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Analysis Of Water Pollution In The Pazhayar River At Kanyakumari District

P.Rajesh Prasanna* and B. K. Ramesh.

Department of Civil Engineering and Environmental studies, University College of Engineering, Anna University, Chennai, BIT Campus, Tiruchirappalli – 620 024, Tamilnadu, India

***Corres.author: rajehshprasanna71@yahoo.com**

Abstract: A study was under taken during the month of September, 2012 and evaluates the water quality of Pazhyar River. The study involves the physical and chemical and analysis like Turbidity, EC, TDS, PH, TALK, TH, Ca, Mg, Na, K, Fe, Mn, Cl, F, NH3 ,NO2, NO3, BOD and DO of river. The results of the present study have been compared with the permissible standards prescribed by the standards such as BIS, CES, CPHEEO, ICMR and WHO. The average value of the water quality index for Pazhayar river was 81.59 indicating that this river is under very poor quality rating. Based on this report, appropriate steps to be taken for control the pollution in this river.
Key words: Pollution - Water quality analysis - Water Quality Index –Pazhayar River.

Introduction

In the planet of the earth, water is one of the most important natural resources for the survival of all living organisms. Rivers are providing main water resources for domestic, agricultural and industrial purposes. The quality and quantity of surface water in a river is influenced by natural factors such as wind, rainfall, temperature and weathering of rocks etc. Kanyakumari district is a coastal district situated at the southernmost tip of Tamilnadu. The early Kings of Venad were conscious of the potential of Pazhayar which originates from the forested area of Surulacode, carries small streams from Mahendragiri peak and flows through Thovalai and Agastheeswaram taluks. The total length of the river is about 37 km and it passes through Boothapandi, Thazakudi, Putheri, Nagercoil, and Suchindrum finally joins with the Arabian sea. The early kings also constructed about 11 check-dams along the course of the river. A Venad ruler, Boothala Sree Veera Udaya Marthandavarma, who ruled this area in 1517, constructed the Veerapuli dam and its canals. The then rulers also constructed 'Kutty' dam, Palikondan dam, Chattuputhur dam, Veera puli dam, Sabari dam, Kumari dam, Cholan Kattar dam, Pillaipethan dam, and Mission dam. All these check dams have well-developed canal systems that irrigated the surrounding areas. Pazhayar river starts from Surulacode regulator headworks at which it gets water from Kodayar system and running almost in plain terrain in the ayacut lands of anandanar

channel and Thovalai channel,N.P.channel. Even though Kanyakumari district there is vast extension of water bodies which includes numerous rivers, streams, ponds and wetland, Now this district is gradually undergoing eco-degradation due to unplanned urban development, deforestation, large scale sand mining, mushrooming, brick kilns, coir retting as well as other domestic, agricultural and industrial waste water being discharged in to various water bodies in this district. The Pazhayar river is one of the important river in this district for drinking and irrigation purposes, Now the major problem faced by the Pazhayar is pollution. According to the Environmental Protection Act, 1986, sewage should not be let into public water bodies. Fifty years ago, one could see hundreds of people taking bath in this river in various bathing gate. The same spot now looks like a cesspool of sewage with solid waste like plastic floating on it. People expect to restore this river and protect the ecological system. Peak demand of the water, corresponding with the population growth, agricultural and industrial development has induced environmentalists to determine the chemical, physical and biological characteristics of natural water resources. In order to protect the good environment in this district the present study was undertaken to monitor the water quality of Pazhayar River.

Materials and Methods

Study area

Kanyakumari district its area of 1,684 sq.km and occupies 1.295 percentage of the total area of the Tamil Nadu. This district lies between 77^0-15' and 77^0- 36' of the eastern longitude and 8^0- 35' and 8^0-35' of the north latitude. Kanyakumari district enjoys a warm climat. The first south west monsoon is from June to September, while the second one northeast is from October to December which provide abundant water source to this district. The annual rainfall ranges between 90 and 160 cm. Maximum flood discharge in this river was 400 cumecs (PWD 2012).

The analysis of water quality study was taken for seven locations of Surulacode (At 0.00KM -N 08◦12.326'-E077◦25.184'), Putheri (At16.00 KM- N 8◦11.889'-E077◦26.338'), Ozhinaseri (At18.00KM- N 08◦11.514' –E 077◦26.348') ,Edalakudi (At 23.00 Km- N 08◦09.501' – E 077◦27.912'), Suchindram (At 25.00 KM N 08◦09.349' – E 077◦28.191'), North thamaraikulam (At 32.00KM- N 08◦07.972' – E 077◦28.957') and Manakudi (At 35.00KM- N 08◦05.407'-E 077◦29.131')in the Pazhayar River and analysis the water quality in the Tamil Nadu Water Supply and Drainage Board at Nagercoil .

Collection of water samples

Using the GPS to locate the sampling location along the river and Sampling of water was carried out in the September months of 2012. The water samples were collected in a 2 litter capacity brought to the laboratory within 6 hrs of collection.Care was taken to guard the samples against under shaking and exposure to the atmosphere during transport. The methods for analysis were followed as prescribed in APHA[1.]

The study involves the physical, chemical and biological analysis like Turbidity, EC, TDS, PH, TALK, TH, Ca, Mg, Na, K, Fe, Mn, Cl, F, NH3 ,NO2, NO3, BOD and DO of river. The results of the present study have been compared with the permissible standards prescribed by the standards such as BIS, CES, CPHEEO[(2)], ICMR and WHO (Table no 1). The average value of the water quality index for Pazhayar river was 81.59 indicating that this river is under very poor quality rating.

Water Quality Index (WQI)

In the present study 19 key parameters were taken for the water quality analysis viz., Turbidity, EC, TDS, PH, TALK, TH, Ca, Mg, Na, K, Fe, Mn, NH3,NO2, NO_3, Cl, F, BOD and DO were taken(Table no 3 to 9) in to account and their standard and observed values were compared. The unit weight of n^{th} parameter (Wn) and sub quality index or quality rating (Qn) for the key parameters for calculating the Water Quality Index (WQI). The calculation of WQI (Table no 2) using weighted arithmetic index method was described by Harkins, 1974[(3)]. The calculation of sub-index or quality rating (QN) is based on the following formula,

Qn= Vn-Vio/Sn-Vio x 100

Qn = Quality rating for the n^{th} water quality parameter.

Vn = Estimated value of the n^{th} parameter at a given sampling station.

Sn = Standard permissible value of n^{th} parameter.

