GLOBE VSS Research

The Effects of Seasons on Water Quality Changes at Wonnapha Beach

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Abstract

The research, " The Effect of Seasons on Water Quality Changes at Wonnapha Beach", aims to study the changes in seawater quality during different seasons and analyze the relationship between rainfall and coastal water quality. Seawater samples were collected from Wonnapha Beach. According to the observation of seawater discoloration in July 2024, measurements of temperature, salinity, pH, dissolved oxygen (DO), and water transparency were taken, with supporting data from The Institute of Marine Science, Burapha University and Thai Meteorological Department (TMD). The study found that seasons significantly affect seawater quality, with water quality ranging from poor to fair during the summer, while it is fair to good during the rainy and winter seasons. The study found that increased rainfall leads to a decrease in salinity and DO levels due to the transport of sediment and nutrients from land-based sources to the sea. This promotes plankton growth and may be the cause of seawater discoloration, which could be related to climate change or global warming.

Introduction

Background and Significance

Changes in coastal seawater quality are a major global environmental issue, directly impacting marine ecosystems and the economic activities of coastal communities. Particularly in developed areas affected by human activities such as settlements and fishing, which result in a continuous increase in the amount of nutrients and pollutants from land flowing into the sea. This study focuses on the phenomenon of red tide, or plankton bloom, a recurring problem that has a severe impact on water quality and marine life. Understanding the factors involved is essential for sustainable coastal management.

Studies have shown that seasonal factors significantly influence plankton blooms. During the summer, high temperatures and intense sunlight are conducive to the growth of phytoplankton. Conversely, during the rainy season, increased rainfall washes pollutants and nutrients, such as nitrogen and phosphorus compounds, from agricultural areas and communities into the sea. This leads to eutrophication, or an oversupply of nutrients in the water, stimulating a rapid and intense increase in phytoplankton. These plankton blooms cause a rapid decrease in oxygen levels in the water, resulting in oxygen deprivation for aquatic animals and impacting fishing and tourism in coastal areas.

Therefore, the research team recognized the importance of studying the relationship between seasonal factors and seawater quality along the coast of Won Napha Beach. The objective was to assess the water quality situation and understand the mechanisms leading to plankton blooms systematically. Data analysis will be based on the Seawater Quality Index (MWQI Score), according to the guidelines of the Pollution Control Department, to obtain reliable and standardized results. The study results will

provide useful baseline data for relevant agencies to plan, monitor, and determine measures to prevent the degradation of aquatic and coastal environmental quality effectively and sustainably.

Objectives

1. Study the changes in water quality along the Wonnapha beach coastline during each season.
2. Analyze the relationship between rainfall and environmental factors and seawater quality.

Experimental Hypothesis

The different seasons and rainfall amounts affect the water quality along the coast of Wonnapha Beach.

Scope of research

This research was conducted at Wonnapha Beach, Mueang Chonburi District, Chonburi Province, at latitude 13.2720140°N and longitude 100.9231140°E, it's Covering three seasons: summer, rainy season, and winter. Seawater samples were collected from designated areas to measure temperature, salinity, pH (acidity-alkalinity), DO (dissolved oxygen). Supporting data from The Institute of Marine Science, Burapha University, and Thai Meteorological Department (TMD) were used to analyze the relationship between rainfall and seawater quality in each season.

Methods and Materials

This research, " The Effect of Seasons on Water Quality Changes at Wonnapha Beach", used the following materials and equipment :

Materials and equipment

1. Water quality testing instrument (Multiparameter)	1 unit
2. DO test kit	1 set
3. pH test kit	1 set
4. Water transparency measuring device (Secchi disk)	1 set
5. Nylon rope	20 meters

Methods

1. Water Quality Data Collection : Water quality measurements were conducted using the GLOBE methodology during each season, measuring temperature, pH, dissolved oxygen (DO), total dissolved solids (TDS), and water transparency.

1.1 Establish a monitoring point at the Won Napha Beach fishing pier.

1.2 Use a bucket to scoop 10 liters of water from a depth of approximately 5 centimeters.

1.3 Measure water temperature, DO, pH, and TDS.

1.3.1 Use a water quality monitoring tool (multiparameter) with the following steps :

1.3.1.1 Preparing the instrument and probe: Turn on the instrument by pressing the power button and connect the probe. Rinse the probe beforehand. Immerse the probe completely in the water, gently stirring it for approximately 3 minutes.

1.3.1.2 Once finished, check for completeness and readiness for use.

1.3.1.3 Select the desired parameters: Temp, DO, pH, TDS, and EC.

1.3.2 Use a dissolved oxygen (DO) test kit to measure the DO levels and compare the results.

1.3.3 Use a pH test kit to measure and compare the results.

1.4 Measure the water's transparency by using a Secchi Disc. Mark the rope at intervals of 10 cm. Slowly lower the Secchi Disc into the water and count the intervals where it is submerged until it is completely submerged and no longer visible.

