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SEWAGE DISPOSAL SITUATION AT DIGHA COAST: A TIME SERIES ANALYSIS

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Abstract

West Bengal is a maritime state in the northeastern part of the Indian subcontinent with a coastal area of 10,158.22 sq. km. The coastal region consists of the Digha coast, which is noted for its tourism and fish landing activities. We highlight in this paper, a load of nitrate and phosphate during premonsoon in the aquatic phase of Digha for more than three decades (1984 – 2020) to observe the trend of these two variables, which are important components of sewage. A uniform increase in the concentrations of the nutrients is observed except in the years 2009 and 2020. A sudden peak observed for both the nutrients during 2009 may be attributed to Aila, a super cyclone that hit coastal West Bengal on 25th May 2009. The dip in the levels of nutrients during 2020, may be the effect of the COVID lockdown phase in the state during which all the tourism and fish landing activities were completely paralyzed.

Keywords: Digha coast, Nitrate and Phosphate, Aila, COVID lockdown

I. Introduction

Study on the aquatic health has gained momentum in recent years as the ecosystem provides several services like fish and fisheries, tourism, water sports, navigation, religious rituals, etc. An aquatic ecosystem is usually polluted by industrial discharges, sewage discharge, oil spills, nuclear testing, etc. Sewage loaded with nutrients like nitrate and phosphate are discharged into the ambient aquatic ecosystem mainly through the municipal waste, domestic waste and waste discharged from tourism units and aquaculture farms [IV], [V], [VII], [VIII], [X], [XVI], [XI], [XII], [XIX], [XX].

In addition, to these sources, fish landing stations in the coastal zone also contribute an appreciable amount of nitrate and phosphate in the adjacent water bodies [II], [III], [VI], [IX], [XVII]. On this background, the present paper aims to highlight the temporal variation of nitrate and phosphate with probable reasoning.

II. Materials and Methods

Digha is a tourist spot on the northeast coast of the state of West Bengal in the district of East Midnapore. For a period of more than three decades (1984 – 2020) surface water samples were collected every year during the 1st week of June before the onset of monsoon in the present geographical locale. Our sampling was carried out during the high tide condition and the procedure did not change during the entire period of observation. To evaluate the average nutrient level of the Digha coast, triplicate samples were collected from the same collection site usually maintaining a collection distance of 500 m, which is a step to ensure the quality of the data. The standard spectrophotometric method of Strickland and Parsons [VIII] was adopted to determine the nutrient concentration in surface water.

Nitrate was analyzed by reducing it to nitrite using passing the sample with ammonium chloride buffer through a glass column packed with amalgamated cadmium fillings and finally treating the solution with sulphanilamide. The resulted in diazonium ion was coupled with N-(1-naphthyl)-ethylenediamine to give an intensely pink azo dye.

Determination of the phosphate was carried out by treatment of an aliquot with an acidic molybdate reagent containing ascorbic acid and a small proportion of potassium antimony tartrate.

III. Results and Discussions

The data collected during June (premonsoon season) in each year are presented in Table 1 and Figures 1 and 2.

Table 1: Concentration of dissolved Phosphate and Nitrate (µg at l^{-1})

Year	Dissolved Phophate (µg at l^{-1})	Dissolved Nitrate (µg at l^{-1})
1984	0.98	19.76
1985	1.05	21.54
1986	1.16	18.85
1987	1.25	20.66
1988	1.39	22.08
1989	1.88	24.71
1990	1.93	25.63
1991	2.04	26.22
1992	2.11	26.89
1993	2.19	27.13
1994	2.37	24.69
1995	2.65	25.44

