



Studies on the Physico-chemical Status of Two Water Bodies at Nagpur City Under Anthropogenic Influences

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Abstract:

This study was aimed to analyse physico-chemical characteristic of two water bodies of Ambazari lake and Futala lake at Nagpur District, Maharashtra. Monthly changes in various physico-chemical parameters of water such as temperature, colour, odour, taste, turbidity, transparency, total dissolved solids, pH, total hardness, dissolved oxygen (DO), chemical oxygen demand (COD), biological oxygen demand (BOD) were analyzed for a period of one year in three different seasons as summer, monsoon and winter from March 2010 to February 2011. The experimental values of water samples were compared with standard values given by world health organization (WHO). Water quality is crucial factor which in turn regulates biotic diversity, energy and mineral cycles & succession. The results revealed that there was significant seasonal variation in physico-chemical parameters of both lakes and therefore the lake must be monitored regularly to prevent the changes that are occurred day by day.

Keywords: Lakes, Physico-chemical parameters, Water quality. DO, BOD.

Introduction:

Water is extremely essential for survival of all living beings however good water quality is essential for the well-being of all people. It is the most indispensable resources and known for the elixir of life. The quality of water usually described according to its physical, chemical and biological characteristics. Water sources available for drinking and domestic purposes must possess high degree of purity and free from chemical contamination and unwanted microorganisms. Many workers Contributed to the assessment of the quality of water resources from different regions. Some prominent groups of scientists such as [28] [27] [34] [16] [23] reported the water qualities especially with reference to the physico-chemical properties.

India is facing a serious problem of natural resource scarcity, especially that of water in view of population growth and economic development. Most of fresh water bodies all over the world are getting polluted, thus decreasing the available potable water. All life is depend on water and exists in nature in many forms like ocean, river, lake, clouds, rain, snow and fog etc. However, strictly speaking chemically pure water does not exist for any appreciable length of time in nature [6]. Water pollution is distinct as a change in the chemical, physical and biological health of a waterway due to human activity. Ways that humans have

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affected the quality of the lakes water over the centuries include sewage disposal, toxic contamination through heavy metals and pesticides, overdevelopment of the water's edge, runoff from agriculture and urbanization, and pollution.

The present investigation involves the analysis of water quality in relation to physico-chemical parameters. Ambazari lake and Futala lake of Nagpur district of Maharashtra was selected for physicochemical analysis of water. Now a day's the lake only source of irrigation water under the canal irrigation. Lake water is polluted due to domestic waste and agricultural discharges. In India many researchers have worked on physicochemical and biological characteristics of reservoirs and rivers [32] [9] [12] [30] [24] [11].

Study Area and Sampling Locations:

The Ambazari and Futala Lakes are within Nagpur city India (Fig 1). Study area and sampling location Lake Ambazari [21° 07' 27.69" N, 79° 02' 33.96" E] with a surface area of 1.5393 Km², and Lake Futala [21° 09' 04.19" N, 79° 02' 36.72" E] with a surface area of 0.35657 Km², were selected for the study. The Ambazari lake sampling location of four sites is represented as Site A₁; Site A₂; Site A₃ and Site A₄. Futala lake sampling location of four sites is represented as Site F₁, Site F₂; Site F₃ and Site F₄.

These are important water bodies of the Nagpur city and are under anthropogenic impacts such as fishing, boating, swimming, immersion of idols, flowers, garlands, etc. The climate in the study area is continental, winter months are cold and rainy and summer is hot and dry.

a) Ambazari Lake

The Ambazari Lake is the biggest lake in the city and spread over 180 acres. Ambazari garden is located along side the lake. The people in the surrounding region use to throw waste into the lake and the cattle also take bath in the lake. Nagpur Municipal Corporation (NMC) has failed to exploit the natural beauty of the lake and garden. Fortunately, the lake is secure due to embankments constructed during the British period. Earlier, the lake was the only source of drinking water for the city. The Nag River use to flow into the lake after flowing through Wadi. However, the lake has been polluted due to flow of sewage from Wadi and nearby areas besides industrial waste from Hingna MIDC. The overflow point is responsible for shedding water during heavy rains. If everything goes well, the lake will get back its lost glory due to National Lakes Conservation Plan (NLCP).

b) Futala Lake

The Futala Lake is a closed water body spread over 60 acres and it is also polluted by sewage water. This lake is located in west Nagpur. The initial purpose for irrigating nearby agricultural land was prominent amongst utilization of lake. The water is unpotable and now-a-days used





for commercial fisheries. It does not have self cleansing capacity. Hence, the continuous addition of nutrients through many polluting sources is leading. The watershed of Futala Lake is a part of Nag river watershed. Four streams are prominent within the catchment [15].