1.5 Record the measured water quality values

1.6 Submit data to GLOBE Data Entry

Image 1 Using Multiparameter

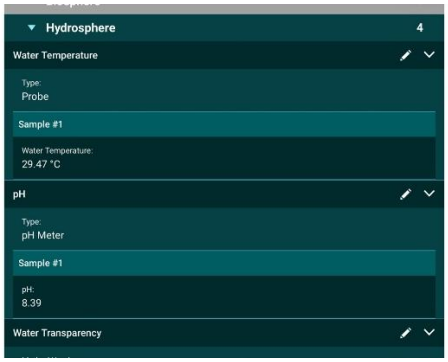


Image 2 Submit data to GLOBE Data Entry

Results and Data

The researcher measured water quality parameters at the Wonnapha Beach fishing pier in Mueang Chonburi District, Chonburi Province. Measurements included temperature, total dissolved solids (TDS), salinity, pH, dissolved oxygen (DO) and turbidity. The results are as follows :

Table 1 The table shows the results of water quality measurements at Wonnapha Beach Pier, Mueang Chonburi District, Chonburi Province in the year 2024.

Month	Rainfall (mm)	Temp (°C)	Salinity (PSU)	pH	DO (mg/L)
1	0	27.9	33.5	8.1	4.4
2	0.6	29.2	36.0	8.1	6.2
3	32.6	30.4	32.2	7.9	6.1
4	16.0	30.7	30.1	8.0	5.2
5	359.3	31.1	33.0	8.4	7.4
6	47.7	30.3	33.4	8.29	5.26
7	173.2	31.9	28.96	6.4	4.1
8	189.4	30.8	25.38	7.8	2.7
9	423.6	29.7	27.6	8.0	6.3
10	107.9	28.9	31.9	7.9	3.5
11	73.5	29.3	28.1	7.9	3.0

***Note :** The data in the table is from The Institute of Marine Science, Burapha University.

Table 1 shows that the water quality parameters at Wonnapha Beach Pier, Chonburi Province, in 2024, including rainfall, temperature, salinity, pH, and dissolved oxygen (DO) over an 11-month period, demonstrate seasonal variation in water quality. Rainfall peaked in September (423.6 mm), the rainy season, resulting in a decreasing salinity trend from July (28.96 PSU) to November (28.1 PSU). Furthermore, dissolved oxygen (DO) was lowest in August (2.7 mg/L), indicating the impact of rainfall and organic runoff on the ecosystem balance.

Table 2 The table shows the results of water quality measurements at Wonnapha Beach Pier, Mueang Chonburi District, Chonburi Province in the year 2025.

Month	Rainfall (mm)	Temp (°C)	Salinity (PSU)	pH	DO (mg/L)
1	0	23.0	33.0	8.1	4.8
2	37.2	29.0	33.0	8.4	8.5
3	121.1	29.6	33.6	8.2	4.6
4	27.6	31.7	33.2	8.2	7.1
5	372.7	31.0	22.0	7.9	4.6

***Note :** The data in the table is from The Institute of Marine Science, Burapha University.

Table 2 shows that the seawater quality at Wonnapha Beach Pier, Chonburi Province, during the first five months of 2025, which coincides with the transition from winter to summer and the start of the rainy season, showed a continuous increase in temperature from 23.0°C in January to 31.0°C in May. This is a significant factor affecting the physical changes in the water. The very high rainfall in May (372.7 mm) reflects the start of the monsoon season, resulting in a sharp decrease in salinity, reaching its lowest

