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Original Research Paper

Physico-chemical Characteristics of the River Amaravathy, Tamil Nadu, India

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ABSTRACT

Water quality by physico-chemical characteristics of Amaravathy river was evaluated for a period of one year from August 2005 to July 2006. The temperature was maintained within the range that commensurate the local climatic conditions, and the colour and the odour suited the seasons. The solid contents were though within the standards, they were on the higher normal side. The pH was found to be essentially alkaline and relatively similar throughout the study period. The nutrient contents were on the higher normal side. The river water is suitable for fishes, agriculture purposes and after appropriate treatment for drinking purposes as well.

INTRODUCTION

Clean water is one of the nature's greatest gifts to mankind. Unfortunately, the clean water resources are not only shrinking in size but are also getting more and more polluted thus, becoming less suitable for various uses (Garge et al. 2006). The intensity of the load, and expedited nature of exposure, with which, contemporary contamination of a water resource is alarmingly on the rise. Amaravathy river is one of the small but important water resources of Tamil Nadu. The basic knowledge of its ecosystem pertaining to physico-chemical characters ought to be known, while studying the fishes from it, since fishes are sensitive indicators of quality of the water medium, and the growth and multiplication of them are affected by pollution.

MATERIALS AND METHODS

River Amaravathy is an important water course that runs around three major districts of middle part of Tamil Nadu State in India. It runs nearly 190 km before merging with River Cauvery, the major river of southern India. It originates from the Western Ghats in Moonar region of Kerala State and receives water from three small rivers namely Pamparu, Thenaru and Cinnaru. It is impounded, as it passes on, by the Amaravathy dam, which is constructed at the foot of Amaravathy hills.

The study area is located 20 km south of Udumelpet Taluk in Coimbatore district at a latitude of 10°29' and longitude of 77°10'. The water samples were collected for a period of one year (August 2005-July 2006) with 30 days interval in polythene containers from the surface at 11.00-12.00 p.m. in order to maintain uniformity. The collected water samples from the investigated sites were subjected to physico-chemical analysis as per the following standard methods (APHA 2005).

RESULTS AND DISCUSSION

Data on the physico-chemical characteristics of the river are presented in the Tables 1-3. Pollution of the aquatic environment generally causes changes in the physiological and structural aspects of the inhabitant organisms, particularly the fishes (Anithakumari & Sreeramkumar 1997). Temperature is one of the important environmental parameters in freshwater ecosystems. It is one among the factors that influence the geochemical aspects and eco-biology of aquatic systems. Lowest temperature was 23°C recorded in December, while highest was 28.4°C in July. Despite the fluctuation of temperature, it is not unsuitable for tropical organisms. The variation of trend in temperature noted in the present study, commensurate with previous records of Amaravathy river (Thirumathal et al. 2002).

The samples were found to be greenish from March to July, clear in August to October and turbid in November and December. Again, it was found relatively clear in January and February. Mostly, water remains colourless. When pollutants like sewage or industrial waste mix with water then water reveals the colour of pollutants. Colour of water is indicative of the degree of pollution caused by humus material, plant weeds, metallic substances and protozoans.

Estimation of pollutants largely depends on the physical appearance like colour, odour and turbidity. The samples, in the study during most months, were found predominantly to be colourless. The odour predominantly was muddy in September and in winter months of November and December. It was essentially algal in the months of April to July. From January to March no odour of specific nature was recorded.

The samples had lowest turbidity value of 13.1 NTU in August, and a highest of 29.3 NTU in November. The values of the suspended solids ranged from 91.3mg/L in January to 98.8 mg/L in July. The dissolved solids varied from 411.9 to 512.6 mg/L. Total solids extended from 507 mg/L in June to 611.2 mg/L in September. The water found turbid or muddy in colour is due to varieties of materials which are being discharged by domestic and industrial use (Hunt 1971). Suspended matter, in general, reduces the diversity of life in aquatic systems. Total solids were recorded as maximum in September. Run off by increased inflow accounts for turbidity. Rain brings in such effects. The observations are in agreement with similar one made by Shastri & Pandey (2001) and Gupta et al. (2005).

