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GROUNDWATER QUALITY ASSESSMENT IN KANCHIPURAM DISTRICT, TAMIL NADU

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Abstract: **Groundwater is widely distributed than surface water and is used for domestic, industrial and agricultural purpose throughout the world. More than 95% of rural population depends on ground water for all needs. The present study was carried out on Groundwater quality Assessment of Kanchipuram district in Tamil Nadu, India. A total of 43 ground water samples were collected in the study area. The groundwater quality assessment has been carried out for pH, EC, TH, TDS, Ca, Mg, Na, K, HCO3, Cl, SO4, NO3, and F. The spatial variations of physio- chemical properties of water were plotted using GIS (Geographical Information Systems). The quality of water is evaluated using Piper and Wilcox Diagram. The results will give the clear cut information about the Groundwater Quality of the study area.**

Keywords: **physio-chemical, water quality, GIS, Piper diagram, Wilcox.**

1. INTRODUCTION

Water has become a scarce resource. All the water resources of earth can be classified as surface water and ground water. The total volume of ground water is only 0.65% of the total water availability of the globe. Ground water is the main source for the drinking, domestic and agriculture. The population explosion and the resultant needs could not be satisfied with available surface water resources. Further, due to various anthropogenic activities, the surface water resources too substantially prone for pollution. The purpose of this study is to understand of the chemical reaction between ground water and its observed chemical character. Ground water is not pure. It usually contains some amount of dissolved minerals ions. The amount of ions concentration and the type of ion will determine the usage of the water for various purposes. The geo-chemical study of the ground water is important with respect to the water use. This study gives better understanding about the quality water and development process taking place in the area. This can also provide information about the limits of total development or permit planning for appropriate treatment that may be required as the results of future changes in the quality of water supply.

2. STUDY AREA

Kanchipuram is a city in the i state of Tamil Nadu. It is one of the administrative head quarters of Kanchipuram district. The Kanchipuram is sub – divided into two divisions-big kanchi also called Shiva Kanchi. Which occupies the wastern portion of the city, and the little Kanchi, also called Vishnu Kanchi is located on the eastern fringes of the city. The city is a pilgrimage site for both Saivities and Vaishnavites. Kanchipuram is located on the banks of "Vegavathy" River. A tributary of the Palar River it lies between 12'14'15'' and 13'03'00'' Northern latitudes and 79'13'00'' and 80'16'00'' Eastern Longitudes. The city covers an area of 11.6 km2 (4.5 sq. mi) and has an average elevation of 83.2 m (273 ft) above mean sea level. In such case obviously, the quality and quantity of water resources are getting reduced. Show the study area. (Map.No.1)

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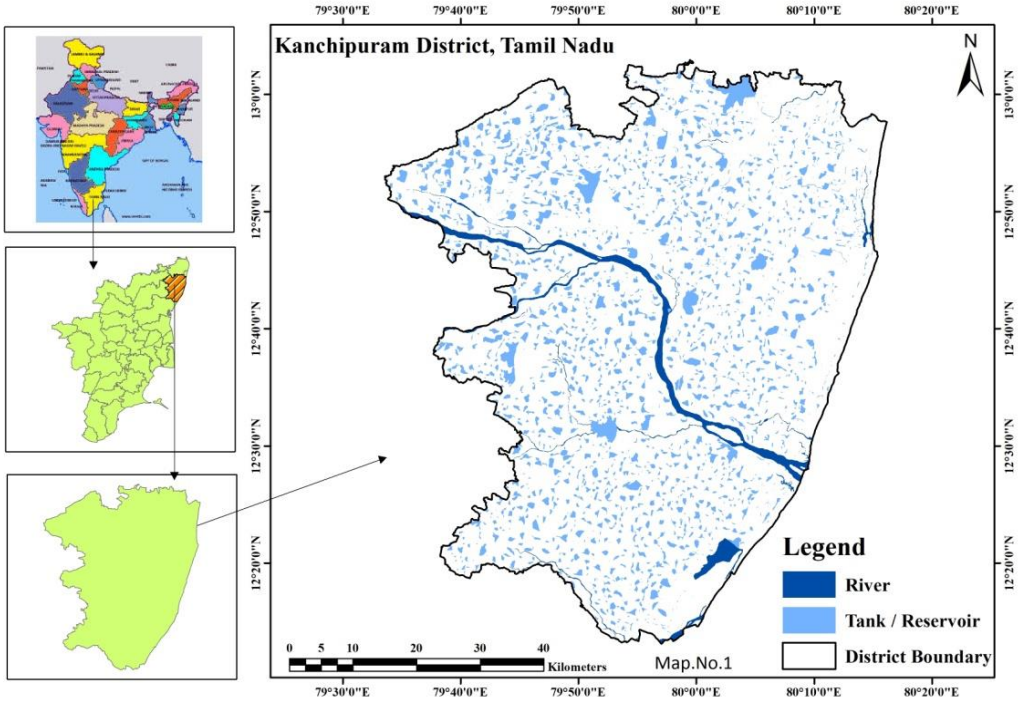

3. MATERIALS AND METHODS

The water samples have been collected from 43 Samples in Kanchipuram District for the year 2015. For the physio-chemical analysis of the water samples, pH, EC, TH, TDS, Ca, Mg, Na, K, HCO3, Cl, SO4, NO3, and F have been taken the Spatial variation of physio- chemical properties of water was plotted the map using GIS (Geographical Information Systems). The quality of water is evaluated using Piper and Wilcox Diagram. The results will give the clear cut information about the Groundwater Quality in the study area.

4. RESULTS AND DISCUSSION

Table -1 Water Quality Parameters for the Kanchipuram District-month of May 2015.

SAMPLE No.	PH	EC	TH	TDS	Ca	Mg	Na	K	HCO3	Cl	SO4	NO3	F
S1	7.6	2100	530	832	90	74	46	5	317	213	58	32	0.14
S2	7.2	1470	410	956	82	50	124	46	488	213	30	12	0.12
S3	7.6	420	155	273	30	19	25	6	110	53	19	37	0.14
S4	7.4	1780	675	1157	92	108	92	16	182	266	107	31	0.12
S5	7.2	1890	525	1229	54	95	179	20	116	496	29	118	0.12
S6	7.4	1440	530	936	90	74	85	11	305	284	58	39	0.12
S7	7.6	2000	300	1300	18	62	350	1	622	234	192	18	0.41
S8	7.5	1580	550	1027	46	106	110	3	488	248	29	25	0.12
S9	7.5	760	250	494	52	29	58	7	183	106	72	12	0.15
S10	7.6	1200	335	780	66	41	129	1	244	248	29	21	0.42
S11	7.6	170	60	111	18	4	12	2	43	25	10	6	0.17
S12	7.6	1350	400	876	34	77	122	1	366	213	24	42	0.15
S13	7.4	4000	190	2600	18	35	920	1	1410	674	62	19	0.04
S14	7.5	2000	390	1300	110	28	306	1	415	390	144	31	0.18
S15	7.5	1610	460	1047	52	80	161	1	305	308	62	50	0.14
S16	7.8	820	295	533	42	46	46	7	238	142	24	7	0.10
S17	7.3	1760	290	1144	34	50	253	25	513	284	29	19	0.41
S18	7.4	1610	400	1047	38	74	104	1	305	177	84	42	0.17
S19	7.7	1180	400	767	120	24	83	8	305	216	24	19	0.15

