IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, June 2023

Study Indicating the Exigency for the Rejuvenation of the Kanamriver in Kannur District, Kerala, India

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Abstract: *The Kanam river of the Kannur district originating from Ayyappanmala at Mundery Panchayath, and flows through various areas such as Elayavoor, ThazheChovva, and Kannur corporation limits. The river was filled with soil from the nearby farms and coastal communities become totally spoiled by the wastes. Research works pertaining to this study site is very scanty.In this context, the physico-chemical analysis of the Kanam River, Kannur, Kerala was determined.The objective of the study was to investigate the seasonal variations of physico-chemical parameters such as temperature, pH, transparency, hardness, primary productivity, ammonia, carbon dioxide, dissolved oxygen, biological oxygen demand and chemical oxygen demand.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 change that led to the degradation of the quality of water. The findings of the present study also provide a better understanding of this damaged ecosystem and remind the need for its restoration and it also suggest the need for the starting up of a Rejuvenation strategy.*

Keywords: Rejuvenation, physico-chemical parameters, Dissolved Oxygen, BOD, COD

I. INTRODUCTION

Rivers are the most important natural resources for human development as it has multi- usage components such as sources of drinking water, irrigation, fishery and energy production. Rivers play a major role in supporting life for all organisms. The Kerala State is blessed with 44 rivers, however many of these are under threat due to anthropological activities like encroachment, sand mining, degradation of river banks, construction of bunds across the rivers and pollution. The safety of drinking water is affected by various contaminants. Contaminants are substances that are dissolved in water and make it unfit for use. Some contaminants can be easily identified only by assessing the taste, odourand turbidity of the water because pure water remains tasteless, colourless and odourless. However, most cannot be easily detected and require testing to reveal whether or not water is contaminated.

Physico-chemical parameters of water are important to determine the quality of drinking water. Physico-chemical properties are the intrinsic physical and chemical characteristics of a substance. Temperature, p H , ammonia , chemical oxygen demand, carbon dioxide, hardness, transparency is important to determine the abundance and distribution of flora and fauna.The water temperature depends on the depth of the water column, climatic as well as the topographic changes (WQA, 1992).Transparency gives an idea about the degree of suspended particles in the water, which in turn affects the light penetration (Verma *et al*., 1993).

The higher pH values suggests that carbon dioxide, carbonate, bicarbonate equilibrium is affected more due to changes in physico-chemical condition (Easa& Shaji.,1995).High levels of ammonia in water cause lethal effects in fishes (Anita and Dev pooja,2013).Carbon dioxide is readily soluble in water and solubility is about 200 times that of oxygen (Abir , 2014).Carbonate hardness is due to the presence of calcium and magnesium carbonate and bicarbonates in

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water. This is also known as temporary hardness because it is highly sensitive to heat and precipitate out readily on boiling. Non-carbonate hardness occurred due to the dissociation of salts of calcium other than carbonate and bicarbonate, such as calcium sulphate or calcium fluoride. This hardness is referred to as permanent hardness because it cannot be removed by boiling (Verma & Agarwal., 2012).Monitoring of the physico-chemical water quality parameters plays a pivotal role in assessing the water environment, ecosystem, hydrochemistry, ecology and restoring water quality (White head *etal.,*2018;Sarkar *etal.*,2016; Islam *et al*., 2019).

Kaanam River, which is a rivulet that originates from the hillocks near Chelora village, is located towards the southern side of Kannur district, Kerala, with geographical location of 11º 87′45′′ N & 75º 37′04′′ E. Its length is approximately 32 km and the flow line includes laterite soils which further leads to paddy fields; gradually widens and crosses NH 17 and finally pours out to Arabian Sea. The river water shows variations in quality and quantity according to the varying climatic conditions and the shore of the river supports profuse growth of many plants.(Gireesh Kumar *et al*,2018; Jigikumari,2018). As not much literature is not available about Kanam river quality status,the present study deals with the assessment of water quality of Kanam River that would form a reminder to conserve this fascinating ecosystem.An understanding of the river ecosystem will facilitate sustainable exploitation of this ecosystem. So that humanity can enjoy the river ecosystem benefits from generations to generations. Taking all these factors into consideration,river rejuvenation can also be achieved by broadly aiming at restoring assured environmental flow in the river system. Water samples were collected from three different sites of Kanam River. These regions were facing threat due to high anthropogenic activities. The regions selected for study are:

- Chelora
- ThazheChovva
- Kuruva

II. MATERIALS AND METHODS

Water samples were collected during the year June 2021- June2022 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 were 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.Bottles were preserved using icebox and transported to the laboratory bottles and the physico-chemical parameters were analysed following standard methods of APHA (2005).

