	48.60	79.2	6.2	0.52
7.	7.60	308	530	345	252	75.35	15.55	32.6	6.2	0.18
8.	7.66	360	834	542	496	107.41	55.40	37.6	20.6	0.54
9.	7.34	368	1620	1053	828	177.96	93.31	83.4	4.0	0.26
10.	8.18	272	1231	800	352	52.91	53.46	140.8	8.8	0.40
11.	7.43	480	1310	852	748	160.32	84.56	1116.8	6.0	0.54
12.	7.60	520	1354	880	744	134.67	99.14	79.2	15.8	0.14
13.	7.00	520	1663	1081	888	166.73	114.70	99.2	14.0	0.00
14.	7.79	400	835	543	428	78.56	56.38	65.6	10.4	2.60
15.	7.51	500	1148	746	524	113.83	58.31	86.4	12.0	0.10
16.	7.00	448	1281	833	624	153.91	58.32	79.2	10.0	0.04
17.	7.69	320	847	551	420	128.26	24.30	39.6	3.4	0.14
18.	8.79	332	1110	722	500	144.29	34.02	73.8	9.8	0.00
19.	7.00	400	1010	657	644	157.11	61.24	31.2	5.4	1.60
20.	7.00	292	938	610	552	142.68	47.63	35.0	6.8	0.54
21.	7.00	372	753	489	560	142.68	49.57	24.0	13.8	1.00
22.	7.38	392	1174	763	728	192.38	60.26	31.4	5.4	0.00
23.	7.62	300	1136	738	616	155.51	55.50	70.8	4.8	0.00

All parameters expressed in mg/l except pH and EC; where EC in µS/cm, pH has no units

Table4: The analytical results showing quality of ground water in the study area

Sl.no	Turbidity(NTU)	Cl	F	SO4	NO3
1.	2.7	244	0.03	173	14.5
2.	6.7	268	0.12	109	3.5
3.	2.4	62	0.05	57	4.5
4.	2.4	180	0.53	153	7.5
5.	2.2	68	0.11	129	5.5
6.	2.7	120	0.06	94	8.0
7.	2.3	34	0.00	80	0.0
8.	2.1	110	0.02	90	4.0
9.	3.1	278	0.03	139	9.5
10.	2.4	160	0.01	170	1.5
11.	1.9	166	0.07	112	7.5
12.	3.8	256	0.03	144	12.5
13.	3.8	74	0.01	120	9.5
14.	1.2	78	0.05	82	3.0
15.	1.1	76	0.07	73	7.5
16.	1.9	110	0.02	181	11.0
17.	3.6	62	0.12	86	5.0
18.	1.0	140	0.05	135	11.5
19.	1.7	64	0.04	83	9.5
20.	2.7	94	0.10	159	14.0
21.	8.0	28	0.07	95	11.5
22.	3.8	116	0.06	131	14.0
23.	2.1	168	0.05	75	14.0

All parameters expressed in mg/l except pH and EC; where EC in µS/cm, pH has no units

Table5: The analytical results showing quality of ground water in the study area

S.no	pH	Alkalinity	EC	TDS	TH	CaH	MaH	Na	k	Fe
24.	7.53	468	1168	759	628	202.00	30.13	78.0	8.8	0.00
25.	7.49	324	672	437	472	117.03	43.74	32.3	10.0	0.06
26.	7.41	396	1343	873	816	211.62	69.98	60.6	12.6	1.60
27.	7.38	376	759	493	588	113.83	73.87	33.2	4.8	1.40
28.	7.80	428	1139	740	652	147.49	69.01	80.4	5.6	0.00
29.	7.80	384	653	424	364	92.99	32.08	36.6	4.4	0.08
30.	7.29	504	1582	1028	848	190.78	90.40	90.0	11.0	0.22
31.	7.73	340	740	481	396	136.27	13.61	38.8	7.2	0.00
32.	7.41	360	896	582	500	131.46	41.80	37.0	4.8	0.22
33.	7.57	344	825	536	544	137.88	48.60	26.0	5.8	0.00
34.	7.80	440	1151	748	628	160.32	55.40	58.2	8.4	0.00
35.	7.36	520	1140	741	628	94.59	95.26	78.0	6.8	0.02
36.	7.59	408	1574	1023	888	169.94	112.75	81.6	6.0	0.24
37.	7.34	472	1546	1005	764	193.99	68.04	90.6	13.8	0.00
38.	7.00	336	931	605	648	177.96	49.57	58.8	5.2	0.06
39.	6.75	744	984	640	560	113.83	67.07	70.4	9.2	0.00
40.	7.00	616	1678	1091	964	184.37	122.47	97.6	13.0	0.24
41.	7.70	368	923	600	520	134.67	44.71	57.6	8.2	1.38
42.	7.77	432	853	554	452	121.84	35.96	34.4	7.4	0.00
43.	6.56	452	850	553	480	109.12	50.54	37.2	4.4	1.40
44.	6.37	492	962	625	572	144.29	51.52	60.0	4.2	0.00
45.	7.00	328	1054	685	548	141.08	47.63	78.4	4.8	1.00
46.	7.00	476	1309	851	876	211.62	84.56	36.0	6.6	0.02

