GIS BASED WATER QUALITY ANALYSIS OF CHALIYAR RIVER

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Abstract: *Assessment of seasonal variations in surface water quality characteristics is an essential aspect for evaluating water pollution due to both natural and anthropogenic influences on water resources. In this study, temporal variations of water quality in Chaliyar river were assessed and an integrated water quality map was created. Water samples from eight locations along the stretch of the river were collected for two seasons and were analysed for physicochemical and microbiological parameters such as pH, turbidity, COD, DO, iron, chloride, nitrate and total coliforms. Variations in these properties for the two seasons were analysed and an integrated water quality map was created using ArcGIS software.*

Keywords **—** Water quality analysis, GIS, IDW interpolation.

1. INTRODUCTION

Water is an utmost necessity for all living organisms. The quality of water is getting worse as a result of the pollution from industrial, agricultural and domestic sources aggravates. This affects health as well as socioeconomic welfare of the region. The uses of streams, rivers, lakes and groundwater are greatly influenced by water quality. Municipal and industrial wastewater discharges and other human activities have transformed pristine natural streams with abundant fish and diverse ecological systems into foul open sewers with few life forms and fewer beneficial uses.

Geographic information system is an organized collection of hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate and display all forms of geographically referenced information. Geographical data describe objects from the real world in terms of their position with respect to a known co-ordinate system, their attributes that are unrelated to position (colour, pH, dissolved oxygen, nitrate) and their spatial interrelations with each other which describe how they are linked together. In GIS, input of data is from maps, aerial photos, satellites, surveys and other sources. Data storage, retrieval and query are possible. Data can then be transformed, analyzed and modelling including spatial statistics can be done. The results can be displayed as maps, reports etc. Thus, with GIS, it is possible to map, model, query and analyze large quantities of data all held together within a single database

2. STUDY AREA

The river Chaliyar is located in India. Chaliyar is the fourth longest river in the state of Kerala at 169 km in length. The Chaliyar is also known as Chulika River or Beypore River as it nears the sea. Nilambur, Edavanna, Areekode, Kizhuparamba, Cheruvadi, Edavannappara, Mavoor, Peruvayal, Feroke and Beypore are some of the towns/villages situated along the banks of Chaliyar. The Chaliyar originates in the Western Ghats range at Elambalari Hills in the Wayanad Plateau of Kerala and flows through Malappuram District for most of its length and then for around 17 km it forms the boundary between Malappuram District and Kozhikode District before entering the city of Kozhikode for its final 10 km journey and finally empties into the Lakshadweep Sea.

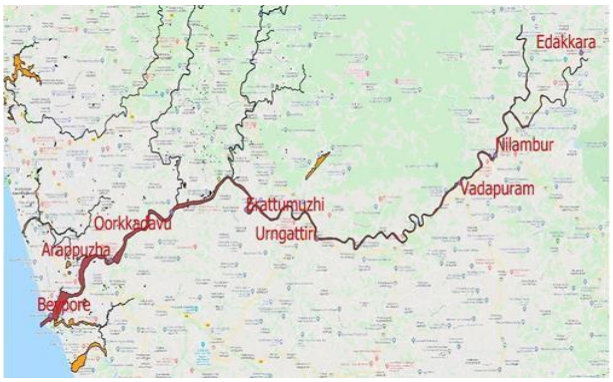

Fig 2.1 Sampling locations in the river

3. METHODOLGY

3.1 Collection of water samples

The water sample were analyzed for various parameters in the laboratory. Various physical and chemical parameters like pH, chloride, nitrate, dissolved oxygen, chemical oxygen demand, turbidity and total coliforms have been measured for the water sample collected from eight sampling points of the river.

Plastic bottles of 1.5 litre capacities were used for collecting samples. Each bottle was washed with distilled water and rinsed with water from sampling points. At each site, water samples were collected from top 30 cm of the water column at the middle of the river. The bottles were filled leaving no air space, and then the bottle was sealed to prevent any leakage. Each container was clearly marked with the name and date of sampling.

Table 3.1 Water quality standards as per IS 10500

No	Parameters	Acceptable Limit	Permissible Limit
1	Chloride mg/l	250	1000
2	COD mg/l	250	-
3	DO mg/l	6.5 =<	-
4	Iron mg/l	0.3	No relaxation
5	Nitrate mg/l	45	No relaxation
6	pH	6.5-8.5	No relaxation
7	Turbidity NTU	1	5
8	Total coliform , MPN/100ml	0	No relaxation

3.2 Water sample analysis

The collected water samples from eight locations monthly were analysed in the laboratory. The analysed parameters are chloride, chemical oxygen demand (COD), dissolved oxygen (DO), iron, nitrate, pH, turbidity, total number of coliforms.

