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Comparison of Physico-chemical Properties of Godavari River at Nashik during Winter and Summer

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ABSTRACT

The Godavari River originates at Nashik, Maharashtra, at an elevation of 1,465 kilometers. It flows for almost 1,465 kilometers before reaching the Bay of Bengal. The aim of the study was to assess the physico-chemical analysis of drinking water that is supplied and distributed. The classification of pesticides, the identification of chemical sources, and the restoration of rivers using various management approaches are all innovative aspects of this work. The preservation of samples and the measurement of various water quality indicators were done in accordance with the APHA's standard protocols (2012). The river water sample was having alkaline qualities, according to the physico-chemical study of water samples. The dissolved oxygen value has declined as pollutants have been introduced to river water at various sites. BOD and turbidity levels have increased at these sites as a result of the addition of pollution. The quality of water in the Godavari River at Nashik has deteriorated as a result of the use of excessive chemical fertilizers and pesticides to boost crop productivity. This has resulted in a rise in nitrogen, nitrate, phosphate, and ammonia concentrations in the water.

1. Introduction

In order for life to survive, water is very essential. Approximately 71 percent of the Earth's surface is covered by water, of which more than 95 percent is found in the seas. There is just 0.00015 percent of water in rivers and lakes, which are the most precious fresh water resources; the rest is ground water and ice at the poles and mountain ranges. In order to ensure that water is used in the most efficient and effective manner possible, it must be carefully planned, developed, and regulated. Human civilization has existed from the beginning of time, and its formation and progress have always taken place in close proximity to water, namely lakes, marshes, and rivers. Beyond the traditional uses of freshwater such as for human consumption, agriculture, and navigation, man has used freshwater for a wide range of additional purposes such as energy generation, industrial development, and

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waste and effluent disposal (Sukumaran, 2002; Patil and Lohar, 2009). When examining human interactions with aquatic ecosystems, it is necessary to take into account the physical, chemical, and biological characteristics of water bodies.

Nonetheless, as pollution has increased exponentially, water's capacity to self-purify has decreased, resulting in an array of new problems. In order to effectively restore, protect, and manage water resources, it is necessary to be knowledgeable of what constitutes a healthy ecosystem in its whole. Regular monitoring and evaluation of our waterways, utilizing water quality analytical methodologies, can provide us with some basic information about the health of our rivers (Kishimba et al., 2004). It is possible that these freshwater resources would play a critical role in the production of food for human consumption in a growing country with a large population such as India. A reliable and safe water supply is the basic requirement for development and stability. The proper use and management of inland water bodies, particularly reservoirs, as well as the specific type, source, and amounts of contaminants, if any, are all important considerations. The physicochemical properties of river water determine its overall quality (Kim et al., 2020).Water is the life-giving elixir of all things. It is the foundation upon which all life on Earth is built. Water is perhaps the most valuable intake necessary for man's survival. Water has proved to be the most essential commodity on the earth; it has direct bearing on health of all organisms including man. It may be found in both lentic and lotic habitats. There are several factors that influence fish development in freshwater, including changes in its physical, chemical, and biological environment (Wetzel, 1983). Therefore, it is necessary to carry out extensive studies of the physicochemical parameters. Knowledge of basic limnological features is important for the management of reservoirs that supply drinking water need to maintain stringent water quality standards as per the set norms by WHO. To conduct successful limnological research, it is essential to first identify and understand the physico-chemical components that influence the tropical dynamics of the aquatic system (Ramchandra et al., 2002). Even while each ingredient has a specific purpose to perform in the system, the final outcome is the result of the interactions between these components. Almost all physical and chemical parameters have an impact on GPP, however the magnitude of their influence varies substantially Environmental changes like as physical and chemical changes have an influence on plankton density, which in turn has an impact on the diversity of fauna and the presence of specific migratory species inside the reservoir's lentic zone (Ayoadeet al., 2009). The overall objective of the study is to evaluate of physico-chemical study of drinking water supplied and distributed and correlation of chemical analysis and water quality with Nasik in relation to human health of local population.

2. Methodology

2.1 Geographical Setting of River Godavari

The Godavari River rises at a height of 1067 metres above sea level in the Western Ghats in the Triambak hills in Maharashtra's Nasik district, near the river's mouth. The Godavari River Basin is India's second largest, covering around 9.5 percent of the country's total land area. It covers the states of Maharashtra 147320.65 Sq. km (48.7%), A.P 71797.49 Sq. km (23.7%), and Chhattisgarh 37463 Sq. km (5.7%), as well as lesser areas of M.P 23767.44 Sq. km (7.8%), Karnataka 4469.3 Sq. km (1.4%), and the UT of Puducherry 36.94 Sq (0.01 percent).

