Thi Thu Hang Ngo; Lan Phuong Mai; Huu Cuong Tran et al.

Article

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Reference: Thi Thu Hang Ngo/Lan Phuong Mai et. al. (2023). How do cooperatives support their members in managing aquaculture risks? : the case study of the northern coastal provinces of Vietnam. In: JEOD 12 (1), S. 56 - 74. https://jeodonline.com/wp-content/themes/jeod/download.php?pid=12754. doi:10.5947/jeod.2023.003.

JEOD JOURNAL OF ENTREPRENEURIAL AND ORGANIZATIONAL DIVERSITY

Volume 12, Issue 1 (2023) 56-74 | Published online 27 June 2023

AUTHORS

THI THU HANG NGO
Vietnam National University of Agriculture (Vietnam)
ngohangvn@gmail.com

LAN PHUONG MAI
Vietnam National University of Agriculture (Vietnam)
mlphuong611@gmail.com

HUU CUONG TRAN
Vietnam National University of Agriculture (Vietnam)
trancuong@vnua.edu.vn

PHILIPPE LEBAILLY
University of Liege, Gembloux Agro-Biotech (Belgium)
philippe.lebailly@uliege.be

How Do Cooperatives Support Their Members in Managing Aquaculture Risks? The Case Study of the Northern Coastal Provinces of Vietnam

ABSTRACT

Millions of Vietnamese farmers seek their livelihoods in aquaculture; however, they face multiple risks in their daily farming practices. Notably, some of these risks cannot be effectively managed by individual farmers because they are beyond their individual capabilities. This is why cooperatives can play a crucial role in effectively addressing these risks. Over the past five years, many aquacultural cooperatives have been established in Vietnam to strengthen the collective power of farmers in managing risks. This study was precisely conducted to assess the role of cooperatives in risk management in aquaculture. The Propensity Score Matching method was applied to analyse field data collected from 158 aquaculture farmers along the northern coastline of Vietnam. The results reveal that cooperative members have better market risk management than non-cooperative members. By contrast, the role of cooperatives in supporting members in managing production and financial risks is still unclear. In addition, collaboration among cooperative members—which generates cooperative power—is not yet well developed. The study also reveals that governments should provide more support—including technical training regarding aquaculture production, marketing and cooperative financial management—in an effective and transparent manner so as to achieve common principles of cooperative work. Members should be well informed about these principles, which should be agreed upon among members themselves, so as to better leverage the collective power of cooperatives in managing farmers' risk.

KEY-WORDS

COOPERATIVE, AQUACULTURE, RISK MANAGEMENT, NORTH VIETNAM

Acknowledgments
This study was funded by the ARES AI Program with VNUA (2014-2021)-Postdoctoral research projects (2021).

JEL Classification: M11, O13, Q22 | **DOI:** http://dx.doi.org/10.5947/jeod.2023.003

1. Introduction

With over 3,260 kilometres of coastline and 112 estuaries, 226,000 square kilometres of internal and territorial waters, Vietnam has high potential for aquaculture development. From 1995 to 2020, Vietnam's aquaculture output increased sharply, from 1.3 million tons in 1995 to 9.05 million tons in 2022 with an average annual growth rate of 4%. Aquaculture is identified as a key economic sector of the country, contributing 4-5% of GDP and 9-10% of the total national export turnover. The turnover from aquaculture product export increased from 315 million USD in 1998 to 11 billion USD in 2022, with an average annual growth of 11% (VASEP, 2023).

Despite its advantages and positive development trends, Vietnam aquaculture has faced multiple risks due to the longer production cycle and the higher initial investments required by aquaculture compared to other agricultural sectors such as crops and livestock farming (Engle, 2010). Large harvest losses caused by diseases and/or farming protection equipment failures, sudden decrease in the market price, or unexpected market changes are risks widely revealed by aquaculture farmers (Del Silva and Soto, 2006; Handisyde et al., 2006; Bondad-Reantaso, Arthur and Subasinghe, 2008; McIntosh, 2008). In addition, climate change brings various direct and indirect impacts on aquaculture, which certainly cause more stress and vulnerabilities to farmers, and thus imply a greater possibility of economic losses. Moreover, the extensive global economic crisis has exposed farmers to further severe conditions in dealing with variability in input and output prices (Miranda and Vedenov, 2001). Notably, most of Vietnam's aquaculture production occurs on a small scale: 75% of the 2.4 million households involved in aquaculture have farms of less than two hectares (Johnson and Hung, 2020). The small-scale nature of Vietnamese aquaculture sector makes it particularly vulnerable to risks, including production risks (i.e., high mortality rates, slow growing capacity caused by degraded natural resources, and massive death caused by natural disasters or polluted environments), market risks (e.g., unpredictable changes in market prices), and financial risks (i.e., substantial investment requirements for aquaculture and high interest rates in the informal credit system). These risks, by their interlinkages, have exacerbated the vulnerability of aquaculture and farmers' livelihood (Nguyen et al., 2019). In addition, Vietnam's aquaculture area has recently decreased due to saline intrusion (Thanh et al., 2017). However, to date, studies on risk management solutions in aquaculture in this area are limited.

