Evaluation of Water Quality of Gandak River at Bagaha, Bihar, India

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Abstract: The Gandak River is one of the most important rivers of the West Champaran District in Bihar, which originates in the great Himalayan range in Nepal. This Gandak river flows from Nepal to West Champaran, East Champaran, Muzaffarpur, and lastly, it merges into Ganga near Patna. During the investigation, the researcher tried to find out the Physico-chemical characteristics of water across one year. Five sampling sites were selected located at the bank of Gandak River at Bagaha, West Champaran, Bihar. In this study, various analytical techniques were used to study the water quality parameters like pH, TDS, DO, BOD, COD, Hardness, Chloride, Calcium, and Magnesium. The findings of the present investigation reflect that most of the water quality parameters are within the acceptable limits in accordance with WHO standards.

Key Words - Gandak River, Water Quality parameters, Bagaha

I. INTRODUCTION

North Bihar is very rich in water resources. It has a number of water bodies like rivers, streams, ponds, and ditches. Water has always been an important and life-sustaining drive to human and animal beings and is also essential for the survival of all organisms. Gandak River is one of the major & significant tributaries of the Ganga in North Bihar. It is also called as Narayani River. This river enters India while flowing South- West & then takes a turn to South- East along with Uttar Pradesh – Bihar State border and across the Indo- Gangetic plain. It enters the Ganga River opposite Patna after a winding course of 765 km. It is an important source of domestic water, irrigation, and fish protein.

Bagaha is an inhabitant area of the West Champaran district of Bihar. It is divided into 35 wards having a population of 1,12,634 (Census 2011). It's a housing area at the confluent point of Bihar, Utter Pradesh, and Nepal. It is located at an altitude of (average) 135 meters (442 feet) in the Terai of the Himalayas. Bagaha is located between 26º 06′ 36 North and 84 º 04′ 34 East. This area is very fertile for agriculture due to the presence of alluvial soil. There are many small-scale manufacturing units, like material (shading reagents), sugar cane businesses have set up on this site. In these areas, domestic and industrial wastes are released into the river by open drains. Several agro-based industries have flourished here and are running fruitfully. Sugarcane factories have been set up at Bagaha-2, Ramnagar and Narkatiaganj. These are the key sources of pollution of the river Gandak at Bagaha, West Champaran.

In the present investigation, an attempt has been made to assess the quality of water to determine the extent of pollution in the river.

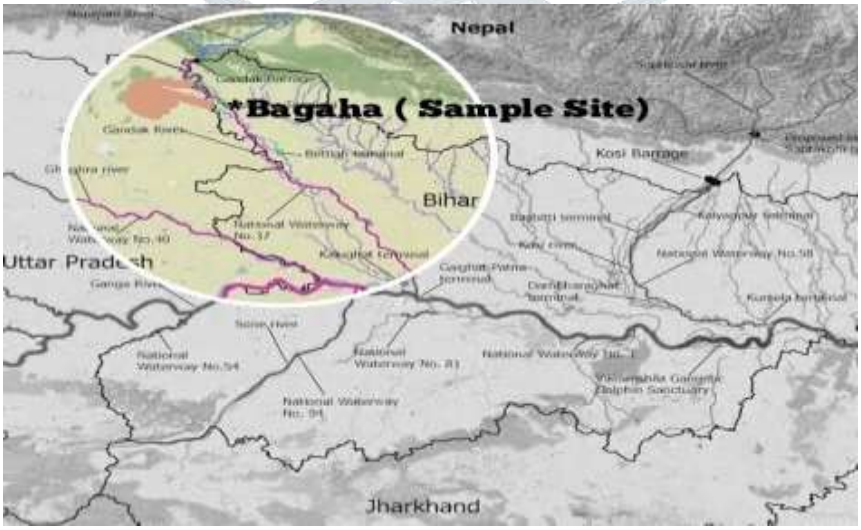

Figure1. Sample Site of Gandak River, Bagaha, West Champaran, Bihar

II. LOCATION OF SAMPLING POINTS

Five sampling points were selected in Bagaha (Figure 1) to monitor the Physico-chemical characteristics of the water of the Gandak River. These are Narayanapur Ghat, Bagaha Ghat, Gudiyapatti Ghat Ratanmala Ghat and Rajwatiya Ghat (Figure

2). They are referred to as SB1, SB2, SB3, SB4 & SB5 respectively. Each Sampling site was located nearly 2-3km from its nearest site.

