Assessment of Water Quality Parameters and Seasonal Trends in Sinhad Talab, Rajasthan

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Abstract:
Water bodies are vital elements of the natural ecosystem, essential for preserving biodiversity, moderating local climate conditions, and sustaining human life and activities. This study investigated the physicochemical properties of Sinhad Talab, Nathdwara, Rajasthan, from January to December 2022. Monthly water samples from selected sites were analyzed for temperature, pH, conductivity, alkalinity, DO, TDS, TSS, and hardness using standard methods. Seasonal trends showed rising temperatures from 15°C to 30°C, influencing pH and DO. Elevated TDS and conductivity indicated ionic concentration due to runoff and evaporation. High alkalinity and hardness were linked to carbonate presence and mineral leaching. DO remained low, suggesting moderate organic pollution. The findings emphasize seasonal variability and the impact of anthropogenic activities on the water quality of the reservoir.

Keywords: Physicochemical parameters, Dissolved oxygen, Electrical conductivity, Water hardness.

1. INTRODUCTION

Water bodies such as ponds, lakes, and reservoirs serve as integral components of the natural environment, playing a crucial role in sustaining biodiversity, regulating local climates, and supporting human livelihoods (Liaw et al., 2012)(Widyastuti & Haryono, 2016). Among these, small and medium-sized ponds hold a unique position due to their ability to act as reservoirs of biodiversity, provide essential ecosystem services, and support various socio-economic activities (Kambo & Dutta, 2015). The Sinhad Talab, a prominent water body located in the region of [specific location if known], offers a unique case study for exploring the physicochemical, biological, and economic dynamics of such systems (Seddon et al., 2000).

Water bodies are often described as the lifelines of ecosystems, supporting a vast array of life forms (Henderson, 2002). They regulate hydrological cycles, recharge groundwater, and serve as habitats for aquatic and terrestrial organisms (Sharqawy et al., 2010). These ecosystems also provide numerous provisioning services, including water for agriculture, aquaculture, and domestic use, as well as recreational opportunities and aesthetic value (Patel & Patel, 2012). Furthermore, they play a pivotal role in carbon sequestration, nutrient cycling, and sediment trapping, thereby contributing to global environmental stability (Duck, 2013).

Rajasthan, despite being India’s largest state in terms of area, is predominantly characterized by its arid and semi-arid climate (Kumar et al., 2012). The state’s wetlands, including ponds, ponds, and reservoirs, provide vital water sources and habitats in this otherwise dry landscape (Leong et al., 2018). Wetlands such as Sinhad Talab serve as lifelines for local communities, offering water for irrigation, livestock, and domestic use, while also sustaining aquatic ecosystems (Rahman et al., 2021)(Mutlu & Uncumusaoğlu, 2016).

Sinhad Talab, located near the holy town of Nathdwara, is not only a natural resource but also holds cultural and religious significance (SHaRma & WalIa, 2017). The talab (pond) supports a diverse range of flora and fauna and is an integral part of the local hydrological system (Manjare et al., 2010)(Mobin et al., 2014). However, rapid urbanization, agricultural runoff, and other anthropogenic activities have increasingly threatened its ecological integrity (Khalik et al., 2013).

The present study was conducted to assess the physicochemical parameters such as temperature, pH, dissolved oxygen (DO), total dissolved solids (TSS), total suspended solids (TSS), alkalinity, hardness, and conductivity were measured to evaluate the water quality. Seasonal trends in these variables were also analyzed to understand the impact of climatic and anthropogenic influences.

2. MATERIALS AND METHODS

2.1. Study area

The present study was conducted on Sinhad Talab in Nathdwara, Rajasthan, from January to December 2022, focusing on its physicochemical properties, phytoplankton, and macrophyte diversity. Historically known as Sinhad, the talab holds religious and ecological significance. Nathdwara, located near the Banas River, is famous for the Shreenathji temple, dedicated to Lord Krishna. The temple was established in 1672 CE when the idol was relocated from Mathura to protect it from Mughal attacks. Nathdwara became a major Vaishnavite center, preserving Pushti Marg traditions, art, and culture, including Pichwai paintings and terracotta crafts. Today, it remains a vibrant pilgrimage and cultural hub.

