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A Study of Seasonal Physicochemical Parameters in River Narmada

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Abstract: The present study was designed to demonstrate the seasonal variations in physico-chemical parameters of River Narmada water for a period of two years from Nov. 2010- Oct. 2012. Water samples were collected on seasonal basis and analyzed for the estimation of water temperature, air temperature, pH, Dissolved oxygen; total dissolved solids, electrical conductivity, free CO_2, alkalinity, total hardness, calcium hardness, magnesium hardness, chloride, nitrate nitrogen and phosphate were also recorded. These parameters were compared with water quality standards to indicate probable pollution in the River Narmada. The overall water quality of the study sites remained within the safe limits throughout the study period. An attempt has been made to explain the effect of seasonal changes on physico-chemical characteristics of river Narmada water.

Keywords: Physico- chemical parameters, Narmada River, seasons and pollution.

INTRODUCTION

The rapid urbanization and industrialization causes a great pollution in surface and ground waters .Due to increase in population people start migrating from rural to urban areas and hence has also increase in domestic effluents. There occurs an increase in industrial effluents due to the development of new industries. Fresh water has become a scare commodity due to overexploitation and pollution[1-3]. Pollution

is caused when a change in the physical, chemical or biological condition in the environment harmfully affect the quality of human life including other animal and plant life[4, 5].

In order to determine the state of pollution in rivers, a continuous monitoring of water quality is essential. Rivers are utilized by mankind over the centuries, to the extent that very few, if any are now in a natural condition[6]. Water quality provides current information about the concentration of various solutes at a given place and time. Water quality deals with the physical, chemical and biological features in relation to all other hydrological properties.

There would be a great loss in the biodiversity of aquatic ecosystems than for the terrestrial ecosystems[7]. Entering of sewage and storm water runoff into rivers are two common ways that causes a pollution in rivers as well as in aquatic ecosystems[8,9]. In India various workers have done a lot of work in the evaluation of water quality[10-19]. If the chloride, bicarbonate alkalinity and PH are present in sufficient quantity, it means that animal waste, sewage and industrial effluents directly discharge into the river Narmada as described by Okendro and Mahanta[20]. With the help of continuous regimes, it is possible for us to mitigate the effect of human societies on natural sources, Belligham[21]. Present study was therefore, to assess the present quality of water in river Narmada and the level to which Narmada water resources is polluted, some physico- chemical parameters which include Dissolved oxygen (DO), pH, Temperature, Electrical conductivity (EC) , Total dissolved solids (TDS), Total alkalinity, Total phosphate (TP), Total nitrate (TN) and Total chloride (TC), were determined. The mean values of these parameters were compared with National standard for drinking water quality (NSDWQ) and US Environmental Protection Agency (USEPA) Standards cited in Zeba *et al*.[22].

MATERIAL AND METHODS

Surface water samples were collected in the morning from the upstream, midstream and downstream of Sethanighat in the river Narmada on seasonal basis, viz., and winter, summer, monsoon and post monsoon during 2010-2012. The air temperature, water temperature, pH, and electrical conductivity were measured on the field itself and other parameters were analyzed in the laboratory within 48 hours following the methods as given in Adoni (1985) and APHA (1995)[23,24]. Mercury thermometer was used for measuring air and water temperature. Standardized digital laboratory grip pH meter was used for recording the pH of water. Do was estimated by the azide modification of Winkler's method. Total dissolved solids was measured by TDS meter by immersing the electrodes of it in a well-mixed sample. Electrical conductivity was measured by Grip conductivity meter. Free co2, alkalinity, total hardness, calcium and magnesium hardness were measured by titration method. Chloride was determined by Argenometric method using potassium chromate as an indicator. Nitrate nitrogen was measured spectrophotometrically. Phosphate phosphorus content of water sample was determined by stannous chloride method.

RESULTS

The results of physico-chemical parameters of water on the seasonal basis were tabulated in (Table 1). Temperature is considered to be the most important factor in the aquatic environment. On an average seasonal basis, the minimum atmospheric temperature (26.3^0C) in the post monsoon season and maximum (41^0C) in the summer season with a mean value of 1520 C was recorded in the river Narmada. The water temperature on an average seasonal basis in river Narmada was recorded a minimum value of

(20.3^{0}C) in the winter season to a maximum value of (28 ^{0}C) in the summer season with a mean value of 24.15^{0}C .The water temperature has been found to increase correspondingly with the increasing atmospheric temperature. In general, temperature peaks were seen during warmer months while dip was recorded during colder months in river Narmada.

