Assessment of Physicochemical Water Quality of Selected Temple Ponds in Northern Kerala (India)

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ABSTRACT

Six temple ponds of Kannur District of Kerala, India were assessed for physicochemical water quality. Parameters including p^{H}, alkalinity, total hardness, BOD, calcium, magnesium, chloride and iron were analysed. The results indicated that all parameters were within the permissible limits recommended by BIS and WHO. Payyavoor temple pond exhibited comparatively higher alkalinity, calcium concentration and BOD, whereas Rajarajeswara Chira showed the lowest hardness. The study indicates that although the ponds are generally suitable from a physicochemical perspective, regular monitoring and proper management are essential to conserve these culturally significant freshwater ecosystems.

Keywords: Temple Pond, Physicochemical Parameters, Water Quality, Freshwater Ecosystem, Sacred Water Bodies

INTRODUCTION

Temple tanks are traditional rainwater harvesting structures that serve ecological, cultural, and religious functions in many parts of India. Usually there are residences all around the temples and the temple tanks. Though in olden times, the water in the temple tank was used for drinking purpose also, now it is used for bathing and washing. These tanks helped in recharging the shallow open wells located in households around the tank. In the recent past, initiatives have been taken to divert rainwater from nearby storm water drains for rainwater harvesting and groundwater recharge. The impact of this system on the groundwater quality is yet to be established. In recent times temple tanks have fallen into disrepair. Houses have been built around the tanks, which contaminated and tarred, thus preventing ground water from seeping in. Today sewages flow into the temple tanks; as the devotees and public wash their clothes and body with detergents and soap for cleaning or for any other cleansing utilization. Some aquifers have lowered levels and the limited ground water intrusion has resulted in many temple tanks going dry. Over exploitation of ground water has also resulted in saline water entering many of the tanks, in coastal region [1]. In India, traditionally settlements are located in and around temples. The temple complex includes a tank, which is as an important site for cultural actions, and the temples and tanks are inseparable. Temple tanks occupy a prime position in the day to day living of the people [2]. The present study aimed to evaluate the physicochemical characteristics of six temple ponds in Kannur District of Kerala, India.

MATERIALS AND METHODS

Collection Sites

The present study was conducted in Kannur district, located in the northern part of Kerala, India. Known as the "City of Looms and Lores," Kannur is rich in cultural heritage and historical significance. The study focused on six temple ponds, including those associated with the Payyavoor Maha Siva Temple at Payyavoor, the temple chira and temple pond at Rajarajeswara Temple at Taliparamba, two temple ponds (I and II) at the Trichambaram Sree Krishna Temple at Taliparamba, and the Pappinisseri Shiva Temple.These temple ponds serve as vital water resources and hold considerable cultural importance in the region.

Collection Techniques

The water samples were collected from the study sites during the month of January – March 2025.The physicochemical assessment of water samples like p^H, Alkalinity, Total Hardness, Biochemical Oxygen Demand (BOD), calcium, magnesium, chloride and iron were carried out using standard method [3] and data were recorded (Table 1).

RESULTS

Table 1: Physicochemical characteristics of water from selected temple ponds in Kannur District, Kerala (India)

Characteristics	**Payyavoor Maha Siva temple pond**	**Rajarajeswara temple pond**	**Rajarajeswara chira**	**Trichambaram Sree Krishna Temple pond I**	**Trichambaram Sree Krishna Temple pond II**	**Pappinisseri Shiva Temple pond**
p^H	8.39	7.7	7.4	7.1	6.78	6.9
Alkalinity (mg L^{-1})	78	30	35	50	46	19
Total hardness (mg L^{-1} as $CaCO_3$)	98	22	23	53.4	50	24
Biochemical Oxygen Demand (BOD) (mg L^{-1})	4.4	3.2	3.49	3.6	3.5	3.3
Calcium (mg L^{-1})	78	18	16	13.78	12	24
Magnesium (mg L^{-1})	20	4	8	35	38	17
Chloride (mg L^{-1})	6.31	4.25	4.1	5.8	5.62	4.9
Iron (mg L^{-1})	Nil	Nil	Nil	Nil	Nil	Nil