From the study on clam farming in Thaibinh province, Ngo's (2018) findings show that farmers applied different household risk management strategies to cope with various types of risks. In general, many strategies positively helped farmers to effectively manage production risks, such as improving production conditions, reducing clam loss and helping them recover more quickly from production and market shocks. However, many risks have remained ineffectively addressed, such as those related to natural resource degradation as well as market and financial risks. Failures to effectively address risks can trap farmers into poverty, further exposing them to vulnerability and preventing them from pursuing other opportunities that could improve their incomes (Ngo et al., 2018). In the aquaculture sector, natural resource degradation, market risks and financial risks

are considered as meso and macro level, thus cannot be solved by individual farmers and require cooperative-level efforts. Therefore, cooperatives should be promoted to improve sustainable resource management, market access, new technologies, and internal credits for processing facilities, in addition to providing collective protection from certain risks, such as unscrupulous business practices or disasters.

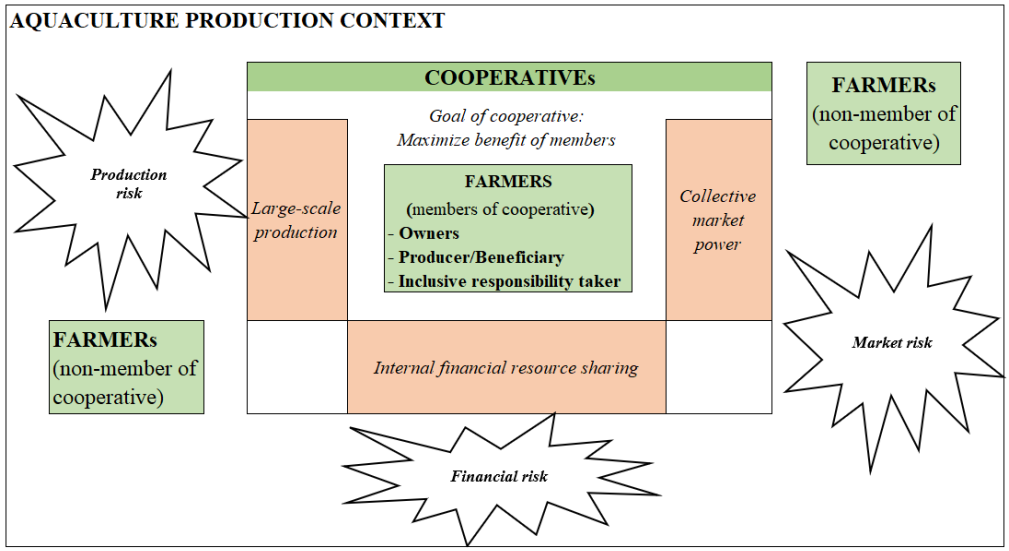
In principle, cooperatives are established to serve their members in aquaculture production, market access and risk management. In return, the commitment and collaboration of members is required for effective governance and operation of the cooperative as a whole. When the income and/or livelihoods of individual members are secure, their families and communities bear the ultimate fruits (Novkovic and Golja, 2015; Billiet et al., 2021). The experience of many countries around the world, such as India, Japan and Korea, reveals that cooperatives are still an effective form for farmers to address resource management challenges, enhance production efficiency and cope with climate change and market risks. In these countries, aquaculture cooperatives regularly work with the goal of maximizing mid- and long-term benefits for members. More importantly, through cooperatives, farmers and small businesses work together to strengthen their cooperative efforts to cope with difficulties and risks. In India, the National Federation of Fisheries provides members of cooperatives various benefits such as technical training, accident insurance for the group, medical security that helps members overcome difficulties when facing risks, and the sale of products through the system of fish consumption and fish products in retail stores. The Japan Federation of Fisheries Cooperatives has improved its organization since the 1990s by merging enterprises in order to react promptly and effectively to changes caused by the poor aquaculture utilization, inflation, financial crisis, etc. Similarly, the National Federation of Korean Fisheries Cooperatives (KNFC) has set up a network of cooperatives from the central to local level to strengthen the capacity of the aquaculture sector as well as household income. The Korean government constantly supports capital for aquaculture farmers, especially for the members of cooperatives. KNFC not only makes many efforts to protect members from economic vulnerability, their rights and interests based on self-sufficient cooperation, individual responsibility, democracy, and equality, but also contributes to the development of the Korean economy in terms of providing safe aquaculture food to consumers (Bang, 2020).

