AN ANALYSIS OF TRIBUTARIES POLLUTION IN TAMIL NADU

Abstract

Due to industrialization, urbanization and economic development the level of pollution in rivers is rapidly rising. The failure to control and prevent the level of water pollution had increased the demand for fresh water. Tamil Nadu, the Southern state India had 17 river basins, of which Cauvery is the major one. Apart from 17 river basins, there are many small rivers and tributaries in Tamil Nadu which are ephemeral in nature joining the major river. The Central Pollution Control Board has identified that nine rivers in Tamil Nadu such as Adyar, Amravati, Bhavani, Cauvery, Palar, Sarabanga, Tambiraparani, Tirumanimutharu and Vasishta ware highly polluted. At this outset the present study aimed to assess the pollutants and parameters viz. temperature, dissolved oxygen, pH, conductivity, B.O.D, fecal coliform and total coliform and its impact on water quality of tributaries in the two districts viz. Erode and Salem. The data source for the present study is Central Pollution Control Board of India. The study has found that the river pollution had occurred in both the districts. The tributaries in Salem district are polluted from the discharge of sewage and effluents from dying and sago industries. In Erode District urban swage and effluents from textile dying units are huge.

Keywords : Tributaries, River Pollution, Fecal Coliform, Total Coliform

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I. INTRODUCTION

Water is one of the vital factors for not only human beings also important for the well-functioning of the ecosystem. The quality of water is mainly affected by anthropogenic activities such as deforestation, farming, mining, industrial and domestic sewage discharges etc. (Ranjeet et al., 2019, Nitasha and Sanjiv, 2014). Unplanned development in the last few decades has completely destroyed the natural system of the rivers (Dhruv Sen Singh, 2017:2). Contamination in water is found increasing due to irresponsibility of public and administrators. Failure in preventing water pollution will increase the demand for fresh water. It is estimated that over half of the world population will be vulnerable to water shortages by 2025 (Kulsreshtha, 1998) and particularly in certain developing countries water demand is likely to exceed its supply by over 50 percent by 2030 (Mckinsey, 2010).

The southern part of India is predominated by the Deccan plateau. The Deccan Rivers or peninsular rivers primarily depend on rainfall. At the time of rainy season these rivers are overwhelming in their course and during the non-rainy season they are dry for the most of the year. Rivers carries large amount of fresh water and it is the major source for restoration of ground water. In Tamil Nadu, a southern state of India has 17 river basins. Cauvery is the only major river basin in Tamil Nadu. Of the remaining 16 river basins, 13 are medium and 3 are minor. And there are number of small rivers and tributaries in Tamil Nadu state which are ephemeral in nature which joins with the major river.

The Central Pollution Control Board (CPCB) identified 351 polluted river stretches in India in 2015. In India the rivers and streams in 31 states and union territories did not meet the water quality criteria (Ashis Senapti, 2021). The tributaries viz. Pandu and Varuna are major cause for increasing pollution in River Ganga at their confluence point (Sowmiya Ashok, 2018). The sub-basin tributaries of the Yamuna contribute 70.9 percent of pollution in the catchment area and remaining 29.1 % account for direct drainage into the Yamuna River through other small tributaries (Raveendra Kumar et al., 2012:18). The latest report of Central Pollution Control Board of India identifies that Coouvam River in Chennai, Tamil Nadu as the most polluted river in India. The report also identified the highly polluted stretches in nine rivers in Tamil Nadu such as Adyar, Amravati, Bhavani, Cauvery, Palar, Sarabanga, Tambiraparani, Tirumanimutharu and Vasishta. The BOD of Vasishta in Salem District was 230 mg per litre (A toxic stew in Chennai: This river is the most polluted river in India now | Chennai News, Times Now (timesnownews.com)). Siddeswaran and Yasotha, 2018 in their study on the impact of Thirumanimutharu river pollution on agriculture production in Salem District revealed that the water quality of the river is not suitable to sustain aquatic life and to agricultural purpose. Major cause for its pollution is the discharge of domestic sewage and the industrial effluents into the river. During the non-rainy season the river caries only waste water with unbearable odour (Saravanan, 2015) and at the time of rain in the city dying units around the city were releasing their untreated effluents illegally into the river. This makes the water extremely bad odorous and hazardous to health which may cause life threatening diseases like cancer and make the water unfit for agricultural purpose. (Shocking visuals! Locals suffer immensely due to toxic froth from Thirumanimuthar River - WATCH (timesnownews.com)). Balamurugan et al., (2020), in his study concludes that the groundwater near the Sarabanga river region based on the Water Quality Index (WQI) value was unfit for domestic purpose and based on irrigation indices it was suitable only for irrigation purposes.

