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Seasonal Study of Nutritional Status for Microcystis Aeruginosa and Water Hyacianth of Water bodies of Indore, India

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ABSTRACT

The present paper embodies the physico-chemical characteristics of water bodies of Indore. These water bodies having highly nutritionally rich status plays an important role in the eutrophication in rivers and ponds. Chemical characteristics of water bodies in present investigation indicates high nutrient level, with reference to Nitrates, Chlorides, Phosphates and T.D.S. Higher values of COD is indicative of the presence of oxidizable, organic matter. The total hardness of water bodies was mainly due to the calcium as observed in present investigation. Although, the sewage water contain heavy metals Fe, Pb, Zn, Cr and Cu, an appropriate dilution can make them worth for use in agricultural fields to minimize its hazardous effect. Long-term applications of these effluents may increase concentration of heavy metals to considerable levels that will ultimately enter in the vegetation grown on such soils.

Key Words: Water Bodies, Nallas, River Khan, Eutrophication.

INTRODUCTION

Comprising over 70% of the Earths surface, water is undoubtedly the most precious natural resource that exists on our planet. Without the seemingly invaluable compound comprised of hydrogen and oxygen, life on Earth would be non-existent: it is essential for everything on our planet to grow and prosper. Water pollution is the contamination of water bodies (e.g. lakes, rivers, ponds, oceans and groundwater).

Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support a human use, like serving as drinking water. Natural phenomena such as volcanoes, algae blooms, storms and earthquakes also cause major changes in water quality and

the ecological status of water. Water pollution affects plants and organisms living in these bodies of water and in almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities. Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds. In order to combat water pollution, we must understand the problems and become part of the solution.

Water pollution has many causes and characteristics. The primary sources of water pollution are generally grouped into two categories based on their point of origin. Point-source pollution refers to contaminants that enter a waterway through a discrete point source. The second primary category, non-point source pollution, refers to contamination that, as its name suggests, does not originate from a single discrete source.

Indore is located at 22.44^0 North latitude and 75.50^0 East longitude on the National Highway No. 3 i.e. Agra-Bombay road. Most of Multinational, National and Local industries like Textiles, Pharmaceuticals, Engineering, Sugar, Dye, Chemical, Automobile, Tyre, Food-stuff, Fertilizers, Steel, Oil, Seed, Cosmetic, Electronic good, etc. are situated at Pithampur, Pologround and Sanwer road industrial estate of Indore district. Indore is also Information Technology and Educational Hub and gives very good Medico logical facilities. As a result of these developments, the place has gained importance and the population of Indore according to latest census of 2001 is 25 lacks 85 thousand and is projected to grow up to 30 lacks in 2010.

Study Area: The entire Indore city is covered by four rivers Khan, Chandrabhaga, Sarsawati, Gambhir and four Ponds Sirpur (15 fit), Pipliyapala (15 fit), Yaswant Sagar (17.5 fit), Bilavli (32 fit). All the four rivers and outlet of ponds are covering the rural area of Indore in the initial stage hence it receives agricultural run-off in a large proportion, the disposal of waste, burning of fossils fuels, discharge of domestic wastes, hospitals and industrial effluents from small and large scale industries which are located at the bank of the rivers. Hence all the rivers and outlet of ponds are converted in to nallas that is why the water of these rivers and outlet of ponds is unsafe for domestic, industrial and irrigation purposes.

Tehsil sanwer in Indore district is situated on the bank of river Khan. This river is one of the important source of water supply for irrigation and main source of water supply to small and large scale industries which are located at the bank of river Khan. At times heavy blooms of algae, especially of Microcystis aeruginosa and water hyacianth (*Melia azedarach*) have been observed in the river Khan. Deterioration of water quality and interruption in industrial water supply are matter of great concern to the authorities.

The main objective of the present investigation is to study the nutritional status of water bodies which are poured into the river Khan in Sanwer where it posses the problem of eutrophication and dark blue green colouration.[1]

In view of the above, physico-chemical analysis of water bodies was carried out to find out the chemical and nutritional potential of water bodies.

