Reality Awareness and Behaviors of Farmer in the Northern Coastal Area in Current Aquaculture

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Abstract:
The survey was carried out on 200 farmers in the coastal areas of Nam Dinh and Quang Ninh with the method of questionnaires and in-depth interviews. Research results show that the majority of people appreciate the importance of some conditions in aquaculture. However, they are not fully aware of the State's regulations for aquaculture activities. In fact, people can only partially comply with the regulations in aquaculture. In some aspects, there is no match between awareness and behavior of farmers in aquaculture
Key words: *Farmers; awareness; behavior; aquaculture.*

1. Introduction

Aquaculture is a production activity based on a combination of available natural resources (sea surface, rivers, ponds, lakes, lowland, lagoons, climate) with aquatic organisms (fish, shrimp, and other seafood) with direct human involvement. In Vietnam, aquaculture includes freshwater, brackish, and saltwater seafood species with the primary forms of aquaculture consisting of (i) intensive farming or semi-intensive farming methods, extensive farming or improved extensive farming methods; (ii) sea cage aquaculture; (iii) krill fishery farming; (iv) aquaculture in ponds and lakes; (v) aquaculture in lowland or rice fields.

The coastal area plays an important role in the socio-economic development of the country. Due to it has rare resources that bring high economic value. The coastal zone provides resources for human activities and plays a role in conditioning the natural and artificial environment. Humans use resources for life (water and food), economic activities (exploitation space, biotic and abiotic resources), and rest or recreation needs (beach, coral reef). Under the pressure of rapid population growth, the demand for economic development increases in the background the depletion of land resources. Hence, people tend to go to the sea, exploit the ocean, get rich from the sea, leading to many threats to the sea. If the coastal population increases rapidly, overdevelopment of coastal economic activities, exploitation of marine resources is unsustainable, and exploitation activities focus on economic development goals to achieve maximum benefit, it will harm the environment.

The North Coast includes four provinces and one coastal city in the North of Vietnam. They are Quang Ninh, Hai Phong, Thai Binh, Nam Dinh and Ninh Binh provinces. The zone has rich and diverse coastal resources. It is consistent with the development of important economics as sea transportation, ports, tourism, industry, agriculture, forestry, and fishery. The North Coast with a dense population, rapid urbanization, and snappy infrastructure development, leading to increased pressure on natural resources and the environment. The knowledge of farmers about the provisions of the law in aquaculture activities; farmers' awareness of their responsibilities in protecting natural resources; farmers' awareness about the importance of condition factors in aquaculture. Based on their knowledge, farmers will form attitudes and behaviors consistent with their thoughts and needs in aquaculture.

In the background of implementing the strategy for sustainable development of Vietnam's marine economy according to Resolution No. 36 of the Eighth Conference of the 12th Central Committee. How are farmers on the North coast knowledgeable of the legal provisions in aquaculture activities? How are farmers aware of the importance of condition factors in aquaculture? How are farmers aware of their responsibilities in protecting natural resources? In terms of behavior, Are the farmers following the production regulations? These are the questions we want to answer in the article.

2. Methodology

2.1. Participants

The investigation data collects through 200 questionnaires surveyed by farmers living in coastal communes of Quang Ninh and Nam Dinh provinces. Of the 200 farmers participating in the survey, there are 145 aquaculture farmers and 59 non-aquaculture farmers. The results show that the prominent characteristics of farmers are male, accounting for 65.2%, and 34.8% were female. The education level of farmers is low, in which 33% of farmers have a second degree, 27.6% of farmers have a high school diploma, college or higher accounts for 20.2%, and 19.2% of farmers have a primary degree.

2.2. Methodology

The study uses a questionnaires survey method and in-depth interviews. Questionnaire on farmers' knowledge and behavior in aquaculture based on several criteria in the Law on Fisheries (2017) and Decree 26/2019/ND-CP on conditions for aquaculture. Regulations and conditions for aquaculture, we use a scale of 11 items, which are the criteria for conditions for aquaculture in ponds and lagoons; technical conditions, food safety, and hygiene, environmental protection. Each item has three answer options including (i) don't understand/ unnecessary/ unfulfilled (one point); (ii) a little bit of understanding/ less necessary/ fulfil a little (two points); understand/ necessary/ well done (three points). The average score of the scale is calculated based on the average score of the items. With the raw data analysis, for the scale of farmers' knowledge about regulations and conditions for aquaculture, understanding of the importance of condition factors in aquaculture, farmers' assessment of the implementation of regulations in aquaculture activities. The higher the farmers' rating, the clearer their awareness and behavior. The result of the reliability test of the scale indicates that Cronbach's Alpha value is 0.7.