2.1 Study Area

Kanam puzha River originated from Ayyappanmala, located 110 feet from sea level, in Mundery panchayat and passes through Kannur cooperation. Kanam river used to be the major water resources that discharged ground water in parts of the town and nearby areas. The river, as it exists now is filled with sewage waste.

Station 1 (Chelora)

The site is located near CheloraChurch. Small amount of municipal waste were deposited on the side of the river stream. Municipal waste includes cattle waste, domestic waste, plastic bottles. Many house hold waste were openly being dumped in to the river.

Station 2 (ThazheChovva)

The site is located just 1Km away from Sree Narayana College Campus. The site lies on the western sides of the NH47 near the railway track. There were about 12 houses on both sides of the river in the area. Western sides of the river were further marked by the presence of a restaurant and chicken stall and bathing of cows.

Station 3 (Kuruva)

The site is located near the Kuruva saw mill. The sources of pollution may be waste discharged by the people, industrial waste, bathing and washing waste.

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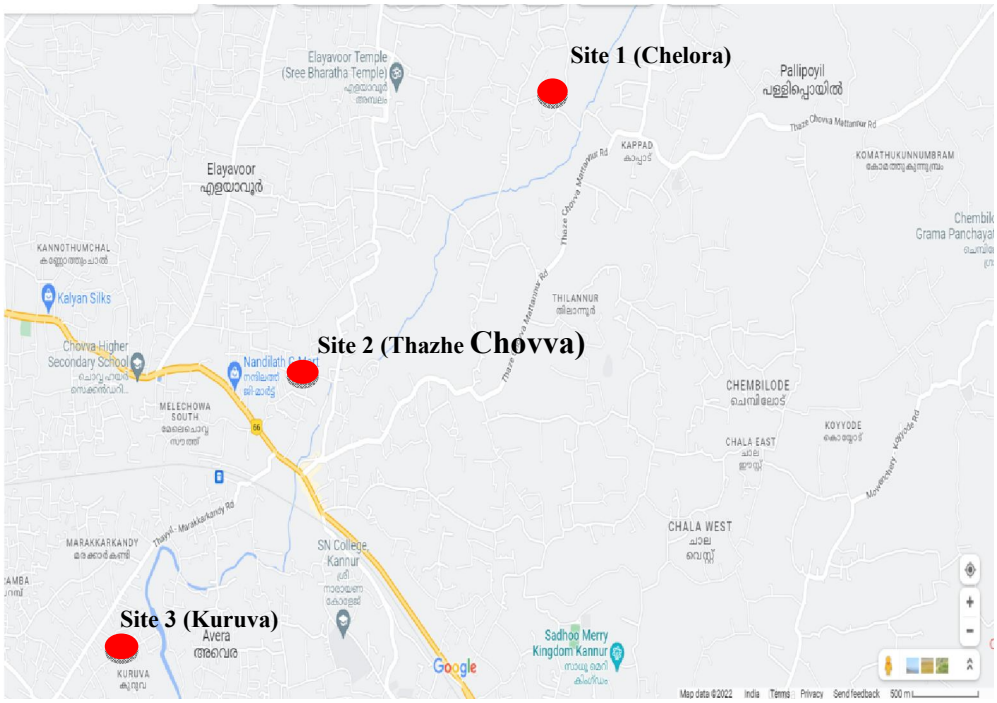
MAP SHOWING STUDY AREA



PHOTOGRAPHS SHOWING SELECTED STATIONS OF KANAM RIVER

STATION 1(CHELORA)

STATION 2 (THAZHE CHOVVA)

STATION 3 (KURUVA)

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III. RESULTS

The study of physico-chemical parameters of selected three stations of Kanam river, station 1 (Chelora), station 2 (ThazheChovva), station 3 (Kuruva), of three seasons were analysed and compared. The physico-chemical parameters of each stations exhibited variations.