pH of the medium was mostly mild alkaline with a high recording of 8.1 in May with corresponding high alkalinity of 177 mg/L. According to Sunkad & Patil (2003), low pH value may be due to incoming rain water. Hence, the alkaline pH of the river medium is explained by the fact that inadequate rain in the region, bringing in no enough water for dilution of alkaline substances resulting in keeping the pH on its higher level possible. However, in natural waters, pH usually ranges from 6.5 to 8.5 and it is bio-tolerable. The medium of the study carried a pH that is conducive for the fishes living in it. Hence, the pH of the river is within the permissible range recommended by WHO (2003). Correspondingly, the highest alkalinity was 177 mg/L, noted in that month. However, the lowest alkalinity noted was 110 mg/L in November. The highest total hardness was 34.2 mg/L in April, and the lowest of 19.4 mg/L in January. Dissolved oxygen ranged from 3.2 mg/L in May to highest of 6.8mg/L in December. The low and high values for BOD were 4.1 mg/L and 11.8 mg/L in September and June, while for COD they were 86.5 mg/L and 117.2 mg/L respectively in February and June.

BOD is an important parameter to assess the pollution of waters, where the contamination occurs due to disposal of domestic and industrial effluents. COD estimates the carbonaceous fraction of organic matter. Dissolved oxygen is needed for living organisms to maintain their biological process. The dissolved oxygen in the water medium plays a vital role for supporting aquatic life. It is susceptible to environmental changes (Jameson & Rena 1996). Highest dissolved oxygen value of the river samples was 6.8mg/L in December. Higher photosynthetic action is attributed as one of the reasons for high dissolved oxygen along with low organic matter.

Presence of nutrients and oxygen in water is essential for the sustained proliferation of organisms. However, nutrient enrichment leads to undesirable change in the structure and function of ecosystems (Smitha et al. 1999). Nutrients stimulate growth of aquatic plants which in turn decay and consume oxygen and emanate hydrogen sulphide. This accumulation exerts high biological demand on the ecosystem. In addition, with accumulation of nutrients the organic biomass increases leading to pollution (Laws 1981). The quantity of nutrients present in the water samples varies. Calcium forms the most abundant cation in freshwater. It contributes hardness to waters. It has been a basic parameter for detecting pollution of water by sewage plant before development of bacteriological procedure. The sulphate ion is one of the important anions in natural waters and when present in higher quantity, it produces cathartic effect in human beings (Srinivas et al. 2002).

Sodium was high in April with a value of 8.8 mg/L, and low in January with a value of 2.8 mg/L. Potassium was 2.5 mg/L and 1 mg/L as high and low in May and February respectively. Calcium ranged from a low value of 17.2 mg/L in January to a high value of 27.2 mg/L in May. Magnesium had high value in February with 4.7 mg/L and 2.4 mg/L as low value in January. Iron was high in April with a value of 2.7 mg/L, while low with 1.4 mg/L in August. Chloride ranged from 33.8 mg/L to 50.9 mg/L in September and July respectively. The values of nitrates varied only slightly and were high in August with a value of 9.7 mg/L, and low as 8.3 mg/L in February. Phosphate was high in March with a value of 4.2 mg/L, while it was 2.5 mg/L in November as lowest value. Sulphate ranged from 8.3 mg/L to 9.6 mg/L in October and May respectively. Silicate varied from 30.2 mg/L in February to 35.4 mg/L in December. The level of fluoride did not unduly vary and the lowest was recorded as 0.6 mg/L in January, and the highest in July with a value of 1.1mg/L.

Most of the freshwaters derive their sodium, potassium, calcium, chloride, sulphate and other nutrients from soils and rocks. Phosphate is considered amongst the primary limiting nutrients in ponds and lakes (Schindler 1971). Phosphate was generally low with a peak in May. The higher concentration of it could be from the run-off from the agricultural fields (Majoo 1991). The main source of the formation of nitrate is the decomposition and biodegradation of organic matters. High nitrates would indicate high pollution load. Intrusion of sewage into the natural water increases

Table 1: Data on the monthly variation in the physical parameters of Amaravathy river (Aug 2005-July 2006).

