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Eco-Restoration of River Rapti Water Quality during Covid19 Pandemic of Balrampur City

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Abstract

The pandemic of novel Covid-19 was reported in India in January 2020 and increased day by day due to movement of people from abroad to India and then to the different parts of the country. The COVID-19 has been declared as pandemic because of its high transmission rate and covered about 195 countries of the world. Under this scenario when there was no medicine for its treatment, the only solution to this problem was to break the chain of transmission and restrict the count of infected people. To contain a corona virus outbreak, the Government of India announced the nationwide lockdown with effect from the midnight of 24 March 2020 followed by the extension of the lockdown periods upto 4 phase. It has been very interesting to note that the behavioral changes in nature are highly positive and atmosphere, hydrosphere and biosphere are rejuvenating and it gives an appearance that the earth is under lockdown for its repairing work. Under this recovery, we tried to look at this improvement in water quality of the river Rapti. To study this river, the concentration of pH, EC, DO, BOD, COD have been measured which showed a reduction by 1-10%, 33-66%, 51%, 45-60% and 33-82% respectively during the lockdown phase in comparison to the pre-lockdown phase.

Keywords: Water Quality, COVID-19, Lockdown, Improvement, Environment.

Introduction

The origin of the deadly pandemics coronavirus has been in December 2019 from the city of Wuhan, China (Travaglio et.al., 2020: Raibhandari et.al., 2020; Chauhan and Singh, 2020) and spread to the almost entire globe. The source of Covid-19 is reported from the novel coronavirus and would have been produced from other mammals (Travaglio et.al. 2020). The World Health Organisation (WHO) in his report updated on 23 May 2020.

Recognizing the rate of spread of this virus with the personal contacts, various countries have imposed complete lockdown in order to maintain forced social distancing and break the chain of the spread of corona virus. The total lockdown has elevated pandemonium among people but helped in reducing the pace of spreading the virus among society. However, under this lockdown period, nature started to respond very positively and started giving several signals of improvement to natural parameters of the atmosphere, hydrosphere, and biosphere. It appears that the earth is rejuvenating under the lockdown period and it's closure for the repairing of earth.

Economic development of the twenty-first century has suddenly been obstructed by the COVID-19 global pandemic. This virus mainly transmits through coughing, sneezing, saliva, and spit of the affected person to another person. At the end of March 2020, over one million positive cases and 50,000 deaths have been reported from different corners of the globe (Dutheil et al. 2020; Han et al. 2020; Isaifan 2020). Simultaneously, eighteen million people were affected by the deadly Coronavirus within the 1st week of August 2020. World Health Organization (WHO) declared this pandemic as an International Emergency of Public Health (Kambalagere 2020; Sohrabi et al. 2020). Scientists of all over the world are continuously trying to find out its antidote or vaccine but desirable results are still elusive. Therefore, to reduce the rapid transmission of COVID-19, maintenance of social distance and face mask is the only way during this critical time. Probably the first time in the world's history, many affected countries have declared "lockdown" or shutdown of their public, educational, industrial, and business sectors to reduce the transmission of coronavirus. Sudden declaration of lockdown very badly harmed the economic sector while the health of the total environment has been improved due to limited anthropogenic actions (Beine et al. 2020; Ray et al. 2020; Huang et al. 2020; Bera et al. 2020). Several studies on environmental quality have been conducted in different parts of the world, and it showed that the ecological restoration has been significantly retrieved (Ma et al. 2020; Yongjian et al. 2020; Sharma et al. 2020a; Gautam and Hens 2020; Bera et al. 2020).

In India, an assessment on the water quality of river Ganga showed that the water quality has been improved by 40% to 50% during the lockdown period (CPCB 2020; Mani 2020). Many relevant studies have also been conducted on the quality of surface water bodies in different sites of India, and it demonstrated that the water parameters like pH, DO, BOD, and TC have been notably enhanced (Dhar et al. 2020; Chakraborty et al. 2020b; Mukherjee et al. 2020). Water quality is the assessment of an individual as well as all the parameters is associated with it. The influence of every individual parameter to the overall quality and the total influence of all parameters collectively determine the state of water quality for its definite use. Water quality index (WQI) is a very effective tool to select adequate treatment techniques (Rana et al. 2018). Similarly, it determines the physical, chemical, and biological parameters of the water (Vasistha and Ganguly 2020a, 2020b). Here, WQI comprises of sub-indices allotted to each parameter as per its importance and all together of sub-indices expressed in a single value which is indicating water quality (Sharma et al. 2020b). The WQI method is widely used by many researchers for the assessment of water quality in different parts of the world (Swami and Tyagi 2000; Kanakiya et al. 2015; Dwivedi and Pathak 2007; Mukherjee et al. 2012; Selvam et al. 2014; Hou et al. 2016). Quality of water is also indicated by the health as well as the growth of plants and aquatic animals in the aquatic ecosystem or environment.