In Vietnam, cooperative development has entered a new phase. The Cooperative Law issued in 2012 reflects innovative thinking on a new cooperative model, aiming to help improve rural production cooperation in the context of a market economy. The innovation of this model is demonstrated by the fact that it focuses on the benefit of members while increasing the autonomy of the cooperative. The attractiveness of this innovative cooperative model is evidenced by the rapid growth in the number of cooperatives and the voluntary participation of members. By the end of 2019, Vietnam had 24,618 cooperatives and 85 cooperative unions with more than seven million members (Vietnam Cooperative Alliance, 2020). In parallel, in recent years, the Vietnamese government has been committed to agricultural sector development and rural development and has enacted several support programs, from the establishment process to the strengthening of

cooperative capacity. Under these supports, aquaculture cooperatives have been established in many provinces along the coastline. A few cooperatives have been able to integrate into global value chains, demonstrating better organization of farming production and sustainable development. Cooperatives have contributed to improving income for aquaculture households, stabilizing livelihoods, increasing product values, enhancing the brand and reputation of made-in-Vietnam seafood products on the domestic and international markets (Thuy, 2020). According to the report of the Directorate of Fisheries of Vietnam (2022), in 2021, Vietnam had 964 cooperatives operating in the aquaculture sector, accounting for 5.4% of the total number of agricultural cooperatives. On average, each aquaculture cooperative has 32-35 members with capital of about 30.75 billion VND, higher than the average level of agricultural cooperatives.

The conceptual framework presented in Figure 1 links the concept of cooperative with its specific features in the context of aquaculture production, which is typically subject to many types of risks. Aquaculture production can take the form of aquaculture cooperatives (consisting of at least seven members) or individual farmers. While individual farmers are responsible for risks alone, cooperatives support their members in managing risks through their capabilities and advantages, such as large-scale production, collective market power, and internal financial support. As presented above, many studies worldwide have already highlighted the role of cooperatives in supporting farmers in risk management, contributing positively to their benefits. The question that arises is why do Vietnamese aquaculture farmers, despite being cooperative members, largely struggle to cope with so many risks? So far, no research has been conducted to explore the underlying reasons why Vietnamese cooperatives have fallen short in supporting their members, especially given that Vietnam has a high risk of aquaculture production. This research is expected to empirically answer this question.

Figure 1. Conceptual framework



By focusing on the coastal aquaculture sector, this research applies the Propensity Score Matching method to evaluate the role of cooperatives in supporting farmers in risk management. Based on data collected from some provinces along the northern coastlines of Vietnam, this research has three purposes: (i) to identify factors affecting farmers' decision making in aquaculture cooperatives; (ii) to compare risk management strategies and outcomes between aquaculture cooperative members and non-cooperative members; (iii) to uncover the reasons why cooperatives do or do not support their members in risk management. The results of the study will help local authorities and farmers in the region to better understand the situation of cooperatives and bring more motivation in the developing process of aquaculture cooperatives, gradually contributing to the development of the aquaculture sector in Vietnam.

2. Methodology and study sites

2.1. Analytical framework

The impact of cooperatives on aquaculture risk management by its members is analysed by the Propensity Score Matching (PSM) method. This is a method developed by Rosenbaum and Rubin (1983), supplemented by Khandker, Koolwal and Samad (2009) and widely used today to assess the impact of policies in the agricultural sector in general as well as the impact of agricultural cooperatives (Dehejia and Wahba, 2002; Bernard, Taffesse and Gabre-Madhin, 2008; Arayesh, 2011; Francesconi and Ruben, 2012; Othman et al., 2012; Abate, Francesconi and Getnet, 2014; Wang et al., 2021). The PSM creates a comparison group based on a probability model of participating in aquaculture cooperatives with observed characteristics. Farmers participating in the cooperative are compared based on the probability value, or propensity score, with the non-cooperative members. Effectivity is calculated as the median difference in outcomes between the two groups.

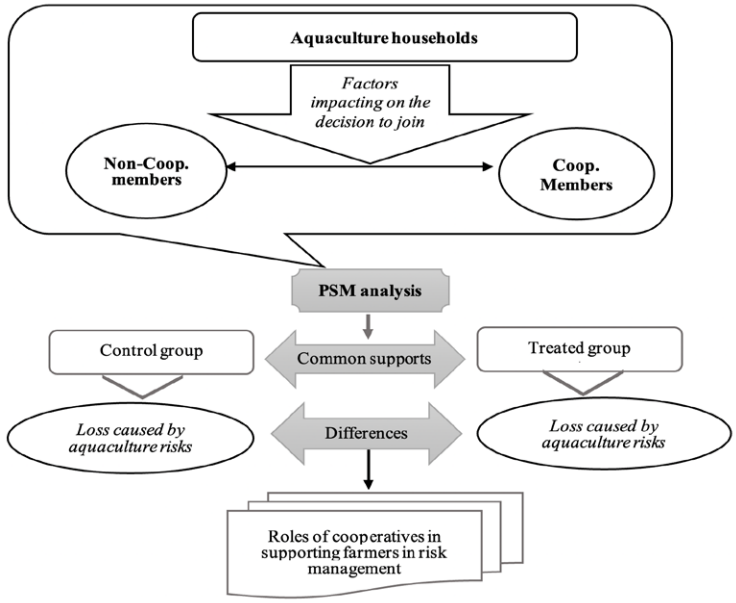
In this study, the process of assessing the impact of cooperatives on the risk management of their member is conducted with the following steps (see also Figure 2).

