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ASSESSMENT OF PHYSICO-CHEMICAL PROPERTIES OF RIVER RAMGANGA WATER QUALITY IN MORADABAD AND BAREILLY REGION OF UTTAR PRADESH, INDIA

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ABSTRACT: Ramganga river water is an important source of irrigation in major parts of the Moradabad and Bareilly region. The current study focuses on the assessment of the water quality of this river. River water samples were collected from five different sites of Moradabad and Bareilly stretch during the summer and winter season of the year 2018. Two sampling sites, namely MDA colony (S1) and Nawapuranalla (S2) were at Moradabad while the remaining three sites *viz*. UchaGaon (S3), Ramganga bridge (S4), and Chaubari village (S5) were at the Bareilly region. In summers, pH at S1 was highest while Total Solid (TS), Total suspended solids (TSS), biological oxygen demand (BOD) and chemical oxygen demand (COD) of river water observed highest at S2. However, in winters, dissolved oxygen (DO) at S1 observed highest while Total dissolved solids (TDS), Nitrate and Phosphate were highest at S2. The mean values of these parameters were compared with WHO and BIS standards and found that all parameters were within the permissible limit except BOD, COD, and Phosphate. While a strong correlation was also observed between TS/TSS (0.998), TS/BOD (0.958), TS/Phosphate (0.892) and TSS/BOD (0.949). The results indicated that the mean of most physicochemical parameters were within the permissible limit of WHO and BIS standards while some parameters (TS, TSS, BOD, Nitrates, and Phosphates) at site S2 in Moradabad were found to be higher in both seasons comparing to the WHO/BIS standards, thus, requires regular monitoring and implementation of remedial measures.

INTRODUCTION: Rapid industrialization, urbanization, and other developmental activities pollute rivers, which are important in the nation's development and sustenance of life [1, 2]. While nowadays, environmental pollution and its impact on health present and future generations are of main concern.

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In India, the river, reservoir, dam, *etc*. were the main source of water for agricultural purposes [3]. Whereas Ramganga is an important river in Uttar Pradesh, which originates from the hills of Garhwal and traverses through Kalagarh, Moradabad, and Bareilly and finally merges into River Ganga at Farukhabad, covering a distance of about 480 km.

Recently, the side effect of rapid industrialization and subsequent urbanization are of great concern and has been universally expressed regarding environmental pollution [4]. Our culture is completely river oriented, and most of our important towns and urban areas are located on the bank of major rivers.

The river water is being polluted by untreated domestic waste way into the rivers through sewage, outfalls drain, *etc*. [5] and increase the water pollution in rivers [2].

The interactions of both the physical and chemical properties of water play a significant role in composition, distribution, and abundance of aquatic organisms [6, 7]. The degree of pollution is generally assessed by studying the physical and chemical characteristics of the water bodies [8, 9]. Studies related to water pollution of the river like Ganga [10], Godavari [11], Chambal [12,] and Yamuna [13], have received greater attention during recent years. An attempt has therefore been made to study the magnitudes of pollution and to assess the water quality by monitoring the changes in Physico-chemical parameters of river Ramganga in the Moradabad and Bareilly region.

MATERIALS AND METHODS: Water samples from the Ramganga river were collected for physicochemical analysis from five different sites of Moradabad and Bareilly stretch during the summer and winter season of the year 2018. Two sampling sites, namely MDA colony (S1) and Nawapuranalla (S2) were at Moradabad while the remaining three sites *viz*. Ucha Gaon (S3), Ramganga bridge (S4), and chaubari village (S5) were at the Bareilly region. As per the norms of the APHA [14], wide-mouthed plastic bottles of one-liter size were used for collecting the samples and preserved until the parameters were analyzed in the laboratory. Water samples were analyzed as per the norms of APHA [14] for following physicochemical and biological parameters *viz*. pH, Total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), Dissolved Oxygen (DO) by Winkler method, Biological Oxygen Demand (BOD) (5 days incubation method), Chemical Oxygen Demand (COD) (by dichromate titration method), Nitrate and Phosphate. Samples for Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD) were collected separately in BOD (glass) bottles.

