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Impact of COVID-19 on Improvement of surface water quality of River Ganga at Buxar, Bihar

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Abstract
Due to Novel Corona Virus (COVID-19 Pandemic), all types of industries, vehicles anthropogenic activities suddenly shut off for months. As a result, the surface water quality of water bodies greatly reduced in terms of SPM(Suspended Particulate Matter). An investigation was done to find out the surface water quality of river Ganga at Buxar, Bihar. During investigation, the surface water quality of river Ganga was examined at various sites which stretches to a distance of 8 km covering the length of the river from Central Jail, Buxar upto the village Sarimpur. The result conclude that the surface water quality of river Ganga is improved during lock down period. This occurs because of the decreasement in the percentage of SPM. As a result, the pollution level of the water of this river also decreases and hence the water quality of river Ganga become more suitable for the growth of aquatic life at this site.

Keywords: Corona virus, water quality, surface water, SPM, River Ganga, Buxar, Bihar

Introduction
The hydrosphere pollution includes pollution of lakes, rivers, oceans and ground water reservoir. The hydrosphere has been severely polluted because of rapid urbanization, industrialization and domestic sewage discharge. Out of above, anthropogenic activities are one of the important factor of pollution in river ecosystem (Masood *et al*., 2016) [7]. In India, river pollution has now reached to a point of crisis due to above factors. The degree of pollution is generally, assessed by studying the physico-chemical characters of the water bodies (Kumar, 2020) [19].

In December 2019,a new infectious respiratory disease originated in Wuhan, China. WHO (World Health Organisation) named it as COVID-19 (Corona Virus disease 2019). It is basically a single stranded RNA virus and giving a crown like appearance. WHO and Governmental authorities requested people for maintaining social distance, avoiding public transportation and stay at their homes. The normal life has come to a standstill since mid March 2020, by shutting down schools, industries, travelling as well as anthropogenic activities like worship, marriage etc. During lock down period, the industrial waste water disposal, water transportation and other worship programmes have been shrunk or completely stopped which improve the water quality of river body. Thus, the level of pollution is expected to be reduced. COVID-19 also turned the aquatic habitat cleaner and reappearance of many aquatic species.

Various investigations have been carried out for analyzing the water quality of river body by many workers as Sharma (1982) [13], Das (1983), Singh (1999), Bhandari (2008), Singh (2008), Ahmed (2010) [1], Pathak (2011) [9] and Monika Dubey (2013) [3]. Hader (2020) [4], Kulshrestha (2020) [5], Muhammad (2020) [8], Saadat (2020) [10], Wright (2020) [17] and Yunus (2020) [18] also worked on the impact of COVID-19 on water quality of river bodies. But, no work has been carried out to find out the water quality status of river Ganga at Buxar, Bihar due to COVID-19 pandemic. Thus, the present research was done to find out the impact of lock down in the improvement of water quality of river Ganga.

Materials and Methods
The Ganga is the most holy river of Hindus and is also a life line of millions of people who live along its course and depend on it for their daily needs. The river Ganga drains the Southern slopes of the central Himalaya and covers the states of Hariyana, parts of Rajsthan, M.P., U.P., Bihar and West Bengal. It begins at the confluence of the Bhagirathi and Alkananda rivers.

The Ganga emerges from the mountains at Rishikesh then drains on to the Gangetic plain at the pilgrimage town Haridwar. Along the way between Allahabad and Malda (W.B.), the Ganga passes the town Chunar, Mirzapur, Varanasi, Gazipur, Buxar, Patna, Sultanganj and Bhagalpur. The total length of Ganga is said to be Slightly over 2500 km. In Bihar, Ganga drains from Buxar to Kahalgaon, covers a distance of 445 km. The river Ganga enters Buxar from South direction and flowing in the south-north direction for about 4 km and then changes its course to west-east direction.

Study Area : In present study, a part of Ganga is study which stretches a distance of 8 km from Central Jail, Buxar to the village Sarimpur. For this purpose, 10 different sites were selected between the entire length of the river from Central Jail to the village Sarimpur.

