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Comprehensive Evaluation of the Pulicat Lake Ecosystem Health Using Physicochemical Indicators

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ABSTRACT

Pulicat Lake, the second-largest brackish water lagoon in India, is an ecologically important wetland that supports rich aquatic biodiversity, fisheries and migratory bird populations. The present study assessed the water quality of the Andhra Pradesh sector of Pulicat Lake from December 2025 to February 2026 using selected physicochemical parameters, namely Total Dissolved Solids (TDS), salinity, pH, and water depth. Field observations were conducted across thirteen sampling beats and the results were compared with historical records for interpretation. The study revealed that seasonal variations in TDS and salinity, with lower values during January and higher values during February. pH remained stable between 7.1 and 7.3 and Water depth showed moderate spatial and temporal variation, contributing to habitat diversity within the lagoon. Comparison with historical records showed that the observed values largely followed normal seasonal patterns and reflected the natural hydro-ecological behavior of the lake. The findings indicate that Pulicat Lake maintained favorable ecological conditions throughout the study period, supporting aquatic life, fisheries, and wetland biodiversity.

Keywords: *Biodiversity, pH, Pulicat Lake, Salinity, TDS, Water Depth, Wetland Ecosystem, Water Quality.*

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Introduction

Wetlands are among the most productive and ecologically important ecosystems on Earth. They serve as transitional environments between terrestrial and aquatic systems and support a wide variety of biological communities adapted to fluctuating hydrological and chemical conditions [1]. Coastal wetlands, in particular, provide numerous ecological services, including nutrient cycling, habitat support, shoreline stabilization, flood control, groundwater interaction, and maintenance of aquatic food webs [2]. These ecosystems also function as important feeding, breeding, nursery, and resting habitats for aquatic organisms and migratory birds [1,3].

The Pulicat Bird Sanctuary is one of the most significant wetland ecosystems in peninsular India and contains the second-largest brackish water lagoon in India, serving as an important habitat for diverse aquatic organisms and migratory birds [4,5]. It is well known for its ecological richness, hydrological complexity, and importance as a bird habitat and supports a range of habitats including shallow water stretches, mudflats, marshes, sand bars, saline patches, and fishery zones [6]. The lake extends across parts of Andhra Pradesh and Tamil Nadu. The Andhra Pradesh side of the lake, falling within the present Tirupati District [7] forms an ecologically sensitive landscape supporting fisheries, wetland vegetation, and seasonally large numbers of resident and migratory birds [8,6]. Mangrove trees and vegetation specially adapted to thriving in partly salty waters fringe the lake [8,9].

Pulicat Lake possesses rich aquatic biodiversity and the sanctuary supports a wide variety of ecological habitats, contributing significantly to its biological importance. The International Union for the Conservation of Nature and Natural resources (IUCN) declared the Pulicat lagoon as a Ramsar site (an internationally recognized wetland under the Ramsar Convention) of international importance, and the World Wide Fund for Nature declared it to be a protected area [10]. During the winter season every year, thousands of migratory birds, including the iconic Greater Flamingo, visit the shallow waters of Pulicat Lake. The sanctuary's wetlands, lagoons, and shallow water bodies provide ideal feeding, nesting, and resting habitats for a wide variety of bird species. The lake also possesses rich flora and fauna that support productive commercial fisheries and sustain a large and diverse population of resident and migratory birds [11]. Pulicat Lake provides nursery and breeding grounds for many species of coastal-marine fauna, including birds and also supports commercial fishing.

The primary source of freshwater to the lake is surface runoff carried by small seasonal rivers. Among them, the Aarani River enters the lake from the southern side, while the Kalangi River flows into it from the northwest. The Buckingham Canal, an important navigation channel, also passes through the lagoon [12]. Sriharikota Island forms the eastern boundary of the lagoon and separates it from the Bay of Bengal.

