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บทความวิจัย

คุณสมบัติของดินและคุณภาพน้ำต่อการผลิตกุ้งก้ามกรามในบ่อดินในจังหวัดกาฬสินธุ์

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ผลผลิตกุ้งก้ามกราม

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บทคัดย่อ

องค์ประกอบของดิน ปริมาณสารอาหารอนินทรีย์ที่ละลายน้ำมีบทบาทสำคัญในการจัดการคุณภาพน้ำและการผลิตกุ้งก้ามกรามเป็นอย่างยิ่ง การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อ 1) เพื่อศึกษาคุณภาพดิน คุณภาพน้ำ ปริมาณธาตุอาหารและแพลงก์ตอนพืชในบ่อเลี้ยงกุ้งก้ามกราม และ 2) เพื่อศึกษาปัจจัยอื่นที่มีผลต่อการผลิตกุ้งก้ามกรามในจังหวัดกาฬสินธุ์ การศึกษาครั้งนี้เป็นการรวบรวมข้อมูลจากฟาร์มกุ้งก้ามกรามในอำเภอเมือง และอำเภอยางตลาด จังหวัดกาฬสินธุ์ โดยการสุ่มตัวอย่างบ่อเลี้ยงกุ้งก้ามกราม จำนวน 7 สถานี เพื่อทำการวิเคราะห์คุณภาพน้ำ คุณภาพดิน ปริมาณแพลงก์ตอนและผลผลิตกุ้งก้ามกราม พบว่า คุณภาพน้ำเฉลี่ยทุกตัวชี้วัดของบ่อเลี้ยงกุ้งก้ามกรามจากทุกสถานีมีการเปลี่ยนแปลงใกล้เคียงกับแหล่งน้ำธรรมชาติและมีคุณภาพอยู่ในเกณฑ์คุณภาพน้ำที่เหมาะสมในการดำรงชีวิตและการเจริญเติบโตของสัตว์น้ำ ขณะที่คุณภาพดินของบ่อเลี้ยงทุกสถานีมีความแตกต่างกัน ($p<0.05$) ผันแปรตามลักษณะของดิน ยกเว้นค่า pH และปริมาณความชื้น ด้านผลผลิตกุ้งก้ามกรามจากทุกสถานี พบว่า เกษตรกรใช้ระยะเวลาในการเลี้ยง 4 เดือนและมีปริมาณผลผลิตไม่แตกต่างกันทางสถิติ ($p>0.05$) โดยผลผลิตกุ้งก้ามกรามที่สถานีที่ 2 และ 4 มีปริมาณผลผลิตเฉลี่ยมากกว่า 200 กก./ไร่ สำหรับการวิเคราะห์สหสัมพันธ์ พบว่า ผลผลิตกุ้งก้ามกรามได้รับอิทธิพลจากค่าความเป็นด่าง ดังนั้นเพื่อเป็นการส่งเสริมการผลิตกุ้งก้ามกรามควรมีการจัดการบ่อที่เหมาะสมเพื่อเป็นการกระตุ้นการการเจริญเติบโตของกุ้งก้ามกราม รวมถึงเป็นการสร้างแหล่งอาหารธรรรมชาติให้กับสัตว์น้ำ

Introduction

Aquaculture of shrimp and prawns in Thailand has proven to be a profitable and dynamic industry, with an increasing market demand for reliable and long-lasting professions. The giant freshwater prawn, *Macrobrachium rosenbergii*, is an economically important aquatic animal commonly farmed in freshwater areas. However, prawn farmers still face problems such as post-larvae management, food supply, farm management, water quality management, and diseases leading to unstable yields and insufficient supply to meet market demand. Modern technology is being employed to assist in feeding shrimp, and a management plan should include semi-intensive, intense, monoculture, and polyculture cultivation methods. The most popular management technique involves a 30 – 60 days nursery period for post-larvae. After this, a combination approach is used for harvesting until the largest market size individuals are reached, starting at five months, and then harvesting occurs every 30 – 45 days (Schwantes et al., 2009; Tucker & Robinson, 1990). The average captured yield is 2,338 kg/ha-2/year (Schwantes et al., 2009). A probiotic additive has been shown to have a positive impact on the growth and production of giant freshwater prawns after eight months, with an average gross production of 639.49-933 kg/ha (Ghosh et al., 2016). The ecosystem of the prawn pond depends on the quality of water (Boyd, 1982), soil (Hasibuan et al., 2023), fertilizer (Adhikari et al., 2014), and phytoplankton (Kamilia et al., 2021) for optimal prawn

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production (Adhikari et al., 2014; Mredul et al., 2022). Soil quality aspects, such as pH, alkalinity, hardness, and dissolved oxygen, are linked to the characteristics of water quality. Changes in water quality are related to changes in soil quality (Hasibuan et al., 2023).

The concentration of oxygen in the pond increases due to the presence of phytoplankton, which modifies the water quality over the course of the agricultural season, among other factors. The production of aquatic creatures, such as prawns, is highly dependent on the water quality of the aquaculture pond. Studies have demonstrated a link between water quality and phytoplankton concentration and the development of yellow catfish (*Pelteobagrus fulvidraco*) in both mono- and polyculture systems (Wang et al., 2022). The dynamics of the phytoplankton population under intensive agriculture can be used to assess shrimp farming health indicators (Lyu et al., 2021). However, long-term shrimp farming may also lead to environmental issues such as ecological imbalance, environmental pollution, land degradation, sedimentation, and disease outbreaks (Zafar et al., 2016).

The quality of soil is a crucial factor in the success of aquaculture, as it has an immediate impact on water quality (Kumar et al., 2012). Benthic species, such as prawns, rely on sediment for food and shelter, and the sediment serves as a nutrient repository, supporting the growth of benthic algae, which in turn provide sustenance for other organisms. However, various farming aspects have been studied, including nutrient content, plankton abundance, soil quality, and water quality, in different locations. A comprehensive study of farmers in the Kalasin Province region would be beneficial for gaining a better understanding of the facts and issues.