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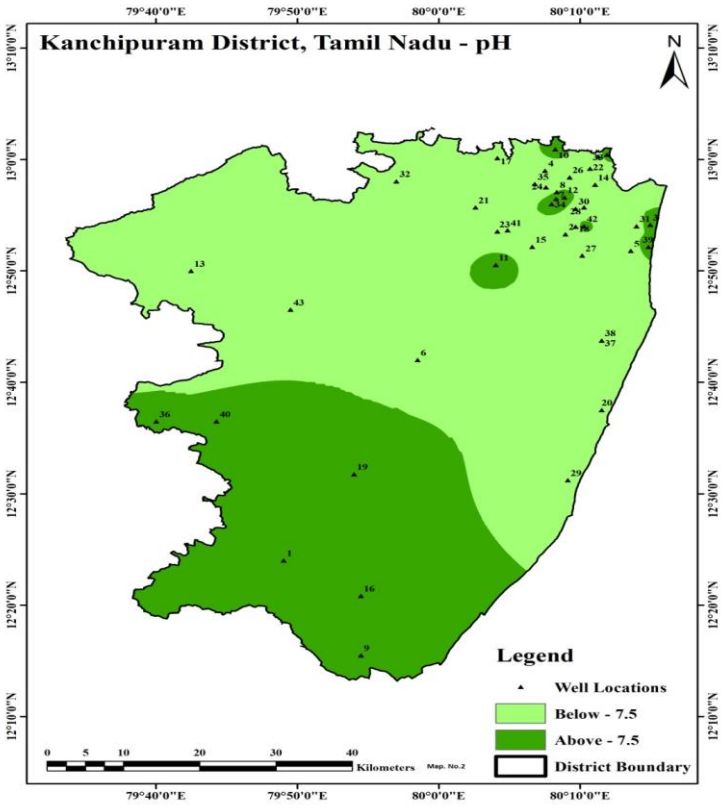
S20	7.4	370	115	241	26	12	30	5	79	71	24	25	0.15
S21	7.2	1450	225	943	30	36	214	27	610	106	24	22	0.37
S22	7.3	1050	235	683	32	38	123	1	305	177	19	8	0.42
S23	7.3	1500	315	975	58	41	184	15	306	284	5	36	0.42
S24	7.3	2100	205	1365	20	38	403	4	439	291	288	11	0.43
S25	7.4	1280	255	1279	28	45	166	21	366	195	38	21	0.39
S26	7.4	1820	515	1819	90	70	184	1	317	393	72	31	0.40
S27	7.4	1550	455	1549	50	80	161	2	427	284	58	31	0.42
S28	7.2	1380	315	1379	40	52	166	5	305	248	58	20	0.41
S29	7.3	1890	600	1889	200	24	145	26	671	248	38	29	0.14
S30	7.5	1400	440	1399	24	92	127	1	409	213	58	25	0.24
S31	7.4	1490	410	1489	50	69	140	22	336	277	72	23	0.10
S32	7.3	5300	640	3445	150	64	920	8	336	1585	120	0	0.08
S33	7.6	1560	370	1014	44	63	184	1	207	323	96	50	0.38
S34	7.6	1120	250	728	20	49	138	2	305	142	77	31	0.41
S35	7.4	1340	435	871	100	45	83	40	397	213	24	25	0.40
S36	7.5	890	200	579	60	12	104	23	305	106	38	37	0.13
S37	7.5	2500	700	1625	60	134	230	6	409	564	67	66	0.10
S38	7.5	2300	700	1495	60	134	230	6	409	546	67	19	0.10
S39	7.7	470	100	306	30	6	60	4	122	64	34	9	0.12
S40	7.5	6300	1120	4095	120	199	1104	9	281	1560	1008	74	0.13
S41	7.5	1570	215	1021	28	35	253	16	488	252	34	19	0.14
S42	7.6	2000	375	1300	74	46	285	36	397	461	48	37	0.40
S43	7.5	1070	375	696	60	55	69	11	366	142	34	6	1.53

4.1. pH

pH is one of the important parameters of water and determines the acidic and alkaline nature of water. The pH value of water ranges between 7.2 -7.8. The pH of the samples are within the prescribed standards for drinking water. The spatial variation map prepared for pH shows a slight increase towards southern portion of district. (Map. No.2)



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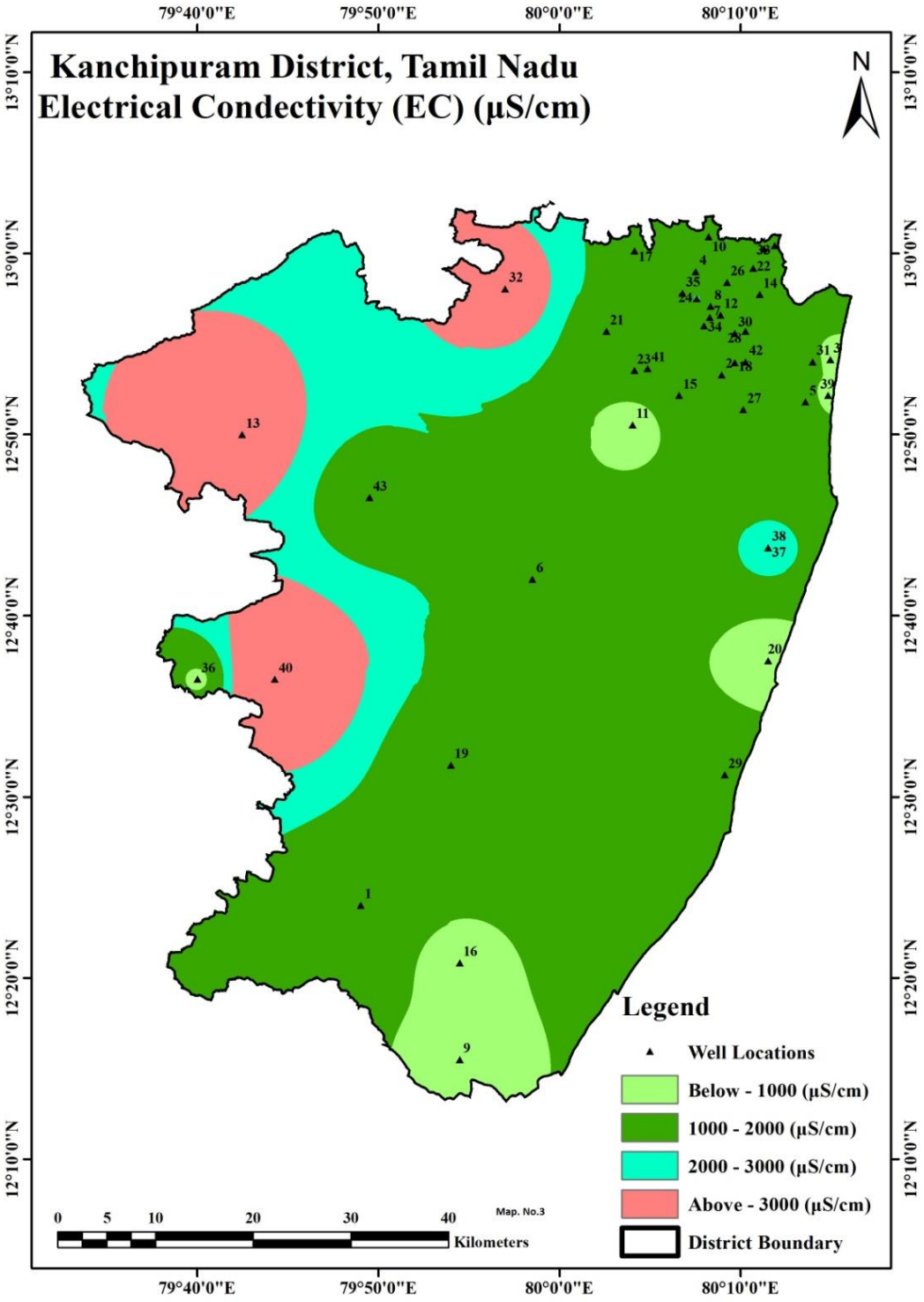
4.2 Electrical Conductivity (EC)

The salt concentration is generally measured by determining the electrical conductivity of water. The EC of water samples varies from 170 to 6300 (µS/cm. The spatial variation for electrical conductivity (EC) is presented in (Map. No 3). From the map it has been observed that very small portion of the study area falls below 1000 (µS/cm), the major portion of the study area is having EC within the limit of 1000-2000 (µS/cm) range and 2000-3000 (µS/cm) range of EC can be seen along the western fringe of the district. The result from sample well shows that the EC observed in the district, exceeding the WHO limit.