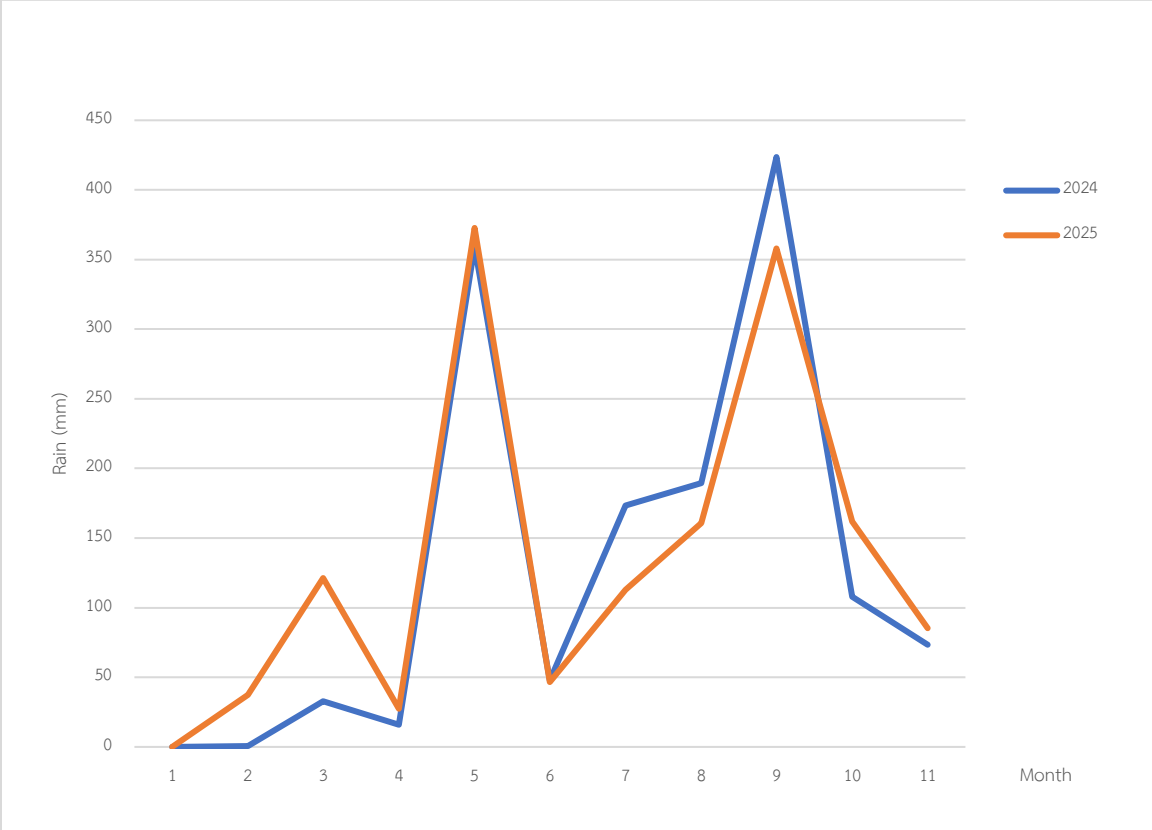
point that month (22.0 PSU). This sudden decrease in salinity at the beginning of the rainy season is correlated with a decrease in dissolved oxygen (DO) to a low level (4.6 mg/L), reinforcing the sensitivity of water quality to seasonal changes.

Table 3 The table shows the results of water quality measurements at Wonnapha Beach Pier, Mueang Chonburi District, Chonburi Province in the year 2025.

Month	Rainfall (mm)	Temp (°C)	TDS (ppt)	Salinity (PSU)	pH	DO (mg/L)	Turbidity (m)	EC (µS/cm)
6	46.7	34.07	16.36	20.21	7.9	5.2	0.6	32.73
7	112.7	30.7	19.7	26.0	7.75	2.0	1.0	38.70
8	160.9	28.9	18.13	22.73	8.56	5.9	0.9	36.67
9	358.1	32.1	17.59	21.97	8.57	7.0	1.8	35.20
10	161.7	29.47	24.27	31.53	8.39	7.6	1.9	48.55
11	85.3	30.42	24.55	31.92	8.48	8.5	1.3	49.11