MATERIALS AND METHODS

The water bodies e.g. rivers and outlets of ponds of Indore lose its identity and convert into 10 nallas of stream full of rubbish material dark brown coloured domestic sewage and industrial effluents along with several contaminated material in the solid and liquid forms. These 10 nallas travel 220 km in entire Indore city and carry city drainage of a metropolitan town Indore in which about 150 tonns municipal wastewater including sewage are being discharged daily. These 10 nallas meet at Kabit Kari and form Khan river. After travelling a distance of 25 km through Kabit Kari, the stream full of various polluted effluents enters into the Tehsil Sanwer along with wastes. (Figure No.1)

Sampling Procedure: Domestic sewage and industrial effluent was collected during March 2009 to February 2010 from 10 sampling stations of 10 nallas, which cover entire Indore city (Table No.1). The surface water quality changes from season to season and is easily polluted. For this purpose, samples were collected from 10 nallas through out the year on a monthly basis. Samples were collected during the first week of each month, between 08.30 am to 10.30 am in clean plastic bottles, labeled properly and brought to the laboratory for analysis.

Sampling Methods: Samples are collected from about 40-50 cm below the surface, to avoid the collection of surface impurities, oils etc. Before sampling, 3L polythene bottles were rinsed with 0.1N chromic acid, than washed twice with distilled water. A separate sample was collected in bottle to measure the dissolved oxygen[2].

Parameters: The following 20 water quality parameters were analysed: Temperature, pH, Turbidity, Total solids, Total dissolved solids, Total suspended solids, Total hardness, Calcium hardness, Magnesium hardness, Nitrate, Sulphate, Chloride, Dissolved oxygen, Biological oxygen demand, Chemical oxygen demand, Iron, Lead, Zinc, Chromium, Copper.

Determination: The sewage samples were analysed for different parameter by different method as mentioned in APHA[3]. Spectrophotometer (EI microprocessor UV/ VIS spectrophometer model 1371) and Turbidometer (Digital M-tronics range O-1000 NTU) were used for analysis and chemicals used were of analytical grade. There observations were taken for each analysis and the average value was taken for further calculation.

Result and Discussion

The data on physico-chemical parameters of 10 nallas are presented in the table no. 2. The spectrum of life in a nalla is closely related to its physico-chemical conditions. Seasonal changes bring about rapid changes in the physico-chemical environment of water, particularly of the small lentic and lotic aquatic bodies[1].

Temperature: Various chemical and biological reactions in water depend to a great extent on temperature. The highest value of temperature i.e. 28.88^0C was recorded in pre monsoon season. The observed values of temperature indicate that the water quality would be certainly affected by this parameter. Among the various water parameters, temperature is one of the most important factors having profound influence on the biotic communities[4].

pH: The pH in present investigation was observed to be slightly alkaline in pre and post monsoon season while neutral during monsoon season. A decline in pH in monsoon season was due to effect of dilution by rain water.

Turbidity: The turbidity ranging from 56.27 NTU in pre monsoon to 64.15 NTU in monsoon. These values indicate that these sewage effluents are more turbid, much higher than the recommended values of 10 NTU for irrigation water. Furthermore, the months of July to October (monsoon season), gave higher turbidity values. This is probably due to more sewage in quantity.

Total Solids: Total dissolved solids influence the qualities of irrigation water because; it has the capacity to control the availability of water to plants through osmotic pressure-regulating mechanism. Settalable matter is able to inhibit the growth of flora and biota. Extraordinarily high values of TDS 783.55 ppm in monsoon and 751.1 ppm in post monsoon season speaks about a very high degree of eutrophication in Khan River.

Dissolved Oxygen: The presence of free oxygen in water is an indication of the ability of that water to support biological life. However DO concentration values can be affected by the water temperature as the solubility of O_2 is a function of temperature and photosynthesis. It may also be related to the concurrent changes in the formation and decomposition of organic compounds and to the uptake of inorganic carbon and release of nutrient elements such as nitrogen, phosphorus[5].

