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ORIGINAL ARTICLE **OPEN ACCESS**

Assessment of water quality of Gaula River by some Physico-Chemical parameters and correlations matrix of Kumaun Himalaya, Uttarakhand, India

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ABSTRACT
During the present survey some physico-chemical properties of the Gaula River were investigated to assess its water quality status for a period of six months from October 2020 to March 2021, taking into consideration its following parameters into account of site-1 (Amiya) such as Atmospheric temperature (17-31)°C, Water temperature (15.1-21.5)°C, pH (7.9-8.7), Total dissolved solids (105-118) ppm, Transparency (88-106) cm, Dissolved Oxygen (8.45-10.07)mg/l, Nitrate(0.42-0.54)mg/l and Phosphate(0.14-0.30)mg/l. and similarly of site-2 (Ranibagh) Atmospheric temperature (19-33)°C, Water temperature (17-24.5)°C, pH (7.8-8.7), Total dissolved solids (140-152) ppm, Transparency (53-93) cm, Dissolved Oxygen (7.04-10.47) mg/l, Nitrate (0.43-0.98) mg/l and Phosphate (0.11-0.23) mg/l respectively. These obtained values were compared with standard values from BIS (2012) and WHO (2021) Standards and indicated that pH values on both sites were found to be slightly on the higher side. Pearson correlation values were also calculated for all the parameters, showing strong positive correlation, strong negative correlation, moderate positive correlation, moderate negative correlation and weak positive correlation and weak negative correlation and very weak positive and negative correlation values respectively.
KEYWORDS: - Aquatic ecosystem, Lotic body, Physico-chemical parameters, Correlation, Water Quality.

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INTRODUCTION

Water is the most essential and important component that is present in this universe apart from the rest of the components that are indeed essential and significant. It not only helps in regulating the climatic conditions but also in shaping the land. There is no life without water. Every living and non-living organism, small or large requires water for their existence. Water's physical, chemical and biological characteristics help in determining the quality of water body. On earth, water is mainly contributed by various sources and channels whether it may be groundwater or surface water as streams, lakes, rivers, reservoirs, ponds, the melting of glaciers, etc., These water bodies which were once considered as holy and pure are now at a risk of getting heavily polluted.

Rapid and massive industrialization, indiscriminate use of chemical fertilizers and pesticides in agricultural lands, and improper sewage waste disposal are causing aquatic pollution, deterioration of water quality, and depletion of aquatic biota. Due to contaminated water, the human population is suffering from various water-borne diseases. It is therefore necessary to check the water quality at regular interval of time (1). In India, the inland water bodies, whether lentic or lotic systems are in a state of distress due to environmental pollution. Water bodies are under severe threat because they have become dumping grounds for various polluting agents, putting biotic life at risk (2).

India is a rich country with numerous freshwater bodies such as rivers, lakes, and streams. There are 14 major rivers present in India. These rivers play an essential role in sustaining the lives of human beings. This river system is a source for irrigation, potable water, electricity, in carrying daily household activities for a large number of people all over the country (3-6). The watershed areas of river basins are under threat from indiscriminate and large-scale deforestation and overgrazing, which has resulted in soil erosion and siltation in and near the water body, causing shrinking of river flow and flooding in rivers during heavy rains, thereby affecting the physical and biological parameters of the water body(7).

In India, the pollution of rivers is a global problem and it is reported that about 70% of the available water is polluted. The chief source of pollution is sewage constituting about 84 to 92 percent of the waste water. Industrial waste water comprises of 8 to 16 percent (8). The domestic sewage discharged from a population

of about 2 million gives rise to numerous water-borne diseases like typhoid, cholera, dysentery, poliomyelitis and cysticercosis, thereby affecting human health and deterioration of the water quality (9), thus leading to the contamination of rivers and lakes chronically affecting its flora and fauna. The present water body which is taken by me for its physical and chemical characteristics along with the Pearson correlation coefficient study is done on Gaula River, which is one of the most essential rivers present in the Kumaun Himalaya, Uttarakhand, India.

