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ASSESSMENT OF WATER QUALITY IN TERMS OF PHYSICO-CHEMICAL PROPERTIES OF SOME SELECTED PONDS FROM SHRIGONDA AND KARJAT TEHSIL, AHMEDNAGAR DISTRICT, MAHARASHTRA, INDIA

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ABSTRACT

Water resources are under major stress all over the world due to agricultural expansion, damming, diversion of water, over-use, and enumerable types of water pollutants released in the irreplaceable resources in many parts of the globe. The Physico-chemical and biological properties of water determine the quality of water for its suitability for drinking, domestic, fishing, industrial and irrigational purposes. Karjat and Shrigonda tehsils are drought-prone areas of Ahmednagar district. The present study was carried out from July 2022 to May 2024 to estimate water quality in terms of its Physico-chemical parameters from 15 sampling sites which supports enormous biodiversity. The parameters *viz.* water temperature, pH, electrical conductivity, total dissolved solids, alkalinity, dissolved oxygen, biochemical oxygen demand, chlorides, nitrates, phosphates, calcium hardness, magnesium and total hardness were analyzed and found that, all parameters showed remarkable seasonal variations. Most of the parameters were beyond permissible limits prescribed by IS, BIS, WHO, and ICMR, so water is not suitable for drinking purpose. Some reservoirs are temporary and need to refill during summer every year.

KEYWORDS: Biodiversity, ICMR, Physico-chemical properties, WHO

INTRODUCTION

Water is one of the vitally important and abundant compounds of the ecosystem. Every living organism depends on water for their survival and growth. The earth is only planet having about 70 % of water (Sharma *et al.*, 2016). The quality of water and water resources available on the earth is also very vital aspect need to be understood. The quality of water depends on physico-chemical and biological properties reflecting its suitability for drinking, domestic, fishing, industrial and irrigational purposes (Bhateria and Jain, 2016). The physical and chemical properties of water massively influences the distribution and richness of biota (Unanam and Akpan, 2006). The water quality gets reduced due to unscientific waste disposal, improper water management and carelessness towards the environment; leads to scarcity of potable water affecting human health (Agarkar and Thombre, 2005). It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose.

Ponds are small but important aquatic ecosystems generally located near human civilization. Due to this reason, these ponds are mostly influenced by human activities which in turn pollute them. Most of the time all domestic wastes, agricultural runoffs and sewage are released into these ponds which elevates the concentration of nutrients *viz.* phosphates, nitrates etc. affecting the quality of water and finally leads to eutrophication.

The quality of water is described by its physical, chemical and biological properties. Thus, study of water quality is extremely important for proper assessment of the associated hazards.

Temporary and seasonal ponds are found throughout the world. Though there are considerable differences in their type and method of formation, but physico- chemical and biological properties are quite similar. The worldwide distribution water body type leads to a large variety of temporary pond type due to climate and geological differences (Solanki *et al.,* 2012). Safe water is one which should be free from pollutants and conform to the limits of chemical contamination.

MATERIALS AND METHODS

The water samples were collected bimonthly from fifteen freshwater bodies distributed among Karjat and Shrigonda Tehsils. Sampling was done from July, 2022 to May, 2024. The sampling sites were abbreviated as Sina Dam (S1), Visapur (S2), Moharwadi (S3), Autewadi (S4), Salvandevi (S5), Ghodegaon (S6), Shedgaon (S7), Bhambora (S8), Khed (S9), Kalewadi (S10), Therwadi (S11), Rakshswadi (S12), Durgaon (S13), Bahirobawadi (S14) and Diksal (S15). Plastic containers of two 2 l were used to collect water samples. Surface water samples were collected by gently wading the container in the upper layer of water to prevent bubbling. All the samples were collected in two groups (Karjat and Shrigonda) during morning time 7.30 am to 10.30 am.