2.2. Collection of water sample

Water samples from different sites in Sinhad Talab were collected monthly throughout the year for analysis. Phytoplankton studies were conducted seasonally through field visits, focusing on plants in and around the talab. Collected water samples were stored in airtight containers, properly labeled, transported to the laboratory, and preserved in a freezer for further analysis. The samples were used to examine various physicochemical parameters, including pH, total alkalinity, dissolved oxygen, total suspended matter, total dissolved substances, to assess the water quality and ecological conditions of the reservoir.

2.3. Physicochemical analysis

Some parameters were totally or partially measured in field (i.e., as soon as the samples were collected).

2.3.1. Temperature:

The temperatures of water sample were measured at the time of water sampling to the nearest 15°C by using Mercury Thermometer.

2.3.2. The pH:

The pH-value of water samples was measured in the laboratory immediately after collection using Bench type (JENWAY, 3410 Electrochemistry Analyzer pH-meter) with reading up to 0.01 pH unit after necessary precautions in the sampling and standardization processes (Widyastuti & Haryono, 2016)

2.3.3. Conductivity:

The conductivity of water sample was measured by the conductivity meter.

2.3.4. Total alkalinity (mg/L):

Alkalinity was measured according to the method mentioned in Michelutti et al., 2002. Water sample was titrated against diluted HCl using methyl orange as indicator. A 50ml of sample was occupied in a flask and to the sample 2-3 droplets of phenolphthalein marker is put in. If water sample appeared pink in colour Phenolphthalein alkalinity is present in the sample, and titrated the sample with Hydrochloric acid (0.1N) till the sample become colourless, this is the end point and note reading as A, (in present study no pink colour indication was noticed in water sample, which meant phenolphthalein alkalinity is negligible). And next to the same sample to determine total alkalinity, addition of 2-3 drops of methyl orange is followed by titrating the content against the Hydrochloric acid (0.1 N), until the yellow colour of sample changes to pink. This is (TA) total alkalinity, and note the reading as B. The total content of the titrant used was noted for calculating total alkalinity.

2.3.5. Dissolved oxygen (DO):

The method described is the common Winkler method, modified by Carritt and Carpenter. Fixation of dissolved oxygen was made in situ using manganous sulphate and alkaline potassium iodide solutions, taking all precautions that no bubbles are formed. After complete fixation of oxygen, the precipitated manganese hydroxide is allowed to settle and then dissolved by 9N H_2SO_4. The liberated iodine was 12. To determine dissolved oxygen, the collected fixed sample (mentioned in above pages) of DO sample were estimated further in laboratory by subsequently adding 2ml of concentrated sulphuric acid (H_2SO_4), mixing the content well by inverting bottle several times and making sure that precipitate get dissolved. Then make sample to settle for 5 to 10 minutes. Afterwards, take 50 ml of sample (from fixed D.O bottle) in a conical form of flask and titrate opposed to (0.025 N) sodium thiosulphate up to the colour of sample appeared pale yellow. Next, add 0.5 ml newly set starch indicator (blue colour seen) and titrate till the first vanishing of the blue colour (end point) noticed. Log the used volume of titrant sodium thiosulphate in ml.

2.3.6. Hardness

The total hardness titration – 50 ml of assembled water sample was grabbed in flask, followed by addition of 1 ml buffer liquid and 3-4 droplets of Eriochrome black T- the indicator. After addition of overall solutions water sample colour changes to wine red. Now the overall content in flask is titrated with 0.01 M solution (EDTA) till the colour wine-red of sample alter to blue. This is the termination point of titration and carefully reading was noted.

2.3.7. Total Dissolve Solids (TDS)

The TDS in the water samples were determined by gravimetric method (evaporating method). We collect the water samples and take the evaporating dish and clean and dry it in the oven at 103-105 ^{o}C for 1 hour. After dried we cool the dish in a desiccator and weigh it using an analytical balance.