1996	2.73	27.89
1997	2.81	29.02
1998	2.56	29.76
1999	2.69	30.35
2000	2.93	30.95
2001	3.02	31.08
2002	3.15	31.23
2003	3.44	31.75
2004	3.58	32.68
2005	3.72	33.01
2006	3.86	33.9
2007	3.9	34.15
2008	3.97	34.66
2009	6.05	40.21
2010	4.18	33.98
2011	3.95	34.85
2012	4.05	35.02
2013	4.23	35.11
2014	4.36	36.76
2015	4.49	37.39
2016	4.58	37.56
2017	4.61	38.07
2018	4.75	38.19
2019	4.82	39.57
2020	1.01	14.41

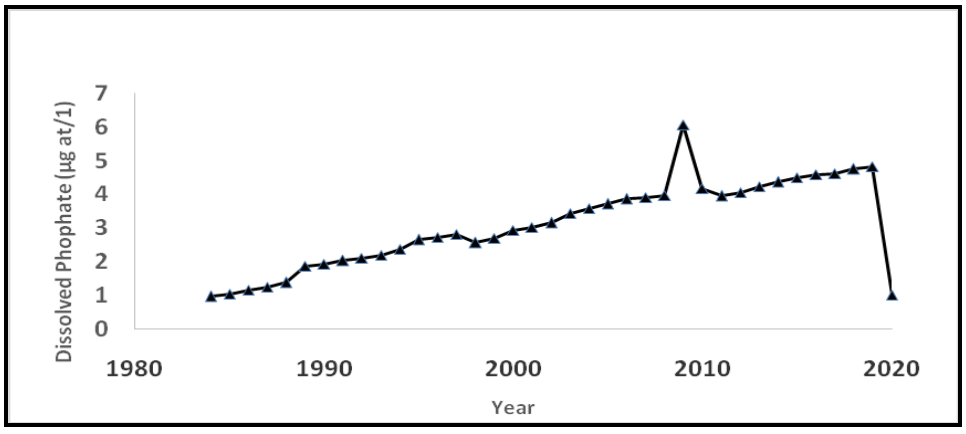

Fig 1. The concentration of dissolved Phosphate (µg at l^{-1}) during premonsoon 1984 to 2020 in the Digha coastal water

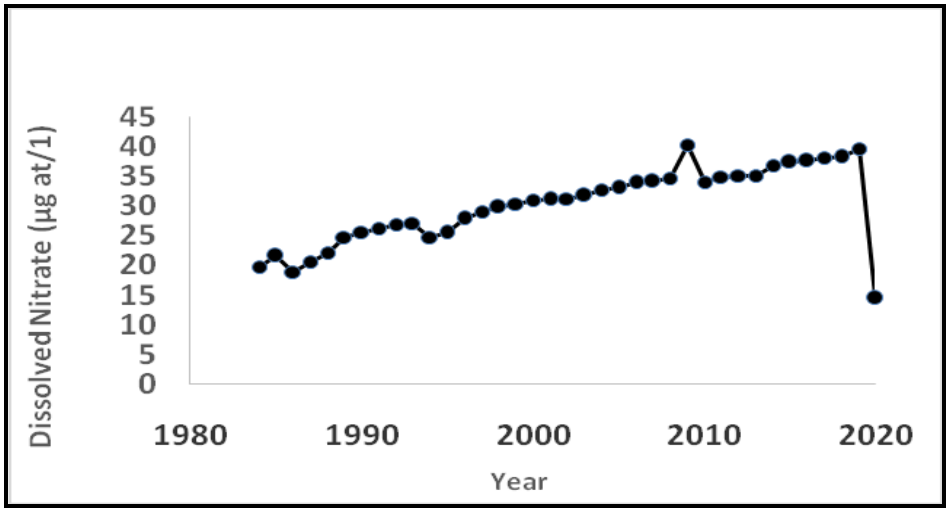

Fig 2. The concentration of dissolved Nitrate (µg at l^{-1}) during premonsoon 1984 to 2020 in the Digha coastal water

