



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 6, June 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

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Studies on Seasonal Variations in Physico-Chemical Parameter of Chandrasarovar Pond of Jhalawar (Rajasthan)

Arjumand Qureshi, Dr. Prahlad Dube

Department of Zoology, Government PG College, Jhalawar, Rajasthan, India

ABSTRACT: Fresh water is very important to sustain life and this supply must be available to all. The increasing population and water scarcity is affecting the quality of life significantly. Availability of clean and potable water has emerged as a key issue in developing countries. Fresh water resources are declining day by day due to anthropogenic impacts, unawareness among people about their importance, lack of legal and institutional framework in conservation of village ponds. Village ponds are one of the major sources of fresh water in rural areas. From ancient time, the rainwater is being stored in village ponds. In rural areas, the people depend upon pond water for domestic, irrigation, fisheries etc. The aim of the present study was to evaluate physico-chemical properties (TDS, conductivity, sodium and potassium) of water in Chandrasarovar pond of Jhalawar, Rajasthan, India, using standard procedures. The analysis was carried out in three seasons viz. pre-monsoon, monsoon and post-monsoon for the period of two years during 2014-15. The observed values of studied parameters of water samples were compared with WHO and Indian standards (IS-10500, 2012). It was observed that 90% samples for TDS, 90.6 for conductivity, 46.6 for sodium, and 91.4 for potassium were not in acceptable limit. Therefore, from the study it is concluded that the water quality of Chandrasarovar pond of Jhalawar, Rajasthan is degrading. Consequently, necessary step should be taken to conserve and manage these small but ecologically important water bodies

KEYWORDS : Fresh water, village ponds, physico-chemical characteristics, water quality, WHO.

I. INTRODUCTION

Aquatic ecosystems are the most diverse ecosystems in the world. In terms of salinity aquatic ecosystems fall under two broad categories i.e. saline ecosystem and freshwater ecosystem. Freshwater ecosystems are inland water that have low concentration of salt .

Ponds are one of the most important freshwater aquatic ecosystems in the entire rural landscape as they can store and purify water, provide various resources to the local communities for their survival and subsistence. They provide habitat to several rare and threatened aquatic plants, amphibians and macro-invertebrates (Bella et al., 2010). Pond ecosystems also contribute significantly to regional freshwater biodiversity (Nicolet et al., 2004; Oertli et al., 2004; Williams et al., 2004; Angelibert et al., 2006). Alongwith the rich reservoir of biodiversity freshwater ecosystem provides numerous other environmental benefits. They provide many ecological services viz. regulating, provisioning, cultural and conservative. They are good site ground water recharge, flood control, storage and recycling of nutrients and carbon sink. The carbon sequestering by pond is greater than forest, grassland and oceans (Downing, 2010). Therefore, they play very important role in CO₂ concentration balance in the environment.

In rural India, village ponds play very important role in socio-cultural, economic and environmental development. They support the livelihoods of marginalized community in rural, urban, coastal and tribal areas of the country. Most of the population of Rajasthan resides in villages and their main occupations are agriculture animal husbandry. Ponds are the source of fresh water for villagers and they mainly depend upon pond water for drinking and bathing of their livestock's, production of fisheries, irrigation etc. At present the water quality of village ponds is declining at alarming pace due to encroachment by villagers, dumping of domestic waste, loading of the periphery by cow dung cakes, consequences of infilling, land drainage, changes in their many traditional uses and dumping of industrial waste in urban areas. There is also a lack of legal and institutional framework for small water bodies, therefore, they are ignored in comparison to large water bodies (i.e. lakes, rivers). All these factors are responsible for degradation of village ponds. The temporary ponds are most affected as they are inconspicuous and poorly known due to their temporary



nature and small size and have been frequently destroyed by anthropogenic activities (Williams et al., 2001; Grillas et al., 2004; William, 2006; Zacharias et al., 2007). Due to use of contaminated water the human and livestock's population are continuously exposed to variety of water borne diseases. Need of the hour is to give particular emphasis on conservation and management of village ponds as an important national/international issue which should be given equal or higher importance as national development or economic development of any country. Therefore, the present study was planned to assess the status and quality of Chandrasarovar pond of Jhalawar, Rajasthan.

II. MATERIALS AND METHODS

Study area

Rajasthan is one of the states of northern India. In Sample collection procedure Water samples were collected from 25 sampling sites situated in Chandrasarovar pond of Jhalawar, Rajasthan. Each sampling site was divided randomly into three sampling points. The samples were collected in three seasons viz. pre-monsoon, monsoon and postmonsoon for a period of two years during 2019 to 2020. To analyze the water quality, samples were collected in one liter bottle from each sampling point. Before sampling again, the bottles were cleaned and washed with detergent and dilute nitric acid. The bottles were finally rinsed with deionised water and then dried in sunlight. After sampling the bottles were screwed carefully and marked with the sampling number i.e. S1, S2, S3, ..., S25.