Temperature

Based on it, the temperature showed a minimum range of 29°C and exhibited maximum range of 33° C. All these stations showed an average temperature range from 29° C – 32° C.There was only a slight variation in temperature. A high range of temperature in pre-monsoon season was observed in station 2 (33°C) and low range was showed in station 3 (31°C). In monsoon period, the temperature ranges from 28°C to 30°C. The temperature of water sample in the post-monsoon period ranges from 30°C to 31°C. (Table 1 and Fig 1). The mean ± standard deviation ranges from 29 ± 1 to 32 ± 1.

pH

From the study, in pre-monsoon season the pH ranged from 6.7 to 7.5.A higher level of pH was observed in station 3 (7.5) and lower pH level in station 2 (6.7).In monsoon season lower pH in station 2 (6.6) and higher pH in station 1 (7.2). The pH of water sample in post-monsoon season ranged from 6.6 to 7.8.High range of pH was shown in the station 3 (7.8) and lowest pH was observed in the station 2 (6.6). The average range of pH in all these seasons ranged from 6.9 to 7.3.(Table 1 and Fig 2).In pre-monsoon period mean± standard deviation was about 7.13 ± 0.40. 6.9 ± 0.3 range of mean ± standard deviation was observed in monsoon period. In post-monsoon period mean ± standard deviation was about 7.3 ± 0.62.

Transparency

Maximum transparency value was noticed about 68cm in station 2 of pre-monsoon season. The minimum range was 15cm in station 1 of pre monsoon season. The average range of transparency was 43.33-42.3 to 21.1cm. In pre-monsoon season the transparency of water range from 15to 68cm, high range of transparency was shown in station 2 (68cm) and lowest was obtained in station 1 (15cm). Transparency of water in monsoon season ranged from 15.6 to 67.5cm. A high range of transparency was shown in station 2 (67.5cm) and lowest was observed in station 1 (155cm). In post-monsoon season the maximum range was observed in station2 (66.3cm) and minimum range was observed in station 3 (16.5). (Table 1 and Fig 3). The mean ± standard deviation was about 40.33 ± 25.45 to 42.3 ± 25.45.

Hardness

Hardness of water sample in the pre-monsoon season ranged from 32 mg/l to 280 mg/l. Maximum range was observed in station 3 (280mg/l) and minimum range was observed in station 1 (32mg/l). Hardness of water sample in monsoon season was nearly 14 mg/l to 82 mg/l. Maximum range was observed in station 3 (82 mg/l) and minimum range observed in station 1 (14 mg/l).In post-monsoon season maximum hardness showed in station 3 (278 mg/l) and minimum range was observed in station 1 (24 mg/l). (Table 1 and Fig 4). Maximum range of mean ± standard deviation was observed in pre monsoon period (122.66 ± 136.78) and minimum range was observed in monsoon period (40.66 ± 36.29).

Primary productivity

Net primary productivity of water sample in the pre-monsoon season ranges from 0.56mgC/m3/hr to 0.96mgC/m3/hr. Maximum ranges was observed in station3(0.96mgC/m3/hr) and minimum range was observed in station 2 (Table 1and Fig5).NPP of water sample in the monsoon season was nearly 0.12 to0.33. In post-monsoon maximum NPP showed in station 2 (0.7875)and minimum NPP in station 3(0.15mgC/m3/hr). Maximum range of mean ± standard deviation was observed in pre monsoon(0.78± 0.20) and minimum range was observed in monsoon (0.193±0.11). Gross primary productivity of water sample in pre monsoon season ranges from 2.84mgC/m3/hr to 3.86mgC/m3/hr. Maximum range was obtained in station1. In monsoon season maximum range was obtained in station 3(2.65mgC/m3/hr) and minimum range was obtained in station 1(1.16mgC/m3/hr).GPP of water sample in post

