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***Research Article** (Open Access)*

OXYGEN DEMANDING PARAMETERS' VARIATIONS IN AMBALA LAKE OF RAMTEK TEHSIL OF NAGPUR DISTRICT, MAHARASHTRA, INDIA

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ABSTRACT
The seasonal variations of Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) & Chemical Oxygen Demand (COD) were analyzed in summer, monsoon & winter season to assess the water quality of Ambala lake of Ramtek Tehsil of Nagpur District, Maharashtra, India. During summers DO was found to be decreased but has shown prominent values during monsoon. Due to increased temperature in summer, decreased DO level are observed. BOD & COD was high during summers followed by winter & monsoon. In the present study all these physicochemical parameters are found within the permissible limits at the study sites during the different seasons.

Keywords: *Water Assessment, Ambala Lake, Water Analysis, Water Analytical Techniques, DO, BOD, COD*

INTRODUCTION
Environmental quality is majorly focused on water because of its importance in maintaining the human health and health of the ecosystem. Availability of Fresh water resources are essential for agriculture, industry and even human existence, without fresh water of adequate quantity and quality, sustainable development will not be possible (Awoyemi *et al.*, 2014).
India is facing a serious problem of natural water resource scarcity, in view of population growth and economic development. Most of fresh water bodies all over the world are getting polluted, thus decreasing the potability of water. Truly speaking chemically pure water does not exist for any appreciable length of time in nature (Bonacci, 2004).
A lake is a large body of water surrounded by land, inhabited by various aquatic life forms, for all practical purpose, pure water is considered to that which has low dissolved or suspended solids and obnoxious gases as well low in biological life. The health of lakes and their biological diversity are directly related to health of almost every component of the ecosystem. As usual, lakes are subjected to various natural processes taking place in the environment like the hydrologic cycle, with unprecedented development activities; human beings are responsible for choking several lakes to death. Storm water runoff and discharge of sewage into the lakes are few of the common causes where various nutrients enter the aquatic ecosystems resulting in their death. Of all the water quality issues facing lakes everywhere, eutrophication is of great concern. Eutrophication is a term used to describe the aging of a lake, resulting due to the accumulation of nutrients, sediments, silt and organic matter in the lake from the surrounding watershed. The role of vegetation and sediments as sources and sink of nutrients has been demonstrated (Dorlikar, 2018, Dorlikar *et al.*, 2013).
It is, therefore, very important to keep the quality of water good for human consumption. Physico-chemical characteristics play key role in evaluating the suitability of water for irrigation and drinking purposes. The objective of the present investigations was to determine the physicochemical properties of water i.e. Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) & Chemical Oxygen Demand (COD) and to analyze its seasonal variation (Gorde *et al.*, 2013).

MATERIALS AND METHODS

1.1 Geographical Location

There is a very famous lake in the name of 'Ambala Lake' which is located in the Ramtek Tahsil of Nagpur district in Maharashtra, India, is selected for the study. This Ambala Lake having GPS coordinates 21° 23′ 32.68″ N, 79° 20′ 41.9″ E with a surface area of 5.5Km^2 has got its ancient historical importance. This water body is half surrounded by natural habitat and half by natural forest. During rainy season the water from hills get collected in this lake which is a source of pollution. Four sites are identified on this water body and the samples were collected in summer, winter & monsoon season in 2022-23 and 2023-24.

1.2 Water Sample

The water samples are collected from the marginal areas at 1 to 1.5 m depth from four selected sites of the lake i.e. East, West, North & South. The water samples are collected in dried plastic cans of 2 lt. capacity and are analyzed in the laboratory. The samples are collected every month for the period of 2 years i.e. February 2022 to March 2024. The purpose of sampling was to handle the water sample very carefully in such a way that no significant changes occur in composition before the tests are made. The bottles were properly labeled with the sample number and date of sampling and were put in the bag to carry them to the lab. The bottles were tightly closed after being filled & stored at room temperature. The recorded data is segregated in 3 seasons i.e. summer (February to May), Monsoon (June to September) and Winter (October to January). During the monitoring, physicochemical parameters like atmosphere temperature, water temperature, pH and transparency are determined on the sampling spot while the other parameter are determined in the laboratory as per the standard methods of APHA (2005) (APHA, 2005).