The water temperature (Mercury thermometer) and pH (Hanna Champ Digital pH Meter) were recorded on site. Physico-chemical Parameters *viz.* Alkalinity, Phosphate, Magnesium, Chlorides, Total Nitrates, Ca Hardness and Total Hardness were determined by methodology of APHA (2005, 2012), Ragothaman and Trivedy (2002) and Kodarkar (1995). TDS (Gravimetric Analysis, APHA 1995), DO (Winkler method, APHA, 1989, 2012), Electrical conductivity (Conductometer) and Biochemical Oxygen Demand (BOD Incubator followed by titrometry APHA, 1989, 2012).

The collected data were subjected to statistical analysis to draw trends and conclusions. Graphical representation and tabulation of data was performed in *Microsoft Excel 2010*. Mean, Minimum and maximum angle and standard deviation (SD) was also conducted in *Microsoft Excel 2010* to visualize whether there is any difference in parameters between sampling sites.

RESULTS AND DISCUSSION

In the present study, the physico-chemical properties of fifteen water bodies located in Shrigonda and Karjat tehsil were selected. As most of them are temporary ponds, water is not used for drinking purpose. The sampling sites *viz.* Moharwadi (S3), Shedgaon (S7), Kalewadi (S10), Therwadi (S11), Rakshaswadi (S12) and Durgaon (S13) undergoes shrinkage due to enormous use of water for irrigation during summer. These water bodies need to recharge by canal water during April and May every year.

The functioning of biotic components is regulated by aquatic ecosystem in every way. Antropogenic activities, *viz.* industrialization, sewage discharge, sand mining, agricultural expansion, fishing, livestock grazing and washing etc. leads to deterioration of water resources (Kumbhar and Mhaske, 2023). Water is the inseparable abiotic factor of the ecosystem. The water quality closely correlates with the health of human race and the entire biota over the globe.

During the study, 13 physico-chemical parameters were analyzed in terms of seasonal variations. **Water temperature:** Water temperature is a vital physical parameter which regulates diverse metabolic and physiological processes in biotic components. The water temperature ranges between 22.3 ^{0}C at S-12 Rakshaswadi during November, 2022 to 30.8 ^{0}C at S-7 Shedgaon during May 2024 (Fig. 1). Maximum average water temperature was recorded during summer (28.70 ^{0}C ±0.989), followed by monsoon (26.27 ^{0}C ±0.487) and winter (24.82 ^{o}C ±0.551). Low water temperature during winter is due to less atmospheric temperature whereas; increased water temperature during summer is because of less water content in ponds and high intensity of solar radiations (Puttaiah and

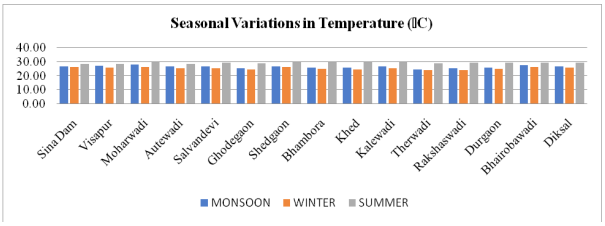

Fig. 1. Seasonal variations in average temperature from all sampling sites

Basavaraja, 2008, Jawale and Patil, 2009). The results obtained are in line with Simpi *et al.* (2011) and Sawant and Chavan, (2013).

Hydrogen ion concentration (pH): Determination of pH reveals acid-base equilibrium and in turn it maintains sustainable balance in aquatic ecosystem. The water pH ranges between 6.3 at S-12 Rakshaswadi during July, 2023 to 8.9 at S-9 and S-10; Khed and Kalewadi respectively (Fig. 2). Maximum average pH was recorded during summer (8.32 ±0.157), followed by 7.78 ±0.196 during winter and 7.37 ±0.177 during monsoon. The similar findings in relation to pH conformity was recorded by Meenakshi Saxena, 2012. Acidic pH adversely affects aquatic ecosystem while alkaline pH decreases heavy metal toxicity in aquatic habitats (Raut *et al.*, 2011). Alkaline water results into high primary productivity (Kumar and Prabhakar, 2012).