3.3 Geographic Information System

Geographic information system is an organized collection of hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate and display all forms of geographically referenced information. Geographical data describe objects from the real world in terms of their position with respect to a known co-ordinate system, their attributes that are unrelated to position (colour, pH, dissolved oxygen and nitrate) and their spatial interrelations with each other which describe how they are linked together. In GIS, input of data is from maps, aerial photos, satellites, surveys and other sources. Data storage, retrieval and query are possible. Data can then be transformed, analyzed and modelling including spatial statistics can be done. The results can be displayed as maps, reports etc. Thus, with GIS, it is possible to map, model, query and analyze large quantities of data all held together within a single database.

4. RESULTS AND DISCUSSION

Some of the data are collected from Kerala water Authority Kozhikode and remaining data analysis are done in the laboratory. KWA Kozhikode monitor the value of these parameters monthly. This monthly data are converted into Pre-monsoon season and monsoon season. Pre-monsoon season starts from December to May and monsoon season starts from June to November. So, I have here taken the average value from December to may as pre-monsoon season and June to November as monsoon season. Here I am attaching the values of 2018 only.

Table 4.1 Chloride

Sl. No	Name of source	Latitude	Longitude	Chloride 2018 mg/l		Standard mg/l
				Premonsoon	Monsoon	
1	Edakkara	11.3571845	76.3127964	16.6	13.3	250
2	Nilambur	11.284125	76.229358	18.6	12	250
3	Vadapuram	11.263978	76.195761	17	13	250
4	Urangattiri	11.222241	76.059226	18.3	14.3	250
5	Erattumuzhi	11.244049	75.992562	16.1	12.6	250
6	Oorkkadavu	11.242464	75.921591	168.3	72.5	250
7	Arappuzha	11.205738	75.863436	3922	2245	250
8	Beypore	11.164488	75.806171	19637.8	17961.6	250

Table 4.2 Chemical Oxygen Demand

Sl. No	Name of source	Latitude	Longitude	COD 2018 mg/l		Standard mg/l
				Pre monsoon	Monsoon	
1	Edakkara	11.3571845	76.3127964	2.66	0	250
2	Nilambur	11.284125	76.229358	2	0	250
3	Vadapuram	11.263978	76.195761	2.66	0	250
4	Urangattiri	11.222241	76.059226	2.66	0	250
5	Erattumuzhi	11.244049	75.992562	13.41	2.86	250
6	Oorkkadavu	11.242464	75.921591	42.25	13.35	250
7	Arappuzha	11.205738	75.863436	701.83	469.66	250
8	Beypore	11.164488	75.806171	486.5	289.16	250

Table 4.3 Total No: Of Coliforms

Sl. No	Name of source	Latitude	Longitude	Total coliform 2018 MPN/100ml		Standard MPN/100ml
				Pre monsoon	Monsoon	
1	Edakkara	11.3571845	76.3127964	283.66	462.66	0
2	Nilambur	11.284125	76.229358	686.66	517.16	0
3	Vadapuram	11.263978	76.195761	412.66	474.66	0
4	Urangattiri	11.222241	76.059226	444	770.66	0
5	Erattumuzhi	11.244049	75.992562	298.66	949.66	0
6	Oorkkadavu	11.242464	75.921591	35	120	0
7	Arappuzha	11.205738	75.863436	393.33	2301.66	0
8	Beypore	11.164488	75.806171	531.66	941.66	0

Table 4.4 Dissolved Oxygen

Sl. No	Name of source	Latitude	Longitude	DO 2018 mg/l		Standard mg/l
				Pre monsoon	Monsoon	
1	Edakkara	11.3571845	76.3127964	5.95	5.25	6.5-8
2	Nilambur	11.284125	76.229358	6.13	4.43	6.5-8
3	Vadapuram	11.263978	76.195761	5.83	5.05	6.5-8
4	Urangattiri	11.222241	76.059226	6.78	4.71	6.5-8
5	Erattumuzhi	11.244049	75.992562	2.75	5.15	6.5-8
6	Oorkkadavu	11.242464	75.921591	1.61	5.18	6.5-8
7	Arappuzha	11.205738	75.863436	1.92	4.5	6.5-8
8	Beypore	11.164488	75.806171	0.3	3.33	6.5-8