Baseline information is available on the various physico-chemical and biological components of these important lakes which has strategically located. No comprehensive account and long term study has been made available on the various physico-chemical and biological components of the lake. Hence, this study was carried out to determine the data of physical and chemical parameters of the both Ambazari and Futala Lake.

Material and methods:

Nagpur city, an urban area is dotted by two prominent lakes viz. Ambazari and Futala. The study was carried for a period of 1 year (March 2010 to February 2011). The surface water samples for physico-chemical analysis were collected from four sampling stations of both lakes early in the morning during 8.00 am to 11.00 am in plastic cans of two litres capacity. Monthly data was collected, but results were represented season wise. Four month make one season [March to June summer season, July to October monsoon season, and November to February winter season]. Water temperature, Air temperature, pH was recorded at sampling station. Collected water samples were brought immediately to the laboratory for the estimation of various physicochemical parameters like total solid, dissolved oxygen, total hardness, and metal analysis. Physicochemical parameters were analysed as per standard methods [2] [32].

Result and discussion:

The water quality of Ambazari Lake and Futala Lake was evaluated with respect to their suitability for designated use and to establish their physico chemical parameters and pollution levels. Out of these Ambazari Lake is for recreational purpose in addition to irrigating urban plantation in Nagpur City, Futala Lake is for fishery purpose as well as for immersing idols during festivals besides being used for recreational and religious purposes. The values of different physico-chemical parameters of the water of lakes from all the sampling points during March 2010 to February 2011 are the mean value of seasonal observation from all the 4 sampling points of each lake.

A. Physical Status of Lake (Ambazari and Futala Lake)

The various physical characters for four different locations of Ambazari Lake and four different locations of Futala Lake were determined. Physical character measurements were analysed during study period such as Aesthetic parameter (Colour, Odour, Taste, Turbidity) Temperature,





Total Solid (TS), Suspended Solids (SS), Total dissolved solid (TDS), Transparency (Secchi Disk) and data represented in respective tables.

a) Aesthetic parameters:

Generally, colour, odour, turbidity are the physical qualities measured in water analysis. Presence of organic matter and iron usually impart colour. Hydrogen sulphide and other objectionable gases also impart colour, and these dissolved gases along with organic compounds, contribute to unpleasant taste. Similarly presence of insoluble colloidal sediments, microorganisms, organic matter and the like also contribute to the turbid appearance of water sources. In the present investigation, colour, odour, and turbidity of the water samples, were measured only qualitatively and all the samples were found to have normal taste, odour and clear appearance. According to different season lake water colour may vary and it has found slightly clear, turbid, greenish and little bit bluish green water of both the lakes are given in Table 1.

b) Turbidity:

Suspension of particles in water interfering with passage of light is called turbidity. Turbidity in Ambazari and Futala Lake ranges from 0.3 NTU to 14.30 NTU. The high value was recorded during monsoon season and low value was recorded during winter season. The findings are in conformity with [8] [33] the maximum values of turbidity in monsoon maybe due to rainfall and surface runoff water bringing a lot of sediments from the surrounding area.

In Ambazari and Futala Lake, it is observed that turbidity was higher during rainy and then in summer seasons while low turbidity was recorded in the winter season. During summer season, low water level due to evaporation, decaying vegetation, high planktonic growth were responsible for the turbidity. Such observations were also made by [4] [10].

c) Temperature:

In the present study, it is found that, the minimum temperature of Ambazari and Futala Lake water were noted in winter and maximum during summer season which is due to greater solar radiation and higher atmospheric temperature due to high water level[7]. This observation has been true for the several water bodies in India [20] [5] [33] [26].

The temperature of both lakes varies throughout the study period, it is clear from the observation Table no.3. The temperature includes air temperature & water temperature. The parameter of water temperature varies in accordance with air temperature. It was found that the temperature is high in summer while low in winter season. It was observed that the period of high temperature coincides with low oxygen content in water. At a period of low temperature the total hardness of water is also low & other parameters are in acceptable range [14].

d) Transparency:

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Suspended materials in water produce turbidity and reduce light penetration and in turn reduce productivity. Transparency is inversely proportional to the turbidity of water. In the present study, transparency was recorded to be maximum during summer and minimum in monsoon which was equal to depth of water. The water was observed mostly transparent except the monsoon season.

e) Total Solid (TS/TSS/TDS):

Total dissolved solids are the solids present in water in the dissolved state. In Ambazari and Futala Lake the amount of total solid recorded ranges from 271 to 386 mg/l. The high amount of TS was recorded during monsoon season with little variation in winter where as low amount of TS was recorded during summer season. The findings are in close conformity with the findings of [17] [29].