As per the APHA guidelines following standard methods were used to analysed Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) & Chemical Oxygen Demand (COD):

Table 1.1: Methods for Investigation Physicochemical Parameters (APHA, 2005)

S.N.	**Physicochemical Parameters**	**Standard Methods Used**
1	Dissolved Oxygen (DO)	Winkler's method
2	Biological Oxygen Demand (BOD)	Winkler's method
3	Chemical Oxygen Demand (COD)	Reflux Titration method

RESULTS & DISCUSSION

1.3 Dissolved Oxygen (DO)

D.O. is the dissolved gaseous form of oxygen. It is essential for respiration of fish and other aquatic organisms. D.O. enters water by diffusion from the atmosphere and as a by- product of photosynthesis by algae and plants. The concentration of D.O. in epilimnetic waters continually equilibrates with the concentration of atmospheric oxygen to maintain 100% D.O. saturation. Excessive algae growth can over-saturate (greater than 100% saturation) the water with D.O. when the rate of photosynthesis is greater than the rate of oxygen diffusion to the atmosphere. Hypolimnetic D.O. concentration is typically low as there is no mechanism to replace oxygen that is consumed by respiration and decomposition (Ingale *et al.*, 2016, Meshram *et al.*, 2014, Sitre, 2013).

Thus DO in the surface water is important parameter because it indicates the status of biological degradation of sewage by aerobic and anaerobic microorganisms. Aerobic microorganisms require free oxygen however anaerobic microorganisms react with the chemically bound oxygen from nitrates & sulphates etc. DO levels of 6mg/l are considered optimal for proper growth of fish and other aquatic life. As dissolved oxygen levels in water drop below 5.0 mg/l, aquatic life is put under stress. Most fishes cannot survive for prolonged periods at DO levels below 3 mg/l. Oxygen-demanding organic matter particularly requires the oxygen from water for the process of decomposition. More organic waste in water results in to decrease in average DO concentrations. However, in water bodies where a large proportion of the organic matter is brought in from outside the water bodies, the oxygen production and consumption are not balanced and DO may decrease (Sitre, 2013, Tapase *et al.*, 2015, Tapase, 2014).

The seasonal variation of DO during the year 2022-23 and 2023-24 is as shown in Figure 1:

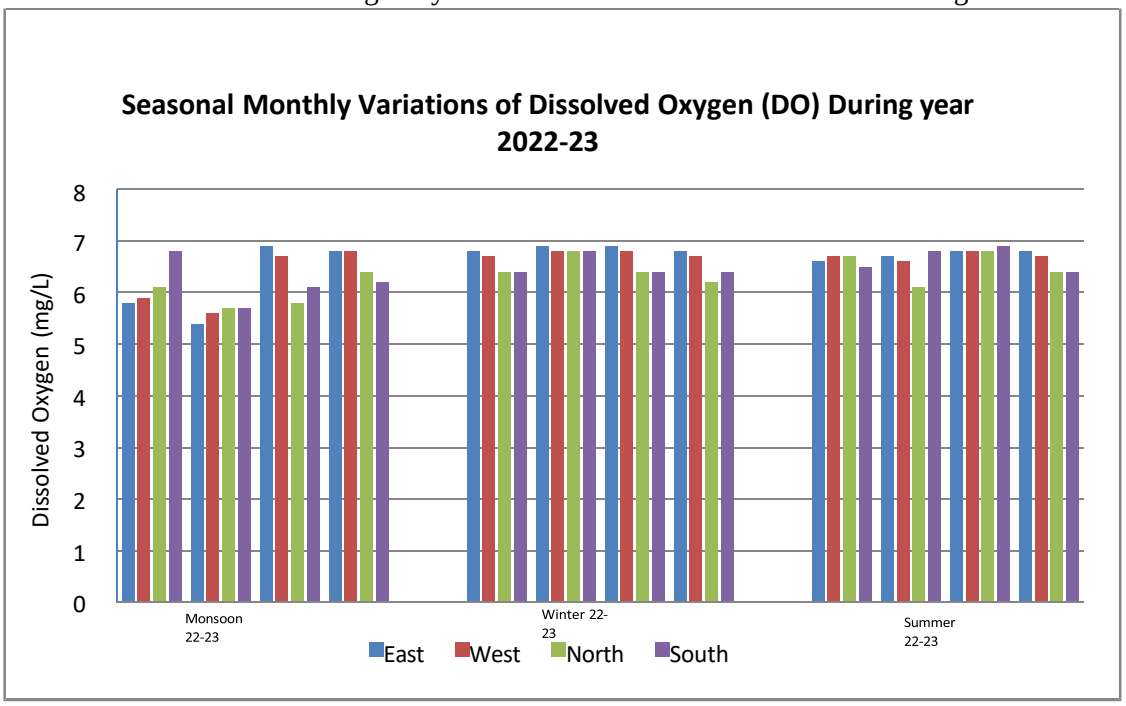
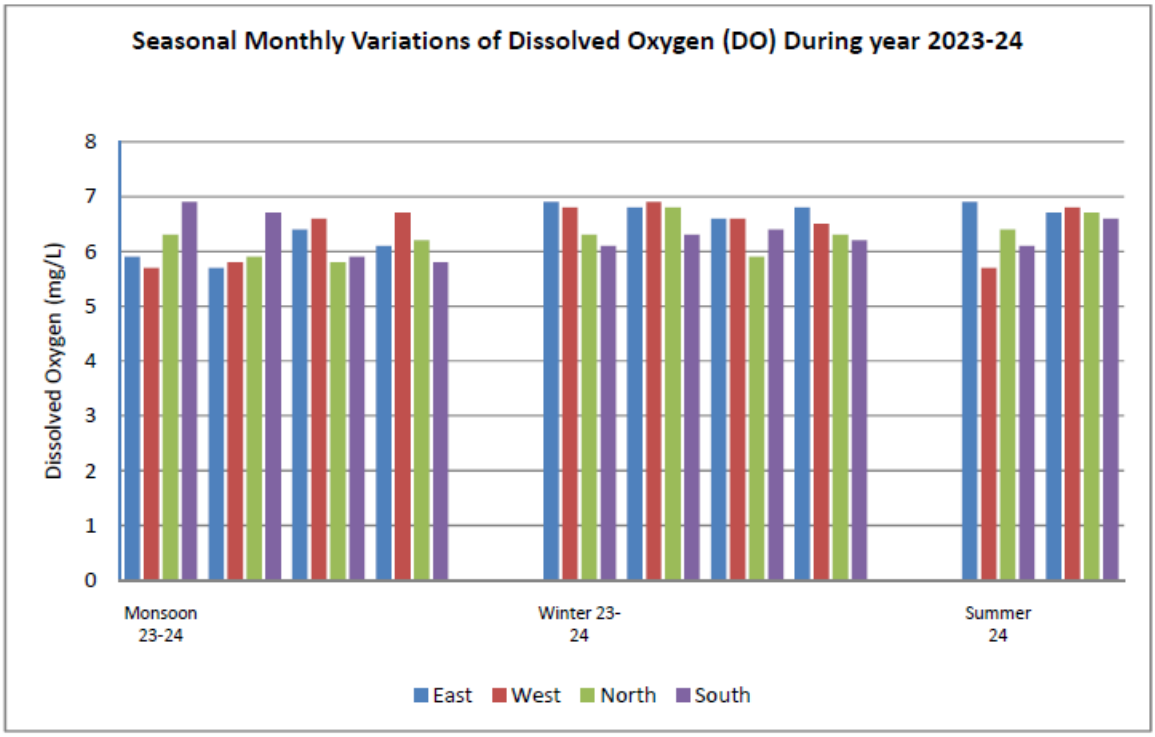


Figure 1: Seasonal Monthly Variations of Dissolved Oxygen (DO) During year 2022-23



. Figure 2: Seasonal Monthly Variations of Dissolved Oxygen (DO) During year 2023-24