The questions related to the responsibility of farmers in the protection of coastal natural resources are designed in the form of closed questions with two answers "Yes" or "No." Respondents will tick the option consistent for themselves and their families.

The survey in October 2020. Survey data were processed using SPSS statistical software. The statistical methods used include frequency, Spearman correlation.

3. Findings and discussion

3.1. Farmers' knowledge about regulations and conditions for aquaculture and their responsibilities for the protection of coastal natural resources

3.1.1. The farmers' knowledge about regulations and conditions for aquaculture

Table 1: The results of the farmer's knowledge about regulations and conditions for aquaculture

Regulations	The level of knowledge about regulations			Mean	Std. Deviation
	1	2	3		
1. Regulations on aquaculture sites, pond, and lagoon conditions for aquaculture.	21.3	47.2	31.5	2.10	0.624
2. Conditions of water quality in aquaculture.	25.3	43.7	31.0	2.06	0.653
3. Regulations on infrastructure at aquaculture sites.	24.1	34.5	41.4	2.17	0.695
4. Regulations on food, drugs, products for environmental treatment and improvement.	13.5	34.8	51.7	2.38	0.615
5. Regulations on aquatic animal breeds.	11.2	44.9	43.8	2.33	0.670
6. Regulations on diets for aquatic animal.	13.6	37.5	48.9	2.35	0.612
7. Regulations on water and waste treatment.	12.4	44.9	42.7	2.30	0.642
8. Record and keep dossier.	14.8	44.3	40.9	2.26	0.681
9. Safe aquaculture process.	9.0	43.8	47.2	2.38	0.603
10. List of banned chemicals and antibiotics.	17.0	43.2	39.8	2.23	0.649
11. Regulations on farming practices of VietGap.	31.8	48.9	19.3	1.88	0.623
The average score				**2.23**	**0.535**

Note: Answer options: 1. Do not understand 2. A little bit of understanding 3. Understand

The results show that farmers' knowledge of the legal provisions for aquaculture is inadequate (2.23 points/ 3 points). Farmers have a relatively complete understanding of several regulations includes regulations on food, drugs for the aquatic animal; safe aquaculture process (mean = 2.38 points) with about of the respondents understanding (51.7%), 34.8% of them are a little bit of understanding and don't understand accounts for 13.5%. Regulations on diets for the aquatic animal (mean = 2.35 points with 48.9% understanding, 37.5% a little bit of understanding, and 13.6% don't understand). Regulations on aquatic animal breeds (mean = 2.33 points with 43.8% understanding, 44.9% a little bit of understanding, and 11.2% don't understand). Many farmers only have a little bit of understanding of regulations essential for aquaculture. They include use food, diets for the aquatic animal, aquatic animal breeds, and safe aquaculture.

For the regulations on the list of banned chemicals and antibiotics or record and keep dossier. The results indicate that many farmers only understand at a relative level (mean = 2.23 points and 2.26 points). The percentage of farmers who a little bit of understanding and don't understand more than the percentage of farmers who understand those regulations (about 40% of the respondents understand, 44% of them are don't understand and a little bit of understanding).

The regulations which farmers are a little bit of understanding include (i) regulations on conditions of water quality in aquaculture, (ii) regulations on aquaculture sites, pond and lagoon conditions for aquaculture, (iii) regulations on infrastructure at aquaculture sites (with a mean score from 2.06 points to 2.17 points). That is one of the significant issues in aquaculture but only about a quarter of farmers understand these issues. In addition, many farmers do not understand the regulations on aquaculture sites, water quality conditions in aquaculture, regulations on aquaculture infrastructure (from 20% to 25%).