Seawater typically enters the lagoon through the northern inlet near Sriharikota Island and exits into the Bay of Bengal through the southern outlet [13,6]. Being influenced by both marine and freshwater systems, Pulicat Lake experiences continuous seasonal variations in salinity, dissolved substances, water extent, and overall habitat conditions.

Hence, the present study was planned to evaluate the ecological health of the Pulicat Lake ecosystem in the Andhra Pradesh sector using selected physicochemical water quality parameters. The specific objectives of the study are to assess the physicochemical characteristics of water in selected beats of Pulicat Lake during December 2025, January 2026 and February 2026 to examine beat-wise variations in parameters such as Total Dissolved Solids (TDS), salinity, pH, and water depth across the study area and to identify seasonal changes in these selected parameters during the field investigation period.

Materials and Methods

Study Area

The present study was conducted in the Andhra Pradesh sector of Pulicat Lake, currently located within Tirupati District. The study area falls under the administrative jurisdiction of the Pulicat Bird Sanctuary Range, Wildlife Management Division, Sullurpet. Pulicat Lake experiences a tropical coastal climate characterized by seasonal variations in temperature, humidity, rainfall, and evaporation. The wetland ecosystem comprises shallow water bodies, mudflats, marshes, sandbars, saline zones, channels, and fishery areas, making it an ecologically significant habitat for migratory birds and wetland biodiversity. The research was carried out by the Departments of Botany and Zoology, SVSSC Government Degree College (Autonomous), Sullurpet, Tirupati District, Andhra Pradesh.

Study Design

The investigation was conducted as a field-based descriptive and analytical study, following the methodology adopted by the researchers [14] to assess the hydro-ecological condition of Pulicat Lake. The study aimed to document beat-wise and month-wise variations in selected water quality parameters and to interpret these variations in relation to ecosystem health, environmental dynamics, and historical trends.

A total of thirteen beats were selected as sampling units:
1.Pernadu, 2. Damaraya 3. Venadu, 4. Attakanitippa, 5. Kudiri, 6. Vatambedu, 7. Irrakam, 8. Ramapuram, 9. Meejuru, 10. Pumbali, 11. Yelluru, 12. Rayadoruvu and 13. Tada.

Data Collection

The study utilized both primary and secondary sources of data.

I. Primary Data

Primary data were collected through field observations conducted from December 2025 to February 2026. Water quality parameters were measured directly at the sampling locations using standard field instruments. All field observations were carried out with the assistance of the Forest Department, Sullurpet. Primary data includes Analysis of Monthly Water Quality Parameters and Physicochemical Parameters Assessed.

Sampling Procedure

A beat-wise sampling design was adopted, wherein each of the 13 beats were treated as an independent sampling unit. Five observations were recorded from each beat during every study month. Sampling was conducted during the daytime between 8:00 AM and 5:00 PM to ensure safe field accessibility and consistency in observation conditions. The representative monthly value for each beat was calculated and used for data tabulation and analysis. The study period of December 2025 to February 2026 was selected because it represents an ecologically important phase characterized by migratory bird activity, fluctuations in freshwater inflow, salinity variations, and habitat changes.

1. Analysis of Monthly Water Quality Parameters

To understand the overall condition of the lake during each month, the range and average values of the observed parameters were calculated from the beat-wise

2. Physicochemical Parameters Assessed

The following physicochemical parameters were selected for assessment and measured through immediate in-situ analysis:

i. Beat-wise variations of Total Dissolved Solids (TDS)

Total Dissolved Solids were measured directly at each sampling location using a calibrated digital TDS meter, measured in (mg/L).

ii. Beat-wise variations of Salinity

Salinity was determined at the sampling sites using a digital salinity meter and a refractometer measured in parts per thousand (ppt).

iii. Beat-wise variations of pH

The hydrogen ion concentration (pH) of water was measured using a calibrated digital pH meter with standard buffer solutions.

iv. Beat-wise variations of Water Depth

Water depth was measured in Feets directly at each sampling site using a measuring tape .