B. Chemical Status of Lake (Ambazari and Futala Lake)

The various chemical characters for four different locations of Ambazari Lake and four different locations of Futala Lake were analysed during study period were pH, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Hardness, and data represented and displayed in respective tables and Fig.

a) Hydrogen Ion concentration (pH):

pH indicates the intensity of acidic or basic character at a given temperature. Measurement of pH is one of the most important and most frequently used tests in determining water quality. Every phase of water treatment and water supply like acid-base neutralization, water softening, precipitation, coagulation, disinfection, corrosion control etc. is pH dependent.

The pH of Ambazari and Futala Lake water was slightly alkaline. pH value being greater than 7 at different stations. Minimum pH was recorded in Summer and maximum in the Monsoon. Significant changes in pH occur due to discharge of industrial and domestic waste. The alkaline pH of Futala and Ambazari lake water might be due to the use of detergents by neighboring population for washing of cloths vehicles and utensils, disposal of idols of God and Goddests. The pH value in the present investigation showed slightly alkaline condition. The regional and seasonal variation of pH values in Lakes Ambazari and Futala is given in Table no. 6.

b) Dissolved Oxygen (DO):

The dissolved oxygen concentration ranged from 2.4 to 8.1 mg/lit. Dissolved oxygen was minimum in Monsoon and maximum in Summer. Eariler workers also observed similar trend of dissolved oxygen in fresh water lakes [3] [22]. Futala Lakes DO levels were consistently low. The studied sites at Futala and Ambazari Lake shows low DO values in summer as expected from the converse relationship of water temperature versus DO





content. During winter season the total dissolved oxygen content in lake water is high whereas it becomes low in the Monsoon season. During winter season the low water temperature, high photosynthetic activity might have increased the amount of dissolved oxygen in lake water.

c) Biological Oxygen Demand (BOD):

BOD is a value of presence of organic materials in water which can support increasing of micro organisms. BOD variations depends on variable of dissolved oxygen and oxidizable organic matter. The low BOD value indicates that the water is free from organic pollution. High value of BOD indicating that the water was slightly polluted. some results of both lakes BOD value indicates moderately polluted water and some values indicated high organic pollution due to seasonally changes of lake conditions. Lake surface water containing BOD values 10 mgL^{-1} are considered to be moderately and more than 20 mgL^{-1} as to be highly polluted water [25]. The greater the decomposable matter present, greater the oxygen demands and greater the BOD values [1]. During winter season the BOD content in lake water is high whereas it becomes low in the summer season.

d) Chemical Oxygen Demand (COD):

These higher values indicated that Futala, Ambazari Lake were rich either with respect to some dissolved organic compounds or oxidisable inorganic substances. The highest COD possible cause of this could be illegal discharge of slaughter house waste, dumping of garbage, (poor) sewage, and surface runoff to Futala Lake. Examination of seasonal changes in COD loads showed insignificant changes in both lakes. The studied sites in Futala and Ambazari Lake showed a general increase in COD in summer and rainy season. This is an indication of increased organic loads due to increased household wastewater and waste discharges.

e) Total Hardness

The total hardness of Ambazari lake found the range from 96 to 308 mg/lit and Futala Lake 69 to 312 mg/lit. The maximum value was recorded during monsoon with slight variation in summer. However minimum value was recorded during winter season. [31] reported maximum and minimum hardness during summer and winter respectively. In Harsal dam it was from 83.8 to 178 mg/lit [21] minimum values was recorded during monsoon, this is in accordance with the view of [18] [19].





Table. 1: Aesthetic Parameters of Various Sites of Ambazari Lake and Futala Lake

Season	Parameter	Ambazari Lake	Futala Lake
Summer	Color	Light green	Light green
	Odour	Odour less	Odour less
	Taste	Taste less	Taste less
Winter	Color	Transparent	Clear
	Odour	Odour less	Odour less
	Taste	Taste less	Taste less
Monsoon	Color	Light brown /Turbid	Light brown/ Turbid
	Odour	Odour less	Odour less
	Taste	Taste less	Taste less

Table. 2: Turbidity of Various Sites of Ambazari Lake and Futala Lake

Turbidity (NTU)		Summer	Winter	Monsoon
Ambazari Lake	A1 Site	2.95	0.41	6.31
	A2 Site	5.87	0.24	5.20
	A3 Site	1.11	2.36	0.36
	A4 Site	0.93	0.30	4.36
Futala Lake	F1 Site	3.21	0.31	3.48
	F2 Site	5.62	0.30	5.50
	F3 Site	4.32	0.49	14.3
	F4 Site	4.56	0.33	3.79