2.2 Study Site

In order to conduct the physico-chemical analysis, six sample sites were chosen (namely SI-SVIII) at Godavari. A total of six samples were collected in amber coloured vials, twice in triplicate. Drinking water samples were collected on a regular basis from chosen sampling sites during the first week of March, April, and May of this year for physico-chemical analysis.

2.3 Sample Collection

In order to conduct physico-chemical and pesticide analyses during the first week of each month, water samples were taken from two sampling locations. The samples were analysed in the laboratory. In each sampling station, the reported value was determined by taking the average of two samples acquired in three replicates at that sampling station and averaging those results together.

3. Sampling of Water

There were two one-liter water bottles collected: one for pesticide analysis and the other for physical chemistry analysis. Both bottles were kept at 4^0C in a separate brown container, which was kept apart from the rest of the equipment. A total of three times with the testing water, the samples were transferred in transparent plastic bottles that had been carefully washed and rinsed three times before being transported. It was important to thoroughly clean the container in order to eliminate any silt or precipitation. According to the authorized techniques of the American Public Health Association (US EPA, 1985), a water testing kit was used to analyse temperature, turbidity, electrical conductivity, and pH at the site using the results from the water testing kit. Both the BOD and DO samples were placed in 300 mL DO bottles before the addition of iodide azide and manganous sulphate, and the iodide azide and manganous sulphate were added soon after. Other variables in the lab were measured using Trivedy and Goel, 1986 procedures, which are well-established. The sample's origins as well as the circumstances under which it was collected were also noted for future reference. A record tag was affixed to the sample container, which included information on the sample numbers, the source of the sample, and the location of the sampling.

3.1 Physico-chemical Analysis of Water Sample

The preservation of samples and measurement of different water quality indicators were carried out in accordance with standard protocols published by the APHA, (2012). Physico-chemical analysis of the materials gathered was carried out in the Department of Environmental Science, JJT University, Rajasthan by a researcher.

4. Results and Discussion

The mean temperature of water during summer 2019-20and 2020-21 was 25.44±0.11°C and 30.61±0.01°C with highly significant difference ($p<0.01$) in their values. The mean pH of water during winter and summer 2019-20 and 2020-21 was 8.1±0.51, and 9.10±0.45, respectively with significant difference ($p<0.05$) during winter, summer 2020-21 (Table 1). The mean electric conductivity of the water during the winter season of 2019-20 and 2020-21 were 302±40.4, and 317.8±13.1 respectively, similarly during the summer season the electric conductivity found were 303.2±30.7 and 301.1±7.9 respectively.

The concentration of Total Dissolved Solids (TDS) was 431.52±22.16, 407.7±21.2 and 410.41±15.05 ,404.7±12.3 mg/L during winter and summer 2019-20and 2020-21, respectively with no significant difference (p<0.05) among their mean values (Table 1).

The average concentration of TSS during the winter season of 2019-20 and 2020-21 was 210.67± 14.31 and 219.9±138.4 respectively. Similarly, during the summer season of 2019-20 and 2020-21, the average TSS value found were 201.21± 11.85, 273± 12.1.

The average total alkalinity of water during the winter 2019-20 and 2020-21 was 149.16±32.19, 201.2±35.3 respectively. While during the summer season of the average value of 2019-20 and 2020-21 observed were 104.8±13.1, 104.8±12.1 respectively.

The average total hardness of water during the winter 2019-20 and 2020-21 was 134.8±17.3, 158.5±11.1 respectively. While during the summer season of the average value of 2019-20 and 2020-21 observed were 105.6± 12.1, 104±7.1, respectively.

4.12±1.04, 4.9±2.1 and 7.13±0.99, 2.14±0.71 mg/L of dissolved oxygen concentration was observed in the water samples during winter and summer 2019-20 and 2020-21, respectively with highly significant difference ($p<0.01$) in the mean values of water sample during winter and summer, 2019-20 (Table 1).

The BOD of water sample observed during the winter season of 2019-20 and 2020-21 were 3.05±0.89 and 4.14±1.01 respectively, and during the summer season the average value observed were 1.16±0.32, 6.09±0.82 respectively for the period of 2019-20 and 2020-21.