- Step 1: Conduct a survey to collect information on the two groups of farmers: the members of aquaculture cooperatives and the non-cooperative members.
- Step 2: Build a probit regression model to estimate the factors affecting the participation of households in cooperatives. The dependent variable takes the value 1 if the household is member of a cooperative, and the value 0 if it is a non-cooperative member. The independent variables are the observed characteristics of the two groups of households. The variables in the probit regression model are described in Table 1.
- Step 3: Determine the propensity score as the predicted probability for each household in the two groups. The value of the propensity score ranges from 0 to 1. Cooperative members households and non-cooperative members households that have similar propensity scores are compared to

determine the impact of being a cooperative member in household risk management. Items with a too high or too low prediction probability are removed because they do not have similar characteristics and therefore are not a sufficient basis for comparison.

- Step 4: Determining the common support groups and testing the balance allows us to compare the impact between the two groups. Then, the impact of cooperation is estimated using three different methods: Nearest-neighbor matching; Kernel matching and Radius matching. Each difference (significantly statistical) between the mean of the two groups calculated from these methods is the impact of cooperatives.

Figure 2. Analytical framework



2.2. Data Collection

Fieldwork was carried out at the study site from October to December 2021. Secondary data regarding risk in aquaculture production was gathered from different local government offices and published papers and reports. Primary data was collected via household surveys. Convenience sampling method was used to select households and a structured questionnaire was used to directly interview aquaculture farmers. Interviewees are directly involved in production and they understand and take key decisions on aquaculture activities at the household level. The information collected with the detailed scale is presented in Table 1. Inheriting the experience from existing studies on factors affecting the participation of farmers in cooperatives in Vietnam and some other developing countries like China and Ethiopia (Hisatoshi, 2016; Ahmed and Mesfin, 2017; Le et al., 2019;

Tran, 2020; Cuong, 2021), the independent variables in Table 1 are selected by the authors to meet the conditions for comparison based on two criteria: (i) independence (e.g., unobserved factors do not affect participation status); (ii) the match (the region of common support group) in propensity scores between the two farmer's groups (Khandker, Koolwal and Samad, 2009).

Table 1. Description of variables used in the probit regression model

Variable namezz	Unit	Description
Dependent variable		
Cooperative member	Dummy (0;1)	1: Cooperative member; 0: Non-member
Independent variable		
Age	Year	Age of the head of households
Gender	Dummy (0;1)	Gender of the head of households
Education	Ordinal scale	0: Illiteracy; 1: Primary school; 2: Secondary school; 3: High School; 4: Higher Education
Total aquaculture area	Ha	Total aquaculture area of household
Number of types of aquatic species	Types	Number of types of aquatic species raised by households
Influence of propaganda program	Ordinal scale	4: Highly impact; 3: Moderately impact; 2: Slightly impact; 1: No impact
Influence of friends & relatives	Ordinal scale	4: Highly impact; 3: Moderately impact; 2: Slightly impact; 1: No impact
Lack of capital	Ordinal scale	4: Totally agree; 3: Agree; 2: Slightly agree; 1: Disagree
Need of technical supports	Ordinal scale	4: Totally agree; 3: Agree; 2: Slightly agree; 1: Disagree
Need to expand the aquaculture area	Ordinal scale	4: Totally agree; 3: Agree; 2: Slightly agree; 1: Disagree
Need support to connect to the market	Ordinal scale	4: Totally agree; 3: Agree; 2: Slightly agree; 1: Disagree
Variables used for PSM model		
Average Total Loss/Ha/Year	Mil. VND	Average of total loss in aquaculture production, estimated by farmers regarding reduction of profit compared to the normal farming and market conditions.
Average Loss caused by Production Risk/Ha/Year	Mil. VND	Average of loss estimated by farmers regarding reduction of profit caused by the reduction of harvest, compared to normal farming and market conditions.
Average Loss caused by Market Risk/Ha/Year	Mil. VND	Average of loss estimated by farmers regarding reduction of profit caused by market instability compared to the normal market conditions (including loss caused by unsold products).
Average Loss caused by Financial Risk/Ha/Year	Mil. VND	Average loss caused by the financial market regarding loans borrowed to finance aquaculture production (e.g., unrepayable debt, the increase of finance charges from informal credit…).

2.3. Study site

The northern coastline is in the western coastal strip of the Gulf of Tonkin, an important bay of Vietnam in the marine socio-economic development strategy with a length of about 460km. The northern coastal region includes four provinces and one coastal city (Quang Ninh, Hai Phong, Thai Binh, Nam Dinh, and Ninh Binh). The population of this region was about 8.65 million people in 2015; by 2025, it is expected to be about 8.6-9 million people.

