Research Title : Study of Water Quality in the Area of Huai Yang Reservoir and Huai Thap Than Stream, Huai Thap Than District, Sisaket Province

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Abstract

This research aims to study and compare the water quality in the area of Huai Yang Reservoir and Huai Thap Than Stream, Huai Thap Than District, Sisaket Province, based on different data collection, time and sampling locations. A total of 54 samples were collected from three study sites: 1.Upstream (Ban Or Village) – A densely populated area. 2.Midstream (Huai Yang Reservoir) – A popular tourist spot with dense habitation. 3.Downstream (Huai Thap Than Stream) – An area with riparian forest along the riverbanks, spanning 6.3 km.Water samples were collected once per month for three months, from November 2024 to January 2025, measuring six physical and chemical parameters: water temperature, electrical conductivity (EC), dissolved oxygen (DO), pH, nitrate concentration, and phosphate concentration.The research findings showed the following results across the three study sites:Water temperature: 27–32°C.Electrical conductivity (EC): 68–73 µS/cm.pH level: 7.2–7.80.Dissolved oxygen (DO): 9.30–10.37 mg/L.Nitrate concentration: 0.26–0.27 mg/L.Phosphate concentration: 0.07–0.12 mg/L.As a result of applying a one-way ANOVA analysis using Scheffe's method to compare water quality across months and sampling locations, it was found that water temperature differed significantly between December and January at a statistical significance level of 0.05.

Keywords: Water quality, parameter values

1. Introduction

Water is a vital natural resource that affects all life on Earth. Climate change has resulted in natural disasters such as droughts, floods, and storms, affecting human water usage and leading to severe water shortages during dry seasons. These issues impact the availability of natural water sources for consumption and sanitation, creating challenges for food security and hygiene.According to reports on Thailand's pollution situation between 1996 and 2021, surface water quality across the country has been categorized as degraded, with 5–44% of sources falling into poor quality and 25–55% classified as fair (Pollution Control Department, 2012, 2017, 2021).Huai Thap Than District has a significant waterway, the Huai Thap Than Stream, originating from the Phrom Dong Rak mountain range and passing through various subdistricts before merging into the Mun River. The stream connects with Huai Yang Reservoir, a major tourist attraction. Many local communities depend on the reservoir for various uses, including agriculture, transportation, and wastewater disposal.Given these concerns, this research aims to study and compare water quality across three study sites within the Huai Yang Reservoir and Huai Thap Than Stream. The study's objective is to evaluate water quality at different points (upstream, midstream, and downstream) and analyze the physical and chemical factors affecting water quality. This will contribute to water management strategies, conservation efforts, and raising community awareness about shared water resources.

2.Research Objectives

To study and compare water quality in the Huai Yang Reservoir and Huai Thap Than Stream, Huai Thap Than District, Sisaket Province.

3.Research Questions

How does water quality differ among the three study sites?

4.Research Hypothesis

Water quality varies across the three study sites.

5.Study Variables

Independent Variable: Sampling locations (upstream, midstream, downstream).

Dependent Variable: Water quality at each study site.

Controlled Variables: Sampling methods, sampling time, water quality measurement instruments.

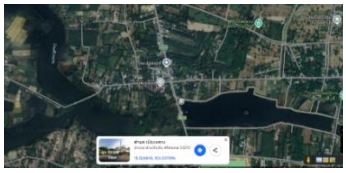
6.Materials and Methods

1.**Study Sites** – Three locations were selected within the Huai Yang Reservoir and Huai Thap Than Stream

Diagram 1 Water sampling Point

Point 1 Upstream (Ban Or Village)

Point 2 Midstream (Huai Yang Reservoir)



Point 3 Downstream (Huai Thap Than Stream)

7.Materials, Equipment, and Chemicals

1.Secchi Disk (for measuring water transparency) 2.Sensor-based Thermometer / Alcohol Bulb Thermometer 3.Electrical Conductivity (EC) Meter 4.Total Dissolved Solids (TDS) Meter 5.pH Meter 6.Lab Quest Sensor (for measuring temperature, pH, and relative humidity) 7.Nitrate Test Kit 8.Phosphate Test Kit 9.Digital Hygrometer 10.Google Sheets 11.Google Slides 12.Canva 13.Mobile Phone 14.Camera 15.Notebook for Data Recording 16.Google Maps 17.Google Earth 18.Pencil/Pen 19.Scissors 20.Medium-sized Test Tubes 21.Droppers 22.Graduated Cylinders 23.Beakers 24.Test Tube Rack 25.Sample Collection Bottles 26.Stopwatch 27.Measuring Tape 28.Distilled Water

Scope of the Study

1. **Content Scope**

   1.1 Study of **physical water quality** parameters: water transparency, water temperature.

   1.2 Study of **chemical water quality** parameters: pH, dissolved oxygen (DO), nitrate

   1.3 concentration, electrical conductivity (EC), and phosphate concentration.