Figure 2. Selected Sampling Site, Bagaha, Bihar

III. EXPERIMENTAL

Water samples were collected from a selected site once a month during the year at a fixed interval between 7 to 9 AM. BOD is determined by a standard method. COD, Hardness, Chloride, Calcium, and Magnesium were analyzed by standard methods prescribed by APHA 1995. pH, TDS, and DO were determined by the VSI-06 water analyzer kit.

IV. RESULTS AND DISCUSSION

Dissolved Oxygen (DO) is an important parameter that indicates the physical, chemical, and biological activities of the water body. Experimental results clearly show that the Dissolved oxygen (DO) was found to be low during the summer season. Its value was found to be high during the winter season at all the selected five sites as shown in Table 1. It is due to high photosynthetic activity during these periods.

BOD (Biological Oxygen Demand) is one of the important parameters which reflect the status of aquatic pollution. It measures the amount of oxygen used by microorganisms during the aerobic decomposition of organic matter. It was found to be maximum during summer and minimum during the winter season. The obtained data suggest that all the selected sites of the river were moderately polluted. The water having BOD less than 1.0 mg/l is unpolluted; the range between 2.0 - 9.0 mg/l is moderately polluted and above 9.0 mg/l is highly polluted **(Table 1).**

COD (Chemical Oxygen Demand) is defined as the total measurement of all chemicals (organic & inorganic) in the water. It is a measure of the total quantity of oxygen required to oxidize all organic matters. The obtained values were found to be within the permissible value set by WHO of 10mg/l. COD value is maximum during the summer and minimum during the winter season.

TDS (Total dissolved solids) and Hardness values of the river water were also found within the permissible standard limit, set by WHO. It includes organic salts & small amounts of organic matter. It influences the taste, hardness, and corrosive properties of water. Its high value adversely affects the quality of water.

The pH (potential of hydrogen) values were also found within the desirable limits. The data of the present investigation reflects a high value during winter when the water is slightly alkaline.

The magnesium, calcium, and chloride values have a similar range at all the sites and were found to be quite low which is within the permissible limits.

V. CONCLUSIONS

The findings of experimental observation clearly indicate that all the parameters are under the maximum permissible limit standardized by BIS and WHO. Conclusively the water quality of Gandak River near Bagaha Subdivision is permissible and suitable for drinking, bathing, and even survival of aquatic life.

Table 1: Physico- Chemical Characteristics of Water Samples

Parameters	Sites	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	WHO (MPL*)
	SB1	6.9	6.1	6.8	6.3	6.1	6.3	6.2	6.7	7.2	8.1	7.7	8.1	
	SB2	7.1	6	6.6	7.1	6	6.2	6.7	7.1	7.3	7.5	8.1	7.6	
DO	SB3	7	7.2	7	6.8	6.2	6.4	6.3	7.3	7.4	6.5	8.3	8.2	4.0-6.0
	SB4	6.8	7.3	6.3	6.6	5.8	5.8	6.4	6.8	7.2	7.7	7.4	7.7	
	SB5	7.6	7.1	6.7	6.5	6.3	6.2	7.3	7.6	8.1	7.6	7.6	8.2	
	SB1	3.5	2.8	2.5	2.2	2.1	2.5	3.3	2.7	2.3	1.8	2.2	2.4	
	SB2	2.3	2.7	2.2	2.1	3.2	2.3	1.7	2.4	2.6	2.7	3.1	3.2	
BOD	SB3	2.5	3.2	2.6	2.4	2.3	1.4	2.6	3.2	2.2	2.4	2	2.7	10
	SB4	3.3	3.3	2.7	2.3	2.1	2.5	2.7	2.8	2.3	2.6	2.3	2.6	
	SB5	2.4	2.7	2.8	1.8	2.5	2.7	2.8	2.3	1.7	3.2	2.8	2.6	
	SB1	6.7	8.3	9.5	9.7	7.1	9.4	8.8	8.2	8.2	6.7	9.2	9.6	
	SB2	8.2	8.1	9.4	8.8	9	9.2	7.7	8.1	9.3	9.5	9.6	9.2	
COD	SB3	8.3	9.3	9.3	9.6	8.2	8.1	9.4	8.5	9.1	8.7	9.7	9.1	10
	SB4	6.7	6.6	8.8	7.7	8.2	7.5	8.7	9.7	7.7	7.6	8.3	8.2	
	SB5	8.8	9.2	9.4	8.5	10.1	8.1	8.3	7.6	7.2	9.9	9.2	9.3	
	SB1	292	232	253	301	211	287	276	284	314	337	342	316	
	SB2	296	224	243	283	193	174	213	242	292	312	317	323	
TDS	SB3	312	325	297	284	222	276	302	291	331	344	336	382	500
	SB4	264	282	318	346	324	373	294	283	312	363	343	341	
	SB5	223	267	242	283	306	282	313	294	283	321	292	312	