In recent years, the population living along the coast and on the islands of Vietnam amounts to about 20 million (Tho, 2018). The total area of aquaculture in the northern coastal region is about 35,348 hectares, producing an annual output of 318,670 tons of aquaculture. Aquaculture farmers can choose to cultivate independently or participate in economic organizations such as cooperatives. According to the annual reports of five Provincial Departments of Agriculture and Rural Development, there are about 55 aquaculture cooperatives located along the northern coastal area. However, the number of farmers participating in cooperatives does not exceed 50% of the total farmers working in the aquaculture sector.

In 2020, due to the social distance situation related to COVID-19, only 158 farming households belonging to two provinces located in these northern coastal provinces—namely Thaibinh and Namdinh[1]—agreed to participate in the survey, of which 78 are cooperative members and 80 are non-cooperative members. These two groups of farmers have adjacent farming areas and are affected by the same climate conditions. Some basic characteristics of the sample are presented in Table 2.

Table 2. Characteristics of households (cooperative members and non-members)

Variable name	Unit	Cooperative member household		Non-member household		T-stat
		Mean	Std. Err.	Mean	Std. Err.	
Age of household's head	Year	46.78	1.09	48.01	1.05	0.8139^{ns}
Gender of household's head	Proportion of HSH head is male	0.74	0.04	0.83	0.04	1.4519*
Education level of household's head	Ordinal scale	2.26	0.05	2.27	0.05	0.0809^{ns}
Aquaculture area (ha)	Ha	0.66	0.09	0.54	0.08	-0.9590^{ns}
Number of types of aquatic species	Number of types	1.77	0.08	1.41	0.07	-3.1822***

****. Significant at the 0.01 level.*

***. Significant at the 0.05 level.*

**. Significant at the 0.1 level*

ns: No statistically significant

[1] In the group of northern coastal provinces, Thaibinh is the province with the highest vulnerability index to climate change, while Namdinh is the province with the lowest vulnerability index (Thanh et al., 2017).

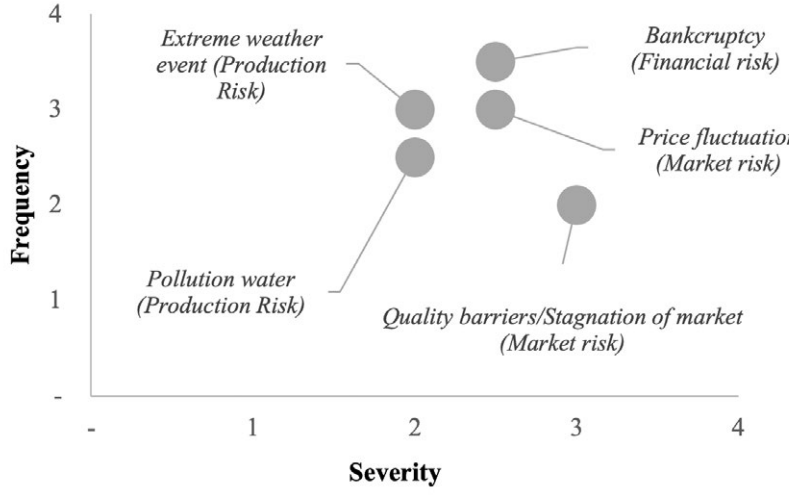
3. Results and discussion

3.1. Aquaculture risks and impacts on farmers

By performing aquaculture activities in the context of climate change together with unstable social conditions, the aquaculture farmers have faced increasing risks, including production risks (i.e.., decreasing product volume or low product quality caused by extreme weather events or pollution water flows), market risks (i.e., sharp decrease of the selling price due to sudden price fluctuation or the overstocking situation caused by the market stagnation), and financial risks (i.e., high interest rates in the informal credit system or bankruptcy situation) (Ngo et al., 2018). These risks, which interact with each other, have exacerbated the vulnerability of farmers and their households.

Due to the impact of COVID-19, the situation has been even more serious on aquaculture activities in general and specifically in the northern coastal provinces. According to information from several businesses, the price of raw materials increased by an average of 21% over the same period in 2020 (Tung, 2021), while the volume of consumption was severely reduced due to the lockdown situation. As a result, aquaculture farmers suffered capital losses because of the extra costs in maintaining aquaculture practices, as well as being faced with risks such as natural disasters and epidemics (Huyen, 2021). More seriously, the prolonged, raging COVID-19 pandemic has disrupted the production chain. Many shrimp farms had to suspend production because of input prices and diseases. Households also had to reduce their production scale to survive.

Figure 3. Heat map for aquaculture risks in studied provinces



Focus groups were conducted in December 2021 to rank the different types of risks according to frequency of occurrence (frequency) and magnitude of loss (severity). The results of the discussions show that financial risks and market risks are the most serious risks according to farmers (Figure 3). Losses caused by aquaculture risks were estimated by farmers and are presented in Table 3. The average total level of loss/ha/year/household is quite high and there is a statistically significant difference between the two groups of farmers. However, when comparing the level of loss for each type of risk, the difference is statistically significant only for the loss due to market-related risks.