TABLE 1: STANDARDS FOR DIFFERENT PARAMETERS USED

S. no.	Parameters	Average (SD)	Recommended agency	Standard
1	pH	7.65 (0.60)	BIS	6.5-8.5
2	Total Solids (mg/l)	534.94 (234.03)	-	-
3	Biological Oxygen Demand (mg/l)	8.74 (4.99)	WHO	6
4	Dissolved Oxygen (mg/l)	4.49 (0.55)	BIS	5
5	Chemical Oxygen Demand (mg/l)	35.42 (10.13)	WHO	10
6	Total Dissolved Solids (mg/l)	253.91 (18.20)	BIS	500
7	Total suspended solids (mg/l)	282.70 (242.95)	WHO	500
8	Nitrates (mg/l)	15.31 (3.86)	WHO/BIS	45
9	Phosphate (mg/l)	4.88 (2.07)	WHO	0.1

RESULTS AND DISCUSSION: Most observations and physicochemical analyses of Ramganga river water clearly show that water quality of river at S2 (Nawapuranalla) at Moradabad was relatively highly polluted because of the incursion of sewage, industrial effluent, commercial and domestic waste as compared to the other remaining sites. Assessment of physico-chemical characteristics at the different sampling sites in summer and winter season is appended in **Fig. 1-9,** while **Table 1** represents the standards of different parameters given by WHO and BIS.

pH is considered an important chemical parameter that determines the suitability of water for various purposes. The optimal pH ranges from 6.5–8.2 is to sustain aquatic life, and it is an important indicator of the water quality and the extent of pollution in the watershed areas [15, 16]. The observed pH values for summer and winter season were shown in **Fig. 1**. pH value of water ranges from 7.5 to 8.6 in summer while it was ranged from 6.2 to 7.7 in winters, which shows the water is slightly alkaline in nature.

However, overall higher pH was recorded in the summer seasons than in the winter seasons. The higher value of pH in the summer season may be due to the influx of sewage, effluents disposal, and low water level. The variation could be attributed to the exposure of river water to the atmosphere, biological activities, and temperature changes [8, 17]. It was observed that the pollutant water directly influenced the pH of the river.

