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Spatial assessment of water quality in the lower reaches of Cauvery River, Tamil Nadu

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Abstract
Assessment of water pollution in the lower Cauvery was executed on the basis of water quality indices. WQI for nine sites were calculated using ten water quality variables (DO, TDS, EC, pH, Alkalinity, Hardness, Calcium, Nitrate, Chloride, Sulphate). WQI for the three stations, Kabisthalam, Hokenakkal and Moovalur were 40.322, 45.206 and 46.486 respectively, i.e., "Good" category of river water quality. The WQI from Kallanai, Mettur dam, Mukombu were below the level of 51 – 75 and these sites can be categorized as moderately polluted. Tiruchi, Kumbakonam and Melaiyur were below the level of 76 - 100 and these sites can be categorized as severely polluted. High values of WQI were observed to be predominantly from the lower estimations of DO, nitrate, calcium, and greater values of pH in the study sites. It was observed that the major cause of degradation in water quality was high anthropogenic practices, unlawful release of sewage, absence of appropriate sanitation, and urban spillover.

Keywords: Cauvery River, water quality, WQI, pollution

1. Introduction
Freshwater is a precious resource and the increasing population pressures account for plenty of the region's poor water quality [1]. As cities and industries expand without adequate waste-treatment facilities, streams and rivers are used increasingly as receptacles to discharge effluents [2]. In the same context, Lean *et al.* [3] stated that India's rivers are little more than open sewers, carrying untreated wastes form urban and rural areas to the sea. The complete lack of river water can produce asymmetric dispute between human being and nature, causing in closure of downriver flows at infrequent in a few major rivers [2]. The position of freshwater bodies confirms that they benefit as terrain recipients, thus water and habitat quality are determined to a great scope by conditions within the catchment [4]. Cauvery is one of the biggest water courses of India and it originates in the Brahmagiri hills in Kodagu, Karnataka and subsequent to experiencing 765km it at last merges with Bay of Bengal [5]. Cauvery River basin is an interbasin in the three peninsular states of Karnataka, Kerala and Tamil Nadu [6]. All the headwaters have their origin in the three states and majority of the larger headwaters are from the Karnataka state. The Major headwaters of Cauvery are Shimsha, Hemavathi, Arkavathi, Lakshmana Theerthm, Lokapavani, Kabini, Bhavani River, Noyyal and Amaravathi River [7]. Cauvery resembles a Goddess for the people of Tamil Nadu and serves the Tamil Nadu state by giving water to state. The water of Cauvery is utilized to create power generation, to give water for irrigation and also for domestic use. The waterway has assisted irrigated agriculture for over 1000 years and served as the backbone of the ancient Kingdoms and current urban communities of South India [8].
In recent decades, pollution of the rivers and streams has begun to be one of the most urgent ecological issues. River degradation in Cauvery River delta have been reported and mostly caused by water quality degradation [9]. Hence an assessment of water quality was executed in nine stretches of Cauvery River, Tamil Nadu along the delta for one year. The aim of the present study was to connect the quality of water in river Cauvery through WQI and the distance from the entry point of Cauvery River into the state of Tamil Nadu at Hokenakkal. The primary goal of WQI is to transform complex water quality information into data that is comprehensible and viable by society.

2. Materials and Methods

Nine stretches were selected for the study right from the entry point of Cauvery River into the state of Tamil Nadu at Hokenakkal. Other stretches include are, Mettur Dam, Mukkombu, Tiruchi, Kallanai, Kabisthalam, Kumbakonam, Moovalur and Melaiyur (Table 1; Fig. 1).

Table 1: GPS Coordinates of the river stretches along the lower reaches of Cauvery River.

Site	Site Name	Longitude	Latitude	Location
1	Hokenakkal	E 77°46'42.5''	N 12°06'54.0''	One km downstream from Hokenakkal.
2	Mettur Dam	E 77°49'31.94''	N 11°47'12.58''	2 km downstream from Mettur Dam
3	Mukkombu	E 78°34'59.95''	N 10°53'46.0''	Upstream, 3 km from Tiruchi city
4	Tiruchi By-pass Bridge	E 78°42'45.2''	N 10°50'10.9''	Downstream, 3 km from Tiruchi city (Near National Highway NH45)
5	Grand anaicut	E 78°49'22.2''	N 10°49'54.5''	Located at a distance of 15km from Tiruchirapalli, the dam was constructed by Karikalan, Chola King, 2nd century.
6	Kabisthalam	E 79°13'21.6''	N 10°55'55.2''	15 km down from Kallanai
7	Kumbakonam	E 79°22'41.5''	N 10°58'05.7''	2 km down from Kumbakonam city
8	Moovalur	E 79°36'34.7''	N 11°05'28.4''	Upstream, 3 km from Mailaduthurai city
9	Melaiyur	E 79°48'18.8''	N 11°08'53.3''	Last check dam, 7 km above the Kaveripoompattinam