For the regulations on farming practices of VietGap, the result shows that few farmers care about it (mean = 1.88 points). About one-third of respondents don't know anything about this issue, accounting for about 31.8%; half of them know a little about aquaculture applying VietGap (48.6%), and only 19.3% of farmers know about aquaculture applying the VietGap. Farmers in the survey sites mostly do small-scale aquaculture, and almost no one practices aquaculture applying VietGap. The VietGap standards apply only in large aquaculture enterprises in the are. Farmers are not interested in VietGap standards because their products can well sell, and the prices meet their needs. "*I have heard about the VietGap standards, but I don't think it is necessary to apply it. Because my products are well sold, supply is not enough for demand, and prices are good, so VietGap is not necessary."* (PVS, male, 38 years old, Hai Hau district, Nam Dinh province). Hence, aquaculture applying VietGap standards has not received much attention from farmers because of the current aquaculture method farmers can sell goods and ensure their income.

Farmers are directly involved in aquaculture activities, but many farmers are not fully knowledgeable of the State's regulations on conditions for aquaculture. Many farmers are a little bit of understanding or don't understand. The results show that farmers are not interested in rules on safe conditions for aquaculture. Most of them only produce based on experience and self-study. Updating the legal regulations in aquaculture in general, the provisions on aquaculture practice applying VietGap standards are not interested in farmers. These issues harm sustainable aquaculture in the North Coast.

3.2.2. The farmers' knowledge about their responsibilities for the protection of coastal natural resources

The farmers' knowledge about the need to comply with the instructions or regulations of the State agencies in exploiting local coastal natural resources, the survey results show that most of the people agree that "Necessary" (86.7%). Besides, only a few percentages said "Less necessary" (2.1%) and "Not necessary" (5.6%). That shows the correct perception of most farmers in the survey area.

Thus, the farmers' knowledge about their responsibilities and local authorities in protecting coastal natural resources is quite good. The farmers participating in the survey were aware of the role of themselves and the coastal people in exploiting and using coastal natural resources to serve economic development and improve the living standards of their families, management, and protection of natural resources.

The results show that not many farmers in the North Coast have full knowledge of regulations and conditions for aquaculture. Farmers are not interested in the rules on aquaculture practice applying Vietgap standards. Most farmers have a relatively good awareness of their responsibility for the protection of coastal natural resources.

3.2. The farmers' knowledge of the importance of condition factors in aquaculture

Table 2: The results of the farmers' knowledge of the importance of condition factors in aquaculture

Regulations	The level of knowledge about condition factors			Mean	Std. Deviation
	1	2	3		
1. The aquaculture ponds meet the standards.	2.8	29.8	67.4	2.65	0.536
2. Manage aquaculture water to meet standards.	2.8	18.2	79.0	2.76	0.489
3. Manage the origin of aquatic breeds and stock them according to the technique.	2.1	14.6	83.3	2.81	0.442
4. Food for aquatic animals is standard.	4.5	14.1	81.1	2.76	0.532
5. Manage food safety conditions.	1.4	13.3	85.3	2.84	0.405
6. Environmental safety conditions for aquaculture comply with regulations.	4.2	12.7	83.1	2.79	0.503
7. Manage the use of drugs and chemicals to clean ponds comply with regulations.	1.4	13.3	85.3	2.80	0.436
8. Assess the level and risk of pollution of the pond.	9.8	20.3	69.9	1.76	0.662
9. Management of pond discharge process.	43.7	36.6	19.7	2.72	0.523
10. Technical management of aquaculture.	4.2	19.7	76.1	2.78	0.485
11. Participating in safe, clean and organic aquaculture is necessary.	2.1	18.2	79.7	1.72	0.561
The average score				**2.52**	**0.462**

Note: Answer option: 1. Unnecessary 2. Less necessary 3. Necessary

The survey results show that farmers are significantly aware of the importance and necessity of most issues and conditions for aquaculture activities (with mean = 2.52 points).

Issues that farmers appreciate include (i) managing the origin of aquatic breeds, (ii) managing the use of drugs and chemicals to clean ponds, (iii) managing food safety conditions (mean score from 2.8 points to 2.84 points) with about 83% to 85% of farmers saying these issues are necessary. These are significant issues in aquaculture. The results obtained show that many people are aware of the importance of these issues. However, according to the results obtained, many people are not fully knowledgeable of the importance of these issues (about 13%). An in-depth interview with an aquaculture farmer (male, 50 years old) argues that *"For aquaculture, it is necessary and important to have a wastewater treatment system before being discharged into the environment to protect the environment. In fact, in our locality in the planning areas, the drainage canal and the water intake channel are shared common roads. Hence, it is difficult to avoid pollution of the culture water environment. We have to use chemicals to clean the ponds, to prevent the risk of diseases for aquatic animals."*

Many people do not appreciate the importance and necessity of safe aquaculture (mean = 1.72 points). Due to farmers' products made by the old method, they can sell, so the conversion to another form of aquaculture production does not receive the interest in the farmer.