Table. 3: Temperature of Various Sites of Ambazari Lake and Futala Lake

Temperature (°C)		Summer		Winter		Monsoon	
		Water	Air	Water	Air	Water	Air
Ambazari Lake	A1 Site	39.2	41.3	20.3	23.6	30.2	32.6
	A2 Site	40.5	42.6	24.2	27.4	29.5	32.1
	A3 Site	40.1	43.2	22.2	25.1	28.6	30.1
	A4 Site	45.6	47.1	23.2	26.1	28.4	31.4
Futala Lake	F1 Site	41.2	43.2	24.7	26.3	31.1	30.2
	F2 Site	40.6	42.5	21.2	23.4	30.2	29.5
	F3 Site	41.2	42.8	23.1	25.8	29.3	32.1
	F4 Site	45.8	47.1	24.5	26.1	28.6	28.4

Table. 4: Transparency of Various Sites of Ambazari Lake and Futala Lake

Transparency (cm)		Summer	Winter	Monsoon
Ambazari Lake	A1 Site	130	83	86
	A2 Site	74	69	62
	A3 Site	85	54	73
	A4 Site	98	82	78
Futala Lake	F1 Site	105	65	78
	F2 Site	138	79	88
	F3 Site	154	50	111
	F4 Site	114	86	95





Table. 5: TS/TDS/TSS of Various Sites of Ambazari Lake and Futala Lake

TS / TDS/TSS (mg/l)		Summer			Winter			Monsoon		
		TS	TDS	TSS	TS	TDS	TSS	TS	TDS	TSS
Ambazari Lake	A1	235	156.2	78.8	273.6	172.6	101	386	270.6	115.4
	A2	201.1	110.6	90.5	282.6	198.3	84.3	375.1	267.3	107.8
	A3	302.5	212.5	90	390.2	315.4	74.8	353	235.5	117.5
	A4	317.2	199.6	117.6	337.6	222.3	115.3	284.2	199.3	84.9
Futala Lake	F1	271.5	144.2	127.3	405	326.2	78.8	382.7	278.4	104.3
	F2	275.1	167.3	107.8	309.1	218.6	90.5	398.7	265.3	133.4
	F3	353	235.5	117.5	402.5	312.5	90	323.6	244.3	79.3
	F4	284.2	199.3	84.9	317.2	199.6	117.6	313.7	217.1	96.5

Table. 6: pH of Various Sites of Ambazari Lake and Futala Lake

pH		Summer	Winter	Monsoon
Ambazari Lake	A1 Site	7.02	8.70	8.90
	A2 Site	8.22	8.20	8.01
	A3 Site	8.48	7.90	7.90
	A4 Site	7.81	8.30	8.30
Futala Lake	F1 Site	7.08	8.26	8.10
	F2 Site	7.90	8.18	8.60
	F3 Site	8.31	8.32	8.11
	F4 Site	8.01	8.39	9.00

Table. 7: DO of Various Sites of Ambazari Lake and Futala Lake

DO (mg/l)		Summer	Winter	Monsoon
Ambazari Lake	A1 Site	6.1	5.4	3.6
	A2 Site	7.7	3.5	3.4
	A3 Site	8.1	6.1	2.4
	A4 Site	7.3	3.6	3.5
Futala Lake	F1 Site	7.6	3.5	4.9
	F2 Site	7.8	7.6	2.6
	F3 Site	7.2	3.6	3.2
	F4 Site	6.3	6.2	6.1

Table. 8: BOD of Various Sites of Ambazari Lake and Futala Lake

BOD (mg/l)		Summer	Winter	Monsoon
Ambazari Lake	A1 Site	12.2	11.5	21.3
	A2 Site	19.7	44.5	16.8
	A3 Site	18.0	11.3	19.8
	A4 Site	24.4	18.6	25.4
Futala Lake	F1 Site	25.3	45.6	25.5
	F2 Site	11.5	38.3	28.4
	F3 Site	6.50	25.4	11.3
	F4 Site	13.3	14.4	18.6



Table. 9: COD of Various Sites of Ambazari Lake and Futala Lake

COD (mg/l)		Summer	Winter	Monsoon
Ambazari Lake	A1 Site	96.6	12.3	27.8
	A2 Site	26.3	82.0	54.6
	A3 Site	102.3	15.6	61.3
	A4 Site	112.6	15.9	32.8
Futala Lake	F1 Site	67.3	22.4	71.3
	F2 Site	17.9	32.0	24.5
	F3 Site	16.2	12.5	21.3
	F4 Site	24.3	47.5	95.5