Table 4.5 Iron

Sl. No	Name of source	Latitude	Longitude	Iron 2018 mg/l		Standard mg/l
				Pre monsoon	Monsoon	
1	Edakkara	11.3571845	76.3127964	0.22	0.82	0.3
2	Nilambur	11.284125	76.229358	0.3	1.22	0.3
3	Vadapuram	11.263978	76.195761	0.2	1.58	0.3
4	Urangattiri	11.222241	76.059226	0.6	1.88	0.3
5	Erattumuzhi	11.244049	75.992562	1.39	2.3	0.3
6	Oorkkadavu	11.242464	75.921591	1.44	2.75	0.3
7	Arappuzha	11.205738	75.863436	0.41	0.98	0.3
8	Beypore	11.164488	75.806171	0.54	1.21	0.3

Table 4.6 Nitrate

Sl. No	Name of source	Latitude	Longitude	Nitrate 2018 mg/l		Standard mg/l
				Pre monsoon	Monsoon	
1	Edakkara	11.3571845	76.3127964	2.75	1.33	45
2	Nilambur	11.284125	76.229358	1.37	0	45
3	Vadapuram	11.263978	76.195761	1.18	1.33	45
4	Urangattiri	11.222241	76.059226	0.4	1.33	45
5	Erattumuzhi	11.244049	75.992562	0.07	2.3	45
6	Oorkkadavu	11.242464	75.921591	0.36	2.75	45
7	Arappuzha	11.205738	75.863436	0.48	1.15	45
8	Beypore	11.164488	75.806171	0.62	1.21	45

Table 4.7 pH

Sl. No	Name of source	Latitude	Longitude	pH 2018		Standard
				Pre monsoon	Monsoon	
1	Edakkara	11.3571845	76.3127964	7.68	6.96	6.5-8.5
2	Nilambur	11.284125	76.229358	7.25	7.26	6.5-8.5
3	Vadapuram	11.263978	76.195761	7.27	7.26	6.5-8.5
4	Urangattiri	11.222241	76.059226	7.16	7.4	6.5-8.5
5	Erattumuzhi	11.244049	75.992562	7.72	7.22	6.5-8.5
6	Oorkkadavu	11.242464	75.921591	7.58	7.23	6.5-8.5
7	Arappuzha	11.205738	75.863436	8.23	7.11	6.5-8.5
8	Beypore	11.164488	75.806171	8.16	7.78	6.5-8.5

Table 4.8 Turbidity

Sl. No	Name of source	Latitude	Longitude	Turbidity 2018 NTU		Standard NTU
				Pre monsoon	Monsoon	
1	Edakkara	11.3571845	76.3127964	5.13	5.58	1
2	Nilambur	11.284125	76.229358	9.03	8.63	1
3	Vadapuram	11.263978	76.195761	4.26	9.58	1
4	Urangattiri	11.222241	76.059226	8.51	14.21	1
5	Erattumuzhi	11.244049	75.992562	12.13	29.98	1
6	Oorkkadavu	11.242464	75.921591	7.98	27.9	1
7	Arappuzha	11.205738	75.863436	3.13	15.6	1
8	Beypore	11.164488	75.806171	7.8	24.15	1