Vi0 = Ideal value of n^{th} parameter in the pure water. All the ideal values (Vi0) were taken as zero for the drinking water except for pH = 7.0 and dissolved oxygen = 14.6 mg/l.

Calculation of unit weight (Wn)

$Wn = K/Sn$

Wn = Unit weight of n^{th} parameter

Sn = Standard permissible value of the n^{th} parameter.

K = Constant for proportionality (k=1)

Calculation of WQI

WQI = Antilog $\sum$Wn log Qn

Table 1: Water Quality Parameters and Its Permissible Standards for Drinking Water

S. No	Parameter	Permissible Std	Agency
1	Turbidity	5 NTU	WHO
2	Electrical conductivity	300	BIS
3	Total Dissolved Solids	1000	WHO
4	pH	6.5-8.5	WHO
5	Total Alkalinity	600	BIS
6	Total Hardness	500	WHO
7	Calcium	200	CPHEEO
8	Magnesium	100	BIS
9	Sodium	200	WHO
10	Potassium	12	WHO
11	Iron	0.3	WHO
12	Manganese	0.1	WHO
13	Nitrate	45	WHO
14	Chloride	250	WHO
15	Fluoride	1.5	WHO
16	Biological Oxygen Demand	5	ICMR
17	Chemical Oxygen Demand	200	WHO

Table 2: Water Quality Index Scale

WQI	Quality Rating
0 – 25	Excellent
26 -50	Good
51 -75	Moderately Polluted
76 -100	Very Poor
100 and above	Unsuitable for Drinking

Table 3: Water Quality Index (At 0.00 Km)

Physical Parameter	Standard value(Sn)	Observed value(Vn)	Unit wt (Wn)	Quality rating Qn=Vn-Vi0/Sn-Vi0x100	WQI= Wn.log Qn
Turbidity NT units	5	2	0.0136	40	0.0217
Total dissolved solids -mg/l	1000	132	0.00006	13.2	0.00006
Electrical conductivity-micS/l	300	200	0.0002	66.66	0.0003
Chemical	**Parameyter**				
Chloride as Cl	250	34	0.0002	13.6	0.0002
Alkalinity Total as CaCO3	600	44	0.0001	7.33	0.00008
Total Hardness as CaCO3	500	48	0.0001	9.6	0.00009

Calcium as Ca	200	13	0.0003	6.5	0.0002
Magnesium as Mg	100	4	0.0006	4	0.0003
Sodium as Na	200	21	0.0003	10.5	0.0003
Chloride as Cl	250	34	0.0002	13.6	0.0002
PH`	6.6-8.5	8.26	0.008	252	0.019
Potassium as K	12	2	0.005	16.66	0.0061
Iron as Fe	0.3	0.24	0.22	80	0.4186
Ammonia NH3	5	0.88	0.9	17.6	1.12
Nitrite NO2	7	0.04	0.58	0.08	-0.14
Nitrate as No3	45	1	0.001	2.22	0.0003
Fluoride as F	1.5	0.2	0.045	13.33	0.0506
Dissolved oxygen	6.00	6.6	0.001	120	0.0019
BOD	5	4	0.013	80	0.0247
				∑Wn.logQn=	1.52443

QI= Antilog.∑Wn.logQn. Antilog.1.52443= 33.40

Hence this area water was in Good condition.

Table 4: Water Quality Index At (16.00Km)

Physical Parameter	**Standard value(Sn)**	**Observed value(Vn)**	**Unit wt (Wn)**	**Quality rating Qn=Vn-Vi0/Sn-Vi0x100**	**WQI= Wn.log Qn**
Turbidity NT units	5	1	0.0136	20	0.0176
Total dissolved solids -mg/l	1000	213	0.00006	21.3	0.000079
Electrical conductivity-mg/l	300	323	0.0002	107.66	0.0004
Chemical Examination					
Chloride as Cl	250	40	0.0002	16	0.00024
Alkalinity Total as CaCO3	600	92	0.0001	15.33	0.00011
Total Hardness as CaCO3	500	80	0.0001	16	0.00012
Calcium as Ca	200	22	0.0003	11	0.00031
Magnesium as Mg	100	6	0.0006	6	0.0046
Sodium as Na	200	34	0.0003	17	0.00036
Potassium as K	12	7	0.005	58.33	0.0088
Iron as Fe	0.3	0.06	0.22	20	0.2862
Ammonia NH3	5	0.38	0.9	7.6	0.7927
Nitrite No2	7	0.11	0.58	1.57	0.11
Nitrate as No3	45	1	0.001	2.22	0.00034
PH	6.6-8.5	8.65	0.008	330	0.02
Fluoride as F	1.5	0.4	0.045	26.66	0.0641
Dissolved oxygen	6.00	5.7	0.001	97.8	0.0022
BOD	5	5	0.013	100	0.026
					∑Wn.logQn=1.33

WQI= Antilog.∑Wn.logQn. Antilog.1.33= 21.37

Hence this area water was in Good condition.

Table 5: Water Quality Index At (18.00Km)

Physical Parameter	Standard value(Sn)	Observed value(Vn)	Unit wt (Wn)	Quality rating Qn=Vn-Vi0/Sn-Vi0x100	WQI= Wn.log Qn
Turbidity NT units	5	4	0.0136	80	0.0258
Total dissolved solids -mg/l	1000	266	0.00006	26.6	0.000085
Electrical conductivity-micS/l	300	404	0.0002	134.66	0.00042
Chemical Parameter					
Chloride as Cl	250	40	0.0002	16	0.00024
Alkalinity Total as CaCO3	600	136	0.0001	22.66	0.00013
Total Hardness as CaCO3	500	120	0.0001	24	0.00013
Calcium as Ca	200	32	0.0003	16	0.00036
Magnesium as Mg	100	10	0.0006	10	0.0006
Sodium as Na	200	37	0.0003	18.5	0.00038
Potassium as K	12	6	0.005	50	0.0084
Iron as Fe	0.3	0.47	0.22	156.66	0.4828
Ammonia NH3	5	0.58	0.9	11.6	0.958
Nitrate No3	7	0.38	0.58	5.42	0.4257
Nitrate as No3	45	1	0.001	2.22	0.00034
PH`	6.6-8.5	8.13	0.008	226	0.0188
Fluoride as F	1.5	0.4	0.045	26.66	0.0641
Dissolved oxygen	6.00	5.8	0.001	96.7	0.0019
BOD	5	5	0.013	100	0.026
					∑Wn.logQn= 2.014

WQI= Antilog.∑Wn.logQn. Antilog2.014= 103.27

Hence this area water was Unsuitable for drinking purpose.