In Figure 1, season-wise monthly variation of Dissolved Oxygen (DO) is shown during the year 2022-23 taken at four sites i.e. East, West, North & South. During the year 2022-23 the average DO value for all the three seasons is 6.48 mg/l at all the four locations.
It is also observed that, in 2022-23, during monsoon variation in DO values is 6.17±0.5 mg/l, during winter it is 6.64±0.23 mg/l and during summer it is 6.64±0.21 mg/l.
During the year 2023-24, season-wise monthly variation of Dissolved Oxygen (DO) is shown in Figure 2 taken at four sites i.e. East, West, North & South. During the year 2023-24 the average DO value for all the three seasons is 6.38 mg/l. It means there is hardly any season wise difference in DO.
It s also observed that, in 2023-24, during monsoon variation in DO values is 6.15±0.4 mg/l, during winter it is 6.51±0.31 mg/l and during summer it is 6.49±0.41 mg/l.
From above observation it is clear that the average DO level in the water body is above 6.5mg/l irrespective of any season which means that this water body is adequate enough for the survival of aquatic organisms and also the water quality is safe for safe human use (Mozumder, 2010, Mulani *et al.*, 2009, Karmakar, 2021).

1.4 Biological Oxygen Demand (BOD)

BOD is the amount of the oxygen required by microorganisms for the decomposition of the organic matter present in water. Therefore, it reflects the amount of organic pollutants in water. A high BOD value indicates the presence of a large number of microorganisms, which shows a high level of pollution (Karra *et al.*, 2018).
The seasonal variation of BOD during the year 2022-23 and 2023-24 is as shown in Figure 3:

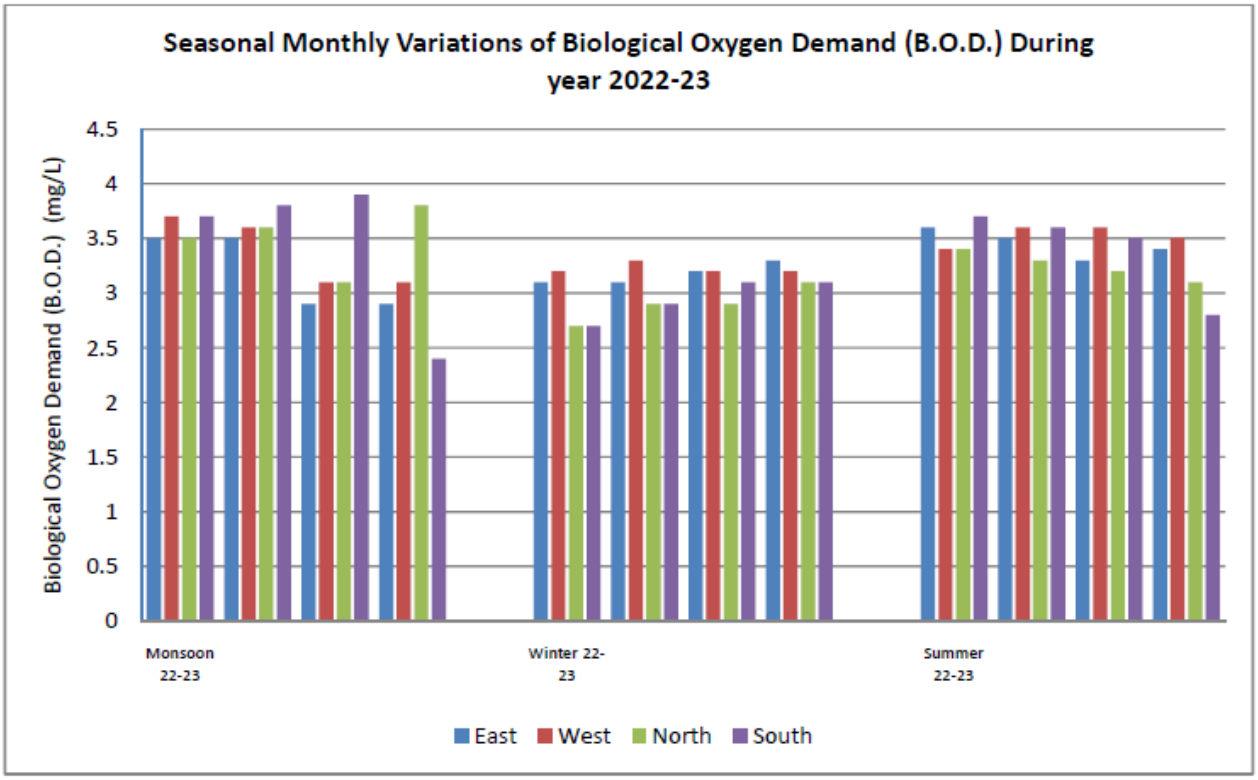


Figure 3: Seasonal Monthly Variations of Biological Oxygen Demand (BOD) during year 2022-23