Table 1: Physico-chemical parameters or river Narmada during Nov. 2010- Oct. 2012.

S.no.	Parameters	Minimum	Maximum	Mean
1	Air temperature (°C)	26.3	41	152
2	Water temperature (°C)	20.3	28	24.15
3	pH units	7.6	8.6	8.1
4	Total dissolved solids (mg/l)	135	200	167.5
5	Electrical Conductivity (µS/cm)	143	180	161.5
6	Dissolved Oxygen (mg/l)	5.9	7.9	6.9
7	Chloride (mg/l)	21.67	47	34.33
8	Nitrate Nitrogen (mg/l)	0.13	0.30	0.215
9	Total phosphorous (mg/l)	0.1	0.4	0.25
10	Free CO_2 (mg/l)	0	9.1	4.55
11	Total alkalinity (mg/l)	129	234	181.5
12	Total hardness (mg/l)	140	198	169
13	Calcium hardness (mg/l)	96	145	120.5
14	Magnesium hardness (mg/l)	22.67	84.67	53.67

The present observation of surface water temperature in river Narmada agrees with the observations of that surface water temperature[25] usually remains close to the air temperature. Due to the shallowness of sampling stations the water temperature has shown a tendency to follow closely the atmospheric temperature. pH is one of the very significant chemical characteristic of all waters, which explains certain significant biotic and abiotic ecological characteristics of aquatic systems in general. Most ecosystems are sensitive to changes in pH and the industrialized countries[21]. The pH of surface water in river Narmada was ranged from (7.6 units) in the winter season and maximum (8.6 units) in the summer season with a mean value of 8.1 units. The pH was low in the winter may be due to the low photosynthetic activity of autotrophs. The pH was high in the summer season because of high metabolic activities of autotrophies, because in general they utilize the co^2 and liberate o^2 thus reducing H^+ ion concentration[25]. Hence the pH of river Narmada was alkaline in nature. This alkaline pH value was also witnessed due to the presence of alkaline earth metals that interact with soluble co^2 forming carbonates and bicarbonates, which then results in the shifting of the pH up over 7. Total dissolved solids further indicate the salinity behavior of the river. TDS content of the river water was in the range of 135mg/l (summer) to 200mg/l (monsoon) with a mean value of 167.5. Appreciable TDS values were observed at all sampling sites indicating the mixing of pollutants in river from anthropogenic activities in and around the river including the washing of clothes, mixing of sewage and garbage dumping which are some common activities at the river bank in this area. After finding out these values, which indicates the river water is most polluted in this area.

Increasing order of TDS was observed from upstream to the midstream, reaching maximum at midstream then starting again decreasing towards the downstream. It is expected that the value would reduce due to the self-cleaning and turbulence of natural waters. Higher TDS value depletes the DO of surface waters by increasing the BOD and COD demand. Dwivedi and Sonar reported[26] total dissolved solids of 150mg/l in a small reservoir in eastern Himalayan state of Arunachal Pradesh in India. Electrical conductivity in waters is due to the ionization of dissolved inorganic solids and is a measure of total dissolved solids[27] and salinity. Lowest value of electrical conductivity (143µs/cm at 25^0C) to the highest value of (180 µs/cm at 25^0C) with a mean value of 161.5 in the monsoon and winter season was measured. The lowest value may be attributed due to the high rainfall and the highest value of conductivity may be due to the low water renewal rate which could be related to the higher trophic status. Dissolved solids affect the quality of water used for irrigation or drinking. They also have a critical influence on aquatic biota, and every kind of organism has a typical salinity range that it can tolerate. Dissolved oxygen is the sole source of oxygen for all the aerobic aquatic life and hence it is considered as an important measure of purity for all waters. Oxygen tends to be less soluble as temperature increases. DO varied from a minimum value of (5.9mg/l) in the monsoon season to a maximum value of (7.9mg/l) in the summer season with a mean value of 6.9. This is due to the fact that DO concentration is high due to the high photosynthetic activities of the phytoplankton at this period. Minimum is due to the mixing of impurities from the surrounding areas. The quality of the water in terms of DO content is always of primary importance, because at the waste discharge points in the river, the DO is required for the aerobic oxidation of the wastes. At the sampling sites, where the concentration of DO is less, more would be the pollution. Also, Zeba *et al*.[22], explained that DO levels are important in the natural self-purification capacity of the river. The chloride on an average seasonal basis recorded maximum value of (47.0mg/l) in the monsoon season to a minimum value of (21.67mg/l) in the winter season with a mean value of 34.33. The highest value may be attributed due to the presence of large amounts of organic matter[28].The reduction in the levels of chloride concentration during colder seasons was possibly due to dilution caused by rainwater and snowfall. Excess chloride ions in water indicate degree of pollution and in natural waters the chloride ions are usually found associated with Na, K, Ca and chloride ions produce salty taste when concentration is 100mg/l[29]. Nitrates are essential nutrients for many photosynthetic autotrophs. The nitrate nitrogen on an average seasonal basis recorded the minimum value of (0.13 mg/l) to the maximum value (0.30 mg/l) with a mean value of 0.215mg/l during winter and post- monsoon seasons. If the nitrate level will be over 10mg/l in natural waters normally indicate man made pollution, but the measured values in the study were within the limit range. Man-made sources include fertilizers, livestock, urban runoff, septic tanks and waste water discharge. The concentration of nitrate was minimum during winter because in this season there were less pollution in the river and higher concentration is on the account of increase in anthropogenic pressure by the way of agricultural intensification in the paddy fields which lie close to the river ecosystem. Phosphate occurs almost soley as phosphates in natural waters. All forms of phosphate such as Orthophosphate, condensed phosphates and organically bound phosphates are found in waters. Phosphate is the nutrient considered to be the critical limiting nutrient, causing eutrophication of the fresh water system[30]. Phosphate concentration of river Narmada on an average seasonal basis recorded the lowest value (0.01mg/l) to the highest value (0.04 mg/l) with a mean value of 0.25 during winter and summer seasons. Phosphate content of 0.05 to 0.1mg/l is the threshold of it as a nutrient for natural waters. But in the present study, the water body with phosphate concentration more than 0.1mg/l represents a fresh water body of meso- eutrophication status. The highest concentration of the phosphate is due to the organic pollution and may also be attributed to the fact that river receives huge amount of