With the understanding of this natural recovery, we tried to look at the water quality status and improvement. The concentration of pH, EC, DO, BOD and COD has been measured at various hotspots for the pollution. The water quality parameters were compared between the lockdown phase and the pre-lockdown. Three major locations of river rapti have been analyzed in this paper that showed a very impressive recovery of the water quality during the lockdown phase as compared to the pre-lockdown status of water quality. This showed that nature is flourishing during the corona pandemic. This lockdown showed that the solution for nature's cleanliness lies in our hands goes through the path of prevention of natural resources and sustainable development. However, as a researcher, it is highly essential to evaluate the water quality of significant rivers during the COVID-19 lockdown for the huge domestic and industrial demand for water. Thus, the main objective of the present study is to analyze the impact of lockdown on the water quality of river Rapti at the vicinity of industrial sites in terms of physical, chemical, and biological standard. Despite the various limitations (laboratory's use, data collection, and monitoring) during lockdown, the significant results will definitely help administrators and policy makers during the formulation of laws as well as the creation of public health awareness. Meanwhile, we stand at the great dilemma between development and conservation particularly with limited resources and over population. The eco-restoration of river quality during COVID-19 lockdown will bring new horizons for environmental sustainability through the amendment of untreated industrial effluents, urban sewage, and rampant water use.

Aim of the Study

To access the water quality of rapti due to Covid-19

Material and Method

Rapti River may refer to one of two rivers in Nepal and India East Rapti River and West Rapti River. The East Rapti River flows from east to west through the Chitwan Valley in Nepal, forming the northern border of the Chitwan National Park. It joins the Narayani River inside the protected area.WestRapti drains RaptiZone in MidWesternRegi on,Nepal,then Awadh and Purvanchal regions of Uttar Pradesh state, India before joining the Ghaghara, a major left bank tributary of the Ganges known as the Karnali inside Nepal. The West Rapti is notable for janajati ethnic groups – Kham Magar among its highland sources and then Tharu in Inner Terai Deukhuri Valley, for its irrigation and hydroelectric potential, and for recurrent floods that led to its nickname "Gorakhpur's Sorrow" with coordinates 28°28′33″N 82°52′44″E and elevation 3,500m (11,500ft). The source region of this river is enriched effluent wastes from sugar industry, organic and inorganic matters. Availability of water supply and cheap labor attract large scale industrial growth in this region. Many industries along with cities and towns have been established now. The water bodies of this zone are highly polluted by many industrial effluents from nearby industries. Many small channels locally called 'naala' which are used as waste or industrial effluents disposal corridors to the main river. The present study was undertaken during March 2020. Collection of water samples were made in a month. Samples were taken from the subsurface layer. Water temperature was measured by thermometer calibrated up to 0.1°C and transparency by the Sacchi disc. The pH of water, conductivity, DO was estimated by water analyzer kit. BOD was determined by the unmodified Wrinkler's method. The other physical and chemical parameters were determined following the standard method (Trivedi and Goel,1984 , APHA 2015).

Result and Discussion

Turbidity

Turbidity of water is affected by SPM (Suspended Particulate Matter) present in the water.

In view of its importance Mitchell and Furnas (2001) have designed river Logger, an instrument to monitor the aquatic SPM. Trace elements were recorded in the SPM of many rivers, including Yarra river in Australia (Sinclair et.al., 1989). SPM also affect the biotic community as studied by Cairns (1968). Turbidity not only affects the water chemically but it reduces the photosynthetic activity of the water body retarding the DO which causes suffocation to the aquatic life.

pH

pH of the river Rapti observed alkaline in nature which varies from 7.1 to 8.7 while it has been observed between 6.8 to7.5 during the pre-lockdown phase. However, pH varies from 7.1 to 7.8 during the lockdown phase. During the lockdown phase, a slight reduction in pH has been observed due to reduction of industrial activities, the non-functioning of essential commercial units, and prevailing weather conditions. The maximum reduction (10%) of pH has been observed in river Rapti. The concentration of pH as also correlated with the primary water quality criteria for bathing water and designated best usable water quality criteria of India. During the pre-lockdown phase, the pH levels were lower than the threshold limit (6.5-8.5). The pH derives most of the chemical and biological changes in water. It acts as a driving force in controlling species distributions in aquatic habitats.

