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A SYSTEMATIC APPRAISAL ON THE COMPARATIVE ACCOUNT ON THE SALINITY LEVELS IN THE THREE RIVERINE ECOSYSTEMS OF KANNUR DISTRICT, KERALA, INDIA

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AUTHOR'S CONTRIBUTION

The sole author designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

The world's ecosystems are being threatened by many factors, that entail the urgent need for research and education programs to create awareness in the society for their protection and conservation. The main objectives of the study were to investigate the salinity intrusion and the seasonal variations of various physico-chemical parameters such as temperature, pH, transparency, carbon dioxide, dissolved oxygen, biological oxygen demand of the three riverine ecosystems of Kannur district namely Kakkad, Kattampally and Pullooppi. Water samples were collected during the year 2019-2020 from the study area and the physico-chemical parameters were analyzed with respect to the seasons following standard methods. The study indicates that there was a pronounced variation of most of the water quality parameters with variations in season and remarkably higher level of salinity intrusion was also noticed with respect to seasons. In the present study it has been observed that salinity range from 14.2mg/l to 339 mg/l. Maximum salinity was recorded in site 3 during post monsoon season and the minimum salinity was recorded in site 1 during Pre-monsoon season. Water with high salinity is not suitable for drinking as well as for irrigation purpose. Biological Oxygen Demand values ranged from 0.48 to 9.92 mg/l. The maximum value of BOD was noticed in site 3 (9.92 mg/l) during monsoon season.The results may provide an early warning signal about the degradation of these precious ecosystems. The findings of the present study also provide a better understanding for the need for the restoration of these natural pristine ecosystems.

Keywords: Physico-chemical parameters; salinity; transparency; BOD; dissolved oxygen; pH.

1. INTRODUCTION

A river is a natural flowing water source, usually fresh water flowing towards the ocean, sea, lake or another river. Rivers provide excellent habitat and food for many of the earth's organisms. They contribute more to biodiversity. Rivers are easily disrupted by man's activity's river water is polluted mainly due to the discharge of waste materials from neighbouring areas, factories, sewage outlets, solid wastes, detergents, chemical pesticides used in agriculture, automobile oil wastes etc. Physico-chemical parameter analysis of any aquatic ecosystem is necessary, because any alterations in the hydrography affects the biota to a

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greater extent. Water quality influences the existence of aquatic organisms as well as human beings [1]. India, though blessed with abundant water resources, is facing the water scarcity and the water pollution plays a significant role in the water shortage. Urban rivers, streams and wetlands are prone to pollution [2] and deterioration of water quality reduces a rivers amenity and aesthetic values.

The rivers always form the life line of the nation band society by providing precious resources for developmental and perpetuation of life.Streams and rivers are ecological systems that are highly variable over space and time, and exhibits high degree of connectivity between systems longitudinally, laterally and vertically [3]. The problem of water quality deterioration in the nation is mainly due to human activities such as disposal of dead bodies, discharge of industrial and sewage wastes and agricultural runoff which are major cause of ecological damages and pose serious health hazards [4]. Besides these unscientific ways of utilizing the rivers and lakes, and the indiscriminate discharge of industrial effluents, domestic and municipal pollution and degradation of quality of water and the fresh water ecosystem themselves (Harikumar&Koikkal,2009).

In the present study physico-chemical parameters of three different rivers belonging to Kannadiparamba Panchayath, Chirakkal Panchayath and Puzhathi Panchayath, Kannur District, Kerala, India was determined. Pullooppi is a hamlet in Kannur District that comes under Kannadiparamba village and Narath grama Panchayath that is located 8 Km towards North from District headquarters Kannur. Kattampally is a village located in Chirakkalgrama Panchayath, eastern part of Kannur District, near Valapattanam river. Kakkad is a suburb of Kannur town and is located 4 km away from Kannur town, located near Cannanore spinning and weaving Mill. Out of 44 major rivers of Kerala, seven are situated in Kannur.The study remind us the need for a check in the remarkably high level of salinity intrusion of these riverine ecosystems that can bring about the need for the conservation of these ecosystems.

2. MATERIALS AND METHODS

Water samples were collected during the year June 2019-June2020 from the study area using wide mouthed 1000ml polyethylene plastic bottles from three sampling points by direct immersion of bottles at water sampling points handled by rope. The containers must be capable of being tightly sealed either by stopper or cap. The collections were made once in a month at the time i.e., 7.00 to 8.30 am and from same sites throughout the period of study.The seasonal variations of various physico-chemical parameters such as salinity, temperature, pH, transparency, carbon dioxide, dissolved oxygen, biological oxygen demand was analysed following standard methods of APHA [5].

