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Physical and chemical analysis of mullaiperiyar river water in Theni district, Tamilnadu, India

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ABSTRACT

Keywords

Mullaiperiyar River, Theni district, Total hardness, BOD, Dissolved oxygen, APHA, sanitation

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Water is a natural resource for the survival of all existing organisms. The Mullaiperiyar River is one of the exceptional rivers of South India. The present study was mainly focused to investigate the physical and chemical analysis of Mullaiperiyar river water in Theni district, Tamilnadu, India. Water samples were collected from the upstream area (Near the Dam-Lower camp, Kullapagoundanpatty, Karunakkamuthan Patty), urban stretch area (Surlipatti, Uthamapalayam, Chinnamanur and Veerapandi) and downstream area (Theni-Aranmanaipudur, Vaigai Dam) during the period of during the period of six months from January to June 2015 for the analysis. The Physico-chemical parameters were analyzed by using APHA and WHO standard procedure. The observed values of different physical and chemical parameters like Temperature, pH, Total dissolved solids (TDS), Total hardness (TH), Total Alkalinity (TA), Calcium Hardness, Magnesium Hardness, Chloride, Nitrate, Nitrites, Dissolved oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical oxygen demand (COD) was also performed. The present study alerts the inhabitant's sanitation, health activities and environmental hygiene. A regularly observed and ensured the river water quality from additional unhygienic.

Introduction

River is one of the most important development resources for purpose in both rural and urban areas. Rivers are essential and susceptible freshwater environment that are critical for the nourishment of all existence. Water constitutes about 85 to 90% in manipulate of the human body

(Bello Temitope *et al.*, 2013). Approximately half of the humankind is without access to improved hygiene facilities and almost huge of public still lack to enhanced drinking-water supplies (Oladipo *et al.*, 2009). The large quantity of the world's inhabitant's uses potable water

for home sanitation, drinking, and cooking purposes (WHO, 2004). During the recent several decades, the Indian rivers water quality has been deteriorating due to incessant discharge of domestic sewage, agricultural and industrial wastes. (Kadarshahib Roshine begam and Sundaraj Selvakumar, 2014). The present study focuses on the effect of physical and chemical factor of Mullaiperiyar river water and an attempt has been made to determine the quality of Mullaiperiyar river water in Theni district.

The Mullaiperiyar river is situated within Latitudes 9°31'43 North and Longitudes 77°8'39' East beside with the rivers flowing west throughout Kerala State and accordingly the name is Mullaiperiyar river. The Mullaiperiyar River was mostly useful to Theni district people. Theni town is located in the southwestern central part of Tamilnadu (9°.39'N and 10'30 north latitude and 77°.00'and 78'30 of east longitude). The Theni district had a population of 1,246 million as per 2011 censuses of India Figure 1. Generally, the Mullaiperiyar river water is the major source for drinking, agriculture, washing, bathing and religious purposes in both urban and rural areas. The Mullaiperiyar River receives large amount of wastes such as domestic, industrial and agricultural effluents is directly receiving from townships like Guddalur, Surlipatti, Cumbum, Uthamapalayam, Veerapandi, Theni, Kunnur and Vaigai dam (Sivamanikandan and Ahmed john, 2015). The deterioration of river water quality is mainly exaggerated by human being behaviors such as discharge of sewage, industrial wastes and agricultural runoff which causes systematic ecological damage and health hazards (Meitei *et al.*, 2004; Shrivastav *et al.*, 2013). The major problems are related with river water are solid suspensions, turbidity and lack of

oxygen, excess of carbon dioxides and organic biomass. The Physico-chemical factors were indicated that the river water and significantly the beneficial microflora has been reduced by xenobiotic compounds may direct to the existence of these complex by anthropogenic activities (Venkateshraj *et al.*, 2010). The unreliable physico-chemical assets of the river water leads to the accumulation of microbial load. Randomly the dumping of sewage and effluent wastes into river changes the physicochemical properties of water production is not fitting for human utilization (Islam *et al.*, 2012). The good quality of river water is an assurance in human health and the protection of the ecosystems and sustainable improvement (Rajini *et al.*, 2010). At present, Siva and Ramakrishnan *et al* researcher have carried out studies on the Mullaiperiyar Periyar River is greatly polluted with industrial and agricultural wastes. These findings demonstrated the non potability of Mullaiperiyar river water and in the direction of augment alertness to the people and maintain the Mullaiperiyar river water in hygiene stage. Hence, the present study is examined about the physical and chemical analysis in Mullaiperiyar river water in various areas from the month of January 2015 to June 2015.