Turbidity has been used to assess the overall water quality. SPM (Suspended Particulate Matter) results in high turbidity in aquatic environment. Sewage disposal, sedimentation, siltataion, other pollutants and bacteria are responsible for SPM generation. Transparency also showed an inverse relationship with light penetration (Ahmed *et al*., 2010) [1]. This theory also helpful in analysing the turbidity of the water body. Reflectance is the ability of water body to reflects the light back. Reflectance increases with increasing turbidity. More suspended particulate matter increases the turbidity of water bodies and excess turbidity indicates the high level of pollution. Secchi disc was also used to measure turbidity (APHA, 2005) [2]. The SPM value is computed from water leaving reflectance by using following equation –

$$SPM = \frac{APw1}{1 - Pw/C}$$

Where, Pw = Reflectance

A and C = empirical co-efficient (A=289.29, C= 0.1686)

Result and discussion

Due to lock down period, the water of Ganga river at Buxar, Bihar become clear and transparent as the domestic and industrial effluents less deposited in it. The transparent condition of water of this river indicates that the level of pollution definitely reduced to a great extent. This reduction in pollution level also helps in flourishing the aquatic organisms including fishes. The mean value of SPM concentration in different sites were calculated before and during lock down period and analysis was done to evaluate the change in SPM concentration value. The average SPM concentration at different sites before lock down period (Table-1) shows a variation ranges from 20.8 mg/l to 24.5 mg/l. While the average SPM concentration at different sites during lock down period (table-2) shows a variation ranges from 12.6 mg/l to 21.9 mg/l. The decreasement in mean SPM concentration occurs due to all types of industries, schools, colleges, vehicles, worships and anthropogenic activities suddenly stops. The % decreasement of SPM concentration was ranged from 8.4 mg/l to 39.7 mg/l (Table-3).

Table 1: Mean SPM concentration (mg/l) at different sites of river Ganga during pre lock down period

Sites	1st Jan	15th Jan	31st Jan	15th Feb	28th Feb	15th Mar	Average Mean SPM
I	27.4	26.4	20.3	23.4	25.4	24.2	24.5
II	25.3	24.8	19.6	26.2	24.2	23.1	23.7
III	21.4	23.2	18.3	25.1	21.6	20.6	21.7
IV	26.3	25.4	19.6	21.2	23.4	20.2	22.5
V	27.2	26.1	25.7	20.2	24.1	18.2	23.6
VI	28.3	24.1	27.2	20.3	24.2	21.3	24.2
VII	20.5	21.3	20.6	25.2	24.3	22 4	22.4
VIII	16.7	20.2	24.3	21.1	26.2	24.4	22.2
IX	19.6	18.3	22.4	22.2	21.3	21.0	20.8
X	18.6	21.0	23.1	20.3	20.4	22.4	20.9

Table 2: Mean SPM concentration (mg/l) at different sites of river Ganga during lock down period

Sites	31st Mar	15th Apl	30th Apl	15Th May	31st May	15th Jun	Average Mean SPM
I	26.4	24.3	18.1	23.6	21.4	18.1	21.9
II	24.3	22.7	17.7	21.2	24.2	20.2	21.7
III	20.2	21.2	16.6	19.7	22.0	16.7	19.4
IV	22.3	20.4	21.1	20.3	18.2	16.3	19.7
V	23.3	24.1	20.2	23.1	20.3	12.3	20.6
VI	24.3	20.2	18.6	14.2	13.1	11.4	16.9
VII	18.6	19.3	15.3	13.4	19.2	11.3	16.1
VIII	14.7	16.1	20.4	24.1	18.3	12.1	17.6
IX	17.6	15.1	21.1	19.3	17.3	10.3	16.8
X	14.3	19.0	16.2	18.4	16.2	8.3	12.6

Table 3: % Decreasment of SPM concentration during pre-lockdown and lockdown period

Sites	Pre-lockdown period	During lockdown period	Percentage Decreasement
I	24.5	21.9	10.6
II	23.7	21.7	8.4
III	21.7	19.4	10.5
IV	22.5	19.7	12.4
V	23.6	20.6	12.7
VI	24.2	16.9	30.2
VII	22.4	16.1	28.1
VIII	22.2	17.6	20.7

IX	20.8	16.8	19.2
X	20.9	12.6	39.7

Conclusion

As all types of industries, vehicles, anthropogenic activities suddenly shut off due to COVID -19 pandemic, this results in decreasement in SPM concentration. The pollution level of river Ganga is reduced drastically at Buxar. Hence, the water quality if river Ganga is improved which provide a better situation for growing the planktons luxuriously.

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