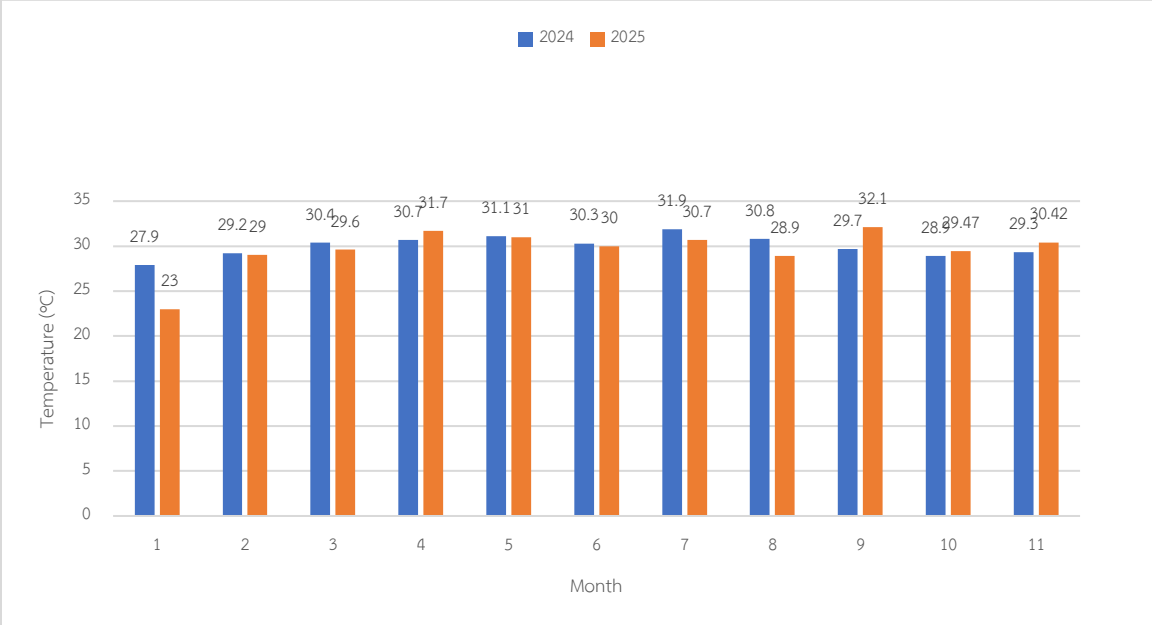
Table 3 summarizes the water quality measurements taken at Wonnapha Beach Pier, Chonburi Province, from June to November 2025, covering the rainy and winter seasons. Additional parameters measured included total dissolved solids (TDS), turbidity, and electrical conductivity (EC). Rainfall remained high in several months, such as August (160.9 mm) and October (161.7 mm). Turbidity peaked in October (1.9 m), consistent with the high rainfall period, indicating runoff of sediment and suspended solids from the land to the coastal area. Electrical conductivity (EC) tended to increase towards the end of the year (October and November), correlated with changes in salinity and temperature as winter approaches.

Diagram 1 The graph shows a comparison of rainfall amounts in Chonburi province for each month between 2024 and 2025



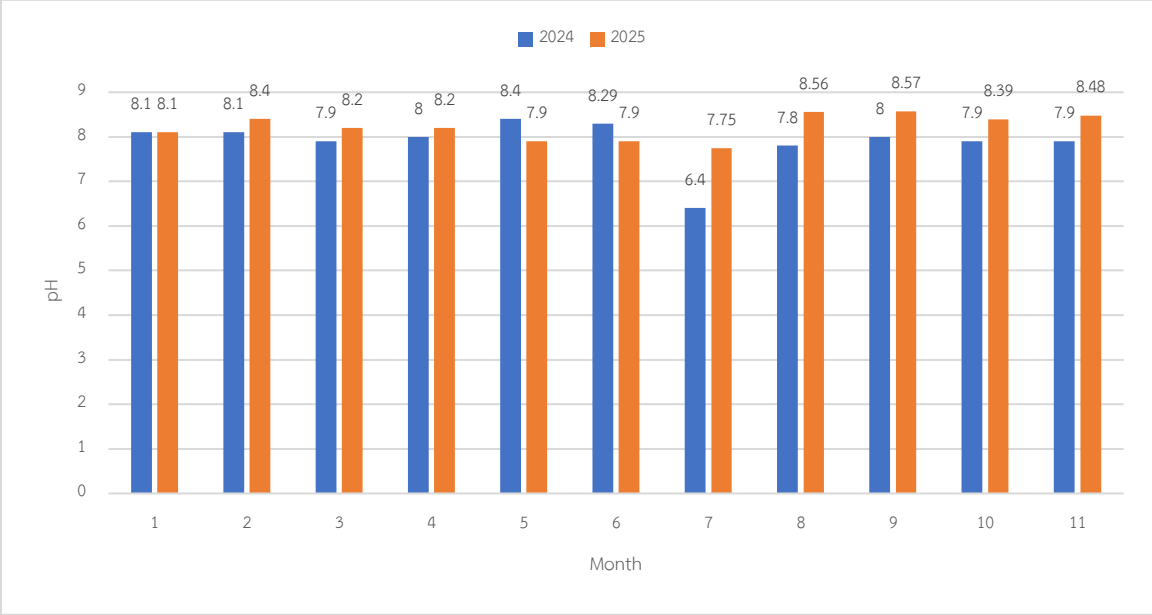
A graph comparing rainfall in Chonburi province between 2024 and 2025 reveals a clear seasonal variation. During November to January (winter) and February to April (summer), rainfall is generally low. Conversely, from May to October (rainy season), rainfall increases significantly, peaking in May and September. In 2024, the highest cumulative rainfall was recorded in September at 423.6 millimeters, demonstrating a consistent trend in rainfall patterns influenced by the seasons in both years.

Diagram 2 The diagram compares water temperature values along the coast of Wonnapha Beach for each month between 2024 and 2025.