MATERIAL AND METHODS

Description of the Study Area: -

Gaula River: - It is one of the most essential and spring-fed rivers of India originating in the lesser Himalayas. The river is also known by the names of kichha and baigul west. It is 500 km long originating from Paharpani village of Uttarakhand and flows south past Kathgodam, Haldwani, Kichha and Shahi and finally merges in Ramganga river about 15 km northwest of Bareilly in Uttarakhand. Two sites were selected along the bank of the river. Site-1 (Amiya) and Site-2 (Ranibagh).

Amiya: - Amiya village is located in Nainital Tehsil of Nainital district in Uttarakhand, India. It is situated 40 km away from Nainital and 11 km away from Haldwani. The total geographical area of the village is 85.32 hectares. Gaula river flows through this village, the water of this river is used by the nearby people for irrigation activities, agriculture, performing day-to-day activities apart from this mining activities are also carried out along the river basin, which lies in the Latitude-29°17'43.7"N and longitude-79°34'42.2"E.

Ranibagh: - Ranibagh village is located in Nainital Tehsil of Nainital district in Uttarakhand, India. It is situated 35 km away from Nainital. The total geographical area of the village is 82.56 hectares. Ranibagh is 8 km away from the main town of haldwani. Gaula River flows through this village; the water of this river is used by the nearby people for irrigation activities, agriculture, and performing day-to-day activities apart from this it is one of the main grounds for performing cremination activities, which lies in the Latitude-29°16'56.7"N and Longitude-79°32'55.4"E.

Sampling and Collection: - The water samples were collected from both the study sites, between 8-12 am in polyethylene bottles; some specific parameters were done on the study sites, i.e., water and atmospheric temperature were measured with a thermometer's help. pH was measured using a digital pH meter, and total dissolved solids were measured by a digital TDS meter. Free carbon dioxide and dissolved oxygen were measured by following the Standard Methods of APHA (2012)(10).Whereas for determining of nitrate and phosphate concentration in water, the water sample was brought to the laboratory and analyzed using YSI 9300 Photometer, following its suitable procedures. The data collected is for six months (October 2020-March 2021). Whereas Pearson correlation was calculated by using SPSS Version 26.0

Statistical Analysis: The Physico-chemical parameters for the sites along the lotic water body were analyzed by calculating Pearson's correlation coefficient (r) value. A Correlation matrix was constructed by calculating the coefficient of different parameters in order to analyze Correlation coefficients and significance was tested by using p-value. Correlation is a relationship between two parameters. It is said to be negative if increase in one parameter causes a decrease in the corresponding parameter however it is considered as positive if increase in one parameter causes increase in the other parameter. The value of p ranges between -1 to +1. The correlation between the parameters is characterized as strong, when it is in the range of ±0.8 to ±1.0, moderate in the range of ±0.5 to ±0.8, and weak in the range of 0.0 to ±0.5.

RESULTS

All the physico-chemical parameters of lotic water body of both the sites are represented below in the tabular form 1&2 as well as in form of charts and drinking water standards are represented in table 3.

Table 1:- Site 1- Amiya

Months	At(°C)	Wt(°C)	pH	TDS(ppm)	T(cm)	DO(mg/l)	NO_3 (mg/l)	PO_4 (mg/l)
October	22	20	8.5	105	96	8.45	0.52	0.25
November	18	16	7.9	118	90	10.07	0.46	0.15
December	17	15.1	8.7	117	106	8.66	0.48	0.19
January	21	18	8.6	115	95	8.45	0.48	0.22
February	24.5	19	8.7	114	88	8.86	0.54	0.30
March	31	21.5	8.5	114	90	9.86	0.42	0.14