All parameters expressed in mg/l except pH and EC; where EC in µS/cm, pH has no units

Table6: The analytical results showing quality of ground water in the study area

Sl.no	Turbidity(NTU)	Cl	F	SO4	NO3
24.	1.8	104	0.04	152	12.5
25.	3.1	44	0.01	54	3.0
26.	1.3	132	0.07	137	10.0
27.	2.3	38	0.06	83	9.5
28.	3.7	132	0.12	140	4.5
29.	2.1	10	0.14	54	9.5
30.	1.1	204	0.12	198	8.5
31.	0.8	42	0.10	111	13.5
32.	1.7	82	0.12	171	14.0
33.	1.5	22	0.06	154	1.5
34.	0.6	102	0.03	179	4.0
35.	1.4	36	0.01	208	9.5
36.	1.8	244	0.06	188	6.0
37.	2.0	246	0.03	144	12.5
38.	4.5	86	0.09	125	9.5
39.	2.0	106	0.06	91	7.0
40.	7.0	256	0.01	160	4.0
41.	3.0	92	0.03	164	3.0
42.	4.2	76	0.11	88	9.5
43.	2.0	50	0.08	147	11.5
44.	9.0	70	0.04	171	5.0
45.	7.0	172	0.02	77	0.5
46.	1.0	150	0.05	179	12.0

All parameters expressed in mg/l except pH and EC; where EC in µS/cm, pH has no units

3.1.4 Total Hardness (TH)

All out hardness is a proportion of the limit of water to the centralization of calcium and magnesium in water and is generally communicated as what might be compared to CaCO, focus. In the current review, the all out hardness of the water sample ranges somewhere in the range of 300 to 888mg/l.

3.1.3 Calcium Hardness (CaL) and Magnesium Hardness (MgH)

The vast majority of the geographical material springs are made out of calcium. It was introduced in groundwater as a material of suspension where calcium bicarbonate is the great reason for the hardness in water. The calcium and magnesium hardness values ranges between 40.08 to 211.62 and 15.55 to 122.47.

