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Research Article

Evaluation of the current status of wastewater management and treatment from super-intensive whiteleg (*Penaeus vannamei*) shrimp ponds in Ben Tre Province

That Lang Ton[1]*, Van Tan Lam[2], Tran Thi Kim Tu[3], Van Tuan Nguyen[1]

[1] Ho Chi Minh University of Natural Resources and Environment, Ho Chi Minh City, Vietnam; ttlang@hcmunre.edu.vn
[2] Department of Science and Technology, Ben Tre province, Vietnam; lvtankhcn@gmail.com
[3] Center of Environment and Technology Service, Ho Chi Minh City, Vietnam; kimtu1610@gmail.com

*****Correspondence: ttlang@hcmunre.edu.vn; Tel.: +84–903893932

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Abstract: Ben Tre province in Viet Nam must contend with the fact that the farming environment is deteriorating beccause of poor disease management practices, pond wastewater discharge, and bottom muck. The current state of extremely intense shrimp farming in Ben Tre province is depicted in this study. In addition, this study also evaluates the state of Ben Tre province's wastewater treatment and super-intensive shrimp farming practices. Shrimp pond wastewater is often held in settling ponds in super-intensive shrimp farming households in three districts of Binh Dai, Ba Tri, and Thanh Phu of Ben Tre province, however, some households will continue to discharge wastewater through treatment ponds. According to the analysis's findings, treated shrimp ponds have considerably superior water quality than untreated shrimp ponds. However, the concentration of COD, BOD_5, H_2S, and NH_3 in treated ponds remained higher than the standard of QCVN 02-19:2014/BNNPTNT, although having dropped in comparison to untreated ponds. As a result of the aforementioned fact, it is imperative to conduct research and develop an environmentally friendly and highly effective wastewater treatment process to conserve and circulate water for extremely intensive shrimp ponds in the Ben Tre Province area.

Keywords: Super-intensive shrimp pond; Wastewater; Penaeus vannamei.

1. Introduction

The Vietnamese government is concentrating on intensive shrimp production, enhancing value chain efficiency, certification and standards enforcement, and minimizing risk in an effort to make the country the top exporter of seafood in the world. An empirical examination of the price relationship and the shrimp exports from Vietnam's supply chain revealed that the white-leg shrimp's price transmission was noticeably superior to the black-tiger shrimp's [1]. Therefore, white-leg shrimp farming is being interested and developed both in terms of area and intensification, especially in the development of high-tech white-leg shrimp farming [2–3]. With high levels of natural resource usage, probable environmental damage, ominous climatic changes, and wealth inequalities related to production intensification, the key question is whether super-intensive production can be the driver toward shrimp production sustainability [4]. In Vietnam, the Mekong Delta's coastal regions are home to the country's largest aquaculture region. Additionally, one of the coastal provinces, Ben Tre have a

super-intensive shrimp farming area of approximately 2500 hectares by 2022. In order to transform the shrimp business into the province's main source of production, adapt to climate change, and safeguard the biological environment, Ben Tre province is also extending the area of marine shrimp farming with high-technology applications. Ben Tre, however, shares the same problem as many other areas in that the farming environment has been negatively impacted by infectious disease management, spontaneous development, discharge, and improper chemical use in general [5–6]. Furthermore, numerous new technological approaches have been discovered in an effort to address the enormous issues surrounding shrimp effluent and ensure its sustainability, but none could claim to be a comprehensive and integrated approach that takes into account all technical, legal, social, environmental, public health, and institutional concerns [7–10]. Regarding the characteristics of water quality and sediment in the vannamei culture system, there are many studies that have demonstrated that the quality evolution of pollutant parameters discharged from the shrimp farming process tends to increase over time [11–13]. Accordareg to research by [2] in 2010, sediment in shrimp ponds is produced from a variety of sources, including suspended solids from runoff, lime, fertilizers, chemicals, and antibiotics; uneaten food, dead phytoplankton, and molting shrimp shells; solid waste from shrimp production; and inorganic matter is eroded from the pond wall. Additionally, the usage of fertilizers, antibiotics, and pesticides in shrimp ponds can build up in the sediment and the environment. In 2019, in Ben Tre province, a study was conducted on the state of waste management and treatment from intensive white-leg ponds to evaluate the level of pollution, and the efficacy of available technologies, and to recommend treatment options that would be practical and affordable for farmers. Anh currently, the majority of shrimp farms directly discharge wastewater and sludge into the environment after each crop, contaminating the surrounding area and harming the health of the local populace. So, this study continues to evaluate the degree of pollution and the treatment potential of existing technologies, it is required to research the current condition of waste management and treatment from super-intensive white-leg ponds in Ben Tre province. This study is required because the practice that it addresses indicates improvements in shrimp farming performance.