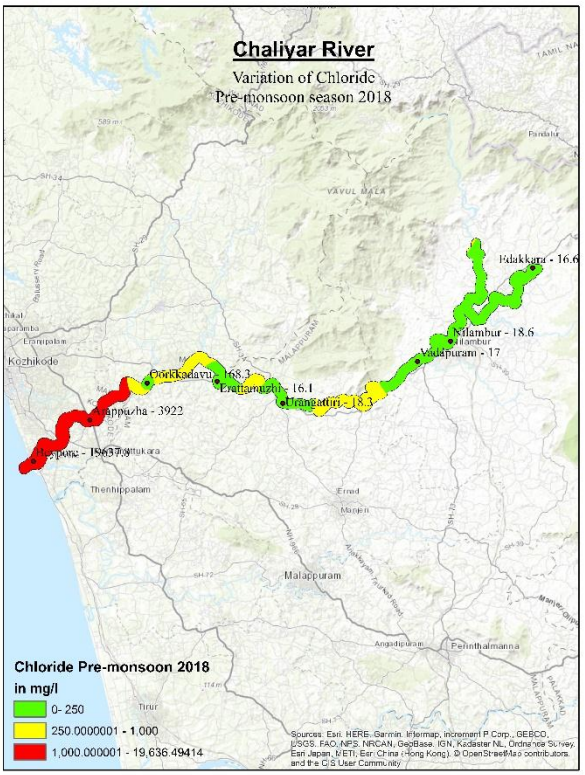

Fig 4.1 Variation of Chloride in Pre-monsoon 2018

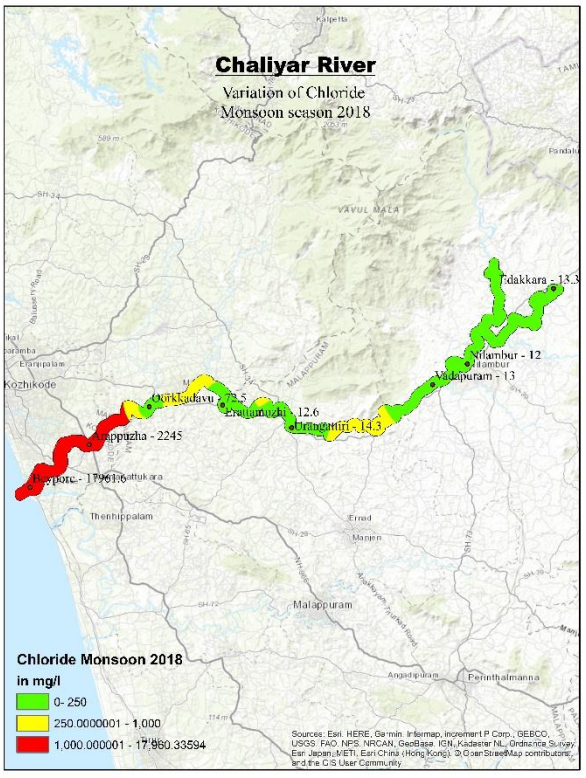

Fig 4.2 Variation of Chloride in Monsoon 2018

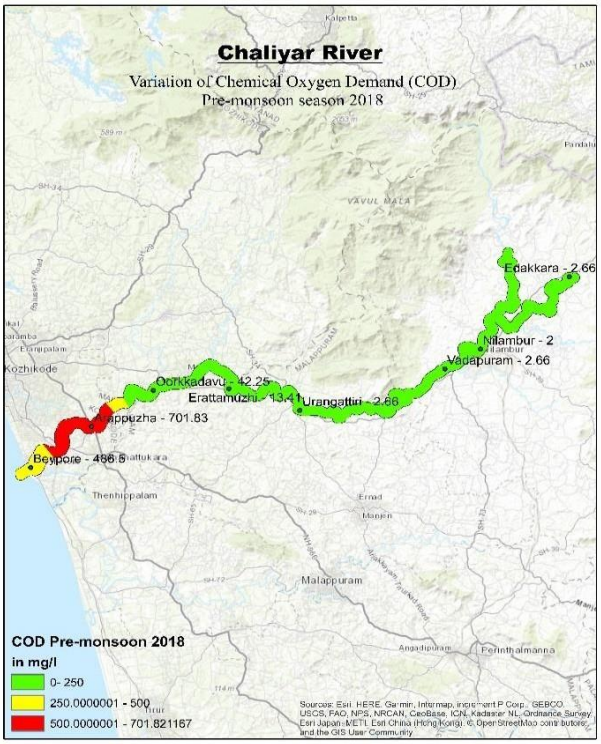

Fig 4.3 Variation of COD in Pre-monsoon 2018

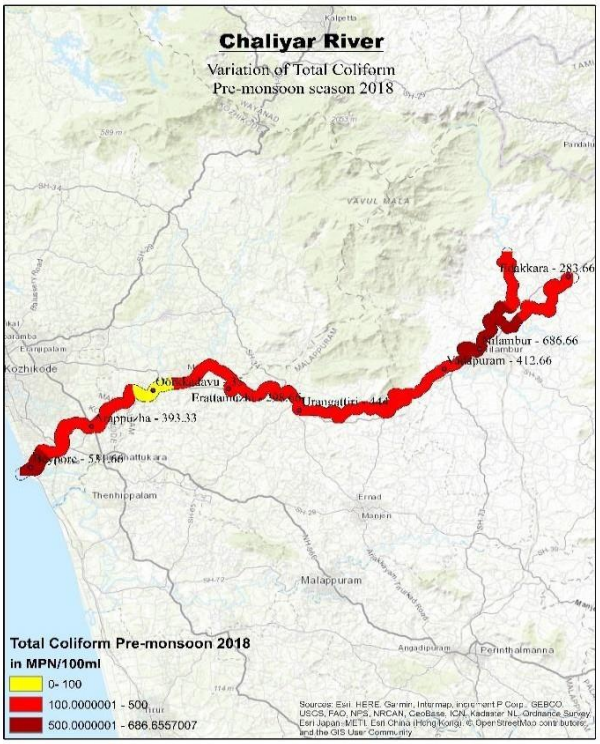

Fig 4.5 Variation of Coliforms in Pre-monsoon 2018

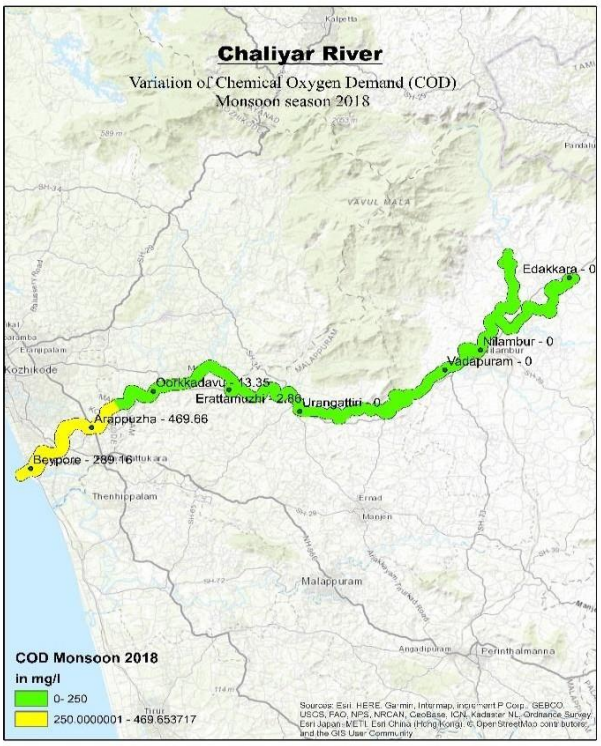