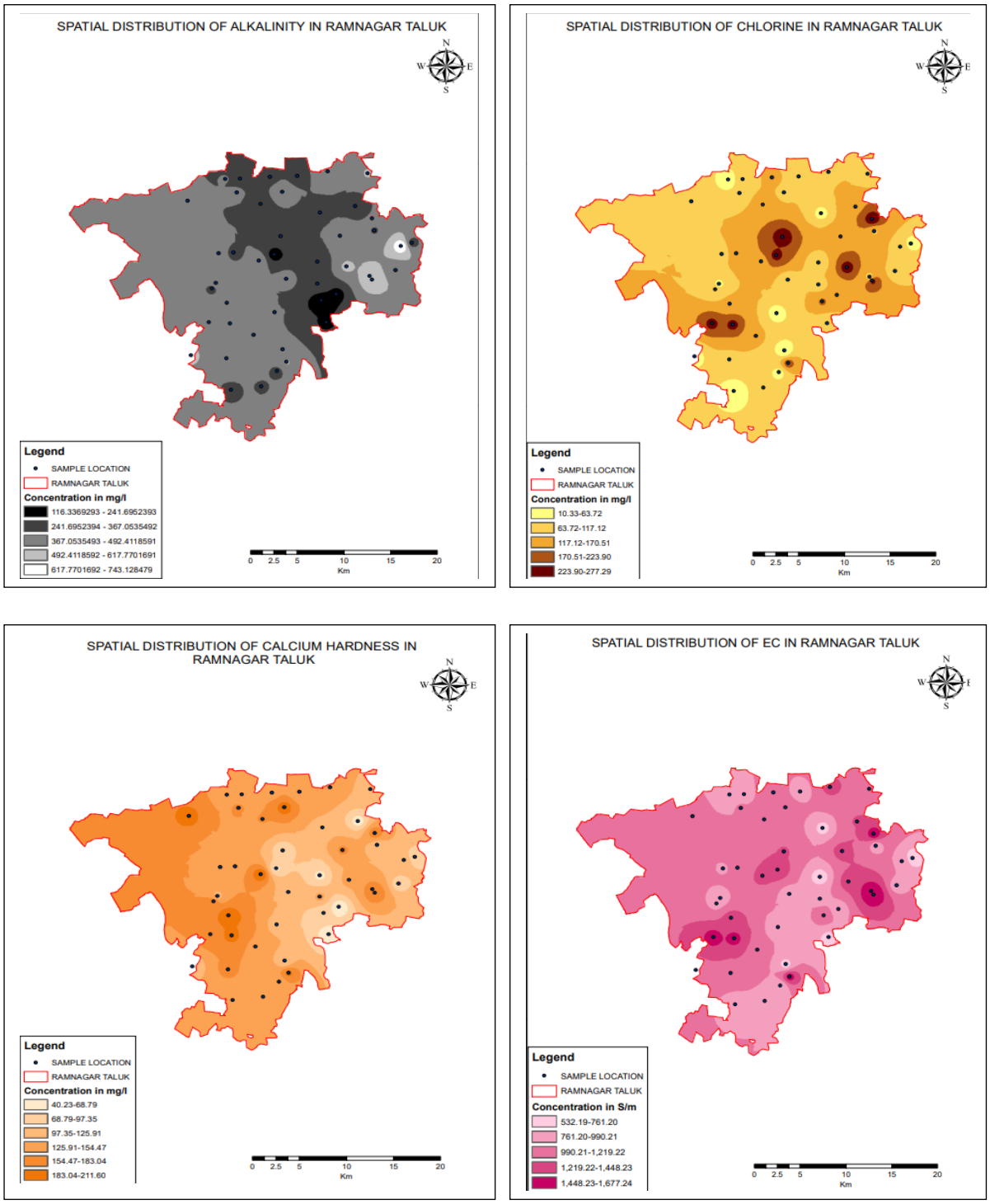
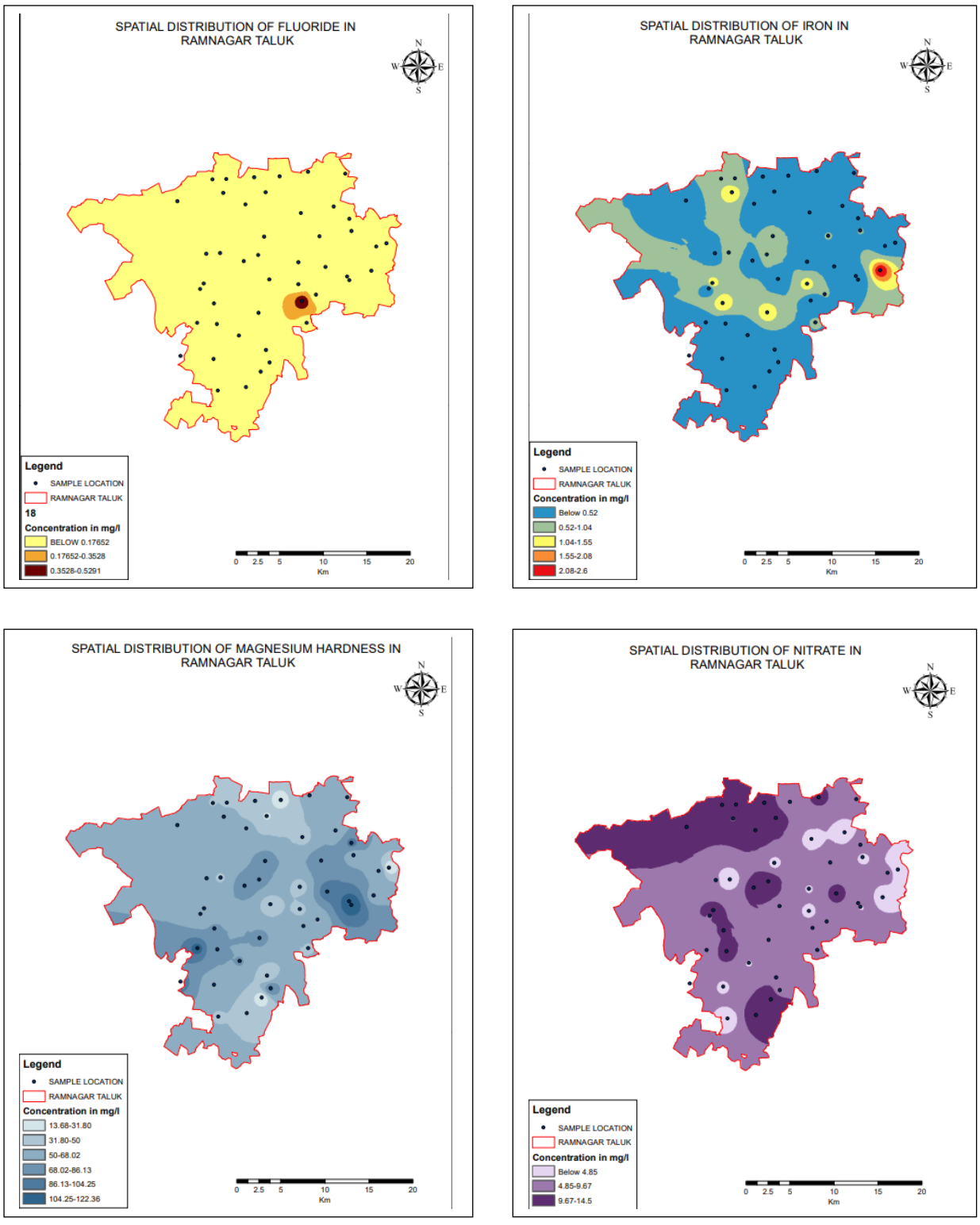


