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Seasonal variation of Water quality in the Peri urban Lakes of Bengaluru Urban area, Karnataka, India

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Abstract— Seasons are in general termed by the rainfall and temperature patterns expected during different times of the year. The season varies greatly depending on our geographic location, however lakes and ponds commonly respond in similar ways to the same ecological inputs. Hence, seasonal variations of physico-chemical analysis of lake water is of prime importance to indicate the pollution loads or inputs from different angles either natural or manmade. To bear out the objective of the assessment of Annual and Seasonal variation of Water quality, a total of 7 lakes were selected for sampling in the peri-urban area of Vrishabhavathi river basin in Byramangala series of Bengaluru Urban area. Sampling and analysis was carried out for 3 years from January 2012 to February 2015. Sampling points were carefully chosen in order to assess the general characteristics of lake water quality by following standard method APHA, 2012 procedures and Global Environmental Monitoring system GEMS, 1992 guidelines. The Variation trend reveled that, nitrate values of all the lakes during study period are changing drastically with the seasons and are due to manmade intrusions with rapid developments within and around the peri-urban lakes the concentrations. The variations of phosphates are also alarming too for the detoriation of peri-urban lakes. The influence of development activities in the peri-urban area are the causal of drastic variations in lakes and are to be monitored by the government authorities by imposing stringent guidelines.

Keywords— *Water quality, lake, Peri urban, Bengaluru, Seasonal*

I. INTRODUCTION

Seasons are in general termed by the rainfall and temperature patterns expected during different times of the year. As for Lake Water is concerned, the lake water plays a key role in different vital activities. Water is a vital component for provisions of life. It governs almost all our activities be it domestic, industrial or of agricultural needs [1] and it has a great social and economic value ultimately affecting human health [2]. The season varies greatly depending on our geographic location, however lakes and ponds commonly respond in similar ways to the same ecological inputs. Since, the Bengaluru city is growing rapid developments in and around the city and facing the manmade inputs in terms of pollutants. The present studies investigate seasonal variations of physico-chemical analysis of lake water is of prime importance to indicate the pollution loads or inputs from different angles either natural or manmade.

II. PREVIOUS RESEARCH

In the last two decades, urban water bodies have been a victim of unplanned urbanization in India, because of which they face several threats like pollution due to entry of sewage and effluents, encroachment, eutrophication, illegal mining activities, ungoverned tourist activities and cultural misuse. Further as cities expand further, they form regional agglomerations, with step-changes in economies of scale taking place, and a new type of peri-urban territory developing. Exploring the dynamics of peri-urban change and the peri-urbanization process makes it clear that, the dimensions views are at more than one aspect, not only in physical scales, but also in understanding the complexity of the system. A research on the ecological status and conservation strategies of five lakes in Bengaluru, namely Bandematta Hosakere, Odegerahalli Dobasipalyakere, Manganahalli Haranakatte, Kannahalli, and Ramasandra Chikkakere reported that, the lakes are polluted due to sewage entry, encroachment, exploitation of lake water, climate change and developmental activities [3]. Further, a group of researchers study on impact of municipal and industrial pollution on Byramanagala reservoir revealed that, the huge amount of wastewater is being discharged into Byramangala reservoir without subjecting them to further secondary or advanced treatments and converting it into a reservoir of sewage. It is also stated that, the water turned

toxic with the discharge of industrial effluents, as Bidadi industrial area is situated in the bank of Byramangala lake which includes numerous heavy metal factories, textile industries, electroplating industries and most of these industries lack proper wastewater disposal facilities [4].

III. MATERIALS AND METHODS

Description of Study Area: To bear out the objective of the assessment of Annual and Seasonal variation of Water quality in the Peri urban Lakes of Bengaluru Urban area, Karanataka, India, 7 lakes namely Dorekere lake, Hosakerehalli lake and Subramanyapura lake, Margondanahalli Hosakere lake, Kommaghatta lake, Bandematta lake and Byramangala lake were selected for sampling in the peri-urban area of Vrishabhavathi river basin in Byramangala series. Sampling points were carefully chosen in order to assess the general characteristics of lake water quality by following standard method APHA, 2012 procedures [5] and Global Environmental Monitoring system GEMS Global Environmental Monitoring System/Water operational Guide, 1992 guidelines [6].

