CCME based Water Quality Index Assessment of Upper Thirumanimuttar Sub Basin Cauvery River South India

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Abstract— Water quality indexing is a means to convert raw data from the field to results that can be utilized by the user. It will provide you with information on just how good your water is for a broad range of applications. A water quality index (WQI-SS) developed by the Canadian council of ministers of the Environment (CCME) was applied to upper Thirumanimuttar Sub Basin Cauvery River South India to study its impact on the protection of aquatic life. The quality index in the study area is rated and discussed in this paper. Thirty groundwater samples were collected during Post monsoon Season of 2013 covering Upper Thirumanimuttar sub basin of Cauvery River South India .Water samples were collected and chemically analysed using Standard Procedures. The concentration of major cations (Na, K, Ca, Mg) , anions (HCO3,Cl,NO3,SO4) and the parameters like pH, electrical conductivity (EC), total dissolved solids (TDS), as per the standard sampling procedures in the Water Samples were determined The water quality index assessed the suitability of ground water in the study area for various purposes like Drinking, Aquatic, Recreation, irrigation and livestock. The obtained index value is ranging from 27 to 100, 100 for recreation and 27 for irrigation, 71 for aquatic, 55 for drinking, 67 for livestock and 51 for overall.

Key words: Thirumanimuttar, Cauvery River, Water quality, CCME- WQI(SS)

I. INTRODUCTION

Water is not only a vital environmental factor to all form of life, but also it has a great role to play in socio-economic development of human population (*Park, K. 1997*). Water is invariably polluted in all countries. India is no exception to this phenomenon (Kudesia, 1980;Muduli, 2006; Nagarajan *et al.*, 2003 and Mehta, M.B.2003). Ground water is the cheapest and most practical means of providing water to small communities. It is likely to be free of pathogenic agents. It is subjected to less contamination and has high mineral content. Today the ground water (bore well water) resources are contaminated by the constant mixing of industrial waste, the use of fertilizers and pesticides, manure, lime, septic tank,etc. The extent of ground water pollution depends on rainfall pattern, depth of water level, distance from the source of contamination, and soil properties such as permeability (APHA. 1989). The extraction of excessive quantities of ground water has resulted in drying up of wells in the study area. It is occurred mainly due to the rapid urbanisation activities. Agricultural, urban & industrial wastes are increasingly threatening groundwater quality, which is likely to become more serious issue than the quantity in coming years. The quality of water can be determined by using various techniques as water quality indices, one such technique is the Canadian Council of ministries of the environment (CCME) Water quality Index (WQI). It facilitates to evaluate surface water for protection of aquatic life with the help of specific guidelines. Water quality indexing is a means to convert raw data from the field to results that can be utilized by the user. It will provide you with information on just how good your water is for a broad range of applications. Considering the above factors the assessment of water quality index (WQI-SS) developed by the Canadian council of ministers of the Environment (CCME) was applied to the study area (upper Thirumanimuttar sub basin)

II. STUDY AREA

The study area lies in the N latitudes 11 25’ and 11 40’ and E longitude 78 5’ and 78 25’ in the Survey of India toposheet numbers 58-I/1,58-I/2,58-I/5 and 58-I/6 (Map No-1). The study area mainly covers Salem City other adjacent place viz. small towns and villages. The Thirumanimuttar river is the main river flowing in the study area and it is one of the minor tributaries of river Cauvery of South India. The Thirumanimuttar rises in the Shevaroys Hills and Manjavadi Ghats, North East of Salem city and it confluences with the river Cauvery at Kooduthurai in Paramathi taluk of Namakkal district after 102 kms journey through Salem and Namakkal Districts. The study area is mainly covered by Archean rocks of Charnockite, Fissile Hornblende Biotite Gneisses. The drainage pattern in the study area shows parallel drainage pattern, dendritic to sub dendritic and parallel drainage Patterns.The study area is very hot in March to June. Whereas December and January are coldest months. The quite pleasant from November to February and moderate humidity and temperature. The weather is minimum and maximum temperature ranges from 20^{o} C to 40^{o}C respectively. The relative humidity percentage ranges from 60%to 90%.Highest relative humidity values were found during east- west monsoon period. The average annual rainfall is 737.50 mm based on 12 years average (2000 to 2011) (VIJAYAKUMAR N et al - 2015).