2. **Location Scope**

   Three study sites were selected: **Site 1:** Upstream (Ban Or Village) **Site 2:** Midstream (Huai Yang Reservoir) **Site 3:** Downstream (Huai Thap Than Stream)

3. Time Scope

Water samples were collected once per month on the 30th of each month for three months: First collection: November 30, 2024 Second collection: December 30, 2024 Third collection: January 30, 2025

Research Methodology

1. Study Site Selection

1.1 Site 1: The upstream area near Ban O.

1.2 Site 2: The midstream area at Huai Yang Reservoir.

1.3 Site 3: The downstream area at Huai Thap Than Stream.

2 Field Survey

Conduct an on-site survey of the study locations.

3 Water Sample Collection and Analysis

3.1 Collect water samples from the three study sites for water quality analysis using the GLOB method (Institute for the Promotion of Teaching Science and Technology, 2012).

3.2 Analyze physical parameters, including water temperature and electrical conductivity (EC).

3.3 Analyze chemical parameters, including pH, dissolved oxygen (DO), nitrate concentration, and phosphate concentration.

3.4 Compare water quality data with standard surface water quality criteria to assess the impact of physical and chemical factors and contribute to water management and conservation planning.

4. Comparison with Water Quality Standards

4.1 pH Measurement: According to the National Institute of Freshwater Fisheries (Maitree Duangsawat & Jaruwan Somsiri, 1985), pH values ranging from 6.5 to 9.0 are suitable for aquatic life.

4.2 Dissolved Oxygen (DO) Evaluation: Based on the Department of Environmental Quality Promotion (Srisuwan Kasemsak et al., 2012), a DO level of 6.0 mg/L or higher indicates good Type 2 water quality, suitable for aquatic life conservation, fisheries, swimming, water sports, and consumption after disinfection and treatment.

4.3 Water Temperature Assessment: According to the Pollution Control Department (2010), water temperature should not exceed natural temperature levels by more than 3°C.

4.4 Electrical Conductivity (EC) Measurement: This parameter measures the ability of a solution to conduct electricity, influenced by the concentration of dissolved ions. Freshwater typically has an EC range of 100–2,000 µS/cm.

4.5 Nitrate Concentration: Nitrate in water originates from the decomposition of organic matter, such as plant and animal remains, feces, wastewater, fertilizers, industrial discharge, and agricultural chemicals. According to National Environmental Board Notification No. 8 (1994), safe nitrate levels should not exceed 5.0 mg/L.

4.6 Phosphate Concentration: Phosphorus in water is generally linked to nitrogen levels, and excessive phosphorus contributes to water degradation. According to the Pollution Control Department (2010), phosphorus levels between 0.05–1 mg/L or above may lead to water quality deterioration, while heavily degraded water sources often exceed 0.6 mg/L of total phosphorus.

5.Submit Data to the Program Upload the data into the system via the Data Entry section on https://www.globe.gov.

Research Findings

The objective of this study was to investigate the causes of water quality changes and compare the water quality in the Huai Yang Reservoir and Huai Thap Than Stream areas, considering the variations in water quality across different months and sampling locations. The statistical data analysis was divided into two parts as follows:

1.Basic Data Analysis of Each Indicator

The indicators included water temperature (°C), electrical conductivity (EC), pH, dissolved oxygen (DO), nitrate concentration, and phosphate concentration. The analysis included the mean, standard deviation, maximum value, and minimum value for each indicator.

2. Comparison of Water Quality

A comparison of water quality was made by examining the changes in the mean values of each indicator, considering two factors: the differences in months and sampling locations. The one-way analysis of variance (ANOVA) was used to analyze the data.

Analysis of Basic Data for Water Quality Indicators

1. Temperature Changes

The temperature changes in the Huai Yang Reservoir and Huai Thap Than Stream areas across all three study sites from November to January are shown in Table

1.Table 1 Results of water temperature measurements at the three study sites from November 2024 to January 2025.