Table 6: Water Quality Index At (23.00Km)

Physical Parameter	**Standard value(Sn)**	**Observed value(Vn)**	**Unit wt (Wn)**	**Quality rating Qn=Vn-Vi0/Sn-Vi0x100**	**WQI= Wn.log Qn**
Turbidity NT units	5	2	0.0136	40	0.0217
Total dissolved solids -mg/l	1000	228	0.00006	22.8	0.000081
Electrical conductivity-micS/l	300	345	0.0002	115	0.00041
Chemical parameter					
Chloride as Cl	250	60	0.0002	24	0.00027
Alkalinity Total as CaCO3	600	72	0.0001	12	0.0001
Total Hardness as CaCO3	500	96	0.0001	19.2	0.00012
Calcium as Ca	200	29	0.0003	14.5	0.00034
Magnesium as Mg	100	6	0.0006	6	0.00046
Sodium as Na	200	27	0.0003	13.5	0.00033
Potassium as K	12	8	0.005	66.66	0.0091
Iron as Fe	0.3	0.24	0.22	80	0.4186
Ammonia -NH3	5	1.08	0.9	21.6	1.201
Nitrite -NO2	7	0.12	0.58	1.71	0.1351
Nitrate as No3	45	2	0.001	4.44	0.00064
PH`	6.6-8.5	8.05	0.008	210	0.0185
Fluoride as F	1.5	0.4	0.045	26.66	0.0641
Dissolved oxygen	6.00	2.3	0.001	135.16	0.0021
BOD	5	6	0.013	120	0.027

					∑Wn.logQn =1.8989

WQI= Antilog.∑Wn.logQn. Antilog1.8989=79.23

Hence this area water has been in very poor condition.

Table 7: Water Quality Index At (25.00Km)

Physical Parameter	**Standard value(Sn)**	**Observed value(Vn)**	**Unit wt (Wn)**	**Quality rating Qn=Vn-Vi0/Sn-Vi0x100**	**WQI= Wn.log Qn**
Turbidity NT units	5	6	0.0136	120	o.0282
Total dissolved solids - mg/l	1000	261	0.00006	26.1	0.000084
Electrical conductivity-micS/l	300	396	0.0002	132	0.00042
Chemical parameter					
Chloride as Cl	250	60	0.0002	24	0.00027
Alkalinity Total as CaCO3	600	72	0.0001	12	0.0001
Total Hardness as CaCO3	500	96	0.0001	19.2	0.00012
Calcium as Ca	200	29	0.0003	14.5	0.00034
Magnesium as Mg	100	6	0.0006	6	0.00046
Sodium as Na	200	27	0.0003	13.5	0.00033
Potassium as K	12	8	0.005	66.66	0.0091
Iron as Fe	0.3	0.24	0.22	80	0.4186
Ammonia -NH3	5	1.08	0.9	21.6	1.201
Nitrite -NO2	7	0.12	0.58	1.71	0.1351
Nitrate as No3	45	2	0.001	4.44	0.00064
PH`	6.6-8.5	8.05	0.008	210	0.0185
Fluoride as F	1.5	0.4	0.045	26.66	0.0641
Dissolved oxygen	6.00	2.3	0.001	135.16	0.0021
BOD	5	6	0.013	120	0.027
					∑Wn.logQn= 2.16

WQI= Antilog.∑Wn.logQn. Antilog2.16=144.54

Hence this area water unsuitable for drinking purpose.

Table 8: Water Quality Index At (32.00Km)

Physical Parameter	**Standard value(Sn)**	**Observed value(Vn)**	**Unit wt (Wn)**	**Quality rating Qn=Vn-Vi0/Sn-Vi0x100**	**WQI= Wn.log Qn**
Turbidity NT units	5	2	0.0136	40	0.0214
Total dissolved solids - mg/l	1000	305	0.00006	30.5	0.000089
Electrical conductivity-micS/l	300	463	0.0002	154.33	0.00043
Chemical parameter					
Chloride as Cl	250	42	0.0002	6.66	0.00082
Alkalinity Total as CaCO3	600	168	0.0001	28	0.00014
Total Hardness as CaCO3	500	164	0.0001	32.8	0.00015
Calcium as Ca	200	46	0.0003	23	0.0004
Magnesium as Mg	100	12	0.0006	12	0.00064
Sodium as Na	200	36	0.0003	18	0.00037
Potassium as K	12	6	0.005	50	0.0084

Iron as Fe	0.3	0.24	0.22	80	0.4186
Ammonia -NH3	5	1.04	0.9	20.8	1.186
Nitrite -NO2	7	0.31	0.58	4.428	0.3748
Nitrate as No3	45	3	0.001	6.66	0.00082
PH`	6.6-8.5	8.36	0.008	272	0.0194
Fluoride as F	1.5	0.6	0.045	40	0.072
Dissolved oxygen	6.00	6	0.001	94.5	0.0019
BOD	5	8	0.013	160	0.0286
					.∑Wn.logQn=2.1349

WQI= Antilog.∑Wn.logQn. Antilog2.1349=136.14

Hence this area water unsuitable for drinking purpose.

Table 9: Water Quality Index At (35.00Km)

Physical Parameter	**Standard value(Sn)**	**Observed value(Vn)**	**Unit wt (Wn)**	**Quality rating Qn=Vn-Vi0/Sn-Vi0x100**	**WQI= Wn.log Qn**
Turbidity NT units	5	7	0.0136	526.2	0.0291
Total dissolved solids - mg/l	1000	5262	0.00006	2651.33	0.00016
Electrical conductivity-micS/l	300	7972	0.0002		0.00068
Chemical parameter					
Chloride as Cl	250	2550	0.0002	1020	0.0006
Alkalinity Total as CaCO3	600	152	0.0001	25.33	0.00014
Total Hardness as CaCO3	500	1500	0.0001	300	0.00024
Calcium as Ca	200	192	0.0003	96	0.00059
Magnesium as Mg	100	245	0.0006	245	0.0014
Sodium as Na	200	980	0.0003	490	0.0008
Potassium as K	12	90	0.005	750	0.0143
Iron as Fe	0.3	0.82	0.22	273.33	0.536
Ammonia -NH3	5	0.31	0.9	6.2	0.713
Nitrite -NO2	7	0.24	0.58	3.4285	0.3103
Nitrate as No3	45	2	0.001	4.44	0.00064
PH`	6.6-8.5	8.65	0.008	330	0.0201
Fluoride as F	1.5	0.6	0.045	40	0.072
Dissolved oxygen	6.00	5.9	0.001	95.6	0.0019
BOD	5	6	0.013	120	0.027
					∑Wn.logQn=1.7286