2. Materials and Methods

This study included shrimp household from three districts of Ben Tre province: Binh Dai, Ba Tri, Thanh Phu, as shown in Figure 1.

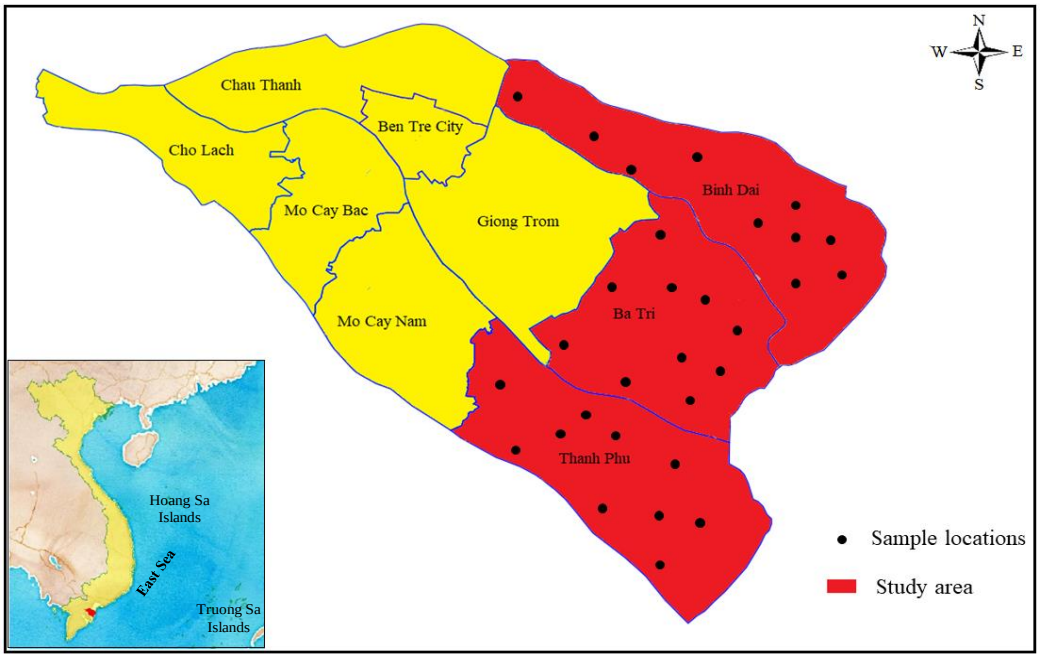

Figure 1. The study area.

The study uses the following methods:

- Method of sociological survey: collect information through 30 questionnaires in three districts of Binh Dai, Ba Tri, and Thanh Phu to determine the area of ponds, farming techniques, the amount of wastewater generated, and the method of production current methods of wastewater management and treatment.

- Statistical method: used to process survey data, from there, determine the mean and standard deviation.

- Data processing: The water quality data were compared among the sampling locations and were also compared with QCVN 02-19:2014/BNNPTNT to assess water quality in farming areas [14].

Wastewater samples were collected in 30 super-intensive shrimp ponds in Binh Dai, Ba Tri, Thanh Phu districts of Ben Tre province. Wastewater samples, after being transported to the laboratory, were analyzed for Temperature, Dissolved Oxygen (DO), pH, Salinity, Ammonia (NH_3), Ammonium (NH_4^+), H_2S, Nitrite (NO_2^-), Phosphate (PO_4^{3-}), Total Suspended Solids (TSS), COD, BOD_5. Wastewater samples were taken and preserved according to the instruction of TCVN 6663-1:2016 and analyzed by specialized methods as shown in Table 1.