II. Secondary Data

Secondary data were compiled from official records maintained by the Pulicat Bird Sanctuary Range Office, Wildlife Management Division, Sullurpet, and from other available official sources. Historical records covering the years 2021–22 and 2022–23 were used for comparative analysis and interpretation of present observations. Seasonal records from October onwards were given special consideration, as the migratory bird season in Pulicat Lake generally begins during this period.

Data Analysis

Statistical analysis was carried out using Two-Way Analysis of Variance (ANOVA IBM SPSS Statistics Version 26.0 [15] with replication to evaluate spatial (beat-wise) and temporal (monthly) variations in water quality parameters. The analysis was performed at the 5% significance level ($p < 0.05$).

Result and Discussion

The result analysis shows that major changes were present in the settlement areas. The values for physicochemical parameters of Pulicat lake during the study period from December 2025 to Febravary 2026 are presented in Tables1,2,3,4 and 5. (Fig-1.2.3.4).

I. Primary field Data

The primary field data collected during the study period are presented below month-wise and Beat-wise Physicochemical Parameters Assessed for all the beats covered under the investigation.

1. Analysis of Monthly Water Quality Parameters

To understand the overall condition of the lake during each month, the range and average values of the observed parameters were calculated from the beat-wise data prasented Table-1

Table-1. Analysis of Monthly Water Quality Parameters

Parameters	Dec-2025	Jan-2026	Feb-2026	Difference increase/decrease in %		
				Dec-Jan	Jan-Feb	Dec-Feb
TDS (mg/L)	26.24	25.26	28.55	3.88	13.02	8.80
Salinity (ppt)	13.69	11.69	19.85	17.11	69.80	44.50
pH	7.14	7.12	7.20	0.28	1.12	0.84
Depth (ft)	3.18	3.45	3.38	8.49	2.07	6.28

The monthly percentage variation analysis (Table-1) revealed that TDS exhibited minor variation between December to January (3.88%) and a moderate increase from January to February (13.02%). Overall, it shows a slight increasing trend from December to February, indicating a gradual accumulation of dissolved solids in the system. Salinity recorded a very sharp increase from January to February (69.80%) and a substantial rise from December to February (44.50%), which may be attributed to reduced freshwater inflow, enhanced seawater intrusion and increased evaporation during the study period. pH values remained highly stable, with very minimal variation ranging from 0.28% to 1.12%. This indicates that the lake maintained a consistent chemical balance without any significant acidic or alkaline shifts, reflecting overall ecosystem stability. Water depth showed moderate variation, with a noticeable increase during December to January (8.49%), followed by a relatively low change from January to February (2.07%). This pattern may be associated with rainfall influence and tidal regulation, which helped stabilize hydrological conditions.

2. Beat-wise Physicochemical Parameters Assessed

The beat-wise variations of physicochemical parameters recorded during the three study months were analyzed and are presented in Tables 2, 3, 4, and 5, and in Figures 1, 2, 3, and 4.

I. Beat-wise variations of TDS

TDS values exhibited spatial variation among the beats during all three study months, indicating heterogeneity in the distribution of dissolved solids within the lake ecosystem (Table 2; Fig. 1).

Table-2. Beat-wise variation in Total Dissolved Solids (TDS) in Pulicat Lake during the study period

Beat	Dec 2025	Jan 2026	Feb 2026
Pernadu	29.4	28.6	31.5
Damaraya	26.8	25.9	28.6
Venadu	28.5	27.8	30.2
Attakanithippa	25.6	25.1	27.8
Kudiri	24.2	23.6	26.4
Vatambedu	30.1	29.5	32.1
Irrkam	27.3	26.7	29.5
Ramapuram	26.4	25.9	28.7
Meejuru	24.8	24.2	27.1
Pambali	29.2	28.8	30.4
Yelluru	23.5	22.9	26.2
Rayadoruvu	24.6	23.8	27.6
Tada	20.4	19.6	25.1

Source of Variation	SS	df	MS	F	p-value
Beats	232.424	12	19.369	75.79	< 0.000001
Months	64.107	2	32.053	125.43	< 0.000001
Error	6.133	24	0.256		
Total	302.664	38			

- There is a highly significant difference in TDS among beats.
- There is a highly significant difference in TDS among months.