A careful observation on the table highlighting the temporal variation of nitrate and phosphate at Digha exhibit a peak during premonsoon 2009, which is the effect of Aila, a super cyclonic that hit coastal West Bengal with a speed of nearly 110 km/hr [I], [XV], [XIII], [XIV], [XXI]. The trend lines of both the nutrients show a dip during June 2020, which may be attributed to the complete closure of all activities (lockdown) as a measure to prevent the spread of Coronavirus. The regression equations also confirm the decrease of nutrient load during 2020, which leads us to conclude that COVID-19 lockdown favoured the up-gradation of coastal water of Digha in context to nutrient load. It is to be noted in this context that nitrate and phosphate, being the important component of sewage accelerate the growth of phytoplankton thus leading to a sharp decrease of Dissolved Oxygen (DO). This might pose an adverse impact on the aquatic lives and disrupt the normal food chain/web of aquatic ecosystem.

It is also observed that sewage discharged from several point sources at Digha coast is mixed in nature, *i.e.*, both nitrate and phosphate are important constituents of the sewage as revealed from the significant positive relationship between the two radicals (Fig. 3).

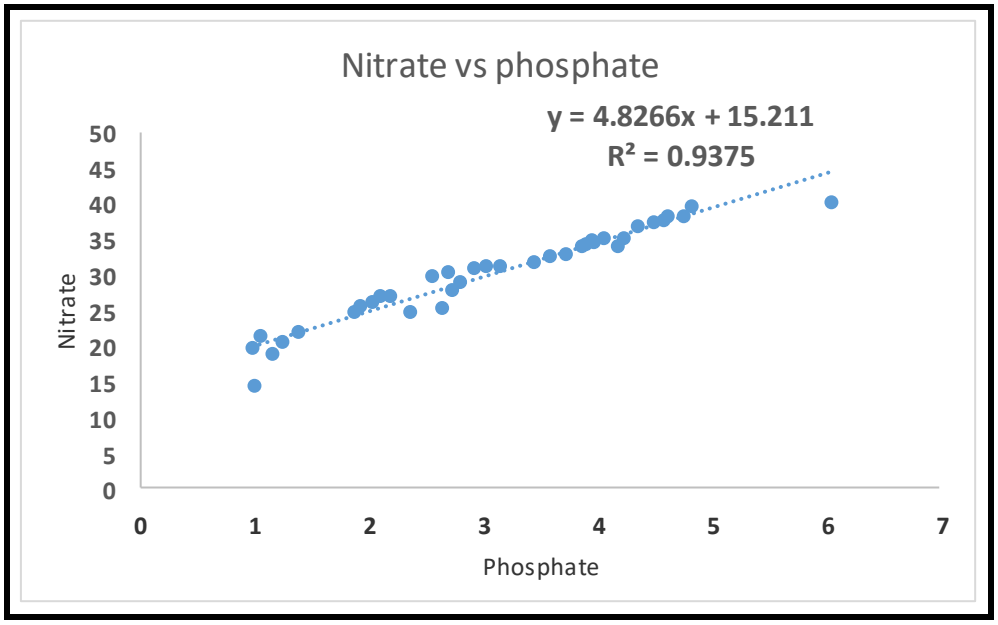

Fig 3. Trend line showing the inter-relationship between nitrate and phosphate considering the observed data sets of 37 years (1984 – 2020)

IV. Conclusion

Digha is a noted tourist spot in the maritime state of West Bengal with an extended coastal beach. The region has a large number of hotels and fish landing stations, which are the sources of nutrients like nitrate and phosphate in the ambient aquatic phase. The data sets of these two nutrients for more than three decades exhibit an increasing trend, except during premonsoon 2020, which may be the result of the COVID-19 lockdown phase. The high nutrient load in the coastal water is a matter of concern as it causes eutrophication leading to the fall of DO and subsequently an adverse impact on aquatic lives. To sum up it can be suggested that an occasional ban on tourism activities (which in some seasons becomes non-sustainable and exceeds the tourist carrying capacity of the region) or fish landing can bring back the overloading condition of coastal water to its normalcy in terms of nutrient values.

Conflict of Interest:

There was no relevant conflict of interest regarding this paper.

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