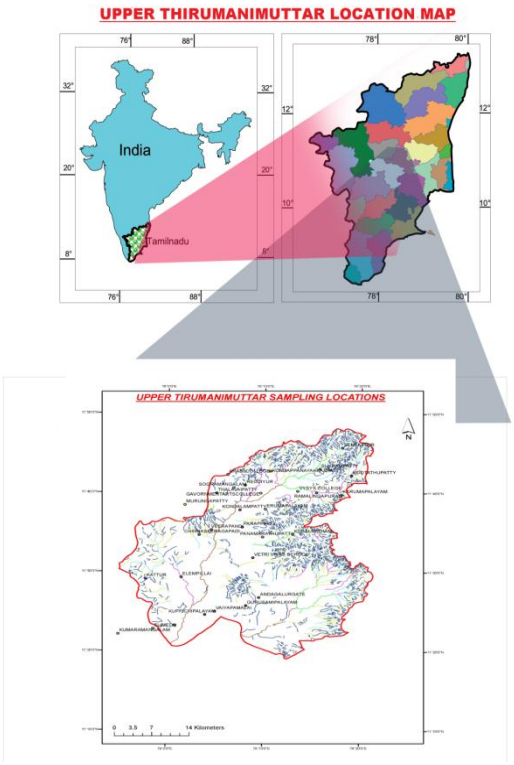

Fig. 1: Map.1.Location Map of the Study Area

III. MATERIALS AND METHODS

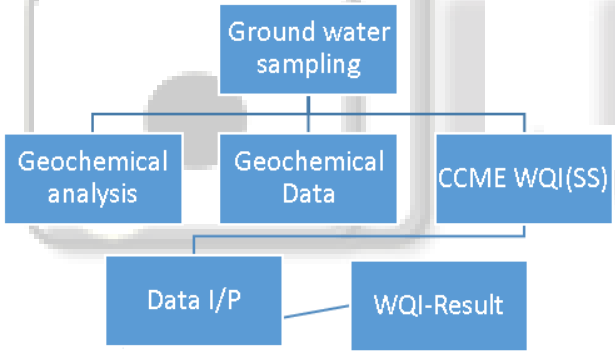

Fig. 2: Methodalogy Flow Chart

Thirty groundwater samples were collected on Post monsoon Season at December 2013 covering Upper Thirumanimuttar .Water samples were collected in pre cleaned, sterilized, polyethylene bottles of one liter capacity as per the standard sampling procedures .They were then carefully sealed and labeled and taken for analyses. The collected samples were Chemically analysed in Soil and Water testing Laboratory Salem , using Standard Procedures. The concentration of major cations (Na K,Ca,Mg) , anions (HCO_3,Cl,NO_3,SO_4) and the parameters like pH, electrical conductivity (EC), total dissolved solids (TDS), in the Water Samples were determined (Table-1)

CCME- WQI was developed with the intent of providing a tool for simplifying the reporting of water quality data (CCME 2001). It is a tool that provides meaningful summaries of water quality data that are useful to technical and policy individuals as well as the general public interested in water quality results. The CCME water quality was calculated by feeding the data to CCME- WQI Software- 1.0.

Constituents	Post monsoon-(2013)		
	Min	Max	Average
pH	7	8.2	7.6
EC µS/cm	900	5400	2363
TDS mg/l	554	3398	1468
Ca mg/l	20	421	155
Mg mg/l	47	325	130
Na mg/l	9	621	113
K mg/l	4	39	13
HCO_3 mg/l	281	866	523
CO_3 mg/l	0	30	7
SO_4 mg/l	5	394	57
Cl mg/l	57	1378	470

Table 1: Geochemical Constituents

S. No	LOCATION	Ca	Mg	Na	K	HCO_3	CO_3	SO_4	Cl
1	VYSYA COLLEGE	124.25	208.62	75.90	15.64	671.22	0.00	72.05	514.17
2	SUKKAMPATTY	116.23	138.62	289.80	7.82	695.63	0.00	52.83	620.55
3	SENKATTUR	114.23	127.68	39.10	3.91	732.24	9.00	9.61	195.03
4	KOOTATHUPATTY	128.26	155.65	39.10	3.91	555.28	0.00	24.02	404.24
5	KARUMAPURAM	246.49	167.81	63.94	4.69	390.53	0.00	52.83	762.39
6	RAMALINGAPURAM	114.23	64.45	41.86	7.04	414.94	0.00	33.62	195.03
7	ERUMAPALAYAM	122.24	179.97	55.20	27.37	457.65	18.00	52.83	524.81
8	PANAMARATHUPATTY	56.11	60.80	23.92	6.26	378.32	12.00	14.41	74.47
9	KURALNATHAM	124.25	121.60	64.40	39.10	732.24	9.00	14.41	262.40
10	VETRI VIKAS SCHOOL	160.32	177.54	71.30	11.73	463.75	0.00	134.48	553.18
11	VEERAPANDI	216.43	324.67	92.00	19.55	738.34	0.00	62.44	1014.16
12	CHINNASEERAGAPADI	92.18	62.02	43.70	15.64	427.14	0.00	14.41	166.66
13	KONDALAMPATTY	196.39	189.70	51.98	13.29	451.55	15.00	81.65	652.46
14	PARAPPATTY	138.28	224.96	78.20	21.90	671.22	12.00	52.83	585.09