Fig4.4 Variation of COD in Monsoon 2018

Fig 4.5 Variation of Total coliforms in Monsoon 2018

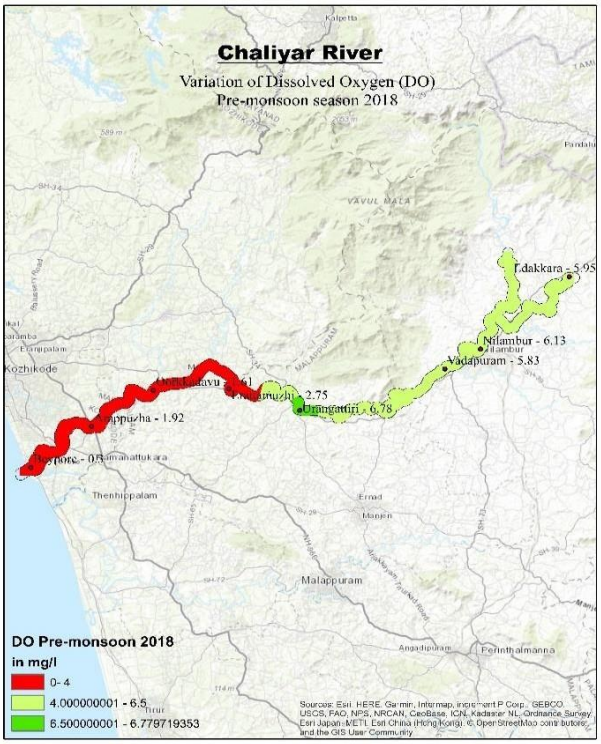

Fig 4.7 Variation of DO in Pre-monsoon 2018

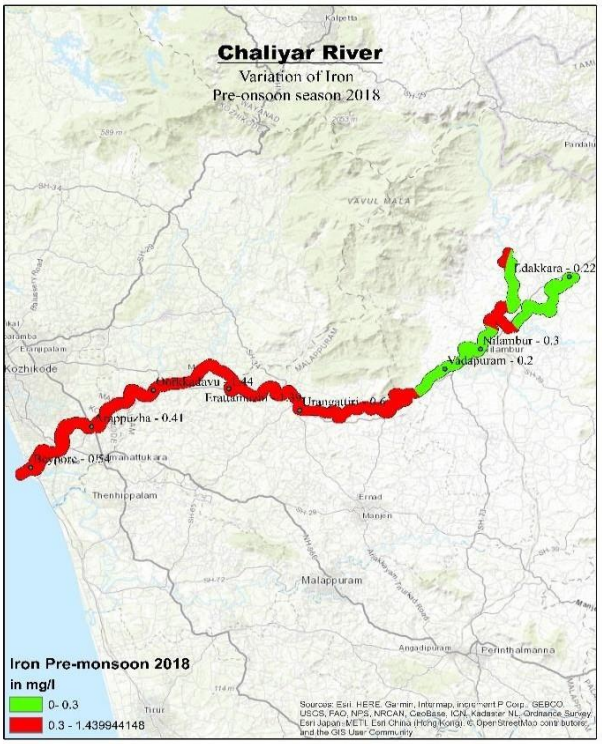

Fig 4.9 Variation of Iron in Pre-monsoon 2018

Fig 4.8 Variation of DO in Monsoon 2018

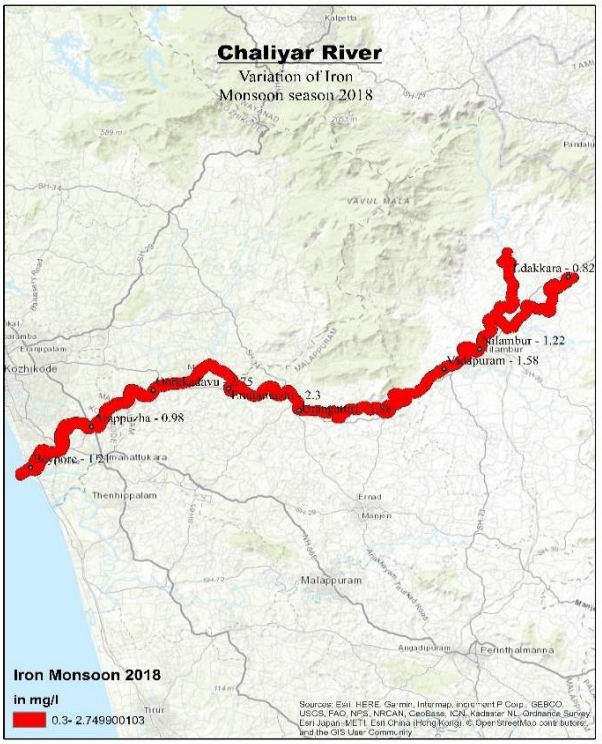

Fig 4.10 Variation of Iron in Monsoon 2018