The purpose of this study is to investigate the impact of water quality and other factors on prawn production in Kalasin Province and provide guidelines for water quality management in prawn ponds. The study aims to address the issues caused by poor water quality in prawn farming and provide farmers with information and insights about the importance of soil quality and other pond-related concerns. By regulating water quality effectively, farmers can improve their profession's stability and sustainability, and increase their profitability while reducing the problems associated with poor water quality.

Materials and methods

The data for this study were collected through continuous monitoring of water quality in prawn farms located in Mueang District and Yang Talat District, Kalasin Province, Thailand. The dataset was compiled using a random intensive prawn culture pond method, and data was obtained from the Kalasin Provincial Fisheries Office 2019 database (Department of Fisheries, 2020).The study examined water quality, soil quality, plankton, and prawn production in prawn ponds at seven different stations across Kalasin Province, including Ban Tum, Ban Khok Kong, Ban Prong Khae, and Ban Pho Si (Bua Ban Subdistrict, Yang Talat District), Ban Non Phakdi, Ban Non Hua Chang (Na Chueak Subdistrict, Yang Talat District), and Ban Nong Muang (Lamphan Subdistrict, Mueang District) during March to August 2021 (Table 1 and Figure 1).

Table 1 Sampling stations to collect water quality, soil properties, and plankton

Station	No.	Site sample
Station 1 (St1)	KS1	103.425020 E 16.495345 N
	KS2	103.423222 E 16.501954 N
Station 2 (St2)	KS3	103.443746 E 16.520991 N
	KS4	103.452816 E 16.521940 N
Station 3 (St3)	KS5	103.455350 E 16.525744 N
	KS6	103.446498 E 16.535862 N
Station 4 (St4)	KS7	103.446391 E 16.536407 N
	KS8	103.434253 E 16.538146 N
Station 5 (St5)	KS9	103.387005 E 16.582799 N
	KS10	103.382936 E 16.580889 N
Station 6 (St6)	KS11	103.394984 E 16.576208 N
	KS12	103.393557 E 16.576642 N
Station 7 (St7)	KS13	103.467629 E 16.574925 N
	KS14	103.443425 E 16.575480 N

Figure 1 Sampling stations to collected water quality, soil properties, and plankton.
Source: Google Earth (2021)

Water quality determination

Water quality parameters were weekly measured, including transparency using a Secchi disc, temperature and pH using a portable pH meter (Hanna HI 98128), and dissolved oxygen using a portable dissolved oxygen meter (Hanna HI 9147). All measurements were taken between 9:00 a.m. and 12:00 p.m. from March to August 2021. Total dissolved solid (TDS), total alkalinity, total hardness, free carbon dioxide (Free CO_3), ammonia-nitrogen (NH_3-N), orthophosphate (PO_4^{3-}), and chlorophyll a were analyzed in the laboratory using methods (Boyd & Tucker (1992): AOAC (2005): APHA (1981)).

Soil properties

At each station, soil samples were collected using a PVC tube soil sampler to a depth of 0-10 cm, with three cores taken from each pond to obtain a total of 15 individual samples at the beginning of the study. The samples were air dried and sieved to a positive size of 2 mm, then analyzed using the sieve-pipette method to evaluate coarse particle distribution and quantify clay and silt. The soil texture was determined by combining the distribution of sand, clay, and silt with the textural triangle. The samples were also analyzed for total nitrogen (N) using the Kjeldahl method, available phosphorus (P) using the Bray no. 2 extraction method with spectrophotometry (molybdenum blue), and extractable potassium (K) using the ammonium acetate extraction and atomic absorption spectrophotometry. Moisture content (MC) was determined using the oven dried method, cation exchange capacity (CEC) was measured by the ammonium acetate saturation and distillation method, and organic matter mass fraction was calculated based on soil bulk density. Ammonia nitrogen (NH^{4+}-N) was determined using the 2 M KCl extraction and distillation with MgO, and pH and electric conductivity (EC) were measured using a pH meter and conductivity meter, respectively.

Phytoplankton analysis

Phytoplankton samples were collected from each pond on the sample day by sub-surface water collection (0.5 m below the water surface) using a 5-liter water sample via a plankton net with a 35 µm mesh size, as described above. The collected samples were immediately fixed with 4 % formaldehyde using the method of Wongrat & Boonyapiwat (2003). The identification and abundance of phytoplankton were determined by microscopic examination (Wongrat, 1999) and calculated using the counting chamber method (Wongrat & Boonyapiwat, 2003; Charubhun et al., 2003).

Statistical analysis

For the statistical analyses, analysis of variance (ANOVA) was performed. The aim was to explore the relationship among stations, water quality, soil parameters, phytoplankton, and prawn production. Pearson's linear correlation coefficients were calculated to assess the relationships between these variables.

Results and Discussion

Water quality parameter

The water quality at all 7 stations showed that water temperature was high at station 6 (34.28°C) and low at station 3 (31.38°C) (Figure 2A). This high temperature was observed in April to May corresponding to the summer season of Thailand. Total dissolved solids were found to be related to transparency and were low at station 6 (0.003 ml/L) and high at station 7 (Figure 2C and B). Electric conductivity (EC) was observed to be high at station 2 (290.283 μSm^{-1}) and low at station 7 (Figure 2D). In general, EC of natural water is expressed by the presence of ions such as Ca_2^+, Na^+, K^+, Mg_2^+, Fe_2^+, Fe_3^+, or another form such as SO_4^{2-}, Cl^-, PO_4^-, NO_3^-. Thus, the high EC values at station 2 and station 4 indicate a high degree of mineralization in the ponds. The typical freshwater conductivity ranges from 20 to 1,500 µs/cm (Boyd, 1979). The average pH ranged as follows: station 4 (9.02 ± 0.49) exhibited a higher value than station 6 (8.97±0.32), station 5 (8.82±0.43), station 1 (8.82±0.87), station 2 (8.81±0.21), station 3 (8.57±0.54), and station 7 (8.47±0.53), respectively. There were no significant differences in pH among the stations ($p>0.05$) (Figure 3A). The factors that contributed to the statistical difference in yield data were the result of a relatively high profile of prawn farming. Prawn production correlates with water quality factors such as hardness, alkalinity, and pH. These values suggest that the water quality is optimal, containing the appropriate mineral elements for the growth of phytoplankton, which is an important factor in the food chain.