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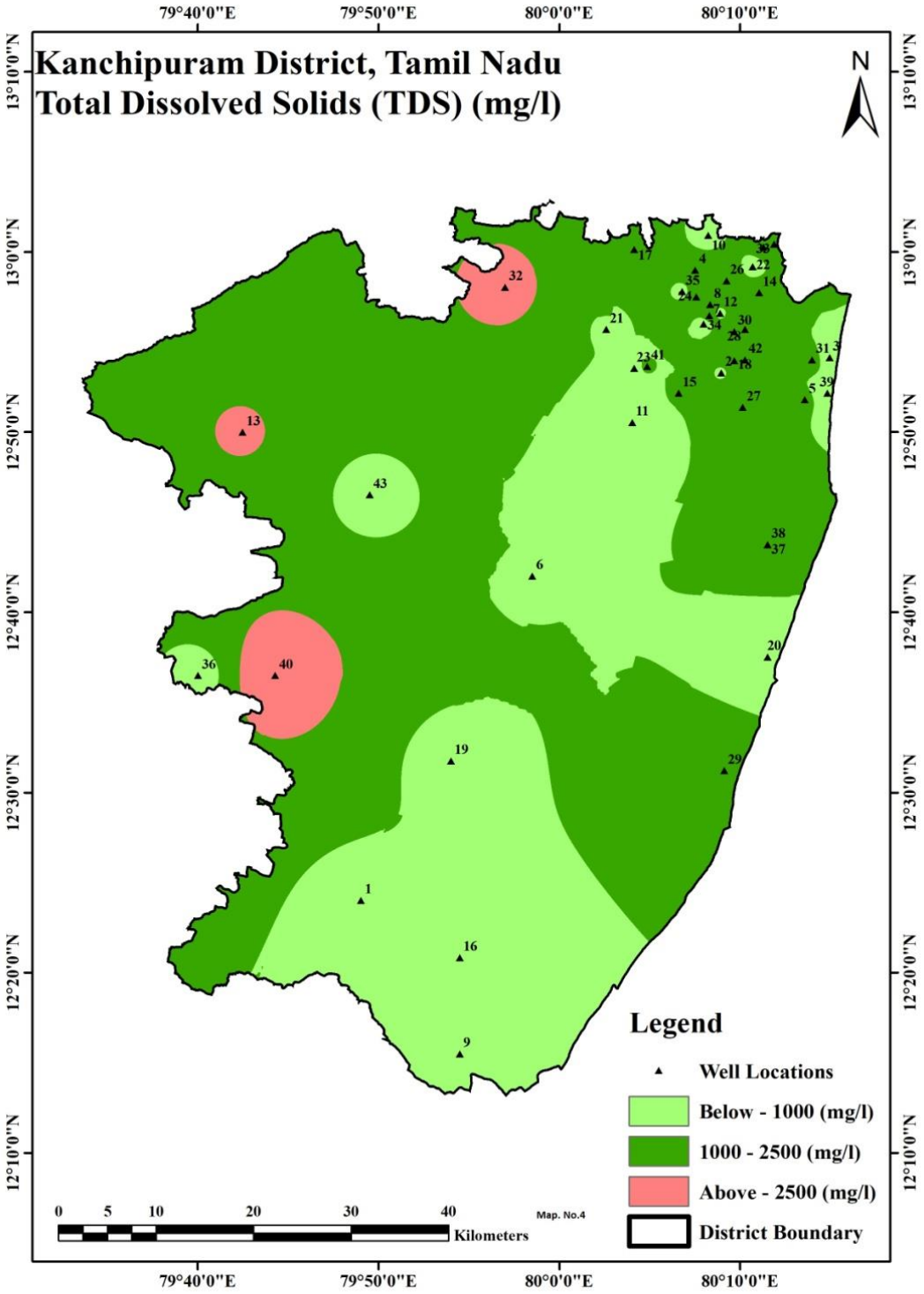
4.3 TOTAL DISSOLVED SOLIDS (TDS)

The weight of the residue consisting of pollutants (Dissolved ions) left behind after all the water from a water samples is evaporated is a measure of the TDS and gives the general nature of ground water quality and extent of contamination (Udhayalaxmi et.al. 2010). The Total Dissolved Solids (TDS) was classified into three ranges (0-1000 mg/l, 1000-2000 mg/l and > 2000 mg/l). The TDS of water samples are presented in (Map. No.4). from the map it has been observed that major portion of the study area is having very high TDS of (1000-2500 mg/l) and moderate range (below - 1000 mg/l), is observed in major portion of the district. And exceeds the standard limit of (1000 mg/l).



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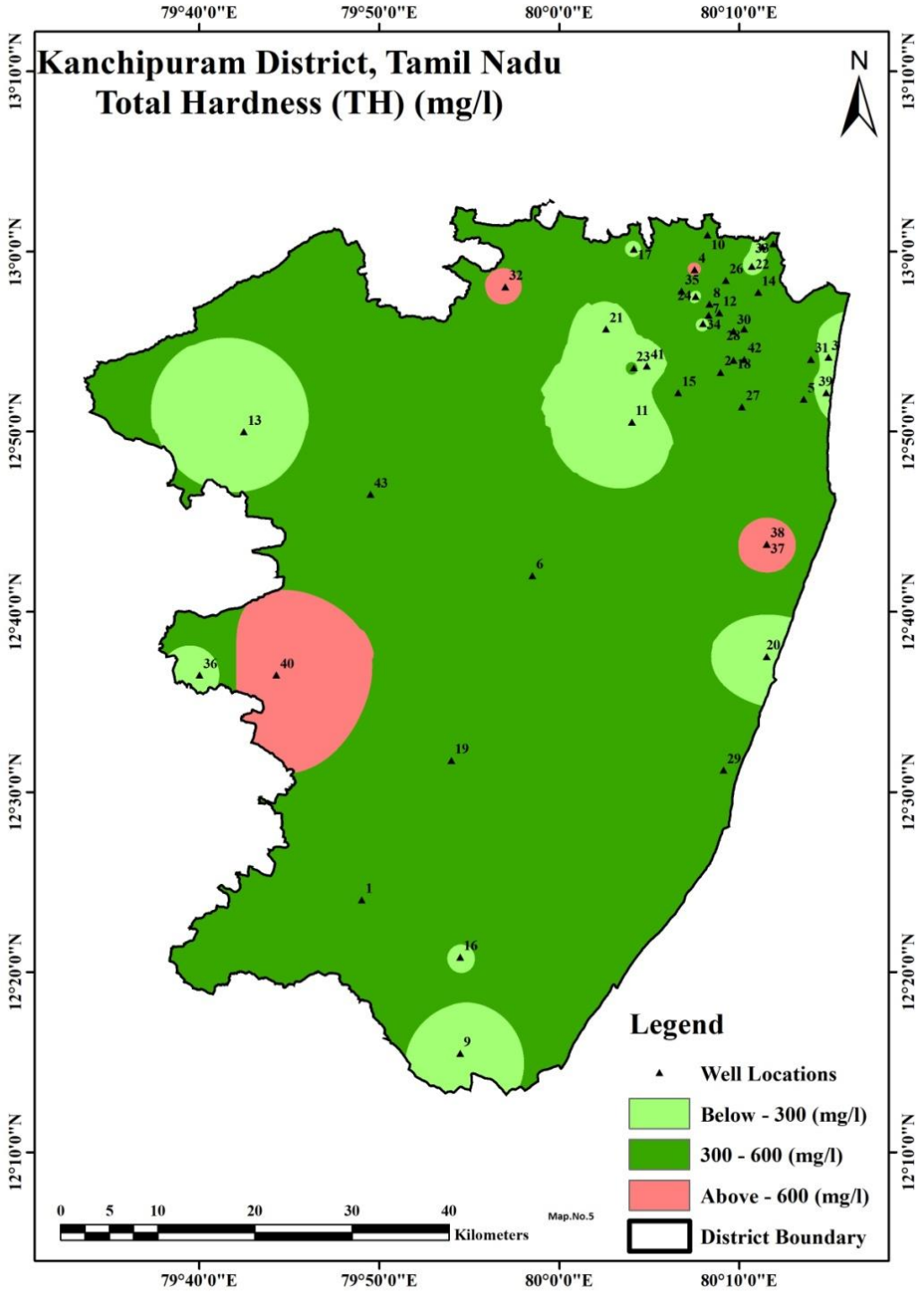
4.4 TOTAL HARDNESS (TH)

Total Hardness, an important property indicating the quality of ground water is mainly caused by calcium and magnesium cations and is defined as the sum of their concentrations expressed in mg/l. The Total Hardness was classified into three ranges (< 300 mg/l, 300-600 mg/l and >600 mg/l) and based on these ranges the spatial variation map for total hardness has been obtained and presented in (Map. No.5). Total Hardness (TH) of water samples ranges from 60-1120 mg/l in the study area. From the map it is observed that in larger areas, the Total Hardness is very high such as (300-600 mg/l) etc., TH also exceeds the WHO limit in the major parts of the district.