Table 1: Sampling coordinates of lakes in the study area

Name of the lake	Latitude	Longitude
Margondanahalli Hosakere	12°56'07.98"N	77°26'01.41"E
Kommaghatta	12°55'49.10"N	77°27'58.67"E
Bandematta	12°55'28.27"N	77°28'51.71"E
Hosakerehalli	12°92'54.37"N	77°53'39.96"E
Dorekere	12°90'29.03"N	77°51'10.65"E
Subramanyapura	12°89'68.77"N	77°54'24.64"E
Byramangala	12°75'95.42"N	77°41'85.19"E

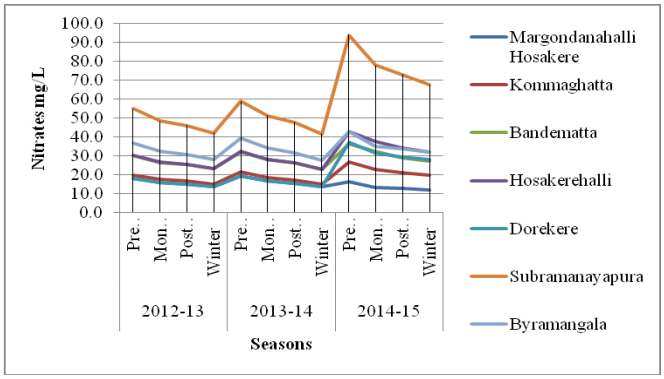
Sampling period: Sampling and analysis of physico-chemical parameters was carried out for 3 years from January 2012 to February 2015. Samples were collected quarterly according to seasons classified by Indian Meteorological Department and were divided as; Winter - January to February; Pre-Monsoon- March, April and May; Monsoon season - June, July, August and September and Post-Monsoon season - October, November and December.

Lake water sampling: The water samples were collected from different sampling points of the lakes. The sampling was done in the morning hours from three sampling points in the lakes. The sampling points were selected to represent the water quality at different points, the inlets – points where the feeder opens into the lake, in the centre – the point which represents a general water quality of the lake and the outlets – the place where the overflow occurs. Samples were collected in clean plastic bottles of 2 liters capacity. Samples were collected seasonally. The samples were brought to the laboratory and were subjected to physico-chemical analysis. Laboratory analysis for each samples were carried out for Nitrates in mg/L (Phenoldisulphonic method) and Phosphates in mg/L by following the standard procedures and methods prescribed by APHA.

IV. RESULTS AND DISCUSSION

Water quality is affected by a wide range of natural and human influences and the quality of life is linked with quality of environment. Hence, the biological components of fresh water depend solely on physico-chemical characteristics. The Annual and Seasonal variation of Water quality in the Peri urban Lakes of Bengaluru Urban area is detailed in Annexure1 and 2 and Graph 1and 2 for Nitrates and Phosphate concentrations respectively.

Nitrates: Nitrogen is also an important nutrient for plant and algae growth. Sources of nitrogen to a lake vary widely, ranging from fertilizer and animal wastes, to human waste from sewage treatment plants or failing septic systems, to groundwater, air and rainfall. As a result, it is very difficult to control or reduce nitrogen inputs to a lake. Different forms of nitrogen are present in a lake under different toxic conditions. Ammonium is released from decomposing organic material under anoxic conditions and accumulate in the hypolimnion of thermally stratified lakes. If ammonium comes into contact with oxygen, it is immediately converted to nitrite which is then oxidized to nitrate.