2.3.8. Total Suspended Solids

The TSS in the water samples were determined by gravimetric method (evaporating method). We collect the water samples and take the evaporating dish and clean and dry it in the oven at 103-105 ^{o}C for 1 hour. After dried we cool the dish in a desiccator and weigh it using an analytical balance.

2.4. Statical analysis

In order to account all the major monthly and seasonal environment alteration of the study area, the data in the month-wise analysis, the measurement values of three selected stations were sum up into the average of particular month, which reveals the variation of studied parameters month-wise. In season-wise analysis, the four months measurements done were grouped into average of three seasons such as the winter season (November, December, January, February), summer season (March, April, May, June) and rainy season (July, August, September, October). Comparison of physicochemical parameters in different seasons explains the fluctuation range of parameters. The data of examined physiochemical parameters of study area were calculated using the ANOVA (analysis of variance) to derive mean, monthly variation, seasonal variation and correlation coefficients among the studied physicochemical parameters.

3. RESULT

The water quality data collected over several months reveals distinct seasonal trends across various physicochemical parameters (Fig.1, Fig.2 & Table 1). Temperature steadily increases from 15°C in January to 30°C in May, reflecting the expected climatic transition from winter to summer. This rise in temperature appears to influence other parameters, notably pH and dissolved oxygen (DO). The pH values range from 7.4 to 8.1, indicating that the water remains slightly alkaline throughout the period, with a gradual increase during the warmer months. This could be attributed to enhanced photosynthetic activity, which tends to elevate pH levels due to the uptake of carbon dioxide by aquatic plants.

The total suspended solids (TSS) show a notable drop from 43 mg/L in January to 17 mg/L in February, followed by slight fluctuations in the subsequent months. This sharp decline suggests reduced runoff or sediment input during the dry season. Similarly, total dissolved solids (TDS) exhibit high values, ranging from 988 to 1769 mg/L, peaking in January. These elevated TDS levels indicate a significant presence of salts and minerals, potentially due to increased surface runoff or anthropogenic discharges during the cooler months. Dissolved oxygen remains fairly stable, between 4.0 and 4.2 mg/L, but the values are relatively low, especially as temperatures rise. This may reflect moderate organic pollution or eutrophic conditions, as warmer water holds less oxygen.

Alkalinity fluctuates between 469 and 728 mg/L, with a maximum in February. High alkalinity suggests good buffering capacity of the water but may also point to human-induced changes, such as wastewater input. Electrical conductivity (EC) values follow a similar pattern to TDS, ranging from 1700 to 2800 µS/cm, with the highest value in April. This indicates a high concentration of dissolved ions, likely from agricultural runoff or industrial waste. Lastly, water hardness increases from 520 mg/L in January to 895 mg/L in May, suggesting a growing presence of calcium and magnesium salts, possibly due to reduced dilution effects and increased mineral leaching during hotter months.

Thus, the results indicate that water quality is significantly influenced by seasonal changes, with higher temperatures and likely anthropogenic inputs contributing to variations in alkalinity, conductivity, and mineral content.