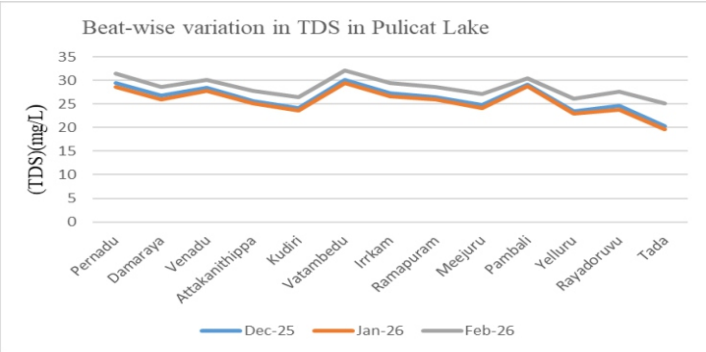

Fig-1. Beat-wise variation in Total Dissolved Solids (TDS) in Pulicat Lake during the study period

Total Dissolved Solids (TDS) exhibited significant spatial and temporal variation among the sampling beats of Pulicat Lake during the study period. The (Table-2 and Fig-1) results shows that the highest TDS concentrations were consistently recorded at Vatambedu, followed by Pernadu and Pambali, whereas the lowest values were observed at Tada throughout the study period. In December 2025, TDS values ranged from 20.4 to 30.1 mg/L, with the maximum concentration recorded at Vatambedu (30.1 mg/L). During January 2026, TDS values showed a slight decline across most sampling locations, ranging from 19.6 to 29.5 mg/L. This reduction may be attributed to post-monsoon freshwater inflow, which diluted dissolved ions and reduced overall TDS concentrations. In contrast, February 2026 recorded a noticeable increase in TDS levels across all beats, ranging from 25.1 to 32.1 mg/L, indicating the concentration of dissolved solids due to reduced freshwater input and increased evaporation during the dry season. The observed spatial variability suggests that hydrological connectivity, tidal exchange, and local circulation patterns strongly influence dissolved solid concentrations within the lagoon. Sampling beats such as Vatambedu, Pernadu, Pambali, and Venadu consistently exhibited higher TDS values, possibly due to greater marine influence and restricted freshwater dilution. Conversely, Tada maintained comparatively lower TDS concentrations, reflecting stronger freshwater influence or greater flushing effects.

The temporal trend observed in the present study is consistent with the seasonal dynamics commonly reported in estuarine and brackish-water ecosystems. Fluctuations in dissolved solids have been reported to be closely associated with variations in freshwater inflow, evaporation rates, and tidal exchange processes [16]. Similarly, [1] noted that reduced freshwater discharge during dry periods often leads to the accumulation and concentration of dissolved minerals in coastal wetlands and lagoons. Comparable seasonal patterns have also been documented in tropical estuarine environments, where TDS levels increase during periods of low river discharge and enhanced evaporation [17]. The significant differences observed among beats and months indicate that both spatial and temporal factors play an important role in regulating TDS concentrations in Pulicat Lake. Since TDS influences salinity, nutrient availability, water quality, and the distribution of aquatic organisms, regular monitoring is essential for understanding ecosystem functioning and maintaining the ecological productivity of the lagoon[18].

ii. Beat-wise Variation in Salinity

The salinity values varied markedly among the different beats and across the study months (Table 3 and Fig. 2).

