HCMUS Fishpond Water Quality Pilot
Round 2–3 Measurements: Analysis

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Dataset: 2025-12-14_pilot_measurements.xlsx (sheet: Raw_Data_Dot1)

1. Context and Objectives

This pilot monitoring activity aims to produce a first, evidence-based snapshot of basic physico-chemical conditions in the HCMUS Campus 2 fishpond area. The parameters measured (pH, electrical conductivity/TDS, and temperature) are commonly used as fast indicators of acidity/alkalinity, dissolved ionic content, and thermal conditions that influence chemical equilibria and aquatic biological processes.

Primary objectives:

- Quantify the range and short-term repeatability (replicate-to-replicate variability) of pH, temperature, and EC/TDS at each sampling point.
- Identify spatial patterns across sampling points (01–09) while explicitly acknowledging possible day-to-day variation.
- Document data limitations (missing replicates, unit/mode inconsistencies) and propose a practical QA/QC protocol for future campaigns.

2. Dataset Overview

The dataset contains 9 sampling points (HCMUS-FishPond-01 to -09) collected on three separate dates. For each sampling point, the team recorded multiple measurement rounds (replicates) for each parameter.

- Total valid measurement records (excluding blank rows): 72
- Sampling dates: 14 Dec 2025 (samples 01–03), 21 Dec 2025 (samples 04–06), 28 Dec 2025 (samples 07–09).
- Replicates: 3 rounds for samples 01–06; 2 rounds for samples 07–09 (measurement interruption).
- Parameters: pH (unit: pH), Temperature (unit: °C), EC/TDS (recorded as either µS/cm or ppm depending on device mode).

3. Measurement Notes (as recorded in the sheet)

The spreadsheet notes indicate that at least one replicate was taken after a standing period at room temperature (e.g., “Measured after 30-minute standing…”). This is relevant because standing can change measured values via temperature stabilization, sediment settling, gas exchange (CO2), and probe equilibration.

Key implication: replicate rounds are not purely identical repeats; they may reflect controlled waiting time between rounds. Therefore, replicate variability should be interpreted as a combination of instrument repeatability and short-term sample changes.

4. Data Quality Checks

The following checks were performed on the provided Excel sheet:

- Removed visually blank spacer rows (rows with missing Sample_ID).
- Verified no duplicate records for the same (Sample_ID, Date, Round, Parameter).
- Confirmed no missing numeric values for recorded rows.
- Identified two important limitations: (i) missing Round 3 for samples 07–09, and (ii) EC recorded in two modes/units (µS/cm vs ppm) for samples 01–03.

Recommendation (immediate): in future field sheets, add a dedicated column to capture device mode (e.g., "EC (µS/cm)" vs "TDS (ppm)"), and avoid switching modes within the same sampling session.

5. Results

5.1 pH (acidity/alkalinity)

Across all samples, pH ranged from 6.93 to 8.61. The highest pH values were observed in samples 01–03 (14 Dec 2025), while samples 07–09 (28 Dec 2025) were closer to neutral.

Group-level mean pH (by sampling point groups): 01–03: 8.458; 04–06: 7.911; 07–09: 7.297.

Replicate variability for pH was generally small (typical within-sample range ~0.16–0.23 pH units for 3-round samples), suggesting reasonable short-term stability and/or acceptable instrument repeatability for a pilot dataset.

5.2 Temperature

Water temperature ranged from 31.0°C to 35.5°C. Temperature differed across sampling dates and points, which is expected given varying time-of-day, weather, and local shading.

Group-level mean temperature: 01–03: 31.52°C; 04–06: 33.62°C; 07–09: 32.52°C.

Replicate temperature ranges were typically <= 0.6°C for many points, though one point showed a larger spread (~2.2°C), consistent with probe equilibration and/or genuine short-term thermal changes during standing.

5.3 Electrical Conductivity / TDS

For samples 04–09, EC/TDS was recorded consistently in ppm and remained in a narrow low-to-moderate range (approximately 63–70 ppm). For samples 01–03, the first round was recorded as µS/cm, while later rounds were recorded in ppm. Because the conversion between conductivity (µS/cm) and TDS (ppm) depends on a device-specific factor (often ~0.5–0.7), direct numeric comparison between µS/cm and ppm is not valid without knowing the instrument's conversion setting.

Within the ppm-recorded subset, the group-level mean EC/TDS values were: 01–03: 70.5 ppm; 04–06: 67.0 ppm; 07–09: 65.8 ppm.

Overall interpretation (conservative): the pond water appears to have relatively low dissolved ionic content in this pilot dataset, and there is no evidence of extreme salinity or abrupt spikes during the recorded rounds.

5.4 Replicate consistency and precision (pilot-level)

A simple replicate consistency check was conducted by computing within-sample ranges across rounds:

- pH: median within-sample range = 0.19 (min 0.01, max 0.26).

- Temperature: median within-sample range = 0.6°C (min 0.0°C, max 2.2°C).

- EC/TDS (ppm subset): median within-sample range = 4.0 ppm (min 0.0, max 10.0).

These ranges are compatible with a pilot field campaign using portable sensors; however, standardizing the protocol (probe rinsing, stabilization time, and consistent mode/unit logging) will likely reduce replicate spread further.