Dissolved oxygen is one of the most important a biotic parameters influencing the life in the coastal environment. Normally high dissolved oxygen is encountered in unpolluted areas, while at polluted areas level of DO is very low. Further depletion of DO to the level of anaerobia is the most critical manifestation of pollution. Lester[6] suggested the usefulness of dissolved oxygen as an indicator parameter for organic pollution.

In the present study we got zero value of dissolved oxygen. This may be due to mixing of untreated domestic sewage, industrial effluents and dumping of municipal solid waste into water bodies. Zero dissolved oxygen values may also be due to the stagnant and non-flushing conditions of the water with increasing waste load by regular addition of foods and pesticides.

The optimum value for good quality water has been 4-6 mg/litre of DO, which is able to maintain aquatic life in a water body[7]. If DO values are somewhat lower than this value, then the water is expected to be polluted.

Biological Oxygen Demand: The BOD is an indication of the organic load of wastewater. The maximum value of BOD was exhibited in the pre monsoon 157.58 ppm and while the minimum was exhibited in the monsoon 146.9 ppm. The results show minimal variation during the period of investigation. The high biological oxygen demand in pre monsoon may be due to extensive use of organic nutrients. Usually the microorganisms require more oxygen to reduce the high organic nutrients present in pre monsoon[8].

Chemical Oxygen Demand: COD is the measure of oxygen consumed during the oxidation of oxidizable organic matter by a strong oxidizing agent. Khan River speaks about the presence of

higher concentration of oxidizable organic matter in the river. COD varied from 302.2 mg/l in monsoon to 325.13 mg/l in pre monsoon season.

Total Hardness (Calcium and Magnesium Hardness): The concentration of Ca^{2+} tended to be the highest 222.8 mg/l in comparison to mg^{2+} 115.03 mg/l in pre monsoon seasons. Furthermore, the results suggest that the hardness is more due to the presence of calcium than magnesium. Generally the water can be said to be hard and therefore unsuitable for both domestic and industrial use as there exists possibility of scale formation in boilers and pipes[9]. Calcium is essential for normal plant growth and is desirable in water for irrigation. Magnesium is also essential to normal plant growth. Calcium and magnesium ions in irrigation water tend to keep soil permeable and in good tilth.

Nitrates: The concentration of different forms of nitrogen give a useful indication of the level of micronutrients in the waters and hence their ability to support plant growth. In the present investigation the minimum and maximum values of nitrate of sewage and effluents were 46.17 mg/l in monsoon and 60.02 mg/l in pre monsoon. The observed nitrate concentrations are less than the WHO upper limit of 50 mg/l for domestic water.

Nitrates are mainly responsible for the process of eutrophication in Khan and other rivers. The higher concentration of nitrates in pre monsoon season as observed in present investigation are probably due to the incoming waters which contain all types of sewage and other rubbish matter including agricultural wasters, waste from human body, domestic cattle, farmland run off and leaching from soil as well as the frequently used fertilizes. According to Sylvester[10], the domestic sewage is mainly responsible for greater concentration of nitrates in fresh water bodies. Heme[11] pointed out that the use of soil fertilizers in the agricultural farms may add large amounts of nitrates to the water.

Sulphate: The amounts of the sulphates present in Khan River water varies from 154.37 mg/l to 177.05 gm/l in different season. Sulphate concentration was also much higher than the tolerable limit for irrigation purpose.

Chloride: Chloride concentration was higher during pre monsoon 237.28 mg/l in comparison to monsoon 207.95 mg/l. Chloride concentration was higher during pre monsoon as compared to monsoon and post monsoon season. The reason for higher value of chloride observed in pre monsoon season may be due to contamination of inflow of wastes from terrestrial runoff or of anthropogenic in origin. Chloride was at toxic level in all seasons on the basis of maximum permissible limit for irrigation. Regarding irrigation waters, chlorides are the most troublesome anion. Chlorides are generally more toxic than sulphates to most plants.

