

## Assessment of Physico-Chemical Parameters and Correlation Coefficient of the River Ganga Water at Budhanath Ghat of Bhagalpur (Bihar)

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### ABSTRACT

In the present investigation the physico-chemical parameter of the River Ganga at Budhanath Ghat of Bhagalpur (Bihar) were analysed. The analysis of water sample were taken during January – December, 2020. Seasonal variations at different sampling sites of Budhanath Ghat were observed. The results shown that the fluctuation occurred in physico-chemical parameter in different seasons. Correlation coefficient value indicates high positive and negative relationships ( $p < 0.01$  level) and also show significant positive and negative relationship ( $p < 0.05$  level). About 11 physico-chemical parameters were taken in consideration for analysis of the river water such as water temperature, Total Alkalinity, pH, Dissolved oxygen, biological oxygen demand, chemical oxygen demand, Turbidity, Electrical conductivity, Phosphate, and Chloride. This paper deal with the study of river Ganga at Bhagalpur.

**KEYWORDS:** Bhagalpur, Physico-chemical, River ganga, Correlation coefficient

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### INTRODUCTION:

Ganga is one of the rivers which fulfil the requirement of vast area in India, it arises from Garhwal Himalayas as a Bhagirathi and have an approximately a run of 2525 km and finally fall in Indian Ocean at Bay of Bengal [1]. Increased in population and industrialization, demand of freshwater increases which was fulfilled by the rivers which provide water for various human activities [2]. Increased urbanization and industrialization the problem of river pollution is also mushrooming day by day and reaches to crisis and further deteriorate the water quality. The factors which basically deteriorate the water quality of river Ganga is disposal of dead bodies, Discharge of sewage and industrial waste, agriculture run off, disposal of various veneration items directly in river Ganga. For effective maintenance of water quality through appropriate

control measures, continuous monitoring of physico-chemical parameters are necessary [3]. DO and BOD are used to check the pollution level of aqueous system directly. Contaminated water may also contain the various heavy metals, it is a metal having a density of 5g/cm<sup>3</sup>, these metals are highly toxic to the environment and in turn to humans, they are associated with deadly disease of humans such as cancer, The organic forms of heavy metals have been reported to be very toxic and adversely affects water quality. It is not necessary that low pH values of water shows the presence of heavy metals such as Zn, Cd, As, etc, shows their presence at neutral pH [4]. Thus, a regular analysis of water quality start fading off the appropriate measure can be taken to prevent these valuable rivers for our future generations.

## MATERIALS AND METHOD

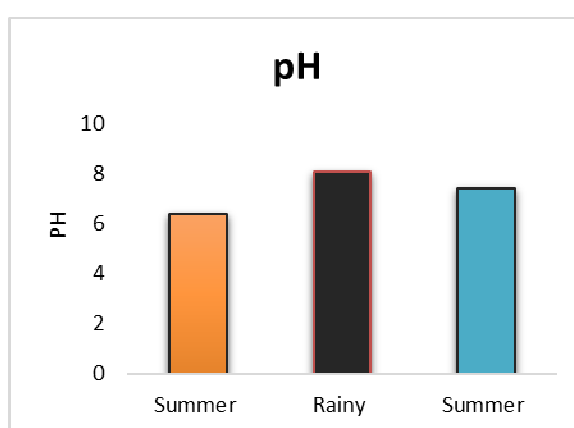
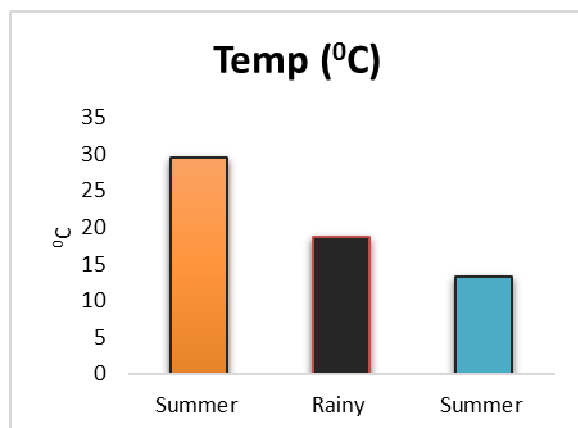
The water sample were taken from different sampling site of Budhanath Ghat of Bhagalpur, in the early morning between 8 am to 11 am in the first week of every month from January – December 2020. Triplicate samples each of two litres in acid washed five litre plastic containers were collected between 8 A.M. to 10 A.M. from sampling site in the first week of every month from January –December 2020. The water samples taken from a depth of 5-10 cm below the surface of water. And samples were brought to the laboratory in ice boxes for the analysis of various physico-chemical parameters. The physico-chemical characteristics of the dam water like water temperature, turbidity, pH, Electrical conductivity, alkalinity, chloride, and phosphate were determined in summer, rainy and winter according to standard methods [5], [6].

