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Studies on Mangalore coastal water pollution and its sources

Francis Andrade[1], H. B. Aravinda[2] and E. T. Puttaiah[3]
[1]*Dept. of Environmental Science, Kuvempu University, Shankeraghatta, Shimoga-577 451, Karnataka, India*
[2]*Dept. of Civil Engineering, Bapuji Institute of Engineering and Technology, Davangere-577 004, Karnataka*
[3]*Gulbarga University, Gulbarga-577 451, Karnataka*
andradefm@rediffmail.com,drhbabiet@yahoo.com,profetputtaiah@rediffmail.com

Abstract

Mangalore coast is a stretch of about 22 Kms at the western part of the Western Ghats of the Indian peninsula. This area is receiving huge quantity of pollution load from the major industries and factories located nearby. This pollution load is discharged into the sea either directly or through the major west flowing rivers of the region, Nethravathi and Gurupura. The pollution load includes runoff of the sediment, waste from oil refineries, nutrients and pesticides, iron ore residues from the nearby iron are company and chemicals from the chemical factory from the point source. Water quality is also altered due to the addition of municipal and sewage wastes discharged into the sea. The pollutants encountered include both the biodegradable (vegetable waste & dead fish) and non-biodegradable (plastic bags, cans and metal materials). The samples analyzed for the various physico-chemical parameters revealed the alkaline condition and low in dissolved oxygen concentration. The concentration of these components were compared with WHO standards and found to be deviated highly.

Keywords: Mangalore, coastal pollution, sediment, pesticide, water quality, human environment.

Introduction

The Mangalore coast which is situated at the western part of the Indian peninsula stretching to about 22 Kms of Coastal district of Dakshina Kannada, Karnataka. The healthy condition of the aquatic system depends upon its physical, chemical and biological characteristics which actually fluctuate with season and degree of pollution. Marine ecosystem is one of the richest ecosystems (Cairns & Dickson, 1971). Industrialisation, development activities in coastal zones have placed enormous stress on habitats. For the better management of natural marine system, observational and experimental studies, monitoring the diversity of various life forms and ecosystem functioning are inevitable. Gurupura Nethravathi estuary is one such where the stress has been experienced by the marine habitats. The Nethravathi river flowing towards the west has 'its' origin at gangamoola at Samse of Chickmagalur district of Karnataka. It merges with Kumardhara at Uppinangady. River Pachamagaru also called as river Gurupura a tributary to Nethravathi is also an important west flowing river. The river originates at an elevation of 1400-1600 m in the Western Ghats after a confluence with 2 tributaries; it drops by 10 m at the junction. 90% of the water of river Nethravathi is used for drinking purpose and other agricultural use. Either directly or indirectly, the effluents of the industries, chemical factories, municipal and sewage wastes, refineries, Iron ore companies which are situated nearby, pump their toxic load to the rivers or the sea and finally everything enters the sea water. Farm chemicals and heavy metals can have harmful effect on the marine life. The local human population which is mainly dependent on fishing activity for their livelihood is much worried about the speed of spread of this pollution load. The quality of water is getting vastly deteriorated due to unscientific waste disposal and improper waste management and careless towards protecting the environment. Increased anthropogenic activities in and around water bodies damage the aquatic systems and ultimately the physico-chemical properties of water. The pollution of coastal water affect the marine organisms which are at the vicinity of the coast. The present investigation throws light on the deviation of the values of the different physico-chemical parameters of water in the coastal area of mangalore.

Material and methods

Study area: The study area for the present project consists of Netravathi-Gurupur river mouth and the areas in its vicinity. It extends from 12°51'34"N, 74°48'33"E to 12°48'31"N, 74°50'30"E covering an area of about 25 km^2. The map constituting the study area is shown in Fig. 1. The coastline is dotted with open coastal stretches and river mouths. The southern part of Karnataka Coast is categorized as "rocky coast with barriers" and is transitional in character from the cliffed Konkan coast to the north and alluvial plain coast of Malabar to the south.

