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**Original Research Article**

# Materials And Methods of Limnological Study of Ganga River Water Within District Haridwar

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**ABSTRACT**
Haridwar is situated on the bank of river Ganga at the foothills of the Shivalik range of mountains that constitute the outer Himalayas. Haridwar city lies at an elevation of 965ft from the sea level and between latitude $20^0$, 58' N and Longitude $78^0$, 13' E. According to Hindu mythology, Hardwar is one of the four sites where drops of the elixir of immortality (AMRITA) accidentally spilt over from the pitcher in which it was being carried (KUMBHA) away by the celestial bird Garuda, after the Samudra Manthan (charging of sea). These four places are Haridwar, Allahabad, Ujjain and Nasik where the famous **"Kumbh Mela"** is held. It is believed that taking a bath here purifies the soul and opens the way for the ultimate freedom, Moksha.

**Keywords:** Physico-chemical parameters, Ganga River, Haridwar, Sapta Rishi Ghat, Har ki Pauri.

## 1. INTRODUCTION

Hydrobiology is the science of life and life processes in water. Water is not only a major component of the environment but also the best solvent and a medium in which all organisms depend for their existence. A fresh water body, which fulfils a variety of human needs is full of value only when it is not abused and polluted. Hydrobiology deals with the details of various forms of aquatic life such as algae phytoplankton, periphyton, lithophytes and benthos, zooplankton, fishes and other groups of living organisms. Phytoplankton, periphyton and benthic algae communities represent the major producers in aquatic ecosystems and Diatoms are good indicators of water quality as pointed out by Odum (1971). Hundling (1971) has described the algae as an important producer component of the littoral zone of water bodies. The freshwater limnology plays an important role in the decision-making process for problems like dam construction, pollution control and aquaculture practices. The river catchment from the mountains to the sea is a single ecosystem by itself, linked to other catchment ecosystems through terrestrial corridors, atmospheric corridors and subterranean

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corridors. Fresh water has been of vital importance to man and animals for the sustenance of life and maintaining the balance of nature. Freshwater constitutes only about three per cent of the total water present on the earth.

**Study Area**

Haridwar is situated on the bank of river Ganga at the foothills of the Shivalik range of mountains that constitute the outer Himalayas. Haridwar city lies at an elevation of 965ft from the sea level and between latitude $20^0$, 58' N and Longitude $78^0$, 13' E. According to Hindu mythology, Hardwar is one of the four sites where drops of the elixir of immortality (AMRITA) accidentally spilt over from the pitcher in which it was being carried (KUMBHA) away by the celestial bird Garuda, after the Samudra Manthan (charging of sea). These four places are Haridwar, Allahabad, Ujjain and Nasik where the famous **"Kumbh Mela"** is held. It is believed that taking a bath here purifies the soul and opens the way for the ultimate freedom, Moksha.

**Sampling Stations**

The following seven sites were selected to evaluate the impact of pilgrims' activities on the water quality of the River Ganga in Haridwar city.

1. Sapta Rishi Ashram
2. Har-Ki Pauri
3. Prem Nagar Ashram Ghat
4. Pul Jatwada

**1. Sapta Rishi Ashram:** Sapta Rishi Ashram ghat is an ancient ashram famous for having hosted seven (sapt) sages (rishis), namely, Kashyapa, Vashisht, Atri, Vishwamitra, Jamadagi, Bharadwaja and Gautam. To avoid any disturbance to the seven sages meditating in the ashram, it is believed that the river Ganga split itself into seven currents at this spot. Hence, this ghat is also referred to as Sapt Sarovar or seven streams. The Sapt Rishi Ashram is located about 5 km away from Har-ki-Pauri. This site is exempt from heavy visitor load and has been treated as an entry point to Haridwar city for river Ganga and selected as a reference site.

**2. Har- Ki- Pauri:** This Ghat/platform is the most popular bathing site and it is the busiest ghat/platform in the city. It is situated on the right bank of the Upper Ganga canal about 2.5 km. away from Haridwar railway station. This spot is famous for its religious inviolability and as a bathing ghat cum tourist place. During the festive days, a congregation of pilgrims occurs and offers different types of offerings to the river Ganga and takes holy dips throughout the length (Approximately 750m) and breadth (100m) of bathing ghats (platforms) at Har Ki Pauri.

**3. Prem Nagar Ashram Ghat:** Shri Prem Nagar Ashram is the premier Ashram established by Shri Hans Ji Maharaj and further developed by Jagat Janani Shri Mata Ji and Shri Satpal Ji Maharaj and It is situated on the banks of the Ganga canal. The twin peaks of Chandi Devi and Mansa Devi, capped by temples, are visible from the Ashram. The sounds of nearby temple bells and devotional songs are carried on the morning and

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evening breezes, mingling with birdsong and augmenting the peaceful and contemplative atmosphere of the Ashram.