Table-3. Beat-wise variation in Salinity in Pulicat Lake during the study period

Beat	Dec 2025	Jan 2026	Feb 2026
Pernadu	14	12	20
Damaraya	12	10	18
Venadu	16	14	22
Attakanithippa	10	8	20
Kudiri	12	10	18
Vatambedu	18	16	22
Irrkam	14	12	20
Ramapuram	16	14	22
Meejuru	18	16	18
Pambali	14	12	20
Yelluru	14	12	20
Rayadoruvu	10	8	18
Tada	10	8	18

Source of Variation	SS	df	MS	F	p-value
Beats	177.64	12	14.80	8.33	0.000006
Months	450.67	2	225.33	126.75	<0.000001
Error	42.67	24	1.78		
Total	670.97	38			

- There was a highly significant variation in salinity both among beats and among months during the study period ($p < 0.001$).

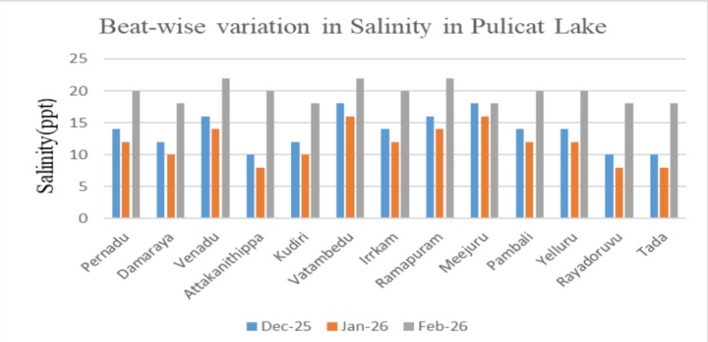

Figure -2. Beat-wise variation in Salinity in Pulicat Lake during the study period

Salinity exhibited significant spatial and temporal variations in Pulicat Lake during the study period (December 2025–February 2026). The observed variations (Table-3, Fig 2) reflect the combined influence of freshwater inflow, tidal exchange, evaporation, and local hydrological conditions that regulate the salinity regime of coastal lagoon ecosystems.

Salinity values ranged from 10–18 ppt in December 2025, 8–16 ppt in January 2026, and 18–22 ppt in February 2026, demonstrating clear seasonal fluctuations across the study area. In December 2025, the highest salinity values were recorded at Vatambedu and Meejuru (18 ppt), while the lowest values occurred at Attakanithippa, Rayadoruvu and Tada (10 ppt). During January 2026, salinity decreased throughout most sampling beats, with values ranging from 8 to 16 ppt. The lowest salinity was again observed at Attakanithippa, Rayadoruvu and Tada (8 ppt), whereas Vatambedu and Meejuru recorded the highest values (16 ppt). A marked increase in salinity was observed during February 2026, when values ranged between 18 and 22 ppt. The highest salinity was recorded at Venadu, Vatambedu and Ramapuram (22 ppt), while comparatively lower values were observed at Damaraya, Kudiri, Meejuru, Rayadoruvu and Tada (18 ppt). The substantial increase in salinity during February may be attributed to reduced freshwater inflow, increased evaporation rates, and prolonged water residence time, which collectively enhance the concentration of dissolved salts within the lagoon. Similar seasonal salinity patterns have been reported in tropical estuarine and coastal wetland ecosystems, where post-monsoon freshwater discharge lowers salinity levels, followed by gradual salinity enrichment during dry seasons [17,19].