The physicochemical of water samples obtained from six temple ponds, namely Payyavoor Maha Siva Temple pond, the Rajarajeswara Temple pond and chira, the two Trichambaram Sree Krishna Temple at Taliparamba, and the Pappinisseri Shiva Temple pond were as follows:

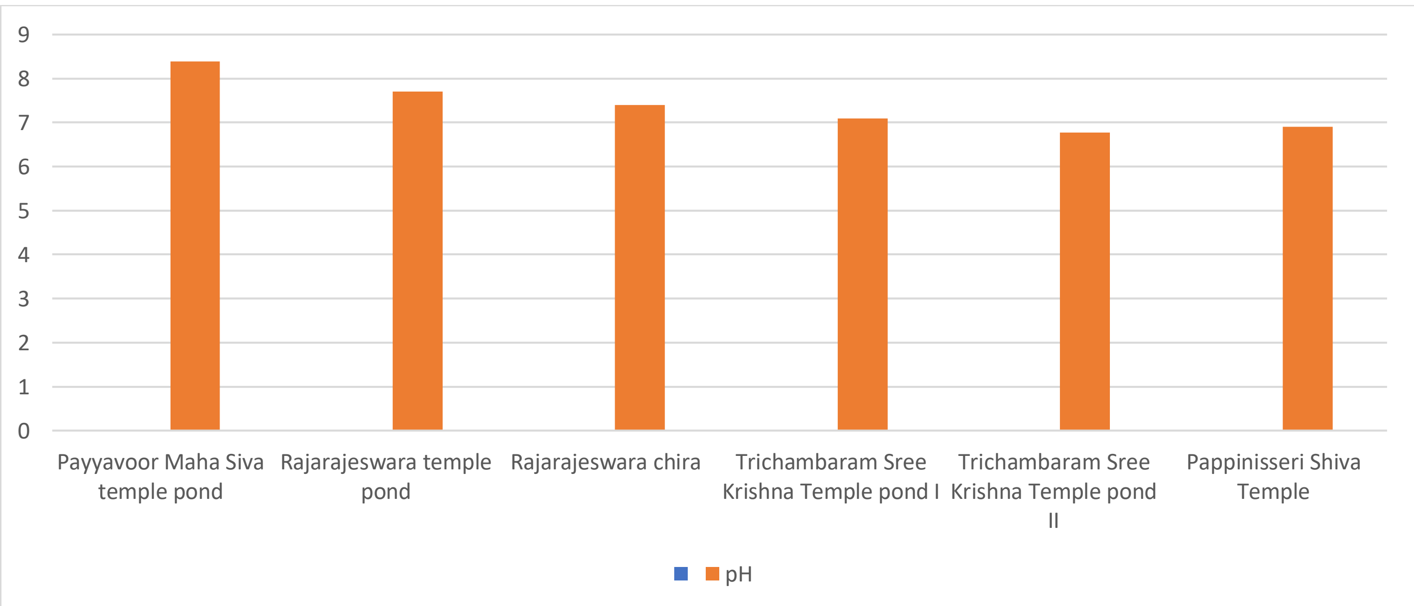

Fig. 1. Comparison of p^H among selected temple ponds.

The p^H of the temple ponds ranged from slightly acidic to strongly alkaline. The highest p^H was observed in Payyavoor Maha Siva Temple Pond (8.39), indicating an alkaline nature, while Trichambaram Pond II (6.78) had the lowest, suggesting mild acidity. Other ponds, such as Rajarajeswara Temple Pond (7.4) and Pappinisseri Shiva Temple Pond (6.9), exhibited near-neutral p^H (Fig. 2).All values fall within or close to the WHO's acceptable range of 6.5–8.5 for drinking water [4], indicating that the water is not corrosive or overly acidic/alkaline for aquatic life.