Study point	Temperature value^{0}C						
	point 1	point 2	point 3	average	SD	Min	Max
Nov.2024	30	32	31	31	1.00	30	32
Dec.2024	31	33	32	32	1.00	31	33
Jan.2025	26	28	27	27	1.00	26	28

From Table 1, the results of the water quality measurements in the Huai Yang Reservoir and Huai Thap Than Stream areas show that the average water temperature ranged from 27–32°C. The highest temperature recorded was 33°C in December at Site 2, Huai Yang Reservoir, and the lowest temperature was 26°C in November at Site 1, the upstream area near Ban O. The water temperature at all three sites fluctuated according to the weather conditions each month and did not significantly differ between the locations. The temperature showed an increasing trend during the second measurement and then decreased again during the third measurement.

2. Changes in Electrical Conductivity (EC) of Water

The changes in electrical conductivity (EC) in the Huai Yang Reservoir and Huai Thap Than Stream areas across all three study sites from November to January are shown in Table

2.Table 2Results of electrical conductivity (EC) measurements at the three study sites from November 2024 to January 2025

Study point	Electrical Conductivity (EC) of Water µS/cm						
	point 1	point 2	point 3	average	SD	Min	Max
Nov.2024	80	75	62	73	7.50	62	80
Dec.2024	78	72	60	70	9.16	60	78
Jan.2025	75	70	57	68	9.29	57	75

From Table 2, the results of the water quality measurements in the Huai Yang Reservoir and Huai Thap Than Stream areas show that the electrical conductivity (EC) had an average value ranging from 68 to 73 µS/cm. The highest EC value recorded was

80 µS/cm in November 2024 at Site 1, the upstream area near Ban O. The lowest EC value was 57 µS/cm in December 2024 at Site 3, the downstream area at Huai Thap Than Stream. It was found that the EC values at all three sites exhibited very little variation. However, the measured EC values can indicate the presence of dissolved organic compounds in the water, such as chloride, bromide, nitrate, and phosphate ions, which may be attributed to community activities, including wastewater discharge into the stream from daily life activities.

3. Changes in pH of Water

The changes in pH of the water in the Huai Yang Reservoir and Huai Thap Than Stream areas across all three study sites from November to January are shown in Table 3.Table 3Results of pH measurements at the three study sites from November 2024 to January 2025.

Study point	pH of Water						
	point 1	point 2	point 3	average	SD	Min	Max
Nov.2024	7.3	7.3	7.2	7.27	0.05	7.2	7.3
Dec.2024	7.5	7.9	7.4	7.60	0.26	7.4	7.9
Jan.2025	7.9	8	7.5	7.80	0.26	7.5	8

From Table 3, the results of the water quality measurements in the Huai Yang Reservoir and Huai Thap Than Stream areas show that the pH ranged from 7.27 to 7.80, with the highest pH recorded as 8.0 in December 2024 at Site 2, the Huai Yang Reservoir. The lowest pH was 7.2 in November 2024 at Site 3, the Huai Thap Than Stream. The average pH values at all sites throughout the seasons were neutral, which has no adverse effects on living organisms. These values are consistent with the general surface water standards. However, it is not recommended to use the water directly for consumption or domestic use. If it is necessary to use it, water quality treatment must be done before use, except for irrigation, where the water can be used directly without treatment.

4. Changes in Dissolved Oxygen (DO) Levels

The changes in dissolved oxygen (DO) levels in the Huai Yang Reservoir and Huai Thap Than Stream areas across all three study sites from November to January are shown in Table

4.Table 4 Results of Dissolved Oxygen (DO) measurements at the three study sites from November 2024 to January 2025.

Study point	(Dissolved Oxygen, DO) (mg/L)						
	point 1	point 2	point 3	average	SD	Min	Max
Nov.2024	10.00	10.20	10.90	10.37	0.47	10.00	10.90
Dec.2024	9.50	9.80	10.60	9.97	0.57	9.50	10.30
Jan.2025	8.90	8.50	10.50	9.30	1.06	8.50	10.50

From Table 4, the results of water quality measurements in the Huai Yang Reservoir and Huai Thap Than Stream areas show that the Dissolved Oxygen (DO) levels ranged from 9.30 to 10.37 mg/L, with the highest recorded DO being 10.90 mg/L in January 2025 at Site 3, the Huai Thap Than Stream. The lowest DO level was 8.50 mg/L in January 2025 at Site 2, the Huai Yang Reservoir.