Iron, Zinc, Copper: Among the micronutrients, Fe was found to be prominent in 0.45 mg/l in monsoon and 0.63 mg/l in pre monsoon seasons. Copper and Zinc were present in small quantities. Concentrations of all these micronutrients are with in the permissible limits for surface application.

Lead and Chromium: Heavy metal concentration followed the order Pb>Cr. The content of Cr varied from 0.025 to 0.042 mg/l, Whereas Pb ranged from 0.056 to 0.076 mg/l. The recommended maximum concentration for Cr is 0.10 mg/l.

Conclusion and Recommendations

It may be concluded from the present study that river Khan is highly eutrophicated, highly polluted water bodies which receives untreated Indore city domestic sewage and industrial effluents are mainly responsible for the process of eutrophication in the Sanwer. Therefore it is suggested that to restore and check the further deterioration of the river ecosystem there is an urgent need of effective and efficient sewage treatment plant for the safe delivery of domestic sewage and industrial effluents to the deteriorating ecosystem of Khan River.

The sewage water contain heavy metals Fe, Pb, Zn, Cr and Cu, an appropriate dilution can make them worth for use in agricultural fields to minimize its hazardous effects. The long-term applications of these effluents may increase concentration of heavy metals to considerable levels that will ultimately enter in the vegetation grown on such soil. Generally, the average application rate of sewage effluent per unit area is in excess of normally permissible application rates in any properly managed irrigation system. Therefore sewage effluents, if treated properly to reduce BOD, salt load and other properties judiciously, one can provide an alternate source of water for irrigation.

From the above discussion it seems fairly obvious that we need to treat sewage not only to recycle the water and nutrients but also to protect human and environmental health. By knowing together to overcome obstacles, water recycling, along with water conservation can help us to conserve and sustainable manage our vital water resources. As individuals and members of a large community, everyone must take responsibility for sewage generated in their community. To protect the health of all, “Everyone must make sure that all sewage in delivered to a good treatment facility and continue to see that the facility is properly managed.

Table No. 1: Location and Name of Sampling Stations

S.No.	Name of Nallah	Name of Sampling Stations (S)	Lenth in meter
1	Khajrana To Kabitkari Nalla	Sukaliya Nalla (S-1)	20km
2	Pipliyahana to Bhagirathpura Nalla	Pardesipura Nalla (S-2)	17km
3	Chitavad Village to Bhagirathpura Nalla (Khan river)	Ranipura Nalla (S-3)	21km
4	Tajpur village to Kishnpura to Bhagirathpura Nalla (Sarswati river)	Chandrabhaga Pul Nalla (S-4)	22km
5	Rajendra Nagar to Karbala to Kishanpura to Bhagirathpura Nalla	Tajpur Gadbadi Nalla (S-5)	23km
6	Sirpur Village to Panchkuiya to Bhagirathpura Nalla	Shankarganj Nalla (S-6)	24km
7	B.S.F. to Panchkuiya to Bhagirathpura Nalla	Panchkuiya Nalla (S-7)	25km
8	Ranjeet Hanuman to Panchkuiya to Bhagirathpura Nalla	Ramkrishan Bag Nalla (S-8)	25km
9	Sch. No. 51 to Bhagirathpura Nalla	Sanwar Naka Nalla (S-9)	18km
10	Gandhi Nagar to Bhagirathpura Nalla	Narval Nalla (S-10)	15km
		Total	**220 km**

