Assessment Of Hydrobiological Status Of Select Lakes Of Nagpur City In View Of Anthropometric Interferences

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Abstract

The importance of freshwater has been realized the most in today's world and time. This is primarily because of the lack of it, which is to be blamed to the humankind for their discriminate use of this finite commodity. The technologically advanced countries have some data that they can use for better management of these precious resources i.e. freshwater lakes and rivers. The lakes in particular are at higher risk because of their landlocked nature, where the pollutants are easy to enter and difficult to exit. In view the above, this study was carried out to determine the prevailing situation of selected lakes of study area i.e. Nagpur District of Maharashtra vis-s-vis certain hydrobiological parameters. The data collection was carried out by conducting survey of the lakes and sample processing in a certified laboratory. Based on the study results, it was found that the primary utility of these lakes is for maintaining groundwater table, and two out of three lakes are at high risk of pollution due to anthropometric activities. The seasonal variation data showed that fish productivity and phytoplankton abundance was high during the summer season, while zooplankton abundance was high during the monsoon season. Overall, the data shows that there is a need to intervene by the local governing bodies to preserve these lakes.

Keywords: Freshwater, pollution, fish productivity, phytoplankton, zooplankton

1.0   Introduction

Not just in India but the world over, the quantity and quality of available freshwater is a big concern (Bose, 2003). Moreover, due to human intervention with the ecosystem, the idea of ecosystem health is also facing grave risk of adverse effect. Aquatic ecosystems are important as they serve as the last destination for "wash" from practically all sources (Goldman, and Horne, 1983). Because biotic systems must traverse a variety of terrains, they naturally accumulate contaminants and become "laden" with extrinsic material that degrades their ability to function naturally. In addition to above, the Lentic system's confined structure means

that when it becomes polluted, it stays in that state for a significantly longer time, frequently leading to lake ageing and eventually dying (Reddy and Char, 2004). Given that it is used for a variety of "human uses" and has an inherent normal quality range, and it is the duty of society members to keep such water bodies in the best condition possible. The utility by the stake holders is limited by the change in water quality (Kedar and Patil, 2011). The quality of clean river water can therefore vary depending on whether it is used for drinking, bathing, enjoyment, agriculture, or power generation.

Since, last few decades the use of freshwater has increased dramatically due to technological advancements. At this time, there is a global water shortage (of good quality water) due to careless water management (Avery and Tebbs, 2018). All people do not have equal access to the fresh water that is currently available at various places on the globe. Variations in the environment, the climate, and population factors are to blame for this (Karagul et al., 2005). The major freshwater resources include lakes, reservoirs, and wetlands because they provide water for the people throughout the entire year. By the water cycle, this is recycled (Kumar and Padhy, 2015). They keep the ecosystem's balance, which is necessary for other systems to function. It has very well established that the ecosystems in the lakes and reservoirs are extremely sensitive and complicated. Highly harmful chemicals are being dumped in discharge water due to better industrial development and greater usage of chemical fertilisers and insecticides (Mukherjee et al., 2019). Our freshwater bodies receive nutrients from agricultural fields and drainage systems (Chapman and Reiss, 1995). Thus, in order to preserve the ecosystem that they are a part of as well as to maximise the system's advantages, it is necessary to conduct specific and focussed studies to identify and ascertain the various risks prevailing for lakes of various cities (James, 2005).

It has been reported that water quality variations may cause abrupt changes in the aquatic life. The composition, distribution, and abundance of aquatic organisms are significantly influenced by the interactions between the physical and chemical components of water. As a result of the growing human population, industrialization, the use of fertilisers in agriculture, and other human-made activities, water bodies become contaminated with a variety of dangerous chemicals. Even when there is no pollution present, the quality of lakes varies with the seasons and geographical locations (Bhatt et al., 1999). Hence, the key physical and chemical factors affecting the aquatic environment that temperature, precipitation, salinity, dissolved oxygen, total suspended and dissolved solids, total alkalinity, acidity, etc. need to be assessed periodically. Moreover, these factors are crucial to aquatic organisms' (like zooplankton and fish's) ability to survive (Chitmanat and Traichaiyaporn, 2010). In view of the above, this study was carried out to determine the hydrological status of the selected lakes of study area i.e. Nagpur city of Maharashtra state.

2.0   Materials & Methods

In view of the above, the methodology adopted for this study has been illustrated in this section. The data pertaining to the primary use of lake water, threats to the water body, and fish productivity was collected from the officials of local governing bodies and residents. Phytoplankton and zooplankton enumeration was done using calibrated cell counters. Furthermore, the data of anthropometric activities at the selected lakes was recorded using field visits and interaction with the local people.