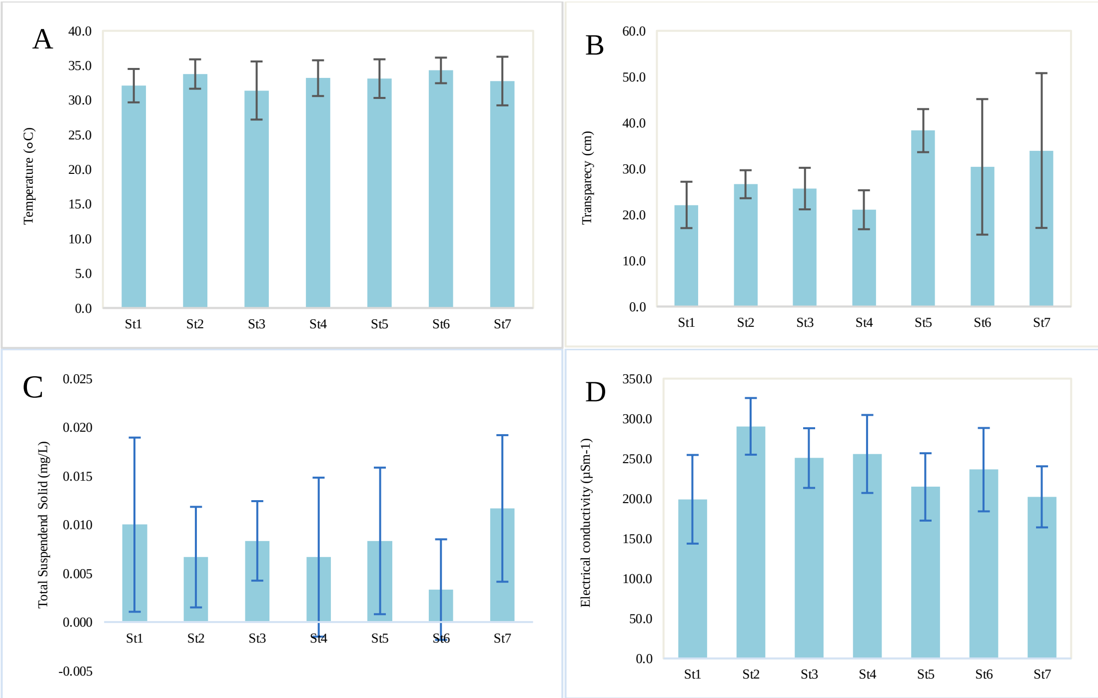

Figure 2 Physical characteristic of water quality; A: Temperature, B: Transparency, C: Total Suspended Solid, and D: Electrical conductivity.

The average of total alkalinity for 7 stations was between 38.50- 51.167 mg/L. The average of hardness ranged from 45.33 to 65.00 mg/L (Figure 3 B). The free carbon dioxide for the station 3 was highest (3.917 mg/L) and that at station 6 was lowest (1.063 mg/L) (Figure 3 G). The average of measured dissolved oxygen concentrations for the 7 stations were highest at station 1, 2, 4, 3, 7, 5, and 7, respectively (Figure 3 D). Ammonia nitrogen level depended on the station with the highest value found at station 4 (1.753 mg/L), and lowest value found at station 5 (0.923 mg/L) (Figure 3 E). The average of orthophosphate values is highest at the station 1 (0.164 mg/L) and data shown low values at all other stations (~ 0.01-0.02 mg/L) (Figure 3 F). The average chlorophyll values were highest at the station 1 (318.50 mg/L), and lowest at station 6 (6.20 mg/L) (Figure 3 H). Chlorophyll a content was found to be highest at station 1 and in the range of 100-150 mg/L at station 2 and station 4, while station 3, 5, 6, and 7 showed low chlorophyll a content. Chlorophyll concentration indicates an excess of nutrients in the environment, and a strong phytoplankton effect can cause the pond's oxygen levels, which are essential for cultivation, to drop. Station 1, 3, 5, 6, and 7 had low yields compared to equivalent yield. Usually, farmers can regulate the phytoplankton concentration in the ponds. However, if the farmers are unable to do so, manipulating the nutrient content in the ponds would also have an influence on prawn output.