Materials and Methods

Study Area

The study area was divided into nine sampling stations Figure 2. River water samples were collected from nine sampling stations from upstream area as Lower camp (S1), KullapaGoundanpatty (S2), KarunakkaMuthan Patti (S3); middle of urban stretch area as Surlipatti (S4), Uthamapalayam (S5), Chinnamanur (S6) Veerapandi (S7) and downstream area as

Theni Aranmanaipudur (S8) and Vaigai dam (S9). (Sivamanikandan and Ahmed John, 2015).

Collection of Water Sample

The Mullaiperiyar river water samples were collected during January to June 2015 from the lower camp to Vaigai dam for the assessment of physico-chemical factors. River water Samples were collected during the first and third week of every month in sterile one liter polythene bottles. The closed bottles were immersed in the river at the depth of 0.5 to 0.7 m and the stopper was opened in bottom of river and was closed again to the river water. After sample collection, the bottles were kept in ice box and transferred immediately to the laboratory for further analyses. (Sivamanikandan and Ahmed John, 2015)

Analysis of Water

The laboratory analysis of Mullaiperiyar river water samples were prepared by the standard procedures of the American Public Health Association (APHA, 2005) and World Health Organization (WHO, 2004). Totally fifteen types of physico-chemical parameters such as Temperature, pH, Electrical conductivity (EC), Total Suspended Solids (TSS), Total alkalinity, Total Hardness, Dissolved Oxygen, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD); Quantification of Calcium, Magnesium, Nitrate, Nitrite, Chloride, Iron, were performed. The pH and Temperature of the river water samples were measured at the site using digital pH meter and digital thermometer respectively. The results were expressed in mg l^{-1}

Results and Discussion

The physico and chemical assessment of

Mullaiperiyar river water samples were analysed in the nine areas during the period of January 2015 to June 2015. The physical and chemical parameters were higher than their acceptable limits like WHO (2004) and APHA (2005). The mean value of physico-chemical parameters of Mullaiperiyar River was presented in the Table 1.

pH: pH are most significant physical parts that change the chemical and biological effect in the river water. The value of pH was determined by digital pH meter. The pH ranged from 6.8 to 7.4 among in nine stations of river water was analysed. The variation of pH value to changes in the photosynthetic activities of river plants and increases the utilization of carbonates/carbon dioxide during the process (Gray, 2006). The difference of pH is appropriate to the variation of discharges from the domestic sewage waste (Raja *et al.*, 2008).

Temperature: River water temperatures are fluctuating with changing climatic situation. The measurement of temperature was determined by using thermometer. The value of temperature ranged from 26°C to 27.50°C in all water sources respectively. The variation of temperature in river water is generally depends on the season and geographic position, (Ahipathi and Puttaiah, 2006).

EC: The electrical conductivity (EC) was recorded with a minimum value of 930 $\mu\text{S/cm}$ at station 1 and maximum of 1550 $\mu\text{S/cm}$ at station 9. The high EC specified larger quantities of dissolved minerals like phosphates, carbonates, ammonia and nitrate, etc. due to microbial degradation of the natural wastes (Abida and Harikrishna, 2008; Gray, 2006).

TDS: Total dissolved solids are mainly

composed of carbonates, bicarbonates, phosphates, chlorides, and nitrates of calcium, magnesium, potassium, sodium, and organic matter and other particles (Mahananda *et al.*, 2010). The amount of total dissolved solids was measured in all nine stations ranged from 1320 to 1575 mg/l was recorded. The high value of TDS present in the river due to the contamination of domestic sewage water, agriculture waste and other garbage. The high concentrations of TDS of the river water were effect into eutrophication of river water sources (Verma Pradeep *et al.*, 2012).

Dissolved Oxygen: The dissolved oxygen of Mullaiperiyar river sample was measured by Winkler's method. The values of DO in nine stations fluctuate from 230 to 275 mg/l. The high level of DO content was due to large decomposition of organic matter with indicates the large amount of pollution in the river water (Radha Krishnan *et al.*, 2007).

