Nutrient load in the River Ganges during the COVID-19 lockdown phase: A Ground Zero observation

Tapti Sengupta, Prosenjit Pramanick and Abhijit Mitra

Abstract

We conducted a field level analysis during COVID-19 lockdown phase from 3rd April to 24th April, 2020 to scan the water quality of the River Ganges with respect to nitrate and phosphate load at three selected sites namely Botanical Garden, Babughat and 2nd Hooghly Bridge. The data generated were compared with the previous data sets in the study area. We observed a sharp decline in the nutrient level during the lockdown phase, irrespective of stations/sites confirming the positive role of lockdown on the aquatic system of the River Ganges. Minimum anthropogenic pollution can be the reason behind the decrease of these nutrients, leading to a balanced ecosystem in the River Ganges. The lockdown phase has allowed the aquatic ecosystem to revive its balance and has reduced the stress on the aquatic flora and fauna.

Keywords: COVID-19, River Ganges, nitrate, phosphate

Introduction

The Coronavirus infection that is causing a worldwide havoc is said to initiate in the Wuhan province of China during December 2019. The disease is presumed to be caused by eating under-processed animals especially bats, although various views exist behind the cause of the pandemics. The virus belongs to the SARS and MERS family and causes pneumonia-like symptoms. Until recently, it was not known to spread from human to humans. The virus seems to have morphed in the past few months causing mass mortalities worldwide and causing casualties in all the continents. This deadly virus has been named COVID-19 and WHO declared it as a pandemic. Since then, speculations and research is going on to find a suitable vaccine for the same. Since the disease spreads from one person to another, and also from contaminated surfaces, social distancing has been cited as a potential measure to contain this infection. Keeping this in view majority of the countries have imposed lockdown to slow down the rate of infection. In India, Maharashtra is the state with highest rate of infection and mortality followed by Delhi and Gujarat. Kolkata too has been facing cases of Coronavirus infection with about 22 deaths as of 28th April, 2020 as informed by Health and Family Welfare Department of Government of West Bengal (https://en.m.wikipedia.org/wiki/2020_coronavirus_pandemic_in_West_Bengal). Lockdown was imposed to slow the spread of this virus and to make people aware of its magnitude of devastation.

The city of Kolkata at present has a total population of 1,48,50,066 with a population density of 24000 people/km^2 (https://worldpopulationreview.com/world-cities/kolkata-population/). The sewage released from this huge population is the primary source of nitrate and phosphate in the aquatic system of the River Ganges. Apart from this, the chain of factories situated along the bank of the River Ganges, the regular bathing in the river, the movements of vessels also contribute appreciable amount of nutrients in the aquatic phase. The COVID-19 pandemic, however, has put a pause to all these activities and hence there is a high chance of alteration of nutrient budget in the Ganges River, along the banks of the city of Kolkata. The present paper is a snapshot of the nitrate and phosphate levels at three stations (Botanical Garden (22°33'06.4"N; 88°18'06.6"E), Babughat (22°34'10.3"N; 88°20'28.5"E) and 2nd Hooghly Bridge (22°33'31.4"N; 88°19'38.5"E)) in the study area during the COVID-19 lockdown phase (3rd April, 2020 to 24th April, 2020) and pre-COVID-19 period (2015-2019).

Methodology

Surface waters for nutrient (nitrate and phosphate) analyses were collected in clean TARSON bottles and transported to the laboratory in ice-freeze condition. Triplicate samples were collected from the same sites to maintain the quality of the data. The standard spectrophotometric method of Strickland and Parsons (1972) was adopted to determine the nutrient concentration in surface water. Nitrate was analysed by reducing it to nitrite by passing the sample with ammonium chloride buffer through a glass column packed with amalgamated cadmium filings and finally treating the solution with sulphanilamide. The resultant diazonium ion was coupled with N-(1-napthyl)-ethylene diamine to give an intensely pink azo dye. Determination of the phosphate was carried out by treatment of an aliquot of the sample with an acidic molybdate reagent containing ascorbic acid and a small proportion of potassium antimony tartarate. The reading was finally taken through UV-spectrophotometer.

Result

The variation of dissolved nitrate and phosphate in all the selected stations over a period of 6 years including the lockdown phase (2015-2020) is highlighted in Figs. 1 and 2 respectively.