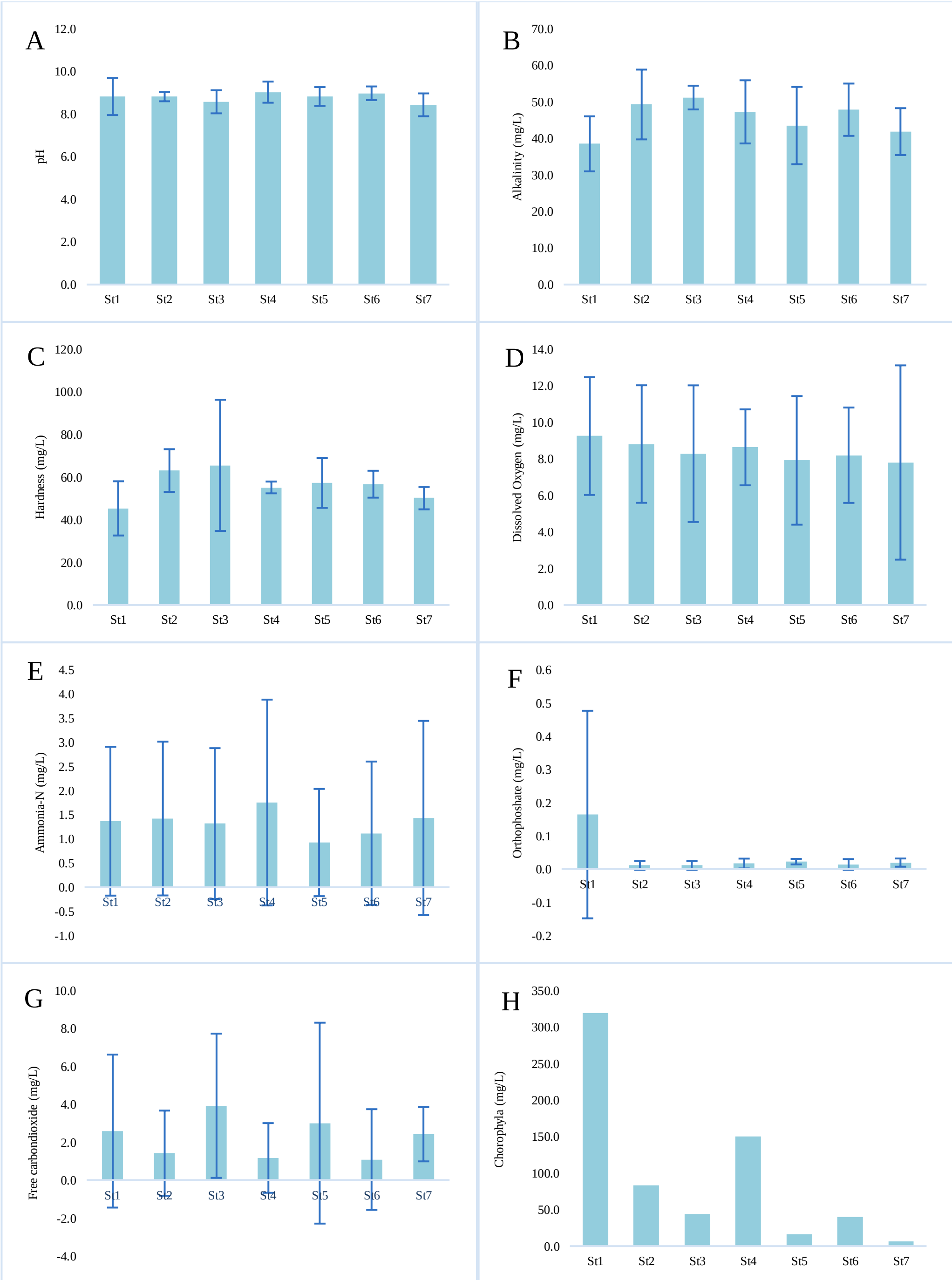

Figure 3 Chemical characteristic of water quality; A: pH, B: Alkalinity, C: Hardness, D: Dissolved oxygen, E: Ammonia-N, F: Orthophosphate, G: Free carbon dioxide, and H: Chlorophyll *a*

Soil organic content

The soil texture for all stations was determined and categorized into four types: sand, loamy sand, sandy loam, and loam (Table 2). The soil pH of all pond stations was recorded, ranging from 5.8 to 6.7 (Figure 4A). No significant variation in soil pH was found. The chemical properties of the stations were measured at the beginning and end of the survey to observe any changes. The application of pelleted feed resulted in an increase in nutrient concentrations in the pond water, which was reflected in the higher levels of EC, ECE, MC, organic matter, ammonia nitrogen, nitrogen, phosphorus, and potassium data shown in figure 4 B, C, D, E, and F.

Table 2 Percentage of composition and texture class of soil collected from different station

Station	No.	Sand (%)	Silt (%)	Clay (%)	Soil Texture	Particle density (g/ml)
Station 1 (St1)	KS1	79.84	17.34	2.82	Loamy sand	2.64
	KS2	55.4	33.48	11.12	Sandy loam	2.6
Station 2 (St2)	KS3	73.97	22.81	3.22	Loamy sand	2.59
	KS4	83.77	12.46	3.77	Loamy sand	2.62
Station 3 (St3)	KS5	82.59	15.52	1.89	Loamy sand	2.64
	KS6	70.51	18	11.49	Sandy loam	2.64
Station 4 (St4)	KS7	88.08	8.81	3.11	Sand	2.64
	KS8	54.77	36.16	9.07	Sandy loam	2.65
Station 5 (St5)	KS9	85.21	12.39	2.4	Loamy sand	2.72
	KS10	46.85	41.11	12.04	Loam	2.63
Station 6 (St6)	KS11	53.65	44.46	1.89	Sandy loam	2.65
	KS12	51.89	36.79	11.32	Loam	2.64
Station 7 (St7)	KS13	73	23.63	3.37	Sandy loam	2.64
	KS14	85.63	9.39	4.98	Loamy sand	2.58

Effect of the earthen pond soil quality on water quality and productivity

Although the concentration of water quality variables does not vary by pond stations, the relationship between water quality concentration and bottom soil quality was more apparent. Pearson's linear correlation coefficients were calculated between soil nutrient parameters, water quality, and production for all stations (Table 3). Most of the concentrations of water quality variables were positively correlated with soil pH, NH_3-N, MC, N, P, OM, and productivity.