2.1 Study Area

Kakkad is a suburb of Kannur town in Kannur district of Kerala State, South India. It is 4km from Kannur town. Cannanore spinning and weaving mill is situated in Kakkad. Kakkad town is 14m above sea level.The 3 rivers nearby to Kakkad town were selected as the study sites for sample collection. They are: -

2.1.1 Site-1 (Kakkad)

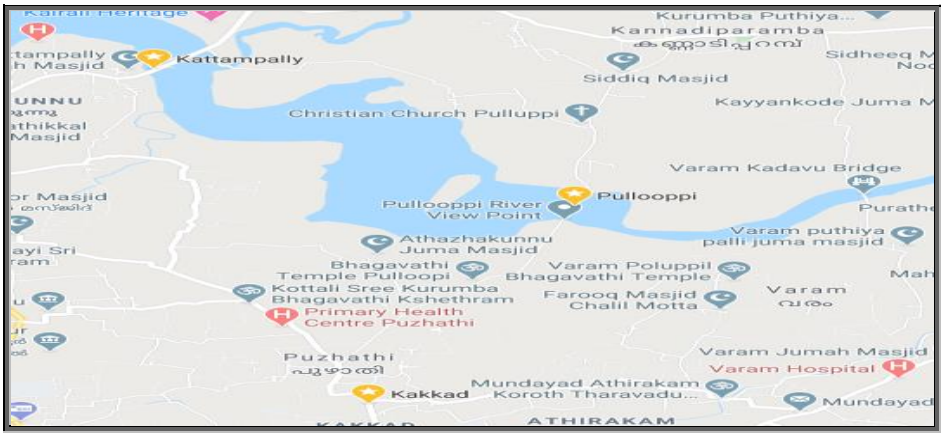
Kakkad river is a tributary of Valapattanam**,** which is the largest river in the Kannur district. Fish market and Butcher shops are situated on the banks of Kakkad river. Plastic waste and waste from hospitals are dumped in this river. Water lilies are abundantly found in this river.

2.1.2 Site-2 Kattampally

Kattampally is a village located in Chirakkal Grama Panchayath, the eastern part of Kannur district, Kerala near Valapattanam river. The nearest towns are Puthiyatheru and kambil. The Kattampally river is a tributary of Valapattanam river, the biggest drainage system (110 km long) in north Kerala. Passing through wooded country the river flows through the plains in a meandering course and joins Valapattanam river at a place called ‘Thuruthu’ about nine kms before it joins the sea. The Kattampally river is nearly 20 kms long and the catchment area of the river is about 83 sq kms It is one of the biggest drainage system (110km long) in North Kerala. The Kattampally river is nearly 20kms long and the catchment area of the river is about 83sq km.

2.1.3 Site - 3 Pullooppi

Pullooppi is a hamlet in Kannur district. It belongs to Kannadiparamba village and Narath Grama Panchayath. It is located 6km away from Kannur town. The famous Agasthya muni temple is located in this region. It is a site of prawn cultivation.



Map 1. Map showing the study sites in kannur district

SITE 1 (Kakkad)

SITE 2 (Kattampally)

SITE 3 (Pullooppi)

Image 1-3. Photographs showing the selected rivers in Kannur District

3. RESULTS

The study of physico-chemical parameters of selected three Rivers in site 1(Kakkad river), site 2(Kattampally river), site 3 (Pullooppi river), of three seasons were analysed and compared. The physico-chemical parameters of each sites exhibited variations in each period.

3.1 Temperature

The temperature showed a minimum range of 25^0C and exhibited maximum range of 40^0C. All these sites showed an average temperature range from 26.33^0C - 35.66^0C. In pre monsoon period, the temperature ranges from 28^0C to 40^0C.A higher range of temperature was observed in site 3 (40^0C) and a lowest temperature was observed in site 2 (28^0C). In monsoon period, the temperature ranged from 25^0C to 28^0C. A higher range of temperature was observed in site 1(28^0C) and lower range was exhibited in site 2 (25^0C). The temperature of water samples in the post monsoon period ranged from 32^0C to 40^0C. A higher temperature was shown in the site 1 (40^0C) and lower range was noticed in the site 2 (32^0C) (Table 1 and Fig. 1). The mean ± standard deviation ranges from 26.33 ±1.52 to 35.66 ± 4.