domestic sewage, municipal sewage and solid waste from the Hoshangabad market. High levels of both phosphate and nitrate can lead to the eutrophication, which increases algal growth and ultimately reduces DO levels in water[31]. It is widely assumed that nitrate concentration in fresh waters are negligible[32,33], and the world wide average concentration has been estimated to be 1mg of nitrate/l[34]. Free CO_2 is essential for the photosynthesis and its concentration affects the phytoplankton, and its productivity. Excess of it gets dissociated into carbonic acid. Increase in CO_2 indicates increase in pollution load[35]. CO_2 recorded a maximum value of (7.0mg/l and 9.1mg/l) with a mean value of 4.55 in the monsoon seasons. Free CO_2 was higher during the monsoon which may be attributed to the heavy inflow of organic waste from the surrounding human settlements and the Hoshangabad town. Free CO_2 was absent in the winter season, because no photosynthetic activity can take place, sunlight was not so bright and photoperiod was less. Sharma and Mathur[36] noted maximum free CO_2 in the monsoon and minimum in the winter in north Indian waters. Total alkalinity is caused by bicarbonates, carbonates, OH ions, borates, silicates and phosphates. Alkalinity is important for aquatic life, because it equilibrates the pH changes that occur naturally and as a result of photosynthetic activity of phytoplankton[37]. The alkalinity of river Narmada was recorded from lowest value of (129mg/l) in the monsoon season to the highest value of (234mg/l) in the winter season with a mean value of 181.5. The increase in alkalinity during winter months may be attributed due to the accumulation of bicarbonate ions in these months as the rate of their uptake is declined in river Narmada. The decrease in the alkalinity in monsoon months is due to the fact that there is decrease in bicarbonate ions and in warm months because of its use by luxuriant growth of phytoplankton in river Narmada. Total hardness fluctuated from 140mg/l to 198mg/l in the winter and monsoon seasons respectively with a mean value of 169 mg/l. Total hardness is governed by the contents of calcium and Magnesium and the major contribution to hardness is usually calcium. It may be due to other ions such as Fe++ ion, practically hardness is a measure of the capacity of water to precipitate soap. Low concentration in the winter season is due to the less pollution, which results in less concentration of carbonates and bicarbonates of calcium. High concentration in monsoon season is due to the regular addition of large quantities of sewage and detergents in the water body from the nearby villages as there is high population pressure. Garg observed a difference in hardness between seasons in river Mandakini, Chitrakoot[38]. The source of calcium in natural waters is basically leaching from calcium rich mineral rocks such as lime stone or mineralization of organic matter by the bacteria. The average seasonal calcium hardness in river Narmada fluctuated from a minimum value of 96.0 mg/l to a maximum value of 145 mg/l with a mean value of 120.5 mg/l in the post monsoon and monsoon season. Lowest value may be attributed due to the consumption of calcium by phytoplankton and zooplankton. Decrease of calcium in water is attributed due to the photosynthetic activity of macrophytes attaining their peak growth and production during the season[25]. Increase in calcium concentration in the monsoon season may be due to the low water level and additional amount of detergents added by human activities and by domestic waste into the ecosystem. The average seasonal Magnesium hardness content in the river Narmada fluctuated from 22.67mg/l to 84.67 mg/l in the winter and monsoon seasons with a mean value of 53.67mg/l. Lowest value of Magnesium is due to the lowest activities take place in the ecosystem and may be due to the less pollution. Laluraj *et al.*,[39] found that in Kayamkulam estuary the Magnesium content varied from 637-1158 mg/l and there the Magnesium and calcium generally reached the maximum during pre-monsoon. Highest value of Magnesium in the monsoon may be due to the human activities in the catchment area which lead to the entry of domestic waste into the wetland. The highest magnesium may be due to the flow of ions from the surrounding areas.