Figure3: Spatial distribution of ground water quality of the study area



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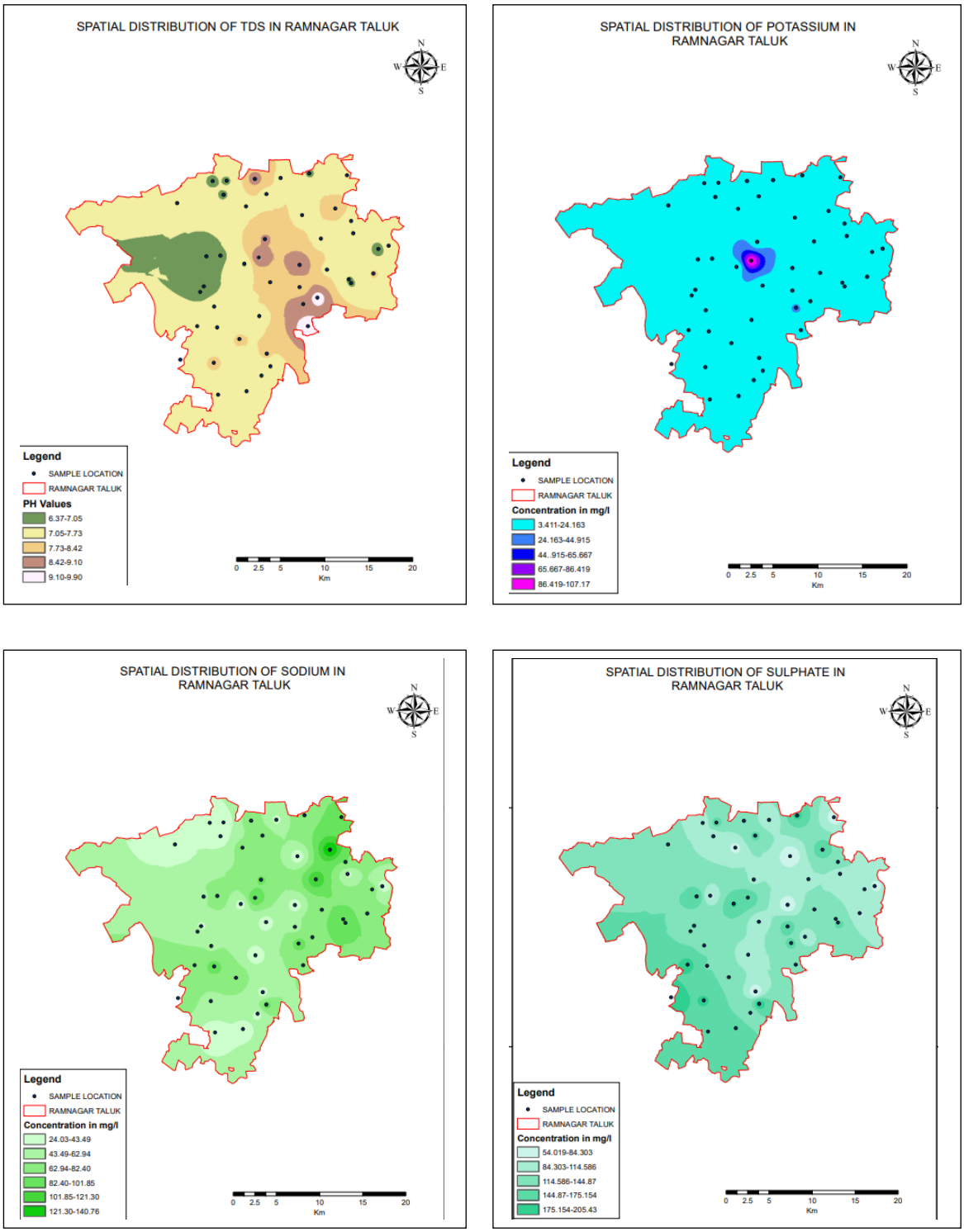