3.2 pH

From the study, in pre monsoon season the pH ranged from 6 to 8. A higher level of pH was observed in site 2 (8) and lower pH was observed in site 3 (6). In monsoon season the pH ranged from 7 to 8. A higher level of pH was observed in site 1 (8) and lower pH in site 2&3 (7).The pH of water sample in post monsoon season remained the same (6). Site 3 only show almost acidic pH in all seasons and the site 1 shows the alkaline pH in monsoon season and site 2 shows alkaline pH in pre monsoon season (Table 1 and Fig. 2). The mean ± standard deviation ranged from 6 ± 0 to 7.33 ± 0.57

3.3 Transparency

Transparency range showed variations in all seasons .A higher transparency value was noticed about 76cm in site 3 of post monsoon season. The lower range was 30cm in site 1 of pre monsoon season. In pre monsoon season the transparency of water ranges from 30 - 71cm. Transparency of water in monsoon season ranges from 34 - 75 cm. In post monsoon season the transparency value ranges from 37 - 76 cm. A higher range of transparency observed in site 3 in all seasons and a lower range was observed in site 1 in all seasons (Table 1 and Fig. 3). The mean ± standard deviation ranged from 50 ± 20.66 to 57.66 ± 19.60.

3.4 Salinity

Salinity of water sample in the pre-monsoon season ranges from 14.2 to 239.6 mg/l. A highest range was obtained in site 2 (239.6 mg/l) and lowest range was observed in site 1 (14.2 mg/l). In monsoon season salinity ranges from 170.4 to 339 mg/l. Maximum range was observed in site 2 (339 mg/l) and minimum range was shown in site 1 (170.4 mg/l).Salinity of water sample in the post monsoon season ranges from 83.4 to 321.3 mg/l. Maximum range was observed in site 2 (321.3 mg/l) and minimum range was shown in site 1 (83.4 mg/l). The site 1 showed comparatively minimum range of salinity in all seasons (Table 1 and Fig. 6). The mean ± standard deviation ranges from144.36 ±116.68 to 262.66 ± 85.42.

3.5 Carbon Dioxide

Carbon dioxide in water sample in pre monsoon season ranged from 7.9 to 26.8 mg/l. The maximum range was observed in site 3 (26.8 mg/l) and minimum range was observed in site 1 (7.9 mg/l). In monsoon season, carbon dioxide of water samples ranges from 11 to 13.2 mg/l. The maximum range of carbon dioxide obtained in site 3 (13.2 m g/l) and minimum range was obtained in site 2(11 mg/l).Carbon dioxide of water sample in post monsoon season ranges from 11.4 to 26.8 mg/l. Maximum range was observed in site 3(26.8 mg/l) and minimum range was observed in site 1 (11.4 mg/l) (Table 1). The mean ± standard deviation ranges from 12.32 ± 1.16 to 17.6 ± 8.15.

3.6 Dissolved Oxygen

Dissolved oxygen of water sample in the pre monsoon season ranged from 6.9 to 11.6 mg/l. The maximum range was obtained in site 3 (11.6 mg/l) and minimum range was obtained in site 1 (6.9 mg/l). Dissolved oxygen of water sample in monsoon season ranges from 6.7 to 10.2 mg/l. Maximum range was observed in site 3 (10.2 mg/l) and minimum range was observed in site 1(6.7 mg/l). Dissolved oxygen of water samples in post monsoon season ranges from 6.5 to 7.2 mg/l. The maximum range was showed in site 1 (7.2 mg/l) and minimum range was showed in site 2 (6.5 mg/l) (Table 1). The mean ± standard deviation ranges from 6.78 ± 0.35 to 9.44 ±2.4.

3.7 Biological Oxygen Demand

Biological Oxygen Demand of water sample in the pre-monsoon season ranges from 0.48 to 6.24 mg/l. Highest range was observed in site 3 (6.24 mg/l) and

minimum range was showed in site 1 (0.48 mg/l). In monsoon season Biological Oxygen Demand ranges from 6.24 to 9.92 mg/l. Maximum range was observed in site 3 (9.92 mg/l) and minimum range was observed in site 1 (6.24 mg/l). Biological Oxygen Demand of water sample in the post monsoon season ranges from 2.04 to 4.32 mg/l. A highest range was observed in site 3 (4.32 mg/l) and lowest range was observed in site 2 (2.04 mg/l). Site 1 shows a comparatively minimum range of BOD value in all seasons (Table 1). The mean ± standard deviation was about 3.36 ± 1.18 to 7.73 ± 1.93.