Study samples: Effluent samples were collected from 6 different randomly selected locations of the study area S1-S6, 3 times during 2008, pre-monsoon, monsoon and post monsoon seasons. The sampling was done during morning hours. The surface water temperature was measured on the spot and recorded. The effluent samples from the sites were collected in well cleaned polythene bottles. Before collection of the samples the bottles were washed with fresh water. Finally the bottles were tightly closed and brought to the laboratory for further analysis. Standard methods were followed for the physico-chemical analysis of the samples (Rainwater & Thatcher, 1960; APHA, 1995). Various methods and

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graphs are used to study and interpret the water analysis data. The mean concentration of the various parameters is depicted in Fig. 2-11.

Fig. 1.Map of the study area

Results and discussion

Rainfall: Rainfall is the most important cyclic phenomenon in tropical countries as it brings important changes in the hydrological characteristics of the estuarine environment. In the present study area peak values of rainfall were recorded during monsoon months from June to September. The rainfall in India is largely influenced by two monsoons. South west monsoon on the west coast, northern and north eastern India and by north east monsoon on south west coast (Perumal, 1993). On the other hand, tidal rhythm, water current and evaporation in summer produced only little variation in those parameters. Maruthanayaga and Subramaniyan (1999) have also reported the occurrence of bulk rainfall during northeast monsoon season along the south east coast of India.

Surface water temperature: Surface water temperature varied from 28°C to 34.75°C with minimum value in winter and maximum value in summer. Sharma and Gupta (1994) had reported that fish growth was better at temperature range of 14.5°C to 38.6°C. The surface water temperature showed an increasing trend from December through April and was influenced by the intensity of solar radiation, evaporation and fresh water influx and cooling and mix up with ebb and flow neritic waters. The observed low value of November was due to strong land sea breeze and precipitation and recorded high values during summer could be attributed to high solar radiation (Das & Sahoo, 1997; Karuppasamy & Perumal, 2000). The observed spatial variation in temperature could be due to the viable intensity of prevailing streams and the resulting mixing water (Reddi *et al.,* 1993).

Nitrates: Nutrients are considered as one of the most important parameters in the estuarine environment influencing growth, reproduction and metabolic activities of the living beings. Distribution of nutrients is mainly based on the season, tidal condition and fresh water flow from land source. The recorded highest nitrate 9.46 mg/l during monsoon season could be mainly due to organic matter received from the catchment area during ebb tide (Das & Sahoo, 1997). The increased nitrate level was due to fresh water inflow, mangrove leaves (litter fall), decomposition and terrestrial run off during monsoon season (Karuppasamy & Perumal, 2000; Santhanam & Perumal, 2003). The concentration of nitrate in the water samples varies from 3.35 mg/l-23.02 mg/l.

pH value: pH is a measure of hydrogen ion concentration in water. Its value determines whether water is acidic or alkaline. pH of the water samples under investigation varies between 7.13 to 8.25 during pre-monsoon season. The value during monsoon varies between 6.87 to7.68. Its value varies between 6.89 to 8.02 during winter season. The pH range which is not directly lethal to fish is 5-9. However the toxicity of several common pollutants is markedly affected by pH changes within this range and increasing acidity or alkalinity may make these poisons more toxic (Lloyd, 1960). In the present study pH ranges between 6.87 to 8.25. pH range of 7 to 8 has been considered good for fish culture (Jhingran, 1997).

Electrical conductivity: Electrical conductivity is a measure of capacity of a substance or solution to conduct electric current. The electrical conductivity (EC) shows seasonal variation with respect to different study sites. It highly depends on the amount of dissolved solids in water. The electrical conductivity is found to fluctuate between 60 µs/cm to 43,110 µs/cm during monsoon season. Highest electrical conductivity 59060 µs/cm is observed during pre-monsoon season.

Turbidity: Turbidity in surface water shows a moderate increase. Turbidity also shows seasonal variation. Its value is high during monsoon season and varies between 11.40 to 31.20 NTU during monsoon season. Clay, silt, organic matter, plankton and other microscopic organisms cause turbidity in water recognized as a valuable limiting factor in the biological productivity of water bodies (Kishore *et al.*, 2005). In the present study high turbidity value of 31.2 NTU recorded during monsoon season and low value of 1.27 NTU was recorded during winter season.