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monsoon season was ranges from 3.72mgC/m3/hr). The mean± standard deviation ranges from 1.95±0.75 to 4.63±1.06 (Table 1 and Fig6)

Ammonia

Ammonia of water sample in the pre monsoon season ranged from 34 mg/l to 59.5 mg/l. Maximum range was observed in the station 3 (59.5 mg/l)and minimum range obtained in station 1 (34 mg/l). In monsoon season the maximum range was observed in station 2 (34 mg/l) and minimum range obtained in station 3 (17 mg/l).Ammonia of water sample in the post-monsoon season range from 25.5mg/l to 51 mg/l. Maximum range was observed in station 3 (51 mg/l) and minimum range was obtained in station 1 (25.5 mg/l). Maximum range of standard deviation was observed in pre-monsoon season (12.98) and minimum range in monsoon period (8.5). (Table 1 and Fig 7). In pre-monsoon period the mean ± standard deviation was observed to be nearly 45.33 ± 13.98. 25.5 ± 8.5 in monsoon period. In post monsoon period the range of mean ± standard deviation was about 37.16± 12.88.

Carbon dioxide

Carbon dioxide of water sample in pre-monsoon season showed the maximum range in station2 (27.28mg/l) and minimum range was observed in station 1 (8.8mg/l). In monsoon season the carbon dioxide of water sample was observed maximum in station 2 (23.32mg/l) and minimum range was observed in station 1 (6.16 mg/l).Carbon dioxide of water sample in post-monsoon season range from 7.04 mg/l to 25.96 mg/l. Maximum range was observed in station 2 (25.96mg/l) and minimum range observed in station 1 (7.04mg/l). (Table 1 & Fig 8). The maximum range of mean ± standard deviation was found in monsoon period (20.24 ± 4.35) and minimum range was observed in post-monsoon period (17.45± 1.60).

Dissolved oxygen

Dissolved oxygen of water sample in the pre-monsoon season, maximum range was obtained in station 2 (6.08mg/l) and minimum range of dissolved oxygen was obtained in station (1.92mg/l).Dissolved oxygen of water sample in monsoon season range from 1.2mg/l to 4 mg/l. Maximum range was observed in station 1 (4 mg/l) and minimum range in station 2 (1.2mg/l). Dissolved oxygen of water sample in the post-monsoon season showed maximum range in station 2(5.6 mg/l) and minimum range was observed in station 3 (2.72mg/l). (Table 1 and Fig 9). The range of mean ± standard deviation was about 3.01 ± 1.57 to 4.26 ± 2.13.

Biological Oxygen Demand

Biological oxygen demand of water sample in the pre-monsoon season ranges from 1.92mg/l to 5.88mg/l. Maximum range was observed in station 3 (5.88 mg/l) and minimum range was noticed in station 2(1.92mg/l) .In monsoon season biological oxygen demand ranges from 2.08mg/l to 6.32mg/l. Maximum range was observed in station 2 (6.32mg/l) and minimum range was observed in station 1 (2.08mg/l). Biological oxygen demand of water sample in the post monsoon season ranges from 2.08mg/l to 4mg/l. Maximum range was observed in station 3 (4mg/l) and minimum range was observed in station 1 and station 2 (2.08mg/l).Standard deviation of Biological oxygen demand in pre-monsoon was 3.72 and in monsoon 3.52. (Table 1 & Fig 10). The maximum range of mean ± standard deviation was observed in pre-monsoon period (3.72 ± 2.004) and minimum range was observed in post-monsoon period (2.72 ± 1.108).

Chemical Oxygen Demand

Chemical Oxygen Demand of water sample in pre-monsoon season ranges from 4.8mg/l to 16mg/l. Maximum ranges was obtained in station 1 and station 2 (16mg/l) and minimum was obtained in station 3 (4.8mg/l). In monsoon season the maximum range was observed in station 2 (4.8mg/l) and minimum range was observed in station 3 (1.6mg/l). Chemical oxygen demand of water sample in post-monsoon season ranges from 7.04mg/l to 25.96mg/l. (Table 1 & Fig 11). The mean ± standard deviation was range from 3.37 ± 1.62 to 17.45± 9.60.