Fig 4.11 Variation of Nitrate in Pre-monsoon 2018

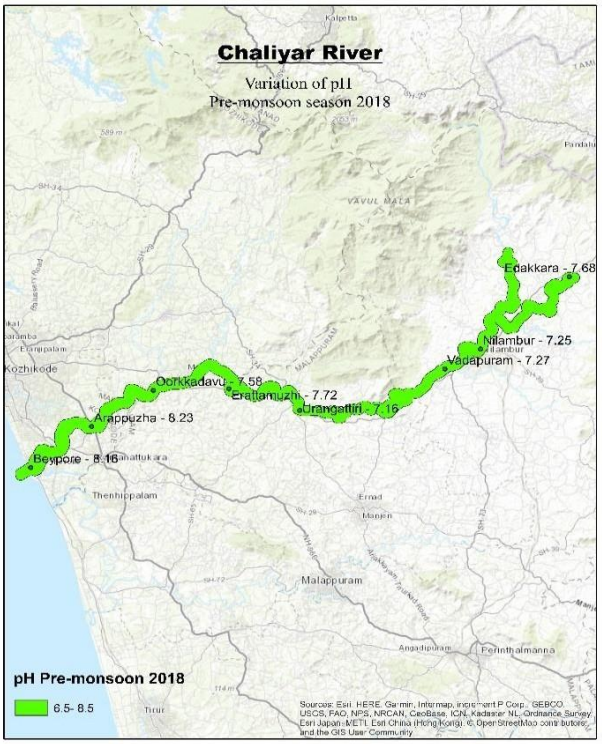

Fig 4.13 Variation of pH in Pre-monsoon 2018

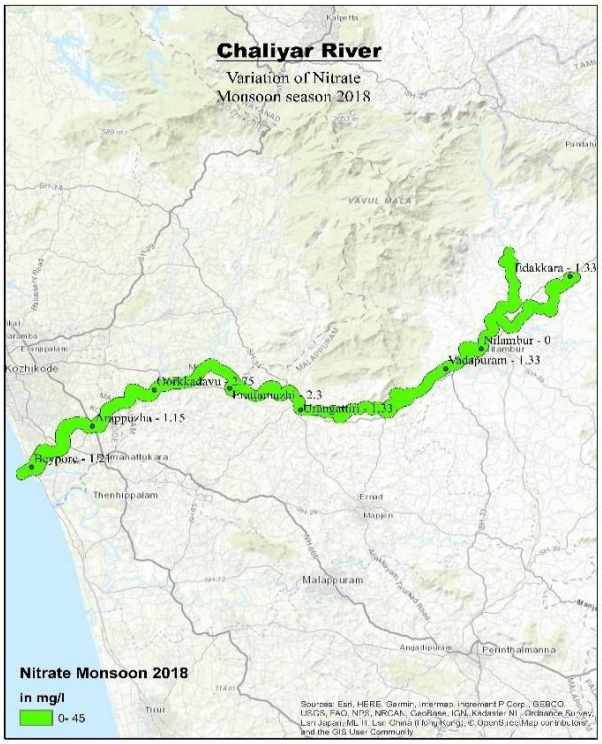

Fig 4.12 Variation of Nitrate in Monsoon 2018

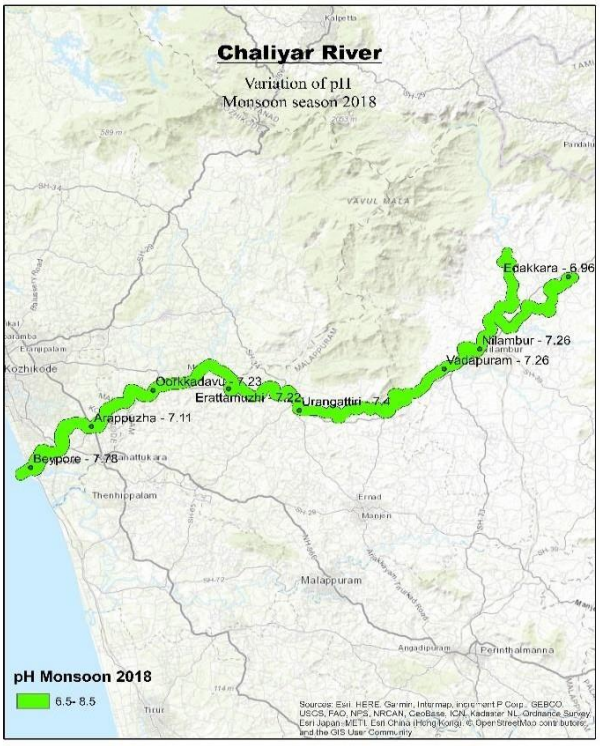

Fig 4.14 Variation of pH in Monsoon 2018

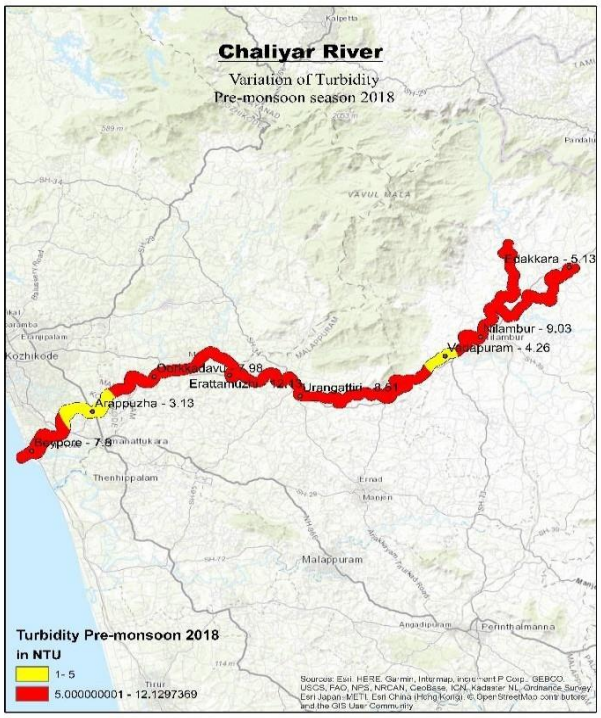

Fig 4.15 Variation of Turbidity in Pre-monsoon 2018

Fig 4.16 Variation of Turbidity Monsoon 2018

4.1 Chloride

Chloride is very high in Beypore and Arappuzha as 19637.8mg/l and 17961.6mg/l respectively in pre-monsoon and monsoon season, because these are very close to sea. Except these two locations chloride is lying under the acceptable limit in all season. A regulator cum bridge is situated at Oorkkadavu. So, there is no chance for intrusion of sea water to upstream of Oorkkadavu point.