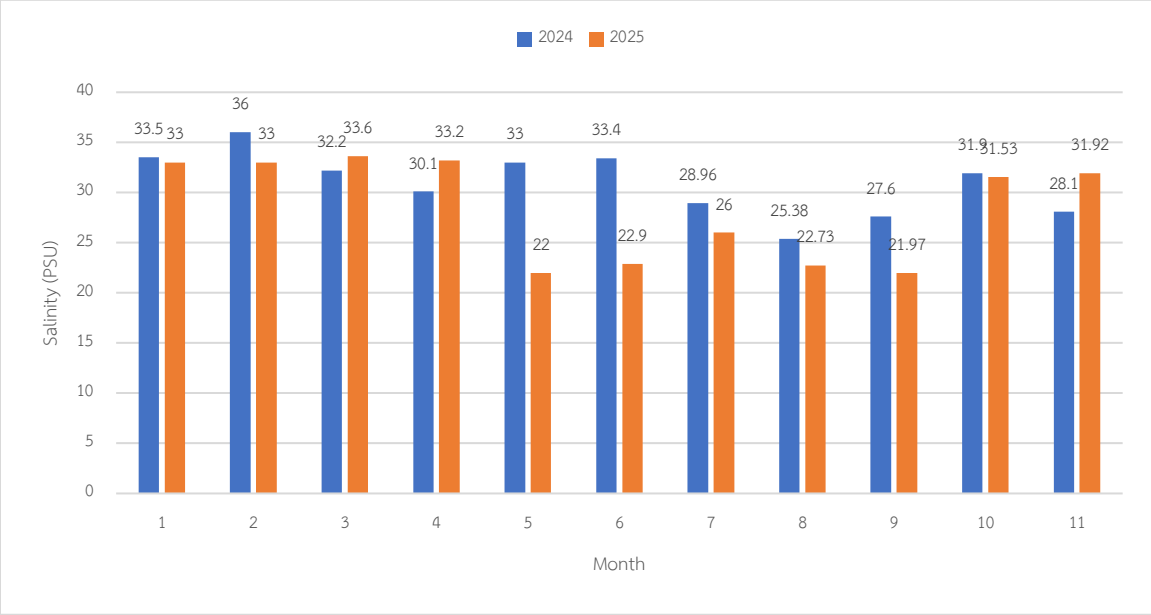
A diagram comparing water temperatures along the coast of Wonnapha Beach reveals a clear seasonal variation. During the winter months (November–January), water temperatures are lowest, with the lowest recorded temperature in January 2025 at 23 degrees Celsius. Subsequently, during the summer months (February–April), water temperatures tend to rise steadily and remain high throughout the rainy season (May–October). The highest temperature recorded in September 2025 was 32.1 degrees Celsius. This demonstrates a direct correlation between water temperature and the seasonal weather patterns in Chonburi Province.

Diagram 3 The diagram shows the pH values along the coast of Wonnapha Beach for each month between 2024 and 2025



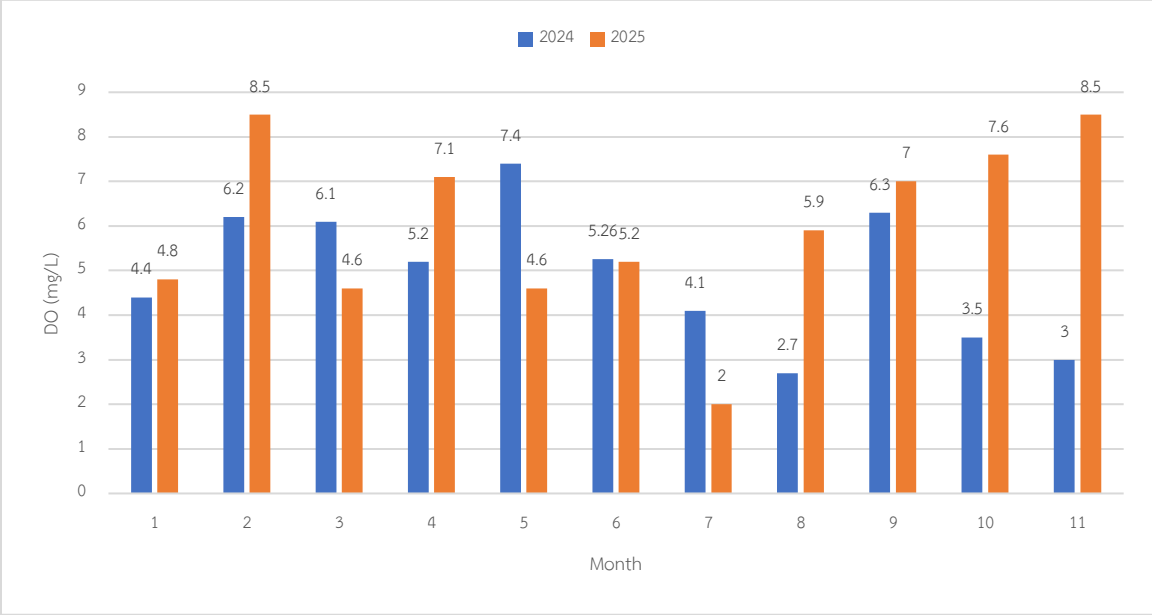
A diagram comparing pH values along the coast of Wonnapha Beach shows that the pH is mostly slightly alkaline, ranging from 7.75–8.57, which is within the normal range for seawater. pH values remain relatively stable during the winter and summer seasons. However, an interesting change in pH is observed during the rainy season (May–October). In 2024, July saw the lowest pH value at 6.4 (slightly acidic), while in 2025, August and September saw a significant increase to approximately 8.56–8.57. This indicates that pH variability is higher during the rainy season than in other seasons.