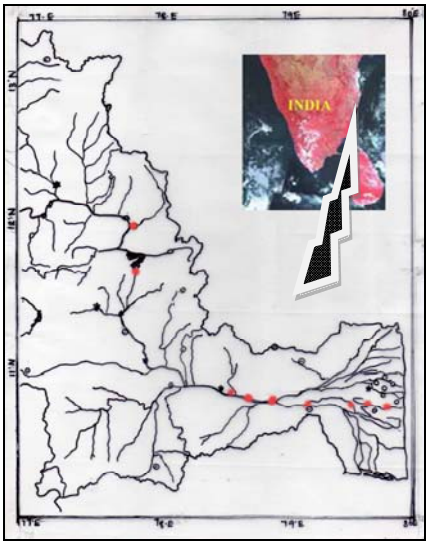

Fig 1: Location of the Cauvery River and sampling area.

2.1. Water Quality Index

In order to evaluate the pollution, water quality index was utilized to look at and assess the river in a spatial scale. WQI shows single digits like a grade that exhibits the whole water quality at a particular area and time based on a few water quality variables. It is also explained as a grading that reflects the composite influence, on whole quality of water, of much water quality variables. This index was computed using the technique proposed by Horton [10] and this was overhauled by Tiwari and Mishra [11]. It suggests relative significance of each of the factor in the overall water quality and it relies on the consuming water standard for every chemical variables in mg/l on the rules of the CPCB [12] and Bureau of Indian Standards [13], For computing WQI, three steps are followed,

In the first step, the Unit weight (W_i) is computed from the following equation

$W_i = K/S_n$ Where,

W_i - Unit weight of chemical factor,

K- Constant of proportionality and is given as

$$K = \frac{1}{1/Vs1 + 1/V\,s2 + \cdots\cdots\cdots + 1/V\,sn}$$

S_n = standard value of i^{th} parameter

In the 2nd step, a quality rating scale Qi for every variable has been assign to compute WQI

$Qi = 100[(V-Vi)/ (Vs-Vi)]$ Where,

V- measured values in the water sample at place

V_s – standard value of i^{th} variable

V_i - ideal value for clear water (0 for all variables except pH and Dissolved oxygen)

So $Qi = 100 (V - V_s)$

In the 3rd step, Water Quality Index has been computed from the formula

$WQI = \sum (WiQi)/ \sum W_i$

Utilizing the water quality index every one of the examples were classified into the accompanying five classes.

Table 2: Scale of Water quality Index

Standard WQI	Quality Rating
0 - 25	Excellent
26 - 50	Good
51 - 75	Moderately polluted
76 - 100	Severely polluted
Above 100	Unsuitable for drinking

if the WQI rating is 0 and 100 it is fit for human use and above 100 showed its unsuitability for use [14].

3. Results and Discussion

The water quality characteristics of all samples are shown in the Table 3. Minimum total dissolved solids (TDS) ranged from 343mg/l (Moovalur) to 690mg/l (Melaiyur) and the mean value was 500.6mg/l. In the three sites, Mettur, Tiruchi By-pass bridge, Kumbakonam and Melaiyur TDS were well above the permissible limits. It reflects the fact that there are intense anthropogenic practices along the course of the river and runoff with high suspended solids [15]. In smaller river basins in peninsular India such as Tamiraparani similar findings have been reported [16-19].

Electrical Conductivity varied from 490 µ mohs/cm (Movalur) to 985 µ mohs/cm (Melaiyur) and the mean value was 715.01 µ mohs/cm. Minimum was recorded in Moovalur station and maximum was recorded in Melaiyur station which is beyond the permissible limits. High electric conductivity was mostly caused by high ionic concentrations. The conductivity of Cauvery River associates negatively with elevation, and concentrations of a few major ions hike downstream. A comparable pattern is obvious in low altitudinal streams in New Zealand streams [20], and reduce in cation concentration with elevation was similarly clear in 3 Nepalese rivers [21] in spite of inter stream contrasts in conductivity and pH.

