Abstract

Title : Study on the Impact on Water Resources and Soil Quality in the Vicinity of White Shrimp Farming Areas In Thung Krabue Subdistrict, Yan Ta Khao District, Trang Province

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This study aims to examine the impact of wastewater discharge from white shrimp farms on water and soil quality in Thung Krabue Subdistrict, Yan Ta Khao District, Trang Province, between December and January 2024. Samples were randomly collected from the shrimp pond wastewater outlet, with water and soil quality monitored monthly. The study measured pH levels, soil color, soil cohesion, soil fertility (NPK), dissolved oxygen in water, water temperature, water salinity, and nitrate concentration in water.

The results showed that the average water temperature during shrimp farming was 24.5 ±0.7°C, and during wastewater discharge, it was 26.33°C. The pH during farming averaged 7.52 ±1, while during discharge, it was 8.49 ±1, both within acceptable limits for coastal aquaculture (Department of Fisheries, 2007). Dissolved oxygen levels during farming averaged 4.25 ±0.35 mg/L, while during discharge, they dropped to 2.58 ±0.35 mg/L. Nitrate levels during farming averaged 10 mg/L, increasing to 11.67 ±0.07 mg/L during discharge.

Soil quality analysis at a depth of 5 cm in areas affected by wastewater showed an average temperature of 27.29°C, a pH of 6.61 ±0.2, and salinity of 10 ±0.9 ppt. Nutrient content (NPK) revealed nitrogen at 52.92 ±10.26 mg/L, phosphorus at 53.63 ±15.98 mg/L, and potassium at 183.67 ±38.07 mg/L, higher than at a depth of 10 cm due to prolonged exposure to wastewater.

The discharge of water from white shrimp farms affects nearby water and soil quality, which may impact the local ecosystem and agricultural land use.

Keywords: Water Quality, Soil Quality, White Shrimp Farming

Preamble

Thung Krabue Subdistrict, Yan Ta Khao District, Trang Province, consists of mixed highland and lowland areas. The land slopes down from the eastern Buntat Mountain range towards the west, making it suitable for agricultural activities such as rubber plantations. The lowland areas are ideal for rice farming and livestock, including shrimp and fish farming.

Currently, shrimp farming is one of Thailand's key industries. In Trang Province, various shrimp species are cultivated, including black tiger shrimp, white shrimp, and giant freshwater prawns. This study focuses on white shrimp farming due to its rapid growth rate, high stocking density, and greater yield compared to other shrimp species. White shrimp can tolerate a wide range of salinity levels and resist several diseases, making them a cost-effective option for farmers.

However, shrimp farming involves wastewater discharge, which may cause environmental issues, particularly affecting soil and water quality in the surrounding areas. Soil and water are vital natural resources, serving as habitats for various organisms within the ecosystem. Their quality changes over time due to contamination from organic compounds, suspended solids, pathogens, and toxic substances, contributing to increasing environmental concerns.

This research aims to study the effects of white shrimp farming on soil and water quality in Thung Krabue Subdistrict, Yan Ta Khao District, Trang Province. The findings will provide essential data for sustainable environmental management and contribute to policy development or strategies for mitigating the environmental impacts of white shrimp farming in the future.

objective

1. Study the water quality in white shrimp ponds and nearby water sources, such as studying the water temperature, water pH. Oxygen content in water, salinity of water, nitrate content in water
2. Study the soil quality around the shrimp pond area, such as soil color, soil pH, soil temperature, soil fertility. Soil moisture and soil salinity
3. Study the impact of water discharge from white shrimp ponds that affect water quality and soil quality in the vicinity.

question

1. What is the water quality in the white shrimp pond and the water source near the shrimp - pond?
2. What is the quality of the soil around the shrimp pond area?
3. Does the water discharged from the white shrimp pond affect water quality and soil quality?

hypothesis

1. The water quality in the white shrimp pond is good quality and the water source near the shrimp pond is of poor quality.
2. The quality of the soil around the shrimp pond area is of low quality.
3. The water released from the white shrimp pond affects water quality and soil quality.