Alkalinity

Alkalinity in water is due to carbonates, bicarbonates and hydroxides. It gives buffering power to water. The high quantity of alkalinity is not harmful to human being while it gives bitter taste to water.

Conductivity

Conductivity varies from 688-730 µS/cm during the pre-lockdown phase while it observed between 559.2-958.2 µS/cm during the lockdown phase. During the lockdown phase a slight reduction in conductivity has been observed due to the reduction of industrial activities, non- functioning of essential commercial units, and prevailing weather conditions. The maximum reduction (45%) of conductivity has been observed in river Rapti. Discharges into the streams are capable of changing conductivity depending on their make ups. A failing sewage system raises the conductivity because of the higher presence of chlorides, phosphates and nitrate.

Dissolved Oxygen (DO)

Dissolved oxygen (DO) is one of the most important indicators of water quality on which the survival of aquatic life depends. When DO becomes too low, fish and other aquatic organisms cannot survive. The data for DO was ranges upto 3.7 during the pre-lockdown phase while it was 4.3 mg/l during lockdown phase. However, DO vary from 2.2 to 7.3 mg/l with a mean value of 3.9 mg/l. During the lockdown phase, improvement in DO has been observed at river Rapti due to the reduction of industrial activities and household wastes. The concentration of DO was also correlated with the Primary Water Quality Criteria for bathing water and designated best use water quality criteria of India. Low DO affects most biological processes in water and responsible for lower biological diversity in water bodies

Chemical Oxygen Demand (COD)

Chemical oxygen demand (COD) is an indicator of contamination that shows the amount of dissolved matter in water susceptible to being oxidized. COD is responsible for the reduction of DO in water bodies. Higher concentration of COD is responsible for quick deterioration of oxygen in water bodies and reduces oxygen availability for higher forms of aquatic life. The major sources that increase the COD in the Rapti River are industrial/domestic effluents, wastewater treatment plants, failing septic systems. COD varies from 28 to 574 mg/l with a mean value of 211.6 mg/l during the pre-lockdown phase while it observed between 6 to 150 mg/l during the lockdown phase. However, improvement in COD has been observed at all locations in the lockdown phase due to the reduction of industrial activities, rainfall, and prevailing weather conditions. The maximum reduction (82%) of the COD level has been observed at river Rapti during the lockdown phase.

Biochemical Oxygen Demand (BOD)

Biochemical Oxygen Demand (BOD) is one of the most important indicators of water quality. BOD directly affects the amount of dissolved oxygen in water bodies. The greater demand for BOD more rapidly depletes the oxygen in the water bodies making lesser availability of oxygen for higher forms of aquatic life. The consequences of the high BOD are similar to the effect of less oxygen availability putting aquatic life under stress, suffocation and could be lethal. The major sources of increase of BOD in the Yamuna river include dead plants and animals; animal manure; industrial/domestic effluents, wastewater treatment plants, failing septic systems; and urban storm water runoff. BOD varies from 7.9 to 154 mg/l with a mean value of 90 mg/l during the pre-lockdown phase while it observed between 2-82 mg/l during the lockdown phase. However, improvement in BOD (i.e. the reduced demand) has been observed at all locations in the lockdown phase due to the reduction of industrial activities and prevailing weather conditions. The comparative analysis is given. The concentration of BOD was also correlated with the primary water quality criteria for bathing water and designated best use water quality criteria of India. Higher BOD affects most biological processes in water and can ultimately lead to reduced biological diversity in streams.

Chemical Parameters

Water quality index of pre-lockdown shows that there is a high reduction in the values of all chemical parameters i.e., Ca^{2+}, Na, K, Cl^{-}, TH and TA, Mg^{2+}. During the lockdown period, values are still exceed the standard limit but there is very sharp reduction in the pollution as shown in table. It is evidence that pollution level is directly related with anthropogenic activities like industrial wastes, continuous air pollution, household wastes.