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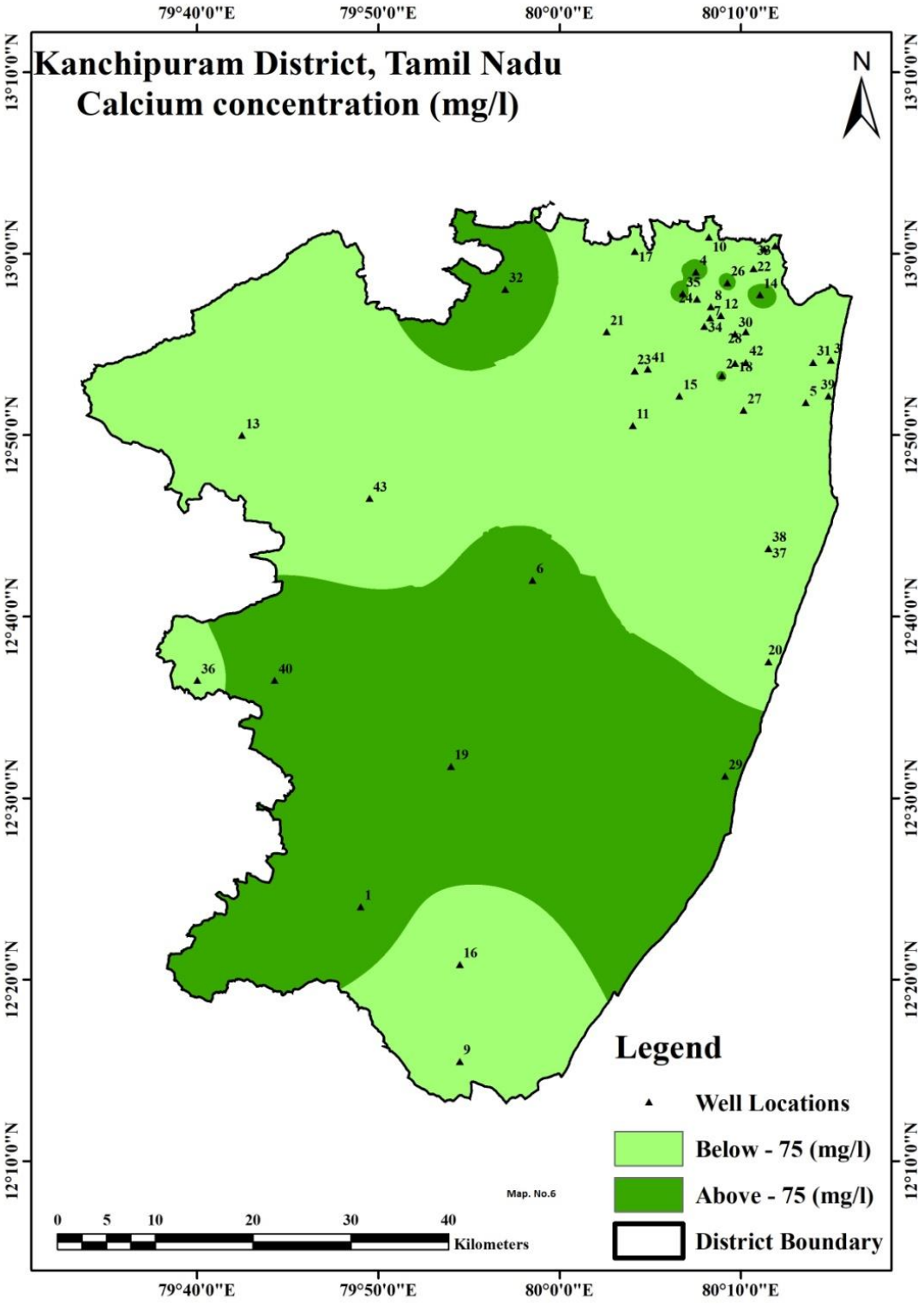
4.5 CALCIUM (Ca)

Calcium was classified into three ranges (< 75 mg/l, >75 mg/l) and based on these ranges the spatial variation map for calcium has been obtained and presented in (Map.No.6). Calcium of water samples ranges widely from 18-200 mg/l. This is shown in the spatial variation map, from the samples it is observed that the Calcium is within the limit few locations exceeding the WHO limit of (75 mg/l).



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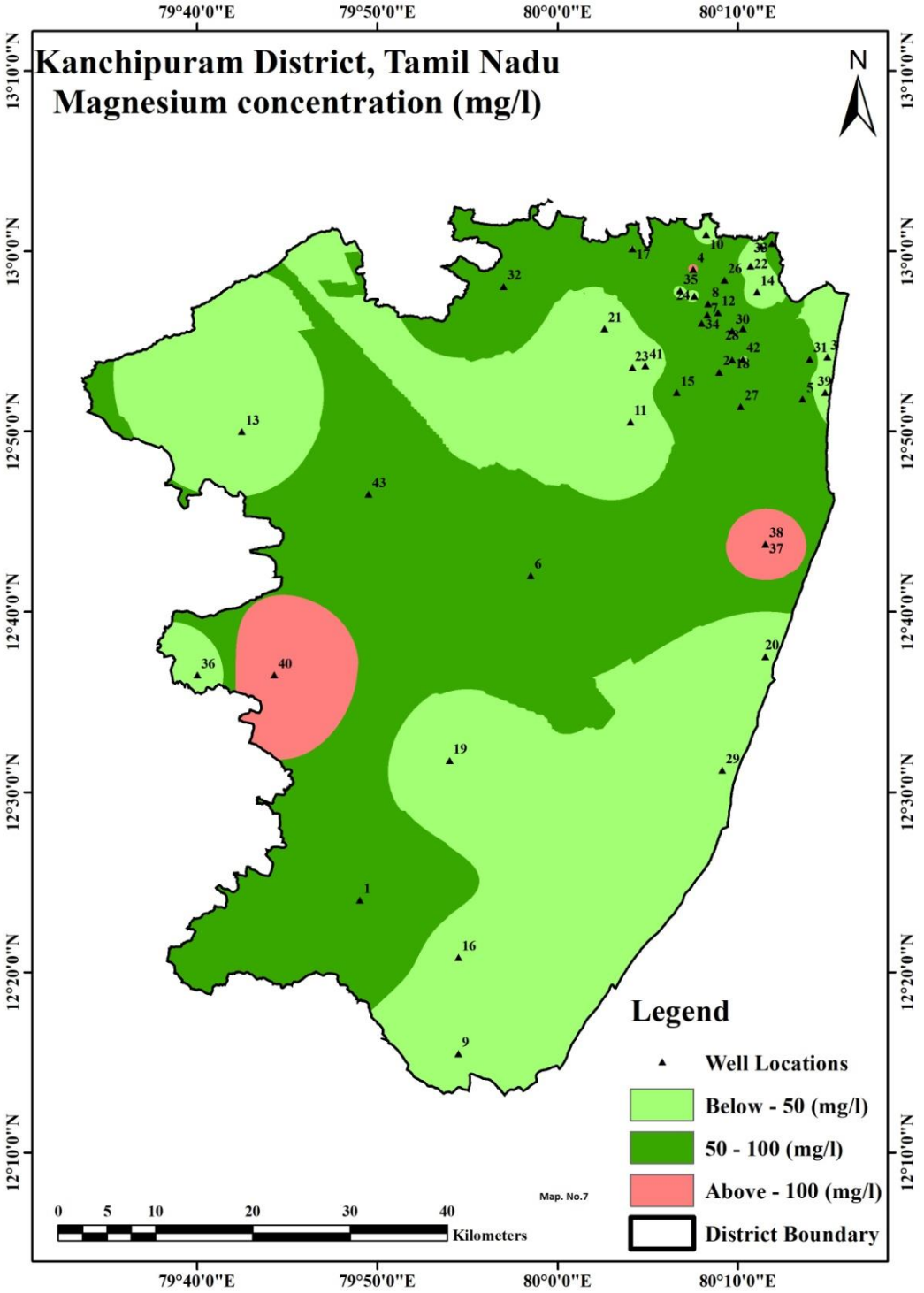
4.6 MAGNESIUM (Mg)

Magnesium also is one of the abundant elements in rocks. It causes hardness in water. Magnesium concentration in water samples ranges from 4-199 mg/l. From the spatial variation map, it is observed that some in part of the study area, the magnesium concentration is in the limit 50 (mg/l). The most part of the study area has 50-100 (mg/l) of Magnesium and moderate portion is having below 50 (mg/l). The map showing Magnesium concentration is presented in (Map. No 7).