Diagram 4 The diagram shows the salinity values along the coast of Wonnapha Beach for each month between 2024 and 2025.



A comparison diagram of salinity at Wonnapha Beach shows that salinity is high and relatively constant during the winter (November–January) and summer (February–April) seasons, reaching a peak of 36 PSU in February 2024. However, during the rainy season (May–October), salinity tends to decrease significantly, particularly in 2025 when it dropped to a low of 21.97 PSU in September. This coincides with the period of heaviest rainfall, resulting in the seasonal dilution of seawater with freshwater.

Diagram 5 The diagram shows the DO (Dissolved Oxygen) values along the Wonnapha Beach coastline for each month between 2024 and 2025.



A diagram comparing dissolved oxygen (DO) levels at Wonnapha Beach shows high variability throughout the year. During most of the winter and summer seasons, DO levels are within acceptable limits (approximately 4.4–8.5 mg/L). However, during the rainy season (May–October), DO levels fluctuate significantly. In 2025, the lowest DO level was recorded in July at 2 mg/L, indicating periods of low oxygen levels. Conversely, the highest DO levels of 8.5 mg/L were recorded in February and November of the same year, demonstrating that oxygen levels in the water change according to environmental factors and weather conditions each month.

Table 4 The table shows a comparison of the MWQI values and overall water quality data for the area around the Wonnapha Beach fishing pier, Mueang Chonburi District, Chonburi Province, between 2024 and 2025.

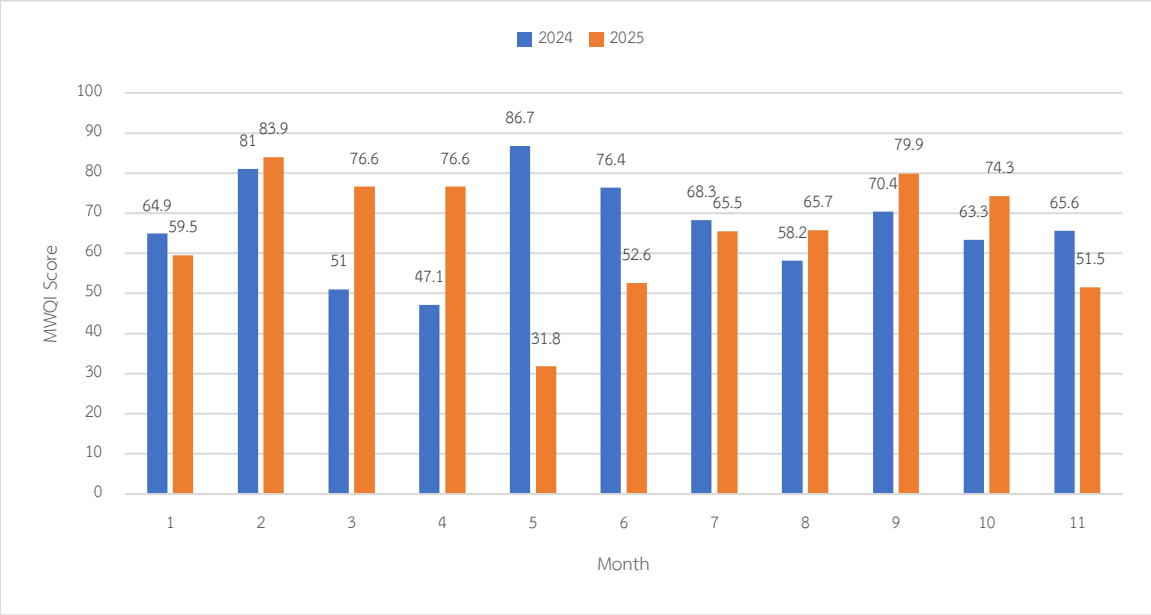
Month	2024		2025	
	MWQI	Overall Water Quality	MWQI	Overall Water Quality
1	64.9	Good	59.5	Fair
2	81.0	Good	83.9	Good
3	51.0	Fair	76.6	Fair
4	47.1	Poor	76.6	Fair
5	86.7	Good	31.8	Poor
6	76.4	Fair	52.6	Fair
7	68.3	Fair	65.5	Fair
8	58.2	Fair	65.7	Fair
9	70.4	Fair	79.9	Fair
10	63.3	Fair	74.3	Fair
11	65.6	Fair	51.5	Fair