**4. Pul Jatwada:** This ghat is situated in the Jwalapur town of Haridwar. This ghat/platform is mostly used by local people for bathing. Two domestic sewer drains are continuously falling near this ghat/ platform.

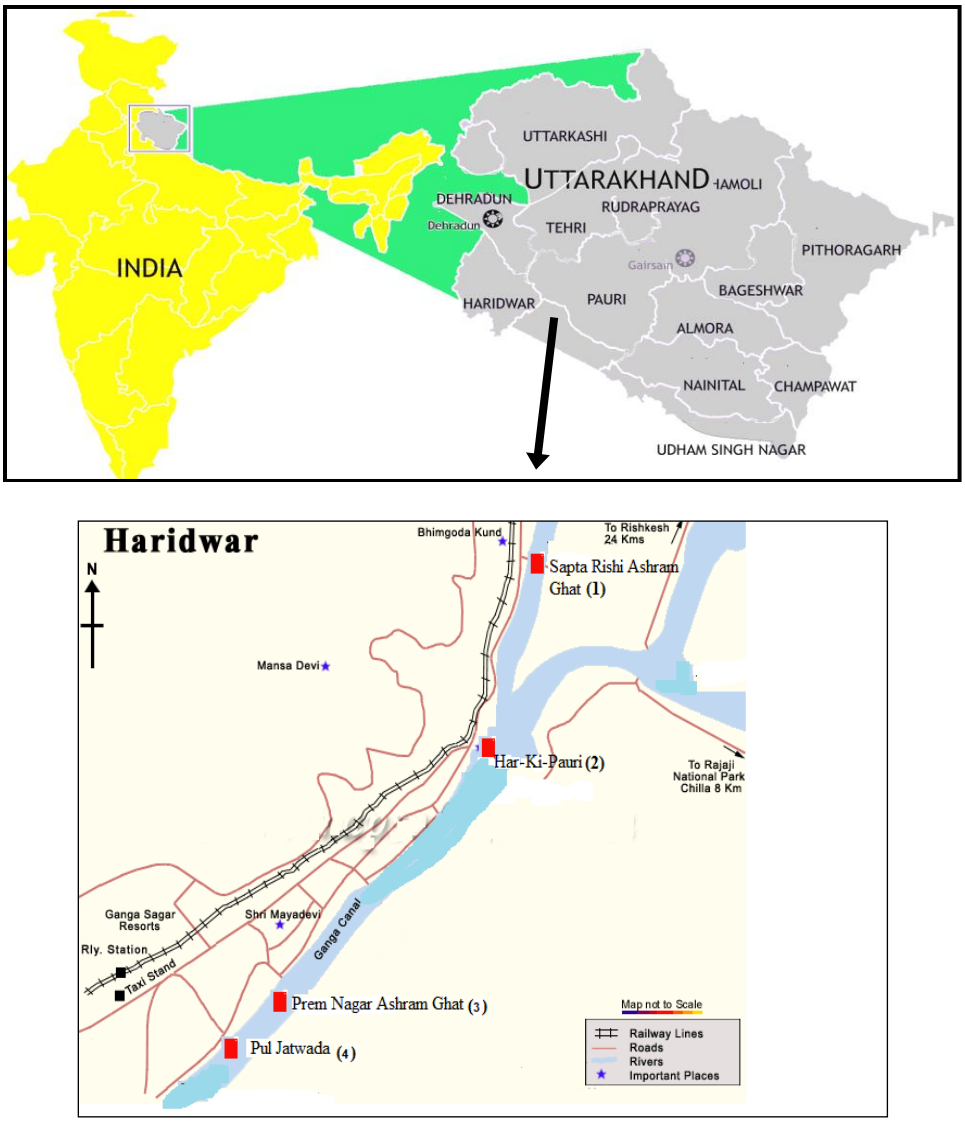


Fig:-1: Map of Haridwar city showing location the of study site

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**Plate 1. Bathing ghat of Sapta Rishi Ashram (Study Site- I)**

**Plate 2. Bathing ghat of Har Ki Pauri (Study Site- II)**

**Plate 3. Bathing ghat of Prem Nagar Ashram (Study Site- III)**

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**Plate 4. Bathing ghat of Pul Jatwada (Study Site- IV)**

**Sampling Schedule**

The monitoring of water quality was conducted every month during the years 2016 and 2017. While Planktonic biomass, Planktonic diversity and Ichthyofaunal diversity were analyzed seasonally during the study period

**Parameters Studied**

**Water quality parameter:** The study was carried out by systematic collection of water samples from four spots namely Sapta-Rishi Ashram Ghat, Har-Ki-Pauri, Prem Nagar Ashram Ghat and Pul Jatwada. The samples were collected monthly for the following parameters