The quality of earthen pond differentiation affected the quality of the pond water nutrient concentrations which were directly corrected with soil N, P, OC (Hasibuan et al., 2023), including the increase in suspended solids and nutrients in the water (Wang et al., 2022). Soil quality is a crucial factor in determining prawn productivity as it influences pond bottom stability, pH of overlaying water, and concentrations of phytoplankton nutrients required for growth. Sandy, clay, and loam is considered to be the most suitable soil type for aquaculture (Siddique et al., 2012). For semi-intensive and intensive culture systems that rely on artificial food as the primary source of nutrition, a soil type ranging from sandy, clay, and loam to sandy loam is preferred. Soil pH is an important factor for prawn farmers who use lime to maintain water quality in the ponds. Banerjee (1967) notes that soil pH can depend on various factors. Poor aeration of the sediment layer can lead to reduced decomposition rates and partial oxidation of products, resulting in the undesirable production of H_2S, CH_4, and short-chain fatty acids. These compounds can make the soil acidic and reduce bacterial activity, ultimately leading to lower productivity. Soils with high organic content are prone to rapid decomposition by bacteria and other microorganisms. These soils typically have between 30 % and 40 % organic matter, which makes them unsuitable for pond aquaculture and should be avoided. In the present study, the highest amount of organic matter recorded was 0.28 % to 0.77 %.

Calcium and phosphorus levels in natural water must be associated as this is a sign of water abundance. Particularly crucial components for the construction of an organism's body are calcium and phosphorus, which are linked to vitamin D. Another advantage of smaller calcium stores is that they will be less likely to be utilized (Boyd, 1982). Typically, soils have low levels of phosphorus and potassium. These levels can vary depending on water quality factors such as pH, O_2, and CO_2 (Table 3). Siddique et al.

(2012) conducted a study on the comparative physiology and chemical properties of soil based on the age of aquaculture ponds in Bangladesh. They found that the age of the pond did not affect soil pH, but had a significant impact on the accumulation of organic matter, organic carbon, silt, and clay, which increased rapidly with prolonged use. This can lead to pond deterioration.

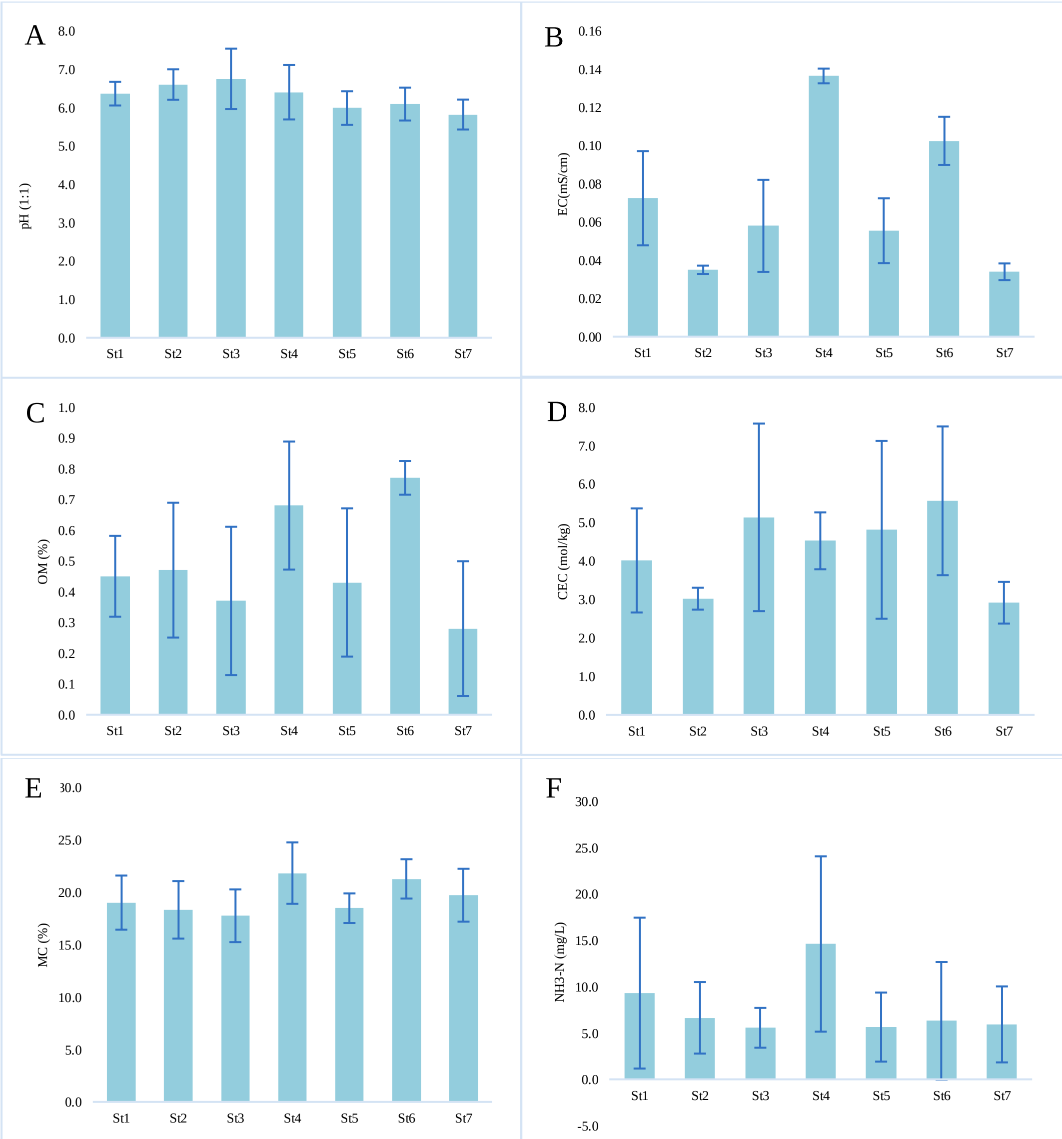

Figure 4 Chemical characteristic of soil quality; A: pH, B: EC (Electric conductivity), C: OM (Organic matter), D: CEC (Cation exchange capacity), E: MC (Moisture content), F: NH_3-N (Ammonia-nitrogen).