At this outset the present study aimed to assess the contamination of fecal coliform and total other coliform bacteria and its impact on water quality of tributaries in the two districts viz. Erode and Salem with the help of data published by the Central Pollution Control Board of India. Bhavani is the second largest river in Tamil Nadu and it is the major tributary of the Cauvery river. It flows through many districts and towns and the published samples were taken from Erode district. In Salem District the tributaries of Sarabanga, Thirumanimutharu and Vasista are taken for analysis. These tributaries flow through Salem district and joined in Cauvery River.

The concentration of pollutants like temperature, dissolved oxygen, pH, conductivity, B.O.D, fecal coliform and total coliform values were compared with the prescribed limits to measure the level of pollution.

The tolerable limits of the parameters of BOD value in mg/l and fecal Coliform (in MPN/ ml) and their corresponding score given by pollution control board is presented below.

Table 1: Criteria of Water Quality based on B.O.D and Fecal Coliform

S.No.	Mean of BOD (weightage – 70 %)	Score	Mean of Fecal Coliform (weightage - 30 %)
	Mean of BOD (in mg/L)		FC score
1.	> 48	100	>500000
2.	24-48	80	50000 to 500000
3	12-24	60	5000 to 50000
4.	6-12	40	500 to 5000
5.	<6	20	< 500

Source: Central Pollution Control Board of India

Table 2: Category of River Monitoring Location

S.No.	Total Score	Category class of the monitoring location	Category of monitoring location
1.	81-100	Category – I	Critically polluted
2.	61-80	Category – II	Severely Polluted
3.	41-60	Category – III	Moderately Polluted
4.	21-40	Category – IV	Less Polluted
5.	<20	Category –V	Good or Fit For Bathing

Source: Central Pollution Control Board of India

The above table shows the score of river monitoring locations based on the quality of different parameters particularly fecal coliform and total coliform level. This was published by Central Pollution Control Board of India. Based on the score obtained by the location the river water quality is determined. There are five categories grouped in descending order as critically polluted if the total score ranges between 81 to 100 in the category-I, severely polluted if the total score ranges between 61-80 comes under category -II, moderately polluted if the score ranges between 41-60 comes under category -IV, if the water quality

total score ranges between 21-40 is less polluted and the if the score value is less than 20 the water is fit for bathing.

The contamination of fecal coliform bacteria in water indicates that the water has been polluted by direct discharge of humans and animals waste into the water bodies. The CPCB of India has described the category of monitoring location based on tolerable limits of the fecal coliform bacteria, as critically polluted, severely, moderately, less polluted and fit for bathing purpose.

The following table presents the change in basic parameters of the tributaries in the two districts viz. Erode and Salem in Tamil Nadu due to discharge of sewage and other industrial waste over the years from 2012 to 2021. The following table analysed water quality of tributaries in Erode and Salem district based on the 'Water Quality Criteria' given by CPCB of India. Water quality criteria categorized as 'A' can be used for drinking without conventional treatment and disinfection, criteria 'B' can be used for outdoor bathing, criteria 'C' can be used as a drinking water with conventional treatment and disinfection, criteria 'D' suits for propagation of wildlife and fisheries and criteria 'E' indicates water can be used for the purpose of irrigation, industrial cooling and controlled waste disposal based on the parameters of pH, dissolved oxygen and total coliform.

The parameter of pH is essential for human health, wildlife and survival of aquatic ecosystem. According to CPCB of India the standard limit of pH in water is 6.5 to 8.5 for drinking water source without conventional treatment but after disinfection. World Health Organisation has recommended the standard limit of pH as 6.5 - 8.5 for healthy ecosystem. In this study it is observed from table -1 for the last 10 years from 2012-2021, the pH ranged between 7 to 7.8 mg/L in the tributaries of Erode district other except for the year 2014. On the other hand in Salem district the trends in pH from 2012-2021 recorded the mean value of 7.3 to 8.1 mg/L are comes under the standard limit (Fig.1-G and 1-H).

Dissolved Oxygen (D.O.) (in mg/L) is one the important parameter which determines the total amount of oxygen dissolved in the water sample. If the dissolved oxygen level is 6 mg/L or more the river water can be used for drinking without conventional treatment and 5 mg/L or more the water can be used for outdoor bathing. From table-1 it is observed that dissolved oxygen level in the tributaries in Erode district was ranged between 7 mg/L 2012 to 7.1 in 2019 and it was reduced to 5.9 mg/L in 2020 and 2021. This indicates that the water can be used for drinking purpose after conventional treatment and disinfection. The dissolved oxygen level is far below the standard limit which indicates the critical level of pollution in the tributaries of Salem district which was recorded 1.1 in 2012 and 4.9 in 2020-21 except for the year 2013 (Fig.1-E and 1-F).