Materials and equipment and methods of conducting research

1. pH Meter
2. Compaction Test Chart
3. Soil Bonding Calibration Plate
4. thermometer
5. Soil Fertility Test Kit
6. Dissolved oxygen content test kit
7. Moisture Meter
8. Nitrate Test Kit

GLOBE Measurement Methodology

Pedosphere (Soil) Measurement Methodology

Hydrosphere Water Measurement Methodology

Designation of Study Points

This study was conducted in Thung Krabue Sub-district, Don Ta Khao District, Trang Province, and will be conducted in the area to collect water and soil samples for a period of 2 months.

Soil quality measurement by designating soil sampling points. Along the ditch that discharges water from the shrimp pond is 600 meters long, with an equal distance between the sampling points. The soil is collected at two soil depths , 5 centimeters deep and 10 centimeters deep.

Water quality measurement by designating 3 water sampling points from white shrimp ponds . Along the line of the ditch that discharges water from the shrimp pond is 600 meters long, with equal spacing between the sampling points.

Point 1 is at the beginning of the ditch, which is where the water from the shrimp pond is re-released.

Point 2 is located 200 meters away from Point 1.

Point 3 is located 200 meters from point 2 and 400 meters from the starting point.

How it works

1. Preparatory stage
    1) Set up a study issue. Select the topic you want to study.
    2) Research Gather knowledge and theories related to the work.
    3) Determine the purpose of the study.
    4) Random sampling points are set in the area of the study area.

2. Steps

1) Make operational planning.
2) Survey the area to be carried out.
3) Soil and water quality measurements were carried out according to the GLOBE methodology as follows:

Measuring soil quality Six water sampling points have been determined from white shrimp ponds .

The soil is collected at two soil depths, namely 5 centimeters deep and 10 centimeters deep.

Measuring water quality Three water sampling points have been set up along the 600-meter-long ditch with equal spacing between the sampling points.

Point 1: At the beginning of the ditch, where the water from the shrimp pond is re-released.

Point 2: Located 200 meters away from Point 1

Point 3: Located 200 meters from Point 2 and 400 meters from the starting point.

1) Water temperature using a thermometer
    1. Immerse the thermometer in water about 10 centimeters deep for about 3-5 minutes.
    2. Read the thermometer at eye level.
    3. Dip the thermometer for another 1 minute for the 2nd and 3rd measurements by changing the thermometer reader.
    4. Read the temperature in degrees Celsius (°C) and repeat all 2 measurements.
2) Measurement of dissolved oxygen content in water by the dissolved oxygen content test kit.
    1. Rinse the sample vial with sample water 3 times before collecting the sample.
    2. To collect water, immerse the vial under water, fill it completely, and close the lid under the water.
    3. Keep the water immediately and perform the test within 2 hours.
    4. Repeat the test for a total of 2 times , with the average value should be between the values specified by the test kit.
3) Measuring water salinity using a hydrometer
    1. Place the collected water into a beaker.
    2. Use the Salinity Meter to measure.

3. Record the obtained result.

4) pH Measurement of Water with pH Paper

1. Place the collected water into a beaker.
2. Use the pH meter to measure the pH.
3. Record the obtained result.

5) Soil Adhesion Measurement

1. Remove the soil grains from the topsoil. If the soil is dry, moisten the soil layer using a spray of water, and then pull out the soil grains to observe the soil adhesion (repeat this for all layers of soil).
2. Hold the soil between your thumb and index finger and gently squeeze the soil until it breaks.

6) 3. Record the characteristics of one of the samples.

7) Determination of nitrate content in water using the Nitrate Test kit

1. Random water sampling
2. Perform the procedure of the Nitrate Test kit used.

2.1 Add a 1st substance (e.g. cadmium) to change NO3 to NO2

2.2) Add a second substance to react with NO_2 to change the color of the solution.

2.3) Read the nitrate content by comparing the color from the color comparison plate provided in the test kit.