3.3. Realistic behavior in aquaculture of coastal farmers

3.3.1. Farmers' assessment of the implementation of regulations for aquaculture activities

Table 3: Farmers' assessment of the implementation of regulations for aquaculture activities (%)

Levels / Regulations	Well done	Partly done	Undone	Mean	Std. Deviation
1. Aquaculture site, area, and conditions of ponds, lagoons, and rafts for aquaculture under regulations.	40.3	49.3	10.4	2.30	0.649
2. Ensure water source in aquaculture according to regulations.	35.5	54.3	10.1	2.25	0.629
3. Management of aquatic breeds origin and stocking techniques.	38.4	47.8	13.8	2.25	0.681
4. Manage food for aquatic animals under the technique.	49.6	37.8	12.6	2.37	0.699
5. Comply with food safety regulations.	44.9	47.8	7.4	2.38	0.620
6. Conditions on environmental safety for aquaculture under regulations.	37.1	52.3	10.6	2.27	0.640
7. Manage aquatic animal health, manage the use of antibiotics for livestock.	36.1	48.9	15.0	2.21	0.686
8. Assess the level and risk of pollution of the pond.	23.1	48.5	28.4	1.95	0.718
9. Implement the process of discharging waste from the	27.5	47.3	25.2	2.02	0.728

pond to ensure environmental sanitation.					
10. Technical management of aquaculture.	39.7	50.0	10.3	2.29	0.645
11. Management when an epidemic occurs.	48.5	44.7	6.8	2.42	0.618
The average score				**2.24**	**0.471**

Source: Authors' analysis

The survey results show that the implementation of rules in aquaculture is only partly done (mean = 2.24 points).

According to the results obtained, the management of food for aquatic animals under regulations is well done (mean = 2.38 points with 49.6% of farmers are well done). Managing when an epidemic occurs (mean = 2.42 points with 48.5% of them are well done); Comply with food safety regulations (mean = 2.38 points with 44.9% of farmers are well done). Other farmers have only partly done and undone with the rules.

According to the farmers participating in the survey, two issues of poor implementation include assessing the pollution level of the pond and implementing the pond discharge process to ensure compliance with regulations (mean = 1.95 points and 2.02 points). For the assessment of the pollution level of the pond, only 23.1% of the farmers are well done, 48.5% of them are partly done, and undone accounts for 28.4%. Besides, for implementing the pond discharge process with 47.3% of farmers are partly done, 25.2% of them are undone, and well-done accounts for 27.5%.

- *For regulations on aquaculture sites, areas, and conditions of ponds, lagoons, and rafts:* farmers perform to a limited extent. Only less than half of the respondents think that they are well-done (40%), of which 59.7% are only partly done or undone. The empirical investigation shows that aquaculture lacks planning or farmers do not comply with regulations on cropping, stocking density, disease control, wastewater treatment, or profit target production. They will tend to use the maximum area for farming. But there is no area for settling ponds to treat wastewater before discharging it into the environment. Farmers who want to increase production but do not care about waste treatment have seriously polluted the aquaculture environment, especially in intensive shrimp farming.

For the use of materials in aquaculture: the survey in aquaculture areas of the Van Don district, Quang Ninh province shows that most of the materials used in marine aquaculture are use foam floats, and some non-originated floats, selling floating in the market. The use of styrofoam for aquaculture in the province tends to increase due to cheap and easy-to-buy materials. The Quang Ninh province has about 10 million foam floats used in aquaculture. According to experts in the agricultural industry, foam floats have good buoyancy, but the average life of foam floats is from 2 to 3 years. If the impact of stormy weather will damage, drift in the sea, it is difficult to collect, polluting the water environment and affecting the ecosystem. In 2020, the total aquaculture area in Quang Ninh province about 21,303 hectares, of which over 5,488 hectares (sea fish farming about 1,400 hectares; mollusk farming about 4,000 hectares) area of foam buoys used for aquaculture. About 2,500 aquaculture facilities are using more than 10 million foam floats. Of the more 5,488 hectares of aquaculture, there are more than 2,575 hectares of foam-pond aquaculture areas outside the planning (approximately 1/2 of the area aquaculture). The delay in the planning of concentrated aquaculture areas and the allocation of water surface leasing is causing many difficulties for the roadmap to replace foam floats with friendly floating materials, ensuring standards in some localities.