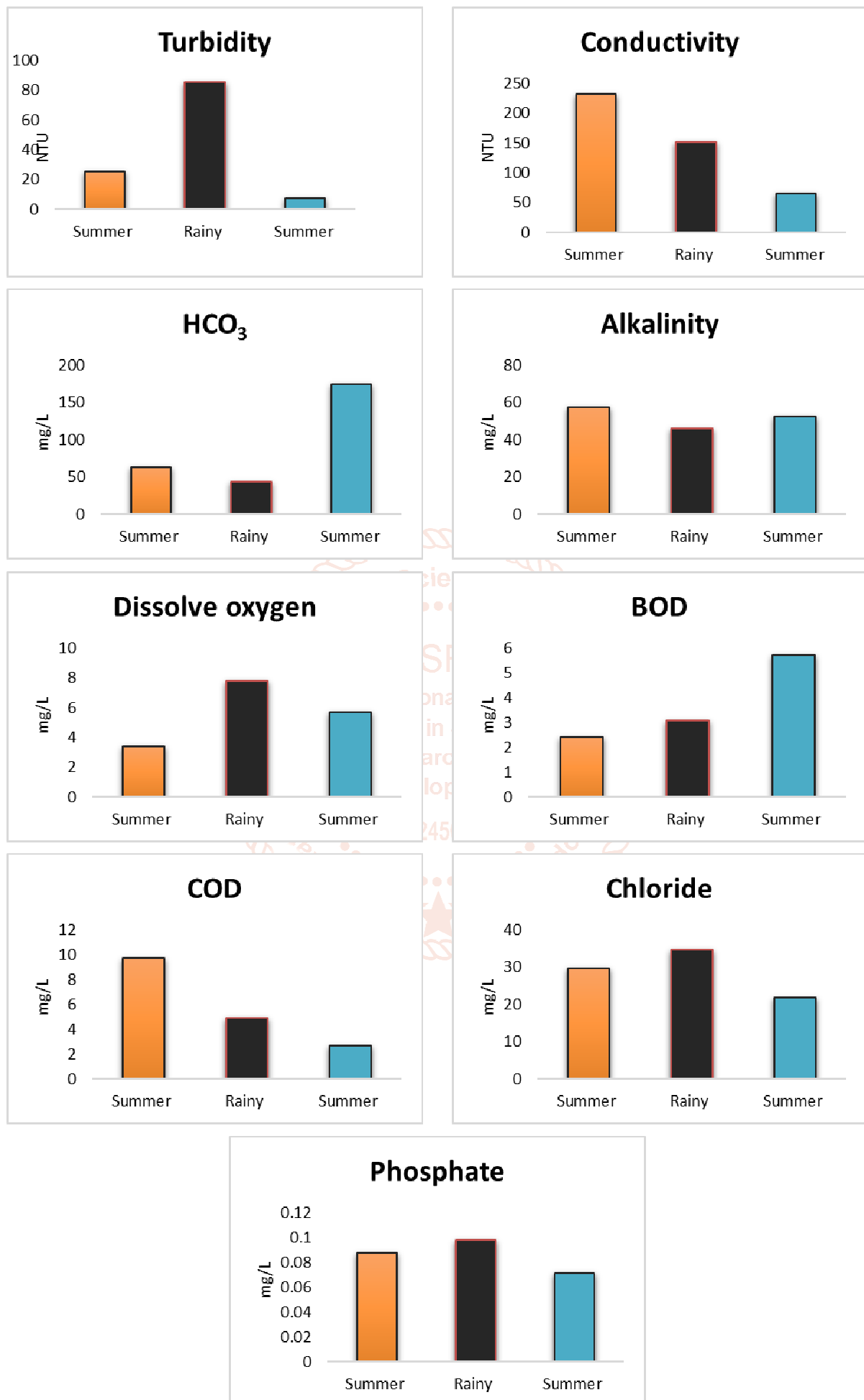


**Fig 1 - Satellite imagery showing the sampling sites of Ganga River used in the study.**

**Table 1: Seasonal variation in Physico-chemical parameter at of Budhanath Ghat of Bhagalpur during the year (January to December 2020)**