Table 1. Methods of analyzing pollution parameters in the wastewater environment of shrimp ponds.

Parameters	Methods
Field	
pH	TCVN 6492:2011
Temperature	SMEWW 2550B:2017
DO	TCVN 7325:2016
Salinity	SMEWW 2520:2012
Laboratory	
TSS	TCVN 6625:2000
COD	SMEWW 5520C:2012
BOD_5	TCVN 6001–1:2008
PO_4^{3-}	TCVN 6202:2008
NO_2^-	TCVN 6178:1996
H_2S	US EPA Method 376.2
NH_3	QCVN 10–MT:2015/BTNMT
NH_4^+	SMEWW 4500–NH_3.B&F:2017

3. Results and discussion

Super-intensive white-leg shrimp farming households use 3 main models in the shrimp farming process as follows:

Model 1: Reservoir Pond → sedimentation pond → Water treatment pond → Prepared Pond → culture pond.

Model 2: Reservoir Pond → sedimentation pond → Water treatment pond → culture pond.

Model 3: Reservoir Pond → sedimentation pond → culture pond.

3.1. Characteristic of shrimp wastewater

From September 2022 to February 2023, a survey was conducted at 30 households that raised white-leg shrimp in three districts of Ben Tre province: Binh Dai, Ba Tri, and Thanh Phu. Based on 10 households in each district, descriptive statistics of the pond, intake, and effluent water quality are presented as mean, standard deviation and derived for the super-intensive white-leg shrimp production characteristics in Ben Tre as shown in Table 2.

Table 2. Statistical analysis of technical parameters of the super-intensive white-leg shrimp farming.

Parameters	Unit	Binh Dai	Ba Tri	Thanh Phu
Pond area	(ha/household)	1.47±1.25	2.45±3.82	1.34±1.37
Pond number	–	9.3±4.69	10.5±11.5	7.6±7.63
Water deep of pond	m	1.53±0.10	1.53±0.48	1.55±0.06
Stocking density	PL/m^2	148±58.08	104±35.96	121±20.79
Production cycle duration	days	110±14.23	113±26.48	101±10.12
Number of employees	–	4±3	2±1	3±3

PL: Post Larvae

According to the study results, Ba Tri district has the greatest shrimp farming area (2.45 ha/household), and there is a significant disparity in size between shrimp farming families. Binh Dai and Thanh Phu districts, however, have shrimp farming areas that are comparable. Since larger areas are sometimes difficult to manage for ponds and water environment factors can easily change in a small area affecting shrimp growth and lowering productivity. Therefore, each shrimp square has an area of between 1 and 5 hectares.

Shrimp seed is stocked at densities ranging from 100 to 200 shrimp per square meter, high or low depending on the technical capabilities and financial resources of each household. According to the study findings, Ba Tri district has a lower stocking density than Binh Dai and Thanh Phu districts. The variables governing water depth, the number of harvest days, and the number of employees tasked with managing ponds are comparable amongst districts.

3.2. The process of raising and managing ponds

The management features of the selected household for the current status of using feed, antibiotics, chemicals and probiotics in super-intensive white-leg shrimp farming in three districts is presented in Table 3.

Table 3. Statistical analysis of using feed, antibiotics, chemicals, and preparations in super-intensive white-leg shrimp farming.