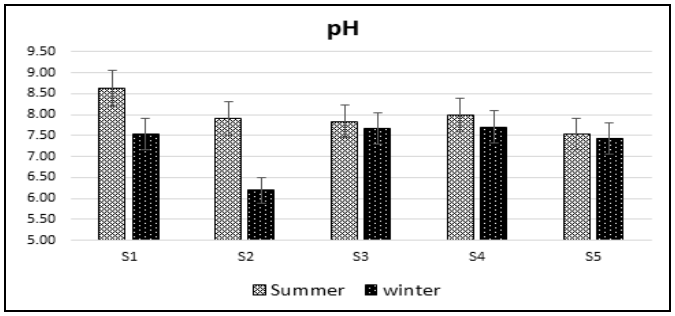

FIG. 1: pH VALUES OF DIFFERENT SITES IN THE SUMMER AND WINTER SEASON

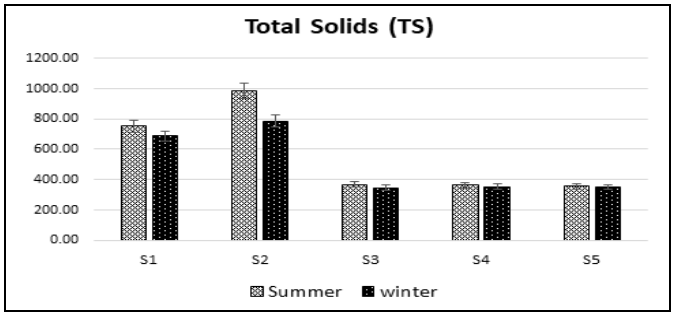

FIG. 2: TS VALUES OF DIFFERENT SITES IN THE SUMMER AND WINTER SEASON

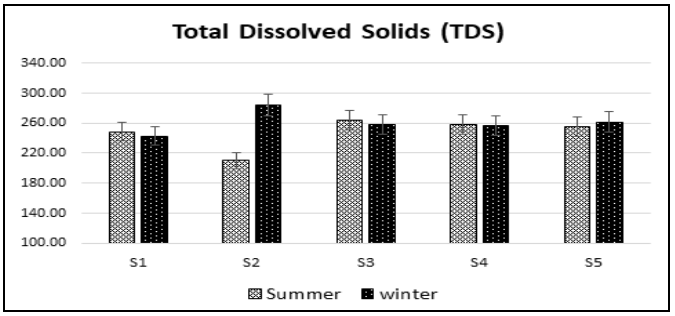

FIG. 3: TDS VALUES OF DIFFERENT SITES IN THE SUMMER AND WINTER SEASON

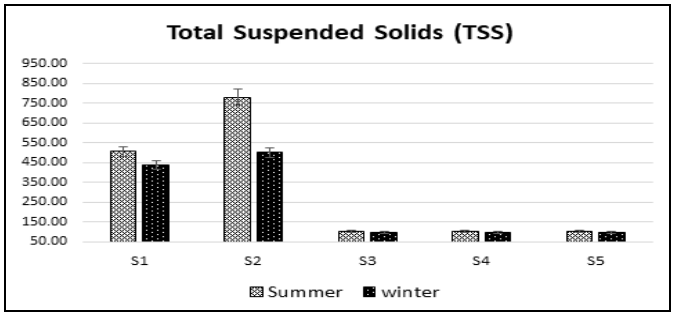

FIG. 4: TSS VALUES OF DIFFERENT SITES IN THE SUMMER AND WINTER SEASON

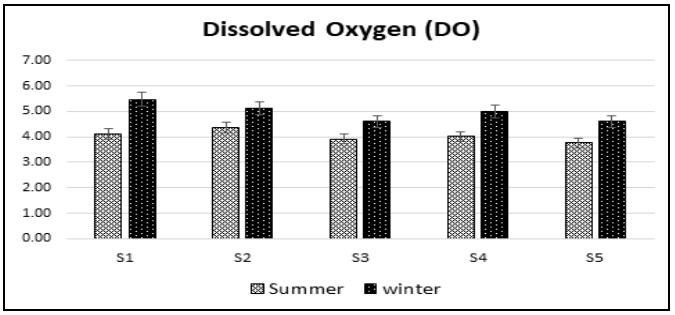

FIG. 5: DO VALUES OF DIFFERENT SITES IN THE SUMMER AND WINTER SEASON

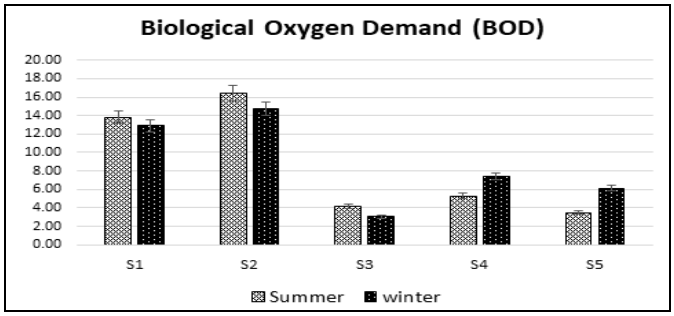

FIG. 6: BOD VALUES OF DIFFERENT SITES IN THE SUMMER AND WINTER SEASON

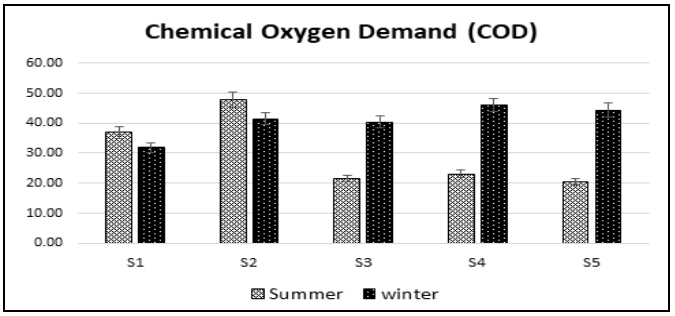

FIG. 7: COD VALUES OF DIFFERENT SITES IN THE SUMMER AND WINTER SEASON

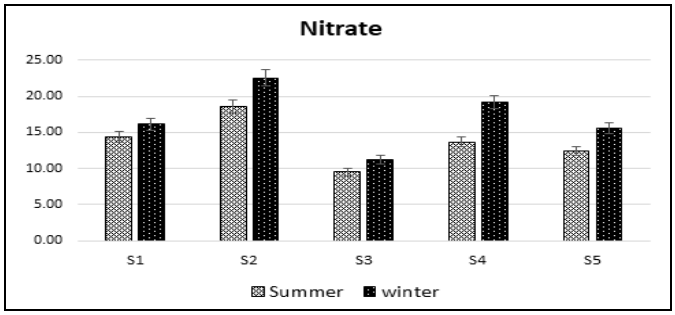

FIG. 8: NITRATE VALUES OF DIFFERENT SITES IN THE SUMMER AND WINTER SEASON

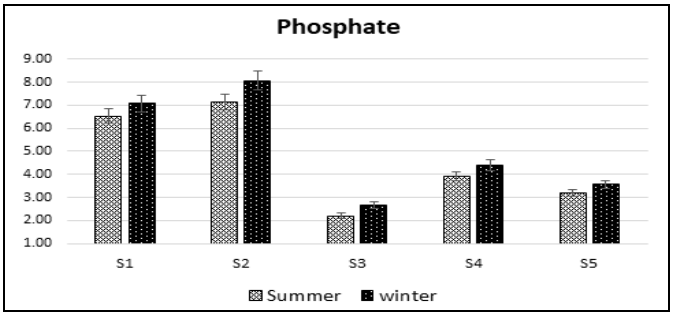

FIG. 9: PHOSPHATE VALUES OF DIFFERENT SITES IN THE SUMMER AND WINTER SEASON

Total solids analysis has great implications in the control of biological and physical wastewater treatment processes. The total solids (TS) determined in the current study ranged between 357.07 to 987.33 mg/l in summer and 351.64 to 785.19 mg/l in winter. The presence of TS could be due to silt and organic matter [18]. The largest number of total solids adds to the highest turbidity [4, 19]. Total solids (TS) mean the total amount of total suspended solids (TSS) and total dissolved solids (TDS) in a particular sample. The total dissolved solids (TDS) ranged between 210.10 to 263.64 mg/l in summer and 242.70 to 284.03 mg/l in winter, whereas the total suspended solids (TSS) ranged between 102.03 to 780.77 mg/l in summer and 96.03 to 500.83 mg/l in winter. The highest values of TS and TSS were observed at S2 in both seasons, which could be due to the discharge of local industrial effluents anthropogenic waste.