***Note :** The data in the table is from The Institute of Marine Science, Burapha University.

Table 4 shows that the Marine Water Quality Index (MWQI) and overall water quality rating at Wonnapha Pier, Chonburi Province, between 2024 and 2025 show that most water quality ratings throughout the two years were at a fair level, reflecting a moderate impact from environmental factors. The influence of seasonality on water quality changes is evident, with the lowest MWQI values observed in April (47.1) of 2024 (late summer) and May (31.8) of 2025 (beginning of the rainy season and highest rainfall). The MWQI in May 2025 is the lowest. Monthly comparisons show that... Fluctuations in the MWQI vary year-to-year (MWQI in 2025 was higher in months 2, 3, 4, 7, 8, 9, and 10,

but decreased in months 1, 5, 6, and 11 compared to 2024), confirming that even with the same season, the intensity and timing of natural phenomena such as rainfall and temperature directly affect the overall water quality assessment.

Diagram 6 The diagram shows the MWQI scores for the Won Napha Beach coastal area for each month between 2024 and 2025.



A comparison graph of MWQI scores at Wonnapha Beach reveals clear changes in water quality over time and year. During the winter and summer seasons (November–April), scores are mostly good to very good, reaching a high of 86.7 points in May 2024. However, significant fluctuations in scores are observed during the rainy season (May–October), particularly in 2025, with the lowest score of 31.8 points in May. This reflects a decline in water quality at the beginning of the rainy season before showing an upward trend towards the end of the season in both years.

Discussions

Rainfall patterns in Chonburi Province show significant seasonal variation. During the dry season, from November to April, rainfall is mostly low, while during the rainy season, from May to October, rainfall increases sharply. Two peak periods were recorded in May and September of both years, with the highest recorded rainfall being 423.6 millimeters in September 2024. Water temperature also shows seasonal changes, with a low of 23.0 degrees Celsius recorded in January 2025 and a tendency to increase during the hot and rainy seasons, reaching a high of 32.1 degrees Celsius in September 2025. Salinity is high during the dry season, peaking at 36.0 PSU in February 2024, and decreases significantly during the wet season, dropping to only 21.97 PSU in September 2025. Regarding pH, seawater is generally slightly alkaline, ranging from 7.75–8.57, but an anomaly was observed in July 2024 when the pH dropped to 6.4, indicating slightly acidic conditions. Dissolved oxygen (DO) levels fluctuate significantly throughout the year, reaching a maximum of 8.5 mg/L, but a critical drop to 2.0 mg/L was recorded in July 2025, below the optimal level for marine life. Concerning the Marine Water Quality Index (MWQI) and transparency, overall water quality is good to very good during the dry season but deteriorates during the rainy season, particularly in May 2025, when the score dropped to 31.8. The highest transparency measured was 1.9 meters in May 2025.

Conclusions

The study results indicate that seasons are the primary controlling factor for seawater quality at Wonnapha Beach. During winter and summer, the seawater is chemically stable due to low freshwater inflow, keeping salinity and pH within standard ranges. However, during the rainy season, water conditions change abruptly as massive amounts of freshwater flow into the shore, resulting in reduced salinity and easier accumulation of water pollutants. Heavy rainfall plays a significant role in altering the marine environment, carrying sediment, organic matter, and pollutants from community consumption along Wonnapha Beach, as well as waste from the Bang Pakong River into the sea. This is explained by the decrease in dissolved oxygen (DO) and increased turbidity during heavy rainfall, as the organic matter carried by rainwater undergoes microbial decomposition, requiring significant oxygen in the water. Furthermore, considering global climate factors, the measured data shows a correlation: In the early part of the year, when El Niño influences Thailand, sea surface temperatures and salinity rise significantly (36.0 PSU) due to low rainfall and high evaporation. From late 2024 to 2025, a La Niña phase will enter, which the Meteorological Department predicts will continue until early 2025 and return again in late 2025. This will result in unusually high rainfall, consistent with measurements in September 2025 showing a minimum salinity drop (21.97 PSU) and a critical decline in MWQI (Marine Water Quality Index). This demonstrates that the La Niña phenomenon is a catalyst for more severe than normal fluctuations in coastal water quality. Furthermore, the influx of freshwater from the Bang Pakong River and waste from communities/tourist areas flowing into the coast will cause seawater discoloration and increased nutrient levels, which can support the growth of oyster rafts and other aquatic life.