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TABLE 1

PARAMETERS	SEASONS	STATION 1	STATION 2	STATION 3	MEAN ± SD
Temperature (°C)	Pre monsoon	32	33	31	32±1
	Monsoon	29	30	28	29±1
	Post monsoon	30	31	30	30.33± 0.57
pH	Pre monsoon	7.2	6.7	7.5	7.13±0.40
	Monsoon	7.2	6.6	6.9	6.9±0.3
	Post monsoon	7.5	6.6	7.8	7.3±0.62
Transparency (cm)	Pre monsoon	15	68	47	43.33±26.68
	Monsoon	15.5	67.5	47	43.33±26.19
	Post monsoon	15.6	66.3	45	42.3±25.45
Hardness (mg/l)	Pre monsoon	32	56	280	122.66±136.78
	Monsoon	14	26	82	40.66±36.29
	Post monsoon	24	48	278	116.44±140.23
Net primary productivity (mgC/m3/hr)	Pre monsoon	0.84	0.5625	0.96	0.78±0.20
	Monsoon	0.13	0.33	0.12	0.193±0.11
	Post monsoon	0.36	0.7875	0.15	0.4325±0.32
Gross primary productivity (mgC/m3/hr)	Pre monsoon	2.84	2.9625	3.86	3.22±0.55
	Monsoon	1.16	2.06	2.65	1.95±0.75
	Post monsoon	3.72	4.3875	5.8	4.63±1.06
Ammonia (mg/l)	Pre monsoon	34	42.5	59.5	45.33±12.98
	Monsoon	25.5	34	17	25.5±8.5
	Post monsoon	25.5	35	51	37.16±12.88
CO_2 (mg/l)	Pre monsoon	8.8	27.28	23.76	19.94±9.81
	Monsoon	6.16	23.32	17.16	20.24±4.35
	Post monsoon	7.04	25.96	19.36	17.45±9.60
Dissolved oxygen (mg/l)	Pre monsoon	4.8	6.08	1.92	4.26±2.13
	Monsoon	4	1.2	3.84	3.01±1.57
	Post monsoon	4.32	5.6	2.72	4.21±1.44
BOD (mg/l)	Pre monsoon	3.36	1.92	5.88	3.72±2.004
	Monsoon	2.08	6.32	2.16	3.52±2.425
	Post monsoon	2.08	2.08	4	2.72±1.108
COD (mg/l)	Pre monsoon	16	16	4.8	12.26±6.46
	Monsoon	3.73	4.8	1.6	3.37±1.62
	Post monsoon	7.04	25.96	19.36	17.45±9.60

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FIGURES

Fig1.Graph showing seasonal variations of temperature

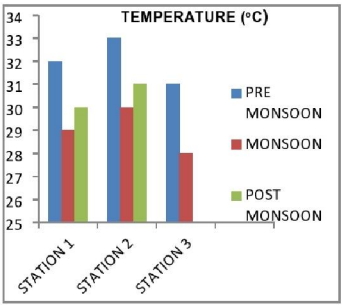
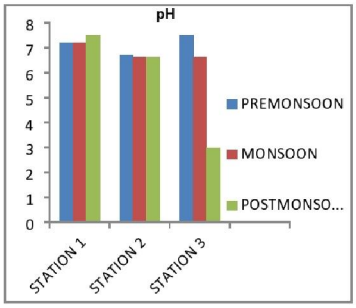


Fig 2: Graph showing seasonal variations of pH.