Seasonal Monthly Variations of Biological Oxygen Demand (BOD) during year 2022-23 taken at four sites is shown in FIGURE 3. In the 2022-23, the variation on the BOD values during

monsoon is observed to be 3.38±0.42 mg/l, during winter it is 3.06±0.19 mg/l and during summer it is 3.41±0.23 mg/l. It means that there exists minimal variation in BOD during the year 2022-23.

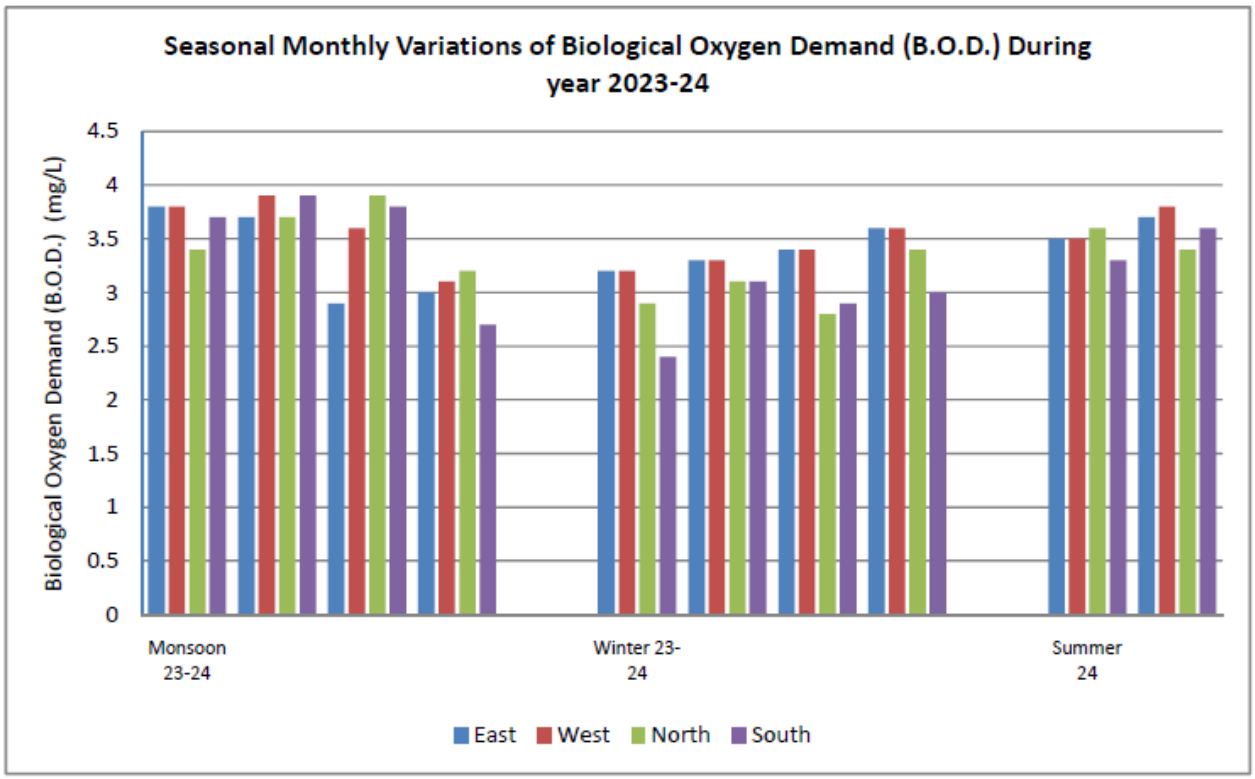


Figure 4: Seasonal Monthly Variations of Biological Oxygen Demand (BOD) during year 2023-24

The variation of BOD at all the four locations during the year 2023-24 is shown in FIGURE 4. It is observed that in this year during monsoon season the variation of BOD was 3.51±0.4 mg/l, during winter season it was 3.16±0.31 mg/l and during summer season it was 3.55±0.16 mg/l.