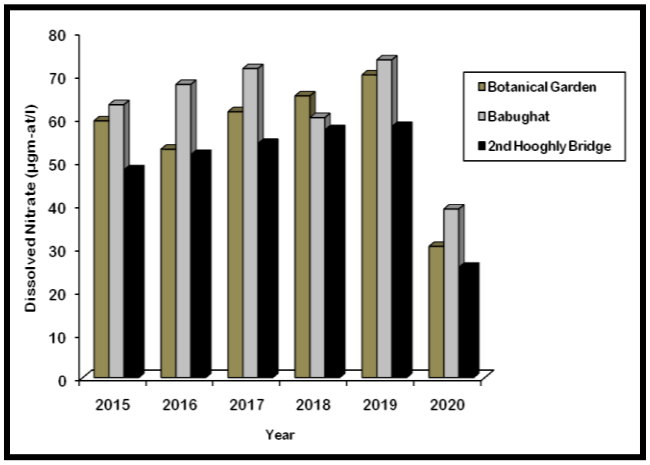

Fig. 1. Spatio-temporal variation of dissolved nitrate (in µgm-at/l) in the selected sites

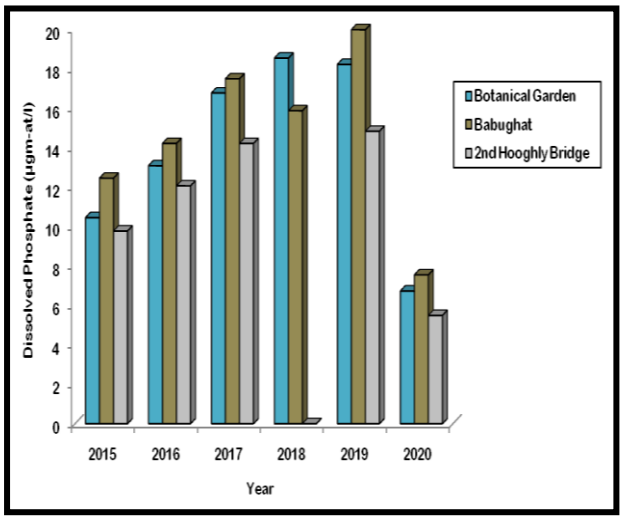

Fig. 2. Spatio-temporal variation of dissolved phosphate (in µgm-at/l) in the selected sites

Weekly observation of the dissolved nitrate and phosphate in the selected stations during the lockdown phase shows a decreasing trend (Figs. 3 and 4).

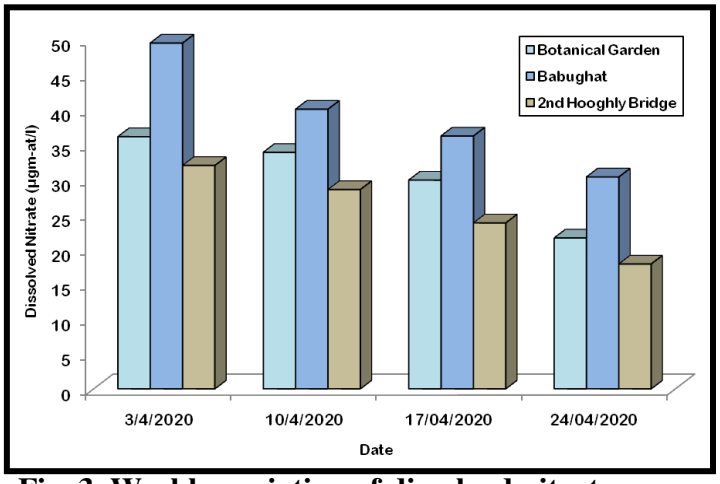

Fig. 3. Weekly variation of dissolved nitrate (µgm-at/l) in three sites during lockdown phase

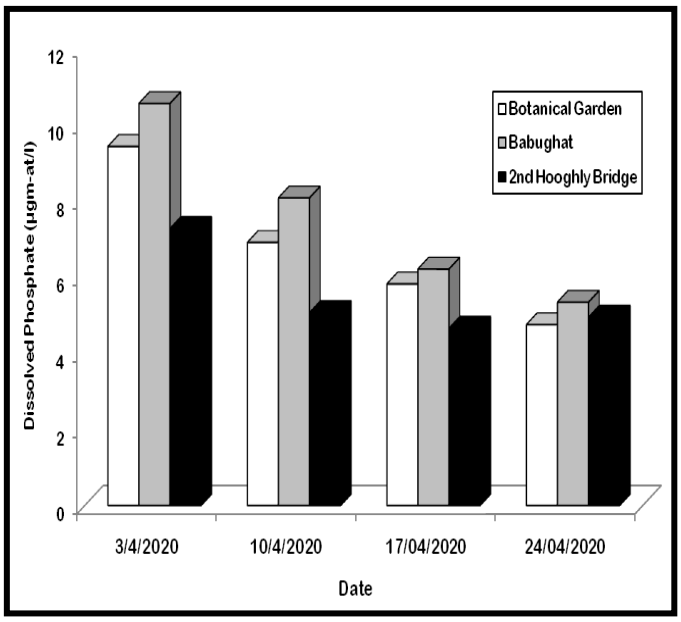

Fig. 4. Weekly variation of dissolved phosphate (µgm-at/l) in three sites during lockdown phase

The concentrations of dissolved nitrate and phosphate in three sites were comparatively lower in the period of lockdown than the pre-COVID-19 period (Figs. 5 and 6).