Parameters	Unit	Binh Dai	Ba Tri	Thanh Phu
Feed intake	kg/ha.day	187.82±29.07	134.97±70.73	200.62±127.96
Sterilizer	kg/m^2	0.043±0.00	0.027±0.0	0.027±0.00
Antibiotics	g/kg of feed intake	8.00±0.82	8.9±1.10	7.85±2.19
Vitamin	g/kg of feed intake	12.5±0.0	10±0.0	9.44±0.0
Bioproducts	l/1000m^2	2.9±0.2	2±0.0	1.8±0.3
Water treatment chemicals	kg/1000m^2	1.76±0.25	1.5±0.00	1.6±0.21

The amount of feed largely relies on stocking density and the length of postlarval days. With a high stocking density, the feed fed to the pond each day increases with the postlarvae's age in days. The behaviors and methods used to maintain and manage the ponds are other factors contributing to the variation in feed requirements among shrimp farms. According to the survey results, Binh Dai and Thanh Phu districts have a fairly high average feed intake, the lowest is Ba Tri district. The evolution of water quality, as well as the growth and development of cultured shrimp, are significantly impacted using food, antibiotics, vitamins, and biological products for detoxification and chemicals for disinfection. The survey reveals that among the three districts, the average amounts of sterilizer, vitamins, probiotics, and water treatment chemicals are not considerably different, and the variability is not

significant. Nevertheless, Ba Tri has the highest amount of antibiotics (8.9 g/kg of feed intake), while the stocking density is the least (104±35.96 PL/m^2).

Table 4. Statistical analysis of water use and wastewater generation in super-intensive white-leg shrimp farming.

Parameters	Unit	Binh Dai	Ba Tri	Thanh Phu
Intake water volume	m^3/m^2	3336±2747.54	2055±1347.11	5400±3806.43
Total of effluent volume	m^3/m^2	3386±2785.47	2060±1340.15	5733.43±4327.73

Statistical analysis of water use and wastewater generation in super-intensive white-leg shrimp farming is shown in Table 4. The water intake in shrimp ponds was the highest in Thanh Phu and the smallest in Ba Tri, while the average pond area in Thanh Phu was the smallest (1.34±1.37 ha/household) and the largest in Ba Tri (2.45±3.82 ha/household). In super–intensive culture ponds, excessive feed, and fertilizer use results in a significant nutrient influx into the natural water through the discharge canal. Without a doubt, during the growth cycles, the water exchange rate has a significant impact on the effluent loading [15–17].

3.3. Analysis results of pond wastewater quality

Sampling to analyze wastewater characteristics in Ba Tri district, Binh Dai district, Thanh Phu district gives the following results of water analysis parameters: Temperature, Dissolved Oxygen (DO), pH, Salinity, Ammonia (NH_3–N), Ammonium (NH_4–N), H_2S, Nitrite (NO_2–N), Phosphate (PO_4–P), Total Suspended Solids (TSS), COD, BOD_5.

Table 5 shows the analytical parameters of untreated super-intensive shrimp pond effluent analysis of some households in Ben Tre province. The analysis of untreated wastewater samples from super-intensive shrimp farming households reveals that the COD, BOD_5, H_2S, and NH_3 have mean values that exceeded the standard except for NH_3 in Ba Tri district. Temperature and pH are within normal ranges of the standard. The pH value in the wastewater from the observed, super-intensive shrimp ponds vary with a small amplitude between 7.4 and 7.8. The pH and DO mean values of the super-intensive shrimp pond wastewater are relatively similar to the pH and DO mean value in intensive shrimp ponds in Bac Lieu province [18]. However, salinity, PO_4^{3-}, H_2S, and NH_3 of super-intensive shrimp ponds are greater than those of intensive shrimp ponds in Ben Tre province, with the exception of H_2S in Thanh Phu and Ba Tri districts and NH_3 in Thanh Phu District. The mean NH_4^+ values of this study are greater, with the exception of Ba Tri district, than the effluent of super-intensive shrimp farms in Bac Lieu, which has NH_4^+ ranges between 0.016 to 1.246 mg/l [19]. Additionally, the concentration of COD and BOD_5 in this study area is significantly higher than that of the hyper-intensive shrimp ponds in Bac Lieu, where COD concentrations range from 4.43 to 55 19 mg/l and BOD_5 concentrations from 10.21 to 90.12 mg/l. Probably, due to humus buildup, excessive manure, excess food, and other factors, water contains a large number of organic materials. Moreover, the amount of fertilizer given to various ponds determines the variation in COD and BOD_5 concentration in shrimp pond water, which contributes to the wide fluctuation range of COD and BOD concentrations in this research area.

