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Seasonal variation in the physico-chemical parameters of river Uma near mul, district Chandrapur (MS), India

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Abstract
The present study was aimed to analyse the physico-chemical parameters of the river Uma, Mul Dist. chandrapur. The study was carried out from the month of October 2023 to September 2024. various physico-chemical parameters analysed were calcium, chloride, electric conductivity, magnesium, nitrate, PH, TDS, total alkalinity, total hardness, turbidity, sulphate. In the present investigation all parameters show different ranges in different season. In the Monsoon season Total hardness, TDS, calcium, Nitrate and Sulphate show highest values and EC, Total Alkalinity, and magnesium show lowest values. In the Summer season Atmospheric and water temperature, EC, Total Alkalinity, Free CO_2, Magnesium and Chloride show highest values and pH, TDS and DO show the lowest values. The paper highlights the condition of this river water in the various seasons with respect to the parameters mentioned above.

Keywords: Seasonal variation, Hardness, Physicochemical Parameters, Uma River, Mul

Introduction
Water issues are a global concern and not confined to any single country. Across the globe, aquatic systems heavily polluted, largely due to the direct discharge of untreated sewage and industrial wastes in rivers. Additionally, various agricultural practices such as the excessive application of pesticides and chemical fertilizers significantly contribute to water pollution. Nutrients originating from agricultural runoff contribute to eutrophication, resulting in decreased dissolved oxygen levels and posing serious challenges for aquatic organisms (Kumar, 2021) [10]. Water contamination has become an inevitable consequence of humanity's relentless pursuit of improved living standards, driven by rapid industrialization and continuous urbanization and these developments have significantly contributed to the pollution of aquatic ecosystems, particularly domestic wastes and industrial effluents containing various organic compounds, are harmful to both human health and aquatic life (Vyas and *et al* 2018) [23].
Water quality is also influenced by changes in the composition of sediments and aquifers. Approximately one-third of the world's drinking water comes from surface sources such as rivers, lakes, dams and streams. Since water plays a vital role in numerous biological and physiological process, it is crucial to monitor and preserve its quality.
Rivers are vital in nature that are responsible for various physicochemical characteristics that shape landscapes and ecosystems. For thousands of years, human community have relied heavily on rivers, altering them so extensively that few truly now remain in their natural state. Analyzing water samples from rivers and lakes through various physicochemical parameters, such as pH, turbidity, total dissolved solids (TDS), Total hardness etc is essential to identify pollution sources, understand eco-biological impacts, and take corrective actions (Vighe *et al* 2021) [22].
In India, many researchers have studied the physicochemical and biological characteristics of rivers and reservoirs to better manage and protect these vital water resources. The physicochemical characteristics of water bodies have been studied by many researchers over time (Mathew and Vasudwan 2000, saksena 2008, Trivedi and Goal 1986, Rao 1993, Patil and Patwari 2003, Shayestehfar 2008 [13, 14, 15, 16], Thitame and Pondhe, 2010) [20].
The present study was carried out for a year i.e. from October 2023 to September 2024. The river undertaken for study is the Uma river, which is the main tributary of Andhari River, rises in the Chimur hills of Maharashtra state. It flows through Naleshwar and Mul forest division and plays a significant role in irrigation and fishing,

Material and method
Study area
The area selected for study is at Chitegaon on Chandrapur - Nagbhid -Nagpur highway near Mul, district Chandrapur Maharashtra state, India. The sampling site is near about 2 kms away from the main city of Mul surrounded by agricultural land on its both banks at geographic coordination (Latitude 20.070917°N and Longitude 79.700848° E).

Water sampling
Water samples were collected in two litters polythene bottles, once in end month from selected sampling site for a year i. e. from month of October 2023 to September 2024. To allow detailed seasonal evaluation, the sampling data were grouped into three seasons. Winter season (October to January) signifies a time of reduced river flow and stabilization of water. Summer season (February to May) is characterised by high temperature and low water flow. Monsoon season (June to September) corresponds to heavy rainfall and run off from catchment area. Water sampling

was consistently carried out during early morning hours to minimise diurnal variations in water quality. The analysis of water temperature, pH and dissolved oxygen was carried out on the field by using portable, calibrated instruments, specifically a digital thermometer (maxtech, India model: DT-01) and Systronics digital pH meter (Model No. 335) for dissolved oxygen the water samples were fixed by using Winklers A and B solution on the sampling site and brought to laboratory for further analysis. The remaining parameters were analysed under controlled laboratory condition followed by standard methods for the examination of water and waste water. For analysing the various parameters, methods given in APHA, (2014) were followed.

Results and Discussion

Water is mandatory for all aquatic animals and other animal. It shared different physical and chemical properties along with great aquatic variation. The quality of water may be destroyed and causes pollution and it harm to biodiversity of water.