Table 3: Comparison of Water Quality Criteria in Salem and Erode Districts (Source: computed based on secondary data)

Year	pH	Dissolved Oxygen	Total Coliform	Category	Designated -Best-Use
Erode					
2012	7.7	7.0	213.0	B	Outdoor bathing (Organised)
2013	7.8	8.2	9101.2	E	Not meeting any of the criteria given by CPCB
2014	5.6	5.2	24231.4	E	Not meeting any of the criteria given by CPCB
2015	7.6	6.2	4005.0	C	Drinking water source after conventional treatment and disinfection
2016	7.5	6.5	899.7	C	Drinking water source after conventional treatment and disinfection
2017	7.3	6.0	376.0	B	Outdoor bathing (Organised)
2018	7.1	7.1	355.0	B	Outdoor bathing (Organised)
2019	7.1	7.1	355.0	B	Outdoor bathing (Organised)
2020	7.0	5.9	210.2	B	Outdoor bathing (Organised)
2021	7.0	5.9	210.2	B	Outdoor bathing (Organised)
Salem					
Year	**pH**	**Dissolved Oxygen**	**Total coliform**	**Category**	**Designated-best-use**
2012	7.6	1.1	21,11,740.5	E	Not meeting any of the criteria given by CPCB
2013	8.1	6.3	759444.5	E	Not meeting any of the criteria given by CPCB
2014	7.9	0.5	680652016.5	E	Not meeting any of the criteria given by CPCB
2015	7.8	2.0	380292566.7	E	Not meeting any of the criteria given by CPCB
2016	7.3	2.2	32292566.7	E	Not meeting any of the criteria given by CPCB
2017	7.6	2.5	1267200.0	E	Not meeting any of the criteria given by CPCB
2018	7.3	0.6	160283.3	E	Not meeting any of the criteria given by CPCB
2019	7.4	3.9	1026340.5	E	Not meeting any of the criteria given by CPCB
2020	7.8	4.9	444.3	B	Outdoor bathing (Organised)
2021	7.5	4.2	691.7	C	Drinking water source after conventional treatment and disinfection

Total Coliform includes bacteria that are found in the soil and in the in water that has been influenced by surface water, and in human or animal waste. This will not cause illness but if its presence in the drinking water causes disease. It is observed from the table-1 that in most of the years, water quality in Erode district had been in the category of B which indicates that the water can be used only for outdoor bathing. Category C indicates the usage of water for drinking water source after conventional treatment and disinfection. This category was observed in the year 2015 and 2016. The category E is not meeting with any of the criteria because it exceeds the tolerable limit of total coliform and dissolved oxygen level in the monitoring locations.

In Salem district it is observed that the tributaries are severely polluted. The coliform level is multiple times greater than the tolerable limits with unstable pH and dissolved oxygen level. When comparing the parameters of pH, dissolved oxygen and total coliform with criteria given by pollution control board is not meeting with any of the criteria i.e. the water in these tributaries are polluted severely. The river water cannot be used both for drinking and outdoor bathing purpose. During the years 2019 and 2020 total coliform level has drastically reduced, which may be attributed due to the COVID – 19 lockdown. The published data indicates that the water quality of the tributaries in Salem city was not meeting with any of the criteria given by PCB of India. This indicated the fact that the river water was not fit for human consumption and also affected the ground water in its surrounding area.

Temperature (in ^{o}C) of Tributaries is an essential parameter to regulate the maximum dissolved oxygen concentration in the water which in turn helps to govern all kinds of aquatic life. Temperature in water varies with season, depth and time of the day and night. According to WHO, the required temperature for human health, wildlife and acquatic ecosystem is 25^{o}C. From the figure 1, it is observed that tributaries in Erode district recorded required level of temperature for the last 10 years except 2014. It was below the required temperature of 25 ^{o} C. Trends in temperature of tributaries of Salem district also recorded standard level for the last 10 years from 2012 to 2021.

B.O.D.(in mg/L) is essential for both fishes and other aquatic organisms for their survival. The B.O.D is a biological method buses to measure the total amount of dissolved oxygen consumed by microorganisms for the process of decomposition of organic matter. The B.O.D level helps to identify the level of pollution in water bodies. The high B.O.D level is caused by high consumption of dissolved oxygen by microorganisms. This indicates that the water was severely polluted. The following table presents trends in B.O.D in tributaries of Erode and Salem district of Tamil Nadu.

Fecal Coliform are types of total coliform that mostly exist in feces (https://doh.wa.gov/community-and-environment/). The presence of fecal coliform indicates the contamination of human and animal fecal materials in water bodies. The CPCB of India fixed the limit for fecal coliform and on its basis it categorized level of water pollution.