The DO levels at all three sites showed minimal changes. However, the average DO in January was noticeably lower than in other months. A significant difference in DO was observed in November, with higher levels than in other months. This increase is likely due to the flow of water into the stream and reservoir during the late rainy season, which results in higher dissolved oxygen levels due to the increased flow of water into the reservoir and Huai Thap Than Stream during the rainy season.

5. Changes in nitrate levels in the water in the Huai Yang Reservoir and Huai Thap Thun River areas at all 3 study points between November - January, as shown in Table 5. Table 5 Results of nitrate levels in the water at the 3 study points between November 2024 - January 2025.

Study point	Nitrate levels in water (mg/L)						
	Point 1	Point 2	Point 3	average	SD	Min	Max
Nov.2024	0.25	0.28	0.24	0.26	0.21	0.24	0.28
Dec.2024	0.28	0.28	0.25	0.27	0.02	0.25	0.28
Jan.2025	0.25	0.29	0.28	0.27	0.02	0.25	0.29

From Table 5, the water quality measurement results in the Huai Yang Reservoir and Huai Thap Tun River area show that the nitrate levels in water averaged between 0.26 and 0.27 mg/L. The highest recorded nitrate level was 0.29 mg/L in November 2024 at Site 2, Huai Yang Reservoir, while the lowest level was 0.24 mg/L in January 2025 at Site 3, Huai Thap Tun River. All study sites had nitrate concentrations not exceeding 1 mg/L, in accordance with the standard.

6. The changes in dissolved phosphate in water in the Huai Yang Reservoir and Huai Thap Tun River area at all 3 study sites between November and January are shown in Table 6.Table 6 Results of dissolved phosphate measurements in water at the three study sites between November 2024 and January 2025.

Study point	Dissolved Phosphate in Water (mg/L)						
	point 1	Point 2	Point 3	average	SD	Min	Max
Nov.2024	0.03	0.02	0.15	0.07	0.07	0.02	0.15
Dec.2024	0.04	0.03	0.15	0.07	0.07	0.03	0.15
Jan.2025	0.05	0.05	0.25	0.12	0.11	0.05	0.25

From Table 6, the water quality measurements in the Huai Yang Reservoir and Huai Tab Tan River areas show that the average concentration of dissolved phosphate in water ranged from 0.07 to 0.12 mg/L. The highest recorded concentration of dissolved phosphate was 0.25 mg/L in January 2025 at site 3, located at the Huai Tab Tan River. The lowest concentration was 0.15 mg/L in January 2025 at the same site, Huai Tab Tan River.Water quality analysis using statistical methods

The comparison of water quality, based on changes in the average values of temperature, electrical conductivity (EC), pH, dissolved oxygen (DO), nitrate levels, and phosphate levels, was conducted using a one-way analysis of variance (ANOVA) with Scheffe's method. This method was used to compare the water quality indicators across different months and sampling points (all 3 locations). The results are shown in the table below.

Table 7 One-Way Analysis of Variance (ANOVA) for Temperature

Measured temperature	Variance Sources	SS	df	MS	F	P-value
November - December	Between Groups	42.00	2	21.00	21.00	0.002
	Within Groups	6.00	6	1.00		
	Total	48.00	8.00			

Table 8 Results of Pairwise Comparison of Mean Temperatures for Each Month (November 2024 – January 2025)

Dependent Variable: Scheffe	Temperature					
Month		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
December	Nov.	1.00000	0.81650	0.512	-1.6187	3.6187
	Jan.	5.00000*	0.81650	0.003	2.3813	7.6187

From Table 7 it can be seen that the temperature in November, December, and January showed significant statistical differences at the 0.05 level. When pairwise comparisons were conducted using the Scheffe method, the results presented in Table 8 showed that in December, the average temperature was significantly different from January at the 0.05 level.

Table 9 One-Way ANOVA Table for Electrical Conductivity (EC) of Water

Electrical Conductivity (EC) of Water	Variance Sources	SS	df	MS	F	P-value
November-January	Between Groups	37.56	2	18.78	0.22	0.809
	Within Groups	513.33	6	85.56		
		550.89	8.00			

From Table 9 it is found that regarding the electrical conductivity (EC) of water in November, December, and January across the 3 study sites, there is no statistically significant difference.