The spatial differences observed among sampling beats indicate the influence of localized hydrological processes. Higher salinity values recorded at Venadu, Vatambedu, and Ramapuram may be associated with stronger marine influence and reduced freshwater dilution, whereas lower salinity values at Damaraya, Kudiri, Meejuru, Rayadoruvu, and Tada suggest greater freshwater contribution and enhanced water exchange. Such spatial heterogeneity is a common characteristic of lagoon ecosystems, where salinity gradients are governed by the balance between seawater intrusion and freshwater inputs [1]. Salinity is recognized as one of the most important environmental factors influencing ecological processes in brackish-water ecosystems. Variations in salinity affect nutrient cycling, plankton productivity, species composition, fish distribution, and overall ecosystem functioning [16,20].

iii. Beat-wise variation in pH

The pH values remained within a narrow range throughout the study, indicating relative chemical stability of the lake water. (Table 4 and Fig 3)

Table-4. Beat-wise variation in pH in Pulicat Lake during the study period

Beat	Dec 2025	Jan 2026	Feb 2026
Pernadu	7.1	7.1	7.2
Damaraya	7.1	7.1	7.1
Venadu	7.1	7.1	7.2
Attakanithippa	7.1	7.1	7.2
Kudiri	7.2	7.2	7.2
Vatambedu	7.1	7.1	7.2
Irrkam	7.2	7.2	7.3
Ramapuram	7.1	7.1	7.2
Meejuru	7.2	7.2	7.2
Pambali	7.1	7.1	7.2
Yelluru	7.1	7.1	7.2
Rayadoruvu	7.1	7.1	7.2
Tada	7.1	7.1	7.2

Source of Variation	SS	df	MS	F	p-value
Beats	0.0462	12	0.00385	2.31	0.049
Months	0.1067	2	0.05335	32.01	< 0.000001
Error	0.0400	24	0.00167		
Total	0.1929	38			

- $p < 0.05$, indicating a significant difference in pH among beats, although the variation is very small.
- There is a highly significant difference in pH among months.

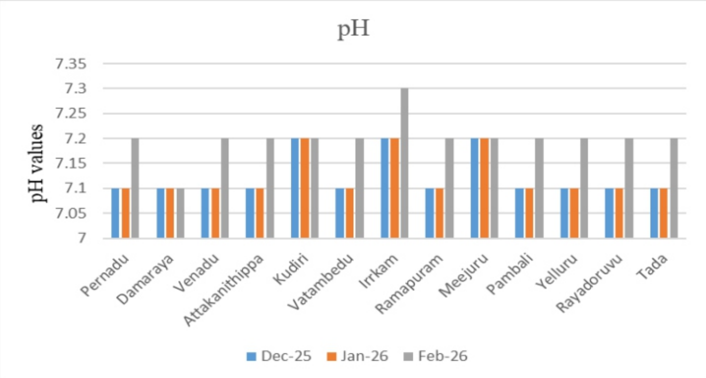

Fig-3. Beat-wise variation in pH in Pulicat Lake during the study period

The pH of Pulicat Lake remained relatively stable throughout the study period (December 2025–February 2026), indicating a well-buffered aquatic environment. This analysis revealed significant differences in pH among sampling beats ($F = 2.31$, $p = 0.049$) and highly significant differences among months ($F = 32.01$, $p < 0.001$) the observed pH values varied within a very narrow range of 7.1–7.3. This suggests that, despite statistically detectable variations, the overall acid–base status of the lake remained chemically stable and maintained near-neutral to slightly alkaline conditions.

The highest pH value (7.3) was recorded at Irrkam during February, whereas the remaining sampling stations exhibited values between 7.1 and 7.2 throughout the study period (Table-4). The slight increase in pH observed during February may be associated with enhanced photosynthetic activity, which reduces dissolved carbon dioxide concentrations and consequently increases pH. Additionally, reduced freshwater inflow and increased concentration of dissolved minerals during the dry season may have contributed to the marginal elevation in pH levels [1]. The narrow range of pH variation observed in the present study indicates the presence of an effective carbonate–bicarbonate buffering system, which helps maintain chemical equilibrium in estuarine and lagoon environments. Similar observations have been reported [16,21] who noted that natural aquatic ecosystems with adequate buffering capacity generally exhibit only minor fluctuations in pH despite seasonal changes in hydrological and physicochemical conditions.