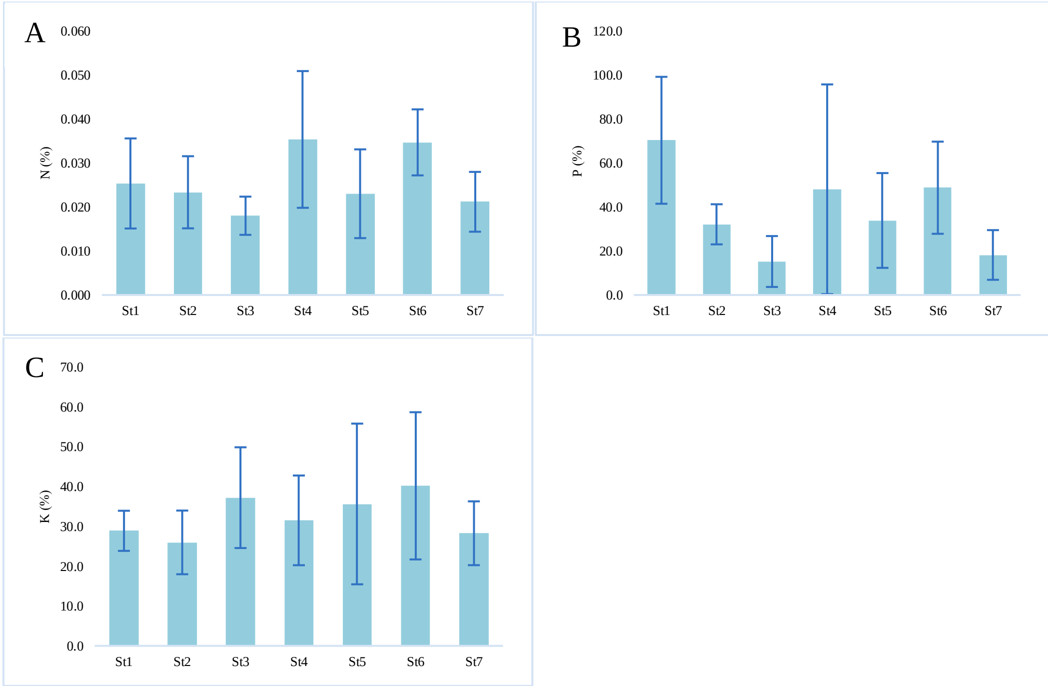

Figure 5 Primary nutrients in ponds; A: N (Nitrogen), B: P (Phosphorus), C: K (Potassium).

Biological quality parameter (Phytoplankton)

Greater station enhanced soil organic matter and nutrition content, which influenced water nutrient content (N, P, and K) but did not change phytoplankton richness. The phytoplankton population in all station were composed of seven major groups: Cyanochloronta (3.13 %), Cyanophyta (18.75 %), Chlorophyta (37.50 %), Chromophyta (12.50 %), Chrysophyta (12.50 %), Pyrrophyta (6.25 %), and Euglenophyta (9.37 %). This resulted in greater phytoplankton growth in response to greater nutrient concentrations.

Production of giant freshwater prawns

Harvesting was carried out at the end of 4 months cultivation period. At stations 2 and 4 production is 207 and 215 kg/ rai, respectively, which is higher than the other stations (1, 3, 5, 6, and 7; Figure 6) with no significant different ($p>0.05$). A rai of land can yield up to 215 kg of prawns, offering financial benefits to farmers and providing them with a sustainable career in prawn farming. However, the water quality in all agricultural pond stations has not significantly deviated from that of natural water sources.

When examining the correlation between prawn production at station 2 and station 4 (207.50±130.81 and 215.00±0.00 kg/rai) (Figure 5), it was found that prawn production statistics were associated with the EC of the water. EC is a widely used parameter in aquaculture systems and is used as an indicator of the total dissolved solids or the degree of ionization of water (Boyd, 1979).