Figure3: Spatial distribution of ground water quality of the study area

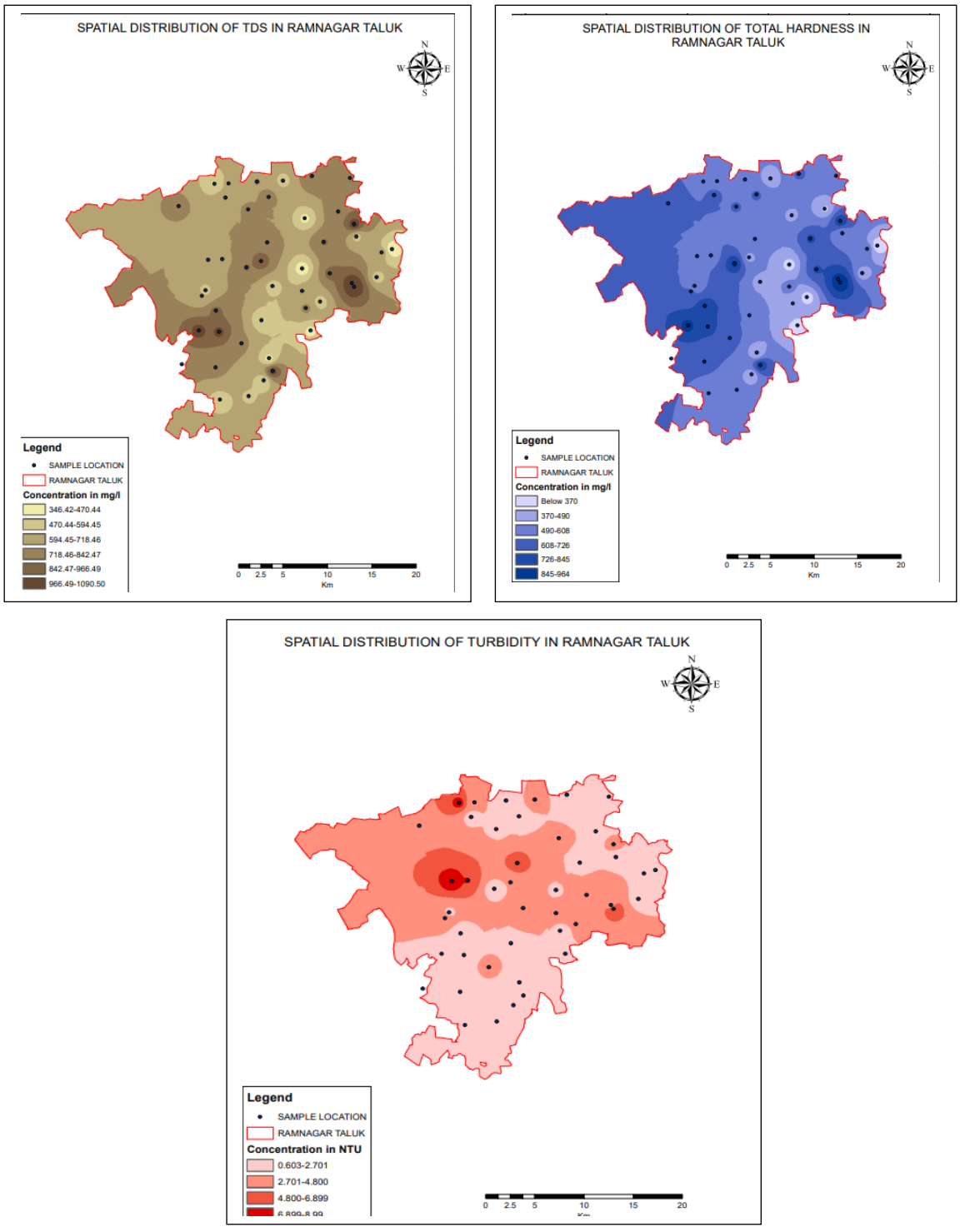

Figure3: Spatial distribution of ground water quality of the study area

3.1.5 Sodium (Na)

Higher upsides of sodium are found in the groundwater in the space of saline water interruption. Release of effluents like homegrown and modern and so on onto the ground is one more wellspring of sodium in water. Overall sodium salts are not really harmful substances to people due to the effectiveness with which mature kidneys discharge sodium. The mean upsides of sodium are shifted from 32.6 to 140.6mg/l

3.1.6 Potassium (K)

Potassium is somewhat more uncommon than sodium in volcanic rocks, yet more bountiful in every one of the sedimentary rocks. Potassium is a fundamental component for plants and creatures. The components present in plant material and are lost from horticultural soil by crop reaping and expulsion as well as filtering and spillover on natural buildups. Potassium changes in the review region from 4.0 to 107.2

3.1.7 Iron (Fe)

Iron is organically a significant component which is vital for all living beings and present in hemoglobin framework. Iron high fixation causes slight harmfulness. The outcomes showed that the groupings of iron during the winter season falls within the permissible limits of the study area

3.1.8 Sulphates (SO)

The sulphate concentrations are varied from 54 to 188 mg/l From the tables it can be observed that all the samples having sulphates value below 200 mg/l fall within the limits.

3.1.9 Chlorides (CI)

Chloride fixations fluctuate generally in normal water and it straightforwardly connected with mineral substance of the water. It is realized that the ocean water interruption is showing unusual centralization of chloride. In consumable water, the salt taste is created by chloride focuses. At focuses over 250 mg/l, water procures pungent taste which is frightful to many individuals. Department of Indian Standards recommends 250 mg/l as admissible cutoff and 1000 mg/l as helpful breaking point without any substitute source. The chloride focus in the review region is under 250 mg/l which permissible limit.