Table 1. Seasonal variation of physico-chemical parameters

Parameter	Seasons	Site 1	Site 2	Site 3	Mean ± SD
Temperature (^{0}C)	Pre monsoon	30	28	40	32.66 ± 6.42
	Monsoon	28	25	26	26.33 ± 1.52
	Post monsoon	40	32	35	35.66 ± 4
pH	Pre monsoon	7	8	6	7 ± 1
	Monsoon	8	7	7	7.33 ± 0.57
	Post monsoon	6	6	6	6 ± 0
Transparency	Pre monsoon	30	55	71	52 ± 20.66
(cm)	Monsoon	34	58	75	55.66 ± 20.59
	Post monsoon	37	60	76	57.66 ± 19.60
Salinity	Pre monsoon	14.2	239.6	179.3	144.36 ± 116.68
(mg/l)	Monsoon	170.4	339	278.6	262.66 ± 85.42
	Post monsoon	83.43	321.3	298.2	234.31 ± 131.17
CO_2 (mg/l)	Pre monsoon	7.92	9.68	26.84	14.81 ± 10.45
	Monsoon	12.76	11	13.2	12.32 ± 1.16
	Post monsoon	11.44	14.52	26.84	17.6 ± 8.15
Dissolved	Pre monsoon	6.88	9.8	11.64	9.44 ± 2.4
Oxygen (mg/l)	Monsoon	6.72	7.52	10.24	8.16 ± 1.84
	Post monsoon	7.2	6.56	6.6	6.78 ± 0.35
BOD (mg/l)	Pre monsoon	0.48	3.84	6.24	3.52 ± 2.89
	Monsoon	6.24	7.04	9.92	7.73 ± 1.93
	Post monsoon	3.72	2.04	4.32	3.36 ± 1.18