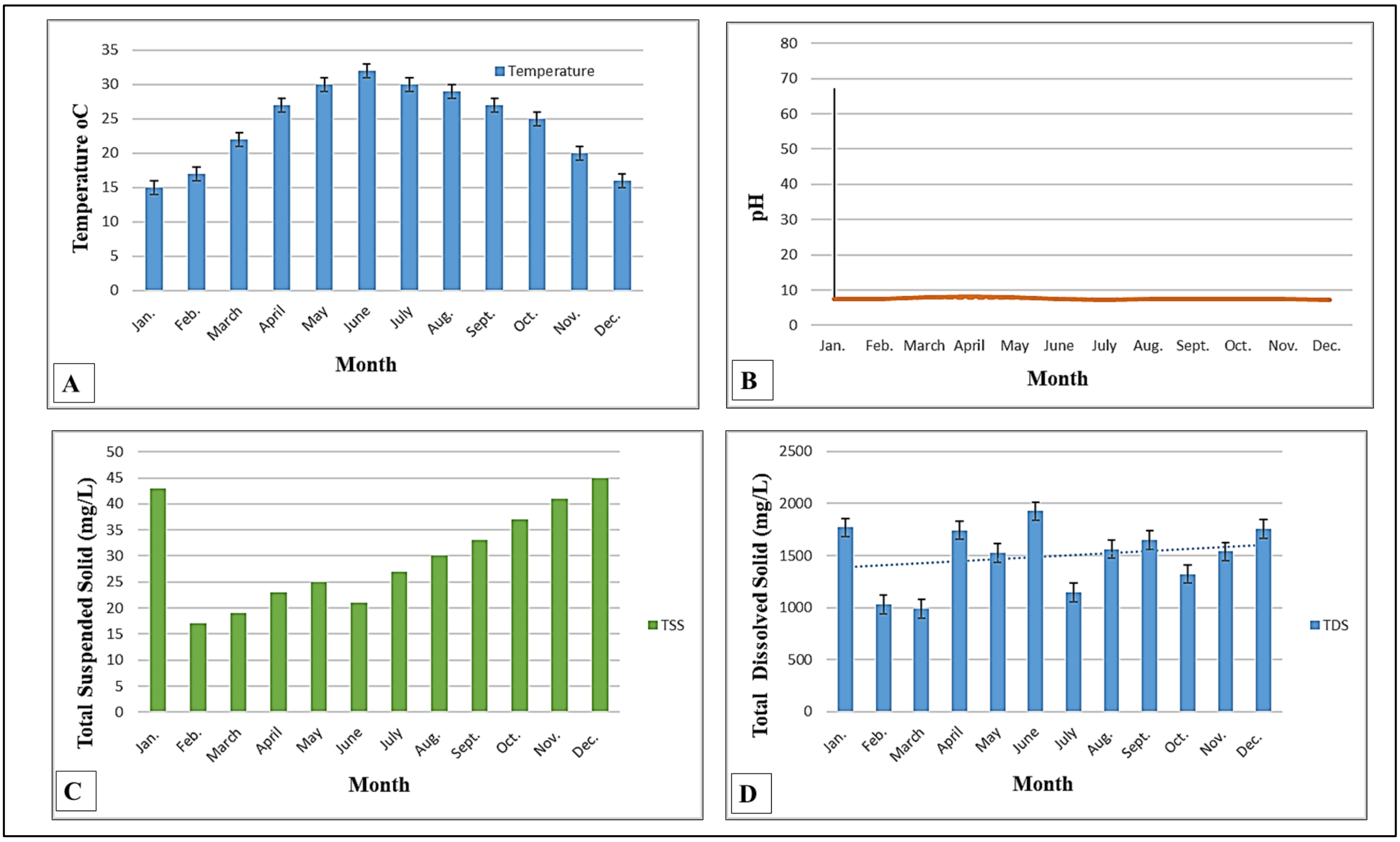

Figure 1 Variation in physicochemical parameters in the Sinhad Talab during different months of 2022 (A). Temperature (B). pH (C). Total suspended solid (D). Total dissolved solid.

