

Contribution of Statistical Analysis Methods to Assessment of the Physicochemical Quality of the Ganga River

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Abstract – Physico-substance Analysis of blessed stream ganga of Varanasi city (U.P.), India in month of February, 2016. Water tests were gathered from seven unique destinations in particular (S1)- Gangamahal Ghat, (S2)- Chedilal Ghat, (S3)- Jain Ghat, (S4)- Prabhu Ghat, (S5)- Niranjini Ghat, (S6)- Mahanirvini Ghat and (S7)- Shivala Ghat. The scope of perceptions are as under; pH of stream water ranges between 7.0 to 7.8, Electrical conductivity from 0.45 to 0.58 dSm⁻¹, Cl from 1.50-4.0 mg L⁻¹, Ca+Mg from 23.50-27.50 mg L⁻¹, CO₃+HCO₃ from 2.80-4.20 mg L⁻¹, SO₄ from 16.00-36.00 mg L⁻¹, Na from 0.40-0.90 mg L⁻¹, K from 1.10-1.40 mg L⁻¹, TS from 800-1600 mg L⁻¹, DO from 5.30-7.30 mg L⁻¹, COD from 15.20-24.00 mg L⁻¹, NO₃ from 20.23 - 24.24 mg L⁻¹ and SAR from 0.14-2.50. Ordinary observing of Ganga waterway water quality is important to have a keep an eye on surface water quality for human life and to keep up a decent aesthetical estimation of strict.

Keywords: River Ganga, Water Quality and Water Resources etc.

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INTRODUCTION

The Ganges ascends in the Garhwal Himalayas (30° 0' 55"N, 79° 0' 7"E) under the name of Bhagirathi. The complete length of Ganges stream is around 2525 Km. The River Ganges is an integral part of regular daily existence in the city and it is one of the most holy stream in India, yet it is being dirtied by numerous sources. The fundamental municipalities of Uttarakhand and Uttarpradesh falling at bank of Ganges waterway are Rishikesh, Haridwar, Garhmukteshwar, Narora, Kannauj, Kanpur, Dalmau, Allahabad, Mirzapur, Varanasi, Ghazipur, Ballia and goes up to the Bay of Bengal in the Indian Ocean. Today, more than 29 urban communities, 70 towns, and a great many towns stretch out along the Ganga banks. Practically the entirety of their sewage-over 1.3 billion liters for each day-goes straightforwardly into the stream, alongside a great many creature remains, essentially steers. Because of quick populace development, farming and modern turns of events, the nature of water in waterways is being debased persistently making it unacceptable for different employments. An exact and balanced appraisal for waterway water quality is needed for deciding the degree of helpfulness of water bodies for different employments. Untreated waste water may contain distinctive scope of microbes including microorganisms, parasites, and infections, harmful synthetic compounds, for example, substantial metals and natural synthetics from agribusiness, mechanical and homegrown sources. The current

examination is worried in Varanasi city of Uttar Pradesh. The investigation of various water boundary is significant for comprehension of the metabolic functions in amphibian framework. The boundaries impact one another, thusly it has gotten compulsory to break down significant water boundaries time to time which can demonstrate the positive or negative changes happening in the environment.

MATERIALS AND METHODS

This section depicts subtleties of approach utilized for the trials performed throughout the examination. The territory chose for the current investigation was River Ganga situated in Varanasi city, month of February, 2016 for successful testing its perception and examination. Tests (Ganga River) was arbitrarily gathered at 1 m profundity of 7 chose destinations viz.

S¹ Gangamahal Ghat

S² Jain Ghat -

S³ Niranjini Ghat

S⁴ Shivala Ghat -

S⁵ Chedilal Ghat

Tests proposed for synthetic examination must be gathered during ordinary working hours, 15 to 30 cm underneath the outside of the water or, where a supply is under 30 cm profound, somewhere between the outside of the water and lower part of the repository. Tests must be gathered in a territory that isn't very frequented by bathers at the hour of examining. According to standard of the APHA . It is additionally critical to gather the example in a zone between the filtration framework Intake and water return. On account of whirlpool showers, tests can be gathered anyplace underneath the outside of the water. It is critical to painstakingly adhere to the guidelines gave by the maker of the substance test packs utilized. It is likewise basic that the hands of the individual who is gathering the examples be incredibly perfect to forestall resulting tainting (by sweat, substance deposits, and so forth) when taking care of tests.