Table. 10: Hardness of Various Sites of Ambazari Lake and Futala Lake

Hardness (mg/l)		Summer	Winter	Monsoon
Ambazari Lake	A1 Site	250	101	273
	A2 Site	268	156	308
	A3 Site	272	96.0	284
	A4 Site	195	147	196
Futala Lake	F1 Site	224	121	155
	F2 Site	219	69.0	169
	F3 Site	156	104	188
	F4 Site	215	102	312

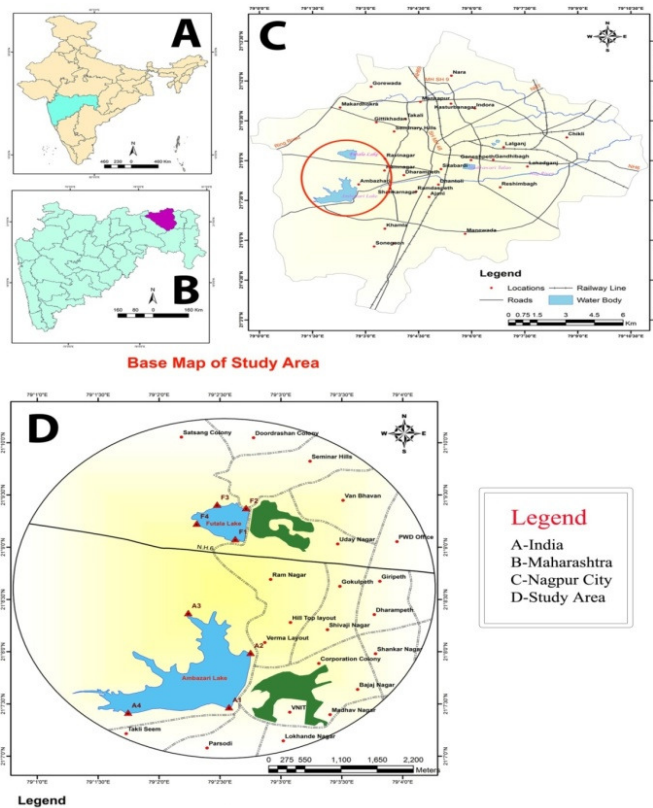


Fig. 1. Base Map of Ambazari Lake and Futala Lake, Nagpur Dist.(MS).

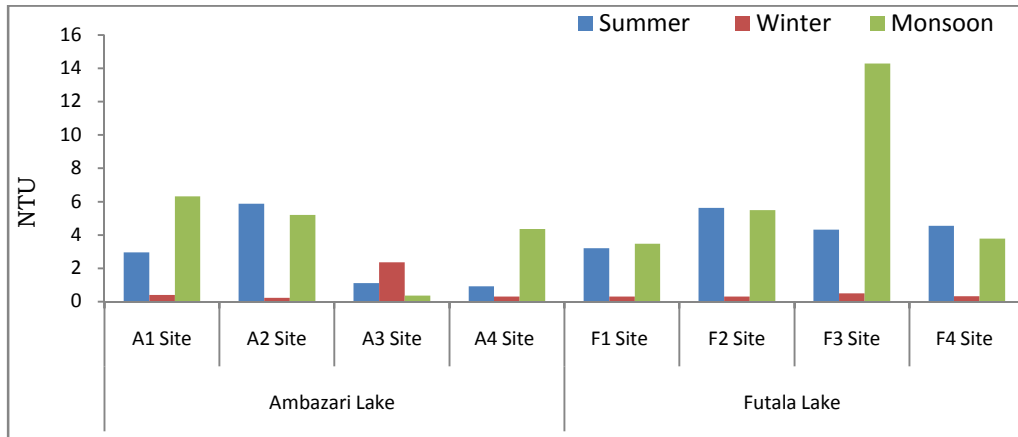


Fig. 2. Turbidity of Ambazari Lake and Futala Lake Water Samples of Different Season