Table 2:- Site 2- Ranibag

Months	At(°C)	Wt(°C)	pH	TDS(ppm)	T(cm)	DO(mg/l)	NO_3 (mg/l)	PO_4 (mg/l)
October	21	24	8.5	144	93	10.47	0.43	0.23
November	19	17	7.8	152	84	7.04	0.53	0.11
December	21	17	8.6	147	68	8.66	0.46	0.15
January	23	19	8.5	143	69	8.25	0.47	0.20
February	25	21	8.7	140	67	8.25	0.44	0.23
March	33	24.5	8.7	144	53	9.66	0.98	0.16

Abbreviations Used:- Atmospheric Temperature (At), Water Temperature (Wt), Total Dissolved Solids (TDS), Transparency (T), Dissolved Oxygen (DO), Nitrate (NO_3), Phosphate (PO_4).

AtmosphericTemperature The minimum atmospheric temperature recorded for Amiya is 17°C in December and the maximum recorded is 31°C in March. Whereas the minimum atmospheric temperature recorded for Ranibagh is 19°C in November and maximum recorded is 33°C in March.

Water Temperature

The minimum water temperature recorded for Amiya is 15.1°C in December and maximum recorded is 21.5°C in March. Whereas the minimum water temperature recorded for Ranibagh is 17°C in November and December and maximum recorded is 24.5°C in March.

pH

The minimum pH recorded for Amiya is 7.9 in November and maximum recorded is 8.7 in December and February. Whereas the minimum pH recorded for Ranibagh is 7.8 in November and maximum recorded is 8.7 in February and March.

Total Dissolved Solids

The minimum total dissolved solids recorded for Amiya is 105 ppm in October and maximum recorded is 118 ppm in November. Whereas for Ranibagh the minimum total dissolved solids recorded is 140 ppm in February and maximum recorded is 152 ppm in November.

Dissolved Oxygen

The minimum dissolved oxygen recorded in Amiya is 8.45 mg/l in October and January and maximum recorded is 10.07 mg/l in November. Whereas for ranibagh the minimum dissolved oxygen recorded is 7.04 mg/l in November and maximum recorded is 10.47 mg/l in October.

Transparency

Minimum transparency recorded for Amiya is 88 cm in February and maximum recorded is 106 cm in December. Whereas for ranibagh the minimum transparency recorded is 53 cm in March and maximum recorded is 93 cm in October.

Nitrate

Minimum nitrate concentration recorded for Amiya is 0.42 mg/l in March and maximum recorded is 0.54 mg/l in February. Whereas for ranibagh the minimum nitrate concentration recorded is 0.43 mg/l in October and maximum recorded is 0.98 mg/l in March.

Phosphate

Minimum phosphate concentration recorded for Amiya is 0.14 mg/l in March and maximum recorded is 0.30 mg/l in February. Whereas for ranibagh the minimum phosphate concentration recorded is 0.11 mg/l in November and maximum recorded is 0.23 mg/l in October and February.