Also the value of BOD is observed to be less which means that the water is less contaminated. That is the water in the Ambala lake is generally purer (Giripunje *et. al.*, 2013, Dwivedi, 2017, Dede *et al.*, 2015, Bhndarakar *et al.*, 2018, Bhandarkar, 2017).

1.5 Chemical Oxygen Demand (COD)

COD is the measure of pollution in aquatic system. High COD may cause oxygen depletion on account of decomposition of microbes to a level detrimental to aquatic life. It is the amount of oxygen present in the water that is required or used in various chemical reactions (mainly oxidation) occurring in the water. Chemical Oxygen Demand (COD) is used as a measure of oxygen requirement of a sample that is susceptible to oxidation by strong chemical oxidant (Bashini *et al.*, 2017).

Figure 5 shows seasonal monthly variations of Chemical Oxygen Demand (COD) during year 2022-23 taken at all four locations. The variation in COD in this year during monsoon was 15.38±1.31 mg/l, during winter it was 16.56±1.41 mg/l and during summer it was 16±2.22 mg/l. The highest value of COD was observed to be 19 mg/l in summer at east and west locations. The lowest value of COD was observed to be 12 mg/l in summer at west in the month of May2022. Insignificant variations were observed among these sites.

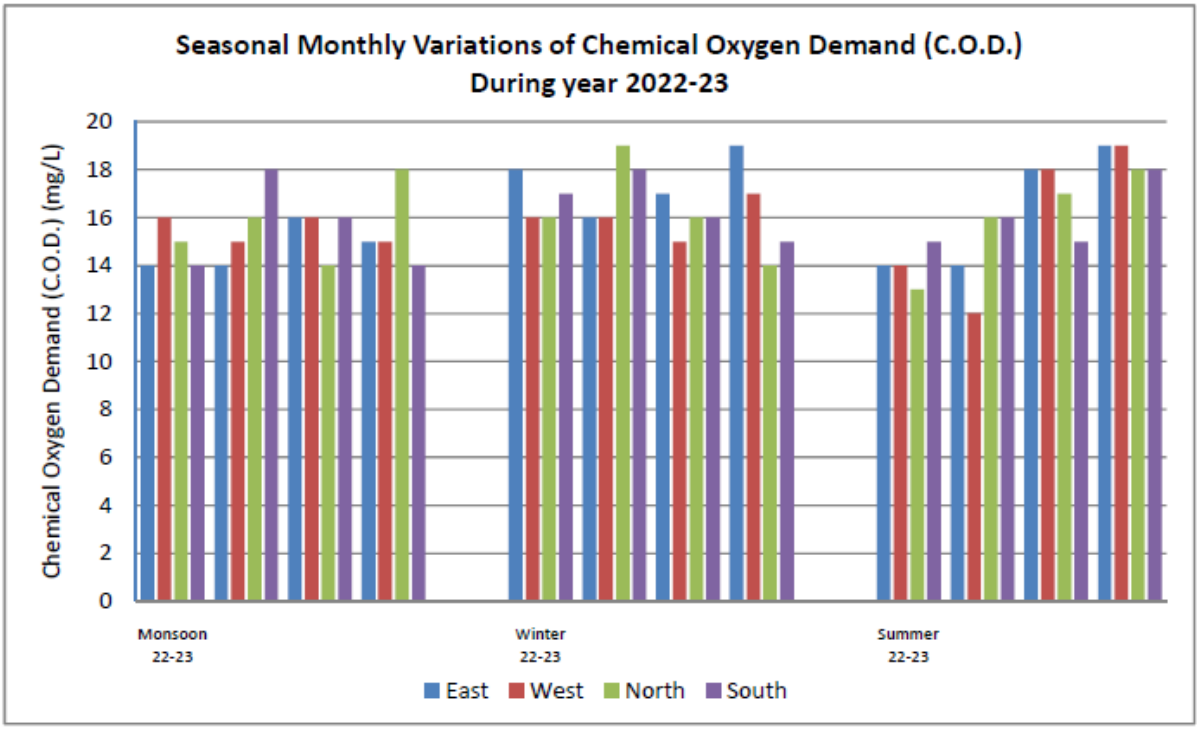


Figure 5: Seasonal Monthly Variations of Chemical Oxygen Demand (COD) during year 2022-23