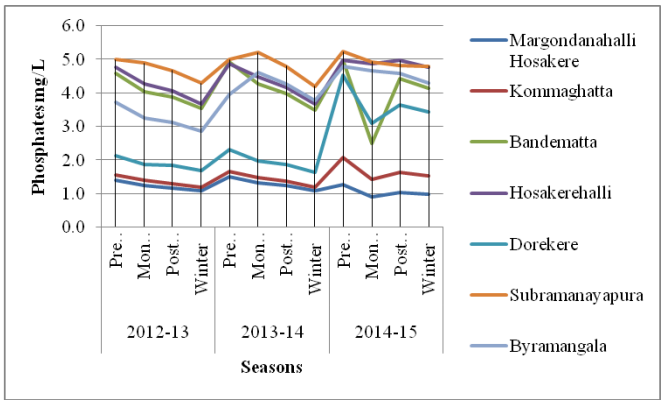


Graph 1: Annual and seasonal variation of nitrates concentration in lake water

During the year 2012-13, nitrate content recorded in the lake water ranged from 13.9mg/L to 55mg/L. Subramanyapura lake recorded maximum nitrate of 55mg/L during pre-monsoon. Margondanahalli Hosakere recorded a minimum nitrate of 13.9mg/L during winter season. The maximum nitrate content with a mean and standard deviation of 48±5.3mg/L was recorded in Subramanyapura lake and Minimum of 15.7±1.7mg/L was recorded in Dorekere lake.
During the year 2013-14, nitrates content recorded in the lake water ranged from 13.7mg/L to 59.0mg/L. Subramanyapura lake recorded maximum nitrate of 59mg/L during pre-monsoon. Margondanahalli Hosakere recorded a minimum

nitrate of 13.7mg/L during winter season. The maximum nitrate content with a mean and standard deviation of 50±7.2mg/L was recorded in Subramanyapura lake and minimum of 16.4±2.4mg/L was recorded both in Margondanahalli Hosakere lake and Dorekere lake. During the year 2014-15, the nitrate content recorded in the lake water ranged from 13.9mg/L to 55mg/L. Subramanyapura lake recorded maximum nitrate of 55mg/L during pre-monsoon season. Margondanahalli Hosakere lake recorded a minimum nitrate of 12.2mg/L during winter season. The maximum nitrate content with a mean and standard deviation of 78.3±11.4mg/L was recorded in Subramanyapura lake and Minimum of 13.8±1.8mg/L was recorded in Margondanahalli Hosakere lake. During the study period, nitrate content was found ranging between 12.2mg/L to 94mg/L. The maximum levels were noticed in pre-monsoon in Subramanyapura lake and the lowest levels in Margondanahalli Hosakere lake. The maximum nitrate content with a mean and standard deviation of 78.3±11.4mg/L in Subramanyapura lake and minimum of 13.8±1.8mg/L was recorded in Margondanahalli Hosakere lake. Maximum concentration of Nitrate in Subramanyapura lake and Byramangala lake is due to increasing loadings of organic waste disposal. The recorded lakes receive industrial effluents through inlets. The concentration of nitrates is indication of level of micronutrients in water bodies and has ability to support plant growth. Nitrate concentration depends on the activity of nitrifying bacteria which in turn get influenced by presence of dissolved oxygen. High concentration of nitrate favored growth of phytoplankton. Identical findings in examining the lakes study of Bengaluru also showed the result in the Byramangala and Bengaluru lakes [7,8]. Out of 7 lakes studied, only Subramanaypura lake is exceeded the limit of 50mg/L for nitrates as per IS 2296-1982 for inland water surface water. Decrease in nitrate content during winter months was probably due to its utilization as nutrient by the algal community as evidenced by the luxuriant growth of algae particularly in the winter months.

Phosphates: Phosphorus occurs in natural waters and in wastewater almost solely as Phosphates. These are classified as Orthophosphates, condensed Phosphates (pyro-, meta-, and other polyphosphates) and organically bound phosphates. They occur in solution, in particles or detritus or in the bodies of aquatic organisms. Orthophosphate is the phosphorus form that is directly taken up by algae, and the concentration of this fraction constitutes an index of the amount of phosphorus immediately available for algal growth. Phosphorus is essential for the growth of organisms and can be the nutrient that limits the primary productivity in water [9].