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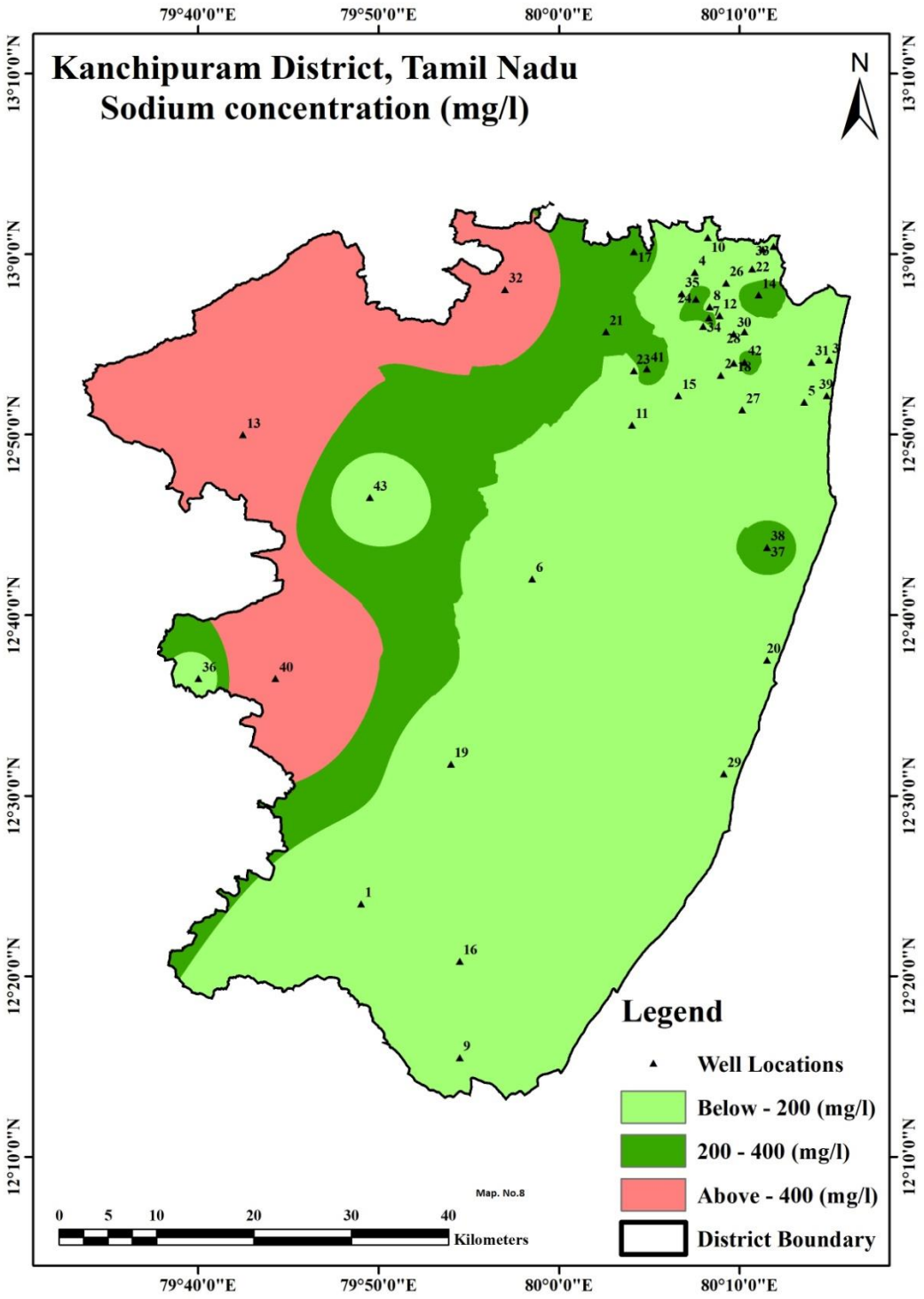
4.7 SODIUM (Na)

Sodium (Na) concentration of water samples ranges from 12-1104 mg/l. the spatial variation map for Sodium has been obtained and presented in (Map. No 8). From the spatial variation map, it is observed that most part of the study area is below 200 (mg/l) and moderate range 200-400 (mg/l) and only smaller portion is having above 400 (mg/l) higher concentration of the Sodium is seen in the eastern of the district.



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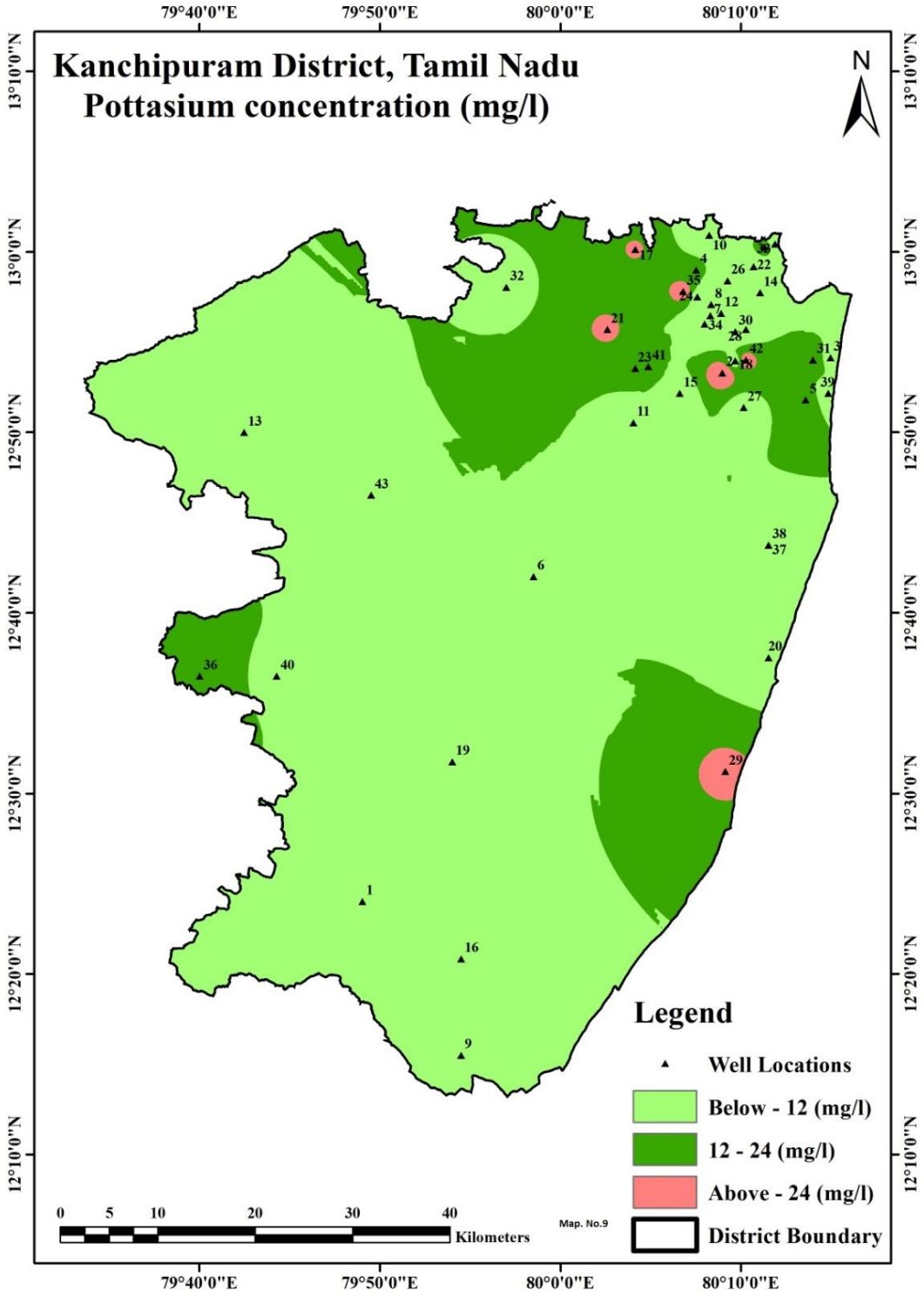
4.8 POTASSIUM (K)

Potassium (K) concentration of water samples ranges from 43-46 mg/l and the spatial variation map for Potassium has been obtained and presented in (Map. No.9). From the spatial variation map, it is observed that most part of the study area is in below 12 (mg/l) and moderate range 12-24 (mg/l) and only smaller portion is having above 24 (Mg/l), in the study area the concentration of potassium is within the limit of WHO.