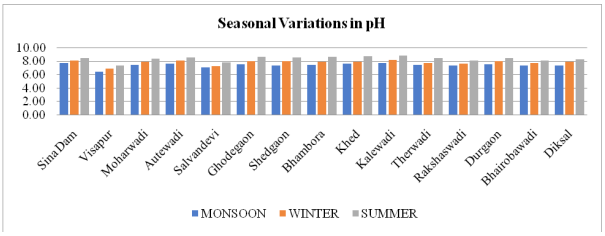

Fig. 2. Seasonal variations in average pH from all sampling sites

Electrical conductivity (EC): Electrical conductivity is an indicator of dissolved ions present in water sample. Pure water is poor conductor of electricity; rather it is a good insulator. The electrical conductivity ranges between 0.40 mS/cm at S-9, Khed during July 2023 to 0.65 mS/cm at S-1 and S-15 at Sina Dam and Diksal during May 2024 and May 2023 respectively (Fig.3). Maximum average electrical conductivity was recorded during summer (0.52 mS/ cm ±0.024) whereas, minimum was recorded at 0.48 mS/cm±0.024. The results obtained are in agreement with Dhembare, (2011) and Sharma and Singh (2018).

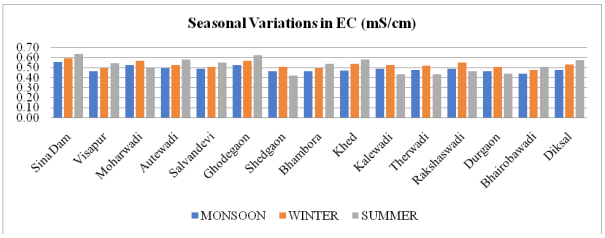

Fig. 3. Seasonal variations in average Electrical Conductivity from all sampling sites

Alkalinity: Alkalinity is simply ability of water to neutralize the acids as it directly reflects the the buffering capacity of water sample. The alkalinity ranges between 78 mg/l. at S-2 Visapur during July, 2022 to 298 mg/l. at S-8 Bhambora during May 2023 (Fig. 4). The upward trend was observed from monsoon (148.68 mg/l ±10.852) followed by winter (174.15 mg/l ±11.813) and summer (198.65 mg/l ±18.631). The results are in broad agreement with Garg *et al.* (2009), Rathod *et al.* (2010) and Simpi *et al.* (2011).

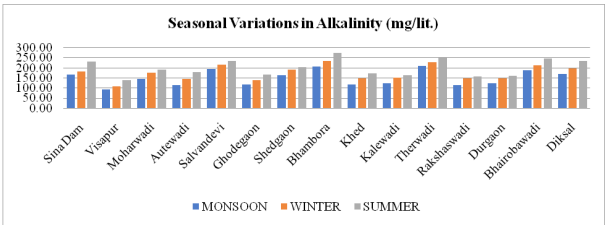

Fig. 4. Seasonal variations in average Alkalinity from all sampling sites

Total dissolved solids: The TDS is very vital parameter which relates to productivity of water reservoir. TDS is used to determine the strength of domestic wastewater and efficiency of treatment units (Verma and Saxena, 2010). The total dissolved solids ranges between 83.12 mg/l at S-7 Shedgaon during September, 2022 to 658.87 mg/l at S-8 Bhambora during May 2023 (Fig. 5). Average TDS increased from monsoon to summer; 223.32 mg/l ±16.088, 253.07 mg/l ±23.676 and 303.95 mg/l ±68.978 respectively. The high amount of TDS during summer season might be due to increased rate of evaporation from small ponds and high concentration of TDS reflects nutrient enrichment leading to eutrophication (Goher, 2002), Gonzalves and Joshi (1946). Low TDS during monsoon is result of dilution of water due to raining which decreases amount of TDS.