Graph 2: Annual and seasonal variation of phosphate concentration in lake water

During the year 2012-13, the phosphate concentration recorded in the lake water ranged from 1.07mg/L to 5.0mg/L. Subramanyapura lake recorded maximum phosphate content of 5.0mg/L during pre-monsoon season. Margondanahalli Hosakere recorded a minimum phosphate content of 1.07mg/L during winter season. The maximum phosphate content with a mean and standard deviation of 4.7±0.3mg/L was recorded in Subramanyapura lake and minimum of 1.2±0.1mg/L was recorded in Margondanahalli Hosakere lake. During the year 2013-14, the phosphate concentrations recorded in the lake water ranged from 1.07mg/L to 5.20mg/L. Subramanyapura lake recorded maximum phosphate content of 5.20mg/during monsoon season. Margondanahalli Hosakere recorded a minimum phosphate content of 1.07mg/L during winter season. The maximum phosphate content with a mean and standard deviation of 4.8±0.4mg/L was recorded in Subramanyapura lake and minimum of 1.3±0.2mg/L was recorded in Margondanahalli Hosakere lake. During the year 2014-15, the phosphate concentration recorded in the lake water ranged from 0.90mg/L to 5.23mg/L. Subramanyapura lake recorded maximum phosphate content of 5.23mg/L during pre-monsoon season. Margondanahalli Hosakere recorded a minimum phosphate content of 0.90mg/L during monsoon season. The maximum phosphate content with a mean and standard deviation of 5±0.2mg/L were recorded both in Subramanyapura lake as well as Byramangala lake and minimum of 1±0.2mg/L was recorded in Margondanahalli Hosakere lake. During the study period, phosphate concentrations were recorded between 0.9mg/L to 5.23mg/L. The maximum value was recorded during pre-monsoon in Subramanyapura lake and the lowest value recorded in Margondanahalli Hosakere lake. The maximum phosphate content with a mean and standard deviation of 5±0.2mg/L were recorded both in Subramanyapura lake as well as Byramangala lake and minimum of 1±0.2mg/L was recorded in Margondanahalli Hosakere lake. The maximum concentrations of phosphate recorded in Subramanyapura lake are due to release of phosphate from bottom sediment

and organic load of the water from direct entry of sewage and runoff from the upland areas. Use of detergents in lakes also increased the phosphate concentration. Subramanyapura lake phosphate concentration exceeded maximum limit prescribed by IS 15000:1991 of 5mg/L for drinking water standards. Whereas "Limnology "reports that, the unpolluted lake phosphates limit as 30µg/L [10]. If the lake water exceeds the limit, then the lake will be towards eutrophication. The sewage and detergent of phosphorus to the lake have a considerable effect on the quality of the water. Such phosphorus is derived mainly from domestic sewage and the runoff from agricultural areas [1,12,13].

CONCLUSION:

The Variation trend recorded in nitrate concentrations of all the lakes during study period are changing drastically with the seasons. The maximum concentrations were recorded in Pre Monsoon seasons and the lowest concentrations were recorded during winter Season. The Variations in seasonal concentrations are due to manmade intrusions with rapid developments within and around the peri-urban lakes the concentrations vaiations of phosphates are also alarming too for the detoriation of peri-urban lakes. Monitoring the phytoplanktonic production, avoiding the decay of macrophytes, reduction of nutrients inflow, release of phosphate from bottom sediment, organic load of the water from direct entry of sewage and runoff from the upland areas, use of non phosphate detergents can mitigate the nitrate and Phosphates concentration variations.

REFERENCES

[1] R.S.Panwar, K.S. Makvana, "Treatment of domestic wastewater by Cattail (Typhalatifolia) based natural wetland system in southern locality of Ujjain city in central India", International Journal of Scientific Research in Biological Sciences, Vol.4, Issue.3, pp.1-6, 2017.

[2] V. Kesre, L.K. Mudgal, D.R. Khanna, G. Matta,, D. Kumar, "Study of Physico-chemical Parameters for a Reservoir at Khandwa District, M.P. India", Waste and Water Management. Vol.2, pp.201-207, 2011.

[3] N. Nandini, M. Vijay Kumar, K. Bheemappa, "Ecological Status and Conservation Strategies of Lakes-A Case Study on Bangalore South, International Journal of Emerging Technologies in Computational and Applied Sciences, Vol.3, No.4, pp.303-307, 2013.

[4] G. Robert Wetzel. "Limnology: Lake and River Ecosystems", 5th Edition, Academic Press an imprint of Elsevier, 2003.

[5] APHA, "Standard Methods for Examination of Water and Wastewater", Washington: American Public Health Association, 22nd ed, 2012.

[6] GEMS, "Global Environmental Monitoring System/Water operational Guide", 3rd edition, pp.1-59, 1992.

[7] M. Inayathulla, J.M. Paul, "Water Quality Index Assessment of Ground Water in Jakkur Sub Watershed of Bangalore, Karnataka, India", International Journal of Civil, Structural, and infrastructure Engineering Research and Development (IJCSEIERD), Vol.3, pp. 99-108, 2013.