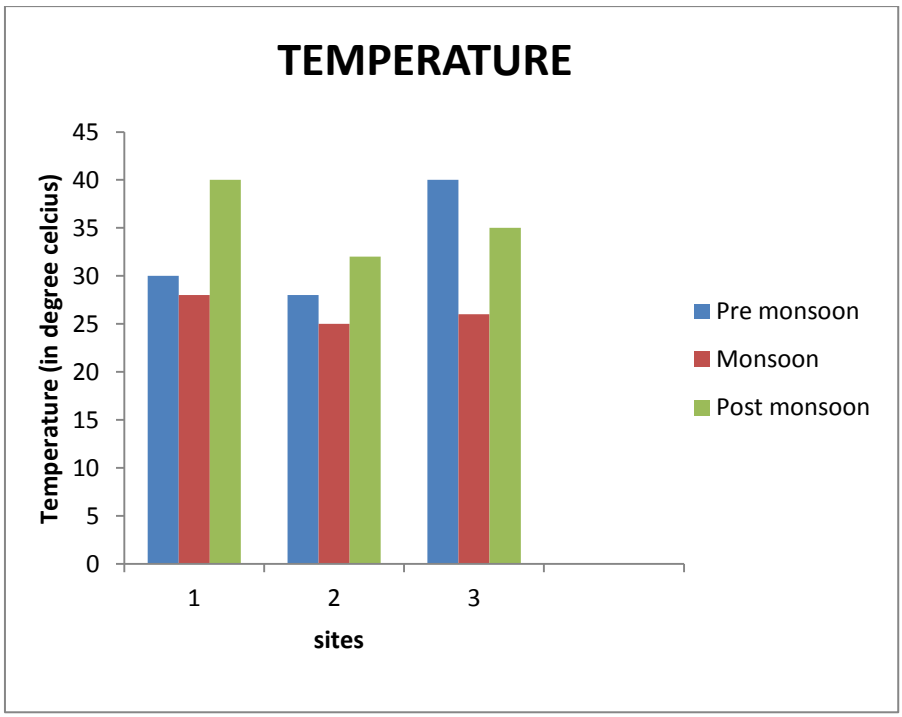


Fig. 1. Graph showing seasonal variations of temperature

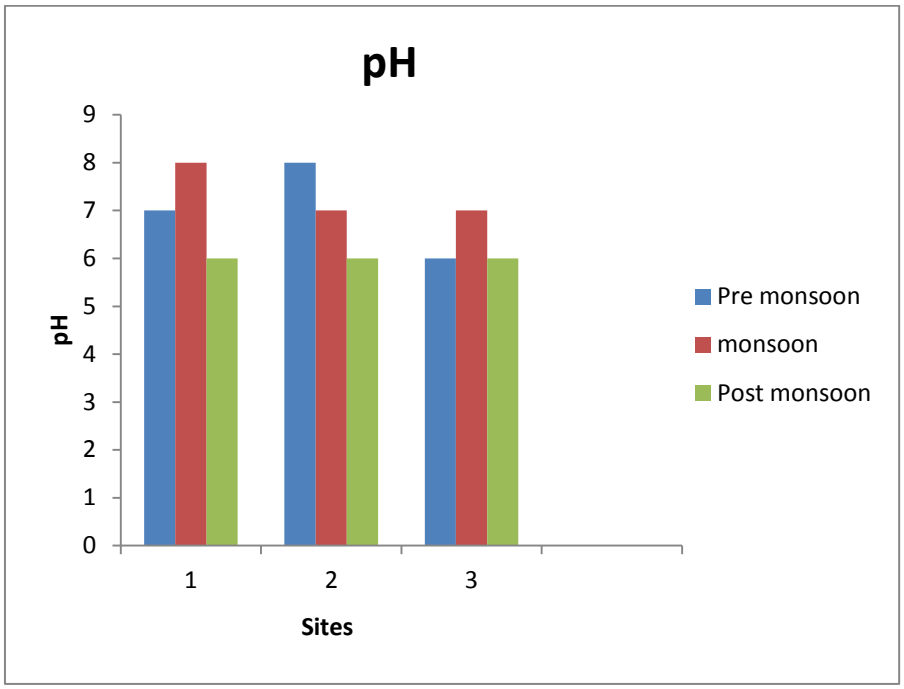


Fig. 2. Graph showing seasonal variation of PH

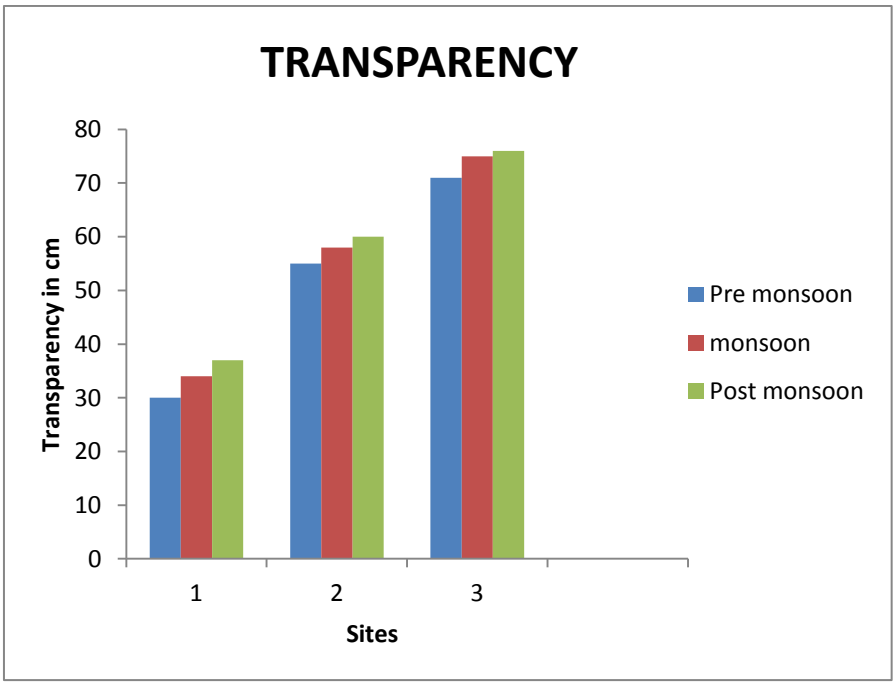


Fig. 3. Graph showing seasonal variation of transparency

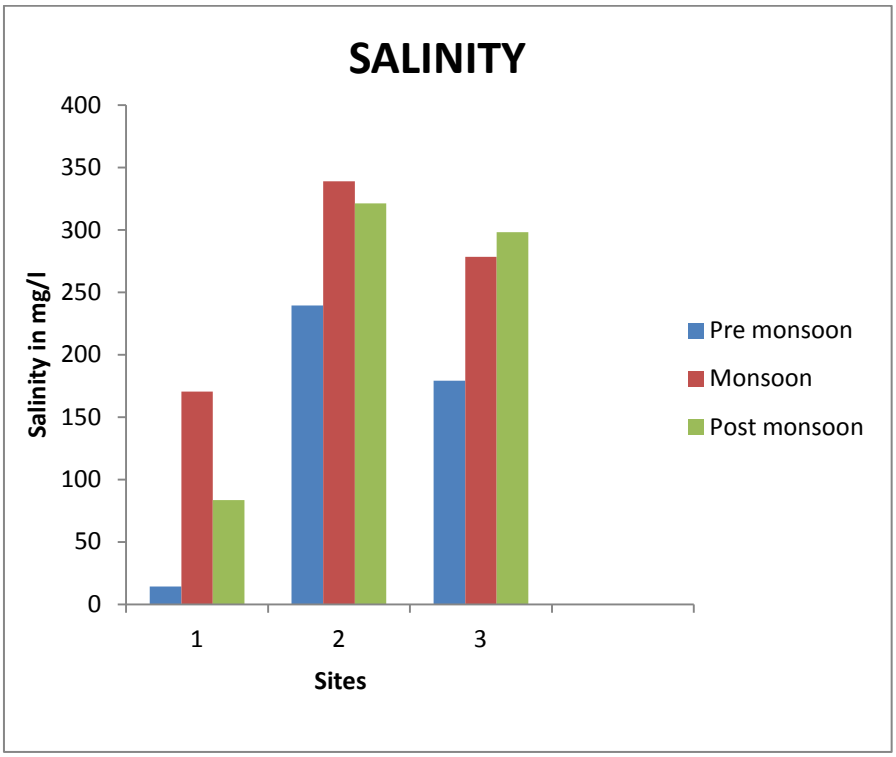


Fig. 4. Graph showing seasonal variation of salinity

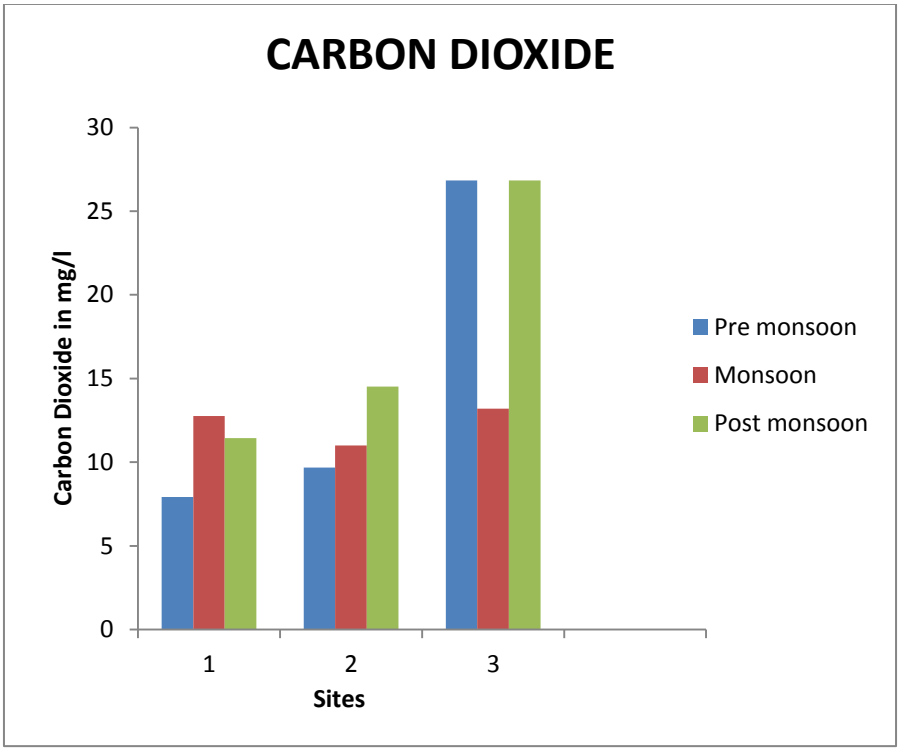


Fig. 5. Graph showing seasonal variation of Carbon Dioxide

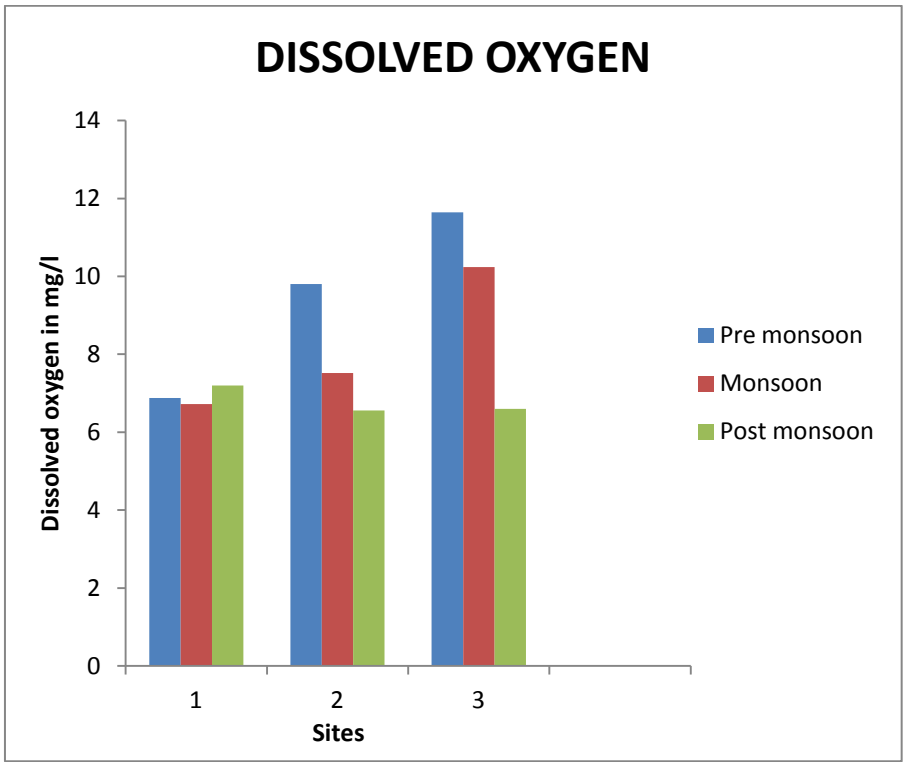


Fig. 6. Graph showing seasonal variation of Dissolved Oxygen

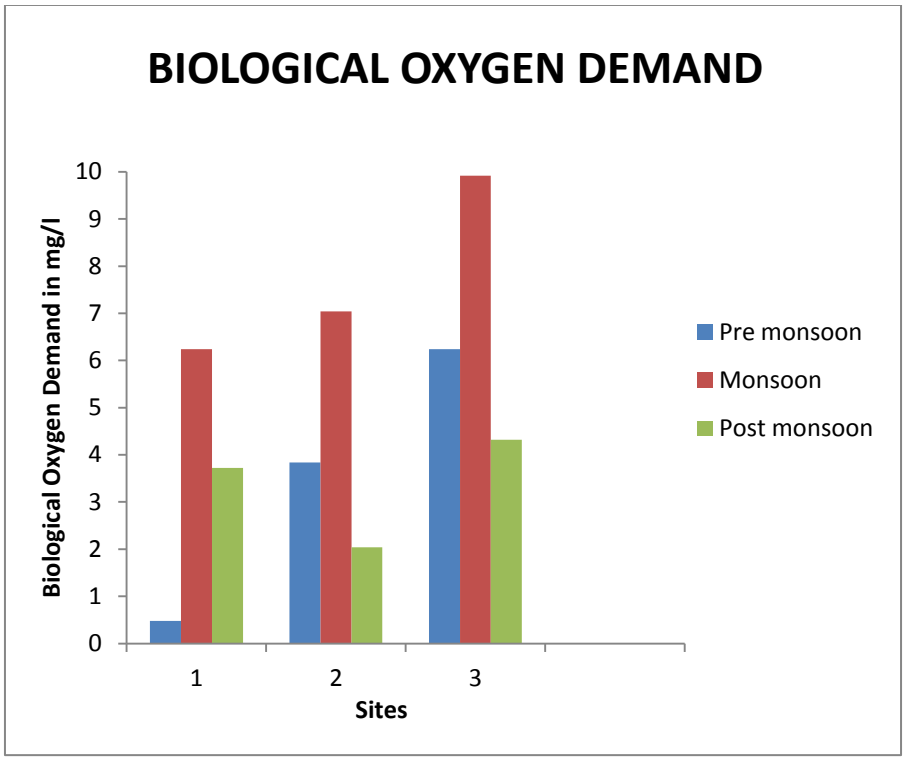


Fig. 7. Graph showing seasonal variation of Biological Oxygen Demand

4. DISCUSSION

The river water temperature is highly influenced by the local climatic conditions. Temperature has an important role in physical, chemical, and biological