The mean Free CO_2 during 2019-20 and 2020-21 winter was 44.01±12.01, and 75.5±18.4 respectively, while as during the summer it was found about 30.34±12.14, 71.7±12.1.

The mean turbidity observed during the period of 2019-20 and 2020-21winter season were 6.13±0.55 and 9.16±2.04 respectively. While as during the summer season the turbidity observed were 7.04±1.01 and 3.12±1.30 respectively.

The range of nitrate during winter 2019-20and 2020-21 was 2.01±0.37,1.01-1.43 mg/Land1.02±0.30, 1.03±0.2, respectively with highly significant difference ($p<0.01$) in the mean value of nitrate during winter 2019-20and 2020-21.

The mean concentration of phosphate during winter and summer 2019-20, 2020-21 was 0.04±0.15, 0.0.31±0.31, and 0.21±0.32, 0.14±0.19 mg/l, respectively. The chlorine content during winter and summer 2019-20and 2020-21 was 13.10±2.13, 16.16±5.80 and 31.11±3.17, 18.2±25.3 mg/l, having a statistically significant difference in their mean values (Table 1, Fig 1, 2). Apart from rubbish thrown into the river by local inhabitants and tourists, the prevalence of nitrate, phosphate, and chlorine in the water samples of River Godavari is attributable to the presence of pesticides and nutrients.

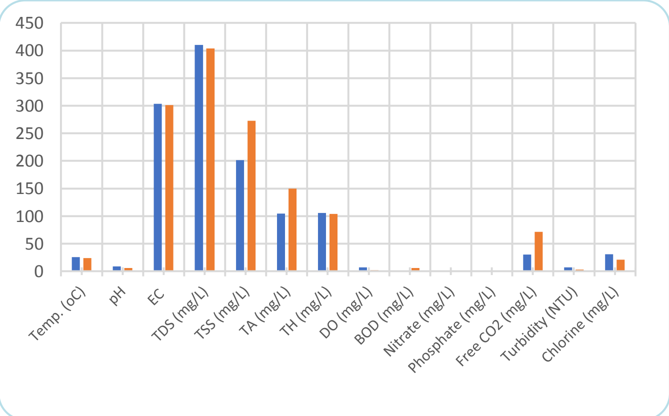

Fig 1: Mean of Physico chemical properties of water during Winter season

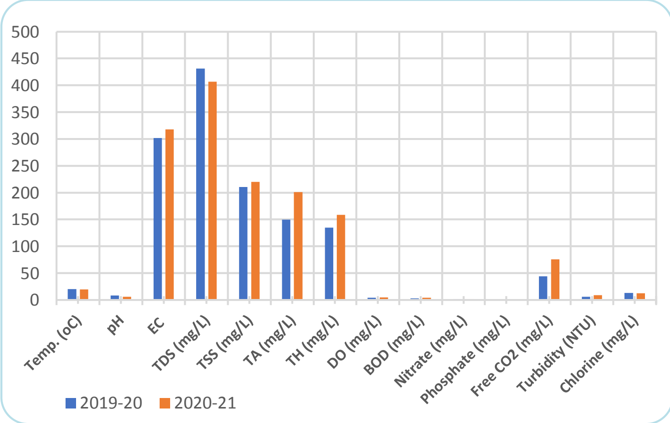

Fig 2: Mean of Physico chemical properties of water during Summer season

The mean temperature during pre-monsoon 2019-20 and 2020-21 was 31.1±1.01 and 32.02±1 with no significant difference in their mean value. However, the mean pH during post monsoon season 2019-20and 2020-21 was 29.08±132, 22.40±0.7, respectively with significant difference ($p<0.05$) during post monsoon 2020-21 (Table 2).

The mean pH of the water during the pre-monsoon season of 2019-20 and 2020-21 were 7.18±0.45 and 7.15±0.33 respectively, similarly, during the post monsoon season the electric conductivity found were 7.28±0.68 and 7.84±0.5 respectively.

The mean electric conductivity of the water during the pre-monsoon season of 2019-20 and 2020-21 were 401.6±31.1, and 401.9±30.2 respectively, similarly, during the post monsoon season the electric conductivity found were 502.7±18.1 and 406.3±10.1 respectively.