Table 5. Analysis results of untreated super-intensive shrimp pond effluent in Ben Tre province.

Parameters	Unit	Binh Dai	Thanh Phu	Ba Tri	Intensive shrimp pond*	QCVN 02–19: 2014/BNNPTNT
pH	–	7.5±0.19	7.8±0.64	7.4±0.11	7.72 ± 0.34	5.5–9
Temperature	°C	28.±0.71	27.7±0.5	26.3±0.5	–	18–33

Parameters	Unit	Binh Dai	Thanh Phu	Ba Tri	Intensive shrimp pond*	QCVN 02–19: 2014/BNNPTNT
DO	mg/l	5.7±0.6	6.5±0.6	5.8±0.5	5.44 ± 0.7	–
Salinity	‰	10.7±0.5	12.3±2.0	10.33±0.5	12.7 ± 4.2	–
TSS	mg/l	58.3±24.74	36.6±12.5	40.3±10.5	74.4 ± 53.2	<100
COD	mg/l	1625.9±337.83	2054.6±448.2	1773.2±138.4	183 ± 4.8	<150
BOD_5	mg/l	657.4±142.06	757.3±154.7	665.9±52.3	74.7 ± 19.7	<50
PO_4^{3-}	mg/l	0.1±0.13	0.1±0.1	0.1±0.0	0.2 ± 0.3	–
NO_2^-	mg/l	0.03±0.03	0.39±0.59	0.01±0.00	–	–
H_2S	mg/l	0.38±0.08	0.21±0.14	0.24±0.17	0.198 ± 0.03	< 0.05
NH_3	mg/l	1.19±0.88	2.24±2.43	0.30±0.15	1.95 ± 1.4	< 0.3
NH_4^+	mg/l	1.26±0.90	2.36±2.50	0.32±0.16	–	–

*: Characteristics of effluent from intensive shrimp ponds of 30 households in 3 districts were sampled and analyzed