The following table analyses the water quality of the tributaries based on the B.O.D and fecal coliform in the Erode and Salem Districts.

Table 4: Comparison of Concentration of B.O.D (Mg/L) and Fecal Coliform in Erode and Salem Districts (From 2012 To 2020)
(Source: Compiled from secondary data)

	Erode District				
Year	**Mean of B.O.D**	**Fecal Coliform mean**	**Score**	**Category**	**Category of monitoring location**
2012	1.3	108.2	20	V	Good or fit for bathing
2013	0.9	22153.3	60	III	Moderately polluted
2014	1.2	23414.9	60	III	Moderately polluted
2015	1.6	1263.8	40	IV	Less polluted
2016	2.0	529.6	40	IV	Less polluted
2017	2.1	401.0	20	V	Good or fit for bathing
2018	1.7	113.8	20	V	Good or fit for bathing
2019	1.7	113.8	20	V	Good or fit for bathing
2020	2.2	31.1	20	V	Good or fit for bathing
2021	2.2	31.1	20	V	Good or fit for bathing
Salem District					
Year	**B.O.D Average**	**Fecal Coliform Average**	**Score**	**Category**	**Category of monitoring location**
2012	48.8	6001792.5	100	I	Critically polluted
2013	63.1	1108582.5	100	I	Critically polluted
2014	72.7	910007375.0	100	I	Critically polluted
2015	197.7	156827583.3	100	I	Critically polluted
2016	164.0	18938650.0	100	I	Critically polluted
2017	94.2	709571.7	100	I	Critically polluted
2018	221.8	73400.0	80	I	Critically polluted
2019	53.4	556167.3	100	I	Critically polluted
2020	6.0	246.2	20	V	Good or fit for bathing
2021	20.0	362.7	20	V	Good or fit for bathing

The above table presents the assessment of trends in the water quality of the tributaries in Erode and Salem District based on the parameters of BOD and fecal coliform. The district-wise analysis shows that there was a variation in water quality. In Erode district the mean value of B.O.D in the tributaries has maintained the Standard level of 6 mg/l which indicates that the water is good and can be used for bathing purpose from 2012 to 2021. In terms of the presence of fecal coliform it is observed from the table that the Bhavani river water in Erode district that is fit for bathing purpose and it was moderately polluted from 2017 to 2021. This river was moderately contaminated in 2013 due to the presence of fecal coliform above 22000 (MPN/100ml) and reduced in 2016 to 529 (MPN/100ml) was less polluted.

On the other hand in Salem District the mean value of B.O.D is greater than 48 mg/l which is above the standard level. This indicated that the water was critically polluted from 2012 to 2019 and it was less and moderately polluted in the year 2020 and 2021. The maximum load B.O.D in Vasista river is recorded 230 mg/l in 2019, 10 mg/l in 2020 and 60 mg/l in 2021. Among the 10 major polluted rivers in the state, Vasista in Salem is one of the most polluted river with highest B.O.D (Cooum most polluted river in the country, says CPCB report (dtnext.in). The mean value of the presence of fecal coliform in the tributaries of Salem district is multiple times greater than the standard level described by pollution control board of India. It is observed from the published data of 2012 to 2019 the tributaries of Salem district were critically polluted.