Table 3: Water quality parameters in 9 study sites in the lower reaches of Cauvery River.

Parameters	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Mini	Max	Average
Dissolved Oxygen	9	6.5	7.5	6.6	6	7.2	6	6.9	5	5	9	6.74 mg/l
Total dissolved Solids	343	588	500	580	420	495	546	343	690	343	690	500.56 mg/l
Electrical Conductivity	490	840	715.31	829.76	602	709	774	490	985	490	985	715.01 µ mohs/cm
pH	7.41	7.58	7.9	8.3	7.5	6.8	7.9	6.9	7.9	6.8	8.3	7.58
Total Alkalinity	206	305	213	236	176	193	193	166	269	166	305	217.44 mg/l
Total Hardness	217	257	169	187	160	190	196	190	198	160	257	196.00 mg/l
Calcium	46	59	38	46.6	30	32	38	40	45	30	59	41.62 mg/l
Nitrate	0.008	0.011	0.071	0.5	0.12	0.17	7	10	0.21	0.008	10	2.01 mg/l
Chloride	34	69	81	92	65.1	56	85	51	143	34	143	75.12 mg/l
Sulphate	9.5	17	25	26	35	17	34	23	40	9.5	40	25.17 mg/l

Minimum pH was 6.8 recorded in Kabisthalam station, and the maximum of 8.3 was recorded in by- pass bridge, Tiruchi and the mean value was 7.58. In general the pH rates are in all stations and are near as far as possible. The values of DO in the sampling stations are 5 -9 mg/l and lowest amount of DO was (5mg/l) recorded at Melaiyur and by- pass bridge at Tiruchi (5.65 mg/L), because of the organic pollution, sewage entering in to the river. Rani *et al.* [22] also reported in Satna reservoir, lower values of DO in summer season because of higher rate of decay of natural matter and restricted streams in low holding environment caused by excessive temperature.

Minimum and maximum total alkalinity was 166 mg/l and 305 mg/l respectively were recorded in Moovalur and Mettur dam stations. Mean value was 217.44 mg/l. These values surpass as far as possible (200mg/l), with the exception of Kallanai, Kabisthalam, Kumbakonam and Moovalur. High value of alkalinity (305mg/l) designates the existence of weak and strong base such as hydroxides, carbonates and bicarbonates, which were probably released from cleaning agents, food residue discharge of city sewage and domestic solid wastes [23, 24].

Average Hardness was 196 mg/l. The maximum was 257 mg/l recorded in Mettur reservoir and minimum was 160 mg/l recorded in Kallanai. The hardness is well within acceptable limits [12]. The aggregate polyvalent cations available in the water, the most divalent cations are calcium and magnesium. Hujare [25] found that in the perpetual tank of Talsande, Maharshtra, hardness was high amid summer than stormy season. Detergents and soaps also disturb the circumstances [26]. Maximum calcium level of 59 mg/l was recorded in Mettur dam and Minimum (30 mg/l) was in Kallanai station and mean was 41.62 mg/l. But the calcium contents in all the stations sufficiently well within acceptable limits. Nitrate in surface water is an important factor for water quality estimation [27]. Our study showed that the amount of nitrate was from 0.008 (Hokenakkal) - 10 mg/l (Movalur) and the mean was 2.01mg/l. Chloride content was ranged between 34mg/l (Hokenakkal) and 143 mg/l (Melaiyur). Chloride concentration demonstrates the existence of pollution due to sewage, distinctive anthropogenic practices like septic tank effluents, animal feeds, utilization of bleaching agents by launderer and washing clothes. Higher amount of chloride reacts with sodium making the water hard and increases TDS values of water [28]. The chloride substance normally increases as the mineral substance increases and which are relationship with expanded level of pollution [29]. The sulphate substance was ranged between 9.5 mg/l (Hokenakkal) and 40 mg/l in Melaiyur. The mean value (75.12 mg/l.) remains much below the standards. The higher concentration of sulphate might be caused by the utilization of washing powder and soap by neighbour and city inhabitants [30].