3.1.10 Fluorides (F)

Fluoride is fundamental for individuals as a minor component and higher centralization of this component causes harmful impacts. Grouping of fluoride between 0.6 to 1.0 mg/l in consumable water safeguards tooth rot and upgrades bone turn of events. Department of Indian Standards has proposed allowable restriction of fluoride in drinking water at 1.0 mg/l and resilience range is upto 1.5 mg/l. Ingestion of water with fluoride fixation above 1.5 mg/l outcomes in fluorosis, dental mottling and bone sicknesses. In the review region, fluoride ranges somewhere in the range of 0.02 and 0.12 mg/l

3.2.1 WQI Index an

Paramaters	**Sn**	**1/Sn**	**∑1/Sn**	**K=1/(∑1/Sn)**	**Wi=K/Sn**	**Vo**	**Vn**	**Vn/Sn**	**((Vn-Vo)/(Sn-Vo))*100=Qn**	**Wn*Qn**
pH	8.5	0.11764706	4.514203	0.22152307	0.026062	7	7.635	0.898235	42.33	1.103185
Turbidity	5	0.2	4.514203	0.22152307	0.044305	0	2.84	0.568	56.8	2.516502
EC	300	0.00333333	4.514203	0.22152307	0.000738	0	1073.91	3.5797	357.97	0.264329
TDS	500	0.002	4.514203	0.22152307	0.000443	0	698	1.396	139.6	0.061849
HCO_3^-	200	0.005	4.514203	0.22152307	0.001108	0	387	1.935	193.5	0.214324
Cl	250	0.004	4.514203	0.22152307	0.000886	0	118.522	0.474088	47.4088	0.042009
TH	300	0.00333333	4.514203	0.22152307	0.000738	0	577.65	1.9255	192.55	0.142181
Ca^{2+}	75	0.01333333	4.514203	0.22152307	0.002954	0	132.27	1.7636	176.36	0.520904
Mg^{2+}	30	0.03333333	4.514203	0.22152307	0.007384	0	60.18	2.006	200.6	1.481251
Na	200	0.005	4.514203	0.22152307	0.001108	0	63.7	0.3185	31.85	0.035278
K	10	0.1	4.514203	0.22152307	0.022152	0	10.7	1.07	107	2.370297
F^-	1.5	0.66666667	4.514203	0.22152307	0.147682	0	0.07	0.046667	4.666666667	0.689183
SO_4^{2-}	200	0.005	4.514203	0.22152307	0.001108	0	127	0.635	63.5	0.070334
NO^{3-}	45	0.02222222	4.514203	0.22152307	0.004923	0	8	0.177778	17.77777778	0.087515
Fe	0.3	3.33333333	4.514203	0.22152307	0.73841	0	0.42	1.4	140	103.3774
		4.51420261			1					**112.9766**