3. Perform all inspections. 2 Repeat

8) Soil pH Measurement with pH Meter

1. Using a pilot wood, the soil is drilled into it.14 By measuring the soil at several points. The area
2. Bring pH meter Insert into the hole of the pilot stick.
3. Record Results

9) Soil Temperature Measurement

1. Thermometer Calibration To ensure accurate readings.
2. Determine the point where the soil temperature will be measured.
3. Use soil pilot steel.
4. Insert the soil thermometer into the pilot slot.
5. Wait 2 minutes. Temperature reading 1st time 2 Repeat Record Results

10) Measuring soil color using a soil color comparison book.

1. Pick up a grain of soil from each layer of soil and observe whether the soil is moist, dry, or wet. If dry, moisten.

2. The bead is divided into two parts, standing so that the sunlight shines through the shoulder to the soil color comparison book and the soil sample being measured.
3. Record the clay color value.

11) Measuring soil fertility N P K Test Kit

1. Soil fertility measurement takes 20 g of dry and sifted soil.
2. Tested in the N P K Measurement Test Kit

12) Measuring soil moisture using a moisture meter

1. Use a pilot steel to drill down to the designated measurement point.
2. Put a soil moisture meter in it. Wait 2 minutes, then save the result.

13) Soil salinity measurement using a Salinity Meter

1.Take water samples from the designated sampling points and place them into a test container.

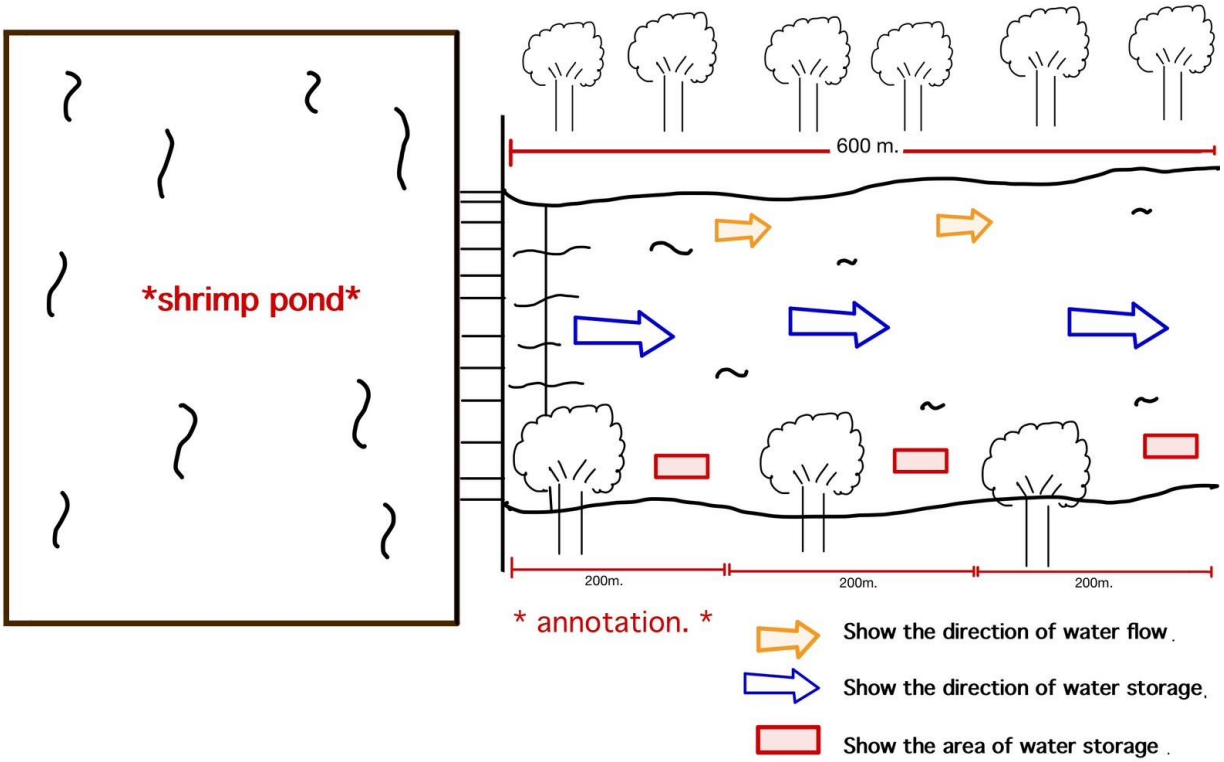
2.Submerge the Salinity Meter into the water to measure the salinity.