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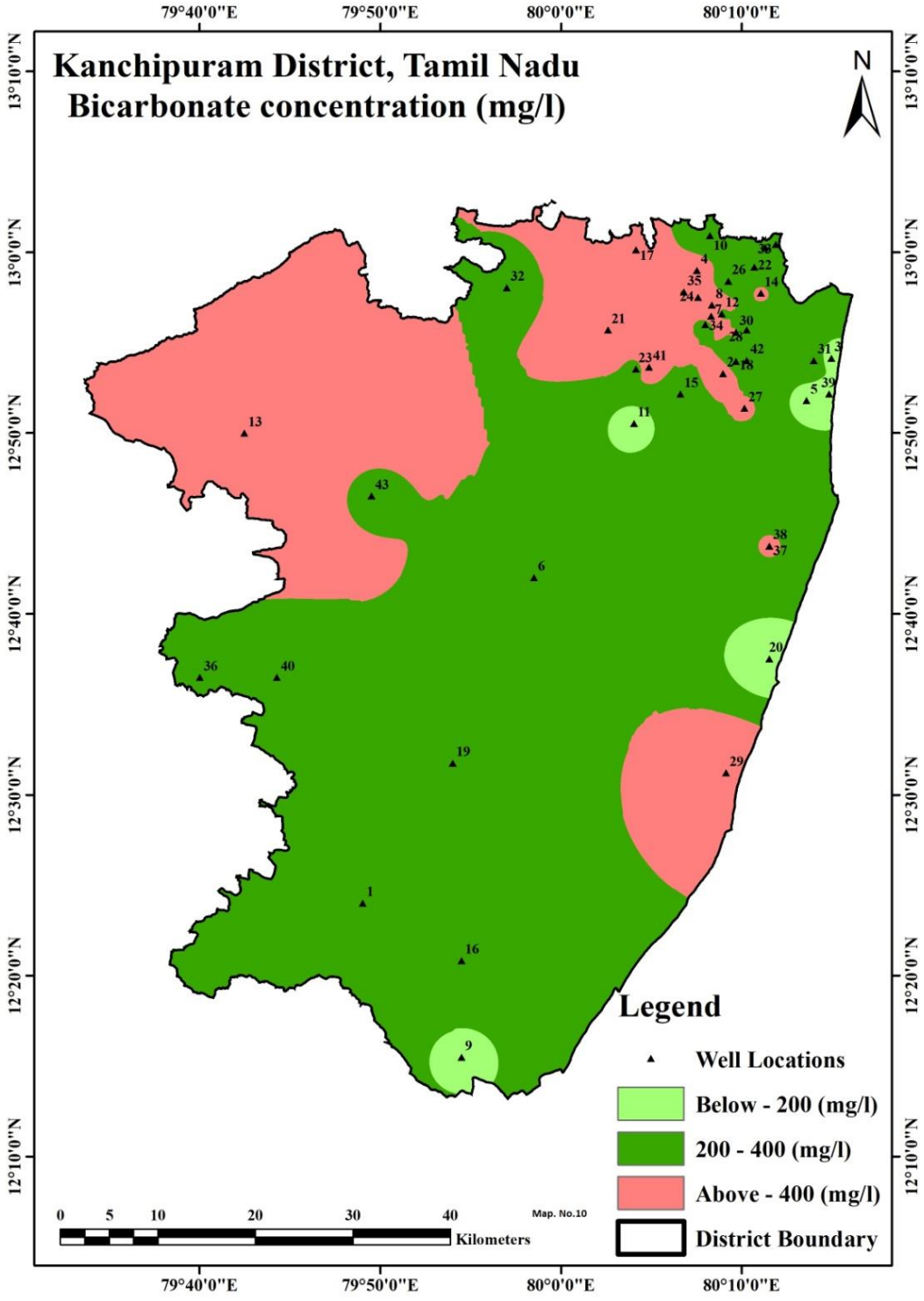
4.9 BICARBONATE (HCO3)

Bicarbonate (HCO3) concentration of water samples ranges from 43-1410 mg/l. the spatial variation map for Bicarbonate has been obtained and presented in (Map. No.10). From the spatial variation map, it is observed that most part of the study area lies in range of 200 - 400 (mg/l) which is beyond the limit smaller portion of area is having high range of HCO3 >400 (mg/l) range.



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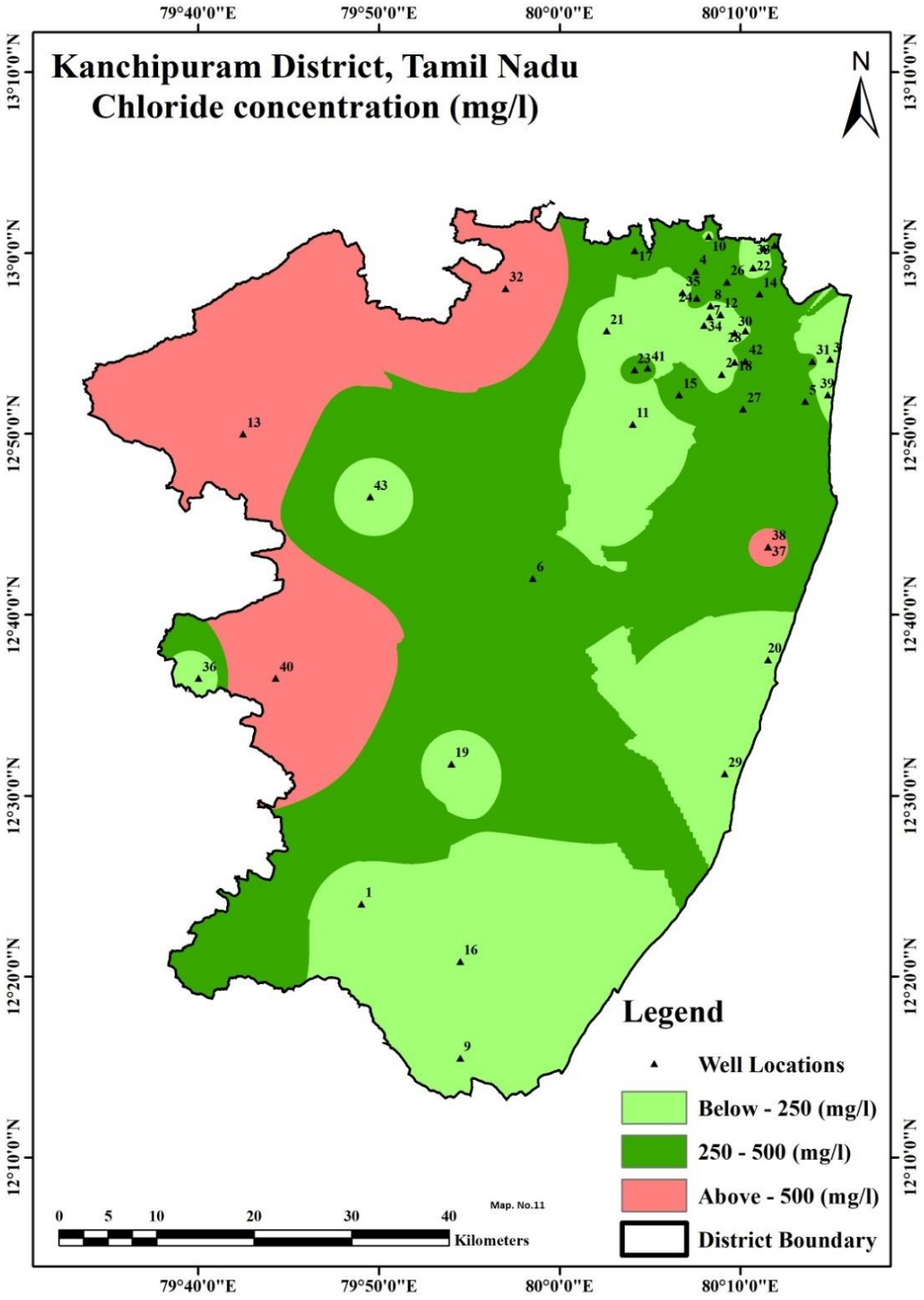
4.10 CHLORIDE (Cl)

Chloride (Cl) concentration of water samples ranges from 25-1585 mg/l. the spatial variation map for chloride has been obtained and presented in (Map No.11). From the spatial variation map, it is observed that most part of the study area is lies below the permissible limit < 250 (mg/l) and only certain areas having higher range of Chloride in the samples.