Sample analysis

The collected samples were taken to the Ecology Laboratory of Department of Botany (Rajasthan University, Jaipur) in ice box for the analysis. Before analysis, all the samples were filtered with Whatmann filter paper to remove unwanted solid and suspended material. Water samples were analyzed for sodium and potassium concentration by using Flame Photometer (ESICO, Model No- 381) against the standard solutions of NaCl and KCl, respectively (Amrutkar, 2013). The turbidity was measured by portable turbidity-meter and conductivity by portable conductivity-meter on the spot. Each analysis was carried out in triplicate for a particular sample.

Preparation of standard solutions for sodium and potassium measurement (Gupta, 2000)

For sodium, dissolve 5.845 g of NaCl in water and make to one litre. It gives 100 me/L of Na. From this, solutions having 10, 20, 30 and 40 me Na/L were prepared. For potassium, dissolve 1.908 g of KCl per litre in distilled water to prepare a stock solution of 1000 ppm K. Working standard having 10, 20, 30 and 40 ppm are obtained from above solution in 100 ml volumetric flask.

Statistical analysis

The results are expressed as mean \pm SD. One way ANOVA was used to analyze level of statistical significance among the pond water samples. Further the difference in the mean values of samples between 2019 and 2020 were analyzed by t-test. PAST (Version 2.17) software was employed for statistical analysis.

III. RESULTS

Total dissolved solids (TDS)

Total dissolved solids (TDS) recorded in the pond water sample during pre-monsoon, monsoon and post- monsoon were ranged from 274-5250, 168-4870, 220- 4950 and 271-5991, 216-5980, 253-5510 mg/L in 2019 and 2020, respectively. The maximum value of TDS was recorded in pre-monsoon season in S23 (5991 mg/L) in 2019 and minimum was recorded in S14 (168.0 mg/L) during monsoon (2020). According to Indian standard (IS-10500, 2019) the acceptable limit of TDS for drinking water is specified as 500 mg/L. When TDS of the samples were compared with Indian standard, it was found that during 2019, samples S1, S14 and S25 were found within the acceptable limits in all the three seasons, all other samples were found out of acceptable limit. Similarly in 2020, only S1 and S14 were found within the acceptable limit in all the three seasons. It was interesting to note that sample S13 was within the acceptable limit only during monsoon. All other samples were found beyond the acceptable limit (fig. 2).

Conductivity

Conductivity recorded in the pond water sample ranged from 410-7510, 260-7280, 338-7396 in 2019 and 420-8950, 325-8945, 386-9240 μ -mho/cm in 2020 during pre-monsoon, monsoon and post-monsoon seasons, respectively. The maximum conductivity was recorded in S23 (9240 μ -mho/cm) during post-monsoon (2020) and minimum (260 μ -mho/cm) in S14 during monsoon (2019). The acceptable limit for conductivity is 600 μ -mho/cm (WHO, 1993). When



compared to WHO standard the sample S20 was only the sample found within the acceptable limit in all three seasons. All other samples were not in acceptable limit. The samples S1 and S14 were within the acceptable limit in 2019 but above the acceptable limit in 2020. It was interesting to note that the sample S25 was found beyond the acceptable limits during 2020 in all the three seasons but during 2019 only in pre-monsoon season .

Sodium

Sodium level recorded in the ponds ranged from 47- 320, 32-310, 40-290 (2018) and 43-348, 32-320, 41-300 mg/L (2019) during pre-monsoon, monsoon and post-monsoon seasons, respectively. The maximum sodium concentration was recorded in S5 (348 mg/L) and minimum in S20 (32 mg/L) . According to WHO standards (2018) acceptable limit for sodium is 200 mg/L. During 2019, the samples (S1 , S7 , S13, S14, S15, S16, S17, S19, S20, S21, S22, S24 and S25) were within the acceptable limit and sample S9 was within acceptable limit during monsoon and post monsoon. Similarly, during 2020 the samples (S1 , S7 , S9, S13, S14, S15, S16, S17, S19, S20, S21, S22, S24 and S25) were within acceptable limit. All other samples were not in acceptable limit .

Potassium

Potassium occurs widely in the environment including all natural freshwater bodies. Potassium concentration recorded in the ponds ranged from 24-310, 13-280, 20-292 mg/L (2019) and 20-332, 23-314, 23-327 mg/L (2020) during pre-monsoon, monsoon and post-monsoon seasons, respectively. Maximum concentration of potassium was recorded in S12 (332 mg/L) during pre-monsoon and minimum in S15 (13 mg/L) during monsoon . The acceptable limit of K⁺ for drinking water is specified at 25 mg/L (WHO, 1919). When the results were compared with the standard it was reported that during 2014, water samples including S15 and S20 in all the three seasons, S13 and S19 in monsoon and S14 in monsoon and post monsoon were found within the acceptable limit. During 2020, water samples including S20 in all the season, S15 in monsoon season were within the acceptable limit . All other samples were not in acceptable limit.