Total alkalinity: Total alkalinity shows variation from season to season. It varies from 50 mg/l to 560 mg/l with highest value recorded during post- monsoon season. Its value varies between 112 mg/l to 256 mg/litre during pre-monsoon. Higher alkalinity favours the growth of phytoplankton. The highest phytoplanktonic density during post-monsoon could be linked to this as natural waters containing 40 mg/l or more, total alkalinity are

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Fig. 2. Mean values of nitrate among study sites.

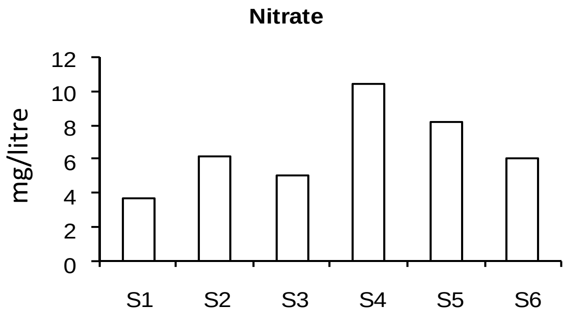


Fig.3. Mean values of Water pH recorded among study sites.

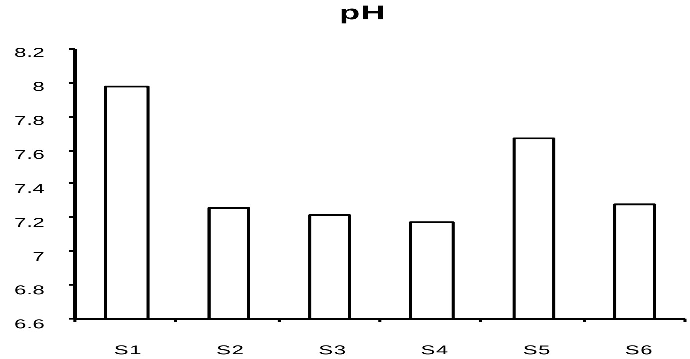


Fig.4. Mean values of turbidity recorded among study sites

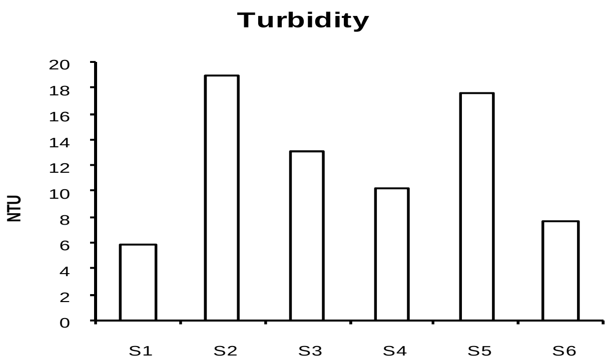


Fig.5. Mean values of total alkalinity recorded among study sites.

