

## Inter-Relationship Between Physicochemical Parameters of River Churni, Nadia, Westbengal, India

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### Abstract

Water samples were collected monthly from nine sampling sites of River Churni of Nadia district, West Bengal for two annual years (2012-2013). A total of 216 samples were analyzed first to determine the values of each water quality parameters. Parameters viz., temperature, pH, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, total hardness, total alkalinity, total nitrogen, total phosphorus, total solid and total coliform were determined to understand the current status of water quality of the river. Correlations between physicochemical parameters were established by the use of Pearson correlation matrix ( $r$ ) to determine the interrelationship between the parameters. Correlation coefficient values between these pollution indicator parameters were found to indicate good interrelationship between them.

**Keywords:** River Churni; Water Quality Parameters; Correlation.

### Introduction

River Churni is an important river of Nadia district of West Bengal. It originates from a distributary of River Padma named River Mathabhanga near Krisnaganj, Nadia. After flowing about 54 km it pours its content to the River Bhagirathi-Hooghly. The entire stretch of the river is situated within the district Nadia. According to Panigrahi and Bakshi (2014), the river is the one of the main sources of surface water of Nadia district. The river was described to face a loss of fish species along with degrading ecological condition by Ghosh and Konar (1991). Bakshi and Panigrahi (2012) had identified various reasons behind the ecological degradation. They had cited that the river was affected by various point and non-point pollution sources at various places. 63.6% of fish species had been recorded to be eliminated from river Churni by Das and Chakrabarty (2007). Loss of benthic macro-invertebrates had also been reported for this river mainly due to increasing anthropogenic pollution load (Das et al., 2007).

Water quality parameters were determined during the total study period as these are said to be good pollution indicators. Several studies on water quality were done focusing on the physicochemical characteristics of waters (Waziri *et al.*, 2009; Izonfuo and Bareweni, 2001). It was very essential to identify

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the interrelations between the various physicochemical parameters for this river to understand the accumulated impact of the parameters.

The aim of the total study for two annual years (January, 2012- December, 2013) was to determine the level of some pollution indicators and establish relation between different parameters.

### Study area and sampling sites

The investigation was carried throughout the complete stretch of River Churni (about 54km). Nine sampling sites were selected as follows: Krishnaganj (S1), Hanskhali (S2), Mamjoani (S3), Aranghata (S4), Kalinarayanpur (S5), Aishtala (S6), Ranaghat Bridge

Point (S7), Anulia (S8) and Shibpur (S9). The geographical position of the sampling stations was listed in Table 1.

**Table 1:** Sampling sites of the study area and their geographical positions

Sites	Name of the areas (present sampling sites)
S-1	Krishnaganj (23.403965°N, 88.709667°E)
S-2	Hanskali ( 23.358589°N, 88.60.8795°E)
S-3	Mamjoani (23.304460°N, 88.581861°E)
S-4	Arranghata (23.263231°N, 88.6008545°E)
S-5	Kalinarayanpur (23.205668°N, 88.559752°E)
S-6	Aishtala, Ranaghat (23.192428°N, 88.566960°E)
S-7	Ranaghat Bridge Point (23.177679°N, 88.558168°E)
S-8	Anulia (23.158119°N, 88.544505°E)
S-9	Shibpur, Payradanga (23.133389°N, 88.502662°E)

## Materials and Methods

Water samples were collected monthly from each sampling site. Samples were collected monthly from lotic zones of two banks and mid-stream of each sampling site. Average value was taken as the monthly data for each site. Water samples were collected at a depth of 6-10 cm from the surface water during 9 a.m. to 12 a.m. of the sampling days. Sample water was collected in sterilized plastic bottles with stoppers. Dissolved oxygen and temperature of the water were measured on the spot by using portable DO meter (IC 70, UK) and simple mercury thermometer (range 0°C to 1000°C) respectively. A portable pen pH meter (pHep Tester, Hanna instrument, Romania) was used to determine the pH of water. All other parameters were analyzed using the guideline of APHA (1995, 19<sup>th</sup> edition). Average values of total 216 observations were taken into consideration for the correlation analysis. A statistical software, XLSTAT-2015, was used to calculate the range of the parameters and the correlation between them.

## Result and Discussion

In the Table 2, measuring units for each parameter are listed.

Ranges of the parameters are listed in the Table 3. The interpretations of the tabulated values are described in the following paragraphs.

Hydrogen ion concentration of water is determined by pH value. It is also an important pollution indicator as low pH value is an indication

of presence of dissolved carbon di oxide in water. Jhingran (1991) has stated that pH more than 9.0 is responsible for stress in carp culture; moreover, pH 11.0 is lethal to the fishes. The pH value of the river water has been found to vary between 6.4 to 8.4 with an average value of 7.758 and standard deviation value of 0.428.

Water temperature of any aquatic ecosystem is a very important parameter to study as temperature below 16.7°C and above 39.5°C have been reported to be fatal for the fishes especially IMCs (Indian major carps) (Jhingran, 1991). The temperature of the river water has been found to vary between 14.1°C to 33.3°C with an average value of 25.74°C and standard deviation value of 5.139.

DO level of any water body indicates the pollution load on the system. Low DO is fatal for aquatic life. According to Jhingran (1991), both high and low value of DO is responsible for adverse effect over fish production. The river water shows a trend of decreasing DO value by the year. Minimum value of DO is observed in May, 2012 at S-1 (0.4 mg/L) whereas; Maximum value (i.e., 7.2 mg/L) is recorded in December, 2012 at S-9.

BOD is also an important water quality parameter as high value of BOD is detrimental for aquatic lives. BOD value is found to be the maximum in January, 2012 at sampling site-1 (37.5 mg/L).