Table 1: Methods used for analysis of Physico-chemical parameters of river Ganga water at Varanasi city and Indian Standards (BIS) for Surface Water and their Permissible Limits. Source: APHA (1998)

Parameters	Methods	Indian Standards (BIS) (IS 10000:1991)
pH	pH meter	6.5-8.5
EC (dSm ⁻¹)	EC meter	0.50-5.00 (dSm ⁻¹)
Carbonate & Bicarbonate (mg L ⁻¹)	Titration Method	600 (mg L ⁻¹)
Nitrate (mg L ⁻¹)	Brucine Method	10-45 (mg L ⁻¹)
Chloride (mg L ⁻¹)	AgCl & C	200-500 (mg L ⁻¹)
Sulfate (mg L ⁻¹)	Gravimetric Method	300-500 (mg L ⁻¹)
Na (mg L ⁻¹)	Flame Photometric method	312-300 (mg L ⁻¹)
K (mg L ⁻¹)	Flame Photometric method	12 (mg L ⁻¹)
Ca & Mg (mg L ⁻¹)	Titration Method	200 & 100 (mg L ⁻¹)
Total Solids (mg L ⁻¹)	Gravimetric Method	500-1500 (mg L ⁻¹)
Dissolved Oxygen (mg L ⁻¹)	Winkler Method	6 (mg L ⁻¹)
COD (mg L ⁻¹)	Winkler Method	500 (mg L ⁻¹)
Boron (mg L ⁻¹)	Colorimetric Cassamite Method	0.5-1.0 (mg L ⁻¹)
Selenium absorption ratio	Richard's method	8-10-30

RESULTS AND DISCUSSION

The current investigation assesses the physico-chemical status of the Ganges River at Varanasi city. The assessment of 14 boundaries (pH, EC, Cl⁻, Ca²⁺ and Mg²⁺, CO₃²⁻ and HCO₃⁻, SO₄²⁻, Na, K, TS, DO, COD, NO₃, B and Sodium ingestion proportion. 3.1: pH: As portrayed in the table 2, the pH esteems were discovered to be greatest 7.80 at Shivala Ghat and least PH 7.10 in Gangamahal Ghats. Soluble scope of pH in a large portion of the water test might be because of the overall antacid nature of the effluents being delivered into examining locales/areas. From the table 3 we can realize that there is a positive relationship of pH with Cl⁻, CO₃²⁻ and HCO₃⁻, Na, TS, DO and Sodium retention proportion. Relationship among's pH and calcium and magnesium is negative - 0.70. This pH esteems having lower focus when contrasted with BIS norms suggested. The various Ghats/Ganges was somewhat above impartial making it's safe for drinking and different purposes . 3.2: EC: As appeared in the table 2 the most extreme EC esteem (0.58 dSm⁻¹) was recorded at Shivala Ghat and least EC esteem (0.44 dSm⁻¹) was recorded at Prabhu Ghat. EC is essentially expanding at all locales to downstream. From the table 3 we can realize that there is a positive connection of EC with Cl⁻, Ca²⁺ and Mg²⁺ and K. Relationship among's EC and

chloride is 0.67. The expanded in EC estimations of water shows that there is a wellspring of disintegrated particles in the region. Higher the estimation of broke up solids, more noteworthy the measure of particles in water. Expanding levels of conductivity and cations are the results of deterioration and mineralization of natural materials [6]. 3.3: Chloride: As spoken to in the table 2 the chloride estimation of Ganga River is greatest at Shivala Ghat i.e 4.0 (mg L⁻¹) and least at Chedilal Ghat i.e 1.5 (mg L⁻¹). From the table 3 it very well may be reasoned that there is a positive connection of chloride with carbonate and bicarbonate, potassium, complete strong and COD and sodium adsorption proportion. Chloride substance can increment because of decay of natural issue. High grouping of chloride can likewise be contributed by mineral stores, and mechanical squanders, just as homegrown waste . This Chloride esteems having lower focus when contrasted with BIS norms suggested. 3.4: Calcium and Magnesium content (Ca²⁺ and Mg²⁺): As spoken to in table 2, Gangamahal Ghat has the most noteworthy estimation of Calcium and magnesium substance and Mahanirvini Ghat had the base among these 7 Ghats. From the table 3 it tends to be inferred that there is a positive connection of calcium and magnesium with Na, K, TS, COD and Boron. The connection among's calcium and magnesium and sodium is 0.02 [8]. This calcium and magnesium content qualities having lower fixation when contrasted with BIS norms suggested.