6. Interpretation (working hypotheses)

Because different sampling points were measured on different dates, any "trend over time" is confounded with spatial differences. The patterns below should therefore be treated as hypotheses to be tested with a same-day spatial survey in a future campaign.

- Higher pH at points 01–03 could reflect stronger photosynthetic activity (algae/macrophytes) during daylight, which removes CO_2 and raises pH, or differences in local inputs (e.g., concrete surfaces, runoff).
- Near-neutral pH at points 07–09 may indicate greater mixing, different sediment/organic matter influence, or sampling at a time with reduced photosynthetic CO_2 uptake.
- Stable low-to-moderate EC/TDS suggests the pond water is not highly mineralized in this period; minor differences between points could reflect localized dissolution, sediment interaction, or runoff dilution.

- Temperature differences likely reflect sampling time, shading, and standing/probe equilibration effects; future protocol should fix a consistent time window to improve comparability.

7. Limitations

- Sampling was not fully synchronized: points 01–03, 04–06, and 07–09 were measured on different dates, limiting strict spatial comparisons.
- Replicate count is unbalanced: samples 07–09 have two rounds only due to measurement interruption.
- EC measurements mix units/modes (µS/cm vs ppm) for samples 01–03, preventing direct numeric comparison unless conversion settings are known.
- Only three basic parameters were measured; additional indicators (DO, turbidity, nutrients, ammonia/nitrate/phosphate) are needed for ecological interpretation.

8. Recommendations for Next Campaign

- Standardize a measurement SOP: (i) calibrate pH with buffer solutions before each session; (ii) rinse probes between samples; (iii) record a fixed stabilization time (e.g., wait until reading changes <0.01 pH or <1 µS/cm per 10 s).
- Lock EC/TDS mode and record both the unit and the device conversion factor (if available). If feasible, record conductivity (µS/cm) consistently and compute TDS later using a documented factor.
- Conduct a same-day spatial survey: measure points 01–09 within the same 1–2 hour window to separate spatial vs temporal variation.
- Add core parameters for water quality interpretation: dissolved oxygen (DO), turbidity, and at least one nutrient indicator (e.g., nitrate or phosphate).
- Improve metadata: record sampling depth, weather (sun/cloud), and any visible conditions (algae bloom, odor, sediment) to support interpretation.

9. PPT-Ready Conclusion

- pH ranged from near-neutral to slightly alkaline (6.93–8.61), with higher values observed at sampling points 01–03 compared to 07–09.
- Water temperature was relatively high (31.0–35.5°C), consistent with environmental conditions and measurement timing.
- EC/TDS values recorded in ppm (samples 04–09) were stable in a low-to-moderate range (~63–70 ppm), with no abnormal spikes across rounds.
- Some samples (07–09) include two rounds only due to measurement interruption; EC mode/unit inconsistency (µS/cm vs ppm) was observed for samples 01–03 and should be standardized in future work.

Appendix A. Descriptive Statistics by Sampling Point

Values are computed from replicate rounds recorded in the dataset. pH and temperature are directly comparable; EC/TDS must be interpreted by unit.

Point	Date	n rounds	pH (mean ± SD) [min–max]	Temp °C (mean ± SD) [min–max]	EC/TDS (ppm) (mean ± SD) [min–max]	EC (µS/cm) (n; value)
01	2025-12-14	3	8.42 ± 0.08 [8.34–8.50]	32.23 ± 1.12 [31.0–33.2]	76.5 ± 0.7 [76–77] (n=2)	n=1; 140
02	2025-12-14	3	8.46 ± 0.10 [8.37–8.56]	31.17 ± 0.29 [31.0–31.5]	71.0 ± 7.1 [66–76] (n=2)	n=1; 128
03	2025-12-14	3	8.49 ± 0.12 [8.38–8.61]	31.17 ± 0.29 [31.0–31.5]	64.0 ± 0.0 [64–64] (n=2)	n=1; 124
04	2025-12-21	3	7.78 ± 0.10 [7.67–7.87]	34.53 ± 0.95 [33.6–35.5]	67.7 ± 4.0 [63–70] (n=3)	—
05	2025-12-21	3	7.96 ± 0.13 [7.84–8.10]	33.40 ± 0.35 [33.0–33.6]	66.7 ± 2.1 [65–69] (n=3)	—
06	2025-12-21	3	8.00 ± 0.13 [7.92–8.15]	32.93 ± 0.83 [32.0–33.6]	66.7 ± 3.5 [63–70] (n=3)	—
07	2025-12-28	2	7.03 ± 0.13 [6.93–7.12]	33.30 ± 0.42 [33.0–33.6]	67.0 ± 4.2 [64–70] (n=2)	—
08	2025-12-28	2	7.33 ± 0.01 [7.33–7.34]	32.00 ± 0.00 [32.0–32.0]	66.0 ± 1.4 [65–67] (n=2)	—
09	2025-12-28	2	7.53 ± 0.07 [7.48–7.58]	32.25 ± 0.35 [32.0–32.5]	64.5 ± 0.7 [64–65] (n=2)	—