REFRENCES

1. S. Gupta and D. N. Shukla, Physico-chemical analysis of sewage water and its effect on seed germination and seedling growth of *Sesamum Indicum*, *J. Nat. Ras. Development*, 2006, 1, 5-19.
2. D. B. Patil, V. Rajendra and Tijare, Studies on water quality of Godchiroli Lake, *Poll. Res*., 2001, 20, 257-259.
3. R. P. Singh and P. Mathur, Investigation of variations in physic-chemical characteristics of a fresh water reservoir of Ajmer city, Rajasthan, *Ind. J. Env., Sci.*, 2005, 9, 57-61.
4. Lowel and F. Thompson, Biodiversity of vibrios. Microbiol, *Mol. Biol. Rev.*, 1992, 68, 403-431.
5. P. A. C. Okoye, R. E. Enemuoh and J. C. Ogunjiofor, Traces of heavy metals in Marinecrabs, *J. Chem. Soc. Nigeria.*, 2002, 27(1), 76-77.
6. L.C, Leonard, *Water and Water Pollution*. Marcel Dekker, Inc. New York, USA. 1971, 1, 256–63.
7. O. E. Sala, F. S. Chapin, J. J. Armesto, E. Berlow, J. Bloomfield, R. Dirzo, E. Huber–Sanwald, L. F. Huenneke, R. B. Jackson, A. Kinzig, R. Leemans, D. M. Lodge, H. A. Mooney, M. Oesterheld, N. L. Poff, M. T. Sykes, B. H. Walker, M. Walker and D. H. Wall, Global biodiversity scenarios for the year 2100, *Science*, 2000, 287, 1770-1774.
8. H. S. Sudhira and V. S. Kumar, Monitoring of lake water quality in Mysore City. In: *international Symposium on Restoration of Lakes and Wetlands*: *Proceedings of Lake*, Ramachandra, T.V., Rajasekara, M.C and Ahalya, N. (Eds.), Bangalore, India: Centre for Ecological Sciences, Indian Institute of Science, 2000, 1-10.
9. O. K. Adeyemo, Consequences of pollution and degradation of Nigerian aquatic environment on fisheries resources, *The Environmentalist*, 2003, 23(4), 297-306.
10. R. P. S. Sangu and K. D. Sharma, Studies of water pollution of Yamuna River at Agra, *Ind. J. Environ. Hlth.*, 1985, 27, 257-261.
11. N. K. Das, and R. K. Sinha, Assessment of water quality of Ganga River, Patna, India, *Environ. Ecol.*, 1993, 11, 829-832.
12. J. Jameson and B.C. Rana, Pollution status of the river complex Sabarmati at Kheda region of Gujrat 1. Physico-chemical characteristics, *Pollut. Res*., 1996, 15, 53-55.
13. B. S. Sharma and A. Agarwal, Assessment of water quality of river Yamuna at Agra, *Pollut. Res.*, 1999, 18, 109-110.
14. B. K. Mahanta and A. K. Patra, Studies on the water quality index of river Sanamachhakandana at Keonjhar Garh, Orissa, India, *Pollut. Res*., 2000, 19, 371-385.
15. B. K. Baruah and D. Baruah, Study on water quality of Subansiri River in Assam- An EIA approach for a proposed hydroelectric power project, *Ind. J. Environ. Ecoplan*., 2003, 7, 381-384.
16. A. Kumar, Ecology of river Mayurakshi in Jharkhand, India. *In*: Ecology and conservation of lakes, reservoirs and rivers (Ed.: A. Kumar). APH Publishing Corporation, New Delhi, 2003, 01-38.
17. R. Rajaram, M. Srinivasan and M. Rajasegar, Seasonal distribution of physico-chemical parameters in effluent discharge area of Uppanar estuary, Cuddalore, South-east coast of India, *J. Environ. Biol*., 2005, 26, 291-297.

