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Hydrobiological study of Wainganga River at district Balaghat (M.P.) India with reference to fisheries

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Abstract
Hydrobiological studies of Wainganga River were carried out for a period of one year from January 2023 to December 2023 from three different stations at Balaghat (M.P.). Temperature, pH, dissolved oxygen, calcium, carbon dioxide, BOD, alkalinity, chlorides, total hardness, and total dissolved solids were among the characteristics measured. These attributes were examined and contrasted with the benchmark values suggested by the World Health Organization and the Bureau of Indian Standards. The goal of the current study is to determine the Wainganga River's water quality at Balaghat. The findings showed that most of the indicators showed notable seasonal fluctuations; the water was determined to be hard, filthy, and unsuitable for fish, residential, and agricultural growth.

Keywords: Hydrobiological status, Wainganga river, water, fish culture

Introduction
The survival of all life depends on rivers, which are delicate freshwater ecosystems. However, it is concerning since the deteriorating water quality in these systems jeopardizes their sustainability. Rivers are strategically significant waterways that supply essential water resources for household, industrial, and agricultural uses worldwide (Sharma *et al*., 2020) [20]. The maintenance of healthy aquatic ecosystem is required for ecological balance and agriculture (Khan *et al.* 2003) [11], which depends on good physico-chemical properties of water. India is gifted with a river system comprising more than 20 major rivers with several tributaries (Kumar *et al*., 2005) [14] and more than 50% of water resources of India are located in various tributaries of these river systems (Lal, 2001) [16]. Wainganga River is one of the key tributaries of the river Godavari. The river rises in the Mahadeo Hills in the Seoni District of Madhya Pradesh. The Wainganga after joining the Wardha River at Chaprala in Gadchiroli district (Maharashtra) is known as the Pranahita River. Wainganga river is polluted due to solid, liquid wastes and sewage disposal which is largely responsible for pollution. Although a large number of workers have studied the hydrobiological parameters and plankton as well as fish diversity of fresh water bodies including Allen (1976) [1], Choudhary (1990) [8], Prakash (2020) [17], Singh and Verma (2016) [21], Kumari *et al*., (2021) [15], Baghel (2023) [3] Verma and Haque, (2023b) [27], Verma and Prakash (2018, 2020a) [24-25], Bhagde *et al*., (2020) [4] but till now there is no sufficient baseline data about physicochemical parameters of Wainganga river at Balaghat. Thus, the current study was conducted to investigate the Wainganga River's hydrobiological features in connection to pollution and fishing. The study's goals were to improve the river's hydrobiological state and investigate potential avenues for improved development and management.

Materials and Methods
The Wainganga River at Balaghat, District- Balaghat. The Wainganga River originates in the Mahadeo Hills in Mundara near the village Gopalganj in Seoni District- Seoni (M.P.). This River travels from west to east. The Wainganga River has a length of nearly 569 km and flows through the states of Madhya Pradesh and Maharashtra.
The water samples were collected from three different sites in morning between 8.30 and 9.30 a.m. during the period of January 2023 to December 2023. Water was collected using sterile glass stopped bottles and 2L capacity plastic bottle. The estimation of various physico-

chemical parameters was done following standard methods described by APHA (2005) [2], Trivedy and Goel (1986) [23] and Kodarkar (1998) [13].

Results and Discussion

The water quality parameters and their range and mean values for selected sampling sites are presented in Table.1.

Table 1: Water quality of Wainganga River at Balaghat.