Dissolved Oxygen indicates the physical and biological processes occurring in water and an important factor to determine whether the biological changes are brought about by aerobic or anaerobic organisms [4]. The oxygen present in water can be dissolved from the air or produced by photosynthetic organisms [19]. Oxygen is generally decreased in the water due to respiration of biota, decomposition of organic matter, rise in temperature, oxygen demanding wastes and inorganic reductant such as hydrogen sulphide, ammonia, nitrites, ferrous iron, *etc*. [10] In this study, DO vary from 3.77 to 4.36 mg/l in summer and 4.60 to 5.47 mg/l in winter. These values indicate relatively mild organic pollution. Low values of DO in summer could be due to the low level of water and discharge of organic waste and anthropogenic waste.

Biological oxygen demand (BOD) is defined as the amount of oxygen required by micro-organisms in stabilizing the biodegradable organic matter under aerobic condition [20]. The BOD observation was recorded 3.50 to 16.43 mg/l in summer and 3.03 to 14.71 mg/l in winter these variations are due to the addition of the amount of organic matter. High BOD and COD values at the upstream sites were due to the direct discharge of untreated domestic waste into the river and led to high organic pollution, which was gradually reduced at the downstream sites [21].

Whereas, Chemical oxygen demand (COD) is the amount of oxygen consumed during the chemical oxidation of organic matter. Chemical oxygen demand (COD) gives us an unfailing parameter for judging the amount of pollution in water [22]. The COD observations were recorded 20.53 to 47.83 mg/l in summer and 31.90 to 46.03 mg/l in winter. The higher values of BOD and COD at S2 of Moradabad region could be due to the effluents released from a number of industries and sewage treatment plant into the river [23].