**Physico-chemical Parameters**

1. Temperature ($^{o}$C)
2. Velocity (m/sec)
3. Total Solids (T.S.) mg/l
4. Total Dissolved Solids (T.D.S.) mg/l
5. Total Suspended Solids (T.S.S.) mg/l
6. Turbidity (NTU)
7. Transparency (cm)
8. pH
9. Dissolved Oxygen (DO) mg/l
10. Biological Oxygen Demand (BOD) mg/l
11. Total Hardness (mg/l)
12. Chlorides (mg/l)
13. Alkalinity (mg/l)

**Biological Parameters:** The following biological parameters were analyzed during the both years 2016 and 2017.

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1. Phytoplankton Diversity
2. Zooplankton Diversity
3. Fish Fauna

## 2. SAMPLING AND ANALYTICAL METHODS

The following physicochemical parameters were analyzed by the standard methods of **APHA (1995) and Trivedi & Goel (1986).**

**Water Temperature**
Temperature is important for its effect on the physical, chemical and biological processes. The temperature was analyzed by using a water and soil analysis kit (model 191 E).

**Surface water**: For the determination of surface water temperature, a water sample was collected in a suitable container. Soon after the collection of the sample, a mercury thermometer was inserted to take readings. Thermometers should be of small thermal capacity to attain equilibrium rapidly and must be graduated up to an accuracy of 0.1 to 0 the accuracy of the thermometer may vary depending upon the type of analysis.

**VELOCITY**
The surface flow method (cork method) was used to find the velocity of the Ganga River at each study site. This is a simple approach. A float (any piece of wood, plastic, etc) is thrown on the water surface. The time required for a float to travel (t), a known distance (d) is observed and the average velocity is obtained by

$$V = \frac{d}{t}$$

The factor 1.2 accounts for the fact that surface velocities are normally about 1.2 times higher. If the cross-sectional area (A) is measured, the discharge Q is given by
**Q= VA**
**TOTAL SOLIDS**
**Principle**
Total solids as determined as the residue left after evaporation of the unfiltered sample**.**

**Calculation**
**Total solids mg/l =** $\frac{\text{A-B x 1000 x 1000}}{\text{V}}$
**Where, A=** Final weight of the dish in gm
**B=** Initial weight of the dish in gm
**V=** Volume of the sample taken in ml
**TOTAL DISSOLVED SOLIDS**
**Principle**

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Total Dissolved solids are determined as the residue left after evaporation of the filtered sample.

**Calculation**

$$\textbf{Total solids mg/l} = \frac{\textbf{A-B x 1000 x 1000}}{\textbf{V}}$$

**Where, A=** Final weight of the dish in gm
**B=** Initial weight of the dish in gm
**V=** Volume of sample taken in ml

**TOTAL SUSPENDED SOLIDS (TSS)**

Total Suspended Solids are the difference between the total solids and total dissolved solids.

**TSS mg/l =TS-TDS**

**TURBIDITY**

**Principle**

When light is passed through a sample having suspended turbidity, some of the light is scattered by particles. The scattering of the light is generally proportional to the turbidity. The turbidity of the sample is thus measured from the amount of light scattered by the sample taking a reference with standard turbidity suspension. The determination of turbidity is interfered with by the presence of debris and other rapidly settable matter, the true colour in the sample reduces the values of turbidity. The turbidity of the Ganga water sample was determined using a digital "water and soil analysis kit" (model 191 E).

**TRANSPARENCY**

**Principle**

Light penetration in the River Ganga at each site was obtained by immersing the Secchi disc and observing its visibility. (Secchi disc is a circular disc of metal 20cm in diameter, painted matt white. Sometimes discs painted alternately black and white in radial fashion are also used. It has got a weight at the lower face to avoid a drift during lowering in water. A string is attached to it for lowering, which may be marked in centimetres.)

**Calculation**

$$\text{Secchi disc light penetration} = \frac{A+B}{2}$$

Where, A= Depth at which secchi disc disappears
B= Depth at which secchi disc reappears

**pH**

pH is negative $\log_{10}$ of Hydrogen ion concentration in a solution. The digital water and soil analysis kit (model 191 E) was used to obtain the pH value of the Ganga water sample.

**DISSOLVED OXYGEN (DO)**

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**Principle**

The manganous sulphate reacts with alkali (KOH or NaOH) to form a white precipitate of manganous hydroxide which in the presence of oxygen, gets oxidized to a brown colour compound. In the strong acid medium manganic ions are reduced by iodide ions which get converted into iodine equivalent to the original concentration of oxygen in the sample. The iodine can be titrated against thiosulphate using starch as an indicator.
The DO was measured using the titration method.

