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PRELIMINARY ANALYSIS OF MICROBIAL CONTAMINATION AND WATER QUALITY PARAMETERS OF MAMAM RIVER IN THIRUVANANTHAPURAM DISTRICT, KERALA

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ABSTRACT :

Enclosing an area about 114sq. km of catchment areas, Mamam river drains its orgin from Panthalacode hills in Trivandrum district . The river flows westward and continues with the Vamanapuram river. The preliminary objectives of the study was to analyze the variations of some of the physico-chemical parameters such as temperature, pH, carbon dioxide, dissolved oxygen, primary productivity and to analyse the microbial content of the study area following seasons. Water samples were collected from the three selected sites Chittatinkara, Nayanakonam and Kurishiyode and certain physico-chemical parameters were analysed with respect to the seasons following standard methods . High rate of carbon dioxide content was observed in the site1. The study point out that the river is slightly acidic and alkaline irrespective of the season , revealing the incidence of acid liberating substances,creating evidences for the presence of dead and decaying matter. The comparatively low level of dissolved oxygen is a sign of contamination in the study area. High rate of total coliforms and fecal coliforms were observed. Since, Coliforms are indicators of contamination in water, the study indicates the need for conservation and rejuvenation of the river water since it is more contaminated with pathogenic bacteria probably due to intense anthropogenic activities that may cause the incidence of waterborne disease if not properly treated. The increase in the microbial count is the sign of fecal contamination in the water.The current investigation on Mamam river will give a picture about the degradation that reminds the need for conservation of this precious ecological paradise.

Keywords: Microbial water quality, coliforms, productivity, Total Plate Count, Dissolved Oxygen.

1.INTRODUCTION :

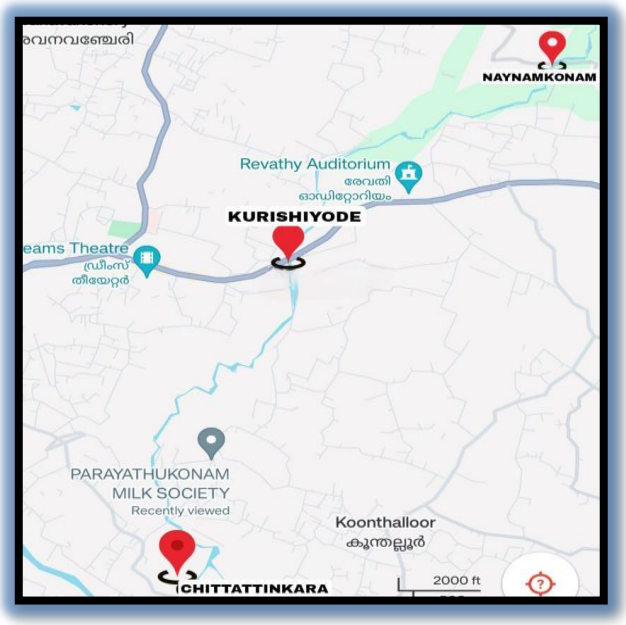
Water is a vital natural resource and one of the marvellous gifts to us that forms the basis of sustenance of all life forms. Water utilized for the purpose of agricultural irrigation, fish rearing, human consumption and domestic uses should be free of disease-producing organisms or large amounts of non – pathogenic organisms. Water quality standards for domestic supplies reminds that faecal bacteria levels should not exceed a geometric mean value of 100 cfu/100 ml while the drinking water standards is < 1cfu/100 ml [12].

Microbiological examination of river water is a mandatory criterion for irrigation and recreation [3]. Microbiological standards of drinking water is usually expressed in terms of the abundance of particular species of bacteria [10]. The normal standards of river water quality is altered by the indiscriminate deposition of sewage without the application of proper sewage drainers that may lead to an increased microbial load within the water bodies. This often results in the incidence of various communicable diseases.Fecal contamination is often indicated by the presence of pathogens . [10]. The organisms are made spread by water contaminated with fecal material from humans and other warm-blooded animals [12]. The wastewater discharged in fresh water and coastal seawaters is attributed as a major source of pathogenic microbes [4].