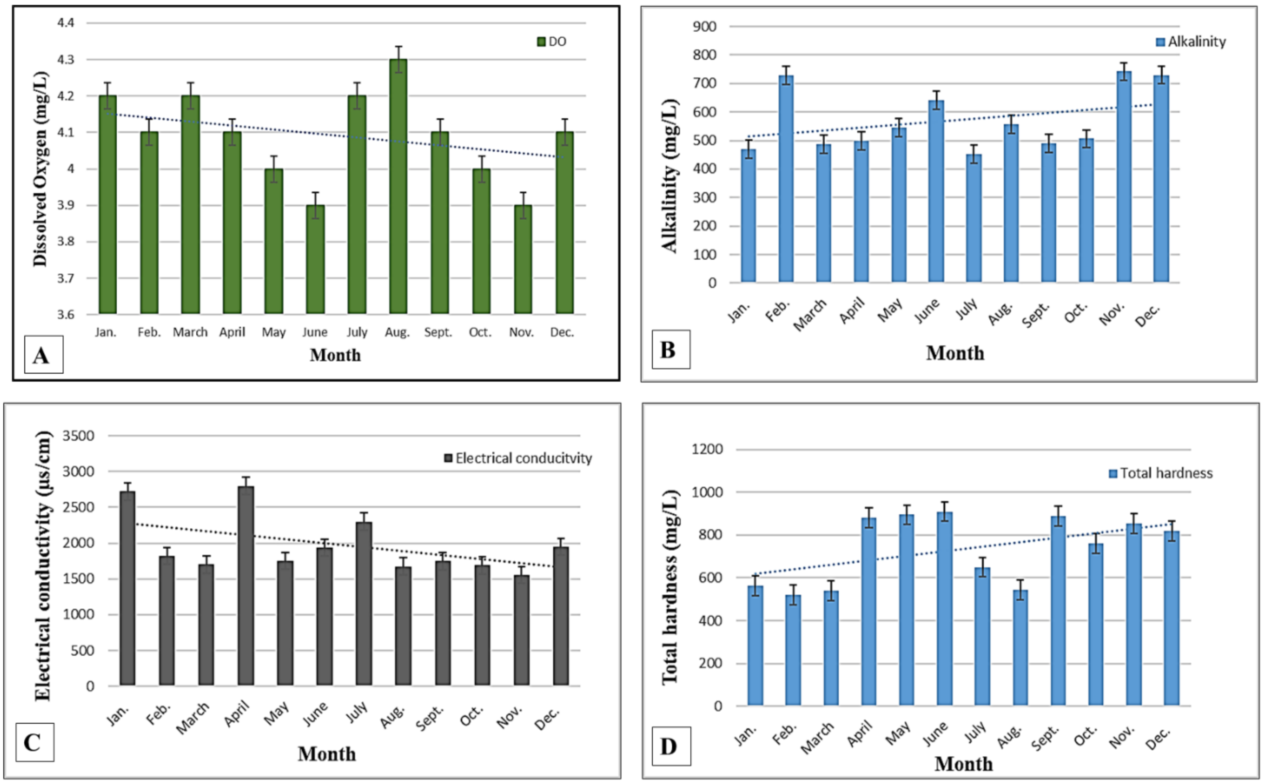

Figure 2 Variation in physicochemical parameters in the Sinhad Talab during different months of 2022 (A). Dissolved oxygen (B). Alkalinity (C). Electrical conductivity (D). Total hardness.

Table 1 Variation in different physiochemical parameter in the Sinhad talab during different months of 2022.

Month	Temp.	pH	TSS (mg/L)	TDS (mg/L)	DO (mg/L)	Alkalinity (mg/L)	Electrical conductivity (ms/cm)	Total hardness (mg/L)
Feb.	17	7.4	17	1028	4.1	728	1.82	520
March	22	7.5	19	988	4.2	488	1.70	540
April	27	7.9	23	1744	4.1	499	2.80	880
May	30	8.1	25	1526	4.0	545	1.75	895
June	32	7.9	21	1927	3.9	642	1.93	910
July	30	7.6	27	1145	4.2	453	2.30	650
Aug.	29	7.3	30	1562	4.3	556	1.67	545
Sept.	27	7.4	33	1648	4.1	491	1.74	890
Oct.	25	7.6	37	1322	4.0	506	1.69	760
Nov.	20	7.5	41	1539	3.9	742	1.55	853
Dec.	16	7.6	45	1756	4.1	730	1.95	820
Jan.	15	7.2	43	1769	4.2	469	2.72	563