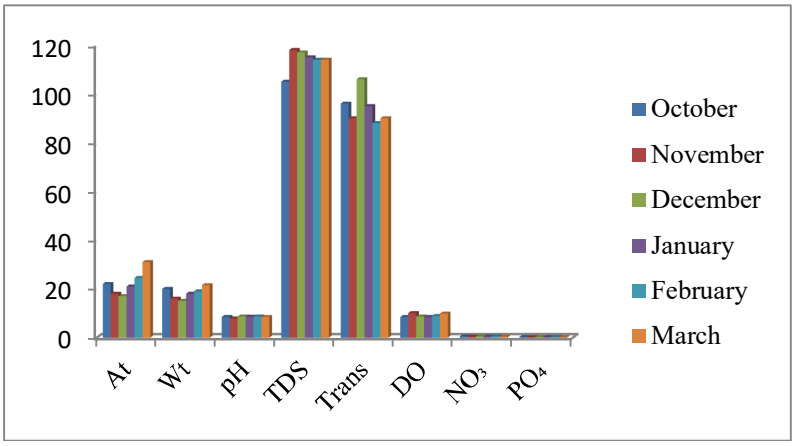

Fig 1:- Shows the graphical representation of the data of table 1- Site Amiya

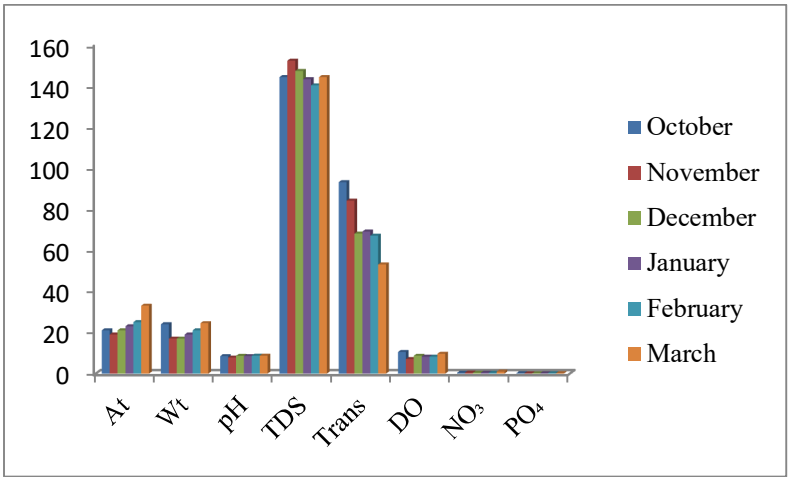

Fig 2:- Shows the graphical representation of the data of table 2- Site Ranibagh

Table 3:- This table shows various drinking standards of water according to (11-12) guidelines for safe drinking water for only some of the parameters as listed below:-

BIS Standard for safe Drinking water (2012)		**WHO Guidelines for Safe Drinking Water (2021)**	
Parameters	**Acceptable limit**	**Parameters**	**Acceptable limit**
pH	6.5-8.5	pH	6.5-8.5
TDS	500 mg/l	TDS	>600 mg/l
Nitrate	45 mg/l	Nitrate	50 mg/l

(Description of Table 4 and 5.)

Pearson Correlation Matrix for Site 1- Amiya

In the present investigation it was observed At-Wt, and PO_4-NO_3 have a strong positive correlations between them.

PO_4-pH have a moderate positive correlation with each other. TDS-Wt, T(At, Wt, DO), DO(pH, NO_3, PO_4) have a moderate but negative correlation with each other.

Weak but positive correlations occurs between pH(At, Wt, T, NO_3), DO(At, TDS), PO_4-Wt and weak but negative correlations occurs between TDS(At, pH, NO_3, PO_4), NO_3-At.

T(TDS, NO_3) and DO-Wt have a very weak positive whereas NO_3-Wt and PO_4(At, T) have a very weak negative correlations with each other.

Pearson Correlation Matrix for Site 2- Ranibagh

In the present investigation it was observed DO-Wt, NO_3-At, have a strong positive whereas TDS(pH, PO_4), T-At have a strong but negative correlations with each other.

Wt-At, pH(At, Wt, DO, PO_4), PO_4(Wt, DO) and NO_3-Wt have a moderate positive whereas TDS-Wt, T(pH, NO_3) have a moderate but negative correlations with each other.

T-TDS, DO-At, NO_3(pH, DO,) and PO_4(At, T) have a weak positive correlation whereas TDS(At, DO), T-Wt, PO_4-NO_3 have a weak and negative correlation with each other.

DO-T, NO_3-TDS, have a very weak but positive correlation with each other.