**Calculation**

**When the whole content has been titrated:**

$$\text{Dissolved Oxygen, mg/l} = \frac{(\text{ml} \times \text{N})\text{of titrant} \times 8 \times 1000}{V_1 - V}$$

**Where,** $\mathbf{V_1}$**=** volume of sample bottle after placing the stopper
$\mathbf{V_2}$**=** volume of the part of contents titrated
**V=** volume of $MnSO_4$ and KI added

**BIOCHEMICAL OXYGEN DEMAND (BOD)**

**Principle**

Biochemical Oxygen Demand (BOD) is the measure of the degradable organic material present in a water sample and can be defined as the amount of oxygen required by the microorganism to stabilize the biologically degradable organic matter under aerobic conditions. The principle of the method involves, measuring the difference of the oxygen concentration between the sample and after incubating it for 5 days at $20^0$C.

**Calculation**

BOD, mg/l = $(D_0 - D_5)$ X dilution factor
Where, $D_o$= Initial DO in the sample
$D_5$= DO after 5 days.

**TOTAL HARDNESS**

**Principle**

Hardness is generally caused by calcium and magnesium ions present in the water. Polyvalent ions of some other metals like strontium, iron, aluminium, zinc manganese etc. are also capable of precipitating the soap and thus contributing to the hardness. However, the concentration of these ions is very low in natural waters, therefore hardness is generally measured as concentrations of only calcium and magnesium (as calcium carbonate), which are far higher in quantities over other hardness-producing ions.

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Calcium and magnesium form a complex of wine red colour with Eriochrome black-T at a pH of 10± 0.1. the EDTA has a stronger affinity towards $Ca^{++}$ and $Mg^{++}$ and, therefore, by addition of EDTA, the former complex is broken down and a new complex of blue colour is formed.

**Calculation**

$$\text{Hardness as mg/l } CaCO_2 = \frac{\text{ml EDTA used} \times 1000}{\text{ml of sample}}$$

**CHLORIDES**

**Principle**

Silver nitrate reacts with chloride to form a very slightly soluble white precipitate of AgCl. At the endpoint when all the chlorides get precipitated free silver ions react with chromate to form silver chromate of reddish brown colour.

**Procedure:**

1. Take 50 ml of sample in a conical flask and add 2 ml of $K_2Cro_4$ solution.
2. Titrated the contents against 0.02 N $AgNO_3$ until a persistent red tinge appears.

**Calculation:**

$$\text{Chloride mg/l} = \frac{(\text{ml} \times \text{N}) \text{of } AgNO_3 \times 1000 \times 35.5}{\text{ml of sample}}$$

**ALKALINITY:**

**Principle:**

Total alkalinity is the measure of the capacity of the water to neutralize a strong acid. The alkalinity in the water is generally imported by the salts of carbonates, bicarbonates, phosphates, Nitrates, borates, silicates, etc. together with the hydroxyl Ions in the free state. However, most of the waters are rich in carbonates and bicarbonates with little concentration of other alkalinity imparting Ions.

Total alkalinity, carbonates and bicarbonates can be estimated by Titrating the sample with a strong acid (HCL or H2SO4), first to pH 8.3 using phenolphthalein as an indicator and then further to pH between 4.2 and 5.4 with methyl Orange or mixed indicator.

In the first case, the value is called phenolphthalein alkalinity (pa) and in the second case, it is total alkalinity. value of carbonates, bicarbonates and hydroxyl ions can be computed from these two types of alkalinity.

**Reagents :**

Hydrochloric acid

Methyl orange indicator

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Phenolphthalein indicator
Sodium carbonate.

**Procedure :**

1. Take 100ml of Sample in a conical flask and add 2 drops of Phenopthalien indicator.
2. If the solution remains colourless, PA=0 and total alkalinity is determined.
3. Now add 2-3 drops of methyl orange and continue the titration further until the yellow colour changes to pink at the endpoint. This is total alkalanity (TA).

**Calculation:**

$$\text{TA as CaCo3, mg/L} = \frac{(\text{A x normality) of HCL x 1000x50}}{\text{ml of sample}}$$

Where A = ml of total HCL used with phenolphthalein and methyl orange
TA = Total alkalanity.

**Biological characteristics:** The physico-chemical parameters mentioned above are influenced by the biological interaction taking place in the water body. Information on the type of aquatic organisms such as plankton, fishes etc. are perquisite in the appraisal of water quality standards. However, the difficulties involved in describing biotic communities in running water are well known; they are often marked as heterogenetic and show rapid temporal changes in the study. The following methods were considered for the determination of biotic communities.