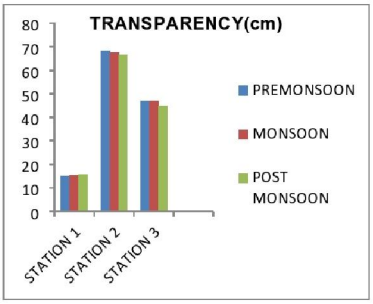


Fig 3: Graph showing seasonal variation of transparency

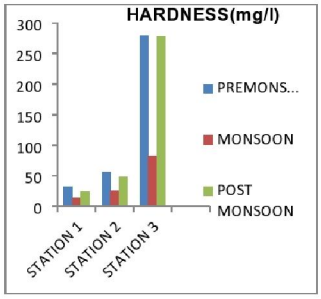


Fig 4: Graph showing seasonal variations of hardness

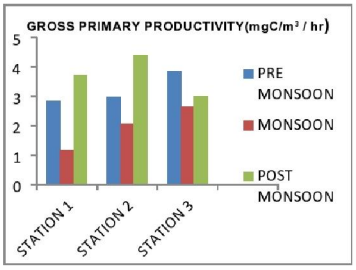


Fig6:Graph showing seasonal variations of GPP

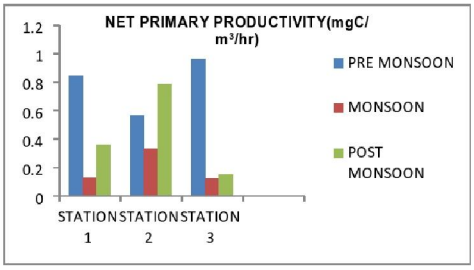


Fig 5: Graph showing seasonal variations of NPP

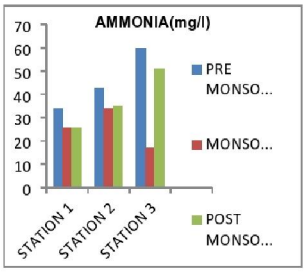


Fig 7: Graph showing seasonal variations of ammonia

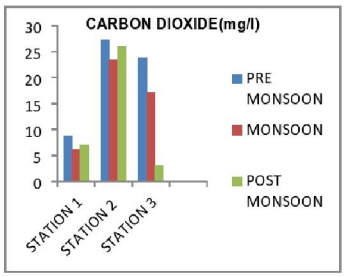


Fig 8: Graph showing seasonal variations of carbon dioxide

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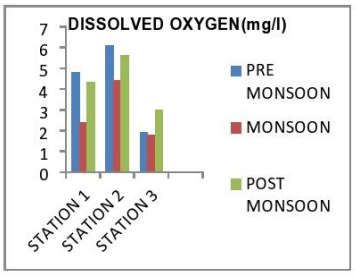

Fig 10: Graph showing seasonal variations of dissolved oxygen

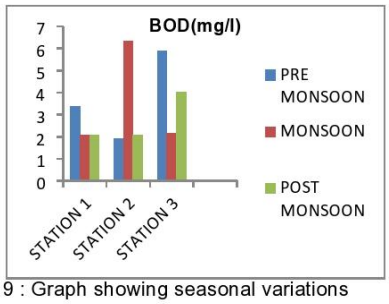

Fig 9 : Graph showing seasonal variations of BOD

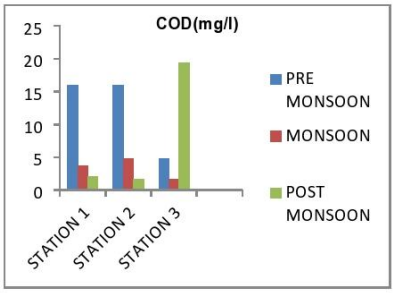

Fig 11: Graph showing seasonal variations of COD

IV. DISCUSSION

Temperature has an important role in physical, chemical, and biological properties of water. Temperature has direct influence on aquatic biota. All living organisms have an optimum temperature for their better survival. The temperature ranged between 28^{0}C to 33^{0}C. The maximum temperature was recorded on pre monsoon season (33^{0}C) and minimum at monsoon season (28^{0}C). Considering the three stations , high temperature was observed in station 2 (33^{0}C) during pre-monsoon season. The variation in temperature may be due to the change in climate and the time of analysis. The water quality may depend on the changes in temperature (Sanalkumar, 2011). pH is one of the physical properties of water. All the aquatic organisms have 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 (2003) normal pH range of the water should be between 6.2-8.5. The maximum pH was reported in station 3 (7.8) during post monsoon season.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. The average range of transparency was 42cm to 43cm. The maximum range of transparency was recorded in station (2) during pre-monsoon and minimum range of transparency was recorded in station 1(15)during pre-monsoon.Transparency of water is generally influenced by factors like wind action, suspended slit particles, plankton concentration and decomposition of organic matter at the bottom.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. Maximum range of hardness was recorded in recorded in station 3 (280mg/l) during pre-monsoon season and minimum range in station 1 (14) during monsoon season. Due to the presence of sulphates and chlorides of Iron, Manganese and Aluminium cause permanent hardness. (Firoz & Sanalkumar,2013). According to APHA (2005) the desirable limit for hardness is 300mg/l. Compared to the desirable limit, the values of the sample are found to be within the limit.