Table 3. Average loss of farmer household caused by aquaculture risks

Variable name	Unit	Cooperative member household		Non-member household		T-stat
		Mean	Std. Err.	Mean	Std. Err.	
Average Total Loss/Ha/Year	Mil. VND	88.44	6.68	141.17	9.50	4.5392***
Average Loss caused by Production Risk/Ha/Year	Mil. VND	40.14	3.98	45.30	2.86	1.0522ns
Average Loss caused by Financial Risk/Ha/Year	Mil. VND	10.17	1.00	8.97	0.98	-0.8485ns
Average Loss caused by Market Risk/Ha/Year	Mil. VND	38.13	3.31	86.89	7.07	6.2467***

****. Significant at the 0.01 level.*

ns: No statistically significant

3.2. Cooperative roles in supporting farmers in overall risk management

To determine the factors affecting the participation in the cooperative as well as to determine the common support area of the two groups of farmers, the probit regression model on the propensity score is performed. The estimated results of the model are presented in Table 4.

There are three variables that have a significant impact on the probability to join a cooperative, including (i) the influence of promotion programs on farmers, (ii) farmers' technical support needs, and (iii) the number of types of aquatic species farmers raise. While the basic characteristics of the farmers (i.e., age, gender, education level of the household's head) seem to have little relationship, the promotion programs appear to have a great correlation with the probability of a household to join a cooperative. This is the result of the cooperative support programs provided by the Vietnamese government in the period following the enactment of the 2012 Cooperative Law. The government programs offer much support to newly established cooperatives and supports the consumption of products for farmers if consumed through cooperatives. In some provinces, newly established cooperatives even receive cash support for their establishment (Ngo et al., 2022). The programs have created an explosion in the number of cooperatives in Vietnam since 2012 (Cox and Le, 2014). The influence of the number of aquatic species raised by the household on participation in cooperatives

shows concern about risks and technical problems in households farming practices. This concern and the need for technical assistance tend to have a positive impact on the participation of farmers in cooperatives. Similar results have been found in other research (Zheng, Wang and Awokuse, 2012; Hisatoshi and Qun, 2015; Le et al., 2019). The results of the analysis also show that the region of common support between cooperative and non-cooperative members is large (i.e., in the range from 0.095 to 1). Thus, the assumption of the region of common support is satisfied and contributes to avoiding inappropriate coupling.

Table 4. Probit regression determines the impact of factors on the likelihood of joining a cooperative

Variable	Coef.	Std. Err.	P>z
Age of household's head	0.0181	.018	0.319
Gender of household's head	-0.2399	.389	0.538
Education level of household's head	0.6239	.396	0.115
Aquaculture area (ha)	-0.1870	.273	0.493
Number of types of aquatic species	0.5416	.229	0.018
Influence of propaganda program	1.9445	.415	0.000
Influence of friends & relatives	0.1348	.194	0.488
Lack of capital	-0.5560	.402	0.166
Need of technical supports	1.7498	.455	0.000
Need to expand the aquaculture area	0.0381	.227	0.867
Need support to connect to the market	0.6102	.474	0.198
_cons	-14.2214	.035	0.000
Log likelihood	*-41.988*		
LR chi2(11)	*135.030*		
Prob > chi2	*0.000*		
Pseudo R2	*0.617*		
Number of observations	*158*		

Note: the common support option has been selected
The region of common support is [.09499824, 1]

The results of the PSM analysis show that all three methods confirm the positive impact of cooperatives on their members risk management. There is a difference in the degree of harm due to risk effects in aquaculture between the two groups of farmers (with all significant levels below 0.1—see Table 5). More specifically, there is significant variation in the outcome of market risk

management between the two household groups, implying that the cooperative is a critical factor for farmers to overcome market risks. Similar results have also been found in other research such as that of Balgah (2019) in Cameroon, Hellin, Lundy and Meijer (2009) in America, and Wollni and Zeller (2007) in Costa Rica. At the same time, in contrast to the results of other research that have shown the supporting role of cooperatives in providing technical support to agricultural production for their members (Abate, Francesconi and Getnet, 2014; Dong, Mu and Abler, 2019; Neupane et al., 2022), the test results of all three PSM methods showed that cooperatives do not play a significant role in supporting their members in controlling production risks and financial risks. The next part of this paper will discuss the underlying reasons that cause the differences between the two groups of farmers in risk management.