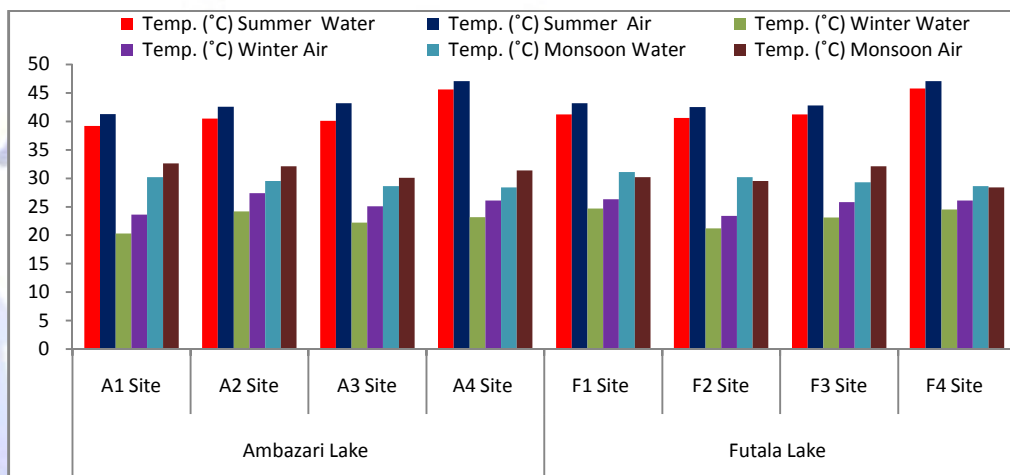


Fig. 3. Temperature of Air & Water Samples of Ambazari Lake and Futala Lake of Different Season

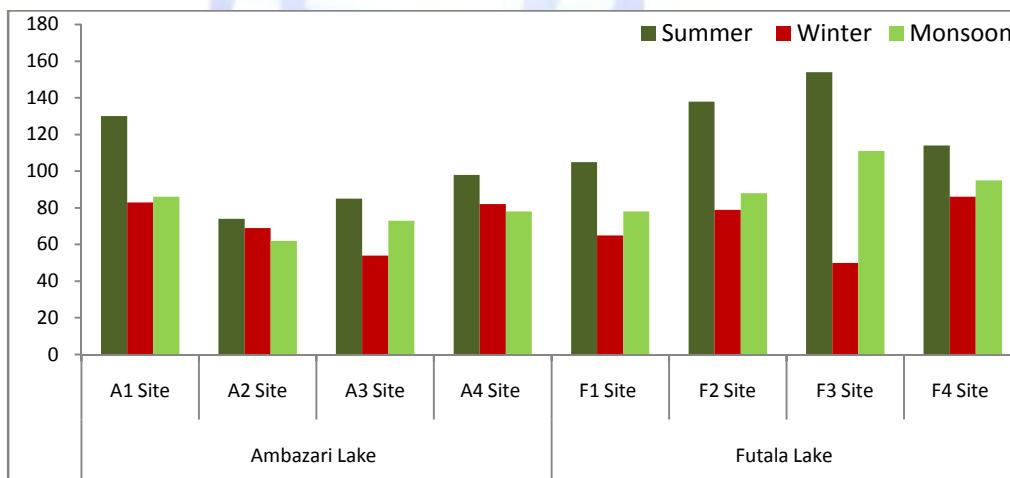


Fig. 4. Transparency of Ambazari Lake & Futala Lake Water Samples of Different Season

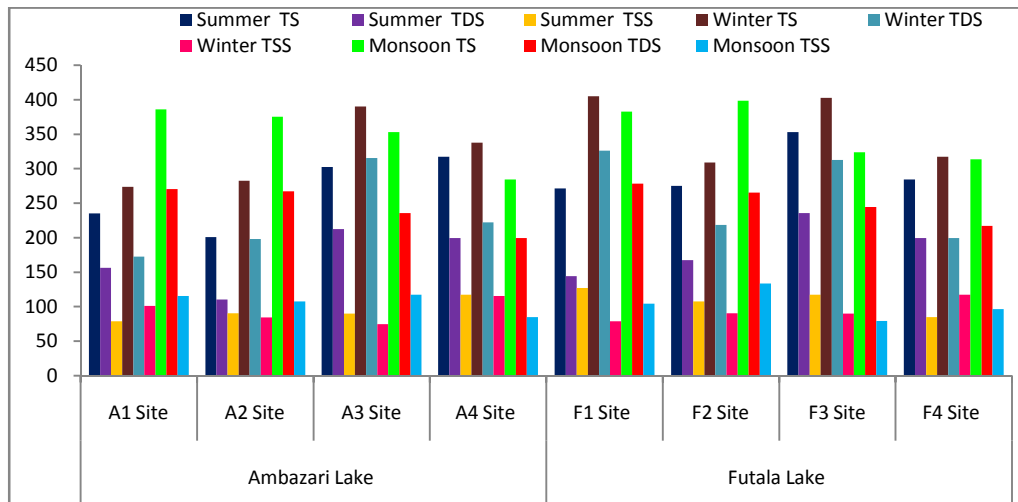


Fig. 5. TS/TDS/TSS of Ambazari Lake and Futala Lake water samples of Different Season