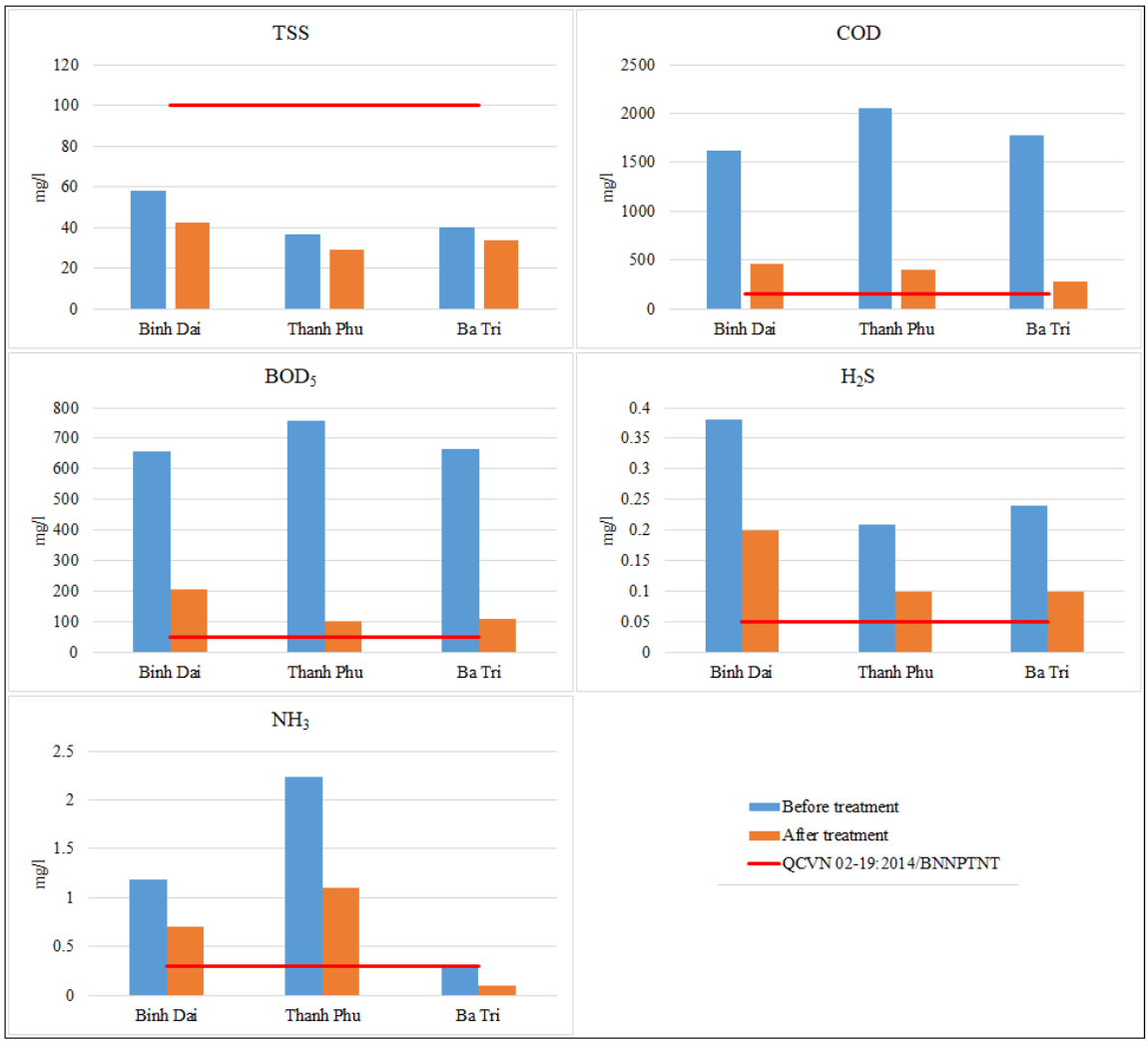

Figure 2. TSS, COD, BOD_5, H_2S, NH_3 concentrations in three districts before and after treatment.

The analysis result of treated super-intensive shrimp pond effluent in Ben Tre province is shown in Table 6. Based on the findings, it can be concluded that the mean pH, temperature, and salinity of treated super-intensive shrimp pond effluent are comparatively similar to those of untreated super-intensive shrimp pond effluent. The remaining analytical parameters with the exception of DO are significantly lower in treated super-intensive shrimp pond effluent than in untreated super-intensive shrimp pond effluent. Except for H_2S in Binh Dai district, the mean pH, temperature, and H_2S values are less than those of the treated intensive shrimp pond in Ben Tre. However, compared to intensive shrimp pond effluent, the DO, salinity, and NH_3 values are higher.

Table 6. Analysis results of treated super-intensive shrimp pond effluent in Ben Tre province.

Parameters	Unit	Binh Dai	Thanh Phu	Ba Tri	Intensive shrimp pond*	QCVN 02–19: 2014/BNNPTNT
pH	–	7.5±0.21	7.8±0.69	7.4±0.09	8.5	5.5–9
Temperature	ºC	28±0.71	27.7±0.5	26.3±0.5	32	18–33
DO	mg/l	6.4±0.22	7.±0.45	6.5±0.18	6.4	–
Salinity	%o	10.7±0.5	12.3±2	10.3±0.5	7	–
TSS	mg/l	42.2±16.9	29.1±13.8	33.7±9.8	–	<100
COD	mg/l	463±157.3	397.6±38.7	284.6±26.2	–	<150
BOD_5	mg/l	205.3±67.5	100.9±7.8	110.7±22.5	–	<50
PO_4^{3-}	mg/l	0.1±0.06	0.03±0.03	0.01±0.01	–	–
NO_2–	mg/l	0.01±0.02	0.1±0.06	0.0003±0.001	–	–
H_2S	mg/l	0.2±0.04	0.1±0.01	0.1±0.05	0.2	< 0.05
NH_3	mg/l	0.7±0.6	1.1±1.1	0.1±0.1	0.46	< 0.3
NH_4^+	mg/l	0.8±0.64	1.1±1.12	0.1±0.1	–	–

*: The water quality after 30 days of settling of a shrimp farming household in Thanh Phu district, Ben Tre.