properties of water. Water temperature values ranged from 25oC to 40oC. The minimum value was recorded in monsoon season and maximum value in pre monsoon and post monsoon seasons. The temperature difference might be either due to the geographical differences in the location or due to the difference between the collection time (Madhuri 2008). Considering the three sites, high temperature was recorded in site 1 (40oC) during the post monsoon season and in site 3 (40oC) during pre-monsoon season. According to Desai [6] water temperature varies depending on seasons. This is reflected by lower temperature at site 2 (25^oC) in monsoon due to cloudy weather and rainfall.

The pH of river water is considered as an index of environmental conditions. It effects the biochemical reactions and controls the activities and distribution of aquatic fauna and flora. A slight variation in the pH can change the acidity or alkalinity of water. In the present study the pH value was maximum in monsoon (7.33 ± 0.57) and minimum in post monsoon 6. External factors that can cause fluctuations in the river pH include agricultural runoff, acidic mine drainage, and fuel emissions such as carbondioxide, that creates a weak acid when dissolved in river water [7].

Transparency is the measurement of light penetration in the water body. The Secchi disc transparency correlates closely with the percentage of transmission of light. The high transparency of 71cm was observed in site 3 during pre-monsoon season. The low transparency of 30cm was observed in site 1 during the same season. Transparency of water is generally influenced by factors like wind action, suspended silt particles, plankton concentration and decomposition of organic matter at the bottom [8].

