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Water Quality in Rice-shrimp Model

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ABSTRACT

Study on "water quality in rice-shrimp model, My Xuyen district, Soc Trang province, Vietnam" at 7 locations, including 5 locations on rice-shrimp model, 1 location on giant freshwater prawn nursery and 1 location outside canal. Regarding the results, it was found that the difference in pH parameter values was statistically significant, the rest of the analysis results of temperature, salinity, EC, DO parameters did not have any difference between the sampling locations and between the sampling period (P>0.05). The results of the study show that the sampling locations are all polluted from moderate to mild pollution.

Key words : *Water quality, Freshwater prawn nursery, Combined rice-shrimp model, My Xuyen district*

Introduction

SocTrang province, Vietnam, one of the developed areas for aquaculture, is the largest intensive shrimp farming area in the country with about 27,017 hectares, making a great contribution to the development of shrimp farming and supplying shrimp for export. My Xuyen district in SocTrang province is an area with strong growth in shrimp industry (Nguyen Van Be *et al.,* 2017). In particular, the shrimp-rice rotation model is considered a sustainable and environmentally friendly organic farming model, which not only improves the environment but also helps farmers reduce production costs in cultivation seasons of the year (Pham Thanh Vu *et al.,* 2013). My Xuyen district is the border between salt water and fresh water, creating favorable conditions for aquaculture development. Therefore, it is necessary to pay attention to environmental changes over time with the criteria of temperature, pH, salinity, ... or the prolonged eutrophication of water in shrimp farming is necessary because of these factors have a direct effect on shrimp productivity. Therefore, it is necessary to rely on water quality changes in the farming model, specifically before, during and at the end of the crop to assess how this farming activity affects the water quality in rice-shrimp model. Therefore, this study was conducted with the aim of surveying "water quality in rice-shrimp model, My Xuyen district, SocTrang" to help people choose the appropriate farming season as well as adjust the farming process reasonably.

Materials and Methods

The study was conducted to collect samples at Hoa De Agricultural and Fishery Cooperative, HoaTu commune, My Xuyen district, SocTrang province. The model started in 1999, with an area of about 1 ha, the site includes 3 shrimp ponds (about 4000 m^2), 2 rice fields (about 6000 m^2). The water used for the rice-shrimp model is taken from the NhuGia River,

before entering the field, it is passed through a small sluice that leads to the canal.

The total for water samples directly measured parameters (pH, temperature, salinity, EC, DO) was 28 samples, in 7 locations.

The sampling locations were as follows:

Location 1: Area to get water from Nhu Giariver. The water level ranges from 100–150 cm.
Location 2: Nursery ponds are used to raise giant freshwater prawns up to 135 days old. The water level is about 100 cm.
Location 3: branch used to raise shrimp and provide water for rice plants. The water level ranges from 30-70 cm, the water body is flowing.
Location 4: The field is used to grow rice varieties ST24. The water level is about 10 cm.
Location 5: branch used for shrimp farming, providing water for rice plants. The water level ranges from 30-70 cm.
Location 6: Field used to grow rice variety ST24. The water level is about 10 cm.
Location 7: branch used to raise shrimp and provide water for rice plants. The water level ranges from 30-70 cm, the water body is flowing.

The coordinates of the sampling points are shown in Table 1.

Table 1. Coordinates of the study area.

Location	X	Y
1	9028′33.88′′	105054′16.11′′
2	9028′31.11′′	105054′16.60′′
3	9028′28.79′′	105054′14.05′′
4	9028′28.32′′	105054′14.47′′
5	9028′26.76′′	105054′15.40′′
6	9028′28.60′′	105054′16.17′′
7	9028′28.80′′	105054′16.66

Results and Discussion

Evaluation of water quality in the rice-shrimp model

To evaluate the difference in pH, temperature, salinity, EC, DO between the points, samples were collected at 7 locations, each location, collect water samples 4 times.

pH

The average pH value was highest at location 1, lowest at location 6 and ranged from 7.91 ± 0.11 to 8.30 ± 0.18 in the survey area. The pH value in the field was always more volatile than in the canal (respectively 7.5-8.5 compared with 7.8-8.1). Besides, locations 1 and 6 were significantly different from the rest (Table 2).

The pH value between samples fluctuated relatively slightly. In the second collection time of location 1, the measured pH index was 8.56. This proves that the water source in the area was almost not affected too much by the acid alum factor.

Temperature

The average temperature of each sampling site was shown in Table 2. The temperature varied from (28.33 ± 0.74) ^{0}C to (29.64 ± 1.36) ^{0}C throughout the sampling cycle. The average temperature was highest at position 1 and lowest at position 6. In general, the average temperature in the channel (29.64 ^{0}C) was higher but less volatile than the other points (28.33 -29.16) ^{0}C, due to the low depth at points in the field, it was affected by temperature fluctuations a lot.

