Water Quality Dynamics and Sustainability Evaluation of Pamba River, Kerala

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Abstract: **Aquatic ecosystems are facing growing threats due to a variety of anthropogenic activities, which entail urgent need for research and education programmes to create awareness in the society for their protection and conservation. In the present study variations in physico-chemical water quality parameters of the river Pamba, Kerala, India was determined .Pamba river with a length of 176 kms is a major river of Kerala. The Pampa River is the third longest river in the South Indian State of Kerala after Periyar and Bharathappuzha and the longest river in the erstwhile princely state of Travancore. The River Pamba enriches the lands of Pathanamthitta District and the Kuttanad areas of Alappuzha District. The objective of the study was to investigate the seasonal variations of physico-chemical parameters such as temperature, pH, transparency, hardness, salinity, ammonia, carbon dioxide, Dissolved oxygen, Biological Oxygen Demand and Chemical Oxygen Demand. As a part of the investigation, four stations were selected for the study for the assessment of water quality of areas such as Kozhancherry, Aranmulla, Chengannur and and Mannar. Water samples were collected during the year 2016-2017 from the study area and the physico-chemical parameters were analyzed with respect to the seasons following standard methods. The study indicates that there is a pronounced variation of most of the water quality parameters with variations in season. There are numerous causes including increasing number of industries and various other anthropogenic activities in the neighbouring regions, global climatic changes that lead to the degradation of the quality of water. The alteration of these water quality parameters may provide an early warning signal about the ecosystem degradation. The findings of the present study also provide a better understanding of this damaged ecosystem and reminds the need for its restoration.**

***Key words*: Dissolved oxygen, salinity, BOD, COD**

I. INTRODUCTION

Water is, literally, the source of life on earth.Water is also the home to a very wide range of micro flora and micro fauna, creating a fascinating environment of extreme biological importance, but which attracts too little attention. Fresh water is emerging as one of the most critical natural resource issues facing humanity. The quality as well as the quantity of water is deteriorating globally as a result of rapid urbanization, population growth and industrialization. Water quality is a major economic and environmental issue in both developed and developing countries. Rapid industrialization, urbanization and development activities, which aim at coping with the population explosion, bring inevitable water crises. Out of many freshwater sources, rivers are the life lines of our culture and economy.

Pamba River is the third longest river in the South Indian State of Kerala. The river is one of the most stressed rivers in Kerala. Pampa is one of the most important rivers in the South Western Hills of Kerala. The famous shrine of Sabarimala is situated in the hills of Pamba plateau which is one of the most popular pilgrim centers in South India and millions of pilgrims visit the shrine. Lack of sanitary latrines, lack of facilities for sewage collection and treatment, accumulation of wastes discharged from hotels and commercial establishments located at Sabarimala are the major sources for the pollution of Pamba River. The pollution is mainly due to human excreta and biodegradable wastes like used leaves, vegetable wastes, discarded clothes, food wastes etc. Indiscriminate disposal of used plastic bottles forms the major portion of the non-biodegradable waste. The gathering of very large crowds over a short period of time every year in an ecologically sensitive area has given rise to various environmental problems [3]. The daily average sewage generated in Pamba town was seven mld (Mega Litter per Day) and 3.5 mld of untreated sewage. This was being discharged into the Pamba River. The daily average sewage generated in Sabarimala was 10 mld and the entire 10 mld of untreated sewage was being discharged into the river. Survey and Analysis of Pamba River and its Pollution reported that fertilizer and pesticide inflow from agricultural fields and plantations situated in the upland catchment of Achenkovil, Pampa, Manimala and Meenachil Rivers were significant.The study of different water quality parameters such as turbidity, pH, Temperature, Hardness, Biological oxygen demand, Chemical oxygen demand, Carbon dioxide, Salinity, Ammonia, Dissolved oxygen help in understanding the metabolic events of the aquatic system.The present study deals with the assessment of water quality of selected stations of Pamba River such as Kozhancherry, Aranmula, Chengannur and Mannar that would form a reminder to conserve this fascinating ecosystem.

II. MATERIALS AND METHODS

Water samples were collected during the year 2016-2017 from the study area and the physico-chemical

parameters were analyzed. Water samples were collected from four different sites of Pamba River. These regions were facing threat due to high anthropogenic activities. The regions selected for study were Kozhancherry,Chengannur,Aranmula and Mannar. The seasonal variations of physico-chemical parameters such as temperature, pH, transparency, hardness, salinity, ammonia, carbon dioxide, Dissolved oxygen, Biological Oxygen Demand and Chemical Oxygen Demand were determined by following the standard methods of [1].

Study Area

The Pampa River is the third longest river in the South Indian State of Kerala after Periyar and Bharathappuzha and the longest river in the erstwhile princely state of Travancore.Sabarimala temple dedicated to Lord Ayyappa is located on the banks of the river Pampa. The River is also known as "Dakshina Bhageerathi" and "River Baris". The River Pamba enriches the lands of Pathanamthitta District and the Kuttanad areas of Alappuzha District.