[8] V. Pattusamy, N. Nandini, M. Vijaykumar, K. Bheemappa, "Water quality studies of Bellandur Lake, Urban Bangalore, Karnataka, India". International Journal of Advanced Research, Vol.1, pp.77-82, 2013.

[9] T.V. Ramachandra, H.S. Sudhira, "Present status of Gottigere Tank: Indicator of Decision maker's apathy". Energy and Wetlands Research Group, pp.1-11, 2007.

[10] G. Robert Wetzel. "Limnology: Lake and River Ecosystems", 5th Edition, Academic Press an imprint of Elsevier, 2003.

[11] M. Sondergaard, J.P. Jensen, E. Jeppesen, "Role of sediment and internal loading of phosphorus in shallow lakes", Hydrobiologia, Vol.506, No.1, pp.135-145, 2003.

[12] S. Kundu, M.V. Coumar, S. Rajendiran, A.S. Rao, "Phosphates from detergents and eutrophication of surface water ecosystem in India", Current Science, Vol.108, No.7, pp.1320-1325, 2015.

V. Pattusamy, N. Nandini, K. Bheemappa, "Detergent and sewage phosphates entering into Lake Ecosystem and its impact on aquatic environment". Int. J. Adv. Res, Vol.1, No.3, pp.129-133, 2013.

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K. Bheemappa pursued his Master of Science in Environmental Science subject from the Bangalore University and Ph.D Scholar at Bangalore University, Bangalore. He worked as technical assistant in the same department. His research fields are Physico chemical, Ground water quality and Shoreline management aspects of lakes in peri-urban areas.

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Annexure 1: Annual and seasonal variation in Nitrates in lake water (mg/L)

Year	2012-13				2013-14				2014-15			
Lakes ↓ Season →	Pre Monsoon	Mon soon	Post Monsoon	Winter	Pre Monsoon	Mon soon	Post Monsoon	Winter	Pre Monsoon	Mon soon	Post Monsoon	Winter
Margondanahalli Hosakere	18.10	15.90	15.10	13.90	19.30	16.90	15.70	13.70	16.40	13.60	13.00	12.20
Kommaghatta	20.10	17.70	16.90	15.50	21.60	18.80	17.50	15.30	26.90	23.00	21.30	20.10
Bandematta	30.30	26.60	25.40	23.30	32.40	28.20	26.30	22.90	36.60	32.80	29.10	27.40
Hosakerehalli	30.20	26.60	25.30	23.20	32.40	28.20	26.20	22.90	42.80	37.60	34.00	32.00
Dorekere	18.00	15.90	15.10	13.90	19.30	16.80	15.60	13.70	37.40	31.50	29.70	28.00
Subramanayapura	55.00	48.50	46.10	42.30	59.00	51.30	47.80	41.70	94.00	78.20	73.10	67.70
Byramangala	36.70	32.30	30.70	28.20	39.30	34.20	31.80	27.80	42.80	35.10	34.00	32.10

Annexure 2: Annual and seasonal variation in phosphates in lake water (mg/L)

Year	2012-13				2013-14				2014-15			
Lakes ↓ Season →	Pre Monsoon	Mon soon	Post Monsoon	Winter	Pre Monsoon	Mon soon	Post Monsoon	Winter	Pre Monsoon	Mon soon	Post Monsoon	Winter
Margondanahalli Hosakere	1.40	1.23	1.17	1.07	1.50	1.33	1.23	1.07	1.27	0.90	1.03	0.97
Kommaghatta	1.57	1.40	1.30	1.20	1.67	1.47	1.37	1.20	2.07	1.43	1.63	1.53
Bandematta	4.57	4.03	3.87	3.53	4.93	4.27	3.97	3.50	4.97	2.50	4.43	4.13
Hosakerehalli	4.77	4.27	4.07	3.67	4.87	4.47	4.17	3.67	4.97	4.87	4.97	4.77
Dorekere	2.13	1.87	1.83	1.67	2.30	1.97	1.87	1.63	4.53	3.10	3.63	3.43
Subramanayapura	5.00	4.90	4.67	4.30	5.00	5.20	4.80	4.20	5.23	4.93	4.83	4.80
Byramangala	3.73	3.27	3.13	2.87	3.97	4.63	4.27	3.77	4.80	4.67	4.60	4.30

