
Reversing the phenomenon of acidification in the River Ganges: A Ground Zero observation

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Abstract

The phenomenon of climate change has spread its arm in the aquatic ecosystem by reducing the pH value as a result of increased dissolution of atmospheric CO₂. The River Ganges along the city of Kolkata is no exception to this rule. The average pH of selected sites during the pre-COVID-19 period (18.3.2020 to 22.3.2020) was 6.69 in Ramakrishna Ghat, 6.63 in Botanical Garden, 6.41 in Babughat. However, with the passage of time since 25th March, 2020, there has been a steady increase of pH in all the sites confirming the reversal of the process of acidification.

Keywords: River Ganges, Acidification, Aquatic pH, Pre-COVID-19, COVID-19 lockdown phase

Introduction

The mighty River Ganges flowing through the city of Kolkata serves as the life line of the people of the megacity. The River provides several ecosystem services like production of fishes, mode of transportation, recreational activities, sports, performance of religious rituals *etc.* (Mitra, 2019). However, the river is still treated as the bin of all the wastes arising from domestic and industrial activities. In addition to this, wastes from

automobile repairing units, emission of Green House Gases (GHGs) from industrial units and air-condition machines have made the city atmosphere highly polluted. Increased emission of CO₂ from anthropogenic sources (Mitra et al., 2020) has enhanced the entry of atmospheric CO₂ to the river water resulting in the formation of carbonic acid, thereby shifting the pH to a lower value. This is commonly referred as acidification and has been reported in several estuaries in the state of West Bengal (Mitra, 2013; Mitra and Zaman, 2014; Mitra and Zaman, 2016; Mitra, 2019). In this study, we have carried out a comparative analysis on surface water pH of the River Ganges between the pre-COVID-19 (18th March to 22nd March, 2020) and COVID-19 lockdown phase (25th March to 30th April, 2020). The COVID-19 pandemic provided an unique opportunity to venture in to such comparative picture as there is no movements of vessels, boats and trawlers in the river and also all the industrial operations have been ceased during the lockdown phase of the state- a condition of retrieving the natural parameters with the withdrawal of anthropogenic influences. This paper, therefore, can be treated as a comparative account of natural vs. human induced factors using River Ganges as the test bed.

Materials and Methods

Study site

Kolkata, Capital city of the maritime state of West Bengal, is the third largest city in India and situated in the east bank of the Hooghly River with an area of 187.33 km². Three sites along the bank of the River Ganges were selected for the present study namely Ramakrishna Ghat (22°34'19.8"N; 88°20'17.0"E), Botanical Garden (22°33'06.4"N; 88°18'06.6"E) and Babughat (22°34'10.3"N; 88°20'28.5"E).

Measurement of aquatic pH

pH of the surface water in the selected sampling station was measured during high tide condition with a portable pH meter (sensitivity = ±0.02). The measurement was carried out during pre-COVID-19 lockdown (18th-22nd March, 2020) and COVID-19 lockdown phases (26th March – 30th April, 2020).

Statistical Analysis

ANOVA was carried out to know whether significant variation of aquatic pH exists between sites and time phase (pre-COVID-19 and COVID-19 lockdown phases).

Results

The spatio-temporal variations of aquatic pH in the three study sites are highlighted in Fig. 1. In the

lockdown phase due to COVID-19, the pH value increases in three selective sites (Fig. 2).