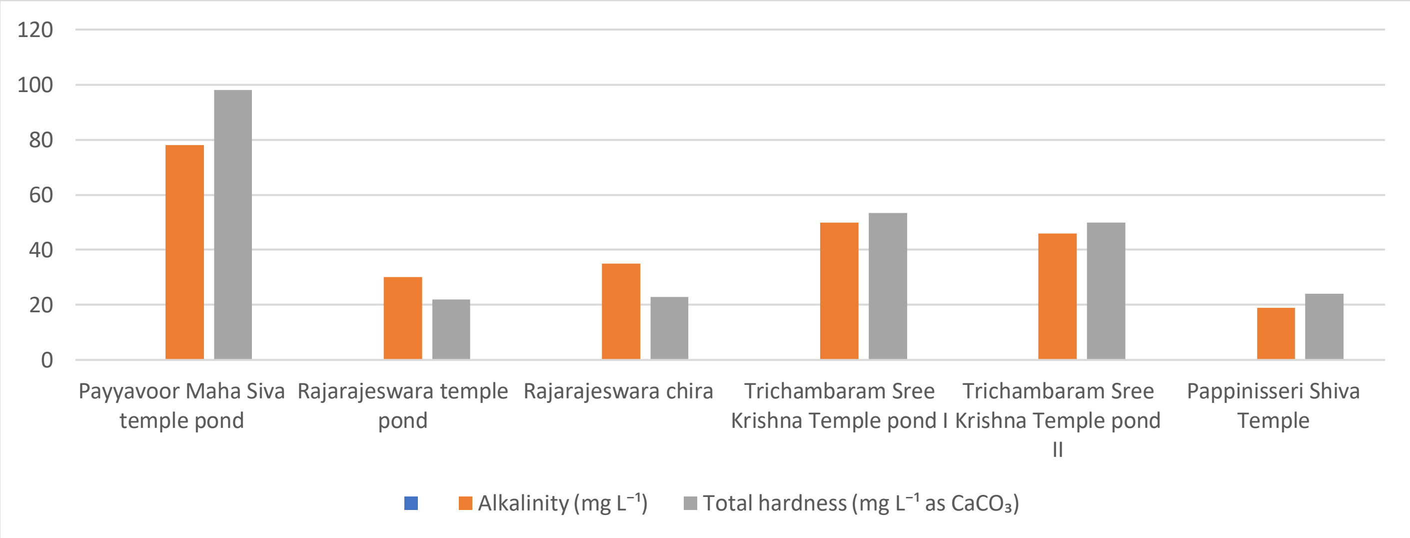

Fig. 2.Comparison of alkalinity and total hardness among selected temple ponds

Alkalinity levels, indicating the water's buffering capacity against p^H changes, were highest in Payyavoor Pond (78 mg L^{-1}), followed by Trichambaram Pond I (50 mg L^{-1}), and lowest in Pappinisseri Pond (19 mg L^{-1}) (Fig.1). All measurements are well below the Bureau of Indian Standards (BIS) guideline of 200 mg L^{-1} (BIS, 2012), suggesting the ponds have low to moderate buffering capacity. The higher alkalinity in Payyavoor may stabilize its high p^H levels.

Payyavoor Pond (98 mg L^{-1}) had the highest total hardness, classifying it as moderately hard water. In contrast, Rajarajeswara Chira (22 mg L^{-1}) and Rajarajeswara Temple Pond (23 mg L^{-1}) were classified as soft water. Most ponds fall under the soft to moderately hard category based on BIS classifications. The variation in hardness is attributed to differing concentrations of calcium and magnesium.