3.0 Results and Discussion

3.1 Primary use of lake

Table 1: Primary use of various lakes of Nagpur city

Primary use	Ambazari	Futala	Vena lake
Water table maintenance	+++	++	+
Recreation	+++	+++	–
Fishing	++	++	+++
Domestic water supply	–	–	+++
Industrial water supply	++	–	–

Extent of use: +: Low; ++: Moderate; +++: High; –: No

In view of the above, the lakes studied in this investigation were assessed for their primary used. The results of the same are presented **Table 1**. The data collected in the study showed that Ambazari and Futala Lakes are primarily used as a means for maintaining ground water table of the region, recreation and fishing. However, the other lake i.e. Vena Lake is primarily used as a means for fishing and local domestic water supply resource.

Lakes are a vital part of the water cycle, the system where water travels and is used. Lakes provide a place for water to collect and be stored. With their depths, water can run into a lake and stay for a period of time. The lakes perform multiple roles, which depends on their geographical location. In addition to above, lakes can have plenty of economic uses and important among them are they are tourist and local visitors' destination for recreation, water source for animals and birds, reservoir for fish, source of food, flood control, local groundwater table maintenance, domestic and industrial water supply, etc.

3.2 Threats to lake water quality

Table 2: Threats from natural and anthropometric activities (surface runoff entry, non point pollution, cattle grazing, bathing, etc.) to lake water quality

Lake	Probable threat
Ambazari	Moderate
Futala	High
Vena lake	Low/ No threat

In view of the above, the lakes studied in this investigation were assessed for their primary used. The results of the same are presented **Table 2**. The data collected in the study showed that threat from natural and anthropometric activities to lake water quality is high at Futala Lake due to immersion of idols and garbage dumping by nearby shops while this threat is moderate at Ambazari Lake. However, the other lake i.e. Vena Lake has no threat of natural and anthropometric activities.

Water resources are essential for life as we know it, in cultivated farmland, sustainability, human consumption, economic development, and environmental systems. Apart from anthropogenic activities, natural heterogeneities of rock/soil interact with water, influencing natural water cycles and affecting water

quality across all domains. Such modifications can have severe repercussions for the functioning of human health and the living organism. In addition, the physicochemical and biological characteristics, as well as quality, quantity and availability of water resources, fluctuate because of the impact of natural and human activities.

3.3   Seasonal variation in fish productivity

Table No. 3: Seasonal variation in fish productivity

Seasons		Ambazari	Futala	Vena lake
Summer	Mean	1.9	1.3	2.4
	SD	±0.3	±0.2	±0.1
	Min	1.7	1.1	2.1
	Max	2.1	1.5	2.6
Monsoon	Mean	1.6	0.9	2.6
	SD	±0.2	±0.1	±0.2
	Min	1.4	0.7	2.4
	Max	1.9	1.2	2.9
Winter	Mean	2.3	1.1	2.1
	SD	±0.2	±0.2	±0.3
	Min	2.1	0.9	1.8
	Max	2.5	1.4	2.3

SD: Standard deviation; **Min**: Minimum; **Max**: Maximum

Note: Seasonal values are mean values of 8 readings recorded in two years for each seasons

Table 3 presents information pertaining to seasonal variation in fish productivity values recorded at from various lakes of Nagpur city during the course of this study. The seasonal variation in fish productivity values are presented for three seasons i.e. summer, monsoon and winter. Average fish productivity recorded at Ambazari Lake during summer, monsoon and winter seasons was 1.9±0.3 tons/day, 1.6±0.2 tons/day and 2.3±0.2 tons/day. However, the fish productivity of Futala Lake was 1.3±0.2 tons/day in summer season, while it was 0.9±0.1 tons/day in monsoon and 1.1±0.2 during winter seasons. In addition to above, average of fish productivity of Vena Lake was recorded as 2.4±0.1 tons/day in summer season while it was 2.6±0.2 tons/day in monsoon and 2.1±0.3 tons/day during winter seasons. The comparative assessment showed that there is significant ($p<0.05$) seasonal variation in fish productivity of all three lakes i.e. Ambazari, Futala and Vena of Nagpur.