Monitoring of the water quality standards plays a pivotal role in assessing the ecosystem, ecology and restoring water quality [11,5]. The study preliminary aims to investigate the abundance of microorganisms and to determine its effects related to certain physiochemical parameters of the Mamam river located near Attingal, Thiruvananthapuram that forms a fascinating ecosystem. Certainly, there is a lacking of scientific awareness data on the microbiology of the Mamam river for appropriate intervention. The findings of the study will be helpful to create conscientization on implementing practical measures to guide waste disposal into water bodies thus, mitigate and control the impact of the anthropogenic activities on its biodiversity.

2.MATERIALS AND METHODS :

Mamam river basin is located in the southern part of Trivandrum district of Kerala state, and is situated between latitudes N 8°35'22" to N 8°42'33" and longitudes E 76°46'30" to 76°58'12". The present investigation was carried out by analysing the water samples at three different stations of Mamam River in Thiruvananthapuram District (Figure 1).The regions selected for study are; Site1.Nayanamkonam, Site 2. Kurishiyode 3, Site 3. Chittattinkara. (Plate 1,2 and 3) Water samples were collected during the year 2023-2024 from the study area and certain physico-chemical parameters were analysed following standard methods [1]. Polyethylene made plastic bottles of clean sterilized, narrow mouthed neutral bottles were used for sampling. The samples were collected early in the morning and brought to the laboratory within 6 hours, which was kept in ice chest. The water was studied microbiologically using the following parameters. Total plate count (TPC), Total coliforms (TC), Total number of *E.coli*. TPC technique was done to calculate the number of heterotrophic bacteria within the water sample. This was conducted in two parts by serial dilution of culture sample and agar plating of the sample dilutions to nutrients medium.Using a colony counter the viable cells per ml of original culture is calculated by multiplying the number of colonies counted by the dilution factor. The count is expressed in colony forming units cfu/ml (Colony Forming Units). Bacterial analysis was carried out using Multiple tube fermentation technique. Multiple Tube Fermentation Technique were carried out by conducting Presumptive and Confirmatory tests. The water samples were thus analysed as per Indian Standards IS: 1622 - 1981.



MAP OF THE STUDY AREAS IN MAMAM RIVER (Figure 1)

PHOTOGRAPHS OF THE STUDY SITES

SITE 1 NAYNAMKONAM (Plate 1)

SITE 2 KURISHIYODU (Plate2)

SITE 3 CHITATTINKARA (Plate 3)

3.RESULTS AND DISCUSSION

The investigated paraameters of station 1 (Nayanakonam), station 2(Kurishiyode), station 3(Chittatinkara) were analysed and compared. The eco-biological parameters exhibited seasonal variations.

Temperature

A minimum range of 27ºC and a maximum range of 33ºCtemperature was exhibited among stations. A high range of temperature in the pre-monsoon season was observed in station 2(30ºC) and a low range of temperature was observed in station 1(27ºC). In the monsoon period, the temperature of the water sample in the post-monsoon period ranges from 30ºC to 31ºC.Table (1), fig(2).The mean ± standard deviation ranges from 28.33±1.52 to 31.33±3.05.

pH

pH ranged from 5.6 - 10 in the pre-monsoon season. station 1(10) and lower pH level in Station 2 exhibited a higher level of acidic pH (5.6). In post-monsoon, pH of water sample ranged from 5.6 to 9.5. pH ranges 6.5 to 9.5 in monsoon period.fig(3).The mean ±standard deviation ranges from 9.1±1.15 to 8.26±1.56.

Carbon dioxide

The maximum range of carbon dioxide was observed in station 1(71.28mg/l) and minimum range was observed in station 3(49.28mg/l). Maximum carbondioxide was marked in station 1(54.56mg/l) and minimum range was observed in station 2(42.24mg/l).Minimum rangeof carbondioxide was observed in station 2(29.92mg/l).fig(4).The mean± standard deviation ranges from 38.13±8.36 to 31.33±3.05.

Dissolved Oxygen Maximum range of Dissolved oxygen was observed in station 2, (6.56mg/l) and minimum range was observed in station 1. Maximum range of Dissolved oxygen was observed in station1,(4.48mg/l) and minimum range was observed in station3(3.2mg/l) .In the post monsoon season maximum range was shown in station2,(5.6mg/l) and minimum range was observed in station3,(3.36mg/l) fig(5). The mean ±standard deviation ranges from 4±0.84 to 5.76 ±1.13.