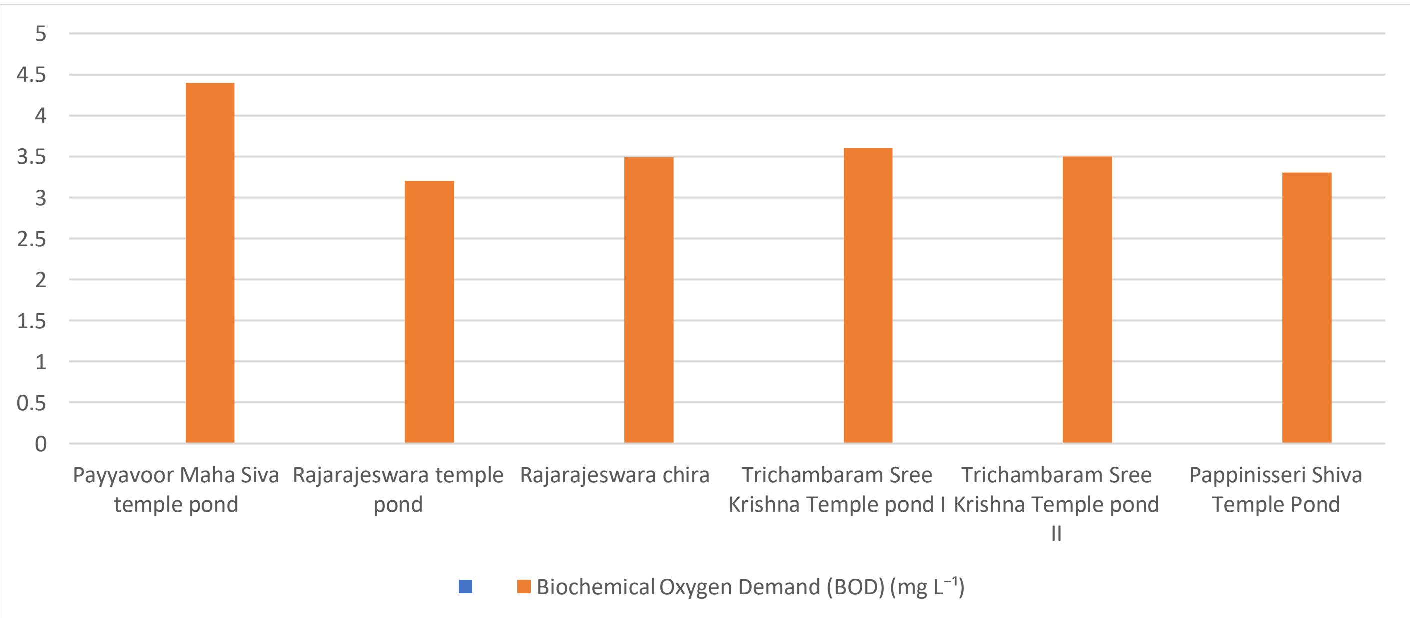

Fig. 3.Comparison of biochemical oxygen demand (BOD) among selected temple ponds

BOD values indicate organic pollution. The highest BOD was found in Payyavoor Pond (4.4 mg L^{-1}), while Rajarajeswara Chira (3.2 mg L^{-1}) had the lowest. Other ponds, such as Trichambaram I and II, recorded moderate levels (~3.5–3.6 mg L^{-1}) (Fig.3). As per Central Pollution Control Board (CPCB) guidelines, BOD values between 3–6 mg L^{-1} denote slight organic pollution. This suggests that while the ponds are relatively clean, there is some biodegradable organic matter present.