Parameter		Summer	Rainy	Winter
Physical	Temp ( $^{\circ}\text{C}$ )	$29.5 \pm 06$	$18.6 \pm 1.4$	$13.3 \pm 1.8$
	pH	$6.4 \pm 0.3$	$8.1 \pm 0.4$	$7.4 \pm 0.3$
	Turbidity (NTU)	$25.6 \pm 0.6$	$85.6 \pm 2.6$	$65.7 \pm 0.7$
	Conductivity ( $\mu\text{mhos/cm}$ )	$232.4 \pm 1.4$	$151.2 \pm 3.4$	$174.3 \pm 2.13$
Chemical	$\text{HCO}_3$ (mg/L)	$63.0 \pm 1.4$	$43.49 \pm 1.21$	$52.7 \pm 2.4$
	Alkalinity(mg/L)	$57.5 \pm 1.0$	$46.13 \pm 2.10$	$56.7 \pm 2.2$
	DO (mg/L)	$3.4 \pm 0.2$	$7.8 \pm 0.8$	$5.7 \pm 0.9$
	BOD (mg/L)	$2.4 \pm 0.2$	$3.1 \pm 0.5$	$2.7 \pm 0.2$
	COD (mg/L)	$9.7 \pm 0.5$	$4.9 \pm 0.9$	$2.02 \pm 0.4$
	Chloride(mg/L)	$29.6 \pm 0.4$	$34.6 \pm 0.7$	$21.7 \pm 1.0$
	Phosphate(mg/L)	$0.088 \pm 0.0$	$0.098 \pm 0.0$	$0.071 \pm 0.0$





**Fig 2: Graph showing average seasonal variation in physicochemical characteristic of water at different season of Budhanath Ghat at Bhagalpur (Bihar). India. (During January – December 2020).**

**Table- 2- Correlation matrix among the physico – chemical; parameter of river ganga at Budhanath Bhagalpur from January – 2020 to December – 2021.**

Para-meter	Temp	pH	Turb	Cond	HCO <sub>3</sub>	TA	DO	BOD	COD	Cl	PO <sub>4</sub>
Temp	1										
pH	-.658*	1									
Turb	-.794**	.849**	1								
Cond	.820**	-.810**	-.982**	1							
HCO <sub>3</sub>	.588*	-.678*	-.763**	.796**	1						
TA	.396	-.771**	-.694*	.671*	.540	1					
DO	-.657*	.918**	.920**	-.857**	-.714**	-.741**	1				
BOD	-.082	.077	.325	-.321	.079	.030	.105*	1			
COD	.978**	-.567	-.722**	.759**	.622*	.299	-.563*	-.010	1		
Cl	.371	.284	.233	-.147	-.263	-.530	.382	.127	.429	1	
PO <sub>4</sub>	.434	.277	.186	-.117	-.241	-.446	.322	.229	.494	.961**	1

\*\* = Correlation is high significant at  $p < 0.01$  level, - indicate negative correlation, \* - Correlation if significant at  $p < 0.05$ .

Temp – Temperature, Turb- Turbidity, Cond – Conductivity, TA – Total alkalinity, DO – Dissolved oxygen, BOD – Biochemical oxygen demand, COD – Chemical oxygen demand, Cl – Chloride, PO<sub>4</sub>- Phosphate.

## RESULT AND DISCUSSION

**Water temperature** - The physico-chemical analysis of the ganga river water indicates that water temperature ranged minimum in winter of  $13.3 \pm 1.8$  °C and maximum in summer of  $29.5 \pm 06$  °C Results indicate that higher temperature were recorded in summer lowest in winter whereas intermediate in monsoon season. Water temperature show high significant Positive and negative relationship with conductivity and pH, Turbidity, BOD and COD.

**Total alkalinity** - The Total Alkalinity value was observed maximum in summer of  $57.5 \pm 1.0$  mg/L and minimum was observed in rainy of  $46.13 \pm 2.10$  mg/L. Results indicate that higher total alkalinity was observed in summer lower in rainy whereas intermediate value were observed in winter season. Alkalinity show high significant positive and negative relationship with Dissolved Oxygen, COD.