Primary productivity

In pre-Monsoon gross primary productivity ranges from 0.225 to0.3628 mgC/m^3/hr.Station1and 2in pre-monsoon season , the value recorded was 0.225 mgC/m^3/hr and in station3 it was 0.3625 mgC/m^3/hr.In Monsoon season ,it was nearly from 0.1188 to 0.1.In post-Monsoon season in station2 it was 0.20625 mgC/m^3/hr and in station 3,0.2 mgC/m^3/hr.fig(6).In the pre-monsoon Net productivity ranges from 0.25mgC/m^3/hr to 0.0125mgc/m^3/hr. Maximum range was observed in station1(0.25mgC/m^3/hr)and minimum range was observed in station 3(0.012mgC/m^3/hr). NPP of water sample in the monsoon season was nearly 0.025 to 0.275 mgC/m^3/hr.In post- monsoon minimum NPP was observed in station1(0.025)and maximun NPP was exhibited in station 3(0.275).fig(7).

Microbiological Analysis

Considering station1, the total plate count (microbial load) was marked as about 1704cfu/ml. The amount of total coliforms was about 988cfu/ml. The amount of Fecal coliform(E.coli) was marked as about 246 cfu/ml.(Table.2)(Fig.8).In station2, the total plate count l microbial load was marked as about 1552 cfu/ml. The amount of total coliform was about 340cfu/ml. The amount of Fecal coliform (E.coli) was 218 cfu/ml. (Table.2)(Fig.9).Considering station3, the total plate count/microbial load was marked as about 2108 cfu/ml. The amount of total coliform was about 502 cfu/ml. The amount of Fecal coliform(E.coli) was about 328 cfu/ml. (Table.2)(Fig.10).

Results of the investigated parameters (Table 1)

PARAMETERS	SEASONS	STATION- 1	STATION -2	STATION -3	MEAN±SD
	Pre monsoon	**27**	**30**	**28**	**28.33±1.52**
Temperature (°C)	**Monsoon**	**30**	**32**	**28**	**30±2**
	Post monsoon	**30**	**33**	**31**	**31.33±3.08**
pH	**Pre monsoon**	**10**	**7.8**	**9.5**	**9.1±1.19**
	Monsoon	**9.5**	**6.5**	**8.8**	**8.26±1.56**
	Post monsoon	**8.5**	**5.6**	**9.5**	**7.86±2.02**
Gross Primary	**Pre monsoon**	**0.225**	**0.225**	**0.362**	**0.27±0.07**
Productivity (mgC/m^3/ hr)	**Monsoon**	**0.1**	**0.118**	**0.1**	**0.10±0.01**
	Post monsoon	**0.2**	**0.206**	**0.2**	**0.20±0.0**
Net Primary	**Pre monsoon**	**0.25**	**0.025**	**0.012**	**0.09±0.13**
Productivity (mgC/m^3/ hr)	**Monsoon**	**0.006**	**0.031**	**0.25**	**0.09±0.13**
	Post monsoon	**0.025**	**0.013**	**0.275**	**0.14±0.12**
	Pre monsoon	**71.28**	**56.32**	**49.28**	**58.96±1.23**
CO_2(mg/l)	**Monsoon**	**54.56**	**42.24**	**45.76**	**47.52±6.34**
	Post monsoon	**46.64**	**29.92**	**37.84**	**38.13±8.36**
	Pre monsoon	**NIL**	**6.56**	**4.96**	**5.76±1.13**
Dissolved oxygen(mg/l)	**Monsoon**	**4.48**	**4.8**	**3.2**	**4±0.88**
	Post monsoon	**5.28**	**5.6**	**3.36**	**4.24±1.21**

Microbiological analysis (Table 2)