Atmospheric temperature: Atmospheric temperature refers to the degree of hotness or coldness of the air at different layers of the atmosphere. It is one of the most fundamental parameter governing weather patterns, climate behavior, and various biochemical processes. Atmospheric temperature is largely influenced by solar radiation, the composition of atmosphere, altitude, and surface characteristics such as land cover and water bidies.in the present investigation high Atmospheric temperature recorded in summer (39±3.92) and low atmospheric temperature recorded in winter (30.25 ± 0.96).

Water Temperature: The water temperature plays a very crucial role in wetland dynamics, influencing various parameters such as alkalinity, salinity dissolved oxygen and electrical conductivity. In this study, water temperature varied significantly across seasons, mirroring the local climate patterns. As a kye physical parameters, temperature affects multiple water properties and play an essential role in regulating changes in vegetation and the overall functioning of aquatic ecosystems. The values of water temperature in Winter season were (23.475±1.45), in the Summer season (29.225±3.62) and in Monsoon season (28.2 ± 2.48). Similar seasonal fluctuation was recorded by Koshy and Nayar (1999) in river Pamba at Kozenchery, Bandarkar and Bhandarkar (2013) [4] in some freshwater lotic ecosystems in Gadchiroli District.

pH: The pH of a water is a kye indicator of water because it influences various chemical reactions, including the solubility of substances and the toxicity of metals (Agbarie 2009). In the present investigation, the low values of pH were recorded in in the Summer season (6.9 ± 0.16), moderate in Monsoon season (7.275 ± 0.44) while low in Winter season (7.25±0.34). Similar ranges of pH were reported by Bobdey (2002) [5], in river Wainganga at Paoni.

E. Conductivity: Conductivity is a numerical measure of a water sample's ability to carry an electrical current. This ability mainly depends on the total concentration of dissolved ionized substances in the water, as well as the temperature at which the measurement is taken. The conductivity was recorded high in summer (743.25±60.95) followed by Winter season (603.75±83.39). However, low values were recorded in Monsoon (419.75±260.33). Chavan et. al. (2012) [6] recorded minimum conductivity 61.34 µmhos/cm at site A during winter might be due to the less human interferences without any appreciable source of pollution, and maximum 110 µmhos/cm at site C during summer might be due to increased concentration of dissolved solids in Wainganga River.

Total Hardness: In the present investigation, hardness was lower in the Winter season (87±6.68), higher in the monsoon season (135.25±59) and moderate in the Summer season (133±33.09). Hardness showed a strong positive correlation with temp. and alkalinity (Lianthuamluaia et. al, 2013 [12]. Hardness in the water is primarily influenced by the presence of calcium and magnesium salts. These ions form temporary hardness through their association with bicarbonate and carbonate, while their combination with sulphates, chloride and other mineral acid anions contributes to permanent hardness (Durge et. al 2018) [7]

Total Alkalinity: Total alkalinity reflects the buffering capacity of water. It is primarily imparted by the presence of carbonate, bicarbonate, phosphate, nitrate along with free hydroxyl ions. In the present investigation, the total alkalinity values were recorded moderate in Winter (81.25±9.14), high in Summer (129.25±28.68) and low in Monsoon (64.5±44.02). Gangwar *et al*. (2013) [8] were recorded the alkalinity values between 130 to 158 mg/ L. in River Ramganga at Bareilly, U.P.

Total Dissolved Solids: Total dissolved solids are determined as the residue remaining after evaporation of a filtered water sample. The assessment of suspended solids is particularly important in the analysis of sewage and other wastewater, as it helps to determine the variation in different physico- chemical parameters. In the present study, the highest TDS values were recorded in the monsoon season (421.5±138.30) and low value recorded in the Summer (234.25±32.23). Kumar *et al*. (2011) [11] reported that Total Dissolved Solids (TDS) showed the highest values during July, ranging from 426.66 to 840 mg/L, while the lowest values were recorded in January, ranging from 40 to 133.33 mg/L, in the sabarmati River and Kharicut canal at Ahmedabad, Gujrat.

Dissolved Oxygen: Dissolved oxygen is one of the most widely measured parameters in aquatic ecosystem studies and crucial for the survival of all aquatic fauna and plays key role in the oxidation, precipitation and decomposition of organic substances within the water column. In the present investigation DO values were recorded high in the Winter (6.652±0.41) and low in Summer (5.55±0.93). In the river Mayurakshi, Arvind kumar and Singh (2002), recorded high value in winter season.

Free carbon dioxide: Carbon dioxide is the final product of organic carbon degradation in most aquatic environments, and its fluctuations often serves as an indicator of net ecosystem metabolism. The values of free CO_2 observed were (3.20 ±0.29) in Winter (4.60 ± 0.39) in Summer and

(6.00 ± 0.50) in Monsoon. Sarwade and Kamble (2014) [17], recorded Free CO_2 values maximum during summer at both the sites and observed that the decreased in productivity leading to decomposition forming more CO_2 in the water.

Calcium: Calcium is abundantly present in the Earth's crust and occurs in various forms such as calcium carbonate, calciun sulphate, and calcium fluoride. It is an essential mineral and plays vital role in the human body. However, excessive calcium concentration can cause water hardness and make it unsuitable for drinking. A desirable limit of up to 60 mg/L is considered safe for consumption. In the present study, calcium concentration were recorded high in Monsoon (34.325±12.83) and low in the Winter (20.875±3.93).