The mean TDS of the water during the pre-monsoon season of 2019-20 and 2020-21 were 502.48±32.10, and 546.04±46.2 respectively, similarly, during the post monsoon season the electric conductivity found were 156.65±21.16 and 173±27.5 respectively (Table 3).

The mean TSS of the water during the pre-monsoon season of 2019-20 and 2020-21 were 292.11±13.11, and 282.4±12.1 respectively, similarly, during the post monsoon season the electric conductivity found were 5114.56±15.69 and 116.5±11 respectively.

The mean total alkalinity of the water during the pre-monsoon season of 2019-20 and 2020-21 were 106.33±21.12, and 174.7±16.6 respectively, similarly, during the post monsoon season the electric conductivity found were 178.1±19.5 and 210.3±10.9 respectively.

The mean total hardness of the water during the pre-monsoon season of 2019-20 and 2020-21 were 107.2±7.1 and 197.4±9.1 respectively, similarly, during the post monsoon season the electric conductivity found were 186.7±15.3 and 201.5±13.6 respectively.

The mean value of dissolved oxygen of the water during the pre-monsoon season of 2019-20 and 2020-21 were 5.63.33±1.01 and 4.9±1.7 respectively, similarly, during the post monsoon season the electric conductivity found were 5.18±0.75 and 4.04±0.3 respectively.

Temperature (0.6174), pH (0.8563), and electrical conductivity (0.4544) were all positively correlated with nitrate content during the winter 2019-20 season, whereas (TDS) (-0.1055), (TA) (-0.4033), (TH) (-0.0621), and nitrate (-0.6174) were all negatively correlated with temperature. TDS has been shown to have a positive connection (0.1018) with TSS once again, as previously discovered.

Table 1: Physico chemical properties of water during Winter and Summer of2019-20and 2020-21

Parameter	Winter				Summer			
	2019-20		2020-21		2019-20		2020-21	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Temp. (°C)	20.23±1.63**	18.4-23.64	19.82±0.07**	18.32-20.5	25.44±0.11**	30.61-32.61	24.19±2.2**	31.5-37.61
pH	8.1±0.51	6.9-8.8	6.01±0.4*	6.9-8.7	9.10±0.45	7.6-8.91	6.15±0.22*	8.2-8.9
EC	302±40.4**	241.05-386.7	317.8±13.1**	344.1-402.2	303.2±30.7**	312.3-397.7	301.1±7.9	387.3-416.4
TDS (mg/L)	431.52±22.16	308.3-204.8	407.7±21.2	318-206.2	410.41±15.05	324.3-187.6	404.7±12.3	432.4-177.1
TSS (mg/L)	210.67±14.31	289.2-130.4	219.9±138.4	202-156.1	201.21±11.85	272.4-109.6	273±12.1	278.4-98.7
TA (mg/L)	149.16±32.19	141.3-210.2	201.2±35.3	156.4-241.6	104.8±13.1**	149.58-195.3	104.8±12.1	149.6-195.3
TH (mg/L)	134.8±17.3**	138.7-182.2	158.5±11.1	146.7-210.3	105.6±12.1**	143.4-174.5	104±7.1**	153.2-176.2
DO (mg/L)	4.12±1.04**	5.6-8.9	4.9±2.1	2.1-5.2	7.13±0.99**	5.81-7.92	2.14±0.71	2.3-5.2
BOD (mg/L)	3.05±0.89	1.9-4.3	4.15±1.01**	3.4-6.7	1.16±0.32	1.46-2.62	6.09±0.82**	5.6-7.8
Nitrate (mg/L)	2.01±0.37**	0.75-1.67	1.11±0.21**	1.01-1.43	1.02±0.30**	0.58-2.36	1.03±0.2	1.56-2.58
Phosphate (mg/L)	0.04±0.15	0.001-0.75	0.31±0.31*	0.06-0.87	0.21±0.32	0.05-1.36	0.14±0.19	0.06-0.61
Free CO_2 (mg/L)	44.01±12.01	25.6-62.3	75.5±18.4	37.6-71.3	30.34±12.14	21.2-61.3	71.7±12.1	42.4-65.4
Turbidity (NTU)	6.13±0.55	6.08-8.7	9.16±2.04	7.1-9.7	7.04±1.01	7.12-10.32	3.12±1.30**	4.3-9.8
Chlorine (mg/L)	13.10±2.13**	11.9-24.3	16.16±5.80**	12.3-23.1	31.11±3.17	13.21-25.6	21.14±1.19	18.2-25.3