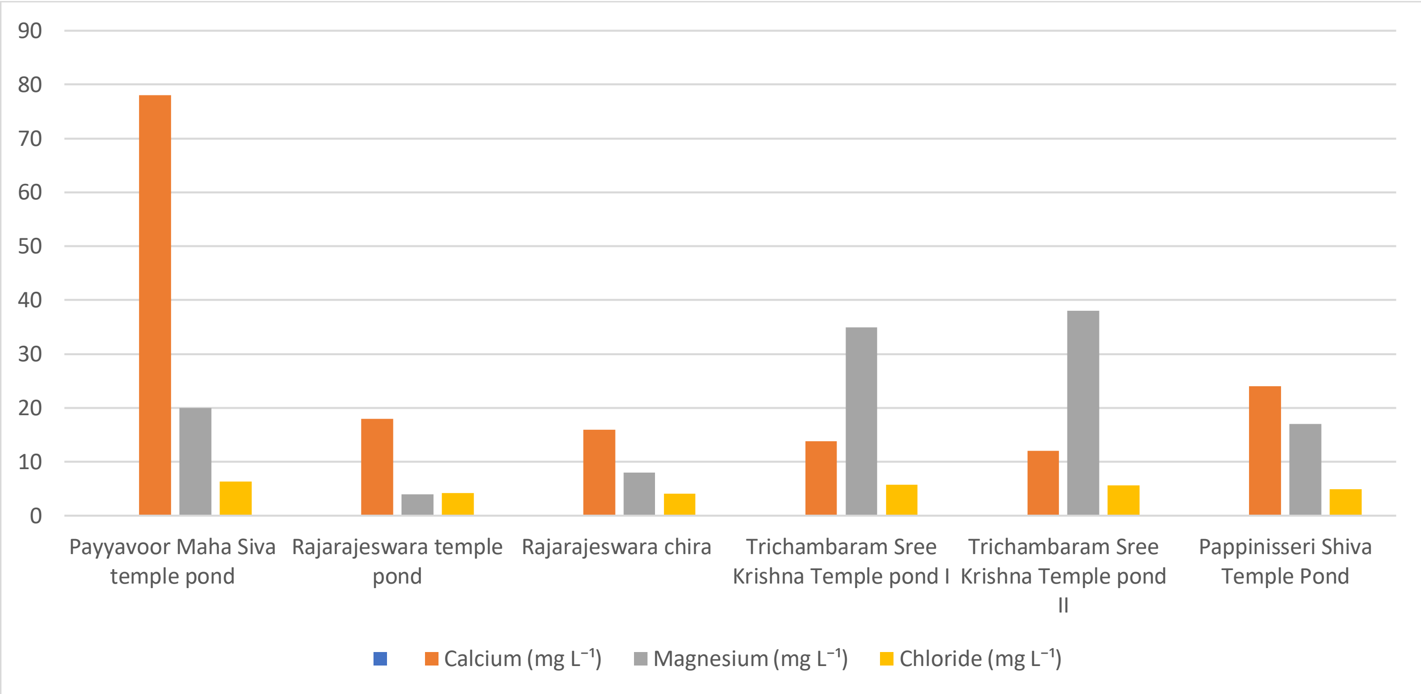

Fig. 4. Comparison of calcium, magnesium, and chloride concentrations among selected temple ponds.

Payyavoor Pond again stood out with the highest calcium content at 78 mg L^{-1}, contributing significantly to its hardness. Pappinisseri Pond (24 mg L^{-1}) and Rajarajeswara Chira (18 mg L^{-1}) followed by Trichambaram temple pond II had the lowest calcium level at 12 mg L^{-1}. In contrast, Trichambaram temple pond II recorded the highest magnesium level (38 mg L^{-1}), potentially due to the geochemical composition of the area, while Rajarajeswara Chira (mg L^{-1}) had the lowest (Fig.4). This magnesium variability reflects geological differences influencing water chemistry.

Chloride levels across all ponds were low, with Payyavoor Pond (6.31 mg L^{-1}) showing the highest, still far below the BIS limit of 250 mg L^{-1} (Fig. 4). The presence of chloride at these low levels suggests minimal contamination from anthropogenic sources such as domestic sewage or industrial waste.

Iron was undetectable in all six ponds, suggesting no significant input from lateritic soils, plumbing corrosion, or industrial discharges. This is a positive indicator, as iron levels above 0.3 mg/L can affect the colour and taste of water and stain surfaces [5].