Station 1 (Kozhancherry)

Local name – Maramun

Kozhancherry is a census town in Pathanamthitta district of central Travancore region in Kerala state, South India. The place is situated on the banks of river Pamba.The Pamba river bank on the Kozhancherry side has wasted heaped on it, with the waste dumping going on steady from the nearby market. The sewage treatment facility installed at the market five years ago is not fully functional now, treating only a portion of the waste generated.

Station 2 (Aranmula)

Local name -Sathrakadavu

Aranmula, a small village in Pathanamthitta district of Kerala, has many cultural, religious and artistic specialities, unique to itself. Aranmula Uthridathi boat race is conducted on the Pamba River on uthridathi day as part of the religious festival of the nearby Parthasarathi temple. Aranmula kannadi is in the list of UN heritage property. The small town lies by the side of the holly pampa nathi which originates from sabarimala. Fertile wetlands, locally called puncha, rich biodiversity and a soothing climate make Aranmula an apex model of the ecofriendly culture of Kerala.

Station 3 (Chengannur)

Local name – Arattukadavu

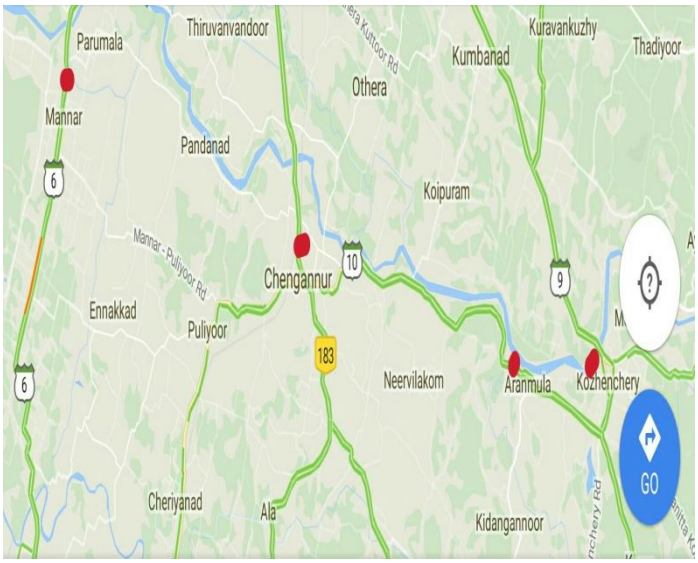
Chengannur is a developing municipal town in the Alappuzha district of the Kerala state. Chengannur is located in the extreme eastern part of Alappuzha, on the banks of Pamba River. Edakadavu Ecotourism Park is situated near the Pamba river banks. Small amount of municipal waste is deposited on the side of the Pampa River.Municipal waste includes cattle waste, domestic waste, plastic bottles. Many house hold waste were openly being dumped into the river.

Station 4 (Mannar)

Local name – Cyclemukku.

Mannar is a small business town situated on the banks of the Pamba River. Mannar is well known for bronze industry, as well as other metals. Mannar cyclemukku have an another important speciality, the River Pamba and Achankovil are joining together at this place and flow as the name Pamba. People depend on this source of river for various activities. The source of pollution were wastes discarded by the people, industrial waste, bathing and washing waste.

MAP SHOWING THE STUDY STATIONS IN PAMBA RIVER



PHOTOGRAPHS SHOWING SELECTED STATIONS OF PAMBA RIVER

STATION 1 (Kozhancherry)

STATION 2 (Aranmula)

STATION 3 (Chengannur)

STATION 4 (Mannar)

III. RESULTS

The study of physico-chemical parameters of selected four stations of Pamba river, station 1 (Kozhancherry), station 2 (Aranmula), station 3 (Chengannur), station 4 (Mannar) of three seasons were analyzed and compared. The physico-chemical parameters of each stations exhibited variations in each period.

Based on it, the temperature showed a minimum range of 29^{o}C and exhibited maximum range of 32.1^{o} C. All these stations showed an average temperature range from 29.1^{o} C – 31.7^{o} C.There was only a slight variation in temperature. A high range of temperature in pre monsoon season was observed in station 3 (32.1^{o}C) and low range was showed in station 4 (31^{o}C). In monsoon period, the temperature range from 30^{o}C to 31.5^{o}C. The temperature of water sample in the post monsoon period range from 29^{o}C to 29.5^{o}C. (Table 1 and Fig 1). The mean ± standard deviation ranges from 29.1 ± 0.25 to 31.7 ± 0.51.

pH range was acidic in nature in all stations in all seasons. From the study, in pre-monsoon season the pH ranged from 5.8 to 6.2.A higher level of pH was observed in station 1 (6.25) and lower pH level in station 3 (5.8).In monsoon season lower pH in station 3 (5.9) and higher pH in station 4 (6.1). The pH of water sample in post monsoon season ranged from 5.9 to 6.1.High range of pH was shown in the station 4 (6.1) and lowest pH was observed in the station 3 (5.9). The average range of pH in all these season ranged from 6 to 6.01.(Table 1 and Fig 2).In pre monsoon period mean± standard deviation was about 6.01 ± 0.18. 6 ± 0.08 range of mean ± standard deviation was observed in monsoon period. In post monsoon period mean ± standard deviation was about 6 ± 0.81.