WQI= Antilog.∑Wn.logQn. Antilog1.7286= 3.53

Hence this area water has been *Moderately polluted.*

Result And Discussion

The water quality parameters of the seven water sampling were determined in September, 2012 and obtained 19 parameters (table1 no 7). At Surulacode, the PH, and Dissolved oxygen is more than the permissible rate. At Putheri, the parameter for the Electrical conductivity, PH is more than the permissible rate. At Ozhuginasery the value of Electrical conductivity, Dissolved oxygen is more than the permissible rate. At Edalakudi and North Thamaraikulam Electrical conductivity and BOD is more than the permissible rate. At Suchindram.Turbidity,Electrical conductivity Iron and BOD is more than the permissible rate. At Manakudi, Turbidity,TDS, Electrical conductivity, pH Total hardness Magnesium, Potassium, Iron Chloride and BOD is more than the permissible rate (Figure no 1 to 18).

The arithmetic calculation for the water quality index (WQI) values made on the basis of observed values and the standard values of the parameter were presented in (Table no 1 to 7). Inorder to identify the river standards for pollution control and quality management can also be suitably prescribed in terms of the WQI.

Based on the the value of WQI (Table no 2) at sululacode was 33.11 and this area river water found in Good condition. The value of WQI at Putheri was 21.37 and this area river waterfound in excellent condition.WQI at Ozhuginasery was 103.27 and this area river water unsuitable for drinking purpose.WQI at Edalakudi was 79.23 and this area river water in very poor quality. The value of WQI at Suchindram was 144.54 and this area river water unsuitable for drinking purpose (figure no1 to 18).The value of WQI at North Thamaraikulam was 136.14 and this area river water unsuitable for drinking purpose.WQI at Manakudi 53.53 (Table no 3 to 9) and this area river water moderately polluted. The 2011 census total population of seven villages and two urban habitations along this river bank was 3,76,018. Calculation of water supply based on the 135 LPCD, the total quantity of water consuming in above area was 4,55,72,200 litter/ day, and its sewage generation (80% of the consuming water) was 3,64,57,832 litter/day. This much quantity of sewage has been discharged into the Pazhayar river without any treatment. The higher values of WQI[4] is due to the above inflow of Urban waste water let-out in to this river will major cause of ecological damage and pose serious health hazards.

Figure. 1

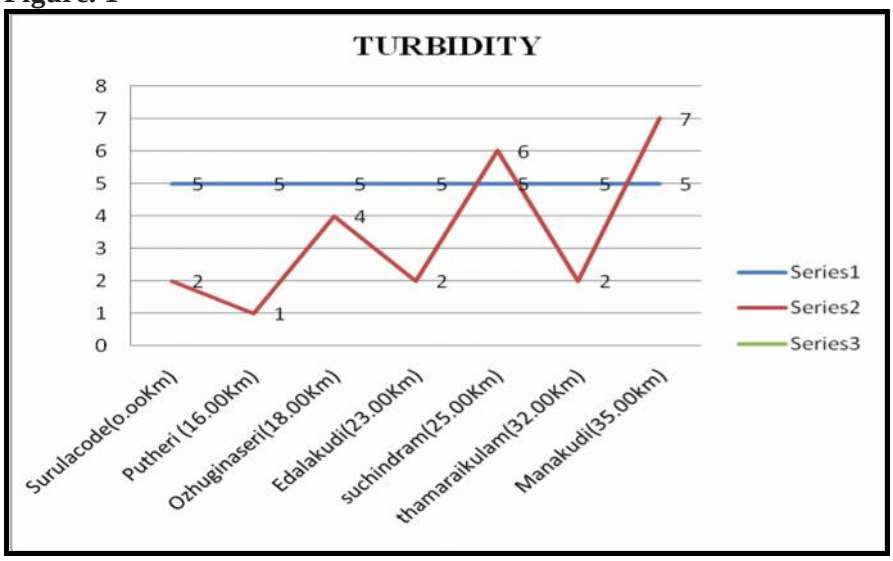

Figure. 2

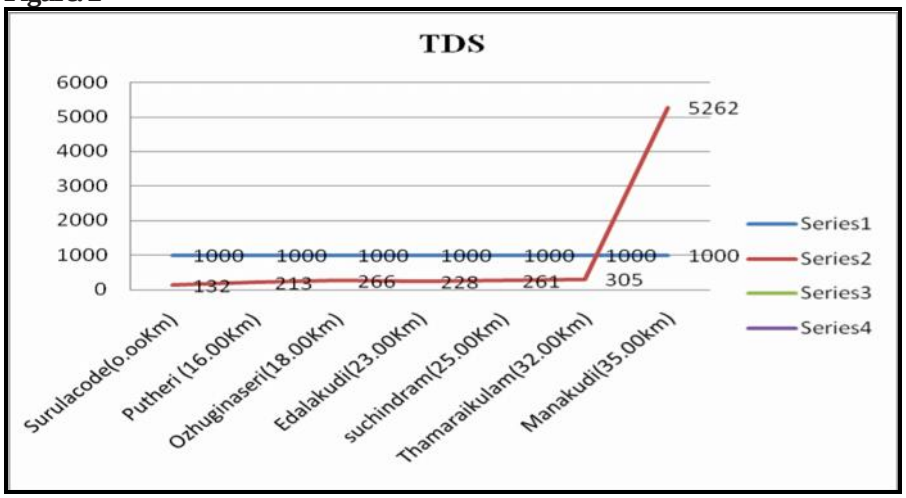

Figure.1 &2 Concentration of Turbidity and Total Dissolved solids compare with the standard value along the river.