Image 3 Oyster farming

Reference: https://shorturl.asia/kvung

Suggestions

Based on this study, the researchers suggest the following data collection suggestions for future project development:

1. The study should include biological parameters such as fecal coliform bacteria and phytoplankton populations to assess the safety of recreational tourism in different seasons.

2. Nutrient load data, such as nitrate and phosphate levels, should be collected to more accurately analyze the sources of pollution from municipal wastewater.

3. The study period should be extended to cover the long-term ENSO (Energy Sensitivity, Oxygen, and Susceptibility) cycle (3–5 years) to create models for predicting future water quality.

Citations

Paerl, H. W., Scott, J. T., McCarthy, M. J., Newell, S. E., Gardner, W. S., & Havens, K. E. (2016). **Nutrient enrichment and eutrophication in coastal waters.** https://link.springer.com/journal/12237

Pollution Control Department. (2561). **Water Quality and Eutrophication** Pollution Control Department.: https://www.pcd.go.th/ความรู้พื้นฐานเกี่ยวกับคุณภาพน้ำและภาวะยูโทรฟิเคชัน

Yuenyong, S., Nimsuwan, N., Buranaprattheprat, A., Gunboa, V., Jintasaeranee, P., Thaipichitburapa, P., & Suriyaphan, J. (2019). **Seasonal variations of water quality in the Bangpakong River during 2016–2018**. *Burapha Science Journal* https://scijournal.buu.ac.th/index.php/sci/article/view/2477

Department of Marine and Coastal Resources (2564).**A phenomenon of seawater discoloration has occurred at Bang Saen beach, Chonburi province.**. https://www.dmcr.go.th/detailAll/52023/nws

Thai Meteorological Department. (2564). **Monitoring El Niño and La Niña phenomena.** https://www.tmd.go.th/climate/El-Nino-La-Nina

Department of Marine and Coastal Resources (2565). **Surface water quality** from https://www.pcd.go.th/wp-content/uploads/2022/08/pcdnew-2022-0823_03- 47-16_304672.pdf

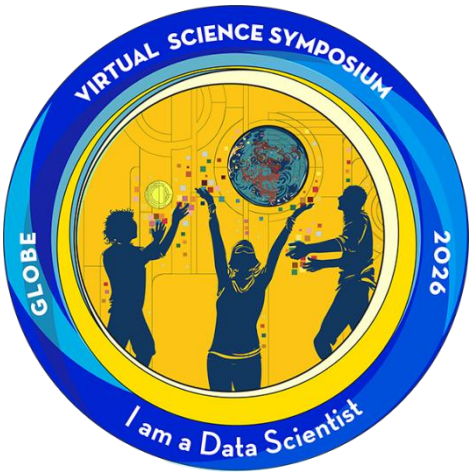
The Institute for the Promotion of Teaching Science and Technology (IPST) The GLOBE Program Thailand (2564) **The main methodology for measuring the quality of Globe.** From https://globefamily.ipst.ac.th/globe-protocols/hydrosphere

Badges

I AM A COLLABORATOR

This research project was completed collaboratively by a team of three members, with each person taking responsibility for specific tasks, including literature review, vegetable leaf collection, experimental setup, and data analysis. Throughout the process, we worked closely together, divided tasks fairly, and maintained clear and effective communication. Our strong teamwork and collaborative efforts demonstrate that we fully meet the criteria for the Collaborator badge.

I AM A DATA SCIENTIST



We selected this badge because our research involved collecting and analyzing a large amount of experimental data, including water quality such as temperature, salinity, pH, dissolved oxygen (DO), and water transparency. We also integrated this with government open data—such as Thai Meteorological Department, Department of Marine and Coastal Resources, Pollution Control Department, and The Institute of Marine Science, Burapha University— for comparative analysis and inference. In addition, we evaluated data reliability, identified potential sources of experimental error, and proposed improvements. These practices align well with the selection criteria for the Data Scientist badge

I WORK WITH A STEM PROFESSIONAL

We selected this badge because during the progress of collecting water samples and water quality and working with results and data, we got help from—the professor from Burapha University—by lending us materials and equipment and also provided us with advice about data analysis to interpret our experimental results more accurately. Under his mentorship, we learned to properly use scientific equipment such as the multiparameter, which helped improve the precision and reliability of our data. This collaboration enhanced our research methodology and supported more careful analysis and interpretation of results, fulfilling the criteria for the STEM Professional badge

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