4.2 Chemical Oxygen Demand

COD is higher in Beypore and Arappuzha, which shows the water is highly polluted. Beypore and Arappuzha receives lots of waste water from the surroundings and these two locations are nearer to the Kozhikode city. Arappuzha shows a higher COD of 701.83mg/l in pre-monsoon season. General standard for discharge of COD effluent into surface water body is 250mg/l.

4.3 Total No. of Coliforms

In both pre-monsoon and monsoon season the presence of total coliform is very high in all the locations. Coliform bacteria are a group of microorganisms commonly found in soil, surface water, and on plants. They are also present in the intestines of animals and humans. Coliform bacteria that are washed into the ground by rain are usually filtered out as the water goes through the soil and into groundwater systems. The primary sources of fecal coliform bacteria to fresh water are wastewater treatment plant discharges, failing septic systems, and animal waste. Bacteria levels do not necessarily decrease as a watershed develops from rural to urban.

4.4 Dissolved Oxygen

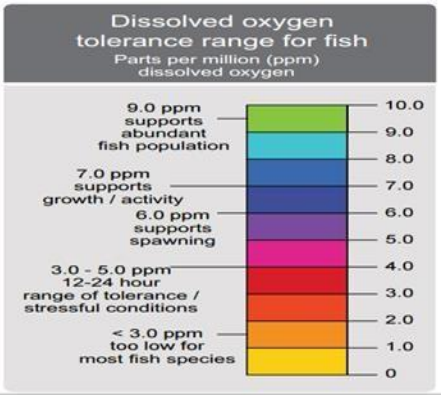

Fig 4.4.1 DO tolerance level in river

Dissolved oxygen level is very low in Beypore, Arappuzha, Oorkkadavu and Erattumuzhi in both seasons. Salinity (saltiness)- Salty water holds less oxygen than

fresh water. Temperature- cold water holds more dissolved oxygen than warm water. It indirectly affects dissolved oxygen concentrations because vegetation shading a stream may decrease water temperatures, and as temperature decreases dissolved, oxygen increases.

4.5 Iron

Iron is very high in both monsoon season. Because rainwater as it infiltrates the soil and underlying geologic formations dissolves iron, causing it to seep into aquifers that serve as sources of groundwater for wells. Iron is mainly present in water in two forms: either the soluble ferrous iron or the insoluble ferric iron. Genaral standard of iron for discharge effluents into surface water is 3mg/l. The iron content is under normal level at Edakkara, Nilambur and Vadapuram during pre-monsoon season.

4.6 Nitrate

Nitrate is lying under normal level in both pre-monsoon and monsoon season. General standard of nitrate for discharge effluents into surface water is 10mg/l.

4.7 pH

In both pre-monsoon and monsoon season the value of pH is under permissible level. General standard of pH for discharge effluents into surface water is 5.5 to 9.

4.8 Turbidity

In monsoon season the turbidity is very high because the runoff water which will carry all the sand particles silt clay etc. into the river and makes the river more turbid. As per revised IS 10500:2012 the maximum allowable turbidity is reduced from 10NTU to 5NTU. In pre-monsoon the turbidity is slightly higher than the normal value.

5.CONCLUSION

The concentration of pH and nitrate are lying under the desirable limit. The value of dissolved oxygen is not in a critical stage and is closer to the desirable limit. The value of chemical oxygen demand is also almost lying under the desirable limit. Iron and turbidity are higher than the normal range in almost all locations. Chloride showing higher values nearer to sea side. Upstream of the river showing the chloride values under the desirable limit. Total number of coliforms are higher in all locations. Proper disinfection method is required for taking the water for drinking purpose.

The problem can be solved only by the installation of adequate treatment plant for the sewage generated especially in the Corporation area. The contamination of the River can be averted only by the proper collection, treatment and disposal of sewage.

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