DISCUSSION

The physicochemical assessment of water samples from six temple ponds namely Payyavoor Maha Siva, Rajarajeswara Chira, Rajarajeswara Temple Pond, Trichambaram Sree Krishna Temple (Ponds I & II), and Pappinisseri Shiva reveals that water quality parameters generally fall within acceptable limits, with observed variations attributable to natural geology, aquifer characteristics, and temple-related anthropogenic activities.

p^H levels ranged from 6.78 (Trichambaram II) to 8.39 (Payyavoor), indicating water quality from slightly acidic to moderately alkaline. Alkaline tendencies, such as that observed in Payyavoor, can be attributed to higher buffering capacities, potentially due to dissolved carbonates from limestone-rich substrata or ritualistic inputs [5]. Similar p^H variability has been reported in studies from temple ponds in Odisha [6], affirming the influence of localized ecological factors.

Alkalinity, which reflects water's capacity to neutralize acids, was highest in Payyavoor (78 mg L^{-1}) and lowest in Pappinisseri (19 mg L^{-1}). The elevated alkalinity in Payyavoor suggests stronger buffering, possibly due to frequent use of organic materials during rituals. Comparable values were observed in Koti Teertha Temple Pond, where values between 64–76 mg L^{-1}were attributed to cultural and natural inputs [5].

Total hardness, expressed as $CaCO_3$, varied considerably. Payyavoor's 98 mg L^{-1} classifies it as moderately hard, while Rajarajeswara Chira (22 mg L^{-1}) and Rajarajeswara Temple Pond (23 mg L^{-1}) are classified as soft. This gradient is indicative of the underlying lithology and water-rock interactions. A similar range of variability has been documented in temple ponds of Bhubaneswar, where hardness varied between 20–100 mg L^{-1} [7].

Biochemical Oxygen Demand (BOD) ranged from 3.2 mg/L (Rajarajeswara Chira) to 4.4 mg/L (Payyavoor). Though all values fall within permissible limits, the higher BOD at Payyavoor indicates a slight organic load, potentially from decaying flowers, oil residues, and other offerings. Guruvayur Temple Pond exhibited a similar trend, where BOD remained below critical thresholds despite heavy ritual usage [8].

Calcium levels were significantly higher in Payyavoor (78 mg L^{-1}), suggesting higher interaction with calcareous bedrock or higher rates of surface runoff carrying calcium-rich materials. In contrast, ponds like Trichambaram II (12 mg L^{-1}) and Rajarajeswara Chira (18 mg/L) had considerably lower levels. Magnesium showed an inverse pattern in Trichambaram, with Trichambaram 2 recording 38 mg L^{-1}, the highest among all, likely due to dolomitic presence or deeper groundwater influence

Chloride concentrations remained below 7 mg/L across all ponds, with Payyavoor recording 6.31 mg/L and Rajarajeswara Chira the lowest at 4.25 mg L^{-1}. These low levels indicate minimal contamination from urban runoff or sewage, a positive sign for both portability and aquatic health. Behera and Nayak [7] noted elevated chloride levels in urban temple ponds due to anthropogenic contamination, a trend not observed in this dataset.

Iron was absent in all samples, denoting good oxidative conditions and lack of heavy metal contamination, which aligns with findings from similar temple pond studies in Gokarna [6]. The absence of iron also implies reduced risks of bacterial growth facilitated by iron as a micronutrient.

CONCLUSION

Physicochemical assessment revealed that water quality parameters remain largely within acceptable limits, with variations reflecting both natural geological features and anthropogenic influences from temple rituals. Ponds like Payyavoor exhibited higher alkalinity, calcium, and BOD, suggesting greater organic input and buffering capacity, while sites like Rajarajeswara Chira showed softer water with lower mineral content, indicative of less altered conditions.

While traditional practices contribute to the ecological character of these systems, their integration with scientific conservation strategies is essential. Regular ecological monitoring, habitat restoration, and community engagement are recommended to ensure the long-term sustainability and biodiversity of these sacred freshwater ecosystems.

The present investigation represents a preliminary physicochemical assessment of selected temple ponds based on a single sampling period. Future studies should incorporate seasonal monitoring, microbiological analyses, nutrient profiling, heavy metal assessment, and advanced statistical approaches to obtain a more comprehensive understanding of the ecological health of these sacred freshwater ecosystems.

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