Dissolved oxygen: Estimation of dissolved oxygen reflects the health of an aquatic ecosystem and

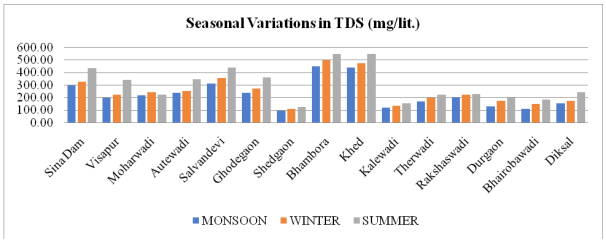

Fig. 5. Seasonal variations in average Total Dissolved Solids from all sampling sites

protects aquatic life, as it is an important limiting factor in aquatic ecosystem because all the biotic components except anaerobic microorganisms solely depends on oxygen dissolved in water and they will die if DO levels falls to zero. The dissolved oxygen ranges between 2.1 mg/l at S-6 Ghodegaon during May, 2024 to 7.5 mg/l at S-12 Rakshaswadi during July 2022 (Fig. 6). The downward trend was observed from monsoon followed by winter and summer as 5.08 mg/l, 4.01 mg/l and 3.70 mg/l respectively. Low oxygen concentration was recorded in summer as DO decreases with increasing temperature and vice-versa. The similar observations were also recorded by Dhembare (2011).

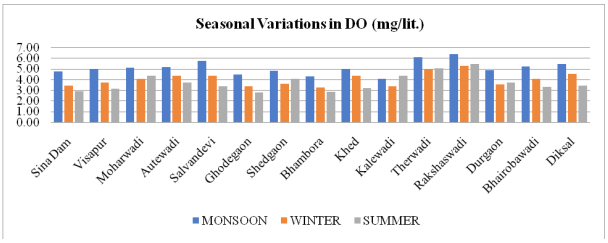

Fig. 6. Seasonal variations in average Dissolved Oxygen from all sampling sites

Biochemical oxygen demand: Biochemical oxygen demand (BOD) reflects the organic pollution in freshwater sources and closely associated with microbial contamination. Measurement of BOD is an important indicator to determine the water quality as it reflects the organic pollution load on freshwater bodies. The biochemical oxygen demand ranges between 2 mg/l at S-10 Kalewadi during July 2022 to 11.3 mg/l at S-9 Khed during May 2023 (Fig. 7). The upward trend of average BOD was recorded from monsoon (3.55±0.713), winter (5±0.848) and summer (6.76±1.304) during both the years of study. The summer maximum of BOD is attributed to the increased organic decomposition. Our results are in good agreement with the findings of Sawant and Chavan, (2013) and Harney *et al.* (2013).

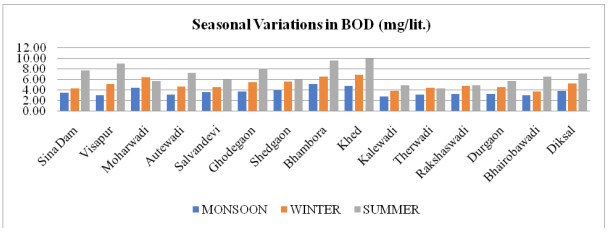

Fig. 7. Seasonal variations in average Biochemical Oxygen Demand from all sampling sites

Phosphates: Phosphates are essential for the growth of aquatic organisms and nutrients that affects the primary productivity of water bodies (Saha *et al.*, 2000). Phosphate monitoring in water bodies reflects the growth of algae and the process of eutrophication. Phosphates enter in water bodies with fertilizers runoff from nearby agricultural land during monsoon. The phosphates range between 0.4 mg/l at S-15 Diksal during May, 2023 to 4.8 mg/lit at S-8 Bhambora during September 2022 (Fig. 8). Minimum average phosphate content was recorded during summer (1.48 mg/l ±0.296), followed by winter (2.27mg/l ±0.341) and monsoon (2.88 ±0.344). Our results are corroborating with the investigations of Kaur *et al.*, (1997), Manjare *et al.* (2010); Rathod *et al.* (2010); Raut *et al.* (2011) and Shaikh and Nikam, (2015).