Comparative Water quality Index of Water

Parameter	Sn	Pre lockdown		During lockdown		Wn	qnwn	
		No	qn	No	qn		Pre	During
Temperature	40	30	75	25	62.5	0.06	4.5	3.75
pH	7.0	6.8	97.14	7.5	107.14	0.264	25.64	28.28
Turbidity	45	350	777.7	290	644.4	0.26	202.20	167.54
Alkalinity	120	60	50	54	45	0.01	0.5	0.45
TDS	0.405	409.2	101.05	280	69.80	0.0037	0.37	0.25
Conductivity	40	958.2	2395.5	559.2	1398	0.04	95.82	55.92
DO	7.3	3.7	103	4.3	103.6	0.12	12.36	12.43
COD	0.72	574	90.27	198	76.38	0.68	61.38	51.93
BOD	97	105	92.78	82	84.53	0.0052	0.48	0.43
Ca	75	87	116	80	106.6	0.024	2.78	2.55
Nitrate	45	65	144.4	56	124.4	0.04	4.97	4.64
Cloride	250	200	80	150	75	0.0074	0.55	0.59
Potassium	20	12	6	10	5	0.092	0.55	0.46
Sodium	200	150	75	134	67	0.0092	0.69	0.61

Water Quality Index of Pre-lockdown

$$WQI=\frac{\sum qnwn}{\sum Wn}$$
$$=\frac{412.79}{1.6155}$$
$$=255.51$$

Water Quality Index of During lockdown

$$WQI=\frac{\sum qnwn}{\sum Wn}$$
$$=\frac{329.83}{1.6155}$$
$$=204.16$$

Conclusion

From the scientific study, it is concluded that the effluents (solid/liquid) of riverside industries have a major harmful effect on the river Rapti. In the past normal years, the quality of this river water was poor, and it directly damaged the water quality or health of the aquatic environment. The previous studies on the water quality of river Rapti proved that the river water throughout the catchment area was very much affected by nearby coal dust, iron and steel industries, power plants, chemical industries, etc. (Bhattacharyya et al. 2013; Sundararajan and Mohan 2011; Ghosh and Banerjee 2012; Singh et al. 2014; Chatterjee et al. 2010; George et al. 2010; Mukherjee et al. 2012). These previous research works focused that the abundance of TDS, TH, BOD, Fe, and NO_3^- in the river water is the principal cause of water quality deterioration. The present study also highlighted that all these parameters are found beyond the permissible limit during pre-lockdown, while lockdown period water quality has significantly improved due to restricted economic activities. Thus, the countrywide lockdown due to the COVID-19 pandemic has brought noticeable changes to the overall quality of river water, and it has turned to be a positive condition for nature's restoration. Industrial effluents from nearby chemical factories, thermal power stations, cement factories, and coal mining activities have been deteriorating the water quality of river Rapti in the last three or four decades. High concentration of pH, TDS, TH, TA, Fe, Ca^{2+}, Mg^{2+}, and BOD badly affects the functions of the river ecosystem and human health. The WQI of the pre-lockdown period indicates as "very poor" to "unfit for drinking" in the study area. Here, during lockdown, no mixing of industrial waste water has improved the water quality within a few months, and it has turned into very good condition. The short-term lockdown is blessings for the health of the total environment. So, sustainable development is most important for the eco-restoration of different components of the environment along with further economic progress. Still, the river water is being polluted from various non-point sources such as agricultural run-off, urban wastewater, industrial waste, and garbage dumping. This ground reality or model is vital for sustainable land-use practices and water resource management. Riparian vegetation zone influences river water chemistry through diverse processes including direct chemical intake and cycling by vegetation to indirect influences such as by supply of organic contents to shallow soils and channels, modification of water movement activities, and stabilization of soil properties (Malan et al. 2018; Chua et al. 2019). It is possible if the industries are situated near the river and clearly maintain the environmental guidelines while releasing their polluted solid or liquid waste into the river water. So, wastewater and industrial waste should be discharged into the river or riparian wetland. The Government policies and actions are very much helpful for implementing measures such as the Water (Prevention and Control of Pollution) Act 1974, Environment Protection Act 1971. However, public awareness about the environment and human health will be the most vital apparatus for the achievement of environmental sustainability. More fundamental and applied research is required to make management policies and laws for sustainable river health restoration from irrational human use. The government should establish a separate department like "River Research Institute" to look after the overall health of the river through the changing natural and anthropogenic paradigm. This field-based scientific study will definitely assist the development planners, policy makers, and administrators for design sustainability during the modern industrial era.

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