In this study, Water Quality Index were between 40.322 and 84.044 (Table 4-12) and for that reason, can be classified into four sorts " good water" to "water unsuitable for drinking" (Table 2). Contrasting the values acquired and water quality standards [13], the water quality rating obviously demonstrates that none of the stations have the analysis of WQI with the extent of 0-25. From this observation it can be stated that none of the stations could be measured for excellent quality of water and WQI of around three stations lie between the levels of 26 – 50. The values of WQI at locations Kabisthalam (Table 4), Hokenakkal (Table 5) and Moovalur (Table 6) are 40.322, 45.206 and 46.486 respectively. This shows that water quality is Good, which is fit for drinking purpose. The analysis revealed that the water Quality Index from Kallanai (64.222), Mettur dam (67.017), Mukombu (67.768) were below the level of 51 – 75 and these sites can be categorized as moderately polluted (Tables 7, 8, 9). WQI values between the level of 76 and 100 can be termed as severely polluted. The closer the sampling site to the city is severely polluted at three sites, Tiruchi By- pass bridge, Kumbakonam and Melaiyur (Tables 10, 11, 12). The effect of urban releases of sewage and solid wastes at the most extreme level in Tiruchi By-pass bridge, Kumbakonam and Melaiyur. High values of WQI are observed to be predominantly from the lower estimations of dissolved oxygen, nitrate, calcium, sulphate, chloride and greater values of pH in study sites. It is caused by the anthropogenic practices such as washing, cleaning, angling, open defecation and leachates from solid squanders like the paper, polythene packs, plastic mugs, sachets, straws, fabrics and leaves in addition to settlement sewage, which are non- point sources of pollution in the sampling areas. Lowland of Indian peninsular river, Cauvery has higher concentration of major ions than Himalayan Rivers and streams [2]. The discharge of domestic sewage in the Kundalika river are the answerable for the greater level of WQI [31] and the same pattern is seen in the Cauvery River [32]. Overall, the chemical configuration of river water in lower part of Cauvery broadly reflects the world average river-water composition given by Meybeck [33] and Himalayan drainage system [2], although there are some spatial variations [34, 35]. Population densities in the Cauvery catchment are high, and some cities are along the river (e.g. Tiruchirapally) lack of sewage treatment facilities completely. River pollution is also a significant and increasingly a problem in delta region, where domestic wastes, sewage and huge quantities of fertilizers and pesticides are release directly into water courses. Similar situation prevails in North Indian Rivers [36-40] Nepal [41, 42] and parts of Srilanka [43, 44].

Table 4: Water quality index at Kabisthalam.

S. No.	Parameters	Unit	CPCB	BIS	V	W_i	Q_i	W_iQ_i
1	Dissolved Oxygen	mg/l	6	---	7.2	0.453	86.05	38.996
2	Total dissolved Solids	mg/l	500	500	495	0.005	99.00	0.535
3	Electrical Conductivity	µ mhos/cm	300	300	709	0.009	236.33	2.151
4	pH		6.5 - 8.5	6.5 - 8.5	6.8	0.389	-13.33	-5.180
5	Total Alkalinity	mg/l	200	200	193	0.014	96.50	1.312
6	Total Hardness	mg/l	300	300	190	0.009	63.33	0.576
7	Calcium	mg/l	75	75	32	0.036	42.67	1.549
8	Nitrate	mg/l	20	45	0.17	0.060	0.38	0.023
9	Chloride	mg/l	250	250	56	0.011	22.40	0.244
10	Sulphate	mg/l	200	200	17	0.014	8.50	0.116
	$\sum W_i = 1.000$		$\sum WiQi = 40.322$			WQI = 40.322		

Table 5: Water quality index at Hokenakkal.

S. No.	Parameters	Unit	CPCB	BIS	V	W_i	Q_i	W_iQ_i
1	Dissolved Oxygen	mg/l	6	---	9	0.453	65.12	29.511
2	Total dissolved Solids	mg/l	500	500	343	0.005	68.60	0.370
3	Electrical Conductivity	µ mhos/cm	300	300	490	0.009	163.33	1.486
4	pH		6.5 - 8.5	6.5 - 8.5	7.41	0.389	27.33	10.619
5	Total Alkalinity	mg/l	200	200	206	0.014	103.00	1.401
6	Total Hardness	mg/l	300	300	217	0.009	72.33	0.658
7	Calcium	mg/l	75	75	46	0.036	61.33	2.226
8	Nitrate	mg/l	20	45	0.008	0.060	0.02	0.001
9	Chloride	mg/l	250	250	34	0.011	13.60	0.148
10	Sulphate	mg/l	200	200	9.5	0.014	4.75	0.065
	$\sum W_i = 1.000$		$\sum WiQi = 46.486$			WQI = 46.486		

Table 6: Water quality index at Moovalur.