Magnesium: Magnesium (Mg^{2+}) is one of the major cations present in natural waters, originating mainly from the weathering of magnesium-bearing minerals such as dolomite and magnesite. It also enters water bodies through domestic sewage, agricultural runoff, and industrial effluents (Sawyer *et al*., 2003) [18]. Magnesium contributes to water hardness and is essential for biological processes; however, higher concentrations may impart an unpleasant taste and produce a laxative effect, particularly when associated with sulphate ions (WHO, 2017, APHA, 2017). Therefore, magnesium is widely used as an important parameter in water quality assessment studies. In the present investigation the high values were recorded in the Summer (33.66±0.74) and low in the Monsoon (10.22±1.86)

Nitrate: Nitrogen is the major component of the atmosphere, its concentration in aquatic ecosystem remains low due to its limited solubility. In other bodies, nitrogen typically occurs in small quantities as ammonia, nitrates, nitrites, organic nitrogen, and related forms. In the present study, only nitrate levels were quantitatively assessed. Nitrate represents the oxidized form of nitrogen and is readily utilized by autotrophs. In the present investigation, nitrate value were maximum in, Monsoon (1.03±0.36) and minimum in Winter season (0.430±0.113). Similar observations were also recorded by Chavhan et. Al (2012), Arvind Kumar and Singh (2002).

Sulphate: Sulphate is a naturally occurring inorganic anion commonly present in surface water, groundwater, and wastewater. It enters aquatic systems through the weathering of sulphate-bearing minerals, atmospheric deposition, and anthropogenic sources including industrial effluents, agricultural runoff, mining activities, and domestic sewage. In the present investigation, maximum Sulphate values were recorded in Monsoon (78.75±18.19), minimum in Winter (40.38±2.53) and moderate in Summer season (66.1±10.90). Kulshreshtha *et al.* (1992) [9] reported highest sulphate concentrations during monsoon season, which was attributed to rainfall introducing a high input of sulphates from the surrounding catchment area into the Manasarovar Reservoir, Bhopal (M.P.).

Chloride: Chloride ions are present in all-natural waters, though their concentrations vary widely. It commonly occurs as Sodium chloride (NaCl), magnesium chloride ($MgCl_2$) in widely varying concentration in natural waters. In surface waters, chlorides originate from the leaching of sedimentary rocks, the discharge of domestic and industrial wastewater, and the natural weathering of rocks, among other source. In the present study, Maximum chloride values were recorded in Summer (60.5±7.55), minimum in Winter (43±3.46), and moderate in monsoon season (44.5±12.66). Sarwade and Kamble (2014) [17] were reported similar values of chloride concentrations in the Krishna River at Sangli, Maharashtra.

Conclusion

In all the findings in the present investigation, underscore the critical need for improved agricultural management and pollution control measures to safeguard freshwater resources. The results indicates that agricultural runoff from the surrounding agricultural fields remains a pressing challenge that threatens the ecological balance of the River. This aligns with broader theoretical frameworks predicting that human activities, especially in agriculture, significantly alter water quality, thus necessitating urgent action to mitigate these impacts for the future health of the river ecosystem.

Table 1: Seasonal variation in physicochemical parameters during Oct. 2023-Sept. 2024 in Uma River.

Sr. no.	Parameters	Winter	Summer	Monsoon	
		Mean±S.D.	Mean±S.D.	Mean±S.D.	Average
1	Atmospheric temperature(^{0}C)	30.25 ± 0.96	39±3.92	32.75±2.87	34
2	Water temperature(^{0}C)	23.475±1.45	29.225±3.62	28.2 ± 2.48	26.97
3	pH	7.25±0.34	6.9 ± 0.16	7.275 ± 0.44	7.2
4	E. Conductivity(µS/cm)	603.75±83.39	743.25±60.95	419.75±260.33	588.97
5	Total hardness(mg/L)	87±6.68	133±33.09	135.25±59.16	118.17
6	Total Alkalinity(mg/L)	81.25±9.14	129.25±28.68	64.5±44.02	91.67
7	TDS	234.25±32.23	351.75±39.72	421.5±138.30	335.83
8	DO	6.652±0.41	5.55±0.93	5.772±0.48	5.99
9	Free Carbon dioxide(mg/L)	3.952± 1.72	4.225 ± 0.61	5.622 ± 0.63	4.6
10	calcium(mg/L)	20.875±3.93	32.85±7.94	34.325±12.83	29.35
11	Magnesium(mg/L)	14.91±5.37	23.182±0.34	26.135±13.37	21.40
12	Nitrate(mg/L)	0.430±0.113	0.715±0.207	1.03±0.36	0.726
13	Sulphate (mg/L)	40.38±2.53	66.1±10.90	78.75±18.19	61.74
14	Chloride(mg/L)	43±3.46	60.5±7.55	44.5±12.66	49.33

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