Figure.3

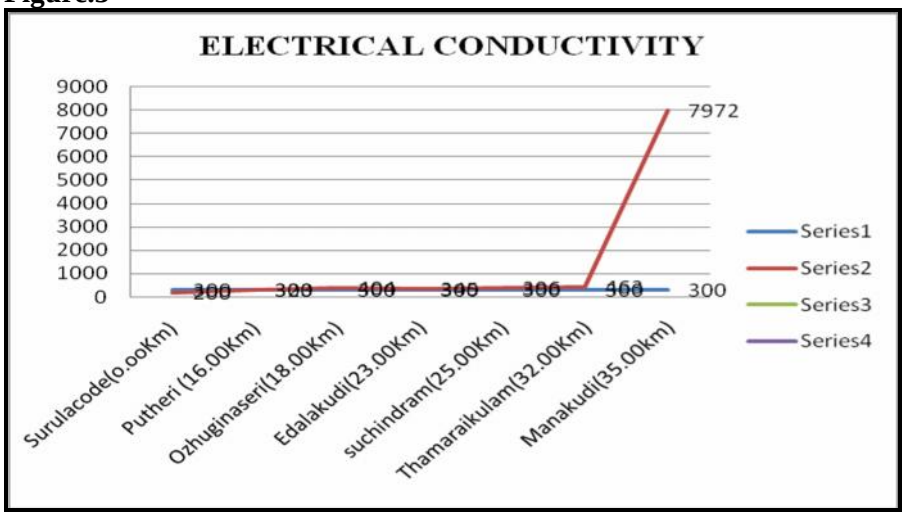

Figure.4

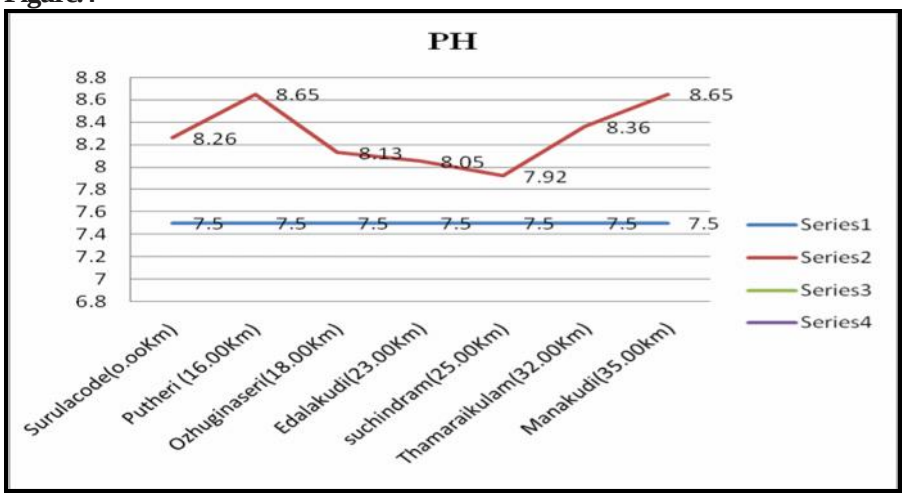

Figure.3& 4 Concentration of Electric Conductivity and pH compare with the standard value along the river compare with the standard value along the river.

Figure. 5

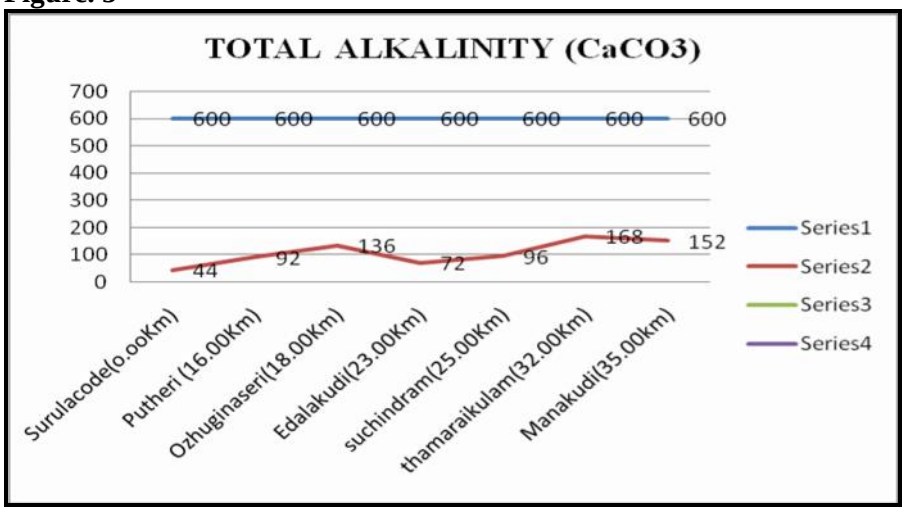

Figure.6

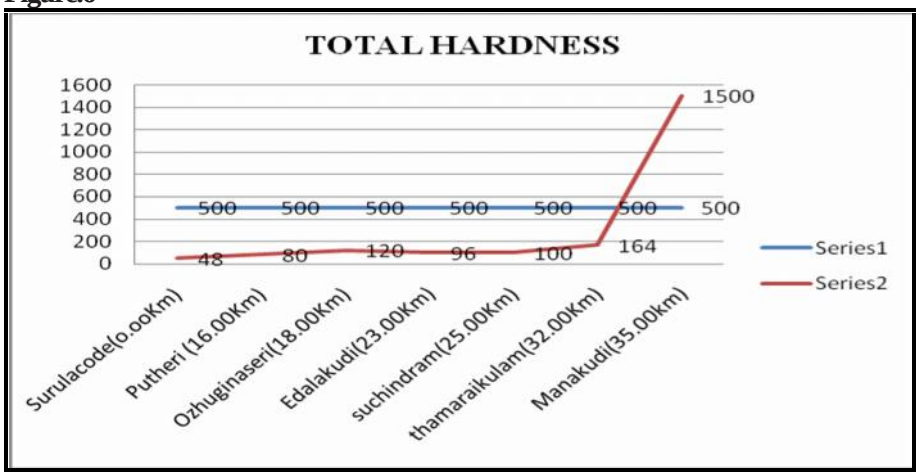

figure.5 &6 Concentration of Total Alkalinity (CaCO3) and total Hardness compare with the standard value along the river.