Cont……

Parameters	Sites	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	WHO (MPL*)
	SB1	7.6	7.3	7.4	7.3	7.2	7.4	7.6	7.4	7.3	7.4	7.1	7.3	
	SB2	7.7	7.2	7.7	7.5	7.3	8	7.7	7.5	7.6	7.5	7.8	7.5	
pH	SB3	7.4	7.5	7.8	7.4	7.6	7.8	7.2	7.8	7.5	8.1	7.7	7.6	6.5-9.2
	SB4	7	7.6	7.3	7.7	8	7.6	7.5	7.7	7.8	7.9	7.9	7.7	
	SB5	7.5	7.3	7.7	7.9	7.8	7.9	8	7.6	7.6	8	7.5	8.1	
	SB1	174	144	133	183	178	166	171	192	135	196	184	177	
	SB2	123	132	112	117	167	133	157	151	142	153	162	153	
Hardness	SB3	144	144	164	116	146	162	182	164	184	174	163	132	500
	SB4	178	143	183	212	196	214	167	163	183	192	184	174	
	SB5	124	137	116	143	144	252	151	134	147	163	153	162	
	SB1	25.4	27.6	31.3	34.4	22.7	27.4	25.7	49.8	28.4	23.5	35.3	27.7	
	SB2	40.6	45.4	32.2	49.6	56.3	41.7	47.6	38.7	42.6	51.2	58.2	57.2	
*Cl	SB3	35.3	48.2	56.5	57.3	42.6	43.5	49.6	38.6	40.2	45.7	35.7	37.7	500
	SB4	36.4	40.3	48.7	29.3	32.5	43.7	41.5	45.4	36.8	37.6	38.6	40.3	
	SB5	42.5	45.2	46.3	56.5	52.3	49.8	60.3	65.3	39.3	45.5	48.5	37.8	
	SB1	37.2	24.6	20.7	38.3	24.3	49.3	29.3	28.5	24.5	20.6	35.3	49.3	

	SB2	28.2	32.2	18.6	14.3	19.5	24.3	26.7	21.6	22.6	25.5	35.6	46.4	
***Ca**	SB3	20.3	25.4	23.2	31.3	18.7	35.6	35.2	28.5	20.7	25.8	30.7	49.3	100
	SB4	22.2	18.6	26.3	27.7	28.4	16.7	23.5	31.7	35.6	26.3	29.8	26.5	
	SB5	19.7	16.5	23.6	21.6	18.5	28.5	32.6	24.8	36.8	28.6	22.8	29.2	
	SB1	22.7	19.4	16.5	14.4	12.2	18.7	15.7	17.7	11.4	22.3	21.7	19.7	
	SB2	19.6	21.3	14.4	14.5	16.7	17.3	18.6	12.8	13.7	22.2	14.3	16.2	
***Mg**	SB3	16.6	17.4	18.7	16.3	13.8	17.7	20.7	10.3	11.3	13.4	12.5	10.3	150
	SB4	17.5	19.3	20.3	21.6	18.7	19.6	13.6	14.4	18.3	16.8	13.7	17.8	
	SB5	18.8	20.4	17.3	19.2	13.6	14.5	12.6	18.5	11.3	12.9	13.3	14.5	

*Cl- Chloride, *Ca- Calcium, *Mg- Magnesium *Maximum permissible limit

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