3.5: Carbonate and Bicarbonate (CO₃²⁻ and HCO₃⁻): As spoken to in the table 2, the carbonate and bicarbonate estimation of Ganga River in greatest was 4.20 (mg L⁻¹) at Niranjini Ghat and least was 2.80 (mg L⁻¹) at Gangamahal Ghat. From the table 3 it tends to be inferred that there is a positive relationship of CO₃²⁻ and HCO₃⁻ with DO, B and sodium assimilation proportion. The carbonate esteems were discovered to be noteworthy because of disintegration of natural issue [8]. High convergence of these can likewise be contributed by modern squanders, just as homegrown waste. This Carbonate and bicarbonate esteems having lower fixation when contrasted with BIS norms suggested. 3.6: Sulfate (SO₄²⁻): As spoken to in the table 2, the sulfate estimation of Ganga River water most extreme was 36.0 (mg L⁻¹) at Jain Ghat and least was 16.0 (mg L⁻¹) at Mahanirvini Ghat. From the table 3 it very well may be reasoned that there is a positive connection of sulfate with DO, boron and sodium ingestion proportion [9]. This sulfate esteems having lower focus when contrasted with BIS norms suggested. 3.7: Sodium (Na): As spoken to in the table 2, the most extreme sodium content worth 0.9 (mg L⁻¹) was recorded at Chedilal Ghat and least Na esteem 0.40 (mg L⁻¹) was recorded at Niranjini Ghat. From the table 3 it very well may be presumed that there is a positive connection of sodium with DO and Sodium ingestion proportion. The relationship among's sodium and TS is negative - 0.71. The reliable in

Na content estimations of water shows that there is source poisonousness is uniform. This sodium focus esteems having lower fixation when contrasted with BIS principles suggested.

Discovered that this worth is lower than BIS standard suggested. 3.9: Total Solid: As spoken to in the table 2, the all out disintegrated strong estimation of Ganga waterway greatest was 1600 (mg L⁻¹) at Gangamahal and mahanirvini Ghat and least was 800 (mg L⁻¹) at Jain and Niranjini Ghat. From the table 3 it tends to be presumed that there is a positive connection of TS with COD and sodium ingestion proportion. The biggest measure of complete solids adds to the most noteworthy turbidity and electrical conductivity [11, 12]. This absolute broke up strong qualities having lower fixation when contrasted with BIS principles suggested. 3.10: Dissolved Oxygen (DO): Ganga waterway in least was 5.30 (mg L⁻¹) at Gangamahal Ghat and most extreme was 7.3 (mg L⁻¹) at Shivala Ghat. From the table 3 we can realize that the connection of DO with sodium retention proportion is positive. The DO esteems were discovered to be altogether extraordinary because of particular destinations [13].

These DO esteems have higher fixation when contrasted with BIS guidelines suggested. The various Ghats/Ganges having higher grouping of disintegrate oxygen making it hazardous for drinking and different purposes. 3.11: Chemical Oxygen Demand (COD): As spoken to in the table 2, the proportion of COD decides the nature of natural issue found in water. From the table 3 we can realize that the connection of COD with boron is positive.

The COD was higher at Niranjini Ghat when contrasted with different Ghats. The greatest COD worth 24.0 (mg L⁻¹) recorded at Niranjini Ghat, anyway the base mean COD worth 17.6 (mg L⁻¹) was seen at Jain Ghat [14]. This compound oxygen request content qualities having lower fixation when contrasted with BIS guidelines suggested. 3.12: Nitrate (NO₃³⁻): As spoken to in the table 2, the Nitrate grouping of Ganga stream water greatest was 24.24 (mg L⁻¹) at Chedilal Ghat and least was 20.23 (mg L⁻¹) at Shivala Ghat [15, 16]. This nitrate fixation having lower focus when contrasted with BIS guidelines suggested. 3.13: Sodium Absorption Ratio (SAR): As spoken to in the table 2 it is essentially certain that Chedilal Ghat has most elevated estimation of sodium retention proportion that is 0.25 and in Niranjini ghat the worth is least this is 0.14. This worth is determined by taking calcium, sodium and magnesium in to thought This sodium retention proportion esteems having lower fixation when contrasted with BIS principles suggested.

Table 2: Physico-chemical parameter levels at different sites of the Ganga river at Varanasi city.