Figure. 7

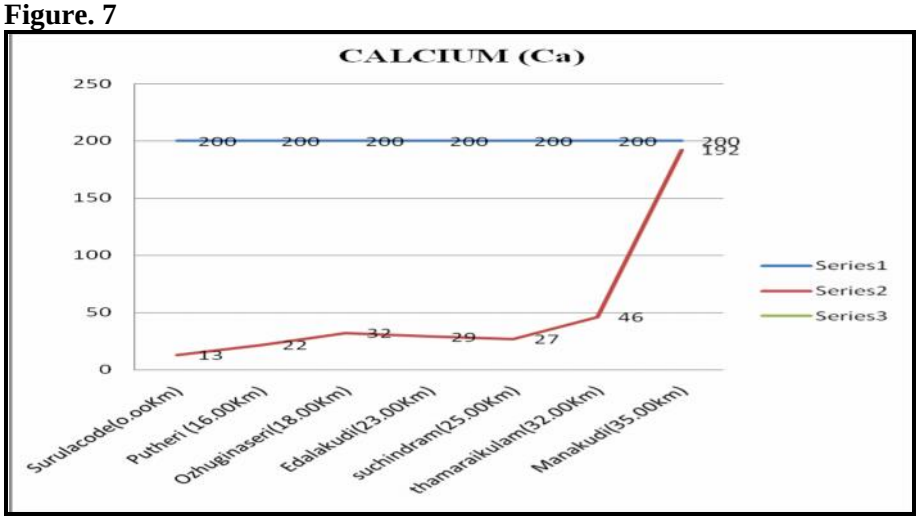

Figure. 8

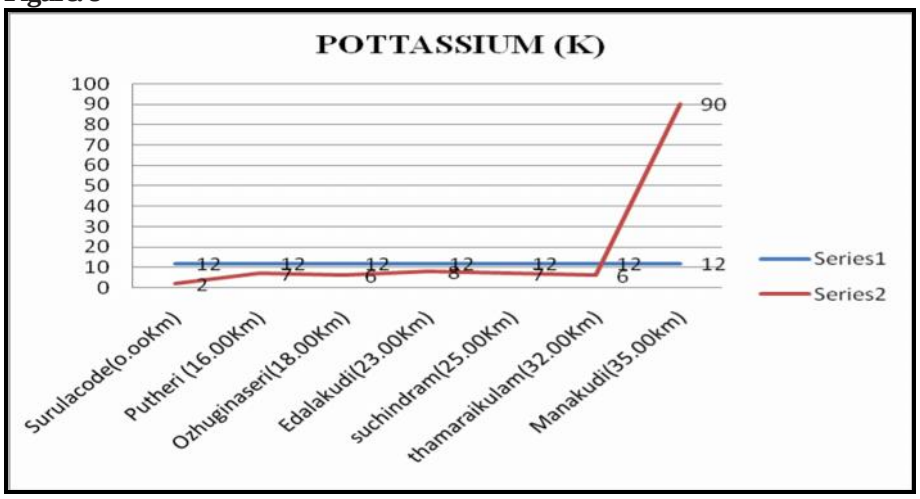

Figure.7&8 Concentration of Calcium (Ca) and Potassium (K) compare with the standard value along the river.

Figure. 9

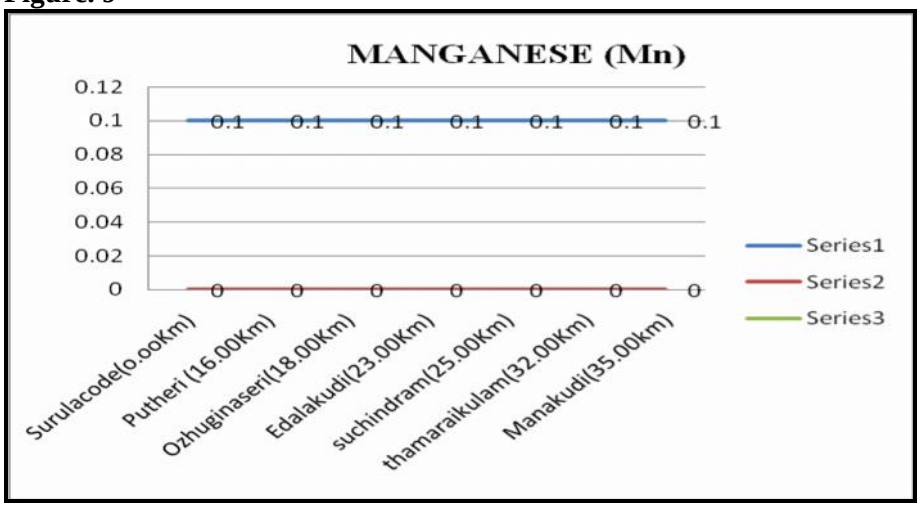

Figure.10

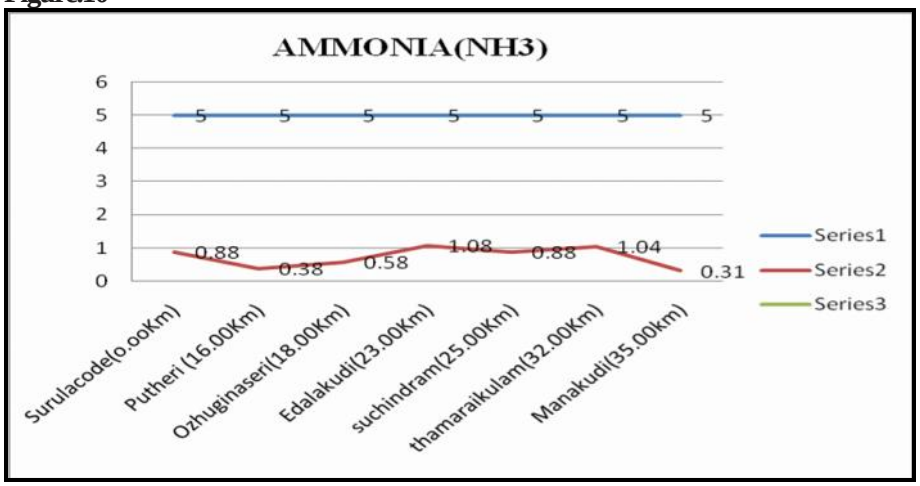

Figure.9 &10 Concentration of Manganese (Mn) and Ammonia (NH_3) compare with the standard value along the river.