Transparency range showed variations in all the seasons. Maximum transparency value was noticed about 24.5cm in station 1 of post monsoon season. The minimum range was 11cm in station 3 of pre monsoon season. The average range of transparency was 16.3 to 21.1cm. In pre monsoon season the transparency of water range from 11 to 21cm, high range of transparency was shown in station 1 (21cm) and lowest was obtained in station 3 (11cm). Transparency of water in monsoon season ranged from 13.5 to 19.5cm. A high range of transparency was shown in station 3 (13.5cm) and lowest was observed in station 4 (19.5cm). In post monsoon season the maximum range was observed in station 1 (24.5cm) and minimum range was observed in station 3 (16.5). (Table 1 and Fig 3). The mean ± standard deviation was about 21.1 ± 3.3 to 16.7 ± 2.9.

Hardness of water sample in the pre-monsoon season ranged from 12 mg/l to 22 mg/l. Maximum range was observed in station 2 (22mg/l) and minimum range was observed in station 1 (12 mg/l). Hardness of water sample in monsoon season was nearly 10 mg/l to 20 mg/l. Maximum range was observed in station 2 (20 mg/l) and minimum range observed in station 1 (10 mg/l).In post monsoon season

maximum hardness showed in station 2 & 3 (18 mg/l) and minimum range was observed in station 1 (14 mg/l). (Table 1 and Fig 4). Maximum range of mean ± standard deviation was observed in pre monsoon period (17 ± 4.1) and minimum range was observed in monsoon period (15.5 ± 4.4).

Salinity of water sample in the pre monsoon season ranges from 3.22mg/l to 5.78mg/l. Maximum range was obtained in the station 2 (5.7mg/l) and minimum range obtained in station 1(3.2mg/l).Salinity of water sample in the monsoon season range from 3.2mg/l to 5.7 mg/l. Maximum range was observed in station 2 (5.7mg/l) and minimum range observed in station 3 (3.2mg/l).Salinity of water sample in the post monsoon season showed the maximum range in station 2 (6.4mg/l) and minimum range observed in station 3 (4.18mg/l). (Table 1 and Fig 5).The range of mean ± standard deviation was about 5.3 ± 0.99 to 4.5 ± 1.07.

Ammonia of water sample in the pre monsoon season ranged from 42.5 mg/l to 59.5 mg/l. Maximum range was observed in the station 4 (42.5 mg/l)and minimum range obtained in station 1 (59.5 mg/l). In monsoon season the maximum range was observed in station 1 (55.5 mg/l) and minimum range obtained in station 4 (38 mg/l).Ammonia of water sample in the post monsoon season range from 34 mg/l to 51 mg/l. Maximum range was observed in station 1 (51 mg/l) and minimum range was obtained in station 4 (34 mg/l). Maximum range of standard deviation was observed in pre monsoon season (7.56.) and minimum range in post monsoon period (7.2). (Table 1 and Fig 6). In pre monsoon period the mean ± standard deviation was observed to be nearly 49.5 ± 7.56. 46 ± 7.5 in monsoon period. In post monsoon period the range of mean ± standard deviation was about 41.5 ± 7.2.

Carbon dioxide of water sample in pre-monsoon season showed the maximum range in station 4 (7.9mg/l) and minimum range was observed in station 1 (4.4mg/l). In monsoon season the carbon dioxide of water sample was observed maximum in station 2 (7.9mg/l) and minimum range was observed in station 4 (5.2 mg/l).Carbon dioxide of water sample in post monsoon season range from 4.4 mg/l to 12.3 mg/l. Maximum range was observed in station 1 (12.3mg/l) and minimum range observed in station 3 (4.4mg/l). (Table 1 & Fig 7). The maximum range of mean ± standard deviation was found in post monsoon period (8.1 ± 3.32) and minimum range was observed in pre monsoon period (6.61 ± 1.6).

Dissolved oxygen of water sample in the pre monsoon season, maximum range was obtained in station 1 (5mg/l) and minimum range of dissolved oxygen was obtained in station 4 (4mg/l).Dissolved oxygen of water sample in monsoon season range from 7.3mg/l to 9.6 mg/l. Maximum range was observed in station 1 and 3 (9.6 mg/l) and minimum range in station 4 (7.3mg/l). Dissolved oxygen of water sample in the post monsoon season showed maximum range in station 1(8.3 mg/l) and minimum range was observed in station 2 and 4 (7.04mg/l). (Table 1 and Fig 8). The range of mean ± standard deviation was about 4.45 ± 0.42 to 8.7 ± 1.1.