S. No.	Parameters	Unit	CPCB	BIS	V	W_i	Q_i	W_iQ_i
1	Dissolved Oxygen	mg/l	6	---	6.9	0.453	89.53	40.577
2	Total dissolved Solids	mg/l	500	500	343	0.005	68.60	0.370
3	Electrical Conductivity	µ mhos/cm	300	300	490	0.009	163.33	1.486
4	pH		6.5 - 8.5	6.5 - 8.5	6.9	0.389	-6.67	-2.590
5	Total Alkalinity	mg/l	200	200	166	0.014	83.00	1.129
6	Total Hardness	mg/l	300	300	190	0.009	63.33	0.576
7	Calcium	mg/l	75	75	40	0.036	53.33	1.936
8	Nitrate	mg/l	20	45	10	0.060	22.22	1.342
9	Chloride	mg/l	250	250	51	0.011	20.40	0.222
10	Sulphate	mg/l	200	200	23	0.014	11.50	0.156
	$\sum W_i = 1.000$		$\sum WiQi = 45.206$			WQI = 45.206		

Table 7: Water quality index at Kallanai.

S. No.	Parameters	Unit	CPCB	BIS	V	W_i	Q_i	W_iQ_i
1	Dissolved Oxygen	mg/l	6	---	6	0.453	100.00	45.320
2	Total dissolved Solids	mg/l	500	500	420	0.005	84.00	0.454
3	Electrical Conductivity	µ mhos/cm	300	300	602	0.009	200.67	1.826
4	pH		6.5 - 8.5	6.5 - 8.5	7.5	0.389	33.33	12.950
5	Total Alkalinity	mg/l	200	200	176	0.014	88.00	1.197
6	Total Hardness	mg/l	300	300	160	0.009	53.33	0.485
7	Calcium	mg/l	75	75	30	0.036	40.00	1.452
8	Nitrate	mg/l	20	45	0.12	0.060	0.27	0.016
9	Chloride	mg/l	250	250	65.1	0.011	26.04	0.284
10	Sulphate	mg/l	200	200	35	0.014	17.50	0.238
	$\sum W_i = 1.000$		$\sum WiQi = 64.222$			WQI = 64.222		

Table 8: Water quality index at Metturdam.

S. No.	Parameters	Unit	CPCB	BIS	V	W_i	Q_i	W_iQ_i
1	Dissolved Oxygen	mg/l	6	---	6.5	0.453	94.19	42.685
2	Total dissolved Solids	mg/l	500	500	588	0.005	117.60	0.635
3	Electrical Conductivity	µ mhos/cm	300	300	840	0.009	280.00	2.548
4	pH		6.5 - 8.5	6.5 - 8.5	7.58	0.389	38.67	15.022
5	Total Alkalinity	mg/l	200	200	305	0.014	152.50	2.074

6	Total Hardness	mg/l	300	300	257	0.009	85.67	0.780
7	Calcium	mg/l	75	75	59	0.036	78.67	2.856
8	Nitrate	mg/l	20	45	0.011	0.060	0.02	0.001
9	Chloride	mg/l	250	250	69	0.011	27.60	0.301
10	Sulphate	mg/l	200	200	17	0.014	8.50	0.116
	$\sum W_i = 1.000$		$\sum WiQi = 67.017$			WQI = 67.017		

Table 9: Water quality index at Mukkombu

S. No.	Parameters	Unit	CPCB	BIS	V	W_i	Q_i	W_iQ_i
1	Dissolved Oxygen	mg/l	6	---	7.5	0.453	82.56	37.415
2	Total dissolved Solids	mg/l	500	500	500	0.005	100.00	0.540
3	Electrical Conductivity	µ mhos/cm	300	300	715.3	0.009	238.44	2.170
4	pH		6.5-8.5	6.5 - 8.5	7.9	0.389	60.00	23.310
5	Total Alkalinity	mg/l	200	200	213	0.014	106.50	1.448
6	Total Hardness	mg/l	300	300	169	0.009	56.33	0.513
7	Calcium	mg/l	75	75	38	0.036	50.67	1.839
8	Nitrate	mg/l	20	45	0.071	0.060	0.16	0.010
9	Chloride	mg/l	250	250	81	0.011	32.40	0.353
10	Sulphate	mg/l	200	200	25	0.014	12.50	0.170
	$\sum W_i = 1.000$		$\sum WiQi = 67.768$			WQI = 67.768		

Table 10: Water quality index at Tiruchi By-pass bridge.