S.No.	Parameters	Locations of Different Ghats							
		S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈
1	pH	7.20	7.30	7.30	7.40	7.00	7.30	7.80	
2	EC (µS/cm)	0.55	0.69	0.53	0.44	0.48	0.55	0.58	
3	Chloride (mg L ⁻¹)	3.20	1.90	3.70	3.80	3.60	4.00	3.50	
4	Ca ²⁺ & Mg ²⁺ (mg L ⁻¹)	27.50	27.00	25.50	22.00	26.00	23.50	24.50	
5	CO ₃ ²⁻ & HCO ₃ ⁻ (mg L ⁻¹)	2.89	3.20	3.80	2.80	4.20	4.80	4.60	
6	SO ₄ ²⁻ (mg L ⁻¹)	17.50	21.00	16.00	19.00	24.0	16.00	27.50	
7	Na (mg L ⁻¹)	0.70	0.90	0.60	0.80	0.40	0.70	0.80	
8	K (mg L ⁻¹)	1.50	1.10	1.10	1.20	1.40	1.30	1.30	
9	Total Solid (mg L ⁻¹)	1600	1300	800	1200	900	1600	1400	
10	DO (mg L ⁻¹)	5.30	6.50	6.30	6.40	6.70	7.20	7.30	
11	COD (mg L ⁻¹)	22.40	20.00	17.00	16.20	24.00	22.40	18.20	
12	NO ₃ ⁻ (mg L ⁻¹)	21.40	24.24	21.47	21.40	22.15	22.14	20.23	
13	Sodium absorption ratio	0.19	0.25	0.17	0.21	0.14	0.19	0.21	

Note: S₁: Gangamahal ghat; S₂: Chedilal Ghat; S₃: Jain Ghat; S₄: Prabh Ghat; S₅: Anantpur Ghat; S₆: Mahanirvini Ghat; S₇: Shivala ghat

Table 3: Correlation between different physiochemical parameters of water sample

Correlation	Different Ghats of Locations											
	pH	EC	Cl	Ca ²⁺ & Mg ²⁺	CO ₃ ²⁻ & HCO ₃ ⁻	SO ₄ ²⁻	Na	K	TS	DO	COD	SAR
pH	1	0.02	0.07	-0.70	0.33	0.02	0.58	0.30	0.40	0.61	-0.59	0.37
EC	0.02	1	0.30	-0.20	-0.14	-0.23	0.24	0.40	-0.15	0.23	0.46	
Cl	0.07	0.30	1	0.04	-0.03	-0.41	0.23	0.36	-0.01	0.23	0.22	
Ca ²⁺ & Mg ²⁺	-0.70	-0.20	0.04	1	-0.28	0.02	0.04	0.32	-0.77	0.41	-0.08	
CO ₃ ²⁻ & HCO ₃ ⁻	0.33	-0.14	-0.03	-0.28	1	0.43	-0.28	-0.47	0.87	-0.35	0.36	
SO ₄ ²⁻	0.02	-0.23	-0.41	0.02	0.43	1	-0.32	-0.71	0.12	-0.61	0.38	
Na	0.58	0.24	0.23	0.04	-0.28	-0.32	1	0.57	0.08	-0.44	0.03	
K	0.30	0.40	0.36	0.32	-0.47	-0.71	0.57	1	0.14	-0.25	0.57	-0.08
TS	0.61	-0.15	0.23	-0.77	0.87	0.12	0.08	0.14	1	-0.05	0.05	-0.11
DO	-0.59	0.23	0.22	0.41	-0.35	-0.61	-0.44	-0.25	-0.05	1	0.14	0.20
COD	0.37	0.46	0.22	-0.08	0.36	0.38	0.03	0.57	0.05	0.14	1	-0.25
SAR	0.37			-0.08	0.36	0.38	0.03	0.57	0.05	0.14	-0.25	1

CONCLUSION

Based on test discoveries it very well may be presumed that Shivala Ghat had higher contamination than different Ghats/Ganges, it might be credited because of expanded force of pH, EC, Carbonate, Bicarbonate, Sodium, Potassium, absolute strong and broke up oxygen contrast with different Ghats/Ganges. The water nature of the Ganga stream can be improved to some level if quick firm ecological reconnaissance is applied so as to check their consistence with ecological norms. The current framework isn't at all satisfactory to subside the contamination. The Ganga waterway water is generally utilized for washing purposes. In long stretches of February of study period the Ganga water is discovered fit in any event, for washing. The systems for reviving water nature of the Ganga waterway may incorporate guarded and proactive methodologies. Improvement in sewage organization, upgrading sewage treatment limits and forestalling contamination load originating from feeders are the measures under guarded methodology which ought to be earnestly executed.

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