Erode District

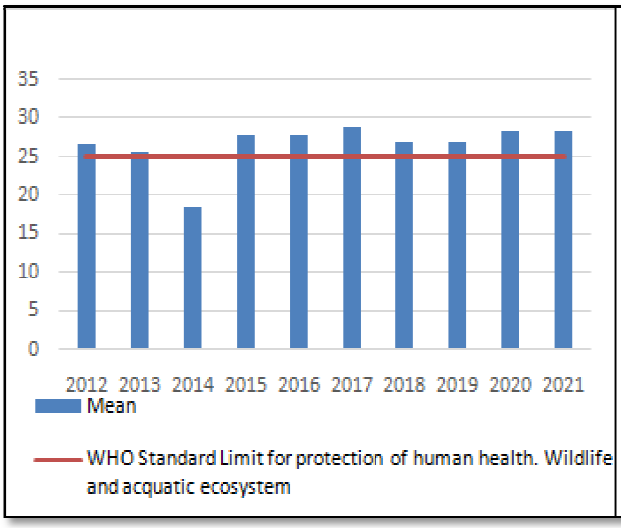

Figure 1: **A** Trneds in Temperature(In Oc) of Tributaries in Erode District

Salem District

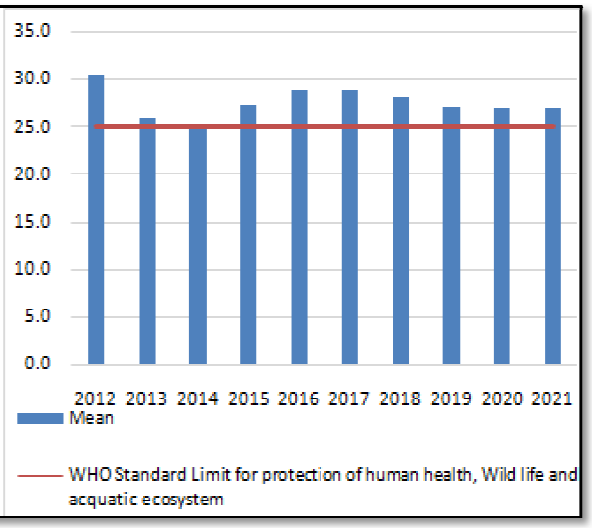

Figure 1: B Trneds in Temperature(In Oc) of Tributaries in Erode District

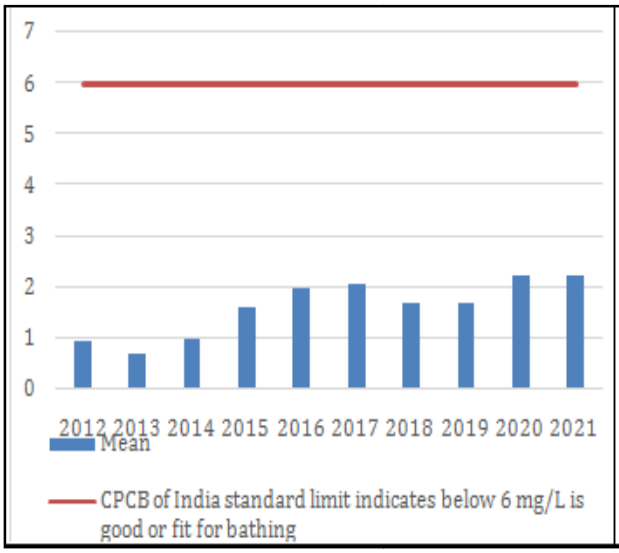

Figure 1: C Trneds in B.O.D (In Mg/L) of Tributaries in Erode District

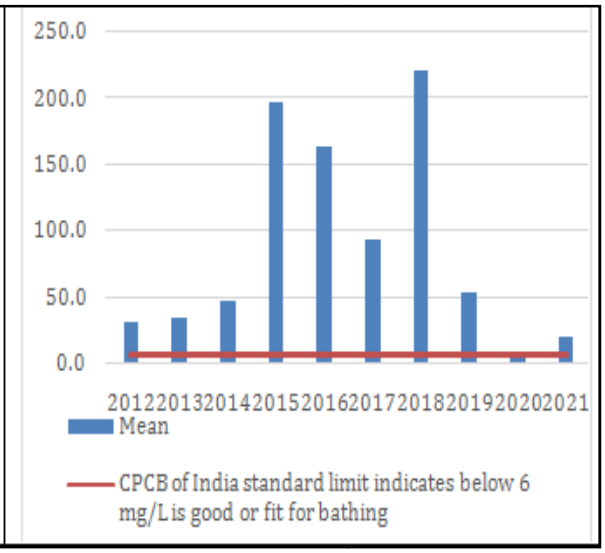

Figure 1: D Trneds in B.O.D (In Mg/L) of Tributaries in Salem District

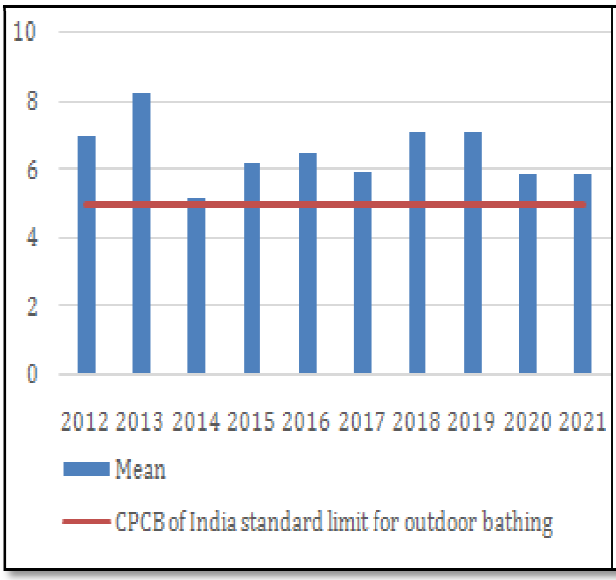