Table 10 One-way Analysis of Variance (ANOVA) of the pH values of water.

pH of Water	Variance Sources	SS	df	MS	F	P-value
November-January	Between Groups	0.44	2	0.22	4.56	0.063
	Within Groups	0.29	6	0.05		
	Total	0.72	8.00			

From Table 10, it was found that the pH values of water in November, December, and January from all three study sites did not show any statistically significant differences.

Table 11 One-way analysis of variance table for dissolved oxygen levels.

pH of Water	Variance Sources	SS	df	MS	F	P-value
November-January	Between Groups	1.74	2	0.87	1.57	0.283
	Within Groups	3.33	6	0.56		
	Total	5.08	8.00			

From Table 11, it is found that the dissolved oxygen levels in November, December, and January at all three study sites do not show statistically significant differences.

Table 12 One-Way Analysis of Variance Table for Nitrate Levels.

pH of Water	Variance Sources	SS	df	MS	F	P-value
November-January	Between Groups	1.74	2	0.87	1.57	0.283
	Within Groups	3.33	6	0.56		
	Total	5.08	8.00			

From Table 12 it was found that the nitrate levels in the water during November, December, and January at all 3 study points did not show any statistically significant differences.

Table 13 One-way ANOVA analysis of phosphate levels in water.

pH of Water	Variance Sources	SS	df	MS	F	P-value
November-January	Between Groups	0.004	2	0.002	0.29	0.759
	Within Groups	0.046	6	0.008		
	Total	0.050	8			

From Table 13 it is found that the phosphate levels in water during November, December, and January from all three study sites show no statistically significant differences.

Summary and Discussion of Research Findings

The study measured water quality in the areas of Huai Yang Reservoir and Huai Thap Than Stream, located in Huai Thap Than District, Sisaket Province, to investigate the causes of water quality changes and compare the quality of water across different months and sampling locations. Water quality was assessed based on six physical and chemical parameters: water temperature, electrical conductivity (EC), dissolved oxygen (DO), pH, nitrate concentration, and phosphate concentration.

The research findings from the three study sites are as follows: Water temperature had an average range of 27–32°C. Electrical conductivity (EC) had an average range of 68–73 µS/cm. pH levels ranged between 7.2–7.80. Dissolved oxygen (DO) levels averaged 9.30–10.37 mg/L. Nitrate concentrations averaged 0.26–0.27 mg/L. Phosphate concentrations averaged 0.07–0.12 mg/L.By comparing these results with the National Environmental Board's Surface Water Quality Standards (Notification No. 8, B.E. 2537 [1994]), it was found that the water quality in both Huai Yang Reservoir and Huai Thap Than Stream met the standards for Type 2 surface water. This classification indicates that the water is suitable for consumption, agricultural use, and aquatic life conservation.Given the high density of residential communities around the Huai Yang Reservoir, water quality changes could be influenced by wastewater discharge from these communities. However, as the reservoir is connected to Huai Thap Than Stream, which facilitates water movement rather than stagnation, the overall water quality remained within acceptable limits based on surface water quality standards.Sampling location differences had minimal effects on water quality, likely due to similar activities occurring along the watercourse. However, variations between months significantly influenced certain water quality indicators. The most noticeable changes were observed in November, with significant differences in water temperature during December and January. Statistical analysis using Scheffe's one-way ANOVA confirmed these differences at a 0.05 significance level.

Recommendations:

1. Additional water quality parameters, such as Biochemical Oxygen Demand (BOD), Suspended Solids (SS), and Total Coliform Bacteria (TCB), should be studied.
2. Water samples should be tested immediately to ensure accuracy.
3. Long-term data collection over an entire year should be conducted for seasonal analysis.

Acknowledgments

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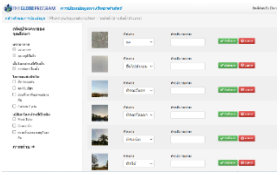
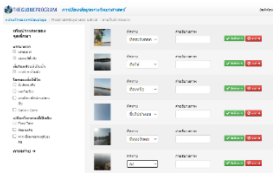
Environmental Data Submission to the GLOBE Database

Point 1 Upstream (Ban Or Village)



Point 2 Midstream (Huai Yang Reservoir)



Point 3 Downstream (Huai Thap Than Stream)

Submitted a total of 6 parameter values.