Table 4:- Pearson Correlations in Matrix for Site 1- Amiya,

	At	Wt	pH	TDS	T	DO	NO_3	PO_4
At	1							
Wt	0.91*	1						
pH	0.24	0.23	1					
TDS	-0.27	-0.62	-0.25	1				
T	-0.58	-0.54	0.38	0.02	1			
DO	0.29	0.06	-0.73	0.46	-0.53	1		
NO_3	-0.29	-0.07	0.38	-0.44	0.03	-0.68	1	
PO_4	-0.05	0.14	0.56	-0.46	-0.08	-0.71	0.95**	1

*Correlation is significant at the 0.05 level (2-tailed)

**Correlation is significant at the 0.01 level (2-tailed).

Table 5:- Pearson Correlations in Matrix for Site 2- Ranibagh

	At	Wt	pH	TDS	T	DO	NO_3	PO_4
At	1							
Wt	0.67	1						
pH	0.61	0.53	1					
TDS	-0.49	-0.57	-0.85*	1				
T	-0.80	-0.12	-0.57	0.36	1			
DO	0.39	0.82*	0.62	-0.46	0.03	1		
NO_3	0.86*	0.50	0.19	0.02	-0.65	0.25	1	
PO_4	0.12	0.55	0.64	-0.88*	0.12	0.54	-0.34	1

*Correlation is significant at the 0.05 level (2-tailed).

DISCUSSION AND CONCLUSION

The present studies in the Gaula River of both the sites depict all the parameter are within the permissible limit except the level of pH on both the sites are slightly high which may be due to certain factors such as temperature fluctuation, geographical disturbances, and other polluting sources. However in terms of Pearson correlation it has been observed that some of the parameters are strongly correlated with each other and some show weak correlations with each other, there are no parameters which are not at all correlated with each other, thereby clearly indicating that the each of the parameters is linked with each other. The present findings in the water body provide us with a bit of information about its present condition, it can be concluded that the river is not very polluted but is at great risk of getting polluted due to anthropogenic activities, disposal of untreated sewage wastes and cremenations activities that are performed along the river bank. However, for further conclusion a broader and vast work need to be done taking into account its other physical-chemical parameters along with biological parameters for a better understanding of the water body so that proper management policies and strategies can be made and implemented for the betterment of the aquatic ecosystem.

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Conflict of Interest: - The authors do not have any conflict of interest.

REFERENCES

1. Florence, M.L. (2013). Ground Water Quality Assessment of Gangavalli Taluk, Salem District, Tamil Nadu, India, Multivariate Statistical Techniques Iracst Engineering Science and Technology: An International Journal, 3(1): 2250-3498.
2. Tembhare, D.R. (2015). Seasonal study of physico-chemical parameters of Kalisarar dam reservoir of Gondia district, Asian Journal of Animal Science, 10(1): 14-19.
3. Rai, A.K., Paul, B. and Singh, G. (2011). Effect of Waste Disposal on water Quality of River Harmu in Ranchi city, Jharkhand, IJEP, 31(9): 758-763.
4. Sreenivas, B.S., Ramana, V.V., Ramesh, K. and Charya, M.A. (2006). Impact of industrial effluents and sewage on the water quality of River Godavari at Bhadrachalam Temple Town in South India, Pollution Research, 12(3): 543-552.
5. Bai, Y.R. and Reji, T.A. (2014). Analytical Study on Water Quality of a River for Drinking and Irrigation Purpose, IJEP, 34(9): 775-782.
6. Singh, B.N. and Rai, S. (1999). Physico-chemical studies of Ganga River at Varanasi. *Journal of Environment and Pollution*, 6(1): 43-46.
7. Goel, P.K. (2006). Water pollution: causes, effects and control, New Age International,
8. Joshi, D.M., Kumar, A. and Agrawal, N. (2009). Studies on physicochemical parameters to assess the water quality of river Ganga for drinking purpose in Haridwar district, Rasayan Journal of Chemistry, 2(1): 195-203.
9. Sharma, R.N., Baruah, A.K., Bora, G.C. and Choudhary, P.K. (1996), Assessment of physico-chemical parameters of the surface water around oil instillation at Rudrasagar, Assam, India, Pollu. Res, 15: 19-27.
10. APHA (2012). American public Health Association, Standard methods for the examination of water and waste water 22nd edition, Washington, DC, USA, 1496.
11. BIS (2012). Bureau of Indian Standards for safe Drinking water.
12. WHO: World Health Organization Guidelines for safe Drinking Water, 2012.

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