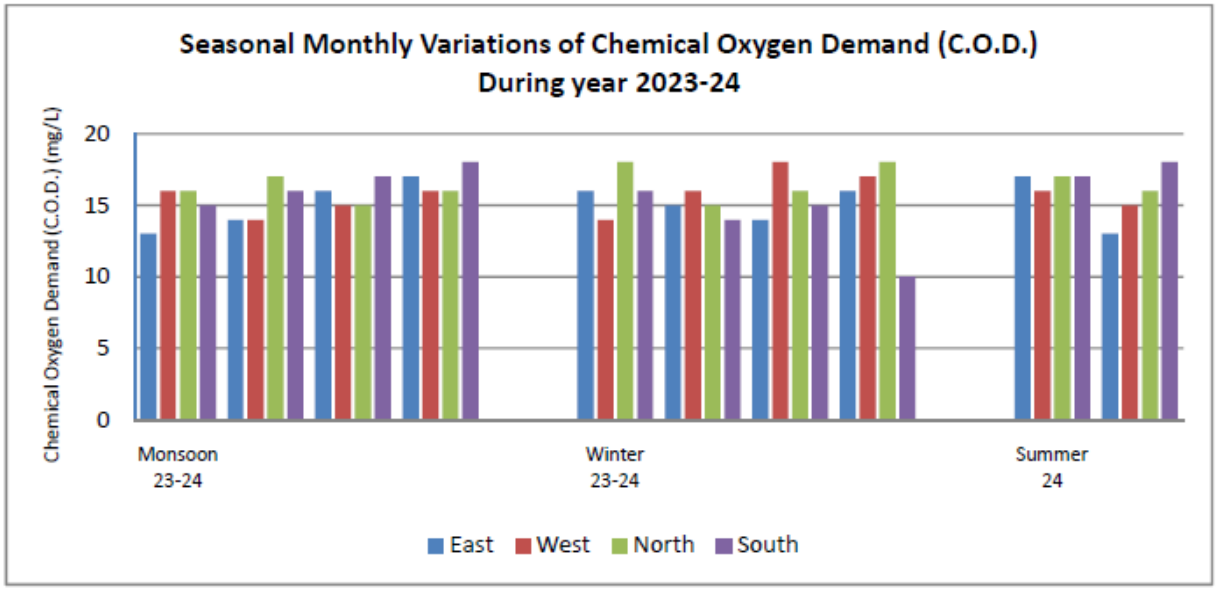


Figure 6: Seasonal Monthly Variations of Chemical Oxygen Demand (COD) during year 2023-24

The seasonal monthly variations of Chemical Oxygen Demand (COD) during year 2023-24 taken at all the four locations are revealed in FIGURE 6. The variation in COD in this year during monsoon was
15.69±1.3 mg/l, during winter it was 15.5±2 mg/l and during summer it was 16.13±1.55 mg/l. The highest value of COD was observed to be 18 mg/l in winter at north location. The lowest value of COD was observed to be 10 mg/l in winter at south in the month of Jan 2024. Insignificant variations were observed among these sites.
It is observed from the above data that the average value of COD is about 15 mg/l which is in the well acceptable range (< 120mg/l) as specified by APHA. Hence the water body at Ambala Lake is safe for human life as well as aquatic life (Awoyemi *et al.,* 2014, Ahangar *et al.,* 2012).

CONCLUSION

It can be inferred from above findings that decreased dissolved oxygen, BOD & COD values have shown organic matter presence in Ambala Lake which is safe for aquatic life & human health. As prescribed by WHO for potable water DO > 6 mg/l, BOD < 5.0 mg/l and COD must be in between 5-20 mg/l. In the present study all these physicochemical parameters are found in the permissible limits at all the study sites among various seasons. Hence as far as these physicochemical parameters are concern, water body at Ambala Lake is safe for the aquatic as well as human life.

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