**PHYTOPLANKTON COLLECTION AND ENUMERATION**

The samples of phytoplankton and zooplankton were collected monthly in the Ganga River at seven different sites by filtering 50 ltr. of subsurface water sample through plankton net made up of bolting silk cloth no. 20 (mesh size 0.06). the filtrate thus obtained was brought to the laboratories of Zoology & Environmental Sciences Gurukula Kangri University Haridwar and centrifuged at a moderately high speed, preserved in 4% formalin and ligule's solution separately for further study i.e. for qualitative and quantitative analysis. Identification was done following, **Ward and Whipple (1959), and APHA-AWWA (1985).**

**ICHTHYOFAUNA**

Fishes were identified from different strata and mainly the collection was made with the help of local fishermen and villagers using simple cloth. Fishes soon after collection were brought to the laboratories of Zoology & Environmental Sciences Gurukula Kangri University Haridwar for their proper identification following the description given by **Mishra (1952), Day (1878), Jayaram (1981), Qureshi and Qureshi (1983), Srivastava (1984, 1997), Talwar and Jhingran (1991), Jhingran (1992) and Badola (2009).**

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## 3. CONCLUSION

This study is focused on the plankton diversity of the Ganga River during the year 2016. Hydrobiology is the science of life and life processes in water. Water is not only a major component of the environment but also the best solvent and a medium in which all organisms depend for their existence. A fresh water body, which fulfils a variety of human needs is full of value only when it is not abused and polluted. Hydrobiology deals with the details of various forms of aquatic life such as algae phytoplankton, periphyton, lithophytes and benthos, zooplankton, fishes and other groups of living organisms.

## 4. REFERENCES

1. Adjia, R., Fezeu. W. M. L., Tchatchueng, J. B., Sorho, S. Echevarria, G. Ngassoum, M. B. (2008): Long-term effect of municipal solid waste amendment on soil heavy metal content of sites used for periurban agriculture in Ngaoundere, Cameroon. *Afr. J. Environ. Sci. Technol.*2 (12): 412-421.
2. Ahmad, U., Praveen, S., Khan, A.A., Kabir, H.A., Mola, H.R.A. and Ganai, A.H. (2011): Zooplankton population in relation to physicochemical factors of a sewage fed pond of Aligarh (UP), India. *Biol. Med*. 3(2): 336-341.
3. Alam, M.J.B., Islam, M.R., Muyen, Z., Mamun, M. and Islam, S. (2007): Water quality parameters along rivers. *Int. J. Environ. Sci. Tech*. 4(1): 159-167.
4. Babu, A., Ravimanickam, Joseph, I., Jerald, A., Shamsudin, M. and Prabakar, K. (2014). Studies on the Diversity of Phytoplankton in Cauvery River, Thanjavur District, Tamil Nadu, India. *Int.J.Curr.Microbiol.App.Sci.* 3(5): 824-834
5. Basavaraja, D., Narayana, J., Kiran, B.R. and Puttaiah, E.T. (2014). Fish diversity and abundance in relation to the water quality of Anjanapura reservoir, Karnataka, India. *Int.J.Curr.Microbiol.App.Sci.* 3(3): 747-757
6. Campiseno, S., Campiseno, M.R., Naguit, M.R. and Flores, B. (2010): Hydrobiological assessment of Liboran River, Dapitan City. *E. Int. Sci. Res. J.* 2(4):366-376.
7. Central Board for Prevention and Control of Water Pollution, New Delhi (1983-1984): In Water pollution from mass bathing case studies in Ganga. Assessment and development study of river basin series: *ADSORBS/19.*
8. Chandra, G., Bhattacharjee, I., Chatterjee, S.N. and Ghos, A. (2008): Mosquito control by larvivorous fish. *Indian J. Med. Res*. 127: 13-27.
9. Das, A., Shrihari, V., Madan Babu, S. and Ananthapadmanaban. (2005): Estimation of Oxygen requirement in a mass bathing tank during Mahamaham, 2004. (Southern Kumbh Mela): A Case study. *Ind. J. Environ. Ecoplan*.10 (1):1-8.
10. Dutta, P., Khan, S.A. Khan, M.A., Sharma, C.K., Doloi, P.K. and Mahnta, J. (1999): Solid waste pollution and breeding potential of dengue vectors in an urban and industrial environment of Assam. *J. Environ. Biol*. 20(4): 343-345.
11. Emery, A.D., Griffiths, A.J., Williams, K.P. and Woollam, T.C. (2004): Material capture from a kerbside recycling scheme and the effects of socio-economic

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conditions on household waste arising. *J. Solid Waste Techn.& Manag*. 30(1): 19-27.