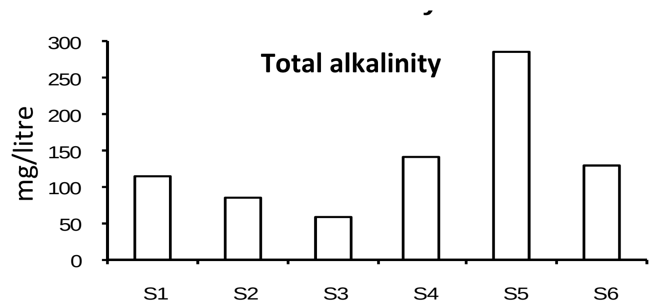


Fig. 6. Mean values of dissolved oxygen recorded among study sites

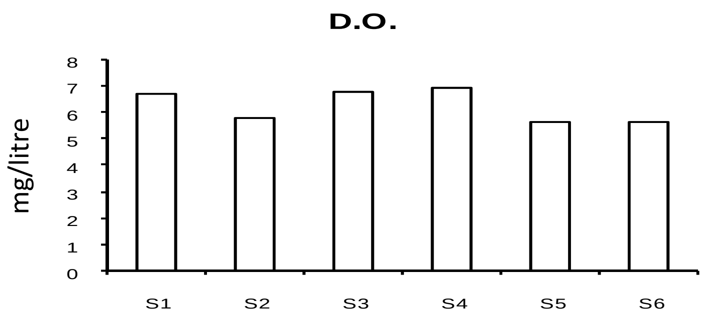


Fig.7. Mean values of biological oxygen demand recorded among study sites

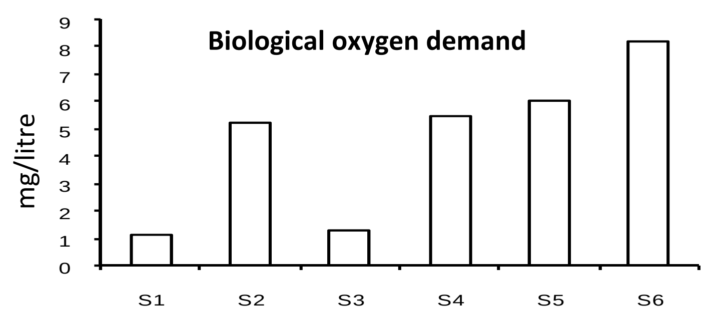


Fig.8. Mean values of Total Hardness recorded among study sites

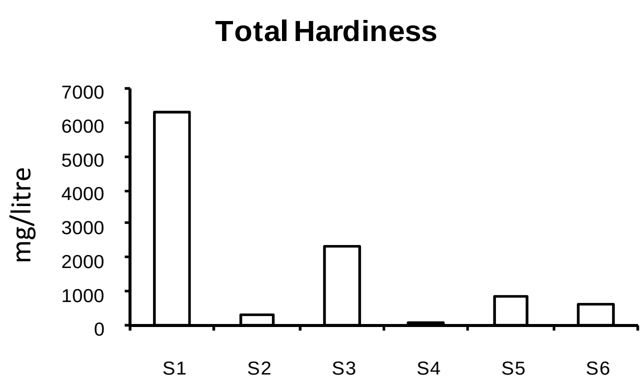
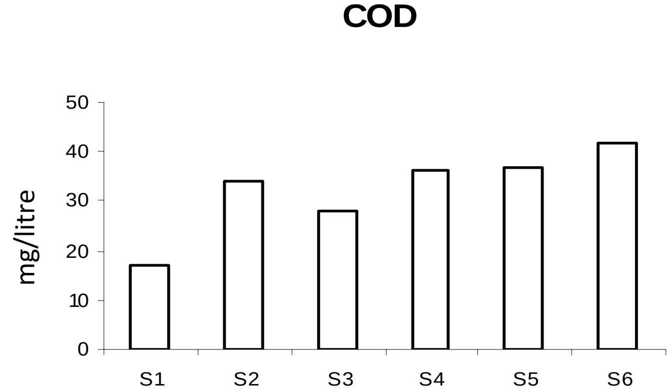


Fig.9. Mean values of COD recorded among study sites



more productive (Manna & Das, 2004). During monsoon fertilizers and like materials from the surrounding coconut and areca nut gardens and paddy fields, accumulate in the system and subsequent drying during post monsoon might have contributed to the highest alkalinity. Trivedi and Goel (1992) pointed out that dilution plays an important role in water, lowering alkalinity of water. In the present investigation total alkalinity varies between 18 mg/l to 560 mg/l.

Fig.10. Mean values of calcium recorded among study sites.

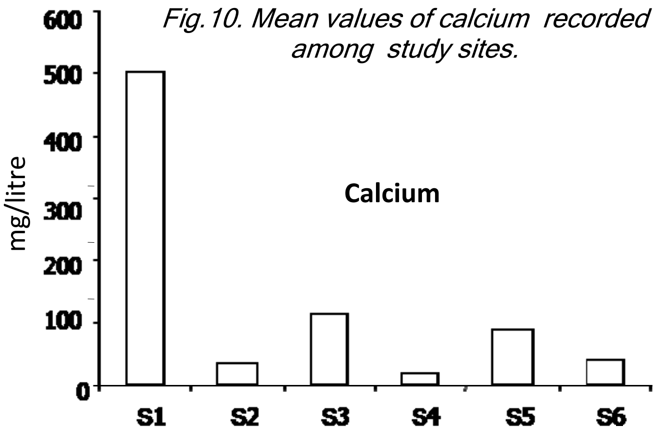
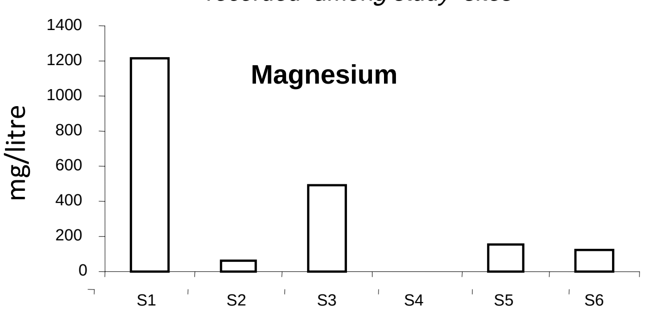