18. H. Kulshrestha and S. Sharma, Impact of mass bathing during Ardhkumbh on water quality status of river Ganga, *J. Environ. Biol*., 2006, 27, 437-440.
19. R.R.Krishnan, K. Dharmaraj and B.D. Ranjitha Kumari: A comparative study on the physicochemical and bacterial analysis of drinking, borewell and sewage water in the three different places of Sivakasi. *J. Environ. Biol*., 2007, 28, 105-108.
20. N. Okendro, S. K. Singh and P. C. Mahanta, Multivariate statistical analysis of water quality data in Narmada river, *J. Ecopysiol. Occup. Hlth*., 2007, 7, 45-53.
21. K. Bellingham, Stevens water monitoring systems, 2012.
22. B. S. Zeba, A. H. Malik, A. Waseem and Q. Mahmood, Water quality assessment of Siran river, *Pakistan Int. J. Phys. Sci.*, 2011, 6, 7789-7798.
23. A.D. Adoni, Work Book of Limnology. Pratibha Publication, Sagar, (M.P) India, 1985.
24. APHA, Standards Methods for the Examination of water and wastewater. American Public Health Association, Washington, D.C 1995.
25. V. Kaul and J. K. Handoo, Physico- chemical characteristics of Nilnag a high altitude forest lake in Kashmir and its comparison with valleys lakes, *Proc. Indian National Sci. Acad.,* 1980, 46(4): 528-541.
26. P. Dwivedi and S. Sonar, Evaluation of physico –chemical and biological characteristics of water samples in water reservoir around Rono Hills, Doimmukh (Dist. Papum Pare), Arunachal Pradesh, *Poll. Res*., 2004, 23(1), 101-104.
27. L. R. Bhatt, P. Lacoul, H. D. Lekhak and P. K. Jha, Physico- chemical characteristics and phytoplanktons of Taudaha Lake, Kathmandu, *Poll. Res.,* 1999, 18(4), 353-358.
28. H. C. Kataria, S. A. Iqbal and A. K. Sandilya, Limno-chemical studies of Tawa Reservoir, *Indian J. of Envtl Prtcn*., 1995, 16(11), 841-846.
29. A. Pandith, Trophic structure of plankton community in some typical wetlands of Kashmir, India. Limnological research in India, Daya Publishing house, 1999, 190-224.
30. N. Rabalais, Nitrogen in Aquatic system, Ambio., 2002, 31(2), 102-112.
31. T. Murdoch, M. Cheo and K. O'Laughlin, Streamkeepers Field Guide; Watershed Inventory and Stream Monitoring Methods. Adopt-A-Stream Foundation, Everett, WA, 2001, 297.
32. D.W. Stanley and J. E. Hobbie, Nitrogen cycling in a North Carolina coastal river. *Limnol. Oceanogr*., 1981, 26, 30-42.
33. E. A. Paul and F. E. Clarke, Soil microbiology and biochemistry. Academic Press, Inc., San Diego, California, 1989.
34. M. Meybeck, Carbon, nitrogen and phosphorus transport by World rivers, *Am. J. Sci.,* 1982, 282, 401-450.
35. M. Koshy and T. V. Nayar, Water quality aspects of river Pampa, *Poll. Res.,* 1999, 18(4), 501-510.
36. S. Sharma and R. Mathur,. A comprehensive study of Entomo fauna in Mesosaprobic systems in Gwalior, *J. Natcon.,* 1992, 4 (2), 39-54.
37. S. Kaushik and D. N. Saksena, Physico- chemical factors and the aquatic density of a pond receiving cotton mill effluence at Gwalior, MP State, India, *Acta Botanica Indica,* 1989, 19, 113-116.
38. S. S. Garg. Seasonal fluctuation on physico- chemical parameters of river Mandakini, Chitrakoot, *Indian J. of Envtl. Prtcn.,* 2002, 22 (9), 986-991.

39. C. M. Laluraj, P. Padma, C. H. Sujatha, S. M. Nair, N.C. Kumar and J. Chacko, Base-line studies on the chemical constitutes of Kayamkulam Estuary near to the newly commissioned NTPC Power station, *Indian J of Envtl. Prtcn.*, 2002, 22 (7), 721-731.

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