In the Van Don district, the total area of aquaculture is using more than 4,250 hectares, with 1,392 organizations and individuals participating. In which, more than 1,000 facilities are using more than 9 million foam floats for farming. However, only 436 facilities or households are assigned to rent out the water surface. The Van Don district has 1,696 hectares of aquaculture area with foam floats outside the planning. The Quang Ninh province has about 1 hectare (over 50 aquaculture facilities) invested in more than 100 cages using cages made of HDPE pipes, concentrated in Van Don, Dam Ha, and Cam Pha districts (Department of Agriculture and Rural Development of Quang Ninh province, 2020). It is an environmentally friendly material, more than 10 years old, capable of withstanding shocks and waves. In addition, aquaculture facilities and households have invested 64,197 reusable plastic drums as floats for fish farming, cages, and oyster rafts with higher durability than foam to minimize the impact on the sea. However, the transition to replace floating materials in aquaculture or materials recognized by state agencies is slow.

Many aquaculture households in the Van Don district think that they have a habit of using foam floats in aquaculture, so they are afraid to convert and use suitable materials to make floats, meeting the

requirements of regulations. In addition, from 2020 to now, the impact of the COVID-19 epidemic has caused a sharp decrease in seafood consumption (mainly oysters). Due to China temporarily suspending the import of commodity products, the income of aquaculture households has decreased. Meanwhile, the cost of installing HDPE plastic material is 1.5 times higher than that of foam buoys, so many households lack funds to convert. Hence, the Quang Ninh province needs a mechanism to support them because the cost is high. In the case of a cage with an area of about 9 square meters, if using foam material, the cost is from seven to eight million VND. If using HDPE material, the cost is up to twenty million VND. The Department of Agriculture and Rural Development of Quang Ninh province pushes the connection between manufacturers and suppliers of regulated floating materials with the locality to provide the list, types, materials, and prices to information for people to grasp and choose investment for production.

- *For the use of water sources in aquaculture*: the survey results show that only 35.5% of them are well-done, the other people are partly done or undone. 85% of the farmers participating in the survey said that farmers' use of water sources for aquaculture was contaminated. Many aquaculture households have to take water from the sea into the pond for treatment to ensure that the water source is less polluted.

- *For the assessment of the level and risk of pollution of the pond*: the survey results indicate that only businesses and a few households are well-done (23.1%). The other farmers are only partly done or undone. The results show that the percentage of households who regularly, sometimes, and never evaluate the pollution level is the same (about 33.3%). Thus, assessing the pollution level of aquaculture ponds has not been caring to the people.

- *For the discharge of wastewater from aquaculture ponds and lagoons into canals*: about one-five of surveyed households regularly discharge wastewater directly into the environment, and households sometimes discharge quite a lot (41.6%). That shows the limitations in the waste discharge process of farmers in aquaculture.

The results indicate that only about a quarter of aquaculture households use wastewater treatment systems (25.8%), the other farmers don't use wastewater treatment systems but discharge directly into the environment (74.2%). They don't use the wastewater treatment system is because of their small farming scale, and they don't have enough financial resources. Recently, aquaculture in Nam Dinh and Quang Ninh provinces has developed stably, transformed from extensive farming to intensive, semi-intensive, industrial adopt on a large scale, and the technical level of farmers and the level of intensive farming are increasing. Besides the positive side, it has led to difficulties that need to hand to ensure sustainable development. Due to the rapid expansion of the area, while the infrastructure doesn't meet, farmers' knowledge of the use of chemicals, antibiotics, and pond management is not good, leading to a polluted water environment, risk of disease outbreaks. The concentrated shrimp farming areas at the survey site do not have their water supply and drainage systems. It is one of the factors that put pressure on the environment. Our survey results are consistent with the research results of Le Thi Thanh Thuy et al. (2017) in the study about *"Situations of water quality in shrimp farming in coastal areas of Nam Dinh and Quang Ninh province."* The study showed that the current status of shrimp farming water in Quang Ninh and Nam Dinh provinces are organic pollution such as P, K, DO, NH$, TSS, and Coliform. Especially in wastewater after farming, the content of indicators is high. According to the research results, most of the shrimp farming areas do not have a separate water supply and drainage system planning, the water supplied to the aquaculture area is shared with the irrigation system for agricultural production. On the other hand, the wastewater after farming does not handle and discharged into the canal system in the area, making the water quality in the shrimp farming area polluted mainly organic pollution. In addition, the linkage between farming households in the area is not close, especially the awareness of responsibility in disease treatment is limited, leading to the spread of diseases to farmed shrimp [1].