Biological oxygen demand of water sample in the pre monsoon season ranges from 4.4mg/l to 6.04mg/l. Maximum range was observed in station 3 (6.04 mg/l) and minimum range was noticed in station 1(4.4mg/l) .In monsoon season biological oxygen demand ranges from 0.8mg/l to 1.92mg/l. Maximum range was observed in station 2 (1.92mg/l) and minimum range was observed in station 4 (0.8mg/l). Biological oxygen demand of water sample in the post monsoon season ranges from 1.16mg/l to 3.2mg/l. Maximum range was observed in station 2 (3.2mg/l) and minimum range was observed in station 4 (1.16mg/l).Standard deviation of Biological oxygen demand in pre monsoon was 0.8 and in monsoon 0.4. (Table 1 & Fig 9). The maximum range of mean ± standard deviation was observed in pre monsoon period (5.21 ± 0.8) and minimum range was observed in monsoon period (1.36 ± 0.49).

Chemical Oxygen Demand of water sample in post monsoon season ranges from 17.7mg/l to 53.2mg/l. Maximum ranges was obtained in station 1 (53.2mg/l) and minimum was obtained in station 2 (17.7mg/l). In monsoon season the maximum range was observed in station 1 (51.9mg/l) and minimum range was observed in station 2 (17.9mg/l). Chemical oxygen demand of water sample in post monsoon season ranges from 16.8mg/l to 35.5mg/l. (Table 1 & Fig 10). The mean ± standard deviation was range from 30.9 ± 15.6 to 32.01 ± 16.1.

TABLE-1

SEASONAL VARIATIONS OF PHYSICO- CHEMICAL PARAMETERS

PARAMETRS	SEASONS	STATION 1	STATION 2	STATION 3	STATION 4	MEAN ± SD
Temperature (^{o}C)	Pre monsoon	32	32	32.1	31	31.7± 0.51
	Monsoon	31	30	31	31	30.7 ± 0.5
	Post monsoon	29	29.5	29	29	29.1 ± 0.25
pH	Pre monsoon	6.52	6	5.8	6	6.01 ± 0.18
	Monsoon	6	6	5.9	6.1	6 ± 0.08
	Post monsoon	6	6	5.9	6.1	6 ± 0.81

Transparency (cm)	Pre monsoon	21	17	11	16.5	16.3 ± 4.1
	Monsoon	19	15	13.5	19.5	16.7 ± 2.9
	Post monsoon	24.5	22	16.5	21.5	21.1 ± 3.3
Hardness (mg/l)	Pre monsoon	12	22	16	18	17 ± 4.1
	Monsoon	10	20	14	18	15.5 ± 4.4
	Post monsoon	14	18	18	16	16.5 ± 1.9
Salinity (mg/l)	Pre monsoon	3.2	5.7	4.8	4.1	4.5 ± 1.07
	Monsoon	4.1	5.7	3.22	4.8	4.5 ± 1.07
	Post monsoon	4.8	6.4	4.1	5.7	5.3 ± 0.99
Ammonia (mg/l)	Pre monsoon	59.5	51	45	42.5	49.5 ± 7.56
	Monsoon	55.5	48	42.5	38	46 ± 7.5
	Post monsoon	51	42.5	38	34	41.5 ± 7.2
CO_2 (mg/l)	Pre monsoon	4.4	7.04	5.2	7.9	6.16 ± 1.6
	Monsoon	10.56	7.9	6.1	5.28	7.48 ± 2.3
	Post monsoon	12.32	8.8	4.4	7.04	8.1± 3.32
Dissolved oxygen (mg/l)	Pre monsoon	5	4.3	4.52	4	4.45 ± 0.42
	Monsoon	9.6	8.32	9.6	7.36	8.7 ± 1.1
	Post monsoon	8.32	7.04	8	7.04	7.6 ± 0.65
BOD (mg/l)	Pre monsoon	4.4	4.5	6.04	5.9	5.21 ±0.8
	Monsoon	1.6	1.92	1.12	0.8	1.36 ± 0.49
	Post monsoon	1.92	3.2	1.6	1.1	1.97 ± 0.87
COD (mg/l)	Pre monsoon	53.28	17.76	35.52	21.5	32.01 ± 16.1
	Monsoon	51.9	17.9	34.5	21.1	31.35 ± 15.4
	Post monsoon	51	16.8	35.52	20.5	30.9 ± 15.6