15	K.P.NAYAKKANPATTY	70.14	48.64	32.20	3.91	384.43	24.00	14.41	56.74
16	REDDIYUR	90.18	69.31	37.95	5.87	384.43	0.00	9.61	195.03
17	ARABI COLLEGE	56.11	74.18	19.78	9.38	335.61	0.00	14.41	148.93
18	SOORAMANGALAM	136.27	119.17	27.60	7.82	579.69	0.00	14.41	290.77
19	THALAVAIPATTY	116.23	104.58	34.50	3.91	506.47	15.00	19.21	241.13
20	MURUNGAPATTY	170.34	47.42	9.20	7.82	329.51	12.00	9.61	248.22
21	ELEMPILLAI	138.28	54.72	32.20	7.82	421.04	9.00	28.82	184.39
22	KATTUR	420.84	109.44	547.40	7.82	744.44	0.00	326.60	1241.10
23	GAC,SALEM-7	78.16	119.17	50.60	3.91	549.18	0.00	43.23	216.31
24	ANDAGALURGATE	396.79	63.23	621.00	39.10	366.12	0.00	393.85	1375.85
25	GURUSAMIPALAYAM	98.20	243.20	66.70	7.82	549.18	15.00	24.02	638.28
26	VAIYAPAMALAI	300.60	86.34	73.60	27.37	659.02	9.00	19.21	514.17
27	KUPPICHIPALAYAM	182.36	179.97	92.00	3.91	671.22	0.00	19.21	588.64
28	ELACHIPALAYAM	220.44	154.43	407.10	23.46	866.48	9.00	72.05	921.96
29	ELIMEDU	20.04	74.18	41.40	3.91	280.69	30.00	4.80	99.00
30	KUMARAMANGALAM	200.40	145.92	268.18	15.64	287.50	15.00	24.02	615.00

Table 2: Hydrogeochemical Results Of The Samples Taken From The Locations During Postmonsoon -2013 (In ppm)

Rank	WQI Value	Description
Excellent	95–100	Water quality is close to natural
Good	80–94	Water quality is protected with only a minor degree of threat or impairment; conditions rarely depart from natural or desirable levels.
Fair	65–79	Water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels.
Marginal	45–64	Water quality is frequently threatened or impaired; conditions often depart from natural or desirable levels.
Poor	0–44	Water quality is almost always threatened or impaired; conditions usually depart from natural or desirable levels.

Table 3: CCME WQI categorization schema

Data Summary	Overall	Drinking	Aquatic	Recreation	Irrigation	Livestock
WQI	51	55	71	100	27	67
Categorization	Marginal	Marginal	Fair	Excellent	Poor	Fair
F1 (Scope)	67	62	50	0	100	50
F2 (Frequency)	34	34	2	0	47	24
F3 (Amplitude)	39	31	0	0	62	13

Table 4: CCME- WQI for Upper Thirumanimuttar for Post Monsoon -2013

IV. Results and Discussion

The result of physico- chemical analysis of water samples has been listed in Table 1. & 2.,Whereas Table 3. Shows the CCME WQI categorization schema .Table.4 gives result for CCME water quality index of Upper Thirumanimuttar for post monsoon -2013. The CCME model consists of three measures of variance from selected water quality objectives (Scope, frequency and amplitude). From results of CCME water quality it is clear that the water quality is marginal for overall purpose, and drinking, ,fair for aquatic and livestock, poor for irrigation and excellent for recreation. The index value ranging from minimum 27 to 100, 100 for recreation and 27 for irrigation, 71 for aquatic, 55 for drinking, 51 for overall and 67 for livestock.

The number of tested data for overall is 9 from which 6 have failed, for drinking 8 variables were tested out of which 5 variables have failed, 2 data were tested for aquatic in which 1 has failed, for recreation only one variable was tested which has not failed, 2 variables were tested for irrigation both of which have failed and for livestock 4 variables were tested out of which 2 variables have failed.

Failing data were TDS, Cl and Na for overall and drinking purpose. For aquatic failing parameter was F. For recreation it was none and for irrigation and livestock it was F and Cl.

V. Conclusion

The results of Physico- chemical analysis and CCME-WQI(SS) indicates that the upper Thirumanimuttar is unfit for use in irrigation due to various anthropogenic activities, sewage disposal and organic pollution which become a threat to the study area .In overall the degradation of water quality may be due to the rapid urbanaisation activities seen in the Salem City which is located in the middle of the sub basin.

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