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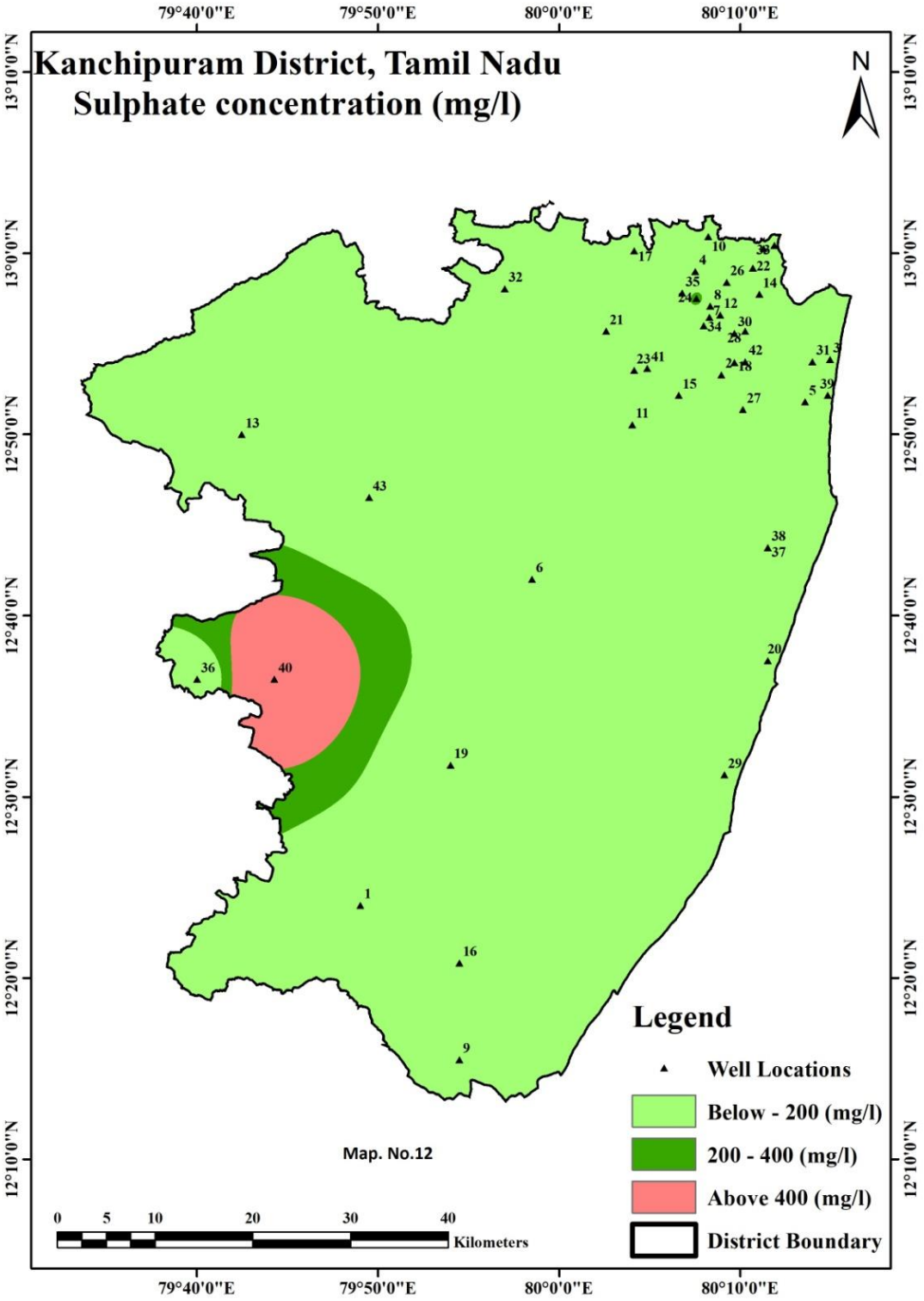
4.11 SULPHATES (SO4)

Concentration of Sulphates is classified into three ranges (< 200 mg/l, 200-400 mg/l, and 400 mg/l) and based on these ranges the spatial variation map for sulphates has been obtained and presented in (Map. No.12). Sulphate in water samples ranges from 5-1008 (mg/l). From the spatial variation map, it is observed that in most part of the study area, the sulphates value is within the limit below 200 (mg/l).



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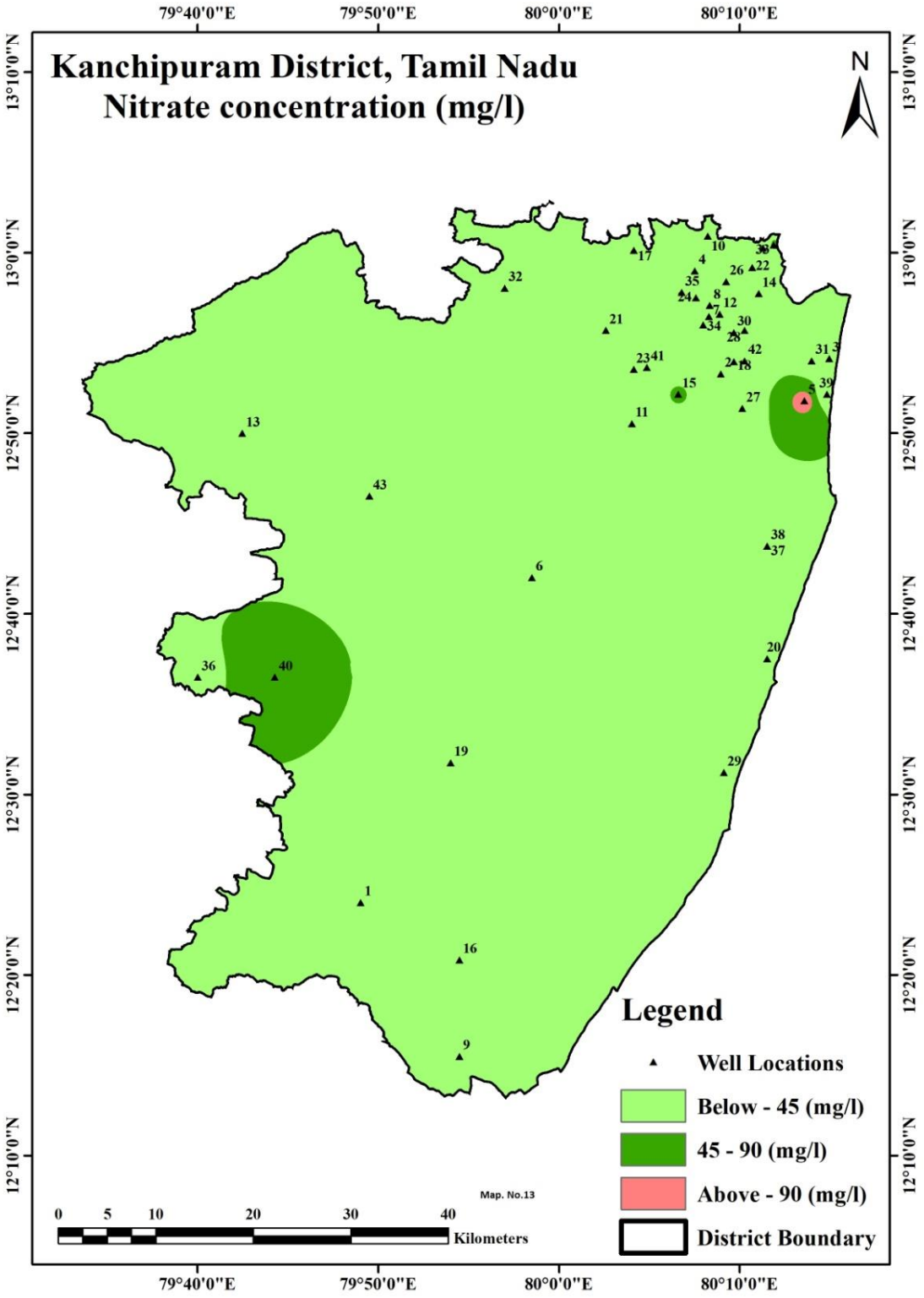
4.12 NITRATE (NO3)

Nitrate (NO3) concentration of water samples ranges from 6-108 mg/l. the spatial variation map for Nitrate has been obtained and presented in (Map.No.13). From the spatial variation map, it is observed that most part of the study area is in the below 45 (mg/l) within the permissible limit and only smaller area is having more than 45-(mg/l) beyond the permissible limit.