In the present study it had been observed that the salinity ranged from 14.2mg/lto 339 mg/l. Maximum salinity was recorded in site 3 during post monsoon season and minimum salinity is recorded in site 1 during Pre-monsoon season. Water with high salinity is not suitable for drinking as well as for irrigation purpose. The salinity, as a measure of the mass of dissolved salts in a mass of water was mainly due to the presence of chloride. Chloride is one of the anions which determine the total salinity of water and make a quantitative accumulation of this anion over a period of time is an indicative of anthropogenic pollution [9]. In the Valapattanam River, there are many small rivers forming the main river network. The behavior of the salt tide is mainly controlled by the upstream runoff and downstream tidal current. When the high saline tidal water mass in the continental shelf flows into the estuary during the flood tidal period, the salt water diffuses and mixes with the fresh water coming from upstream, which makes the water in upstream river salty and causes salinity intrusion. Some of the main factors affecting salinity intrusion in the Valapattanam River are: river topography, the sea level variation, increase in temperature, decrease in precipitation etc. [10].

Carbondioxide is the end product of organic carbon degradation in almost all aquatic environments and its variation is often a measure of net ecosystem metabolism [11]. In the present study the maximum carbondioxide value was recorded in site 3 (26.84mg/l) during pre-monsoon and monsoon season. Minimum range was recorded in site 2 (11mg/l) during monsoon season. According to Joshi et al. [12], the increase in carbondioxide may be due to the decay and decomposition of organic matter.

Dissolved oxygen is one of the most important parameters of the water quality and the fundamental requirement of plant and animal life in water. Dissolved oxygen indicates the level of water quality and organic production in water. In the present study dissolved oxygen is varied from 9.44 to 6.78. According to Chaurasia and Pandey [13] the quantity of dissolved oxygen in water is directly or indirectly depended on water temperature, partial pressure of air etc. Rodgi and Nimbergi [14] found that dispersal of domestic sewage and other oxygen demanding wastes reduced the dissolved oxygen of the receiving water body. The maximum range of dissolved oxygen was recorded in site 3 (11.64 mg/l) during pre-monsoon season and minimum range was recorded in site 2 (6.56mg/l) during post monsoon season.

BOD is a measure of organic material contamination in water. The greater the BOD the more rapidly oxygen is depleted in the river.BOD varies significantly among rivers.BOD values range from 0.48 to 9.92 mg/l. The maximum value of BOD was noticed in site 3 (9.92mg/l) during monsoon season. The minimum value of BOD was observed in site 1 (0.48mg/l) during pre-monsoon season. The BOD and other microbial activities are generally increased by the introduction of sewage [15]. Unlike lakes and ponds, rivers are open systems where frequent water exchange occurs [7]. Rivers provides the excellent habitat and food for many of the earth's organisms. Various indicators give a measure of the quality of river water. Some of them include temperature, pH, transparency, salinity, carbon dioxide, dissolved oxygen and BOD.

5. CONCLUSION

The present study indicates the seasonal variations of physico-chemical parameters of three different rivers of Valapattanam region of Puzhathi Panchayath namely Kakkadriver (site 1), Kattampally river (site 2), Pullooppi river (site 3). The study indicates that there was a pronounced variation of most of the water quality parameters with variation in season. The temperature range was maximum in post monsoon period and minimum value was recorded in monsoon period. pH value was maximum in monsoon period and value was minimum in post-monsoon period. All the three sites exhibited almost pH in post monsoon season and site 1 and site 2 showed alkaline pH in monsoon and pre monsoon season. Moderately high levels of transparency were observed in post monsoon season. Salinity was maximum in the monsoon period. Carbon dioxide was maximum in the post monsoon period. Increased carbon dioxide affects the pH which effects the biota of that region. Dissolved oxygen and Biological Oxygen Demand are depended on each other. The maximum value of BOD was noticed in the monsoon season. Rivers have been used as a traditional source of water supply from time immemorial in India. The sand mining activities in the river basin causes the widening of river mouth and depth of the river surface, which induce the salt water intrusion. High chloride content in water bodies harms metallic pipes and structures as well as agricultural crops.These water bodies are now polluted mainly due to discharge waste water, water from residential areas, sewage outlets etc. The study indicates that the physico-chemical factors investigated exhibited well marked variations with distinct minima and maxima. The investigation reveals the necessity for rejuvenation of these rivers for preventing the dark future of these rivers if no effective measures are undertaken. Water is indispensable and one of the most abundant resources of nature and prime necessity for the survival of life. So, the availability of water both in terms of quality and quantity is essential for the existence of living world.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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