Table 3 Correlations among the water and soil parameters at the seven stations

Correlations																								
	TEM	LIGHT	CON	PHW	DO	CO_2	ALK	HARD	NH	PO_4	TSH	pH	EC	OM	CEC	MC	NH_3	N	P	K	Y	% Sand	% SILT	% CLAY
TEM	1																							
LIGHT	0.175	1																						
CON	0.090	-0.162	1																					
PHW	0.513	-0.097	0.302	1																				
DO	0.015	-0.035	0.210	0.148	1																			
CO_2	-0.685	0.030	-0.272	-.806**	-0.281	1																		
ALK	-0.059	-0.084	.615*	0.009	0.285	0.033	1																	
HARD	-0.241	0.129	.699**	-0.053	0.172	0.151	.784**	1																
NH	0.042	-0.408	0.191	0.047	0.281	-0.089	0.013	-0.117	1															
PO4	-0.162	-0.176	-0.175	0.525	0.148	-0.305	-0.461	-0.332	0.073	1														
TSH	-0.382	0.164	-0.286	-0.406	0.208	0.226	-0.455	-0.170	0.398	0.188	1													
pH	-0.531	-0.273	.616*	-0.158	0.443	0.204	0.485	.628*	-0.035	-0.074	-0.034	1												
EC	0.133	-0.343	0.107	0.262	0.288	-0.171	0.170	0.039	0.222	-0.145	-0.312	0.228	1											
OM	0.036	-0.117	0.327	0.101	0.485	-0.131	0.322	0.334	0.093	-0.191	-0.164	0.431	.704**	1										
CEC	-0.223	-0.078	0.096	-0.105	0.141	0.115	0.230	0.458	-0.272	-0.228	-0.043	0.401	0.500	.704**	1									
MC	0.414	-0.168	0.064	.591*	-0.227	-.607*	-0.265	-0.311	0.202	0.217	-0.258	-0.316	0.498	0.268	0.048	1								
NH3	0.145	-.689**	0.076	0.455	-0.067	-0.365	-0.146	-0.232	0.425	0.228	-0.114	-0.075	.567*	0.151	0.081	.613*	1							
N	0.490	-0.228	0.154	.604*	0.342	-.604*	0.133	-0.032	0.306	0.094	-0.294	-0.130	.723**	.696**	0.343	.678**	.558*	1						
P	0.170	-0.213	-0.055	.600*	.533*	-.536*	-0.275	-0.390	0.015	.634*	-0.119	0.091	0.388	0.386	0.024	0.378	0.310	.538*	1					
K	0.139	-0.008	0.029	0.214	-0.020	-0.296	0.060	0.245	-0.267	-0.073	-0.042	-0.003	0.278	0.399	.795**	0.271	0.151	0.404	0.029	1				
Productivity	0.178	-0.217	0.373	0.167	0.242	-0.055	.541*	0.327	0.507	-0.198	-0.148	0.000	0.160	0.195	-0.152	-0.069	0.316	0.373	-0.110	-0.267	1			
% Sand	-0.051	-0.103	0.059	0.006	-0.447	0.127	-0.080	-0.087	0.334	0.153	0.122	-0.272	-0.517	-.814**	-.738**	-0.112	0.102	-0.481	-0.462	-.538*	0.232	1		
% SILT	0.172	0.168	-0.054	0.077	0.506	-0.211	0.082	0.006	-0.269	-0.124	-0.165	0.186	0.498	.796**	.586*	0.151	-0.163	0.530	.539*	0.427	-0.191	-.971**	1	
% CLAY	-0.335	-0.135	-0.052	-0.254	0.092	0.177	0.043	0.297	-0.397	-0.180	0.059	0.423	0.372	.546*	.907**	-0.050	0.121	0.144	0.048	.661*	-0.266	-.692**	0.499	1

*Significance for statistics test: $p<0.05$, **Significance for statistics test: $p<0.01$ TEM=Temperature, LIGHT=Light, CON=Conductivity, PHW= pH of water, DO= Dissolved oxygen, CO_2=Carbon dioxide, ALK=Alkalinity, HARD= Hardness, NH=Ammonia PO_4=ortho-Phosphate, TSH=Total solid, pH= pH of soil, EC= soil electric conductivity, OM=soil organic matter, CEC=soil cation exchange capacity, MC=Moisture content, NH_3=Ammonia, N=Nitrogen, P=Phosphorus, K=Potassium, Y=Yield

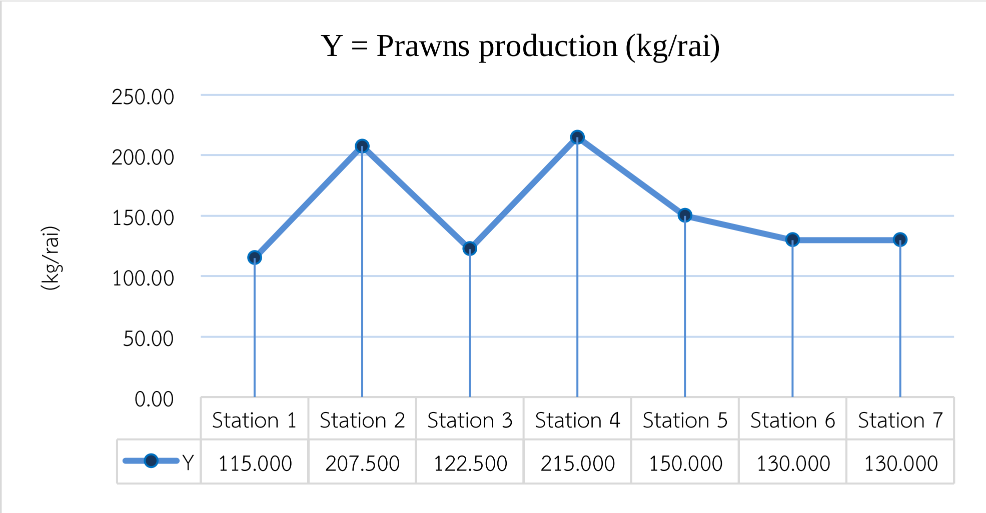

Figure 6 Prawns production in Kalasin Province separate from station.

Conclusion

The average water quality in giant freshwater prawn ponds was within the appropriate standard for the growth of aquatic animals. However, there are some qualities that exceed the benchmark for aquaculture at certain times and some below the benchmark, which may affect the growth of the prawn. In addition, improving the water quality can be very beneficial to giant freshwater prawn production.

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References

Adhikari, S., Sahu, B. C., Mahapatra, A. S., & Dey, L. (2014). Nutrient budgets and effluent characteristics in giant freshwater prawn (*Macrobrachium rosenbergii*) culture ponds. *Bulletin of Environmental Contamination and Toxicology*, *92*(5), 509–513. doi: 10.1007/s00128-014-1227-4

Association of Analytical Chemists (AOAC). (2005). *Official methods of analysis* (18th ed.). Washington D. C., United States: Association of Official Analytical Chemists.

American Public Health Association (APHA). (1981). *Standard methods for the examination of water and wastewater*. Washington D. C., United States: American Public Health Association.

Banerjee, S. M. (1967). Water quality and soil codition of fish ponds in some states of India in relation to fish production. *Indian Journal of Fisheries*, *14*(1 & 2): 115-144.

Boyd, C. E. (1982). *Water quality management for pond fish culture*. Amsterdam, the Netherlands: Elsevier Scientific Publishing Company.

Boyd, C. E. (1979). *Water quality in warmwater fish ponds*. Alabama, United States: Printers Inc.