Bacteriological parameters of stations	Station 1 Nayanakonam	Station 2 Kurishiyode	Station 3 Chittatinkara	Method of Analysis	Acceptable limit Per IS No.10500:2012
Total Plate Count/ Total Microbial Load	1704 cfu/ml	1552 cfu/ml	2108 cfu/ml	IS 5402:2012	<500 cfu/ml
Total coliforms	988 cfu/ml	340 cfu/ml	502 cfu/ml	IS 15185:2016	Absent/ml
Fecal Coliforms:E.coli	246 cfu/ml	218 cfu/ml	328 cfu/ml	IS 1622 : 1981	Absent/ml

Figures

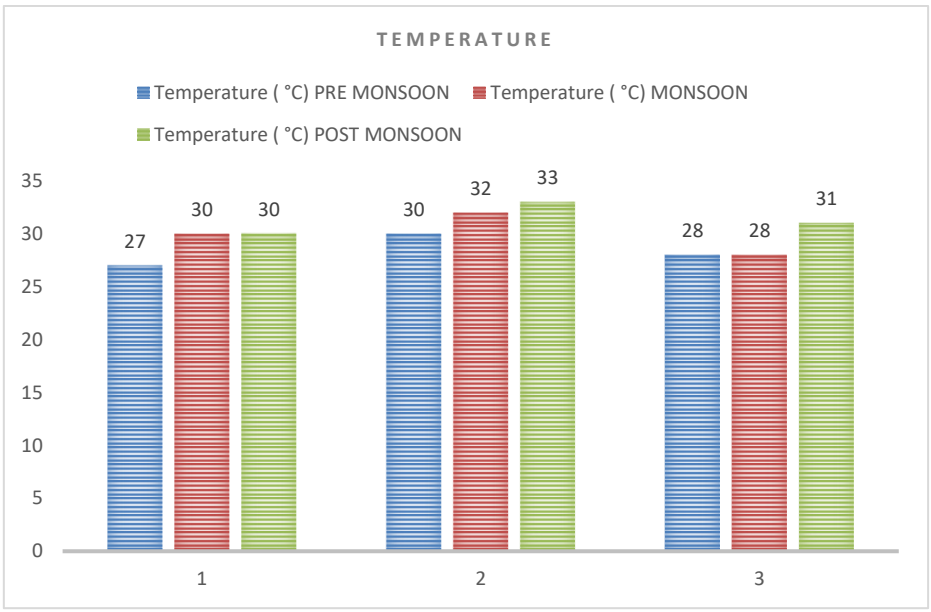


Fig.2 Temperature fluctuations

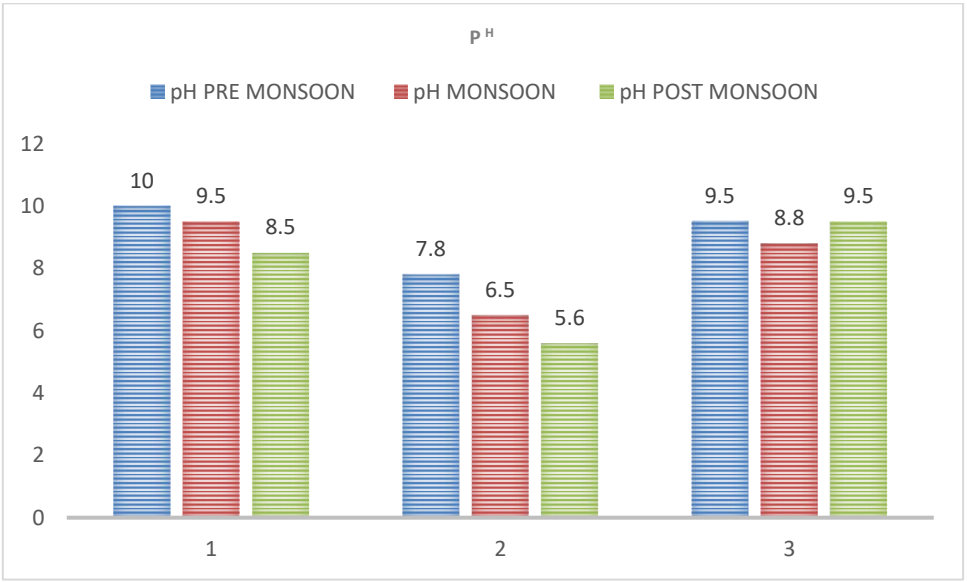


Fig.3 pH variations

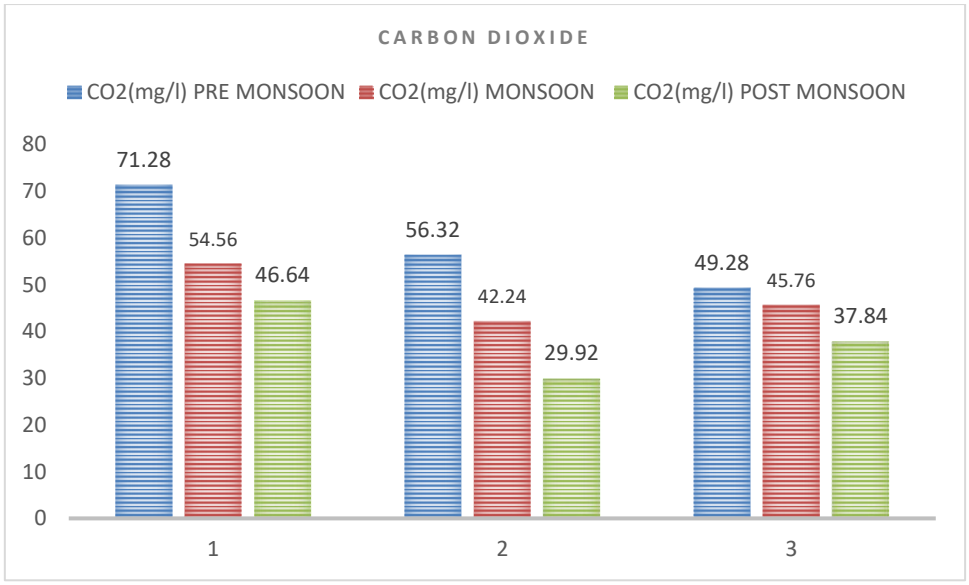


Fig.4 Carbondioxide concentration

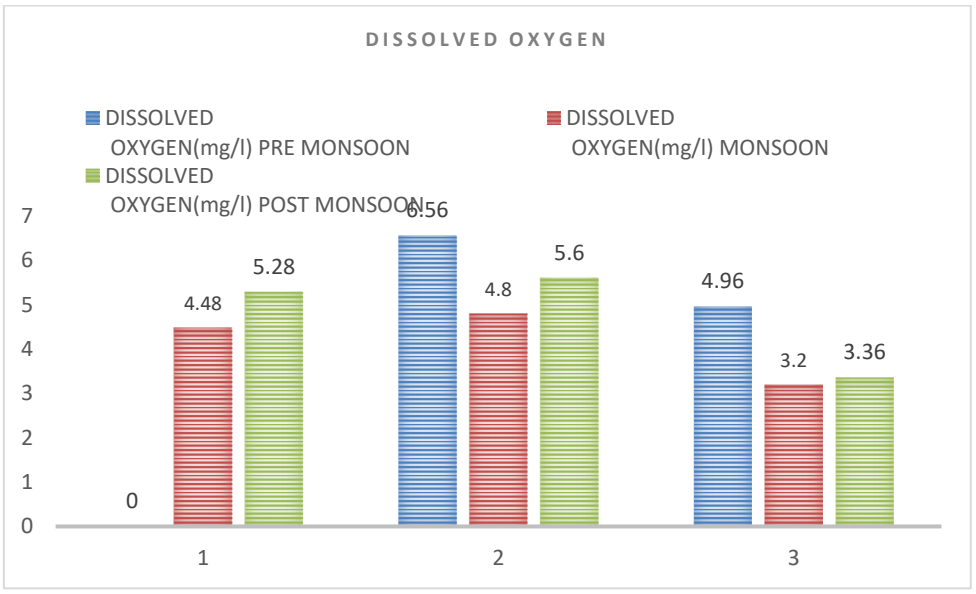
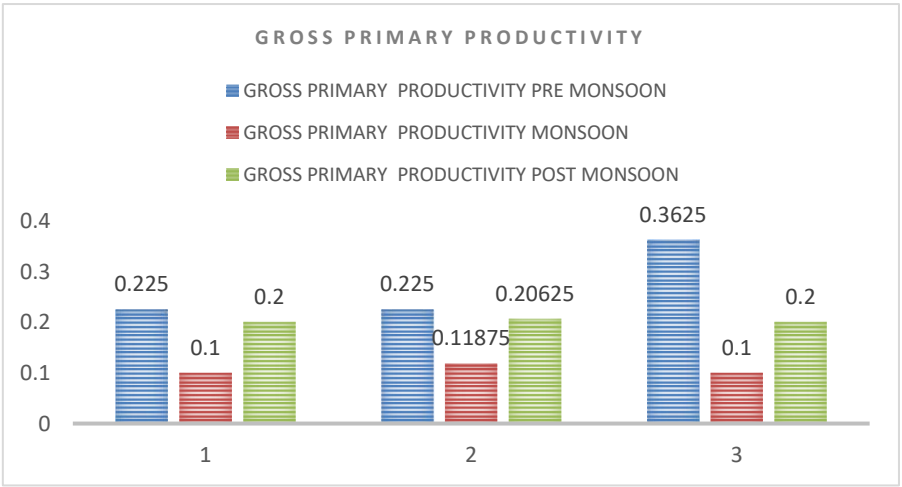