In addition, the temperature at 7 locations over the days of measurement had a relatively large fluctuation, the highest was in the 1st sampling collection period at location 1 (30.5 ^{0}C), decreasing over the sampling periods and the lowest was in the sampling collection time 3, at location 7, it was 26.45 ^{0}C. Due to the high amount of solar radiation sampling process. In particular, during the 3rd sampling period, when the sample was collected, it rained, so this was the main cause of the temperature fluctuations mentioned above.

In the field (locations 4 and 6), the depth was lower than that of the canal, so the average temperature was relatively higher and more variable (Le Van Cat *et al.*, 2006). In water, the temperature between (27.7-31.6) ^{0}C was a favorable temperature range for aquatic life.

Salinity

Salinity fluctuated relatively small (0.1-3 ‰), average ranged from (0.7 ± 0.33) ‰ to (1.58 ± 0.63) ‰, the difference was not significant between positions. In which, the highest was 2.91 ‰ (10/01/20, location 3) and the lowest was 0.12 ‰ (12/12/19, location 1), salinity tended to decrease gradually from the sampling period time 1 to 3 and tended to increase sharply in period time 4, corresponding to the highest salinity values in January 2020 and the lowest in December 2019 in SocTrang, Vietnam. This

could be seen in the rice-shrimp environment, rainfall had a great influence on salinity (Le Van Cat *et al.*, 2006), heavy rainfall occurred one day before sampling in collection time 3, which reduced salinity in this research area. At the end of the rainy season, the rainfall decreased, leading to a slight saline intrusion in the ponds. The range of salinity at which crayfish could live is from 0 ‰-15 ‰ (Huynh Kim Huong *et al.*, 2015).

EC

The conductivity and salinity parameters had a close relationship with each other, so similar to the salinity, the average conductivity ranged from (1.514 ± 819) µS/cm to (3.436 ± 1.402) µS/cm, the difference was not significant between sites, the EC was relatively high at sampling collection time 4. Conductivity parameters tended to fluctuate uniformly with salinity parameters.

DO

The average dissolved oxygen concentration ranged from (6.69 ± 0.58) mg/l to (8.17 ± 1.06) mg/l. It could be seen that the second collection time had a relatively higher dissolved oxygen content. Compared with the remaining 3 collection periods, because the field was changed water before the measurement on this day, the organic matter from dead algae was reduced, the organic matter content decreased, so the turbidity in the pond was low, helping the photosynthesis process of the algae, so the DO content was high. The DO difference between the locations in each collection timewas relatively stable. The oxygen content in the field tended to be lower than in the canal during the surveys and ranged from 5.81 to 9.65 mg/l in the survey area. In general, the oxygen content in the study area was still consistent with the DO index specified in the Vietnam standard 08-MT: 2015/Ministry of Natural Resources and Environment (DO≥4 mg/l). According to Vu

Table 2. Water quality at 7 locations.

Sampling location	Collection time	pH	Temperature (^{0}C)	Salinity (‰)	EC (µS/cm)	DO (mg/l)
Location 1	1	8.14	30.50	0.31	688.92	7.08
	2	8.56	30.00	0.34	758.50	9.58
	3	8.21	28.89	0.13	287.14	8.30
	4	8.30	29.19	2.62	5048.70	7.71
Location 2	1	7.97	30.17	2.05	4204.97	7.68
	2	8.33	29.74	1.88	3856.01	7.84
	3	7.95	27.84	0.65	1354.57	6.51
	4	8.22	28.89	1.73	4328.15	7.73
Location 3	1	8.01	29.59	0.60	1304.19	6.66
	2	8.05	29.17	1.12	2316.79	8.80
	3	7.87	26.81	0.21	440.02	6.24
	4	7.59	28.70	2.92	5719.11	6.55
Location 4	1	7.94	30.14	0.52	1139.15	6.98
	2	7.92	28.78	0.55	1185.36	9.65
	3	8.13	26.82	0.20	432.37	5.81
	4	7.79	28.53	2.79	5453.32	6.98
Location 5	1	8.10	29.63	0.66	1420.03	8.06
	2	8.15	29.04	0.55	1185.55	11.31
	3	7.82	26.81	0.23	482.47	6.77
	4	7.87	28.06	2.29	4932.10	6.07
Location 6	1	7.80	29.84	0.65	1410.05	7.36
	2	7.74	28.79	0.75	1574.23	6.83
	3	7.74	26.59	0.25	535.69	5.97
	4	7.89	28.11	1.27	2535.19	6.59
Location 7	1	7.83	29.75	0.68	1472.86	5.58
	2	8.04	28.79	0.76	1606.80	10.34
	3	7.82	26.45	0.26	557.69	6.04
	4	7.94	28.33	1.07	2635.91	6.75

Ngoc Ut (2013), oxygen in water bodies was provided by diffusion from the air and photosynthesis.

Conclusion and suggestion

The temperature and pH of the water environment fluctuated according to the amount of solar radiation. Because the survey was in the rainy season, the pH and temperature fluctuations were not large between the points as well as the sampling periods. The water source in the area was hardly affected by the acid alum factor.

Use Primer at different similarity levels in combination with pollution indicators to find the right value.

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