3.Wait for the reading to stabilize, then record the result.

Results and conclusions

Geographic coordinates

zone	Geographic coordinates	
	Latitude(N)	Longitude(E)
White shrimp pond	7.3753	99.6361



The picture shows the direction of water flow.

Results

1. Water quality

Record Table

Water Measurement Area	Measured value (average)				
	pH	Water salinity(ppm)	Oxygen in water (mg/L)	Water nitrates (mg/L)	Water Temperature (°C)
Water nearby	8.49 ±1	5920 ±1	2.58 ±0.35	11.67 ±7	26.33 ±2
In the shrimp pond	7.52 ±1	2260 ±1	4.25 ±0.35	10 ±0	24.5 ±0.71

From the summary table of the results of the experiment.

The study analyzed water quality during the white shrimp farming process and the wastewater discharge phase to assess potential environmental impacts.The results showed that the average water temperature during shrimp farming was 24.5 ± 0.7°C, while during wastewater discharge, it increased to 26.33°C. This rise in temperature may be influenced by various factors, including environmental conditions and farming activities. The pH level during shrimp farming averaged 7.52 ± 1, while during wastewater discharge, it increased to 8.49 ± 1. According to the Department of Fisheries (2007), both values fall within the suitable range for coastal aquaculture, indicating that the water remains within acceptable conditions for shrimp farming. However, a significant change was observed in the dissolved oxygen level. During shrimp farming, the dissolved oxygen concentration averaged 4.25 ± 0.35 mg/L, but it decreased to 2.58 ± 0.35 mg/L during wastewater discharge. This reduction suggests a decline in water quality, which may impact aquatic life in the surrounding environment. Similarly, the nitrate concentration increased from an average of 10 mg/L during shrimp farming to 11.67 ± 0.07 mg/L during wastewater discharge. This indicates a potential accumulation of nutrients in the water, which could contribute to environmental issues such as eutrophication.Overall, while some water quality parameters remain within acceptable ranges for shrimp farming, changes observed during the wastewater discharge phase highlight the need for proper water management to minimize environmental impacts and maintain ecological balance.

2. Soil quality study

2.1 Soil color calibration and soil fixation table

Soil Sampling Area	Soil Color Code	Soil Texture
Soil without shrimp pond discharge	2.5Y6/4	Compact
Soil in the canal where shrimp pond water flows	2.5Y5/4	Loose

From the summary table of the results of the experiment.

The soil in the area affected by the shrimp pond water is darker. (2.5Y5/4) compared to unaffected soils. (2.5Y6/4) which shows the change in soil from the discharge of water from the shrimp pond.

2.2 Table of measurements of various values of soil

Measurement Value		Soil at 5 cm depth	Soil at 10 cm depth
Temperature (°C)		27.29 ±1.75	26.75 ± 1.08
pH value		6.61 ±0.2	7.04 ± 0.21
Soil moisture		10 ±0.9	1 ± 0.16
Salinity (ppt)		894 ±305.46	818.67 ± 299.24
Organic matter content In soil (N P K)	N	52.92 ±10.26	51.17 ± 9.92
	P	53.63 ±15.98	76.33 ± 11.34
	K	183.67 ±38.07	199.08 ± 30.79

Summary of Soil Quality Analysis

The study of water quality in white shrimp ponds and nearby water sources revealed that during the wastewater discharge phase, the pH level, salinity, nitrate concentration, and water temperature were higher compared to the shrimp farming phase. This increase is primarily due to the farmers' practice of adding lime to the shrimp ponds. Lime is used to disinfect the pond and regulate the water’s pH level to create a suitable environment for shrimp farming. Alkalinity plays a crucial role in shrimp molting, ensuring a successful process. Additionally, lime helps reduce water turbidity by causing suspended particles to settle. Farmers typically apply lime during the pond preparation phase before introducing shrimp and during water exchange.