Depletion of oxygen in freshwater bodies could be a result of Nitrate reactions. Municipal and industrial wastewater, septic tanks, feedlot discharges, animal wastes (including birds and fish) and discharges from car exhausts are the major sources of nitrogen into the water bodies. In the present study, the nitrates values were ranged between 9.52 to 18.54 mg/l and 11.20 to 22.53 mg/l in summer and winter, respectively. Higher nitrates values are found at S2 in both seasons due to continuous discharge of commercial and domestic sewage. In water bodies, the growth of algae and other photosynthetic aquatic life were encouraged by nutrients such as nitrogen and phosphates compounds [24]. The phosphorus content was also recorded between 2.20 to 7.13 mg/l and 2.67 to 8.07 mg/l with the maximum at S2 in both summer and winter season, respectively. In respect to WHO standard, overall higher values of phosphate in both seasons could be due to the use of detergent which may increase the phosphate concentration to a great extent. The anthropogenic activities (use of detergents, domestic sewage, agricultural runoff *etc*.) may increase the phosphate concentration to a greater extent and have a considerable effect on the quality of the water. A higher amount of phosphate cause eutrophication and represent high pollution loads of the aquatic body [25].

Pearson's correlation coefficient was carried (SPSS *vs*. 23.0) out between different pairs of water quality parameters of river Ramganga to develop a significant correlation among the parameters. The correlation coefficient (r) between average (summer and winter) of every parameter during the year is shown in **Table 2** in the form of a correlation matrix. Strong positive correlation was observed between TS/TSS (r=0.998), TS/BOD (r=0.958), TS/Phosphate (r=0.892) and TSS/BOD (r=0.949).

TABLE 2: CORRELATION MATRIX

	pH	TS	TDS	TSS	DO	BOD	COD	Nitrate	Phosphate
pH	1								
TS	-0.075	1							
TDS	-0.541**	-0.500**	1						
TSS	-0.029	0.998**	-0.557**	1					
DO	-0.501**	0.270	0.094	0.252	1				
BOD	-0.115	0.958**	-0.396*	0.949**	0.425*	1			
COD	-0.172	0.413*	-0.232	0.424*	0.554**	0.496**	1		
Nitrate	-0.539**	0.571**	-0.001	0.549**	0.627**	0.707**	0.655**	1	
Phosphate	-0.262	0.892**	-0.247	0.873**	0.524**	0.956**	0.431*	0.759**	1

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

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

CONCLUSION: Declining water quality is one of the major concerns globally. Both natural and anthropogenic activities are responsible for declining water quality. A large number of factors directly or indirectly influence the water quality of the river Ramganga. Based on various parameters studied it was concluded that the water quality of River Ramganga is not good. The mean values of these parameters were compared with WHO and BIS standards and found that all parameters were within the permissible limit except BOD, COD, and Phosphate. Higher COD values than BOD indicates the industrial discharge into the river water at the studied sites. The results indicated that TS, TSS, BOD, Nitrate, and Phosphate were higher at S2comparing to other sites in both seasons, pointing towards the bad water quality at Moradabad. Thus, it requires regular monitoring and implementation of remedial measures before using for domestic and agricultural purposes.

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CONFLICTS OF INTEREST: The authors declare that they have no conflict of interest.

REFERENCES:

1. Bhutiani R, Ahamad F, Tyagi V and Ram K: Evaluation of water quality of River Malin using water quality index (WQI) at Najibabad. Environment Conservation Journal 2018; 19(1&2): 191-01.
2. Sinha SN, Paul D and Biswas K: Effects of *Moringa oleifera* Lam. and *Azadirachta indica* A. Juss. leaf extract in treatment of tannery effluent. Our Nature 2016; 14(1): 47-53.
3. Thitame SN and Pondhe GM: Assessment of seasonal variation in physico-chemical characteristics and quality of Pravara River water for irrigation use in Sangamner, Dist Ahmednagar, Maharashtra. Journal of Chemical and Pharmaceutical Research 2010; 2(2): 316-20.
4. Gangwar RK, Khare P, Singh J and Singh AP: Assessment of physico-chemical properties of water: River Ramganga at Bareilly, U.P. Journal of Chemical and Pharmaceutical Research 2012; 4(9): 4231-34.
5. Chandra R, Gupta M and Pandey A: Monitoring of river Ram Ganga: Physicochemical characteristic at Bareilly. Rec Res in Science and Technology 2011; 3(6): 16-18.
6. Pal S and Chakraborty K: Importance of some physical and chemical characteristics of water bodies in relation to the incidence of zooplanktons: A review. Indian Journal of Social and Natural Sciences 2014; 3: 102-16.
7. Heinrichs ME, Mori C and Dlugosch L: Complex interactions between aquatic organisms and their chemical environment elucidated from different perspectives. In: Jungblut S., Liebich V and Bode-Dalby M: (eds) YOUMARES 9 - The Oceans: Our Research, Our Future. Springer, Cham 2020. https://doi.org/10.1007/978-3-030-20389-4_15.
8. Prasad KH, Anjali C and Reddy MS: Study of physico-chemical characteristics of penna river at Chennur, Cuddapah Basin, India. Indian Journal of Advances in Chemical Science 2016; 4(1): 20-24.
9. Dunca AM: Water Pollution and Water Quality Assessment of Major Transboundary Rivers from Banat (Romania). Journal of Chemistry 2018; special issue: 8 pageshttps://doi.org/10.1155/2018/9073763
10. Dwivedi S, Mishra S and Tripathi RD: Ganga water pollution: A potential health threat to inhabitants of Ganga basin. Environmental International 2018; 117: 327-38.
11. Hussain J, Husain I, Arif M and Gupta N: Studies on heavy metal contamination in Godavari river basin. Applied Water Science 2017; 7: 4539-48.
12. Saksena DN, Garg RK and Rao RJ: Water quality and pollution status of Chambal River in National Chambal Sanctuary, Madhya Pradesh. Journal of Environmental Biology 2008; 29(5): 701-10.
13. Rout C: Assessment of Water Quality: A Case Study of River Yamuna. International Journal of Earth Sciences and Engineering 2017; 10(02): 398-03.
14. APHA, AWWA and WPCF. "Standard methods for. Examination of water and wastewater" 20th Edition 1998.
15. Kumar V, Arya S, Dhaka A, Minakshi and Chanchal: A study on physico-chemical characteristics of Yamuna River around Hamirpur (UP), Bundelkhand region central India. International Multidisciplinary Research Journal 2011; 1(5): 14-16.
16. Singh P: Studies on seasonal variations in physico-chemical parameters of the River Gomti (U.P.) India. International Journal of Advanced Research 2014; 2(2): 82-86.

17. Adebowale KO and Agunbiade FO and Olu Owolabi BI: Impacts of natural and anthropogenic multiple sources of pollution on the environmental conditions of Ondo state costal water Nigeria. Electronic Journal of Environmental, Agricultural and Food Chemistry2008; 7(4): 2797-11.
18. Weldemarianm MM: Physico-chemical analysis of Gudbahri River Water of Wukro, Eastern Tigrai, Ethiopia. International Journal of Scientific and Research Publications 2013; 3(11): 1-4.
19. Kumar A and Bahadur Y: Physico-Chemical studies on the pollution potential of river Kosi at Rampur, India. World Journal of Agricultural Science 2009; 5(1): 1-4.
20. Saha M, Sengupta S, Sinha B and Mishra DK: Assessment of physico-chemical properties, some heavy metals and arsenic of river Teesta in Jalpaiguri District, West Bengal, India. Asian Journal of Research in Chemistry 2017; 10(3): 399-04.
21. Matta G, Srivastava S, Pandey RR and Saini KK: Assessment of physicochemical characteristics of Ganga Canal water quality in Uttarakhand. Environment, Development and Sustainability 2017; 19: 419-31.
22. Shrivastava VS and Patil PR: Tapti River water pollution by industrial wastes: A statistical approach. Nature Environment and Pollution Technology 2002; 1: 279-83.
23. Khan MYA, Gani KM and Chakrapani GJ: Assessment of surface water quality and its spatial variation. A case study of Ramganga River, Ganga Basin, India. Arabic Journal of Geosciences 2016; 9: 28.
24. Dubey VK, Sarkar UK, Kumar RS, Mir JI, Pandey A and Lakra WS: Length-weight relationships (LWRs) of 12 Indian freshwater fish species from a un-impacted tropical river of Central India (River Ken). Journal of Applied Ichthyology 2012; 28: 854-56.
25. Usharani K, UmaraniK, Ayyasamy PM, Shanthi K and Lakshmanaperumalsamy P: Physicochemical and bacterio-logical characteristics of Noyyal River and groundwater quality of Perur, India. J of Applied Sciences and Environmental Management 2010; 14(2): 29-35.

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