Parameters	Sites			Mean
	S1	S2	S3	
Water Temperature (°C)	20.6-32.3	22.7-33.8	21.5-31.9	30.4°C±1.04
pH	7.1-8.3	7.3-8.6	7.5-8.4	7.7±0.14
Dissolved Oxygen (mg/l)	2.6-3.4	2.3-3.1	2.4-4.2	3.0±0.18
Calcium (mg/l)	24-29	27-36	28-41	32.3±1.06
Free CO_2 (mg/l)	7.4-8.0	8.1-8.5	7.8-8.9	8.6±0.84
BOD (mg/l)	37-44	35-45	38-46	42±1.05
Alkalinity (mg/l)	168-176	165-181	170-179	174±1.8
Chloride (mg/l)	281-285	274-282	280-287	279±2.06
Total Hardness (mg/l)	110-121	120-128	112-124	118.7±1.46
TDS (mg/l)	820-834	818-822	790-810	814±2.18

Table 2: Wainganga river water analysis correlation

	Water temp.	pH	DO	Cl	Free CO_2	BOD	Alkalinity	Chloride	T hardness	TDS
Water temp.	1									
pH	0.5471	1								
DO	-0.343	-0.254	1							
Cl	0.531	0.367	-0.603	1						
Free CO_2	0.507	0.402	-0.636	0.911	1					
BOD	0.431	0.246	-0.592	0.604	0.542	1				
Alkalinity	-0.069	-0.122	-0.356	0.501	0.267	0.141	1			
Chloride	0.553	0.476	-0.263	0.125	0.381	0.204	-0.409	1		
T. hardness	0.147	0.351	0.234	0.161	0.194	-0.059	-0.143	0.326	1	
TDS	0.401	0.487	-0.341	0.517	0.672	0.514	0.238	0.491	0.265	1

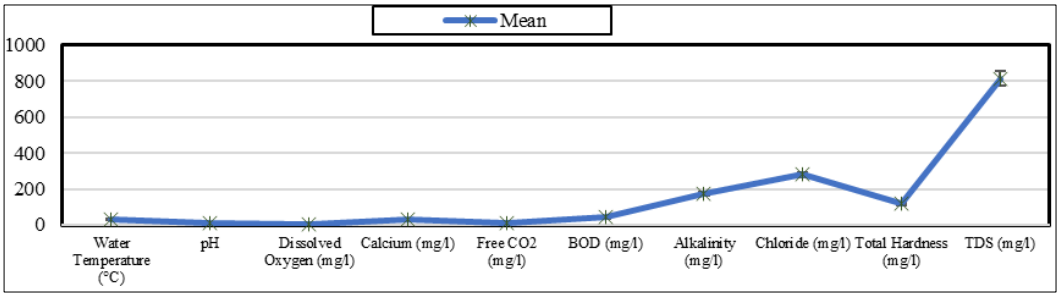

Fig. 1: Graph analysis of mean variations in Water quality of Wainganga River at Balaghat.

In addition to determining the solubility of various gases in the water, temperature measurement influences specific biochemical reactions occurring in aquatic species, making it a crucial component of water quality assessment (Singh and Singh, 2020) [22]. The temperature was ranged between 20.6 and 33.8 °C with mean temperature 30.4 °C. The maximum temperature was recorded as 31.5 °C at site - S2 in the month of June and minimum was recorded as 21.0 °C at site – S1 in the month of December. The water was often warmer in the summer than it was in the winter (Prakash *et al*., 2015) [18]. Fluctuation in air temperature had direct impact on water temperature (Welch, 1952) [28]. The water temperature was within the ideal range and appropriate for fish growth and development (Jhingran, 1988) [9].

The pH level was adjusted from 7.1 to 8.6. Site-S1 reported the lowest pH of 7.1, whereas site-S2 recorded the highest pH of 8.6. This value is within the acceptable ranges set forth by the World Health Organization. The range of alkalinity in river water indicates that photosynthetic activity outweighs the biota's respiratory activity (Saravanan *et al.*, 2003) [19]. The water's pH ranged from 7.0 to 8.5, indicating ideal conditions for fish productivity.

The three sampling locations had dissolved oxygen levels ranging from 2.3 to 4.2 mg/l. During the winter, it was at its lowest (2.3 mg/l) at site S2 and at its highest (4.2 mg/l) at site S3. At site-S3, the high range of dissolved oxygen was discovered in December, which is the winter season. The dissolved oxygen value was slightly lower throughout the year from the permissible limit (BIS, 1983) [6]. Since fish require at least 5 mg/l of dissolved oxygen to develop and grow, river water is unsuitable (Verma and Haque, 2023b) [27].