Figure 1: E Trneds in D.O. (In Mg/L) of Tributaries in Erode District

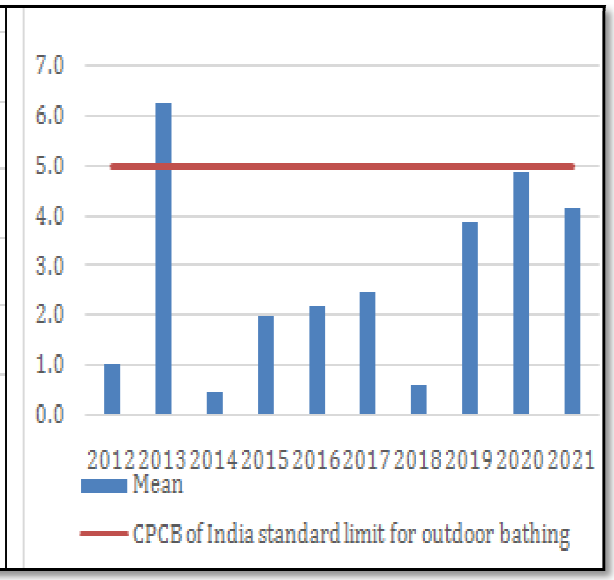

Figure 1: F Trneds in D.O. (In Mg/L) of Tributaries in Salem District

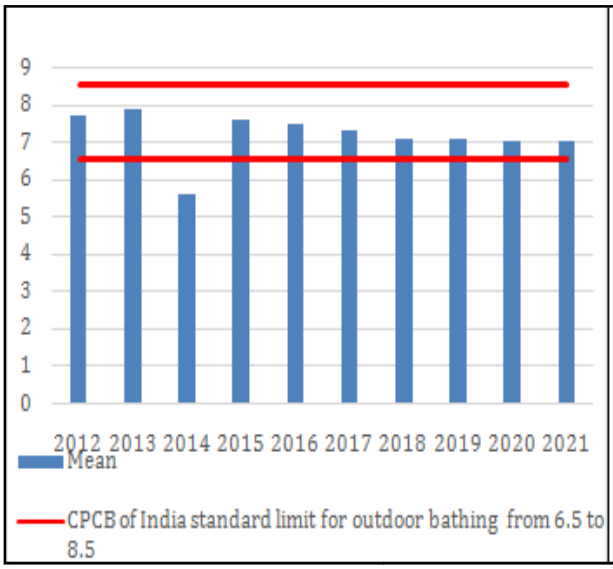

Figure 1: G Trneds in Ph (In Mg/L) of Tributaries in Erode District

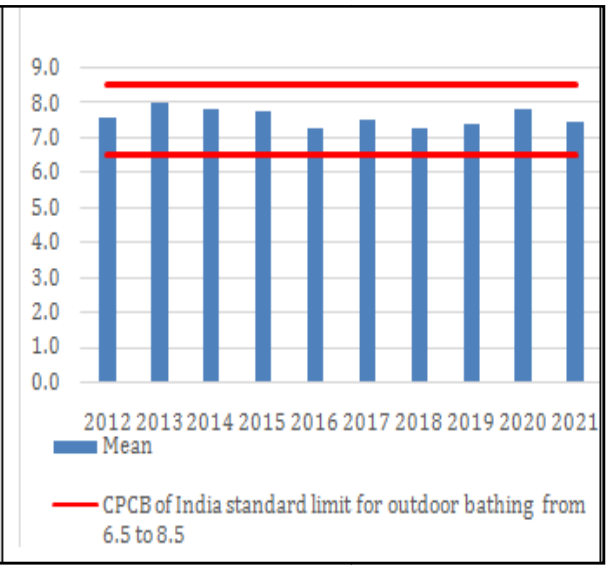

Figure 1: H Trneds in Ph (In Mg/L) of Tributaries in Salem District

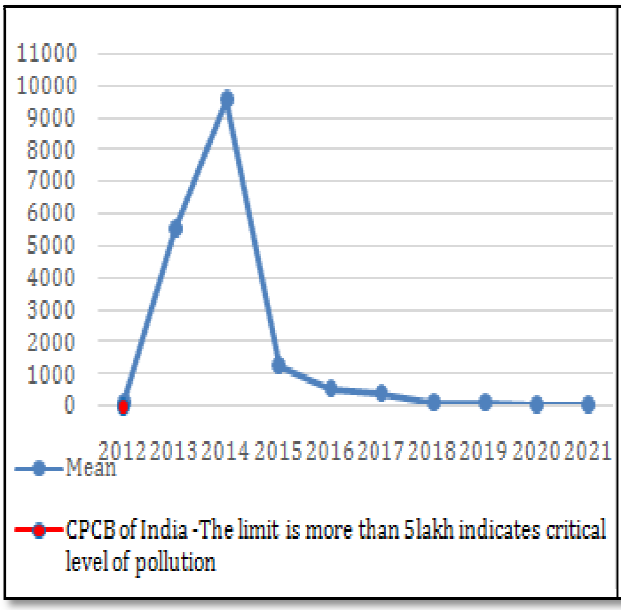

Figure 1: I Trends in Fecal Coliform (In MPN/ Ml) of Tributaries in Erode District