**pH** - The pH value was observed maximum in rainy of  $8.1 \pm 0.4$  and minimum was observed in summer of  $6.4 \pm 0.3$  Results indicate that higher pH was observed in summer lower in winter whereas intermediate value was observed in monsoon season. The overall mean was  $7.87 \pm 0.77$  and coefficient variation was 9.78. pH shows high significant positive and negative relationship with Turbidity, Conductivity, HCO<sub>3</sub>, TA, Dissolved oxygen.

**Turbidity (Tur)**- The Turbidity value was observed maximum in rainy of  $85.6 \pm 2.6$  NTU and minimum was observed in summer of  $25.6 \pm 0.6$  NTU. Results indicate that higher Turbidity was observed in monsoon lower in winter whereas intermediate value were observed in winter season. The overall mean was  $44.55 \pm 7.72$  NTU and coefficient variation was 39.77. During the monsoon season higher value of

turbidity observed due to influx of rain water from catchment area, washes silts, sand and cloudiness area. Turbidity show positive and negative relationship with water temperature. DO, COD.

**Conductivity** - The Electrical conductivity value was recorded higher in summer of  $232.4 \pm 1.4$  μmhos /cm and lower in rainy of  $151.2 \pm 3.4$  μmhos /cm. Results indicate that higher electrical conductivity was observed in summer season lower in monsoon whereas intermediate in winter season. Electrical conductivity shows significant positive and negative relationship with water temperature, turbidity, DO.

**Dissolved oxygen (DO)** - The DO value was observed maximum in rainy of  $7.8 \pm 0.8$  mg/L and minimum was observed in summer of  $3.4 \pm 0.2$  mg/L. Results indicate that higher DO was observed in winter lower in monsoon whereas intermediate value were observed in winter season. Demand oxygen show high significant positive and negative relationship pH, turbidity, Conductivity.

**Biological oxygen demand (BOD)** -The BOD value was recorded higher in rainy of  $3.1 \pm 0.5$  mg/L and lower in summer of  $2.4 \pm 0.2$  mg/L. Results indicate that higher BOD was observed in summer season lower in monsoon whereas intermediate in winter season. Biological oxygen demand shows high significant positive relationship with DO.

**Chemical oxygen demand (COD)** - The COD value was observed maximum in summer of  $9.7 \pm 0.5$  mg/L and minimum was observed in winter of  $2.02 \pm 0.4$  mg/L. Results indicate that higher COD was observed in summer lower in monsoon whereas intermediate value were observed in rainy season. Chemical



oxygen demand shows significant positive relationship with DO.

**Chloride** - The Chloride value was recorded higher in rainy of  $34.6 \pm 0.7$  and lower in winter of  $21.7 \pm 1.0$  mg/L. Results indicate that higher chloride were observed in summer season lower in monsoon whereas intermediate in summer season. Chloride shows high significant positive relationship with  $PO_4$ .

**Phosphate** - The Phosphate value was observed maximum in rainy of  $0.098 \pm 0.0$  mg/l and minimum were observed in winter of  $0.071 \pm 0.0$  mg/L. Results indicate that higher phosphate was observed in monsoon lower in summer whereas intermediate value were observed in summer season.

## CONCLUSIONS

The present study shows detailed physico-chemical characteristics and quality of water in Budhanath Ghat of Bhagalpur (Bihar). The summer, rainy and winter seasons shown different seasonal fluctuations in various physico-chemical parameters. The Correlation coefficient indicates positive and negative significant correlation of physico-chemical parameters with each other. Positive correlation means one parameter directly proportional to other parameter (i.e., one parameter  $\propto$  other parameter) and negative correlation means (one parameter  $1/\propto$  other parameter) one parameter inversely to other parameter increases with other parameters and negative correlation mean one parameter increase with other parameter decrease. The value of correlation coefficient helps in selecting the proper treatment to minimize the contamination of the Ganga River water. There is also need of increasing awareness among the people to maintain the river water at their highest quality and purity level. To

improve the quality of water there should be continuous monitoring of pollution level and methods should be applied for removing water pollution at Budhanath Ghat of Bhagalpur (Bihar).

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