Fig.5 Dissolved oxygen fluctuations



Fig, 6 Gross Primary Productivity variations

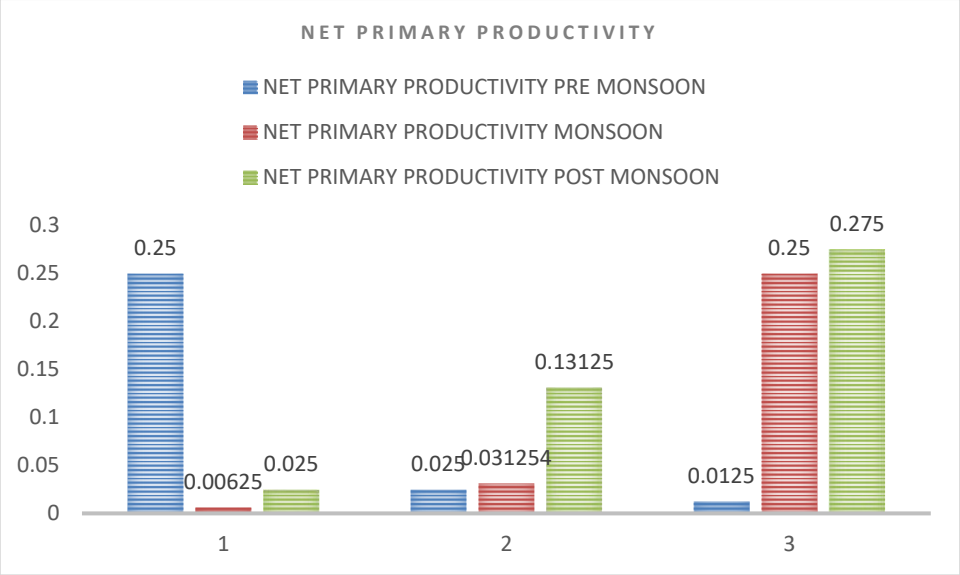


Fig . 7 Net Primary Productivity values observed

Pie chart showing bacteriological parameters of selected sites

Station1

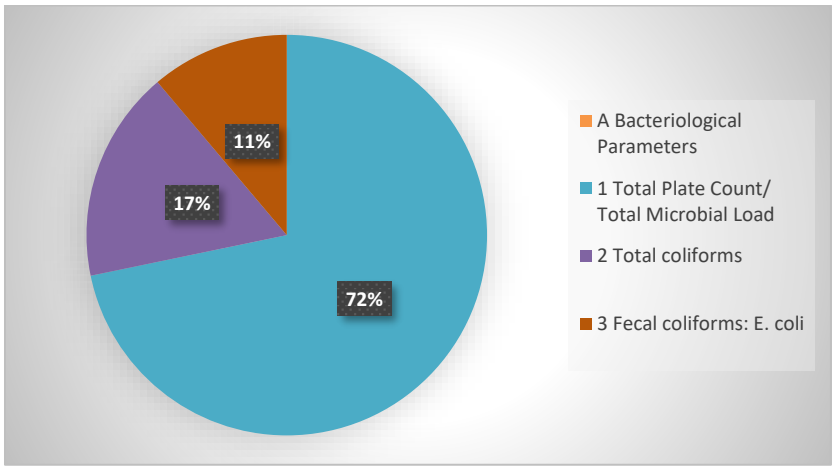


Fig.8 shows Bacteriological parameters of Nayanamkonam

Station 2

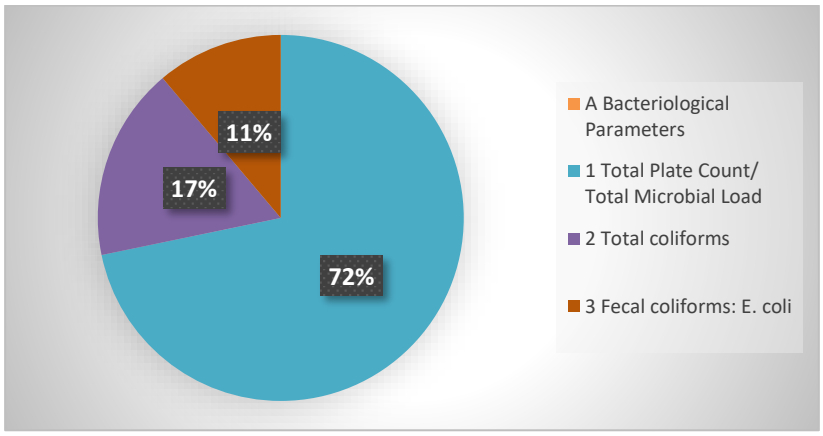


Fig.9 shows Bacteriological Parameter of Kurishiyodu

Station 3

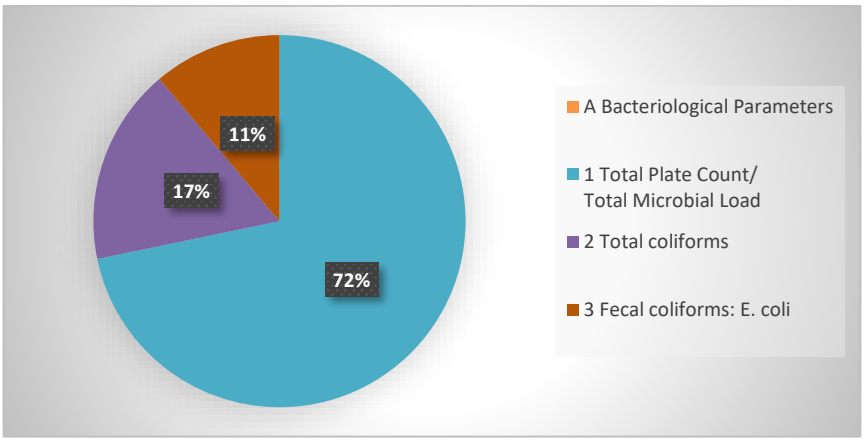


Fig.10 shows Bacteriological Parameter of Chitattinkara

The temperature is guiding a pivotal role in altering the physical, chemical and biological properties of water. The maximum temperature was recorded in post monsoon season (33 ^{0}C) and minimum at pre monsoon season (27^{0}C). Considering the three stations, high temperature was observed in station 2 (33^{0}C) during Post monsoon season. The variation in temperature may be due to the change in climate and the time of analysis. The water quantity may depend on the changes in temperature. 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. [9].

All aquatic organisms have an optimum pH known as minimum pH for their sustenance. Any alteration in pH can change the acidity or basicity of water. In station 1, during pre-monsoon The maximum pH was reported (10). pH is probably by far the most important parameter regulating the behaviour of other water quality parameters as well as the presence of metals in the aquatic environments [2].