4. DISCUSSION

The physicochemical parameters analyzed across different months indicate significant seasonal variations in water quality, which can be attributed to both natural climatic cycles and possible anthropogenic influences. The gradual increase in temperature from January to May (15°C to 30°C) is consistent with the expected seasonal warming in tropical and subtropical regions, which often results in changes in water chemistry and biological processes (Kumar et al., 2012). Slight alkalinity in pH (7.4 to 8.1) observed throughout the study period suggests that the water remained within acceptable limits for aquatic life and agricultural use. However, the increase in pH during the warmer months may be linked to enhanced photosynthetic activity, which removes CO_2 from the water and raises pH levels (Arhonditsis et al., 2004). This phenomenon is commonly observed in eutrophic water bodies with high biological productivity. The fluctuations in total suspended solids (TSS), with a peak in January (43 mg/L) followed by a sharp decline in February (17 mg/L), could be associated with surface runoff during winter rains or agricultural activity, leading to increased sediment load (Kambo & Dutta, 2015). Lower TSS levels in the following months might indicate sedimentation under relatively calm conditions or decreased rainfall and runoff. High total dissolved solids (TDS) values throughout the dataset (988 to 1769 mg/L) suggest significant ionic concentration in the water. Elevated TDS levels can result from agricultural runoff, industrial effluents, or natural weathering of rocks. The positive correlation between TDS and electrical conductivity (EC) further supports this interpretation, as EC is a direct indicator of dissolved ion concentration in water. The highest EC (2800 µS/cm) in April coincides with one of the highest TDS readings, suggesting increased solute input, possibly from irrigation return flows or evaporation effects under rising temperatures. Dissolved oxygen (DO) values remained relatively low (4.0–

4.2 mg/L), which could raise ecological concerns. DO concentrations tend to decrease as temperature increases, due to reduced solubility of oxygen and increased microbial activity (Chapman, 1996). Such conditions may stress aquatic organisms and indicate the presence of biodegradable organic matter. According to the Central Pollution Control Board (CPCB) of India, DO values below 5 mg/L can indicate slight pollution. Alkalinity values varied from 469 to 728 mg/L, reflecting the buffering capacity of the water body. High alkalinity can be attributed to the presence of bicarbonates and carbonates, often from limestone bedrock or agricultural lime use (Lake & Alexandria, 2017). While beneficial in neutralizing acids, extremely high alkalinity may also suggest anthropogenic inputs such as untreated wastewater. Water hardness increased significantly from 520 to 895 mg/L from January to May. This trend may reflect seasonal evaporation and concentration of dissolved calcium and magnesium ions, or it may indicate leaching from surrounding rocks (Ghavzan et al., 2006). Excessive hardness can have implications for domestic use and industrial processes, although it is not typically harmful to human health. Hence, the results highlight the importance of seasonal monitoring of water bodies to understand the interplay of natural and human-induced factors on water quality. Continuous and comprehensive water quality assessments are essential for maintaining ecosystem health and ensuring sustainable water resource management.

5. CONCLUSION

In the present study Sinhad pond of Nathdwara, Rajasthan have been studied for selected physicochemical parameters, phytoplankton diversity and macrophyte vegetation present in and around of the pond. This study was conducted during the year 2022. The physicochemical parameters studied include analysis of water temperature, electrical conductivity, pH (hydrogen ion concentration), TH, TA & DO. Based on overall average values monthly and seasonal variation of selected physicochemical parameters was depicted. The result from average values of water temperature indicate relatively higher temperature in summer and lower in winter. Electrical conductivity is the indication of electric current in water. From this point of view, confined values of EC contents were found in the sinhad talab with highest average water conductivity in winter followed by rainy and summer. The result of pH value during this study in sinhad talab maintained alkaline water quality condition with average higher pH of 8.05 observed in summer and rainy season represents the lowest average value of 7.72. In the present study total hardness in sinhad talab were found much less than critical level of 910 miligram per liter thus indicating lower level of calcium and magnesium ions in water. The higher average value was observed in summer followed by winter and rainy season. The total alkalinity content in the Sinhad talab remains between 453 to 742 milligram per L. On the basis of average dissolved oxygen values of sinhad talab it was concluded that winter season maintained the highest average value of 4.3 milligram per litre followed by rainy and summer season with 4.1 and 4.0 milligram per litre, respectively. Sinhad talab is categorized into less fairly clean followed by doubtful condition to poor water category based on average seasonal and monthly values.

Ethical approval and Consent to participate: Not applicable, and all authors participated in this work.
Consent for publication: All authors agree to publication.
Availability of data and materials: The data and materials that support the findings of the study are available from the corresponding author upon request.
Competing Interests: The author declare that they have no competing financial interest or personal relationship that could have appear to influence the work reported in this paper.
Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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