Total alkalinity and total hardness values of river water are observed to remain closer to slight alkaline state.

Total nitrogen and total phosphorus value of water is the indicator of nutrient level of any aquatic system. Total nitrogen value ranges from 2.96 mg/L to 5.64 mg/L and total phosphorus value ranges from 0.17 mg/L to 2.01 mg/L during the total study period.

Pearson correlation matrix is constructed using all the values of the parameters. The matrix is cited in Table 4.

Interpretation of table 4 is put down in the following paragraphs.

Coefficient of Pearson correlations are listed in the aforesaid table and put down in the brackets in the following part of the paragraph. Significant positive correlations are observed between pH & total hardness (0.320), pH & total solid (0.394), pH & COD (0.289), pH & total nitrogen (0.211), pH & total alkalinity (0.458), temperature & total phosphorus (0.444), temperature & total nitrogen (0.287), temperature & total coliform (0.486), BOD & total hardness (0.154), BOD & COD (0.230), BOD & total solid (0.156), BOD & total alkalinity (0.284), COD &

total hardness (0.460), COD & total solid (0.568), COD & total alkalinity (0.389), total hardness & total alkalinity (0.779), total phosphorus & total coliform (0.590), total alkalinity & total solid (0.598), and total hardness & total solid (0.643). Significant negative correlations are found between pH & total coliform (-0.701), pH & total phosphorus (-0.473), temperature & COD (-0.398), temperature & total solid (-0.343), temperature & BOD (-0.264), temperature & total alkalinity (-0.445), temperature & total hardness (-0.278), DO & total hardness (-0.206), DO & BOD (-0.633), DO & COD (-0.182), DO & total alkalinity (-0.237), DO & total solid (-0.363), BOD & total coliform (-0.180), COD & total coliform (-0.295), COD & total phosphorus (-0.258), total hardness & total coliform (-0.307), total hardness & total phosphorus (-0.343), total alkalinity & total coliform (-0.428), total alkalinity & total phosphorus (-0.403), total phosphorus & total solid (-0.515) total nitrogen &

total coliform (-0.300) and total solid & total coliform (-0.440). The correlation study shows non-significant relations between rests of the parameters.

**Table 2:** Units of different water quality parameters

Parameters	Units
pH	-
Temperature	°C
Dissolved Oxygen	mg L <sup>-1</sup>
Biochemical Oxygen Demand	mg L <sup>-1</sup>
Chemical Oxygen Demand	mg L <sup>-1</sup>
Total Alkalinity	mg L <sup>-1</sup>
Total Hardness	mg L <sup>-1</sup>
Total Nitrogen	mg L <sup>-1</sup>
Total Phosphorus	mg L <sup>-1</sup>
Total Solid	mg L <sup>-1</sup>
Total Coliform	MPN/dL

**Table 3:** Table showing total observations, Observation with missing data, Observation without missing data, Minimum and Maximum value of the parameters, Mean and Standard deviation value of each parameter

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
pH	216	0	216	6.400	8.400	7.758	0.428
Temp	216	0	216	14.100	33.300	25.740	5.139
DO	216	0	216	0.400	7.200	3.227	1.434
BOD	216	0	216	0.500	37.500	6.144	6.699
COD	216	0	216	34.500	235.390	118.668	44.702
Total Hardness	216	0	216	100.600	406.120	214.932	58.012
Total Alkalinity	216	0	216	96.400	380.600	210.275	51.016
Total Nitrogen	216	0	216	2.960	5.640	4.185	0.540
Total Phosphorus	216	0	216	0.170	2.010	1.026	0.526
TS	216	0	216	253.700	610.500	430.983	98.557
Total Coliform	216	0	216	0.090	22.450	5.041	4.958

**Table 4:** Pearson correlation matrix (n) (Values in bold are different from 0 with a significance level alpha=0.05)

Variables	pH	Temp	DO	BOD	COD	Total Hardness	Total Alkalinity	Total Nitrogen	Total Phosphorus	TS	Total Coliform
pH	1	-0.51	-0.09	0.120	0.289	0.320	0.458	0.211	-0.473	0.394	-0.701
Temp	-0.51	1	-0.01	-0.26	-0.39	-0.278	-0.445	0.287	0.444	-0.34	0.486
DO	-0.09	-0.01	1	-0.63	-0.18	-0.206	-0.237	-0.086	0.097	-0.36	0.108
BOD	0.120	-0.26	-0.63	1	0.230	0.154	0.284	0.045	-0.041	0.156	-0.180
COD	0.289	-0.39	-0.18	0.230	1	0.460	0.389	0.197	-0.258	0.568	-0.295
Total Hardness	0.320	-0.27	-0.20	0.154	0.460	1	0.779	0.022	-0.343	0.643	-0.307
Total Alkalinity	0.458	-0.44	-0.23	0.284	0.389	0.779	1	-0.050	-0.403	0.598	-0.428
Total Nitrogen	0.211	0.287	-0.08	0.045	0.197	0.022	-0.050	1	0.052	0.020	-0.300
Total Phosphorus	-0.47	0.444	0.097	-0.04	-0.25	-0.343	-0.403	0.052	1	-0.51	0.590
TS	0.394	-0.34	-0.36	0.156	0.568	0.643	0.598	0.020	-0.515	1	-0.440
Total Coliform	-0.70	0.486	0.108	-0.18	-0.29	-0.307	-0.428	-0.300	0.590	-0.44	1

## Conclusion

The study represents the variation in different water quality parameters which help to assess the present ecological condition of the river. The result shows that water quality of the river is not very good for the aquatic bio life. Correlation coefficient may predict the average value of one parameter with the help of other.

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