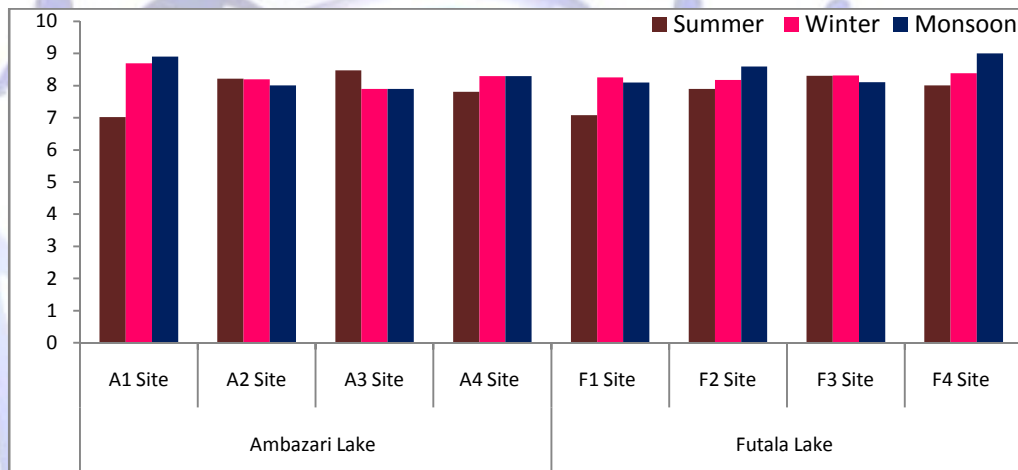


Fig. 6. pH of Ambazari Lake and Futala Lake Water Samples of Different Season

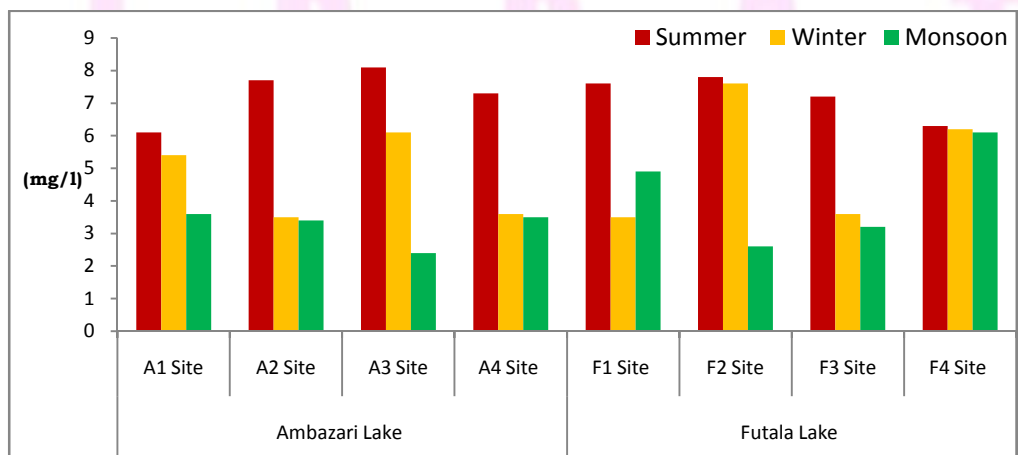


Fig. 7. DO of Ambazari Lake & Futala Lake water Samples of Different Season

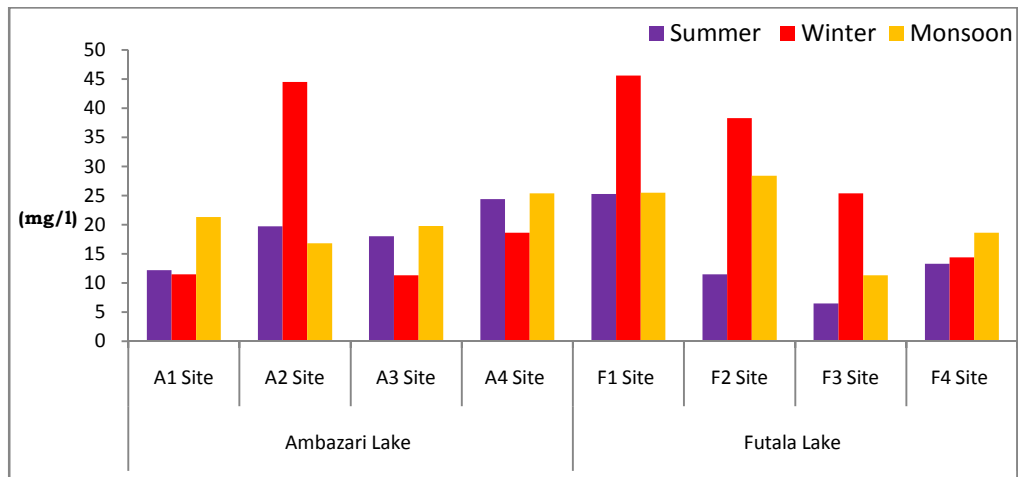


Fig. 8. BOD of Ambazari Lake & Futala Lake Water Samples of Different Seasons

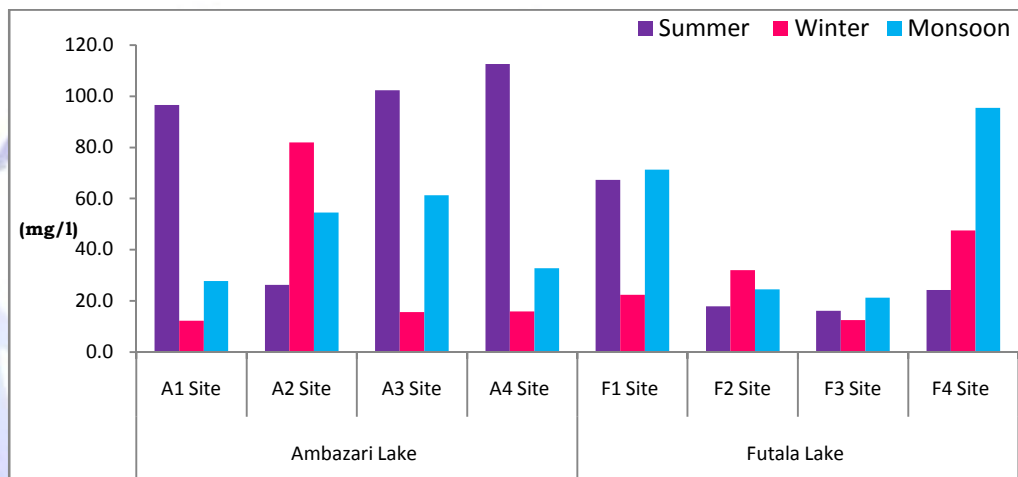


Fig. 9. COD of Ambazari Lake & Futala Lake of Water Samples in Different Season

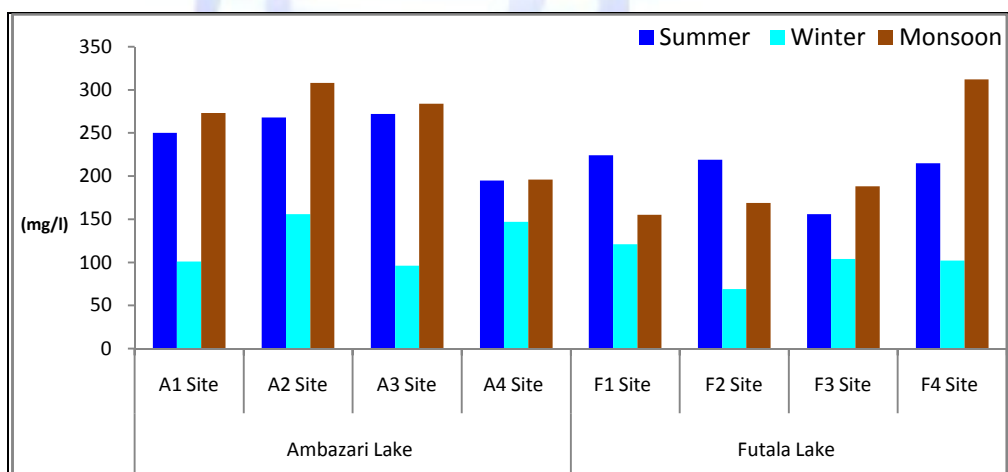


Fig. 10. Hardness of Ambazari Lake & Futala Lake of Water Samples in Different Seasons



Conclusion:

Assessment of water quality is an important factor for assessment of pollution levels. Drinking water or potable water is the term used for safe water, which is fit for human consumption. Water is one of the main sources for microorganisms, which cause health problems. As observed, the quality of water changes according to the seasons.

From the present study, the comparative analysis of Ambazari lake and Futala lake was found which is not acceptable and not fit for public use according to water quality standards (WHO, ISI, ICMR, FAO). This study revealed that the water in the area is not suitable for drinking and other domestic purposes. The comparative study also concluded that the any changes in water, the physico-chemical parameters are very much essential and it is also necessary for all living beings for metabolic reaction. Periodical assessment of both physico-chemical analysis of the area should be carried out, as this would be helpful in early detection of any future degradation. So Ambazari lake and Futala lake must be protected before it reaches the extent pollution.

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