Carbon dioxide is It is also required for the phytoplankton and forms the vital component for photosynthetic activity . Carbon dioxide is formed by the process of decomposition and respiration. Carbon dioxide value was recorded maximum in station1(71.28mg/l) during the monsoon period and the minimum range was (29.9 mg/l) during post monsoon. The surge in carbon dioxide concentration may be due to the death decay and decomposition of organic matter. The minimum range of dissolved oxygen was observed in (3.2mg/l) station 3 of monsoon season. Dissolved oxygen levels below 3 mg/l leads to the death of fishes and affect reproduction and spawning. Low level of dissolved oxygen directly affects the fish community. In pre monsoon of station 1 ,dissolved oxygen was lacking. The increase in carbon dioxide may be due to decay and decomposition of organic matter [6].

Maximum gross primary productivity was recorded in station 3(0.36mgC/m^3/hr) during pre-monsoon and maximum value in stations 1 and 3 (0.1mgC/m^3/hr) during monsoon season. Net primary productivity in the present study ranges from 0.006mgC/m^3/hr to 0.245 mg/C/m^3 maximum net primary productivity was observed in station3(0.25mgC/m^3/hr) during post-monsoon and minimum values were observed in station 1 during monsoon season. Net Primary Production is the base line ecological process that reflects the amount of carbon synthesized within an ecosystem, which is ultimately available to the ecosystem. It reveals that aquatic algae are a significant contributor to food webs in tropical rivers and streams [8].

Considering the microbiological analysis of the selected sites ,pronounced variations in the microbial count was noted. The maximum range of total microbial load was found in station 3. The minimum range was found in station 2. The maximum range of total coliform was found in station1. The minimum range of fecal coliform was found in station3. If *E.coli* bacteria is detected in a water sample, it is an indicator of fecal contamination of the water. That means there is a greater risk that water – borne pathogens are present . According to the World Health Organization, a zero count of *E.coli* per 100ml of water is considered as safe for drinking. A count of 1-10MPN/100ml is regarded as low risk. 11-100MPN/100ml is medium risk. Finally, an E. coli count greater than 100MPN/100ml is adjudged high risk [7].

4.CONCLUSION :

The Mamam River, flowing through Attingal in the southern state of Kerala, India, is a vital water body that holds significant importance for its biodiversity. Originating from the Western Ghats, it meanders through lush green landscapes, providing sustenance to the surrounding ecosystem. The river's journey begins as a small stream, gradually gaining momentum as it receives contributions from various tributaries along its path. As it courses through Attingal, the Mamam River serves multiple purposes crucial to the local population. Its water is utilized for irrigation, supporting the cultivation of paddy fields, coconut groves, and other crops that form the backbone of the region's agricultural economy. Furthermore, the river supplies water for domestic use, ensuring access to clean drinking water for communities residing in its vicinity. Ecosan toilets have to be implemented for restoring the damage caused by insanitary practises.On the contrary, the investigated microbiological parameters indicate that Mamam river water is contaminated as per the standard values of Bureau of Indian Standards that will finally culminate in the incidence of water borne diseases.Beyond its utilitarian functions, the Mamam River holds cultural and spiritual significance for the people of Attingal. It is often considered as a sacred entity, with rituals and ceremonies conducted along its banks during religious festivals and auspicious occasions. Additionally, the river serves as a recreational

space for locals and visitors, offering opportunities for activities such as fishing, boating, and leisurely walks along its serene shores. However, despite its importance, the Mamam River faces various challenges, including pollution, encroachment, and reduced water flow due to human activities and environmental degradation. The study indicates that the Mamam river is contaminated by pathogenic microorganisms thus making it unfit for direct drinking purpose or household purposes. That indicated the need for creating awareness programmes among the local people by rendering Environmental education from the grass route level. Efforts to conserve and rejuvenate the river are underway, highlighting its critical role in sustaining both the ecological balance and the socio-economic well-being of Attingal and its inhabitants.

Recommendations suggested

Taking into account of the results of the study, the following recommendations have to be implemented for creating an awareness regarding the conservation and restoration of Mamam river.

- Water has to be treated using various water treatment strategies.
- Sewage treatment measures have to be adopted including the installation of primary, secondary and tertiary treatment plans have to be implemented.
- Make use of the principle reduce, recycle and reuse.
- Necessity for providing Environmental Education, enforcement of strict laws and regulations regarding the proper disposal of wastes.
- Implementation of proper sanitary measures and hygienic practises.

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