12. Fatai, E., Monavari, S.M., Shariet, S.M., Laghaei, H.A. and Ojaghi, A. (2005): Management of collection, transportation and landfilling of solid waste in Sarein city. *J. Solid Waste Tech. & Manag*. 31(4): 224-229.
13. Goswami, U.C., Basistha, S.K., Bora, D., Shyamkumar, K., Saikia, B. and Changsan, K. (2012). Fish diversity of North East India, inclusive of the Himalayan and Indo Burma biodiversity hotspots zones: A checklist on their taxonomic status, economic importance, geographical distribution, present status and prevailing threats. Int. J. Biodv. Cons. 4(15): 592-613.
14. Hayakawa, K., Okumura, R., Yamamoto, H., Fujiwara, M., Yamaji, N. Takada, H., Kanernatsu, M. and Shimizu, Y. (2007): Distribution and fluxes of fluorescent whitening agents discharged from domestic wastewater into small rivers with seasonal changes of flow rates. *Limnology.* 8: 251-259.
15. Ingal, S.T., Vishwarajan, S., Suryawanshi, S.A. and Kulkarni, B.G. (1993). Impact of urbanization of heavy metal concentration of the Patalganga river, Maharashtra. *Environ. and Ecol. 11: 747-752.*
16. Iqbal, F., Salam, M.A.A, Khan, B.A., Ahmad, S., Qamar, M. and Umer, K. (2004): Seasonal Variation of physico-chemical; characteristics of river Soan water at Dhoak Pathan Bridge (Chakwal), Pakistan. Int. J. Agri & Biol. 1: 89-92. *Applied Sci. Environ. Mgt*. 5 (1): 47-55.
17. Joshi, B.D., Pathak, J.K., Singh, Y.N. Bisht, R.C.S. and Joshi, N. (1993). Phytoplankton production in the snow-fed river Bhagirathi in the Garhwal Himalaya. *Him. J. Env. Zool*. 7: 60-63.
18. Joshi, B.D., Pathak, J.K., Singh, Y.N. Bisht, R.C.S. and Joshi, P.C. (1993). On the Physico-chemical characteristics of river Bhagirathi in the uplands of Garhwal Himalayas. *Him. J. Env. Zool*. 7: 64-75.
19. Joshi, B.D., Pathak, J.K., Singh, Y.N. Bisht, R.C.S., Joshi, P.C. and Joshi, Namita (1993): Assessment of water quality of river Bhagirathi at Uttarkashi. *Him. J. Env. Zool*. 7: 118-123.
20. Julian,J.P., Beurs, K.M., Owsley,B., Colley, R.J.D. and Ausseil, A.J.E. (2017). River water quality changes in New Zealand over 26 years: response to land use intensity. *Hydrol. Earth Syst. Sci*. 21:1149–1171.
21. Kakar, S.U.R., Wahid, A., Tareen, R.B., Kakar, S.A., Tariq, M. and Kayani, S.A. (2010): Impact of Municipal wastewater of Quetta City on Biomass Physiology and yield of Canola (Brassica napus L.). *Pak.J. Bot*. 42(1): 317-328.
22. Kang, S., Su, X, Tong, L., Shi, P., Yang, X, ABE, Y., Du, T., Shen, Q. and Zhang, J (2004): The impact of human activities on the water land environment of the Shiyang River basin, and arid region in north-west China. Hydrological Science-*J.des Science Hydrologiques*. 49 (3): 413-427
23. Karagul, R., Samandar, A., Yilmaz, M., Altun, L. and Gedikli, R. (2005): Evaluating the seasonal changes of some water quality parameters of the Buyuk Melen river basin (Duzce, Turkey). *J. Environ. Bio*. 26 (2): 179-185.

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24. Karthikeyan, S., Jambulingam, M., Sivakumar, P., Shekhar, A.P. and Krithika, J. (2006): Impact of Textile effluent on freshwater fish Mestacembelus armatus (cuv. & Val.). *J. Chemistry*. 3 (13): 303-306.
25. Kulshreshtha, S.K., Adholia, U.N., Bhatnagar, N., Khan, A.A, Saxena, M. and Baghai, M. (1989): Studies on polluted in river Kshipra: Zooplankton in relation to water quality. *Int. J. Ecol. Environ. Sci*. 15:27-36.
26. Kumar, A.; Singh, Y V., Joshi, B.D. and Rai, J.P.N. ((2003): Effect of distillery spent wash on some characteristics of soil & water. *Ind. J. Ecol.* 30(1): 7-12.
27. Kumar, A.; Singhal V.J., Joshi, B.D. and Rai, J.P.N. ((2002): Seasonal variation in physicochemical characteristics of soil & groundwater as induced by pulp & paper mill effluent in the nearby area of Lalkuan. In: *Proc. National Symp. Biochem. Sci.* 2002: 245-250.
28. Leal, M.A., Joppert, M. Licinio, M.V. Evangelista, H. Maldondo, J. Dalia, K. C. Lima, C. Barros, L. C. V., Correa, S.M., Medeiros, G. and Dias, K. (2009): Atmospheric impacts due to anthropogenic activities in remote areas: The case study of admiralty bay/king George Island/ Antarctica Peninsula. *Wat. Air Soil Pollut.* 188: 67-80.
29. Leveque, C., Oberdorff, T., Paugy, D., Staissny, M.L.J. and Tedesco, P.A. (2008): Global diversity of fish (Pisces) in freshwater. Hydrobiologia, 595:545-567.
30. Mani, S., Banerjee, R., Sinha, N., Das, R., Porwal, P. and Wankhede, S. (2007): Implementation of sustainable municipal solid waste management in four temple towns of India: Puri, Tirupathi, Ujjain and Vrindavan. *Proceeding of International on sustainable solid waste management.* 482-489.
31. Mathivanan, V., Vijayan, P., Sabhanayakam, S. and Jeyachitra, O. (2007): An Assessment of plankton population of Cauvery River with reference to pollution. *J. Environ. Biol*. 28(2): 523-526.
32. Mishra, D., Mudgal, M., Khan, M.A., Padmakaran, P. and Chakradhar, B. (2009): Assessment of groundwater quality of Bhavnagar region (Gujrat). *J. Sci. Ind. research.* 68: 964-966.
33. Ogunfowokan, A.O., Okoh, E.K., Adenuga, A.A. and Asubiojo, O.I. (2005): An Assessment of the impact of point source pollution from a University Sewage Treatment Oxidation pond on a Receiving stream- A preliminary study. *J. Appl. Sci.* 5(1):36-43.
34. Oohakasaraie, L., Basri, N.E.A., Bakar, A.A. and Maulud, K.N.A. (2009): Erosion and sediment control plan to minimize impacts of housing construction activities on water resources in Malaysia. *European J. Sci. Res.* 33(3): 461-470.
35. Pandey, M, Dixit, V.K, Katiyer, G.P, Nath, S., Sundram, S.M, Chandra, N., Shomvansi, A.K., Kar, S. and Upadhyay, V.K. (2005): Ganga Water Pollution and occurrence of enteric disease in Varanasi City. *Indian J. Comm. Med.* 30(4): 115-120.
36. Rahmanian, N., Ali, HSB., Homayoonfard, M., Ali, N. J., Rehan, M., Sadef, Y. and Nizami, A.S. (2015). Analysis of Physiochemical Parameters to Evaluate the Drinking Water Quality in the State of Perak, Malaysia. Hindawi Publishing *Corporation Journal of Chemistry*. Article ID 716125, 10 pages http://dx.doi.org/10.1155/2015/716125.