The pH values recorded during the present investigation fall within the optimum range for most aquatic organisms and are considered favorable for biological productivity, nutrient cycling, and ecosystem functioning [18]. Stable pH conditions support the growth and survival of plankton, benthic organisms, fish, and other aquatic biota, thereby contributing to the ecological health of the lagoon. Overall, the findings demonstrate that while pH exhibited statistically significant spatial and temporal variations, these changes were ecologically minor and did not alter the overall chemical stability of the lake.

iv. Beat-wise Variation in Water Depth (ft)

Water depth varied among beats and months, reflecting localized hydrological differences.Table-5, Fig-4

Table-5. Beat-wise variation in Water Depth in Pulicat Lake during the study period

Beat	Dec 2025	Jan 2026	Feb 2026
Pernadu	4.2	4.5	4.0
Damaraya	3.5	3.8	3.5
Venadu	3.5	3.8	3.5
Attakanithippa	2.5	2.8	3.0
Kudiri	2.5	2.8	3.0
Vatambedu	2.5	2.8	3.0
Irrkam	4.2	4.5	4.0
Ramapuram	3.5	3.8	3.5
Meejuru	2.5	2.8	3.0
Pambali	2.5	2.8	3.0
Yelluru	2.5	2.8	3.0
Rayadoruvu	4.2	4.5	4.0
Tada	3.5	3.8	3.5

Source of Variation	SS	df	MS	F	p-value
Beats	11.282	12	0.940	112.80	< 0.000001
Months	0.367	2	0.183	22.00	< 0.000001
Error	0.200	24	0.0083		
Total	11.849	38			

- Water depth differed highly significantly among beats.
- Water depth differed highly significantly among months.

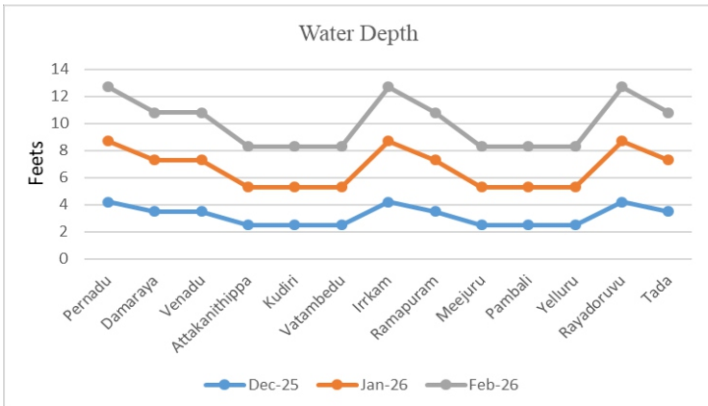

Fig-4. Beat-wise variation in Water Depth in Pulicat Lake during the study period

Water depth exhibited significant spatial and temporal variation in Pulicat Lake during the study period (December 2025–February 2026). Results (Table-5, Fig 4) revealed highly significant differences among sampling beats ($F = 112.80$, $p < 0.001$) and among months ($F = 22.00$, $p < 0.001$), indicating that both location-specific characteristics and seasonal hydrological processes strongly influenced water depth patterns within the lagoon. Water depth ranged from 2.5–4.2 ft in December 2025, 2.8–4.5 ft in January 2026, and 3.0–4.0 ft in February 2026. The greatest depths were consistently recorded at Pernadu, Irrkam, and Rayadoruvu throughout the study period. In December, these stations exhibited the maximum depth of 4.2 ft, while several other stations recorded minimum depths of 2.5 ft. During January, water levels increased slightly, with the highest depth of 4.5 ft observed at Pernadu, Irrkam, and Rayadoruvu. This increase likely reflects the retention of post-monsoon water and continued freshwater contributions within the lagoon system. In February, depth values became more uniform across sampling locations, with maximum depths of 4.0 ft recorded at Pernadu, Irrkam, and Rayadoruvu, while several other beats, including Damaraya, Venadu, Ramapuram, and Tada, recorded depths of 3.5 ft.