As a result, wastewater discharged from shrimp ponds has an altered pH level, which can impact the surrounding environment (Korakwee Sri-In, 2016).

A study on Vannamei shrimp farming found that during the wastewater discharge phase before harvesting, the average BOD (Biochemical Oxygen Demand) was 26.57 ± 1.74 and suspended solids were 74.17 ± 1.65, exceeding the standards set by the Ministry of Natural Resources and Environment. This contributes to the accumulation of pollutants in wastewater from shrimp ponds.

Regarding soil quality, the study analyzed soil along the wastewater flow path at depths of 5 cm and 10 cm. At a depth of 5 cm, the soil temperature was 27.29°C, the pH level averaged 6.61 ± 0.2, and the salinity was 10 ± 0.9. The nutrient content of the soil showed an average nitrogen concentration of 52.92 ± 10.26, phosphorus at 53.63 ± 15.98, and potassium at 183.67 ± 38.07. At a depth of 10 cm, the soil quality parameters were lower than those at 5 cm, indicating that pollutants from wastewater discharge tend to accumulate more in the upper soil layers.

These findings highlight the impact of shrimp farming wastewater on both water and soil quality, emphasizing the need for effective environmental management strategies to minimize negative effects and promote sustainable aquaculture practices.

Summary

Based on the study of water quality in white shrimp ponds and nearby water sources. It was found that the discharge of water from the shrimp pond affected the surrounding water quality. The salinity of the water in the nearby water source was significantly higher than that of the shrimp pond (5920 ppm vs. 2260 ppm), indicating that the drainage from the shrimp pond had an effect on the salinity of the surrounding water source. In addition, the pH of the water in the shrimp pond was lower than that of the nearby water (7.52 vs. 8.49), while the dissolved oxygen content in the shrimp pond was higher than in the surrounding area (4.25 mg/L vs. 2.58 mg/L), which may be caused by the aeration system in the shrimp pond.

For soil quality It was found that the soil in the area affected by the shrimp pond water was darker and more crumbly compared to the soil that was not affected. In addition, the soil moisture value at a shallow level (5 cm) higher than the soil at a depth (10 cm). Meanwhile, the salinity of the soil tends to decrease as the depth increases. Nutrient content in the soil (NPK) found that nitrogen was constant at both depths. Meanwhile, phosphorus and potassium increase in the deep soil.

in conclusion The results of this study confirm that the discharge of water from white shrimp ponds affects the water quality and soil quality in the vicinity. In particular, the salinity, nitrate, and dissolved oxygen in the water, as well as the structure and composition of the soil, may have an impact on the ecosystem of water resources and the use of agricultural land in the area.

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Organizers

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OPTIONAL BADGES

I AM A COLLABORATOR

Conducting research on white shrimp farming ponds requires teamwork, from designing experiments and assigning responsibilities for collecting water samples from different points in the pond to recording data and analyzing results. We work systematically, consulting and exchanging ideas to find the best approach for studying water quality in white shrimp farming ponds, as well as the quality of the surrounding soil. Additionally, we receive cooperation from shrimp farmers and water quality experts, which helps us better understand the environmental factors affecting water quality. This collaboration enhances the completeness of our study and ensures that our findings can be effectively applied to solving real-world problems.

I AM A DATA SCIENTIST

Our research focuses on analyzing data related to water quality in white shrimp farming ponds, as well as the quality of the surrounding water and soil. We measure the chemical and physical properties of water that affect the growth of white shrimp and compare the collected data with water and soil quality standards to identify correlations and trends among various factors. Statistical analysis, along with graphical and tabular representations, is used to illustrate changes in water and soil quality. This approach helps predict and plan efficient water management in the ponds. Therefore, this research is not merely about data collection but also about applying the findings to solve problems and improve the efficiency of shrimp farming.

I MAKE AN IMPACT

This study provides an overview of the impact of white shrimp farming on water and soil quality in surrounding areas. The collected data has been analyzed and summarized into guidelines that help mitigate environmental effects by improving farming methods and implementing effective water quality management. Additionally, this study raises awareness among farmers and local communities about the importance of environmental conservation, promoting sustainable practices that offer long-term benefits.

Appendix