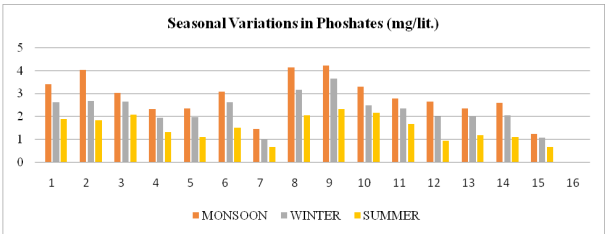

Fig. 8. Seasonal variations in average Phosphates from all sampling sites

Magnesium: Magnesium is mainly present as Mg^{+2} (aq.) in water. The magnesium content of water bodies under study ranges between 27.5 mg/l at S-5 Salvandevi during July, 2023 to 199.28 mg/l at S-4 Autewadi during May 2024 (Fig. 9). The upward trend in average magnesium was recorded from monsoon to summer as 77.08±6.970, 95.38±7.142 and 103.27±11.616 respectively. Similar trend of seasonal variations in magnesium was also recorded by Meenkshi Saxena, (2012), Sawant and Chavan, (2013, 2005).

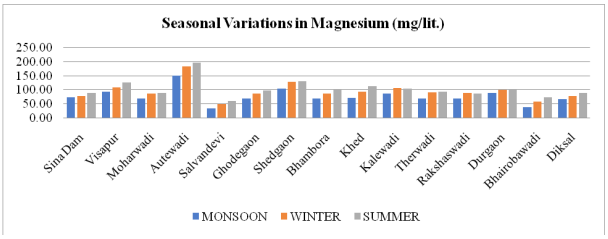

Fig. 9. Seasonal variations in average Magnesium from all sampling sites

Chlorides: Chloride contributes to the total salts (Salinity) content of soils, which is necessary for

plant growth to some extent whereas, high concentration will inhibit plant growth, harms metallic pipes and growing plants (APHA, 2012). The chlorides ranges between 34.8 mg/l at S-12 Rakshaswadi during July, 2023 to 207.58 mg/l at S-6 Ghodegaon during May 2024 (Fig. 10). The average chloride content was found maximum during summer (113±21.142) and minimum during winter (79.69±12.162). Similar finding were also recorded by Bade *et al.* (2009) and Simpi *et al.* (2011).

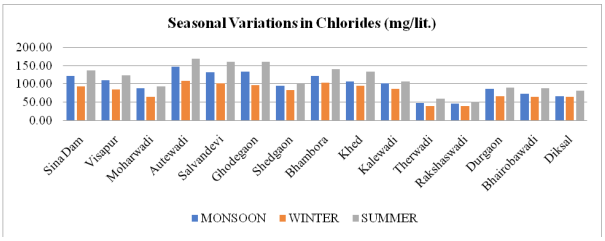

Fig. 10. Seasonal variations in average Chlorides from all sampling sites

Total Nitrates: Determination of nitrate and nitrite in surface water gives a general indication of the nutrient status and level of organic pollution. The nitrate content ranges between 1 mg/l at S-15 Diksal during January 2024 to 9.87 mg/l at S-9 Khed during September 2022 (Fig. 11). Maximum nitrate content was recorded during monsoon and gradually decreases towards summer as 5.54±1.428, 3.95±1.129 and 2.42±0.576 respectively. The maximum values of nitrates were obtained in monsoon, as they are mostly found in fertilizers and during monsoon get mixed with the runoff and enter the water body through catchment area, resulting in elevation of the amount of Nitrates. Low values of Nitrates during summer indicate its utilization for the growth of aquatic weeds and phytoplankton. Similar trend in seasonal fluctuations of nitrate concentration was also recorded by Rathod *et al.* (2010); Raut *et al.* (2011), Simpi *et al.*, 2011; Harney *et al.* (2013); Shaikh and Nikam, (2015).