BOD: Biochemical oxygen demand (BOD) of the river water test was enumerated by Winkler methods respectively. The value of BOD in nine stations ranged from 7.5 to 50.5 mg/l in the same way. The BOD is increased due to the sewage discharge, open defecation and urban runoff. (Ahiarakwem and Onyekuru, 2011)

COD: The measure of COD determines the amount of organic matter found in river water (Faith, 2006). Chemical oxygen demand (COD) of the Mullaiperiyar river water sample was measured by Reflux method respectively. The value of COD in nine stations of Mullaiperiyar river water ranged from 11 to 110 mg/l. COD is one of the useful indicators of organic and inorganic substance of river water by sewage discharge and anthropogenic activities (Sivamanikandan and Ahmed John, 2015).

Total Alkalinity: Alkalinity is the defense capacity of a water body (Borlongan *et al.*, 2010). Total alkalinity in river water samples were measured by Acid titration method. The amount of total alkalinity recorded in Mullaiperiyar river ranges between 280 to 920 mg/l. In this study, total alkalinity in all areas was above the standard level. The dumping of domestic, agricultural and industrial wastes is increased alkalinity assortment (Osibanjo *et al.*, 2011).

Total Hardness: Total hardness is dependent upon the quantity of calcium or magnesium salts (APHA 1998; Adejuwon and Adelokun, 2012). Total hardness of river water samples was measured by Ethylene diamine tetra acidic acid (EDTA) titration method. The value of hardness ranged from 240 to 1100 mg/l in the nine stations of Mullaiperiyar River. The huge amount of total hardness is due to assimilation of sewage effluents into the river (Roy and Kumar, 2002).

Calcium and Magnesium: The calcium and magnesium in the river samples were measured by EDTA titration. The value of calcium and magnesium ranged from 150 to 180mg/l and 130 to 160 mg/l respectively. Calcium is generally present in river water as the carbonate, bicarbonate, sulphate, chloride and nitrate forming permanent hardness (Adejuwon and Adelokun, 2012). The large amount of calcium may be access by discharge of the rocks into the river water organization (Sivakumar *et al.*, 2011). Magnesium is one of the important sources for chlorophyll development and it acts as a restrictive factor for the growth of phytoplankton (Dagaonkar and Saksena, D.N, 1992).

Chloride: Chloride was measured by Argentometric Method and the value was observed within the range from 265 to 320

mg/l. In the present study, large quantity of chloride presence in the Mullaiperiyar River is mostly used of high potash fertilizer by the cultivator, washing-cloths, human-animal waste discharge and additionally the

septic tank discharge throughout the river flow. The previous work by Sivamanikandan and Ahmed john reports the chloride content of Mullaiperiyar river water to be 285 to 355 mg/l.

Table.1 Physical and Chemical Analysis of Mullaiperiyar River Water in Theni District

Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9
pH	6.8	7.0	7.0	7.2	7.4	7.5	7.5	7.2	7.4
Temperature	26	26.50	27.10	27.75	28.50	27.50	27.10	28.50	27.50
Electrical Conductivity (µS/cm)	930	950	975	1100	1150	1190	1125	1350	1550
TDS mg/L	1320	1200	1075	985	950	975	1100	1350	1575
Dissolved Oxygen	230	225	210	180	165	140	125	220	275
Biochemical Oxygen Demand (mg/L)	7.5	8.0	10.5	13.5	16.0	18.5	22.0	32.5	50.5
Chemical Oxygen Demand (mg/L)	11.0	11.5	14.0	16.5	18.5	23.0	28.5	62.5	110
Total Alkalinity (mg/L)	280	285	290	300	325	345	420	675	920
Total Hardness (mg/L)	240	255	270	295	340	365	425	785	1100
Calcium Hardness (mg/L)	150	145	135	120	110	95.0	100.5	125	180
Magnesium Hardness (mg/L)	130	120	115	90	85	85	90	115	160
Chloride (mg/L)	265	250	225	180	165	150	170	255	320
Nitrate (mg/L)	4.50	4.65	4.85	5.20	5.55	5.75	6.20	7.25	7.65
Nitrite (mg/L)	0.50	0.50	0.50	0.52	0.45	0.42	0.45	0.52	0.55
Iron (mg/L)	6.25	6.20	5.50	4.50	3.25	3.15	2.45	4.55	5.30