Figure 2 illustrates that the concentration of COD and BOD in treated wastewater declined the most, whereas the concentration of TSS in the shrimp pond did not vary much between before and after treatment. In addition, the concentration of H_2S and NH_3 in treated wastewater was reduced by half. However, the quantities of COD, BOD_5, H_2S, and NH_3 in treated ponds remained higher than the standard of QCVN 02-19:2014/BNNPTNT, although having dropped in comparison to untreated ponds.

4. Conclusions

The average water surface area per household for the super-intensive white-leg shrimp ponds in the three districts of Binh Dai, Ba Tri, and Thanh Phu in the province of Ben Tre is 1.34–2.45 ha, with a water depth of 1.53–1.55 m. According to the three main methods of shrimp farming, shrimp pond wastewater is typically stored in a settling pond after each crop, with 100% of the wastewater being treated by settling ponds. Some facilities will also keep processing shrimp pond wastewater using treatment ponds. The parameters of H_2S, NH_3, BOD_5, and COD remain exceed the permitted limits for the pond, despite the fact that the quality of shrimp pond wastewater after treatment is better than the quality of shrimp pond wastewater before treatment.

Wastewater treatment is therefore necessary to recycle, reuse, or discharge waste into the canal. In comparison to the criteria for surface water quality [20] and marine water quality [21], PO_4^{3-}, NO_2^-, and NH_4^+ must be treated to minimize their concentrations in order to ensure the survival of aquatic animal life. To support the sustainable development of the fishing industry, it is important to create a high-tech shrimp farming model that is both ecologically beneficial and associated with financial gains.

Author Contribution: Conceptualization: D.H.P.; methodology: D.H.P.; Processing of data: D.H.P.; Construction of maps: D.H.P.; Analysis of results: D.H.P.; writing–original draft preparation: D.H.P.; writing–review and editing: D.H.P.

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Conflicts of Interest: This manuscript is the research work of the collective author, not published anywhere, not copied from previous studies.