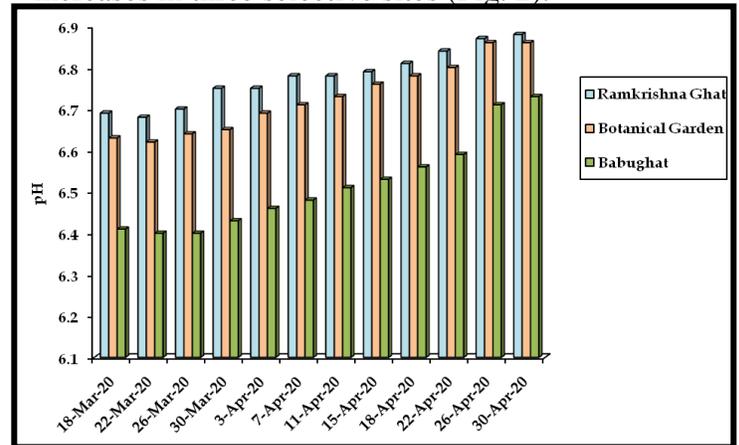


Fig. 1. Spatio-temporal variation of pH during the study period

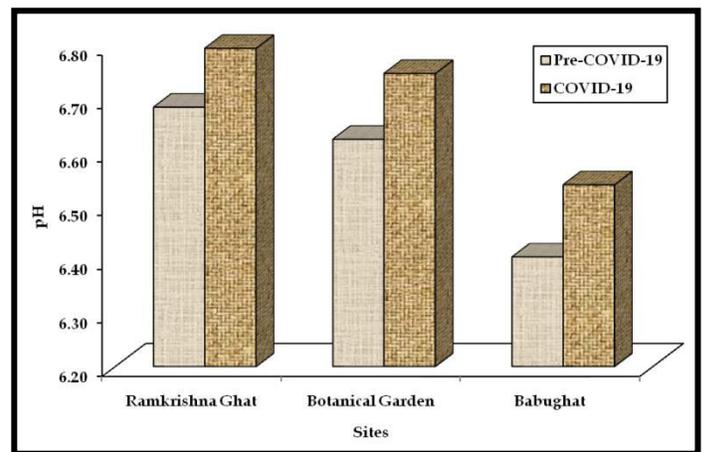


Fig. 2. pH variation in the three selected sampling sites between pre-COVID-19 and COVID-19 lockdown period

Results of ANOVA show significant variations between stations and between pre-COVID-19 and COVID-19 lockdown phases ($p < 0.01$) (Table 1).

Table 1. ANOVA of the pH value between sites and between pre-COVID-19 and COVID-19 period

<i>Source of Variation</i>	<i>SS</i>	<i>d f</i>	<i>MS</i>	<i>F</i>	<i>P- value</i>	<i>F crit</i>
Between Pre-COVID-19 and COVID-19	0.022571	1	0.022571	288.7505	0.003445	18.51282
Between Sites	0.080143	2	0.040071	512.6418	0.001947	19
Error	0.000156	2	7.82E-05			
Total	0.10287	5				

Discussion

The increase of atmospheric carbon dioxide in West Bengal, a maritime state in northeast coast of India has touched almost 51% since 1980 (Mitra, 2019). The gradual increase of carbon dioxide coupled with unplanned expansion of shrimp culture in places like Sundarbans (adjacent to the city), unplanned urban development and industrial activities has lowered the aquatic pH considerably (Mitra and Zaman, 2016). It is interesting to note that in all the sampling stations selected in the present study, the pH has increased by 2.84%, 3.46% and 4.99% at Ramakrishna Ghat, Botanical garden and Babughat respectively. This may be due to complete closure of all industrial operations along the bank of the River Ganges. Also the movements of vessels, flotels (a boat or ship that serves as a hotel, sometimes permanently moored to

a dock) and other recreational activities have also been ceased to abide by the rules of mass gathering and social distancing during the COVID -19 lock down phase. The CO₂ level of the atmosphere also showed a considerable dip in the value (Mitra.et.al, 2020). All these have posed a joint impact on pH level of the aquatic phase (synergistic effect) due to which a sudden turn in the trend of acidification has taken place.

The phenomenon of acidification due to climate change is never supportive and congenial for the aquatic organisms preferably for the survival of molluscs and other aquatic organisms with calcareous shell. Thus COVID-19 lockdown phase served as a boon to these faunal community by providing a reverse swing in the process of acidification.

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