Table 2: Coefficient of correlation values of water among physical and chemical properties during winter 2019-20

Parameter	Temp.	pH	EC	TDS	TSS	TA	TH	DO	BOD	Nitrate	P	Free CO_2	Turb.	Cl
Temp.	1													
pH	0.8563	1												
EC	0.4544	0.7878	1											
TDS	0.1847	0.6691	0.8505	1										
TSS	-0.1055	0.0821	0.0145	-0.1018	1									
TA	-0.4033	-0.4445	-0.5514	-0.1283	-0.0249	1								
TH	-0.0621	-0.3732	-0.477	-0.3215	0.3029	0.2962	1							
DO	-0.4601	-0.6223	-0.324	-0.347	0.0732	0.4526	0.2401	1						
BOD	0.118	0.0897	0.2154	0.2134	0.6106	-0.1146	0.2117	0.4122	1					
Nitrate	0.6174	0.355	0.0829	-0.8996	-0.4838	-0.2194	-0.3019	-0.7137	-0.3255	1				
Phosphate	0.5118	0.2738	-0.018	-0.0264	-0.3111	-0.2169	0.3121	-0.3116	-0.1298	0.3769	1			
FreeCO_2	-0.3443	-0.3712	-0.524	-0.418	0.3144	0.6875	0.6124	0.2198	0.3239	-0.4733	-0.216	1		
Turb.	0.2515	0.1886	0.3875	0.462	-0.5016	-0.3616	-0.0211	0.113	0.124	03145	0.3733	-0.393	1	
Cl	-0.3162	-0.1783	-0.218	-0.1206	0.1326	-0.0201	-0.0017	-0.2102	-0.1012	-0.1223	-0.3977	0.1941	-0.6201	1

Table 3: Coefficient of correlation values of among physical and chemical properties during summer 2019-20

Parameter	Temp	pH	EC	TDS	TSS	TA	TH	DO	BOD	Nitrate	P	Free CO_2	Turb.	Cl
Temp	1													
pH	0.18	1												
EC	-0.1903	0.2176	1											
TDS	0.6781	0.8152	-0.1012	1										
TSS	0.0322	-0.1002	-0.5177	-0.1109	1									
TA	0.4226	0.6077	0.1958	0.6735	-0.0915	1								
TH	-0.2105	-0.0209	0.3219	0.123	-0.2282	0.1504	1							
DO	0.4301	0.0122	-0.1661	0.0212	0.4501	-021238	-0.6028	1						
BOD	0.4686	0.1512	-0.9173	0.2348	0.6149	0.0845	-0.364	0.5387	1					
Nitrate	0.4676	0.581	0.3867	0.1912	-0.2694	0.5298	-0.1016	-0.187	-0.1062	1				
P	0.4509	0.5703	0.1011	0.2911	-0.1008	0.0882	-0.2729	0.2165	-0.0266	0.5087	1			
FreeCO_2	-0.9102	-0.8253	0.3568	-0.7903	-0.2038	-0.4537	0.2987	-0.355	-0.5917	-0.3489	-0.6013	1		
Turb.	0.7898	0.7861	-0.007	0.8504	-0.046	0.6967	0.1507	-0.068	0.1737	0.2946	0.37284	-0.7146	1	
Cl	-0.3024	0.0285	0.1274	-0.1469	0.4034	0.2958	0.2936	-0.339	-0.0227	0.072	-0.1238	0.1618	0.1118	1

5. Conclusion

The swings in nutrient levels during the winter and summer seasons are responsible for the changes in water parameters. When the observations are compared to the allowed limits set by standards (WHO and ISI), it is clear that the water of the Godavari river at all Nashik is unfit for drinking. According to the findings, Godavari river water is polluted at several locations, and the pollution level increases in the summer. The scenario poses a major threat to public health, necessitating strict pollution management and mitigation measures in these river areas.

After adequate treatment by the authorities and municipality, it is critical to dump the city sewage and municipal garbage. Activities such as soil excavation and brick making on the riverbank have a negative impact on river water quality, hence they should be strictly forbidden up to 500 meters from the high flood line. River Regulation Zone regulation should be tightly enforced to limit activities along the riverbank. Encroachments, depositions, construction, and any other type of development activity on riverbanks should be prohibited. The current evaluation research concludes that implementing the above recommendations within administrative limits will assist in maintaining the river water quality of the Godavar at Nashik.

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Declaration of Conflict

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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