References

1. Truong, H.N.; Le, T.C.; Pham, T.T. Price transmission in shrimp production in Vietnam. *IOP Conf. Ser. Earth Environ. Sci.* **2023**, *1155(1)*, 012028. Doi:10.1088/1755-1315/1155/1/012028.
2. Ngoc, P.T.A.; Le, V.; Pham, T.T.; Pham, H.C.; Le, T.C.; Lansink, A.O. Technical and scale efficiency of intensive white-leg shrimp (Litopenaeus vannamei) farming in Vietnam: A data envelopment analysis. *Aquac. Econ. Manag.* **2023**, *27(1)*, 50–65. Doi:10.1080/13657305.2021.2003483.
3. Thakur, K.; Patanasatienkul, T.; Laurin, E.; Vanderstichel, R.; Corsin, F.; Hammell, L. Production characteristics of intensive whiteleg shrimp (Litopenaeus vannamei) farming in four Vietnam Provinces. *Aquac. Res.* **2018**, *49(8)*, 2625–2632. Doi:10.1111/are.13720.
4. Nguyen, T.A.T.; Nguyen, K.A.T.; Jolly, C. Is super-intensification the solution to shrimp production and export sustainability?. *Sustainability* **2019**, *11(19)*, 1–22. Doi:10.3390/su11195277.
5. Phu, T.M.; Vinh, P.Q.; Dao, N.L.A.; Viet, L.Q.; Thinh, N.Q. Chemical use in intensive white-leg shrimp aquaculture in Ben Tre province, Vietnam. *Int. J. Sci. Res. Publ.* **2019**, *9(8)*, 92112. Doi:10.29322/ijsrp.9.08.2019.p92112.
6. Nguyen, T.C.; Phan, D.N.; Nguyen Thi, H.D.; Nguyen Ngoc, K.N.; Dang Ngo, Y.L. Water Quality Status of White Leg Shrimp Farming Areas in Binh Dai District, Ben Tre Province, Vietnam. *Tra Vinh Univ. J. Sci.* **2022**, *1(46)*, 94–103. Doi:10.35382/tvujs.1.46.2022.866.
7. Iber, B.T.; Kasan, N.A. Recent advances in Shrimp aquaculture wastewater management. *Heliyon* **2021**, *7(11)*, e0828. Doi:10.1016/j.heliyon.2021.e08283.
8. Chellapandi, P. Development of top-dressing automation technology for sustainable shrimp aquaculture in India. *Discov. Sustain.* **2021**, *2*, 26. Doi:10.1007/s43621-021-00036-9.
9. McIntosh, R. Advancing Shrimp Farm Technologies Support Greater Efficiencies, Sustainability. *Glob. Aquac. Advocate* **2008**, 88–90.
10. Beltrán-Lugo, L.; de León, F.I.D.; Peinado-Guevara, V.; Peinado-Guevara, H.; Herrera-Barrientos, J.; Cuadras-Berrelleza, A.A.; Montoya-Leyva, M.A. Sustainable Innovation Management in the Shrimp Sector of the Municipality of Guasave, State of Sinaloa, Mexico. *Sustainability* **2023**, *15(4)*, 3161. Doi:10.3390/su15043161.
11. Umamaheswari, T.; Rajakumar, M.; Senthiladeban, R.; Felix, N.; Athithan, S.; Sugumar, G. Value chain approaches in farmed white leg shrimp Penaeus vannamei in Nagapattinam district of Tamil Nadu. *J. Entomol. Zool. Stud.* **2018**, *6(5)*, 2071–2077.
12. Mateka, H.A.; Tamatamah, R.; Kyewalyanga, M. Study on the Water Quality Parameters in Semi-Intensive Coastal Shrimp Culture System in Mafia Island, Tanzania. *J. Environ. Earth Sci.* **2015**, *5(1)*, 142–151.
13. Barraza-Guardado, R.H.; Arreola-Lizárraga, J.A.; López-Torres, M.A.; Casillas-Hernández, R.; Miranda-Baeza, A.; Magallón-Barrajas, F.; Ibarra-Gámez, C. Effluents of shrimp farms and its influence on the coastal ecosystems of bahía de Kino, Mexico. *Sci. World J.* 2013, 2013. Doi:10.1155/2013/306370.

14. MONRE. National technical regulation on backish water shrimp culture farm-Conditions for veterinary hygiene environmental protection and food safety, 2014.
15. Hopkins, J.; Hamilton, R.; Sandifer, P.; Browdy, C.; Stokes, A. Effect of Water Exchange Rate on Production, Water Quality, Effluent Characteristics and Nitrogen Budgets of Intensive Shrimp Ponds. *J. World Aquac. Soc.* **2007**, *24*, 304–320. Doi:10.1111/j.1749-7345.1993.tb00162.x.
16. Boopathy, R.; Lyles, C. Shrimp Production and Biological Treatment of Shrimp Wastewater in the United States. *New Horizons Biotechnol.* **2008**, 235–252.
17. Makmur, Taukhid, I.; Tampangallo, B.R.; Asaad, A.I.J.; Rachmansyah. Application of sludge collector in super-intensive Vannamei shrimp farms. *IOP Conf. Ser. Earth Environ. Sci.* **2021**, 919, 012059. Doi:10.1088/1755-1315/919/1/012059.
18. Trang, D.T.D.; Tram, H.T.B.; Ton, T.L. An assessment of the province of Ben Tre's wastewater management and treatment practices related to the extensive white shrimp (Litopenaeus vannamei) ponds. *Resoures Environ. J.* **2020**, 1–3.
19. Giao, N.T.; Nhien, H.T.H.; Anh, P.K.; Thuptimdang, P. Groundwater quality assessment for drinking purposes: a case study in the Mekong Delta, Vietnam. *Sci. Rep.* **2023**, *13*, 4380. Doi:10.1038/s41598-023-31621-9.
20. MONRE. National technical regulation on surface water quality. 2015, pp. 13.
21. MONRE. National technical regulation on marine water quality. 2015.