Mean values of physical and chemical parameters of Mullaiperiyar river water in Lower camp to Vaigai dam (values are in mg/L, except pH, Temperature and EC). Here, S1- Lower camp, S2- Kullapagoundan patty, S3- Karunakkamuthan Patti, S4- Surlipatti, S5- Uthamapalayam, S6- Chinnamanur, S7- Veerapandi, S8- Theni Aranmanaipudur, S9- Vaigai dam

Figure.1 Outline Map of Tamilnadu

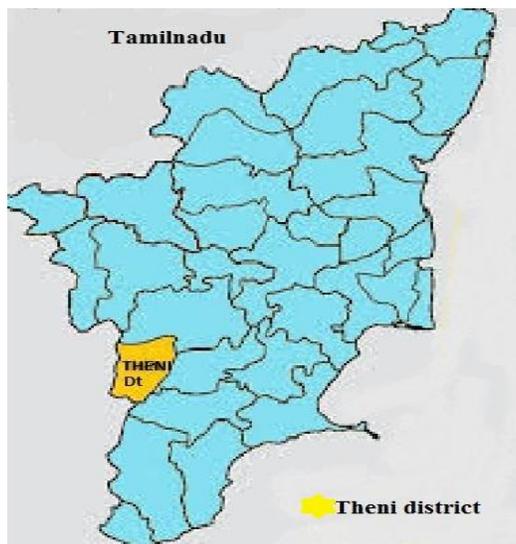
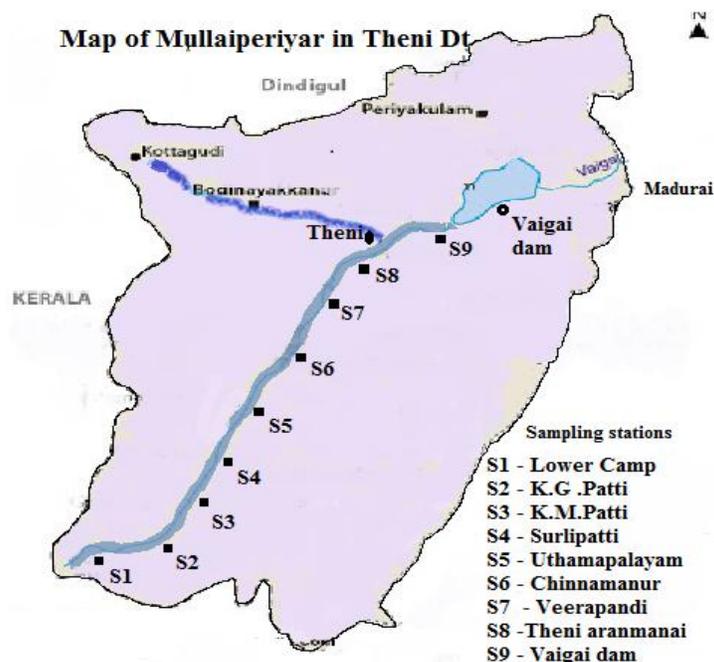


Figure.2 Map of Mullaiperiyar River in Nine Sampling Stations- Theni District



Nitrate and Nitrite: Nitrate and Nitrite is the most importance source of biological oxidation of organic nitrogenous materials. The mean values of nitrate and nitrite in all nine stations were observed at a range from 4.50 to 7.65 mg/l and 0.50 to 5.55 mg/l. The increases of nitrate in river water can also be recognized to agricultural waste and human and animal wastes. Artificial manure waste, human and animal feces can be the most important source of river water. These augmented amounts of nitrate were originated to stimulate the aquatic plants and thereby added to the BOD level in the river (Peavey *et al.*, 1985; Lalitha *et al.*, 2003).

Iron: In Mullaiperiyar River Iron was detected by Phenanthroline spectrophotometric method. Iron ranged from 6.25 to 5.30 mg/l in all nine stations. The high concentrations of iron are produced direct and indirect toxic effects on

the river biota (Peuranen *et al.*, 1994). In conclusion, the present study was concluded that Mullaiperiyar river water was highly polluted due to the discharging of solid waste such as domestic and municipal waste, mixing human and animal feces, industrial and agricultural waste like pesticides, and fertilizers released into river water. The physico chemical analysis reveals the current status of river quality is most probably not fit for drinking purpose. The quality of physico-chemical increase within the standard limits of WHO and APHA standards. This indicates that the water of Theni city and its surrounding area is not suitable for drinking purposes directly if development river water resources are protected hygienically.

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