- *For the use of the breed in aquaculture*: Although most respondents (95.8%) are aware of the importance of knowing the origin of the breed, only a few aquaculturists understand the breed origin they are using (34%), the other people are a little bit of knowledge, and about one-five of them don't know the breed origin they buy. The results show that 42.7% of respondents argue that they choose the breed from reputable facilities; 31.5% buy from acquaintances; 29.4% buy from shops in the village. The supply of them with spontaneous, so the origin of the breed used in aquaculture in the surveyed localities is not guaranteed.

Some aquatic breeds cannot be produced domestically and must import from China. Due to the impact of the COVID-19 pandemic, which has interrupted and cannot be imported, such as grouper fish, sea bass, persimmon, etc. So, the farming season has slowed down. The production of mollusk breeds faced many difficulties in importing and selecting quality clams or oysters. Hence, it makes the quality of the breed produced not guaranteed to supply to farmers.

The primary livestock with high economic value is white leg shrimp. Nam Dinh and Quang Ninh provinces have not actively produced seeds on the spot. The source of shrimp breed is mainly from the southern localities. Hence, the quality of shrimp breed is difficult to control, the cost and loss rate during the transportation is high. So, the Departments of Agriculture and Rural Development of Nam Dinh and Quang Ninh provinces with relevant sectors to implement support programs to create conditions for breeders to upgrade their technical infrastructure and receive new technologies for production to meet the demand for stocking, especially for mainstay breeds.

- *For the use of chemicals to clean aquaculture ponds and lagoons*: households use a lot (31.5% of them are usually, and 38.6% of farmers are sometimes). To rapidly increase fishery production, most farmers are adopting the intensive farming model. However, with this form of farming, livestock is much affected by the environment and diseases, causing mass death. Bacteria causing disease in aquatic animals. To solve this situation, farmers choose to use antibiotics and biological products to improve the farming environment. The higher the level of farming, the more drugs and chemicals are used. However, in many cases, farmers use chemicals to improve the environment, but they are not technically correct, so they are not as effective as expected. The use of chemicals and antibiotics in aquaculture can cause many serious problems such as toxicity, altering the microbiome of consumers, or making consumers resistant to drugs.

3.3.2. The correlation between knowledge and realistic behavior of farmers in aquaculture

The results of the correlation analysis show that the knowledge is correlated with the realistic behavior in aquaculture of farmers in several specific issues in the direction of the more knowledge about the importance of complying with regulations in aquaculture, the better the farmers will follow these regulations. However, in each specific issue, the strength of the correlation between knowledge and realistic behavior is different.

For aquaculture sites, conditions for placing cages, rafts, area, and depth of ponds ($r = 0.189$, $p < 0.05$): the better the knowledge, the more ensure the behavior. Although the correlation is weak, among those who understand the regulations on aquaculture sites, pond conditions, and aquaculture rafts (31.5%), a large number of these people think that they have well-done the rules on aquaculture sites, the requests of ponds, lagoons, and rafts for aquaculture are under regulations.

For the knowledge about food and products for treatment, environmental improvement in aquaculture link with the behavior ($r = 0.276$, $p < 0.05$). It means, the better knowledge people have about food and products to treat and improve the environment in aquaculture, the better the behavior will be.

For the knowledge, the origin of breed stock and stocking techniques related to the behavior of using breeding stock ($r = 0.532$, $p < 0.01$). The better knowledge the farmer has on seed management and stocking techniques, the better the behavior is.