3.4   Seasonal variation in surface water phytoplankton

Table No. 4: Seasonal variation in surface water phytoplankton

Seasons		Ambazari	Futala	Vena lake
Summer	Mean	152	168	124
	SD	±10.2	±13.9	±14.8
	Min	134	154	109
	Max	169	180	148
Monsoon	Mean	149	158	113
	SD	±9.8	±10.5	±11.7
	Min	138	146	105
	Max	155	168	130
Winter	Mean	130	141	98
	SD	±10.1	±14.9	±13.2
	Min	120	134	94
	Max	142	152	105

SD: Standard deviation; **Min**: Minimum; **Max**: Maximum

Note: Seasonal values are mean values of 8 readings recorded in two years for each seasons

Table 4 presents information pertaining to surface water phytoplankton values recorded at from various lakes of Nagpur city during the course of this study. The surface water phytoplankton values are presented for three seasons i.e. summer, monsoon and winter. Average phytoplankton recorded at Ambazari Lake during summer, monsoon and winter seasons was 152 ± 10.2 ind./cm^3, 149 ± 9.8 ind./cm^3 and 130 ± 10.1 ind./cm^3. However, the phytoplankton of Futala Lake was 168 ± 13.9 ind./cm^3 in summer season, while it was 158 ± 10.5 ind./cm^3 in monsoon and 141 ± 14.9 ind./cm^3 during winter seasons. In addition to above, average of phytoplankton of Vena Lake was recorded as 124 ± 14.8 ind./cm^3 in summer season while it was 113 ± 11.7 ind./cm^3 in monsoon and 98 ± 13.2 ind./cm^3 during winter seasons. The comparative assessment showed that there is significant ($p<0.05$) seasonal variation in phytoplankton of all three lakes i.e. Ambazari, Futala and Vena of Nagpur.

3.5 Seasonal variation in surface water zooplankton

Table No. 5: Seasonal variation in surface water zooplankton

Seasons		Ambazari	Futala	Vena lake
Summer	Mean	88	92	74
	SD	±8.8	±8.2	±7.4
	Min	82	82	72
	Max	94	96	80
Monsoon	Mean	93	101	82
	SD	±7.5	±6.9	±7.2
	Min	88	95	77
	Max	98	108	90
Winter	Mean	90	94	77
	SD	±6.7	±8.1	±9.4
	Min	85	86	72
	Max	94	98	86

SD: Standard deviation; **Min**: Minimum; **Max**: Maximum

Note: Seasonal values are mean values of 8 readings recorded in two years for each seasons

Table 5 presents information pertaining to surface water zooplankton values recorded at from various lakes of Nagpur city during the course of this study. The surface water zooplankton values are presented for three seasons i.e. summer, monsoon and winter. Average zooplankton recorded at Ambazari Lake during summer, monsoon and winter seasons was 88 ± 8.8 ind./L^{-1}, 93 ± 7.5 ind./L^{-1} and 90 ± 6.7 ind./L^{-1}. However, the zooplankton of Futala Lake was 92 ± 8.2 ind./L^{-1} in summer season, while it was 101 ± 6.9 ind./L^{-1} in monsoon and 94 ± 8.1 ind./L^{-1} during winter seasons. In addition to above, average of zooplankton of Vena Lake was recorded as 74 ± 7.4 ind./L^{-1} in summer season while it was 82 ± 7.2 ind./L^{-1} in monsoon and 77 ± 9.4 ind./L^{-1} during winter seasons. The comparative assessment showed that there is significant ($p<0.05$) seasonal variation in zooplankton of all three lakes i.e. Ambazari, Futala and Vena of Nagpur.

4.0 Conclusions and Recommendations

The conclusions are drawn on the basis of results that are obtained on the basis of statistical analysis of the data. The major conclusions are as follows.

4.1 Lake water use and threats to lake water quality

4.1.1 Primary use of lake

- In view of the study results it is concluded that the primary use of Ambazari and Futala Lakes of study area are ground water table maintenance in the region, while the purpose of Vena Lake is fishing and domestic water supply.

4.1.2 Threats to lake water quality

- From the study results it is evident that the threat from natural and anthropometric activities is moderate to Ambazari Lake, high to Futala Lake and Low to no threat to Vena Lake.

4.2 Seasonal variation in fish productivity

- The comparative assessment showed that there is significant (p<0.05) seasonal variation in fish productivity of all three lakes i.e. Ambazari, Futala and Vena of Nagpur. The surface water fish productivity was high at Ambazari lake during winter while it was high at Futala lake during summer and fish productivity was high at Vena lake during monsoon season.

4.3 Phytoplankton and Zooplankton

4.3.1 Seasonal variation in surface water phytoplankton

- The comparative assessment showed that there is significant (p<0.05) seasonal variation in phytoplankton of all three lakes i.e. Ambazari, Futala and Vena of Nagpur. The surface water phytoplankton was high at all the lakes during the summer season.

4.3.2 Seasonal variation in surface water zooplankton

- The comparative assessment showed that there is significant (p<0.05) seasonal variation in zooplankton of all three lakes i.e. Ambazari, Futala and Vena of Nagpur. The surface water zooplankton was high at all the lakes during the monsoon season.

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