Net primary productivity in the present study ranges from 0.193mgC/m^3/3hrs to 0.78mgC/m$^{3/}$hr. Maximum net primary productivity was observed in station 3(0.96mgC/m$^{3/}$hr) during pre-monsoon and minimum value observed in station 3 during monsoon season. Gross primary productivity was ranges from 1.95mgC/m$^{3/}$3hrs to 4.63mgC/m$^{3/}$hr. Maximum gross primary productivity was recorded in station 3 (5.8mgC/m^3/hr) during post monsoon and minimum value in station 1 (1.16mgC/m^3/hr) during monsoon. The higher value of NPP and GPP during pre monsoon may be due to

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penetration of high intensity which facilitate higher rate of photosynthesis and ultimately the productivity of the riverine system (Singh 1995).

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. (Varunprasath, and Nicholas, 2010). The maximum amount of ammonia was observed in station 3 (59.5mg/l) during pre-monsoonseason and minimum level was observed in station 3 (17mg/l) during monsoon. 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. The maximum carbon dioxide value was recorded in station 2 (27.28mg/l) during pre-monsoon period and the minimum range was 6.61mg/l.

For indicating the water quality and organic pollution, dissolved oxygen is an important parameter. Dissolved oxygen level below 3 mg/l leads to the death of fishes and affects the reproduction and spawning. The maximum range DO was recorded on pre monsoon period (6.08 mg/l). The minimum range of dissolved oxygen was observed in monsoon period (1.2mg/l).Maximum biological oxygen demand was observed in station 2(6.32mg/l) during post monsoon season and minimum value in station 2 (1.92mg/l) during monsoon season. According to BOD water status, BOD of 1mg/l to 2mg/l indicates clean water, 3mg/l is fairly clean, 5mg/l is doubtful and 10mg/l is contaminated (Trivedi and Raj.,1992).Chemical oxygen demand of water sample was observed maximum in station 2 (25.96mg/l) during post monsoon and minimum value in station 3 (1.6mg/l) during monsoon season. COD is an indicator of organic pollution, which is caused by the inflow of domestic, livestock and industrial waste that contains elevated levels of organic pollutants (Ayati, 2003).

V. CONCLUSION

The present study indicates the seasonal variation of physico chemical parameters of selected three stations of Kanam river namely, station 1 (Chelora), station 2 (ThazheChovva), station 3 (Kuruva). The study indicates there is a pronounced variation of most of the water quality parameters with variation in seasons. pH was between 6.6 to 7.8 in all stations of all season. High level of transparency was observed in station 3 in all seasons. Moderately high level of hardness was observed during pre-monsoon and post monsoon season. Primary productivity is high during pre-monsoon period and low primary productivity was observed during monsoon period. Ammonia content was maximum during pre-monsoon and minimum during monsoon season. Carbon dioxide range was high during post monsoon. Dissolved oxygen and biological oxygen demand are depending on each other. The results of the studies shows that all the three sites exhibited seasonal variations in the physic- chemical parameters.The study indicates that water is polluted at all the three stations and unqualified for drinking and domestic purposes. It is essential to rescue the Kanam river and its aquatic life from the current environmental problems.

VI. ACKNOWLEDGEMENT

The authors are extremely grateful to the PG & Research Department of Sree Narayana College, Kannur for the facility rendered during the tenure of the work.

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IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, June 2023

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