Knowledge of the importance of wastewater treatment in aquaculture correlated with wastewater treatment behavior in aquaculture. But the correlation is not strong ($r = 0.250$, $p < 0.05$). The more farmers have well knowledge about the importance and regulations of wastewater treatment in aquaculture, the better their behavior is to treat wastewater under regulations. Besides, only some large aquaculture companies invest in building wastewater treatment systems before discharging them into the environment. For the other aquaculture households, including households in the planned area, the discharge system is shared with the water system for aquaculture. Hence, despite the best efforts, it is still inevitable that the discharge water and the input water flow in the same stream, causing water pollution in aquaculture. It was a difficulty in the two surveyed provinces.

On the other hand, farmers' behavior is quite multidimensional. Not everyone with good knowledge will have good behavior. For example, the awareness of the need to notify local authorities if an outbreak occurs is negatively correlated with family self-management behavior ($r = -0.19$, $p < 0.01$). Although the correlation is weak, it shows that if it is possible to handle the disease, some aquaculture households will not report it to the authorities, and they will solve it themselves. Hence, it will affect the ability to control the disease locally. Due to farmers do not always accurately assess the severity of the disease. Besides, although

some farmers know the regulations on conditions for aquaculture ponds, lagoons, and rafts, they still build aquaculture ponds, and lagoons outside the planning area do not meet the requirements. For the use of chemicals in aquaculture, although farmers know using microorganisms to improve ponds and aquaculture ponds will bring better results, many people still use chemicals to clean ponds.

Thus, despite having good knowledge, aquaculture people have both good and bad behaviors in aquaculture depending on the context.

4. Conclusions

The results show that not many people on the North Coast have sufficient knowledge about the legal provisions for aquaculture activities and the conditions of aquaculture ponds, lagoons, and rafts, water sources in aquaculture. Most farmers understand their roles and responsibilities in exploiting and protecting coastal natural resources. The farmers participating in the survey positively assess the necessity of some regulations and conditions for aquaculture activities. Most farmers appreciate the significance of the requests for aquaculture activities. However, farmers do not high assess the necessity of safe aquaculture, applying Vietgap standards for aquaculture.

Compared with the knowledge, the realistic behavior of farmers is not proportional. Many regulations for aquaculture activities don't fully implement. However, the knowledge and the actual action of aquaculturists correlate in the trend that the better the knowledge, the more often the correct practice behavior. For example, (i) knowledge and behavior of using feed and products to treat and improve the environment in aquaculture; (ii) knowledge of the importance of wastewater treatment in aquaculture and wastewater treatment behavior in aquaculture; (iii) knowledge about breed origin, stocking techniques, and behavior of using breed.

In addition, knowledge and behavior related to some other regulations do not correlate, reflecting the reality of disagreement between knowledge and behavior on some specific issues.

Thus, the relationship between knowledge and the realistic behavior of farmers in aquaculture is not uniform. It can start from many reasons as the farmers do not have enough knowledge of the necessity of the requirements for aquaculture. Hence, they answer according to the expectations of society. Or farmers have not given up some habits in aquaculture according to the old thinking, have not been used to aquaculture behaviors with new requirements, etc. Whatever the cause, we think that training and propaganda on the necessary conditions for aquaculture for farmers should continue to be carried out more effectively and with better quality.

References

i. *Le Thi Thanh Thuy, Nguyen Hong Son, Do Phuong Chi, Tran Quoc Viet, Bui Thi Lan Huong, Do Thi Hai Ha (2017), Situations of water quality in shrimp farming in coastal areas of Nam Dinh and Quang Ninh province, Journal of Vietnam Agricultural Science and Technology, Vol. 2 No. 2.*

ii. *Law on Fisheries (2017), Law No. 18/2017/QH 14, dated November 21st, 2017.*

iii. *Decree 26/2019/ND-CP of the Government detailing a number of articles and measures to implement the Fisheries Law.*

iv. *Pham Tang, Quang Ninh Province decided to remove foam floats in aquaculture, available from: https://www.quangninh.gov.vn/chuyen-de/tangtruong/Trang/ChiTietTinTuc.aspx?nid=100228, accessed on June 25th, 2021.*

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Led by Dr. Bui Thi Van Anh.