**ISSN: 0975-3583, 0976-2833 VOL 09, ISSUE 03, 2018**


37. Rajagopal, T., Thangamani, A., Sevarkodiyone, S.P, Sekar, M. and Archunan, G. (2010): Zooplankton diversity and physico-chemical conditions in three perennial ponds of Virudhunagar district, Tamilnadu. *J. Environ. Biol.* 31: 265-272.
38. Saravanakumar, A., Rajkumar, M., Serebiah, J.S. and Thivakaran, G.A. (2008): Seasonal variation in physico-chemical characteristics of water, sediment and soil texture in arid zone mangroves of Kachchh- Gujarat. *J. Environ. Biol.* 29(5): 725-732.
39. Sheyla, R.M.C., Hamada, N., Sergio, L.B.L., Forsberg, B, R. and Pimentel, T.P. (2007): Deforestation and sewage effect on aquatic macroinvertebrates in an urban stream in Manaus, Amazonas, Brazil. *Hydrobiologia.* 575: 271-284.
40. Shirodkar, P.V., Pradhan, U.K., Fernandes, D., Haldankar, S.R. and Rao, G.S. (2010): Influence of anthropogenic activities on the existing environmental conditions of Kandla Creek (Gulf of Kutch). *Curr. Sci.* 98 (6): 815-828.
41. Singh, H.R., Nautiyal, P., Dobriyal, R.C., Pokhriyal, R.C., Negi, M., Baduni, V., Nautiyal, R., Agarwal, N.K., Pautiyal, P. and Gautam, A. (1994): water quality of river Ganga (Garhwal Himalaya). *Acta Hydrobiologia*. 36(1) :3-15.
42. Sinha, A.K., Srivastava, R. and Srivastava, K.N. (1989): Physico-chemical studies of River Ganga water at Kalakankar (Pratapgarh). *Indian. J. Environ. Prot.* 9(3): 194-197.
43. Sreekantha, M.D., Chandran, S., Mesta, D.K, Rao, G.R., Gururaja, K.V. and Ramachandra, T.V. (2007): Fish diversity in relation to landscape and vegetation in central western Ghat, India. *Curr. Sci*. 92 (11) 1592-1603.
44. Totawar D. V. (2018). Fish Diversity of Godavari River, Nanded, Maharashtra. INDIA. *Int.J. Sci. Res.* 7(3): 4-5.
45. Yogesh, K. and Mudgal, L.K. (2018). Study on the Fish Species Diversity of the River Narmada in Nimar Region of M.P. International Journal of Engineering & Scientific Research. 6(1): 189-193.
46. Joseph (2017). Diversity and distribution of phytoplankton in an artificial pond. Int. J. Adv. Res. Biol. Sci. 4(5): 114-122.
47. Rani, A.K and Jobiraj (2017). Fish fauna diversity of Karamana River, Kerala, India: A study. Advances in Aquaculture and Fisheries Management. 5 (8): 001-006
48. Anyinkeng, N., Mih, A.M., Suh, T.A. and Awah, C.C. (2016). Phytoplankton diversity and abundance in water bodies as affected by anthropogenic activities within the Buea municipality, Cameroon. *Journal of Ecology and the Natural Environment*. 8(7): 99-114.
*49.* Belkhode, P.P. and. Sitre, S.R. (2016). Phytoplankton Diversity of Dham River in Wardha District of Maharashtra State, India. *Indian Journal of Fundamental and Applied Life Sciences* 6 (1): 10-13.
50. Yin, C., Huang, L., Huang, L.X.J. and Gao, M. (2016). Fish diversity in nature reserves of Jiangxi Province, China. eco.mont – 8(2): 33-42.
51. Deori, D.J. Abujam, S. and Biswas, S.P. (2015). Fish diversity and habitat ecology of Dihing River -A tributary of Brahmaputra River. *Int. J. Fishe & Aqua. Std*. 2(4): 190-197.