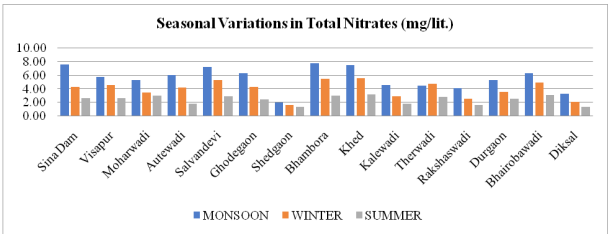

Fig. 11. Seasonal variations in average Nitrates from all sampling sites

Calcium Hardness: Calcium plays very vital role in plants and animal nutrition as it is an essential component of bones, shell and plant structure. Calcium contributes in the total hardness of water and acts as an important micro-nutrient in aquatic habitat and specially needed in large quantities by Mollusks and vertebrates. Sirsath *et al.*, 2006, stated that, cations of calcium and magnesium are principal components in determination of total hardness. The calcium hardness ranges between 78.26 mg/lit at S-14 Bhairobawadi during July, 2023 to 301.51 mg/l at S-9 Khed during May 2023 (Fig. 12). The upward trend of calcium hardness was observed from monsoon (147.56±26.117) followed by winter (170.68±34.004) and summer (192.02±46.322). The maximum values of calcium during summer may be due to rapid oxidation and decomposition of organic matter. The results obtained are in line with the investigations of Meenakshi Saxena (2012), Verma *et al.* (2010) and Sawant and Chavan, (2013).

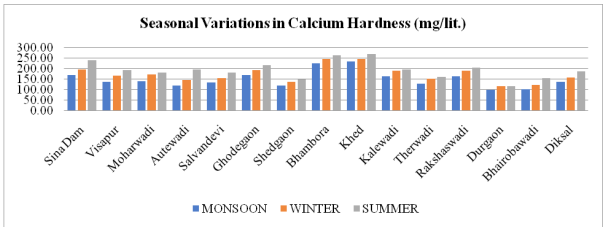

Fig. 12. Seasonal variations in average Calcium Hardness from all sampling sites

Total Hardness: Hardness avoids lather formation with soap and accelerating the boiling point of water (Trivedy and Goel, 1987). The total hardness ranges between 116.37 mg/l at S-14 Bhairobawadi during July 2023 to 446.72 mg/l at S-9 Khed during May 2023 (Fig. 13). Total harness was increased from monsoon to summer as 234.89±32.795, 274.72±41.560 and 303±56.290 respectively. Minimum total hardness during monsoon may be due to heavy rainfall and increased water volume of reservoir. Our results are in complete conformity

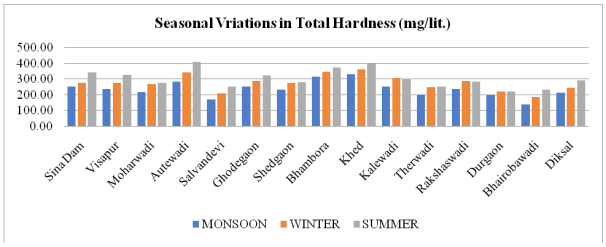

Fig. 13. Seasonal variations in average Total Hardness from all sampling sites

with the findings of Rathod *et al.* (2010) and Sawant and Chavan (2013).

CONCLUSION

Water is the vital component for survival of all living beings from every ecosystem. Physico-chemical analysis provides deep insight into quality of water (pollution status), aquatic biodiversity and threats associated to aquatic ecosystem. Water temperature was within permissible limits at all fifteen sampling sites, pH values were beyond permissible limits at S1 (Sina Dam), S6 (Ghodegaon), S8 (Bhambora), S9 (Khed) and S10 (Kalewadi). EC was recorded between 0.40 – 0.65 mS/cm, TDS was recorded maximum at S5 (Salvandevi), S8 (Bhambora) and S9 (Khed). The BOD values indicates some water bodies, S8 (Bhambora) and S9 (Khed) are much polluted. Magnesium values was found to be maximum at S4 (Autewadi), S2 (Visapur), S7 (Shedgaon), S8 (Bhambora) and S9 (Khed). Calcium hardness was beyond permissible limits at all sampling sites under study except S7 (Shedgaon), S11 (Therwadi), S13 (Durgaon) and S14 (Bhairabawadi).

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Conflict of Interest- None

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