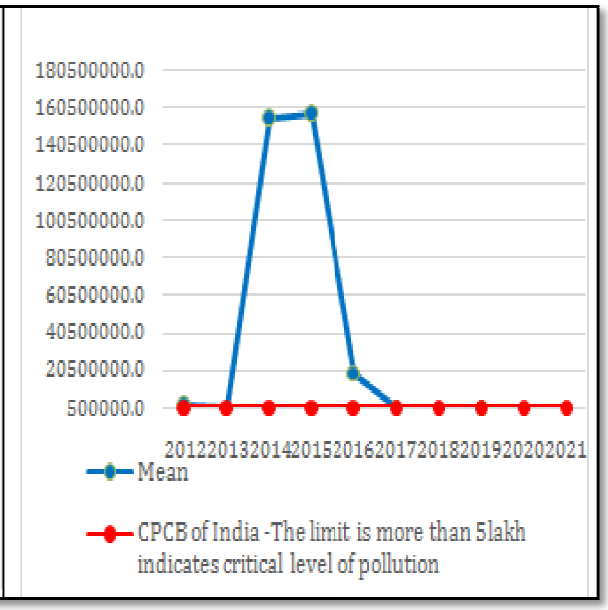

Figure 1: J Trneds in Fecal Coliform of Tributaries in Salem District

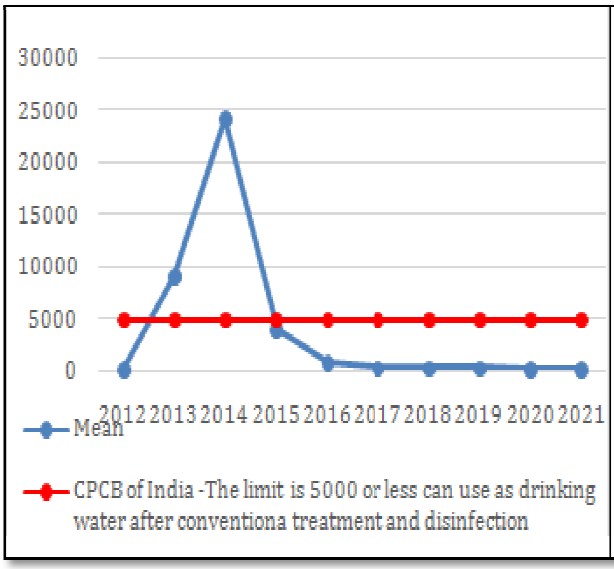

Figure 1: K Trneds in Total Coliform of Tributaries in Erode District

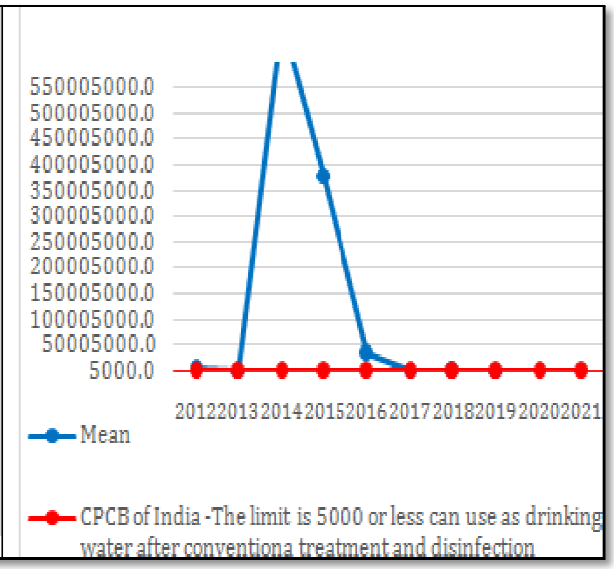

Figure 1: L Trneds in Total Coliform of Tributaries in Salem District

The trends in other parameters of the water quality of the tributaries of Erode and Salem districts are illustrated in the above figures. Based on the standard limit fixed by CPCB of India and WHO for the different parameters, it was found that tributaries in Salem district were critically polluted than the tributaries in Erode district. This may be attributed due to the unplanned urbanization and increase in slum population.