Fig.11.Mean values of magnesium recorded among study sites



Dissolved oxygen: Dissolved oxygen is an important parameter in water quality assessment and it reflects physico- chemical and biological processes prevailing in water. In the present investigation DO ranges from 2.60 to 7.30 mg/l comprising of pre-monsoon, monsoon and post-monsoon seasons. DO is very essential and in some cases even limiting factor for maintaining aquatic life. Its depletion in water is probably the most frequent result of water pollution of certain forms. Highest value of DO 7.30 mg/l was recorded during summer season.

Bio-chemical oxygen demand: Bio-chemical oxygen demand reveals the content of microorganisms present in the water under investigation and its organic matter load. During monsoon season BOD has shown upward trend ranging from 0.90 mg/l to 5.70 mg/l. In the present investigation BOD ranges from 0.70 mg/l to 14.40 mg/l.

Total hardness: Total hardness showed highly significant positive correlation with calcium and magnesium. Calcium and magnesium play an important role in antagonizing the toxic effects of various ions and neutralizing the excess acid produced (Das & Srivastava, 2003). In this study significant relationship of phytoplanktonic density with calcium and total hardness could be attributed to the fact that calcium is an important part of plant tissue, increases the availability of other ions reduces the toxic effect of NO_2-N (Manna & Das, 2004) and this might have played a vital role in the growth of phytoplankton. The total hardness is due to the presence of divalent of which calcium and magnesium. The total hardness in the present study varies between 13 mg/l to 7000 mg/l. The high levels of hardness increase toxicity of zinc to fish (Lloyd, 1960).

Chemical oxygen demand: COD is a measure of oxygen equivalent of the organic matter content of water that is susceptible to oxidation by a strong chemical oxidant. Thus, COD is a reliable parameter for judging the extent of pollution in water (Amirkolaie, 2008). The COD of water increases with increasing concentration of organic matter (Boyd, 1981). In the present study COD ranges from 1.48 mg/l to 68.79 mg/l. Highest value during monsoon season indicates large scale disposal of untreated waste water into the river. High value of COD indicates high degree of organic pollution (Upkar & Vyas, 1992).

Calcium & magnesium: Magnesium is often associated with calcium in all kinds of waters, but its concentration remains generally lower than calcium (Venkatasubramani & Meenambal, 2007). Magnesium is essential for chlorophyll growth and acts as a limiting factor for the growth of phytoplankton (Dagaonkar & Saksena, 1992). Therefore depletion of magnesium reduces phytoplankton population. In the present investigation maximum magnesium was recorded during pre-monsoon season and a minimum of 1.22 mg/l was recorded during monsoon season. Calcium and magnesium play an important role in antagonizing the toxic effect of various ions and neutralizing the excess acid produced (Das & Srivastava, 2003). Magnesium varies from 1.22 mg/l to 1434 mg/l. Lower concentration of magnesium is observed during monsoon season. Calcium varies from 3.20 mg/l to 656 mg/l. Lowest value of calcium recorded during monsoon season and calcium varies from 3.20 mg/l to 408 mg/l during monsoon season and 22.40 to 656 mg/l during winter season.

It is evident from the investigation that discharge of pollution in to the coastal water has resulted in the deviation in the values of physico-chemical characteristics of water and they are also influenced by seasonal variation. Due to rapid industrialization and formation of SEZs, there is an urgent need to arrest the spread of pollution of coastal water.

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