Months	Temperature (°C)	Colour	Odour	Turbidity (NTU)	Suspended Solids(mg/l)	Dissolved Solids(mg/l)	Total Solids(mg/l)
Aug	25.0	Clear	Nil	13.2	95.9	504.26	600.16
Sep	26.0	Clear	Muddy	17.4	98.7	512.63	611.33
Oct	24.0	Clear	Nil	19.4	96.2	503.56	599.76
Nov	24.1	Turbid	Muddy	29.3	98.2	492.43	590.63
Dec	23.0	Turbid	Muddy	26.5	97.9	487.86	585.76
Jan	23.5	Clear	Nil	17.4	91.4	517.93	609.33
Feb	24.0	Clear	Nil	16.8	98.7	428.43	527.13
Mar	26.0	Clear	Nil	20.5	90.9	472.60	563.50
Apr	26.1	Clear	Algal	20.2	95.2	421.16	516.36
May	27.1	Clear	Algal	21.5	97.6	483.30	580.90
June	28.0	Turbid	Algal	20.5	95.1	411.90	507.00
July	25.5	Turbid	Algal	18.7	98.8	443.26	542.06

Table 2: Data on the monthly variation in the chemical parameters of Amaravathy river (Aug 2005-July 2006).

Months	pH	Total Alkalinity (mg/l)	Total Hardness (mg/l)	DO (mg/l)	BOD (mg/l)	COD (mg/l)
Aug	7.1	130.04	24.56	5.3	8.7	98.51
Sep	7.1	165.02	27.81	6.5	5.8	85.90
Oct	7.2	105.10	26.40	6.3	5.8	94.50
Nov	7.2	110.08	27.11	5.8	5.8	85.90
Dec	7.7	120.07	28.63	6.6	8.8	97.66
Jan	7.9	145.34	19.40	4.6	5.5	99.57
Feb	7.9	172.01	24.37	5.9	6.8	87.52
Mar	7.9	167.54	22.46	5.9	6.7	108.80
Apr	7.9	143.01	34.20	4.7	5.3	109.51
May	8.1	177.03	22.02	3.2	10.1	106.40
June	7.9	158.41	22.44	3.5	7.3	102.28
July	7.9	166.82	21.53	3.4	7.8	104.26

Table 3: Data on the monthly variation in the nutrients of Amaravathy river (Aug 2005-July 2006).

Months	Iron (mg/l)	Sodium (mg/l)	Potassium (mg/l)	Calcium (mg/l)	Magnesium (mg/l)	Chlorides (mg/l)	Nitrates (mg/l)	Phosphates (mg/l)	Sulphates (mg/l)	Silicates (mg/l)	Fluorides (mg/l)
Aug	1.4	7.3	1.3	20.0	3.1	47.7	9.7	3.3	9.1	30.9	0.7
Sep	1.7	8.4	1.4	23.0	3.6	33.8	9.3	2.9	8.7	32.4	0.6
Oct	1.8	6.6	2.1	23.8	3.1	37.2	9.4	2.6	8.3	33.9	0.8
Nov	1.9	6.9	1.7	26.2	2.8	38.7	9.0	2.5	8.6	35.2	0.8
Dec	2.4	7.5	1.4	25.1	3.9	39.0	9.1	2.8	8.7	35.4	0.8
Jan	2.5	2.8	1.1	17.2	2.4	33.9	9.7	3.8	8.9	31.1	0.6
Feb	1.9	5.6	1.0	20.6	4.7	41.2	8.3	3.7	9.1	30.2	0.9
Mar	2.1	7.4	1.3	20.1	3.2	46.5	8.8	4.2	8.9	30.7	0.7
Apr	2.7	8.8	2.3	19.8	3.6	49.2	8.9	3.7	9.4	31.4	1.0
May	2.2	6.1	2.5	27.2	3.9	48.9	9.3	4.1	9.6	32.8	0.7
June	2.6	7.2	2.1	18.7	2.5	50.3	9.8	3.7	8.7	32.5	0.9
July	1.7	7.2	1.7	17.9	2.7	50.9	9.2	3.8	9.1	31.4	1.1

levels of nitrate (Mansom 1991). Nitrate level in the samples is below permissible limits making them suitable for humans and live stock consumption (Ragunathan et al. 2000).

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