The relatively greater depths observed during January suggest the influence of post-monsoon water storage and hydrological connectivity within the lagoon. In contrast, the more uniform depth distribution observed during February may indicate stabilization of water levels during the dry season as inflows decreased and water levels gradually adjusted across the system.

Similar seasonal patterns have been reported in coastal lagoons and wetlands where water depth is strongly influenced by rainfall, freshwater inflow, evaporation, and local hydrological conditions [1]. Water depth is recognized as an important environmental variable influencing water circulation, nutrient dynamics, aquatic vegetation, and the distribution of aquatic organisms [16]. Deeper areas often serve as refuges for fish and other aquatic fauna during periods of environmental stress, whereas shallow zones support benthic productivity and provide important feeding habitats for waterbirds. Seasonal fluctuations in depth can also influence the availability of breeding, nesting, and foraging habitats, particularly for migratory and resident bird species that depend on shallow-water environments and exposed mudflats [22]. The observed variation in water depth contributes to habitat diversity and ecological heterogeneity within Pulicat Lake, supporting a wide range of aquatic and avian communities. Maintaining appropriate water levels is therefore essential for sustaining ecosystem productivity, biodiversity, and wetland functioning.

II.Comparison with Historical Record-Based Summary

To understand whether the present observations align with broader seasonal patterns, the field results were compared with the available year-wise summary compiled from historical records.

Table -6. Historical Record-Based Summary for Comparative Interpretation

Year	Month	TDS	Salinity	pH	Depth
2021–22	Oct	33–40	40–50	7.1–7.3	2–2.5 ft
2021–22	Dec	19–30	8–16	7.1–7.2	2–4 ft
2022–23	Jan	18–28	6–14	7.1–7.2	2–4 ft
2022–23	Feb	24–30	15–20	7.2	2.5–3.5 ft

The comparison of present observations with historical range office records indicates that the hydro-ecological conditions of Pulicat Lake during December and January 2025–26 were generally consistent with historical seasonal patterns. February also showed the expected increase in TDS and salinity, although some beats recorded slightly higher values than the historical upper range. These findings suggest that the observed seasonal variations largely reflect the natural hydrological characteristics of the lake. However, the slightly elevated values in certain beats highlight the importance of continued monitoring to track potential changes in water quality. Historical records from October, which marks the beginning of the migratory bird season, showed considerably higher salinity and TDS levels than those observed during the present winter study. This emphasizes the strong seasonal variability of Pulicat Lake and the need to interpret water quality parameters within their seasonal context rather than in isolation.

Conclusion

The present study assessed the spatial and temporal variations of key physicochemical parameters, namely Total Dissolved Solids (TDS), salinity, pH, and water depth, in the Andhra Pradesh sector of Pulicat Lake from December 2025 to February 2026. The findings demonstrated significant variations among sampling beats and months, indicating the influence of both local environmental conditions and seasonal hydrological processes on water quality. TDS and salinity showed clear seasonal variation, with lower values in January and higher values in February, reflecting the influence of post-monsoon freshwater inflow followed by increased evaporation and reduced freshwater input during the dry season. Higher TDS and salinity were generally observed at Vatambedu, Pernadu, Venadu and Ramapuram, while lower values occurred at Tada and other inland beats. In contrast, pH remained stable throughout the study period (7.1–7.3), indicating a well-buffered and chemically stable aquatic environment. Water depth varied significantly among beats and months, with the greatest depths recorded at Pernadu, Irrkam, and Rayadoruvu, and the highest average depth observed during January. Comparison with historical records showed that the observed physicochemical parameters were generally within the normal seasonal ranges reported for Pulicat Lake. Overall, the study indicates that the lake maintained suitable water quality conditions for supporting aquatic and avian communities during the study period. Continuous monitoring of water quality and hydrological parameters is essential for effective conservation and sustainable management of this ecologically important brackish-water lagoon.

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