Boyd, C. E., & Tucker, C.S. (1992). *Water quality and pond soil analyses for aquaculture*. Alabama, United States: Agricultural Experiment Station, Auburn University.

Charubhun, N., Charubhun, B., & Thongpan, A. (2003). Water quality and Identification of organisms found at the intake water area of south Bangkok thermal plant. *Kasetsart Journal (Natural Science)*, *37*(3), 307–320.

Department of Fisheries. (2020). *Statistics of freshwater aquaculture production*. Accessed March 8, 2022,Retrieved from https://www4.fisheries.go.th/local/file_document/20220324135109_new.pdf

Ghosh, A. K., Bir, J., Azad, M. A. K., Hasanuzzaman, A. F. M., Islam, M. S., &

Huq, K. A. (2016). Impact of commercial probiotics application on growth and production of giant fresh water prawn (*Macrobrachium rosenbergii* De Man, 1879). *Aquaculture Reports, 4*, 112-117. doi: 10.1016/j.aqrep.2016.08.001

Google Earth (2021). [Sampling stations to collected water quality, soil properties, and plankton]. Accessed August 30, 2021, Retrieved from https://earth.google.com

Hasibuan, S., Syafriadiman, S., Aryani, N., Fadhli, M., & Hasibuan, M. (2023). The age and quality of pond bottom soil affect water quality and production of *Pangasius hypophthalmus* in the tropical environment. *Aquaculture and Fisheries, 8*(3), 296-304. doi: 10.1016/j.aaf.2021.11.006

Kamilia, H., Sasmito, B. B., & Masithah, E. D. (2021). Phytoplankton and its relationship to white leg shrimp (*Litopenaeus vannamei*) culture productivity in Alasbulu, Banyuwangi. *The Journal of Experimental Life Sciences*, *11*(2), 43–48. doi: 10.21776/ub.jels.2021.011.02.03

Kumar, P., Jetani, K. L., Yusuzai, S. I., Sayani, A. N., Dar, S. A., & Rather, M. A. (2012). Effect of sediment and water quality parameters on the productivity of coastal shrimp farm. *Advances in Applied Science Research*, *3*(4), 2033-2041.

Lyu, T., Yang, W., Cai, H., Wang, J., Zheng, Z., & Zhu, J. (2021). Phytoplankton community dynamics as a metrics of shrimp healthy farming under intensive cultivation. *Aquaculture Reports*, *21*,100965. doi:10.1016/j.aqrep.2021.100965

Mredul, M. M. H., Akkas, A. B., Elsaidy, N., Ali, M. L., Mondal, M. A. H., & Alam, M. R. (2022). Using of mustard oil cake in safe organic aquaculture through increasing pond primary productivity. *Aquaculture Reports*, *23*,101073. doi: 10.1016/j.aqrep.2022.101073

Schwantes, V. S., Diana, J. S., & Yi, Y. (2009). Social, economic, and production characteristics of giant river prawn *Macrobrachium rosenbergii* culture in Thailand. *Aquaculture*, *287*(1-2), 120-127. doi: 10.1016/j.aquaculture.2008.10.017

Siddique, M. A. M., Barua, P., & Ghani, M. H. (2012). Comparative study of physico-chemical properties of soil according to the age of aquaculture pond of Bangladesh. *Mesopotamian Journal of Marine Sciences*, *27*(1), 29-38. doi:10.58629/mjms.v27i1.169

Tucker, C. S., & Robinson, E. H. (1990). *Channel catfish farming handbook.* New York, United States: Springer New York. doi: 10.1007/978-1-4757-1376-3

Wang, M., Feng, W., Wang, Y., Li, B., Wang, J., Zhu, X., & Zhang, L. (2022). Water quality, plankton composition, and growth performance of juvenile yellow catfish (*Pelteobagrus fulvidraco*) in mono- and polyculture systems. *Aquaculture*, 552, 738017. doi: 10.1016/j.aquaculture.2022.738017

Wongrat, L. (1999). *Phytoplankton.* Bangkok, Thailand: Kasetsart University Press. (in Thai)

Wongrat, L., & Boonyapiwat, S. (2003). M*anual of sampling and analytical methods of plankton*. Bangkok, Thailand: Kasetsart University Press. (in Thai)

Zafar, M. A., Haque, M. M., Aziz, M. S. B., & Alam, M. M. (2016). Study on water and soil quality parameters of shrimp and prawn farming in the southwest region of Bangladesh. *Journal of the Bangladesh Agricultural University*, *13*(1), 153-160. doi: 10.3329/jbau.v13i1.28732

Research article

Effect of soil properties and water quality on production in giant freshwater prawn ponds in Kalasin Province

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ABSTRACT

Soil properties and dissolved inorganic nutrients play a critical role in the effective management of water quality and prawn production. This research had two aims: 1) to study soil quality, water quality, nutrient content, and phytoplankton in prawn ponds; and 2) to study other factors affecting prawn production in Kalasin Province. The data of this study was collected by randomly sampling from 7 stations in prawn farms located in Mueang District and Yang Talat District, Kalasin Province, Thailand. Water quality, soil quality, and the amounts of phytoplankton and prawn production from 7 stations were analyzed. The result showed that the average water quality of all parameters of prawn ponds at all stations was similar to natural water sources and the water quality remained well suitable criteria for the livelihood and growth of aquatic animals. Soil quality of prawn ponds from all stations had different values ($p<0.05$) according to soil characteristics except pH and moisture content. Prawn production from all stations showed that farmers in Kalasin Province used 4 months cultivation period and the yield was not different ($p>0.05$). The yield of prawn production at stations 2 and 4 was more than 200 kg/rai. Analysis of the correlation revealed that the production of prawns is influenced by alkalinity. Thus, enhancement of freshwater giant prawns production should be proper pond management to encourage the growth of prawn and produce natural food sources.

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