Table 5. The impact of cooperatives on farmers' aquaculture risk management

Average Loss Estimated	PSM Methods	Mean		ATT	S.E.	T-stat
		Coop	Non			
Average Total Loss/ Ha/Year	Nearest-neighbor matching	101.808	181.600	-79.792	35.214	-2.270**
	Kernel matching	101.808	149.051	-47.243	26.778	-1.760*
	Radius matching	101.808	153.016	-51.208	23.039	-2.220**
Average Loss caused by Production Risk/ Ha/Year	Nearest-neighbor matching	50.519	51.939	-1.421	11.367	-0.120^{ns}
	Kernel matching	50.519	46.393	4.126	9.984	0.410^{ns}
	Radius matching	50.519	47.662	2.857	9.488	0.300^{ns}
Average Loss caused by Financial Risk/ Ha/Year	Nearest-neighbor matching	10.395	9.058	1.337	2.477	0.540^{ns}
	Kernel matching	10.395	7.261	3.134	2.223	1.410^{ns}
	Radius matching	10.395	6.803	3.592	2.669	1.350^{ns}
Average Loss caused by Market Risk/Ha/ Year	Nearest-neighbor matching	40.894	120.603	-79.709	26.214	-3.040***
	Kernel matching	40.894	95.397	-54.503	18.716	-2.910***
	Radius matching	40.894	98.551	-57.657	15.681	-3.680***

****. Significant at the 0.01 level.*
***. Significant at the 0.05 level.*
**. Significant at the 0.1 level*
^{ns}: No statistically significant

3.2.1. Cooperative roles in enhancing farmer's market access

Aquaculture farmers face market risks caused by many reasons (i.e., input and output price instability, quality barrier or market stagnation). According to farmers' ranking, these risks are at the meso level (Figure 2) and thus require effective solutions at the cooperative level. In fact, cooperatives have played this role relatively well, as shown by the results of the three PSM analysis methods (Table 5). These findings are in line with those of Bernard, Taffesse and Gabre-Madhin (2008) in Ethiopia.

Cooperatives take various forms in an attempt to support smallholders in managing market risks. In the period 2012-2015, many farmers encountered the problem of following pre-orders from strange aquatic product buyers without a contract or deposit thus causing an oversupply of aquatic harvests (Ngo et al., 2016). In other cases, some fishery companies in the local areas complained that it was difficult to sign contracts with farmers as farmers can easily break the agreement. The contracts do not guarantee anything to both parties. To cope with this risk, many cooperatives signed contracts with (identified) buyers on behalf of their members. As shown in previous studies, the price and yield guaranteed in the contracts have a positive effect on farming practices and farmers' welfare (Bellemare, 2012; Dedehouanou, Swinnen and Maertens, 2013; Verhofstadt and Maertens, 2015).

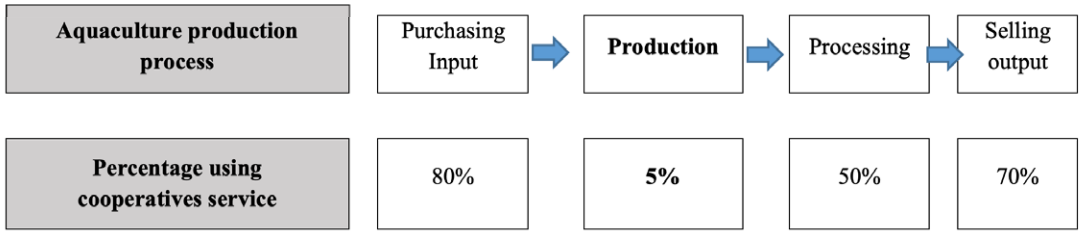
For farmers accessing international markets, there is an issue of quality barriers and value added to the products. Farmers only have raw products and lack sufficient financial capital to invest in processing facilities; they also lack the ability to register for quality certification and trademark registration. Therefore, another support for farmers to overcome barriers related to the quality of products exported to the international market is to rely on the capital resources of cooperatives (some cooperatives receive capital from the government support program) to invest in processing facilities and a quality control system. Stamps are then used to guarantee the quality of processed products. Value-added processed products are assured by the cooperative's reputation and thus have better access to markets. As a result, farmers are more attracted to joining cooperatives. This trend is evidenced in many cooperative models in different sectors such as horticultural, meat, dairy and fish products (Holloway et al., 2000; Reardon and Barrett, 2000).

3.2.2. Cooperative roles in farmers' production risk management

Contrary to the results of previous studies demonstrating that cooperatives can buffer crises, resist the negative effects of extreme weather events and increase the technical efficiency of their members' production (Pinto, 2009; Abate, Francesconi and Getnet, 2014), the results of the PSM analysis of this study show that cooperatives do play an active role in supporting members in production risk management (Table 5). The main reason for this problem is the common existence of individual farm aquaculture production even when farmers have become members of the cooperative. It is found that the common activities of aquaculture cooperatives normally focus

on the stage of purchasing inputs and selling output products, and that only 5% of the cooperatives of this study have been involved in organizing production on a cooperative scale (Figure 4). This is also somewhat unique to aquaculture production activities, which require collective decisions to be made at necessary times, so cooperation in production among individual households often leads to conflicts in decision making (Ngo et al., 2018). Individualized farming practices certainly harm the advantage of large-scale production, which always is an important benefit of cooperatives (Liu and Bailey, 2013).

Figure 4: Percentage of cooperatives that organize cooperation activity among members



Source: Data collected from fieldtrip in December 2021.