**ISSN: 0975-3583, 0976-2833 VOL 09, ISSUE 03, 2018**


52. Jana, A., Sit, G. and Maiti, K. (2015). Ichthyofaunal diversity of Keleghai river at Medinipur district in West Bengal. *Int. Resea. J. Basic Appl. Sci*. 1 (2015) 24-26.
53. Gulecal, Y and Temel, M. (2014). Water Quality and Phytoplankton Diversity in Büyükçekmece Watershed, Turkey. *Journal of Water Resource and Protection*, 2014, 6, 55-61
54. Naik, A.S.K. Kumar, J., Mahesh, V. and Benakappa, S. (2013). Assessment of Fish Diversity of Tunga River, Karnataka, India. *Nature and Science*. 11(2):82-87.
55. Sarkinnoma, A., Yarkasuwa, C.I. and Modu, K.A.(2013).Analysis of Physicochemical Parameters of Sewage Water Used for Irrigation in Bauchi Metropolis–Nigeria. *J.Environ. Earth Sci*. 3(10): 37-42.
56. Srivastava, P.K. (2013). Fish Diversity and Conservation Perspectives of Gandak River, India. *Our Nature*. 11(1): 76-8.
57. Weldemariam, M.M. (2013). Physico-chemical Analysis of GudBahri River Water of Wukro, Eastern Tigrai, Ethiopia**.** *Int. J. Sci. and Res. Publ*. 3(11): 1-4.
58. Annalakshmi, G. and Amsath, A. (2012): An assessment of water quality of river Cauvery and its tributaries arasalar with reference to physical-chemical parameters at Tanjore DT, Tamilnadu, India. *Int. J. Appl. Biol. & Pharma. Tech.* 3(1): 269-279.
59. Chopra, G., Bhatnagar, A. and Malhotra, P. (2012): Limnological characteristics of River Yamuna in Yamunanagar, Haryana, India. Int. J. Water Res. & Enviro. Eng. 4(4): 97-104.
60. Khan, R.M., Jadav, M.J. and Ustad, I.R. (2012): Physicochemical Analysis of Triveni Lake Water of Amravati District In (Ms) India. *Bioscience Discovery*. 3(1): 64-66.
61. Mustapha, A. (2012): Identification of anthropogenic influences on water quality of Jakara river, Northwestern Nigeria. *J. Appl. Sci. Environ. Sani.* 7(1): 11-20.
62. Solanki, H.A., Chitnis, R.D. and Bhavsar, H.A. (2012): Physico-chemical and Bacterial analysis of Sabarmati river in Ahmedabad. *Life Science leaflets.* 2:70-82.
63. Verma, P., Champawat, D., Gupta, U. and Solanki, H. (2012): Water Quality Analysis of an Organically Polluted Lake by Investigating Different Physical and Chemical Parameters int. J. Res. Chem. Env. 2(1):105-111.
64. Grady, D.O. (2011): Sociopolitical condition for successful water quality trading in the south nation river watershed, Ontario Canada. *J. American Water Resources*. 47(1): 39-50.
65. Joshi, N. and Sati, V. (2011): Assessment of water quality of river Ganga at Haridwar during Kumbh Mela-2010. *Report and Opinion*. 3(7): 30-36.
66. Singh, J.P., Yadav, P.K. and Singh, L. (1989a): Mass bathing effect on water quality of Sangam during Mahakumbh Mela at Allahabad. *Indian. J. Environ. Prot.* 9(3): 189-193
67. Singh, J.P., Yadav, P.K. and Singh, L. (1989b): The assessment of water quality of Sangam and its adjoining rivers Ganga and Yamuna after Mahakumbh Mela at Allahabad. *Indian. J. Environ. Prot.* 9(5): 372-375.
68. Shiddamallayya, N. and Pratima M., 2008. Impact of domestic sewage on freshwater bodies. *J. Environ. Biol. 29(3) 303-308.*