Figure. 11

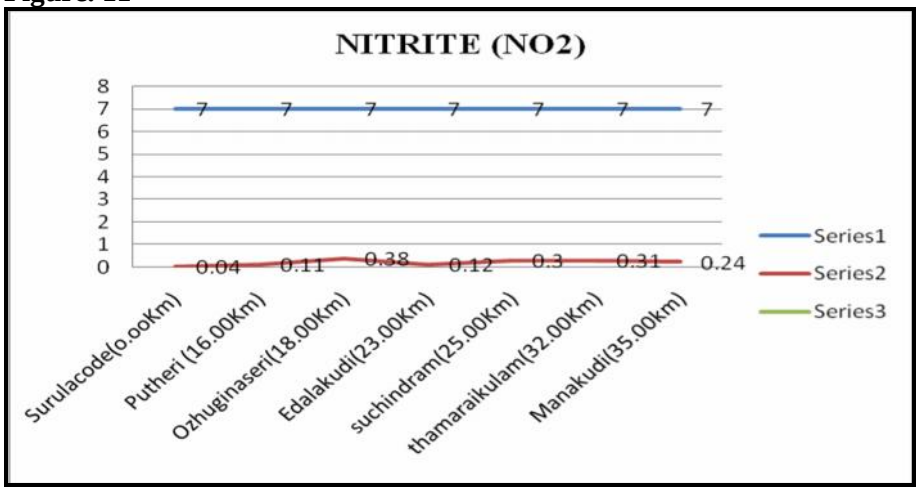

Figure.12

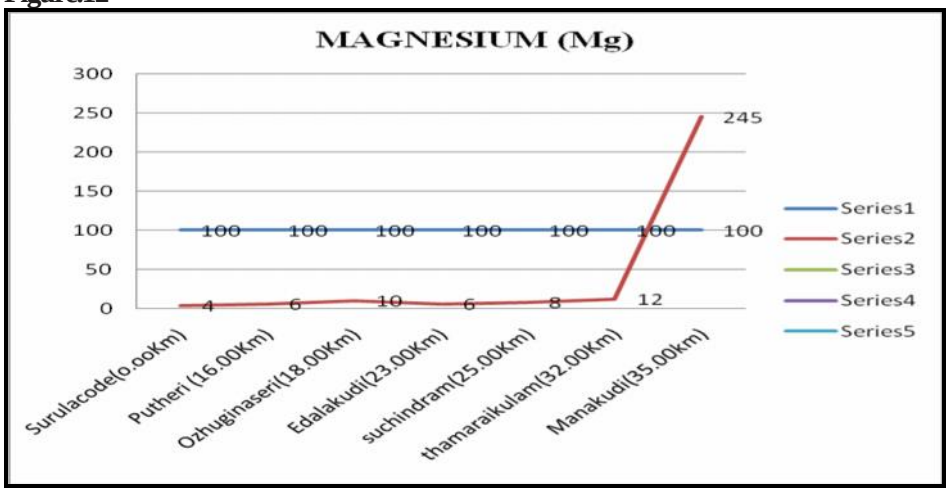

Figure.11& 12 Concentration of Nitrite (NO_2) and Magnesium (Mg) compare with the standard value along the river.

Figure. 13

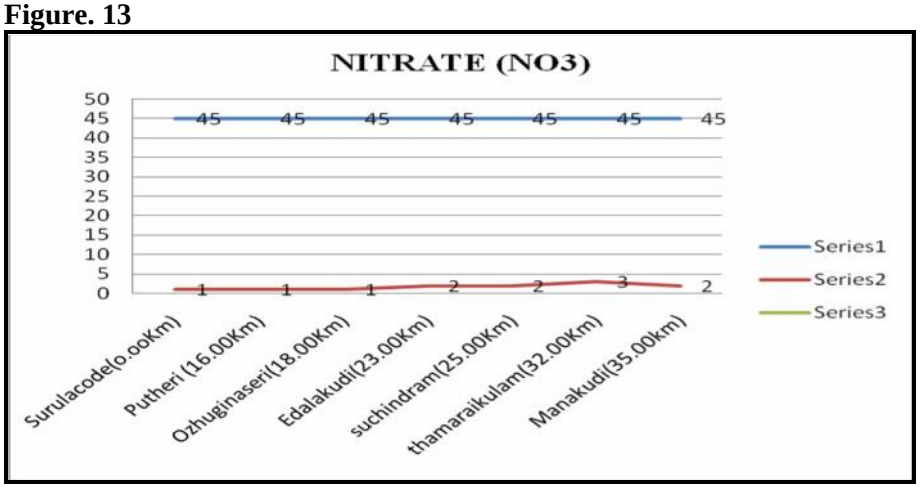

Figure.14

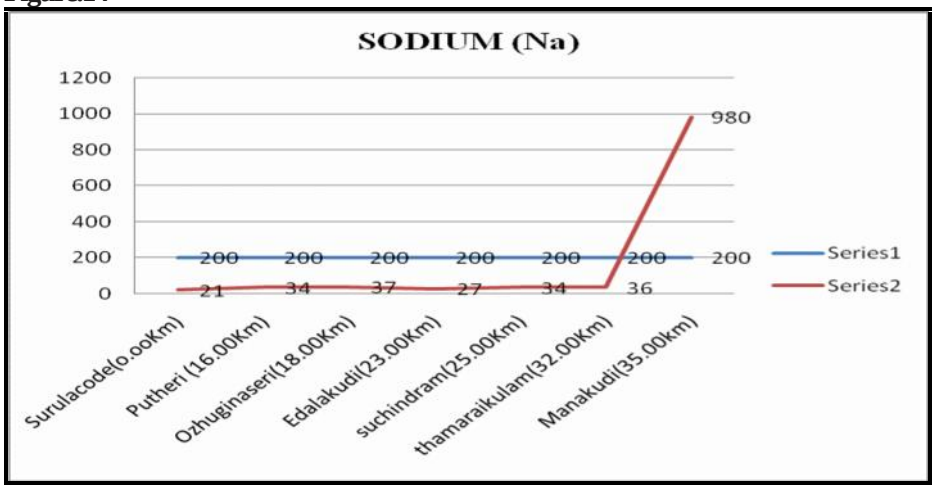

Figure.13 & 14 Concentration of Nitrate (NO_3) and Sodium (Na) compare with the standard value along the river.