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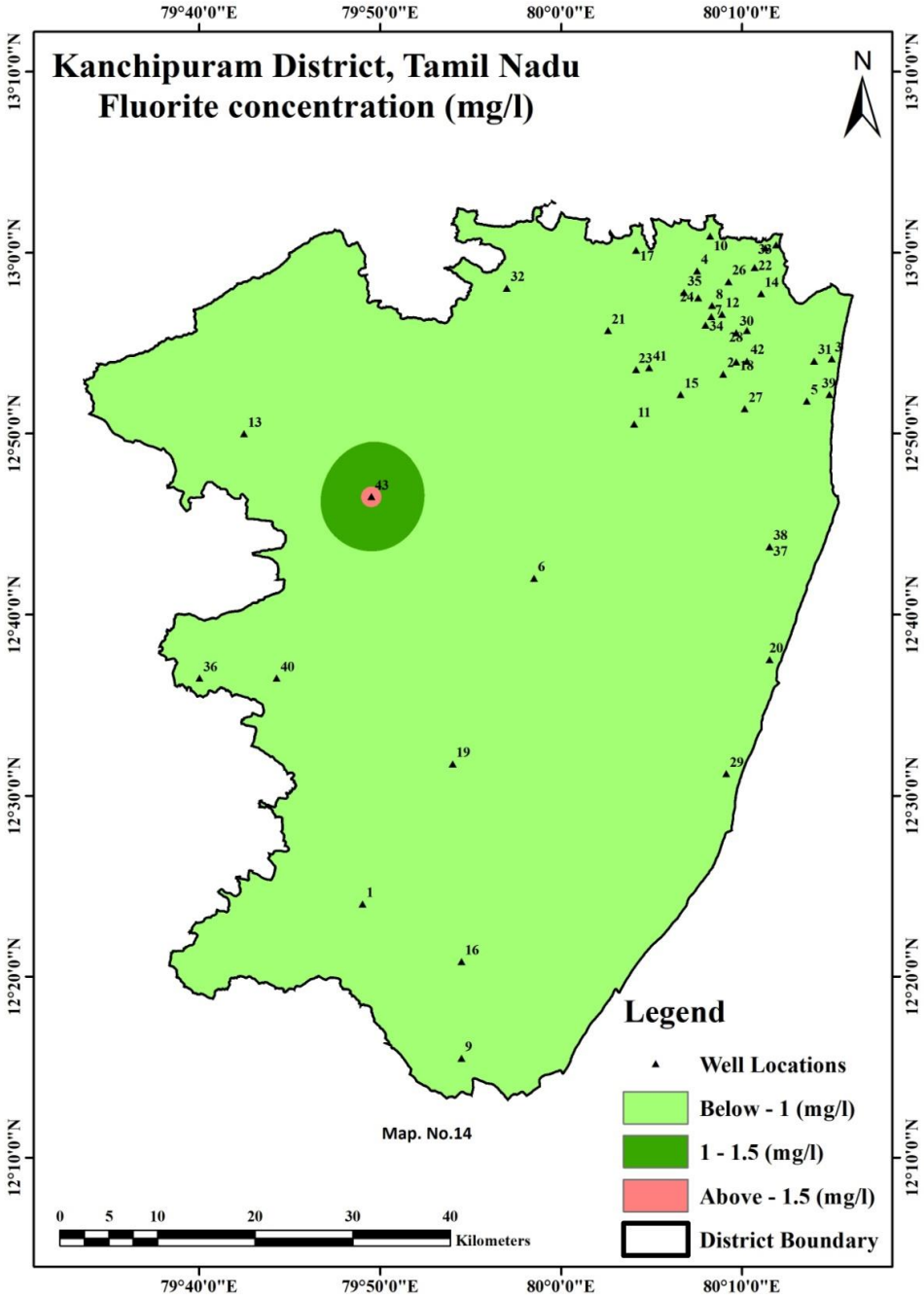
4.13 FLUORIDE (Fl)

Fluoride (Fl) Concentration in water samples ranges from 0.04-1.53 mg/l. The spatial variation map for Fluoride has been obtained and presented in (Map.No.14). From the spatial variation map, it is observed that most part of the study area is within the limit of 1.5 mg/l.



5. HYDROGEOCHEMICAL FACIES

The Hydrochemical evolution of groundwater can be understood by plotting the major cations and anions present in groundwater, over the Piper diagram. This diagram reveals similarities and differences among water samples because those with similar qualities will trend to plot together as group. This diagram is useful in bringing out chemical relationships among water in more definite terms. Major ions are plotted as cation and anion in percentages of mili-equivalents in two base triangles. Piper diagram is a graphical representation classifying water based on the dominant

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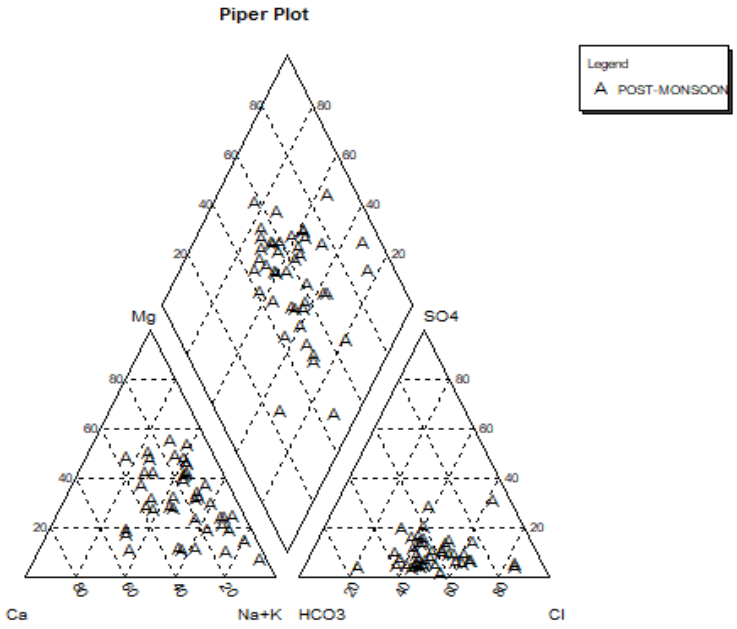
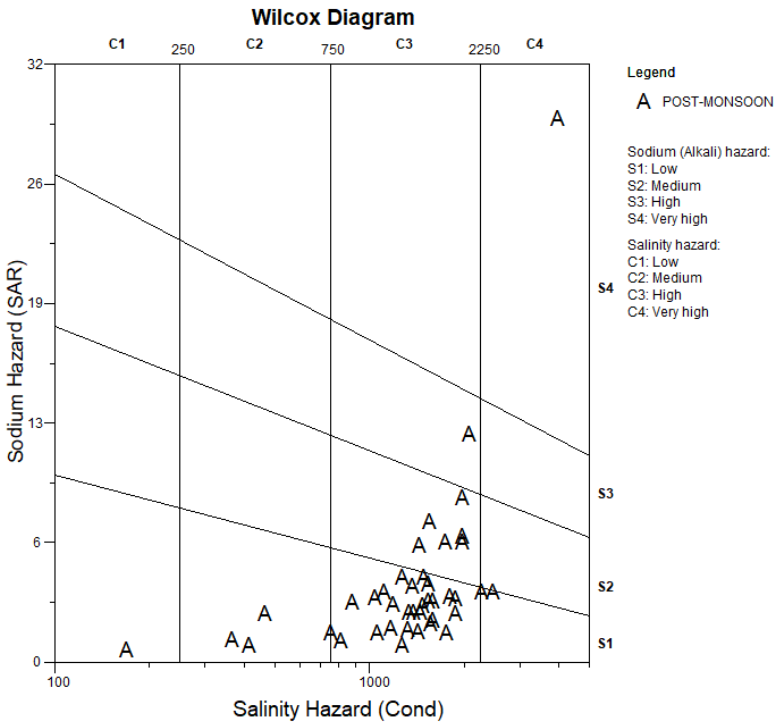
presence of cations and anions and has widespread use to assess the water type. Piper diagram can predict the water type in three ways- fresh type, sulfate type, and saline type. In (figure 1) it can be seen the water samples fall under (HCO3) the bicarbonate type during post monsoon groundwater in certain locations falls under the Ca-Mg-Cl-SO4 type as well.



Piper diagram figure 1.

5.1 WILCOX DIAGRAM

According to the sodium percent and specific conductance in evaluating the suitability of the water samples are varying from excellent the suitability of the water samples are varying from excellent to doubtful classes for irrigation. The results show that (figure 2), Sodium hazard concentration is in the S1- Low and S2 Medium range and Salinity hazards concentration is in the C3 High range.



Wilcox diagram figure 2.

6. CONCLUSION

The dependence on groundwater is increasing in many regions because of limited surface water as perennial rivers and frequent failure of monsoon. The ground water quality is equally important as that of quantity. Ground water continues to be exploited at ever increasing rates, especially in the rapidly expanding urban areas of country. The present study has been undertaken to analyze the spatial variation of major ground water quality parameters such as PH, EC, TDS, TH, Ca, Mg, Na, K, HCO3, NO3, SO4 and F using GIS approach. The groundwater quality of 43 randomly distributed in Kanchipuram district, Tamil Nadu was selected for the present study. The spatial variation maps of ground water quality map shows the broad idea about good, moderate and poor groundwater zones in the study area. The majority of samples of irrespective formation fall in low to medium Sodium and Salinity hazards some of the samples fall in the Sodium and high Salinity hazards. The Piper and Wilcox classification has shown that the groundwater is under "Good to Permissible" zone in most of the samples and few representation of unsuitable.

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