FIGURES

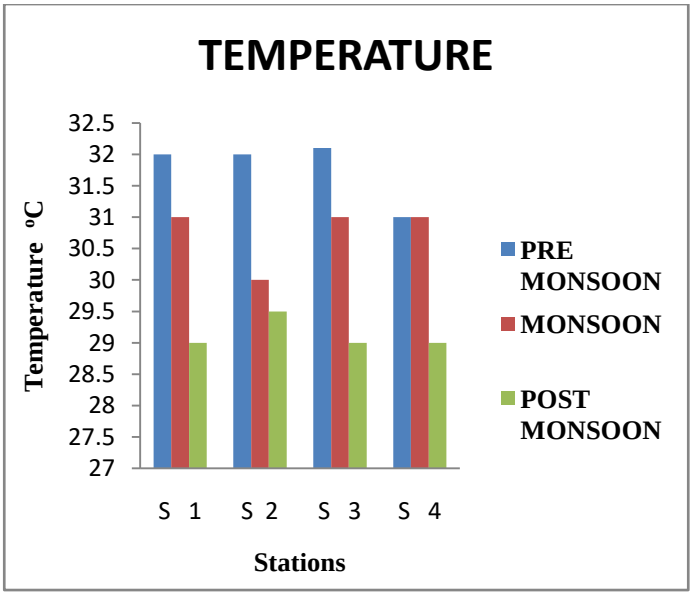


Fig 1: Graph showing seasonal variations of temperature

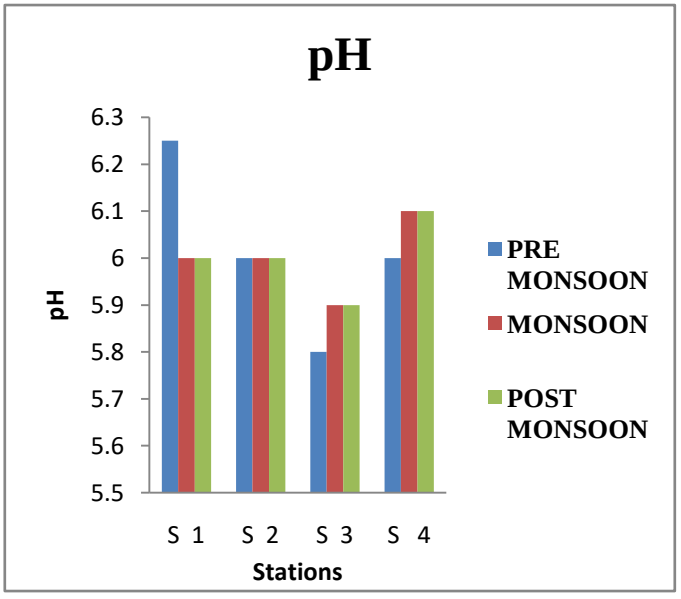


Fig 2: Graph showing seasonal variations of pH

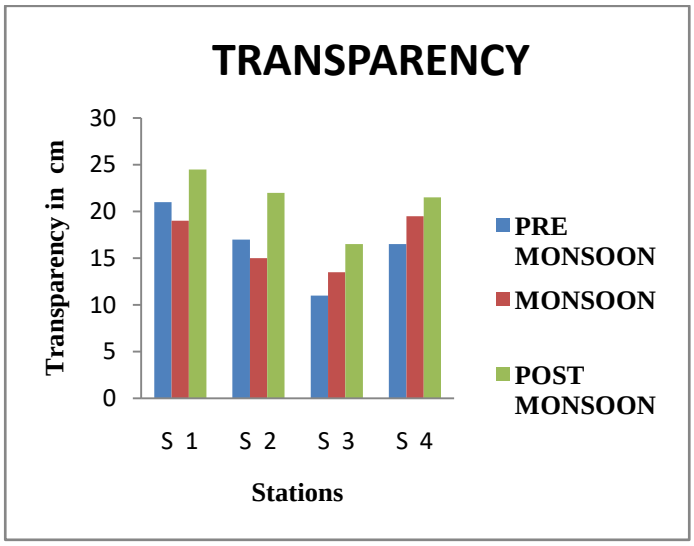


Fig 3: Graph showing seasonal variations of turbidity

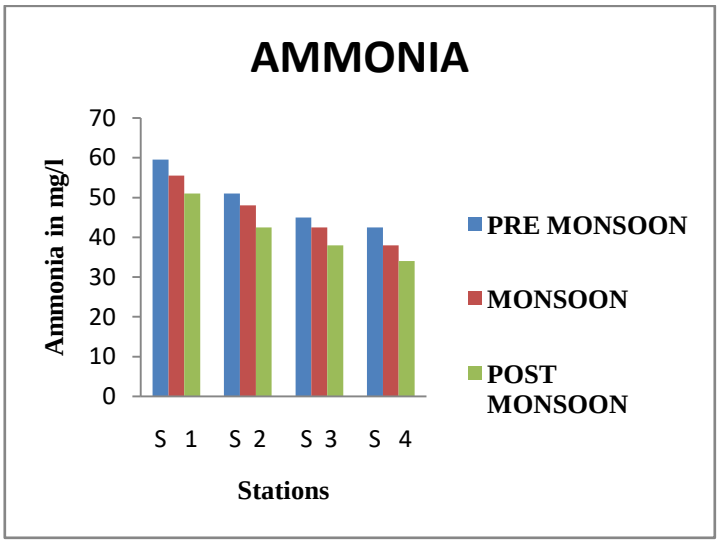


Fig 6: Graph showing seasonal variations of ammonia

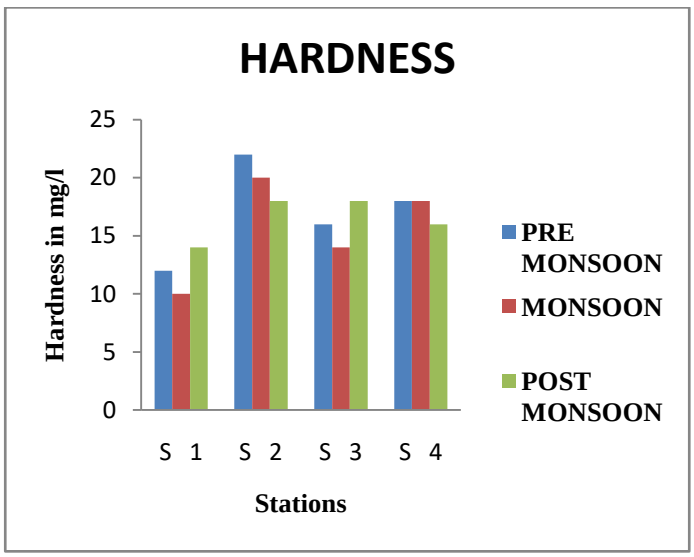


Fig 4: Graph showing seasonal variations of hardness

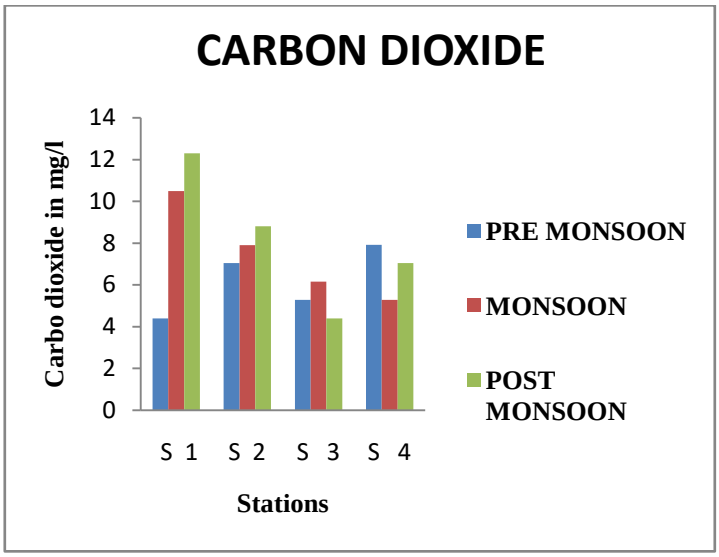


Fig 7: Graph showing seasonal variations of carbon dioxide

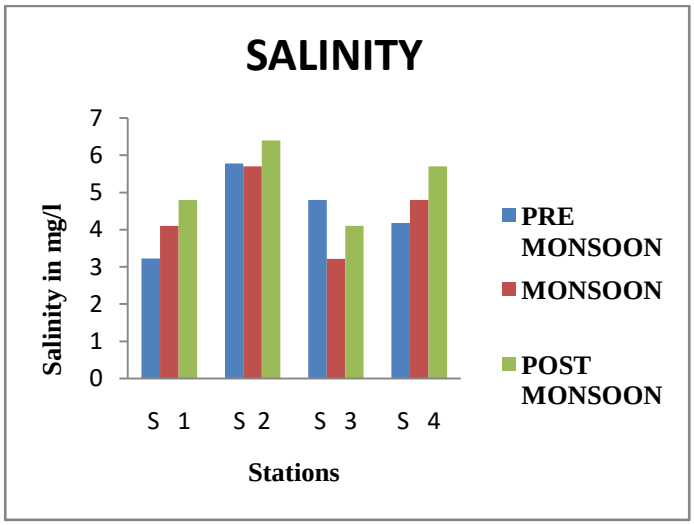


Fig 5: Graph showing seasonal variations of salinity

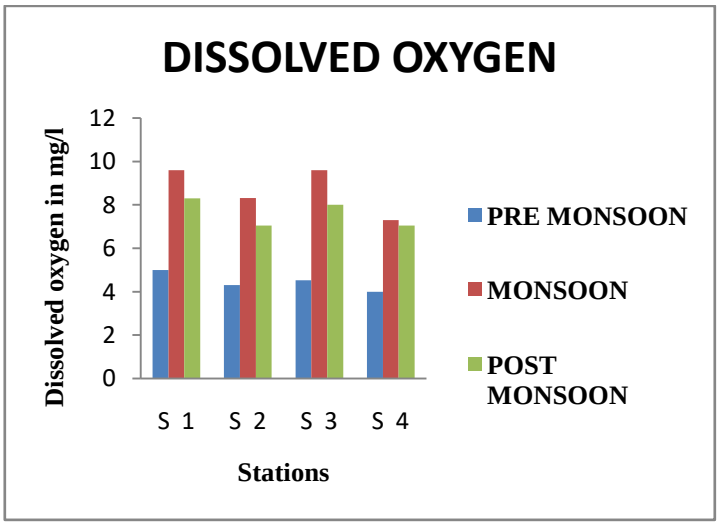


Fig 8: Graph showing seasonal variations of dissolved oxygen

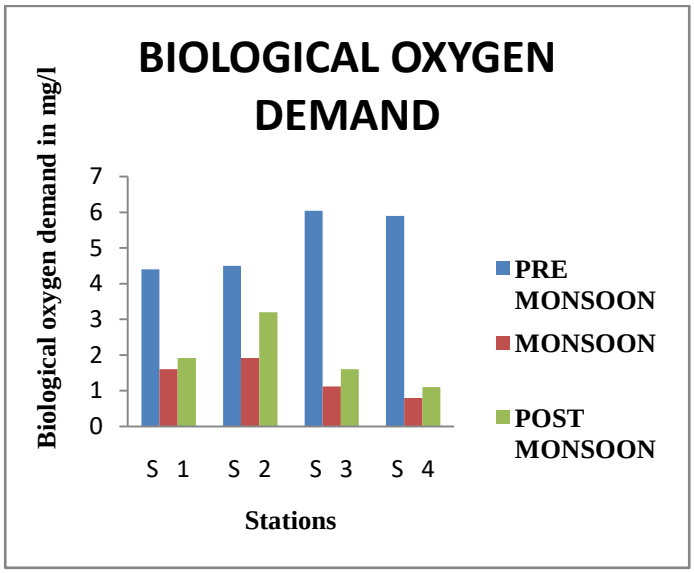


Fig 9: Graph showing the variations of biological oxygen demand

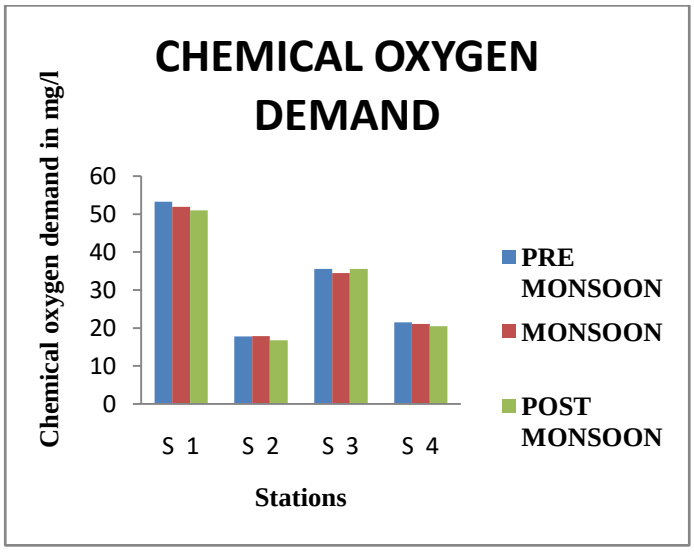


Fig10: Graph showing the variations of chemical oxygen demand

IV. DISCUSSION