Figure.15

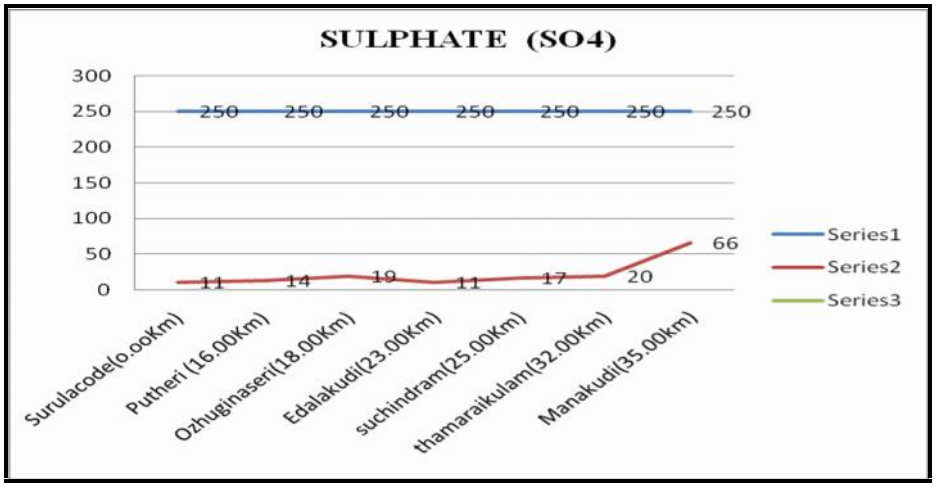

Figure. 16

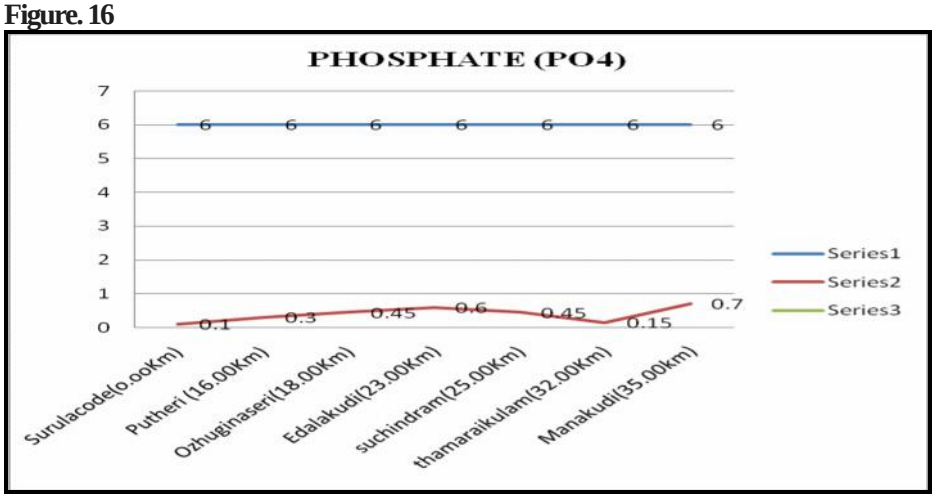

Figure.15 & 16 Concentration of Sulphate (SO_4) and Phosphate (PO_4) compare with the standard value along the river.

Figure.17

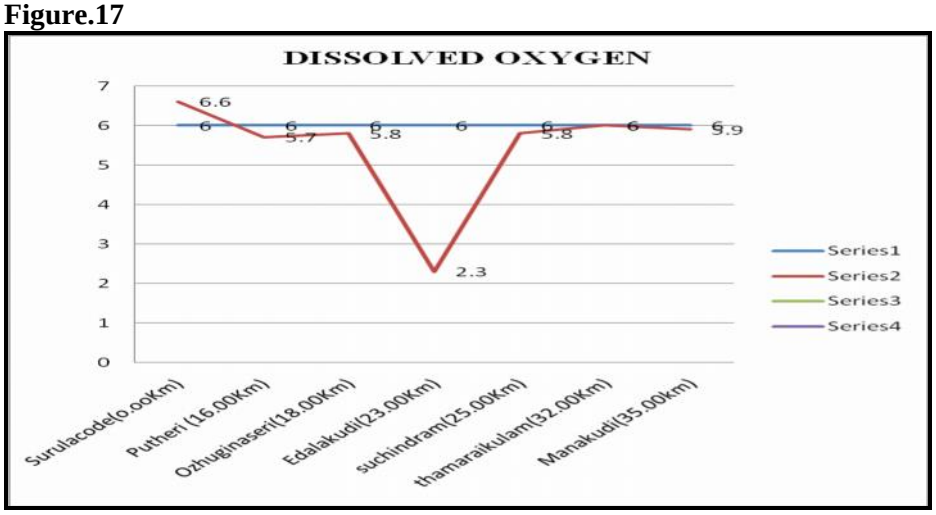

Figure.18

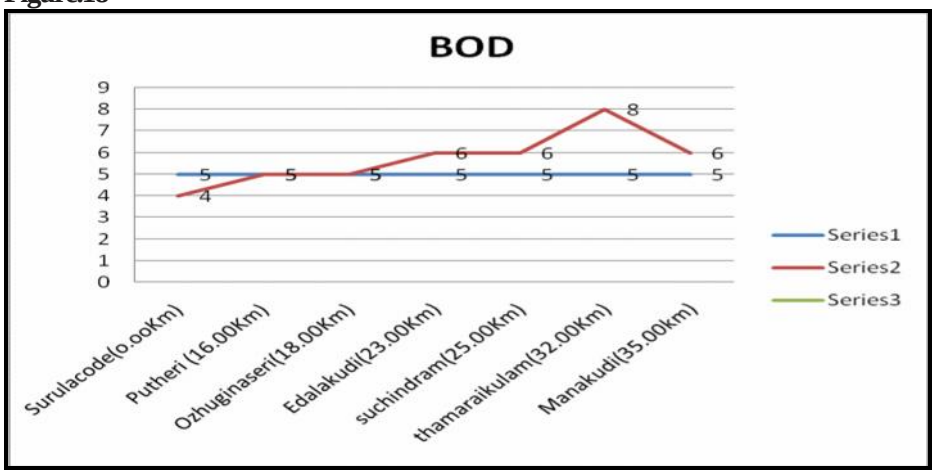

Figure.17 & 18 Concentration of Dissolved Oxygen and BOD compare with the standard value along the river.

Conclusion

The present study concluded that Pazhayar river was polluted in very poor condition.This method of calculating the water quality index shows that it can be used as a useful tool for quick assessment for the river water quality. The average value of the water quality index for Pazhayar riverwas 81.59 indicating that this river is under very poor quality rating. Based on theWQI scale very much necessary to save this river as early as possible[5],It needs to aware local villagers to safeguard the precious river and its surrounding. It is significant to note that the concentration of chemical properties were higher in the water collected from Pazhayar river. People nearby this river largely depend this river source for drinking and domestic purpose. Numerous studies indicate a possible link between water pollution and human disease. The river water from these localities should be avoided totally for drinking and cooking purpose. Adopting proper collection, transporting, treatment, and disposal of waste water system for the adjoining habitations along this river will give the solution in order to protect not only this river, but also to save the Kanyakumari District from the pollution.

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