IV. DISCUSSION

TDS analysis

Total dissolved solids (TDS) gives indication of the salinity behavior of water and it describes all solids particularly mineral salts that are dissolved in water. In the present study maximum value of TDS was recorded in S23, it was mainly because of ongoing construction work around this pond. Most of the ponds showed maximum TDS in pre-monsoon, moderate during postmonsoon and minimum in monsoon season. High value of TDS during pre-monsoon season may be due to high evaporation rate. Some previous reports by Sahni and Yadav (2012), Yadav et al. (2013) also obtained the similar results.

In some pond samples including S22 and S24 in 2019 and S1 , S6 , S7 , S9 , S16 and S18 in 2020 the high value of TDS was reported during monsoon in comparison to pre-monsoon . It may be due to addition of domestic waste water, garbage and sewage etc. during monsoon. Our results are in agreement with Dhanalakshmi et al. (2013) and Chaurasia and Pandey (2007). Increased concentration of TDS increases the nutrient level of water body which results into eutrophication of aquatic bodies (Swarnlata and Narsigharao, 1998; Singh and Mathur, 2005; Verma et al., 2012)

Conductivity analysis

Conductivity is the capacity of water to carry electric current. It mainly depends on the presence of relative concentration of ions their mobility, valence and on the temperature of the liquid. In present study, most of the ponds had high value of EC during pre-monsoon season. During pre-monsoon period, the amount of salt accumulates because of comparatively high temperature and therefore high rate of evaporation (Talling and Talling, 1965). During pre-monsoon, high temperature compel the livestock's to frequently visit these ponds, their urination and other excreted inside the pond water is also responsible for increasing total ions concentration. The results are in concordance with the similar studies conducted (Chaurasia and Pandey, 2007; Baruah and Kakati, 2012; Mishra et al., 2013; Qureshimatva et al., 2015).

It was interesting to note that the pond samples (S1 , S6 , S7 , S9 , S16, S18, S22 and S24) showed high conductivity during monsoon than pre-monsoon. The results are in agreement with Hulyal and Kaliwal (2011),) and Luharia et al. (2016). The fluctuations in EC in different seasons are due to fluctuation in total dissolved solids (TDS) and salinity (Pandey and Pandey, 2003).



Sodium analysis

Sodium is a natural component of fresh water. The high concentration of sodium in natural freshwater ecosystem is mainly due to pollution such as soapy solution, detergent, human and animal waste disposal, precipitation runoff, sewage disposal, mineral deposits and water treatment chemicals such as sodium fluoride, sodium bicarbonate and sodium hypochlorite etc. In most of the ponds the values of sodium were higher in premonsoon season when compared with monsoon and postmonsoon seasons. High sodium content during pre monsoon season may be due to increased rate of water evaporation and high atmospheric temperature during this period (Sahai and Sinha, 1969). The results were supported by Bordoloi and Baruah (2014) in one of the study conducted on historical pond of Upper Assam. In Chandrasarovar ponds including S4 , S6 , S11 (2019) and S4 , S9 , S21 (2020) the value of sodium was found high in monsoon in comparison to pre-monsoon season. The high level of sodium during monsoon season may be due to the rainwater as it carries the salt dissolved from the surrounding area (Sahai and Sinha, 1969). The similar results were also obtained by Kumar et al. (2014) in one of the study conducted on Lahru pond located in Himachal Pradesh.

Potassium analysis

In Chandrasarovar pond the value of potassium were found higher in pre-monsoon season. The higher value of potassium may also be due to high rate of evaporation during pre-monsoon. The results were supported by Bordoloi and Baruah (2019) in one of the study conducted on historical pond of Assam. In samples S6 , S8 , S10, S14, S18 in 2014 and S8 , S16, S23 in 2015, the value of potassium was high during monsoon in comparison to pre-monsoon. The probable cause of high potassium during monsoon may be due to dumping of surface runoff water, containing soaps, detergents, cow dung cakes etc. Our results are in concordance with the reports of Mohamed (2005) from pond water samples of Abu za'baal ponds, Egypt.

V. CONCLUSION

From the present study, it is concluded that 90% samples of TDS, 90.6 for conductivity, 46.6 for sodium, and 91.4 for potassium were not in acceptable limit. It was found that there is no significant difference in sodium concentration between 2019 and 2020 in all the three seasons. There is significant difference in TDS and conductivity between 2019 and 2020 in monsoon and no significant difference in pre-monsoon and post-monsoon seasons. Potassium has significant difference between 2019 and 2020 in post-monsoon and no significant difference in pre-monsoon and monsoon seasons. There is also no significant difference in TDS, conductivity, sodium and potassium in all the three seasons. Present study only provides baseline information on the water quality of Chandrasarovar pond of Jhalawar, Rajasthan.

Therefore broader scale study is required to obtain needed information. The higher level of TDS, conductivity, sodium and potassium in these ponds need some attention for their management efforts like separate disposal of village waste water, reduction in leaching of excessive nutrient from catchment area through plantation and water treatment would definitely be helpful in the regulation of the water quality of Chandrasarovar pond of Jhalawar, Rajasthan.

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