II. MAJOR CAUSES FOR THE POLLUTION IN THE TRIBUTARY RIVERS IN SALEM AND ERODE DISTRICTS

POPULATION GROWTH

The growing population was observed as the major cause for all environmental problems. Populations in developing countries were characterized by high levels of poverty, poor standard of living and increase in slum population without any basic amenities like sanitation facilities, drinking water and sewage facilities. Salem District is one of the most populous and urban agglomerative cities in Tamil Nadu. The size of population Salem district is higher than Erode District. The population of Salem district is characterized by low level of literary and poor standard of living. Corresponding to the poor level of literacy, the lack of awareness about environment was largely observed among public. The following figure compares population growth of two cities.

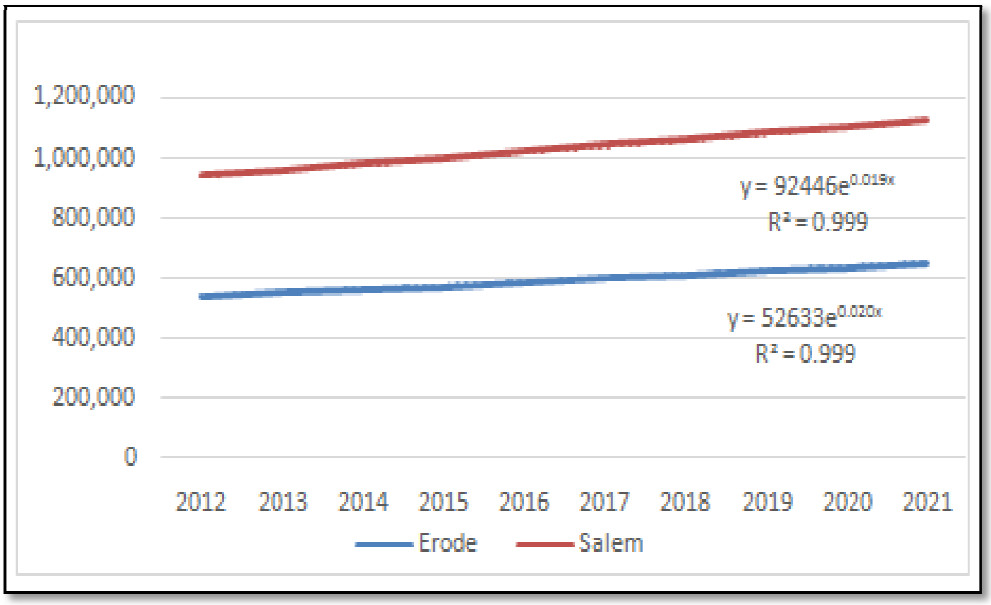

Figure 2 : Trends in Urban Population

III. URBANIZATION

Tributaries and rivers crossing urban areas are found severally polluted. The runoff from streets, discharge of sewage into water bodies and industrial effluents both in the form of solid and liquid waste carrying heavy metals, plastics and chemicals were much higher in the urban areas. This makes the water bodies unfit for human consumption and affects life of aquatic life and makes groundwater pollution.

IV. UNPLANNED URBANIZATION

Several parts of the major cities in India are flooded during rainy season which reflects the unplanned urbanization in the cities of India. According to National Green Tribunal (2019) in India more than 60 per cent of sewage generated by urban India is untreated and discharged into the water bodies which make them severely polluted and unfit for human consumption.

V. COMMUNITY RESPONSIBILITY

Community responsibility plays a vital role in preventing water pollution. Due to lack of awareness about water pollution and its impact by the public makes the river as sewage canal. It is observed from the news published reveals that people in Salem Corporation are dumping garbage and other forms of waste such as meat and fish waste from stalls and illegally discharge of untreated industrial effluents into the tributaries of Sarabanga, Thirumanimutharu and Vashista in the city and its adjacent rural areas. The National Green Tribunals has insisted the Government and TNPCB to take action against industries, individuals and municipal bodies for polluting river (Ngt Orders Monitoring Panel To Check Pollution Of River In Salem | Chennai News - Times of India (indiatimes.com)).

VI. CONCLUSION

The above analysis concluded that though the river pollution had occurred in both the districts, the severity of pollution is much higher in Salem district. The study covered three tributaries in Salem district, which are polluted not only from the discharge of sewage, but also from the direct discharge of effluents from dying and sago industries. Thirumanimutharu, a tributary river in Salem was severely polluted by the industrial effluents from cottage industries such as silver crafts, dying industry and hotels and restaurants. Since the river flows through the urban limits of Salem city, it is hugely polluted by the discharge sewage. Vashita River is mainly polluted by the effluents from sago industry. Salem has been described as a land of sago. The production of sago from tapioca is very much water intensive and the effluent discharge containing higher amount of BOD is also huge, which may cause the higher pollution load in Salem District.

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