Table 7 : WQI Analysis data result Analysis

Conclusion:

- Ec, TDS, Cl, Bi-Carbonate, F, Sulphate, where within the limit as per IS-10500 2015 (Reaffirmed 2018)
- The Ph, TH, Fe, Mg, k, Ca, Na, Turbidity, where not in the permissible range.
- Overall WQI 112.97 Result obtained hence its comes under very poor quality.
- Iso-contour maps are prepared for all the quality parameter by using GIS software and spatial variation is analyzed.
- All out hardness is a proportion of the limit of water to the centralization of calcium and magnesium in water and is generally communicated as what might be compared to CaCO, focus. In the current review, the all out hardness of the water sample ranges somewhere in the range of 300 to 888mg/l.
- **Sodium (Na**Higher upsides of sodium are found in the groundwater in the space of saline water interruption. Release of effluents like homegrown and modern and so on onto the ground is one more wellspring of sodium in water. Overall sodium salts are not really harmful substances to people due to the effectiveness with which mature kidneys discharge sodium. The mean upsides of sodium are shifted from 32.6 to 140.6mg/l
- **Potassium (K**Potassium is somewhat more uncommon than sodium in volcanic rocks, yet more bountiful in every one of the sedimentary rocks. Potassium is a fundamental component for plants and creatures. The components present in plant material and are lost from horticultural soil by crop reaping and expulsion as well as filtering and spillover on natural buildups. Potassium changes in the review region from 4.0 to 107.2
- **Iron (Fe)** Iron is organically a significant component which is vital for all living beings and present in hemoglobin framework. Iron high fixation causes slight harmfulness. The outcomes showed that the groupings of iron during the winter season falls within the permissible limits of the study area
- **Sulphates (SO)**The sulphate concentrations are varied from 54 to 188 mg/l From the tables it can be observed that all the samples having sulphates value below 200 mg/l fall within the limits.
- **Chlorides (CI)**Chloride fixations fluctuate generally in normal water and it straightforwardly connected with mineral substance of the water. It is realized that the ocean water interruption is showing unusual centralization of chloride. In consumable water, the salt taste is created by chloride focuses. At focuses over 250 mg/l, water procures pungent taste which is frightful to many individuals. Department of Indian Standards recommends 250 mg/l as admissible cutoff and 1000 mg/l as helpful breaking point without any substitute source. The chloride focus in the review region is under 250 mg/l which permissible limit.

- **Fluorides (F)**Fluoride is fundamental for individuals as a minor component and higher centralization of this component causes harmful impacts. Grouping of fluoride between 0.6 to 1.0 mg/l in consumable water safeguards tooth rot and upgrades bone turn of events. Department of Indian Standards has proposed allowable restriction of fluoride in drinking water at 1.0 mg/l and resilience range is upto 1.5 mg/l. Ingestion of water with fluoride fixation above 1.5 mg/l outcomes in fluorosis, dental mottling and bone sicknesses. In the review region, fluoride ranges somewhere in the range of 0.02 and 0.12 mg/l
- **Calcium Hardness (CaL) and Magnesium Hardness (MgH)**The vast majority of the geographical material springs are made out of calcium. It was introduced in groundwater as a material of suspension where calcium bicarbonate is the great reason for the hardness in water. The calcium and magnesium hardness values ranges between 40.08 to 211.62 and 15.55 to 122.47.

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