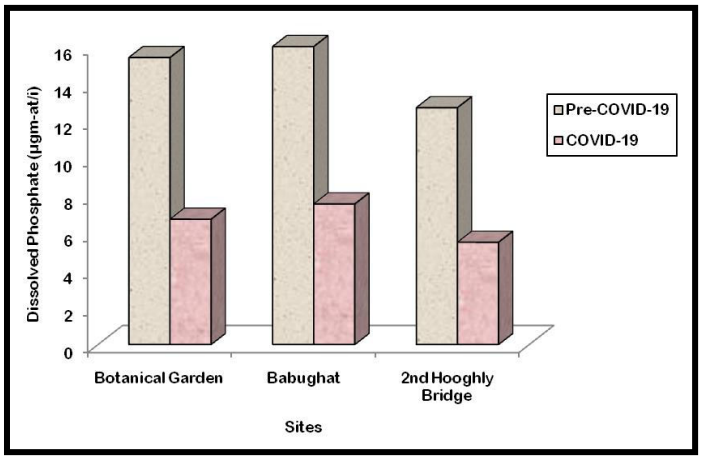

Fig. 5. Variation of dissolved nitrate (µgm-at/l) in three sites during pre-COVID-19 and COVID-19 period

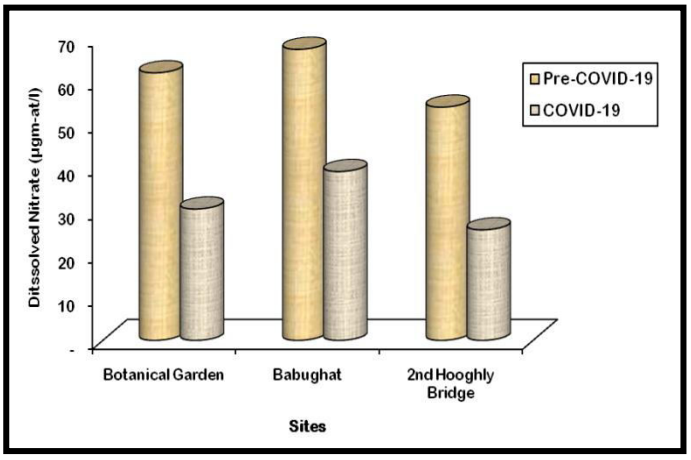

Fig. 6. Variation of dissolved nitrate (µgm-at/l) in three sites during pre-COVID-19 and COVID-19 period

Discussion

COVID-19 pandemic has created a massive devastation in every sector of human life starting from industry to agriculture. The on-line education system in the educational sector is still under testing process. However, the pandemic has opened a positive horizon in the environmental sector (Mitra et al., 2020) due to shut down of the point and non-point sources of pollution. In this study also, it is observed that both nitrate and phosphate exhibited a sharp decline during this lockdown phase (3rd April, 2020 to 24th April, 2020) which may be due to less discharge of anthropogenic wastes from the outfalls and industrial effluents from the plants. A significant spatial variation is observed in the study zone, with highest value at Babughat (62.56 µgm-at/l for dissolved nitrate and 14.59 µgm-at/l for dissolved phosphate) and lowest at 2nd Hooghly bridge (49.18 µgm-at/l for dissolved nitrate and 11.27 µgm-at/l for dissolved phosphate). This spatial variation may be related to difference in the magnitude of anthropogenic activities at the sites concerned. Babughat is highly congested area with a large bus terminus, market places, public toilets, hotels and food stalls. The nutrients released from these point sources without any treatment have made the adjacent Ganges water rich in nutrients compared to other two sites. The lockdown period, however, made these units mostly non-functional due to which the nutrient load has decreased gradually as revealed from the weekly data of April, 2020. Previous studies have documented the phenomenon of eutrophication in these areas (Tiwari et al., 2016) which can lower the level of dissolved oxygen and pose adverse impact on aquatic lives. Low nutrients in the aquatic phase (as witnessed during the COVID-19 lockdown phase) is congenial for aquatic ecosystem and has the ability to prevent eutrophication leading to better water quality of the River Ganges in terms of nutrient load and harmful microbial population. Lesser anthropogenic pollution may also lead to a decrease in pathogenic microbes and coliforms, making the water cleaner and healthier.

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