S. No.	Parameters	Unit	CPCB	BIS	V	W_i	Q_i	W_iQ_i
1	Dissolved Oxygen	mg/l	6	---	6.6	0.453	93.02	42.158
2	Total dissolved Solids	mg/l	500	500	580	0.005	116.00	0.626
3	Electrical Conductivity	µ mhos/cm	300	300	829.8	0.009	276.59	2.517
4	pH		6.5 - 8.5	6.5 - 8.5	8.3	0.389	86.67	33.670
5	Total Alkalinity	mg/l	200	200	236	0.014	118.00	1.605
6	Total Hardness	mg/l	300	300	187	0.009	62.33	0.567
7	Calcium	mg/l	75	75	46.6	0.036	62.13	2.255
8	Nitrate	mg/l	20	45	0.222	0.060	0.49	0.030
9	Chloride	mg/l	250	250	92	0.011	36.80	0.401
10	Sulphate	mg/l	200	200	26	0.014	13.00	0.177
	$\sum W_i = 1.000$		$\sum WiQi = 84.007$			WQI = 84.007		

Table 11: Water quality index at Kumbakonam.

S. No.	Parameters	Unit	CPCB	BIS	V	W_i	Q_i	W_iQ_i
1	Dissolved Oxygen	mg/l	6	---	6	0.453	100.00	45.320
2	Total dissolved Solids	mg/l	500	500	546	0.005	109.20	0.590
3	Electrical Conductivity	µ mhos/cm	300	300	774	0.009	258.00	2.348
4	pH		6.5 - 8.5	6.5 - 8.5	7.9	0.389	60.00	23.310
5	Total Alkalinity	mg/l	200	200	193	0.014	96.50	1.312
6	Total Hardness	mg/l	300	300	196	0.009	65.33	0.595
7	Calcium	mg/l	75	75	38	0.036	50.67	1.839
8	Nitrate	mg/l	20	45	7	0.060	15.56	0.940
9	Chloride	mg/l	250	250	85	0.011	34.00	0.371
10	Sulphate	mg/l	200	200	34	0.014	17.00	0.231
	$\sum W_i = 1.000$		$\sum WiQi = 76.855$			WQI = 76.855		

Table 12: Water quality index at Melaiyur.

S. No.	Parameters	Unit	CPCB	BIS	V	W_i	Q_i	W_iQ_i
1	Dissolved Oxygen	mg/l	6	---	5	0.453	111.63	50.590
2	Total dissolved Solids	mg/l	500	500	690	0.005	138.00	0.745
3	Electrical Conductivity	µ mhos/cm	300	300	985	0.009	328.33	2.988
4	pH		6.5 - 8.5	6.5 - 8.5	7.9	0.389	60.00	23.310
5	Total Alkalinity	mg/l	200	200	269	0.014	134.50	1.829
6	Total Hardness	mg/l	300	300	198	0.009	66.00	0.601
7	Calcium	mg/l	75	75	45	0.036	60.00	2.178
8	Nitrate	mg/l	20	45	0.21	0.060	0.47	0.028
9	Chloride	mg/l	250	250	143	0.011	57.20	0.623
10	Sulphate	mg/l	200	200	40	0.014	20.00	0.272
	$\sum W_i = 1.000$		$\sum WiQi = 83.164$			WQI = 83.164		

4. Conclusion

From the above analysis, it can be concluded that the water quality of lower reaches of Cauvery River during study period revealed that the three stations, (Kabisthalam, Hokenakkal, and Moovalur) could be rated for good quality of water, which is suitable for consuming purpose. The WQI from Kallanai, Mettur dam, Mukombu are below the level of 51 – 75 and these sites can be categorized as moderately polluted. Tiruchi By- pass bridge, Kumbakonam and Melaiyur were below the level of 76 -100 and these sites can be categorized as severely polluted. High values of WQI were observed to be predominantly from the lower estimations of dissolved oxygen, nitrate, calcium, sulphate, chloride and greater values of pH in study sites. The closer the sampling site to the city is severely polluted at three sites, which is caused by the anthropogenic practices such as washing, cleaning, open defecation and leachates from solid squanders like the paper, polythene packs, plastic mugs, sachets, straws, fabrics and leaves in addition to settlement sewage, which are non-point sources of pollution in the sampling areas. The higher end of the WQI of the samples was 84.044 and this value not exceeded 100 for unsuitable for drinking purpose, if this trend continues to extend the pollution level, the river has been changed into unsuitable for domestic usage. To making awareness, controlling expansion of squanders and sewage, sand mining are a portion of the measures were prescribed to ensure the water quality.

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