3.2.3. Cooperative roles in supporting members in financial risk management

The common characteristic of agricultural cooperatives is usually a group of poor farmers (Fischer and Qaim, 2012), while aquaculture always requires high capital investment. Consequently, farmers always need external financial support. However, in the case of aquaculture cooperatives in this research, farm members did not receive the financial support expected from cooperatives. In fact, the number of cooperatives with internal credit funds accounted for only 23% of the total number of cooperatives studied. The hidden reason for this is members' limited trust in the cooperative's internal credit, as they think (other) members can leave the cooperative at any time, based on the cooperative principle of "open and voluntary membership". Exemplifying this are the words of one cooperative member: "*I am very worried about lending money to the cooperative's internal credit fund. Interest rates are not very different from outside mainstream credit institutions. However, I am very worried about my money security. If any member decides to leave the cooperative without returning the money, I don't know to whom I should claim my money. My relatives experienced the same problems in their cooperatives five years ago"* (in-depth interview in Thai Binh, November 2021).

In general, like the situation in Malaysia (Othman, Mansor and Kari, 2014), many newly established aquaculture cooperatives in northern Vietnam are small in size and capital, face problems of member apathy and have poor networking and collaboration among themselves. Therefore, they have problems in raising sufficient capital to invest in aquaculture production activities. Meanwhile, the high risks of aquaculture, combined with the lack of collaboration of cooperative members, mean that the percentage of cooperatives that can access loans from outside to meet the needs of

their members accounts for only 25% of the total cooperatives studied. The difficulty of mobilizing both internal and external capital has led to a limitation of cooperatives' financial capacity to support their members. In other words, within cooperatives, the collective financial power of members has not been effectively activated to make their internal credit system work.

4. Conclusion and implications

Affected by the COVID-19 pandemic as well as the inherent difficulties of natural and social conditions, aquaculture activities of people located along the northern coastal region of Vietnam face many uncertainties. In this risky context, aquaculture farmers may choose to join together in cooperatives to benefit from the collective power in responding effectively to different risks. Several factors have an impact on farmers' decision to join or not join cooperatives, including (i) the influence of government support programs for farmers, (ii) farmers' needs to obtain support from cooperatives (such as technical, financial and market access), and (iii) the types of aquatic species raised by households. Empirical data from this research shows that aquaculture cooperatives have played an active role in assisting members to access the market for aquaculture products. However, the study also shows that existing cooperatives are not efficient in supporting farmers in managing production risks and loans such as for processing facilities. The reasons are related to the characteristics of aquaculture activities (high risks, large capital requirements) and the limitations of farmers' collaboration (i.e., aquaculture production is mostly individual, there are no cooperative efforts and individual reliance on internal credit activities). To enhance the effectiveness of cooperatives, changes in the approach to cooperative creation and governance are needed.

Because internal factors—e.g., how cooperatives are composed and managed—are likely to have a greater influence on performance than uncontrollable external conditions (Velten, Jager and Newig, 2021), most cooperatives in Vietnam have been largely physically formed under government supports (most recently the New Rural Program 2010-2020 endorsed in the Decision 800/QD-TTg of the Vietnamese government) without adequate awareness and mutual understanding of the members involved. For this reason, most farm members have not well understood what cooperatives mean to them (Tu, 2011; Ngo et al., 2022). The lack of understanding of values and members' roles and rights in cooperatives could largely explain the lack of commitment and efforts by members in working together for effective cooperative performance and development, as indicated in above. For positive change in the future, Vietnamese governments and service providers need to do much more to prepare for the formulation of a cooperative, for example, raising farmers' awareness of cooperatives and assessing farmers' needs and capacities to join cooperatives as well as the needs of the cooperative to be effectively started and operated (such as organizational structure, including administration, accounting and internal inspection system, record keeping and office, etc.).

More systematic efforts to prepare for the formulation of cooperatives will serve as an effective basis for the operation of cooperatives themselves in delivering better services and supports to their

members. This will also help strengthen collaboration among cooperative members to be able to reap the benefits of larger-scale production, such as through increased technical efficiency and production risk mitigation. Cooperative leaders, with the changes in vision and actions to improve cooperative governance and transparency, will help enhance members' trust in cooperatives and their efforts in collective aquaculture production, marketing and risk mitigation.

For existing cooperatives, farm supporting organizations and local governments should provide more support, including technical training in aquaculture production, marketing and financial management of the cooperative in an effective and transparent manner. Furthermore, internal credit systems within cooperatives are extremely important to support members' investment in processing facilities that help minimize post-harvest losses, cope with sudden market risks, and increase the quality of aquaculture products. In addition, the central governments should reconsider policies for loans specifically applied to aquaculture sectors (e.g., appropriate interest rates and loan duration). Other government interventions are also suggested, such as monitoring the quality of support services (in the provision of technical assistance and farm certification) and promoting access to markets, especially export markets, to foster the development of the Vietnamese aquaculture sector in line with international sustainable standards.

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