Temperature has an important role in determining physical, chemical, and biological properties of water. Temperature has direct influence on aquatic biota. The water quality may depend on the changes in temperature [7]. All living organisms have an optimum temperature for their better survival. The temperature ranged between 29°C-31°C. The maximum temperature was recorded on pre monsoon period and minimum during the post monsoon. Considering the four stations, high temperature was observed in station 3 (32.1°C) during the pre monsoon season. Presence of rich vegetation will reduce the temperature. Water temperature controls the rate of all chemical reaction; affect the fish growth, reproduction and immunity [10].

pH is one of the physical properties of water. All the aquatic organisms has an optimum pH known as minimum pH. A slight variation in the pH can change the acidity or basicity of water. According to the WHO [12]normal pH range of the water should be between 6.2-8.5. In the present study all stations show acidic nature. Acidic pH affects the photosynthetic activity.[13]High organic content will tend to decrease the pH. Most metals will become soluble in acidic pH which negatively affects the health of the organisms [8].The maximum pH was recorded in station 1 during the pre monsoon period.

Transparency is the measurement of light penetration in the water body. Due to the presence of suspended solids like silts, clays, industrial waste, sewage will cause the transparency in water. Light penetration in to the bottom of the water surface will prevented by the transparent condition of the water which affect the benthic organisms and primary productivity [5].The average range of transparency was 16.37 cm-21.12 cm. The maximum range of transparency was recorded in station 1 (24.5 cm) during the post monsoon period and minimum range was recorded in station 3(11cm) during the pre monsoon period.

Water hardness is the capacity of water to precipitate the soap. Presence of sulphates and chlorides of calcium and magnesium may cause hardness in water. Hardness is mainly two types. Due to the presence of sulphates and chlorides of Iron, Manganese and Aluminium cause permanent hardness.[4].Maximum range of hardness was observed in station 2(22mg/l) during the pre monsoon season and minimum during monsoon season.