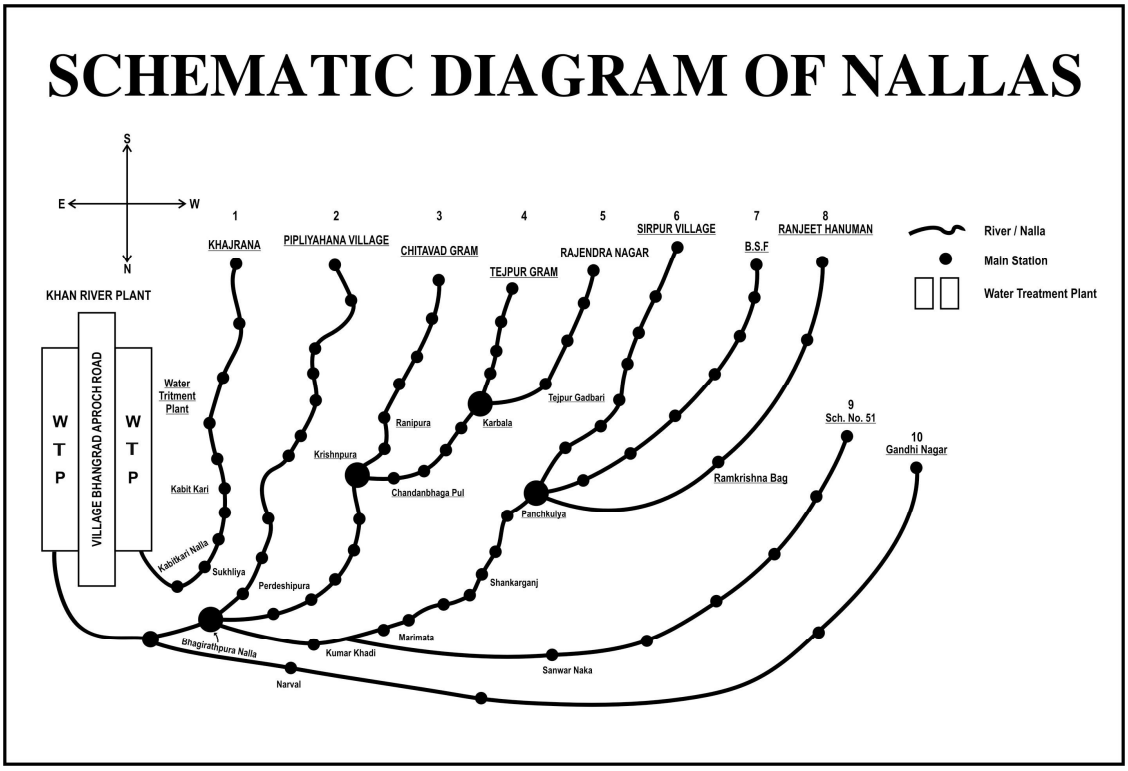

Figure No.1: Sketch map of 10 Nallas of Indore city

Table No.2: Average values of the parameters for all the sampling stations 1-10 during the year 2009-2010

PARAMETER	UNIT	PRE MONSOON	MONSOON	POST MONSOON
Temperature	^{0}C	28.88	26.66	21.31
pH		8.28	7.53	8.00
Turbidity	NTU	56.27	64.15	59.77
Total Solids	mg/l	1013.5	1019.98	1008.075
Total Dissolved Solids	mg/l	783.55	734.57	751.8
Total Suspended Solids	mg/l	229.98	285.4	256.275
Total Hardness	mg/l	337.83	281.575	314.325
Calcium Hardness	mg/l	222.8	181.22	206.35
Magnesium Hardness	mg/	115.03	100.35	107.97
Sulphate	mg/	177.05	154.37	168.82
Chloride	mg/	237.28	207.95	225.85
Nitrate	mg/l	60.02	46.17	54.8
DO	ppm	0	0	0
BOD	ppm	157.58	134.82	146.9
COD	ppm	325.13	302.2	310.45
Iron	mg/l	0.638	0.452	0.543
Lead	mg/l	0.076	0.056	0.065
Zinc	mg/l	0.074	0.052	0.062
Chromium	mg/l	0.042	0.025	0.032
Copper	mg/l	0.033	0.015	0.021

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