An essential nutrient for aquatic life is calcium. The range of the calcium level was 24–41 mg/l. Because of its greater solubility at low temperatures, it is observed to be low during the monsoon season and high throughout the winter (Saravanan *et al.*, 2003) [19]. The water resource's low calcium content can be the cause of its consistent hardness level. In the winter, site-S3 had the highest calcium levels. During the monsoon season, site-S1 had the lowest calcium value.

The range of the free CO_2 level was 7.4–8.9 mg/l, with an average of 8.6 mg/l. The CO_2 range was lowest at site-S1 during the monsoon months, and it peaked at site-S3 in

December. Phytoplankton and macrophytes exploit the free carbon dioxide in the river for photosynthetic processes Chaurasia and Raj (2013) [7]. Rapid organic matter decomposition in the sediments may be linked to the development of a high concentration of free carbon dioxide.

The mean BOD value was 42.0 mg/l, with a range of 35–46 mg/l. In the months of July and August, site-S3 recorded the highest BOD, whereas site-S2 had the lowest BOD. Variations in BOD seem to indicate the quantity of organic matter in an aquatic solution that promotes the growth of microorganisms in the water. More sewage entering the river should be the cause. Because low BOD rivers have low nutrient levels, a large portion of the oxygen stays in the water. The BOD of uncontaminated, natural waters will be 5 mg/l or lower. The amount of dissolved oxygen in rivers and streams is directly impacted by BOD. The stream's oxygen content decreases more quickly the higher the BOD. This implies that higher aquatic living forms have less access to oxygen. According to Verma and Haque, (2023b) [27], the ideal BOD level for fishes' typical activities is 3.0 to 6.0 mg/l.

The quantitative ability of a water sample to neutralize a strong acid to a specific pH is known as alkalinity, and it is crucial for regulating enzyme activity (Chaurasia and Raj, 2013) [7]. There was also a seasonal variation in total alkalinity in the current study. At site-S3, the values peaked in December, while at site-S2, they fell in July. The total alkalinity range of 165–181 mg/l suggests that the water is harsh and unsuitable for fish growth (Verma and Prakash, 2020b) [26].

Chloride concentrations in normally uncontaminated water are modest, less than 10 mg/l. 250 mg/l of chloride is the permissible limit (Joseph and Jacob, 2010) [10]. The chloride value in this study ranged from 274 to 287 mg/l, with a mean of 279 mg/l. The concentration of chloride suggests that the river water was extremely contaminated.

The mean total hardness level is 118.7 mg/l, with a range of 110–128 mg/l. The accumulation of calcium and magnesium salts causes the river's water to become more hard. Kiran (2010) [12] divided the water into four categories based on its hardness: soft (less than 75 mg/l), moderately hard (75-150 mg/l), hard (150-300 mg/l), and very hard (more than that). Accordingly, the current data points to a relatively harsh river water.

The overall mineral contents, which may or may not be harmful, are represented by the total dissolved solids. It serves as a gauge of the aquatic ecosystem's fertility. The TDS of river water in the current investigation ranged from 790 to 834 mg/l. The river's water was unfit for fish, as indicated by the total hardness, which ranged from 795 to 800 mg/l (Jhingran, 1988) [9].

Conclusion

The current investigation's findings show that the water is unfit for household, agricultural, or drinking uses. This river was deemed unsuitable for fish cultivation in its current state. Human activity and unlawful commercial projects in the Wainganga River's basin were the cause of the issue. The river, a natural drain, is turned into a "nallah" (channel) where untreated solid and liquid municipal trash is deposited, severely polluting the priceless aquatic resource. For the river's sustained conservation, the authors advise putting appropriate conservation measures into place.

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