Salinity determines the salt concentration in the water. Increased salt content water will not be used in drinking or irrigation. [11].Maximum range of salinity was recorded in station 2 (6.4mg/l) during the post monsoon period and minimum during monsoon period. Flocculation of fine materials allows more penetration of salts in to the water.

Ammonia is released in to the water by organic decomposition and also by the metabolic waste of aquatic organisms. The conversion of organic nitrogen in to inorganic ammonia is called ammonification or mineralization and is brought about by heterotrophic bacteria, actinomycetes and fungi.[9]The maximum range of ammonia was observed in station 1 (59.5mg/l) during pre monsoon period. In monsoon season the maximum range was observed in station 1 (55.5 mg/l) and minimum range obtained in station 4 (38 mg/l).

Carbon dioxide is essential for the photosynthetic activity and aquatic vegetation. It is also required for the phytoplanktons. By the process of decomposition and respiration carbon dioxide is formed. Carbon dioxide depletion will affect the aquatic ecosystem. Fish diversity and aquatic biota are adversely affected.[4]The maximum carbon dioxide range was recorded in station 1 (12.3mg/l)of the post monsoon period and the minimum range was 4.4 mg/l. Carbon dioxide will affect the aquatic pH. It

will result in the formation of carbonic acid and cause changes in water equilibrium.[7]

For indicating the water quality and organic pollution dissolved oxygen is an important parameter. Large fish population depends the minimum amount of dissolved oxygen. Dissolved oxygen level below 3 mg/l leads to the death of fishes and affects the reproduction and spawning. Low level of dissolved oxygen directly affects the fish community.[2]The present study indicates that the pre monsoon season showed high pollution. House hold wastes are the main source of the pollution. The maximum range DO was recorded on pre monsoon period (5 mg/l). The minimum range of dissolved oxygen was observed in post monsoon period (4 mg/l).

During pre monsoon season, Biological oxygen demand was found to be 4.4 mg/l in station 1, 4.5 mg/l in station 2, 6.04mg/l in station 3 and 5.9 mg/l in station 4. Maximum Biological oxygen demand was observed in station 3. In monsoon season the maximum Biological oxygen demand was recorded in station 2 and minimum in station 4. In post monsoon season, the maximum range of Biological oxygen demand was found in station 2 and the minimum range was found in station 4. Biological oxygen demand is an indicator of organic pollution in the water and also that affect the availability of Dissolved oxygen and pH values.[6]

Chemical Oxygen Demand of water sample in post monsoon season ranged from 17.7mg/l to 53.2mg/l. Maximum range was obtained in station 1 (53.2mg/l) and minimum was obtained in station 2 (17.7mg/l). In monsoon season the maximum range was observed in station 1 (51.9mg/l) and minimum range was observed in station 2 (17.9mg/l). Chemical oxygen demand of water sample in post monsoon season ranges from 16.8mg/l to 35.5mg/l.

V. CONCLUSION

The present study indicates the seasonal variations of physico-chemical parameters of selected four stations of Pamba River namely station 1 (Kozhanchery), station 2 (Aranmula), station 3 (Chengannur), station 4 (Mannar). The study indicates that there is a pronounced variation of most of the water quality parameters with variation in season. The temperature range was high in pre monsoon period and minimum during the post monsoon season. pH was acidic in all stations of all seasons. Monsoon and post monsoon season showed similar range of pH. Moderately high levels of transparency were observed in post monsoon period.Hardness indicates that these are soft water. Salinity range indicates the concentration of chlorides. Moderately high level of hardness and salinity were observed in pre monsoon and post monsoon period.Ammonia content is maximum in pre monsoon and minimum during post monsoon season. Carbon dioxide content will affect the pH range. Increased carbon dioxide affects the pH which affects the biota of that region. That will leads to increased salinity. Dissolved oxygen and Biological Oxygen Demand are depended each other.The quality of fresh water is vitally important. We depend on surface and ground water sources for our drinking water. We also need water to generate energy, to grow crops, to harvest fish, to run machinery, to carry wastes, to enhance the landscape and for a great deal more. Many human activities and their by product have the potential to pollute water. Pollutants from such activities may enter surface or ground water directly, may move slowly within the ground water to emerge eventually in surface water, may run off the land or may be deposited from the atmosphere. In recent days water pollution is due to the alteration in physical, chemical and biological characteristics which may lead to harmful effect on human and aquatic biota.In natural systems, water always flows from upstream to downstream and it is very important to maintain this flow in order to retain a good ecological balance. The study areas are polluted because of the high amount of the waste accumulation. Polluted conditions will equally affect both the human being as well as the other living organisms. It will cause harmful effect on our environment. There are numerous causes including increasing number of industries and various other anthropogenic activities in the neighboring regions, global climatic changes that lead to the degradation of the quality of water. This study will be helpful for finding the important values of our natural recourses and will remind the need for conserving the biodiversity. The study will help to remind the need for conservation of water bodies.It is important that a concerted effort is made to address the issues related to sustainability of the Pamba River by considering the ecosystem deterioration as a component of a suite of anthropogenic activities.

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