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A Multinomial Logit Model Analysis of Farmers' Participation in Agricultural Cooperatives: Evidence from Vietnam

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Abstract

This study aims to test the determinants of farmers' participating behavior in agricultural cooperatives. A model of multinomial logistic regression is employed using survey data of 640 farmers in the Mekong Delta of Vietnam. The estimation results reveal that farmers are more likely to participate in agricultural cooperatives when they possess more favorable resources, including their level of higher education, farmland size, access to credit, social capital, access to extension, and market constraints. Farmers also regard cooperatives as institutions that can help them reduce production and marketing risks and ultimately enhance their chance of expanding their business operations.

Keywords: agricultural cooperatives, human capital, social capital, Vietnam
JEL Classification: D19, Q13, Q18

1. Introduction

Farmers could overcome market failures, maintain their position in the market, and improve economic and technical efficiency by organizing themselves into groups or

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producing organizations which can serve as platforms for capacity building, information exchange, and innovation in rural settings (Abate, Francesconi, & Getnet, 2014; Abebaw & Haile, 2013; Ahmed & Mesfin, 2017; Ma & Abdulai, 2016; Verhofstadt & Maertens, 2014; Wollni & Zeller, 2007). For 28 years (1990–2018), agricultural and rural areas have continued to play an essential role in Vietnam's economy, accounting for approximately 60% of the workforce and 17% of GDP (General Statistics Office of Vietnam [GSO], 2018). Consequently, increasing participation in agricultural cooperatives should further enhance efficiency gains among smallholder farmers. The Cooperatives Law of 2012 generated much interest in the activities of organizations. Vietnam has also rapidly opened its agricultural markets as a result of various international trade agreements. Due to the favorable climate, many high-value crops have improved in Vietnam, and these results create enormous opportunities for farmers to export their agricultural products. Farmers need to be organized to have access to the more profitable and high-end markets, or at the very least have negotiating power. However, the participation of members is minimal. Currently, there are approximately 13,856 formally registered agricultural cooperatives with 4.1 million members and 26,978 agricultural collaboration groups with 63,824 members in Vietnam, accounting for only 20% of the employed population in the agricultural sector, and only 55% of total cooperatives perform to an effective level (GSO, 2018); this has become a barrier to the success of agricultural cooperatives in Vietnam.

Previous studies have identified that numerous variables have positive impacts on farmers' adoption of innovative agricultural practices (Dung, Ho, Hiep, & Hoi, 2018; Feder, Just, & Zilberman,1985; Lee, 2005; Rogers, 2003; Teklewold, Kassie, & Shiferaw, 2013; Wollni, Lee, & Thies, 2010; Zbinden & Lee, 2005). Several studies have assessed the determinants of farmers' participation in cooperatives and other behavioral aspects, such as member trust, commitment, and intensity of participation in cooperatives (Esayas & Gecho, 2017; Fischer & Qaim, 2014; Gyau, Mbugua, & Oduol, 2016; Karlı, Bilgiç, & Çelik, 2006; Kidane, Lemma, & Tesfay, 2018; Mojo, Fischer, & Degefa, 2017; Österberg & Nilsson, 2009; Nugusse, Huylenbroeck, & Buysse, 2013). Expanded studies focused on member behavior in specific decision situations, such as farmers' choices between cooperative and investor-owned partner firms (De Moura Costa, Chaddad, & Furquim de Azevedo, 2013;

Lind & Åkesson, 2005). In the context of a transforming Vietnamese agricultural market, there is little existing research in this area focused predominantly on the aggregate macroeconomic level (Cox & Le, 2014; Dung, Trinh, & Linh, 2015; Wolz & Duong, 2010). Moreover, limited research has been conducted at the microeconomic level with an emphasis on farming households' participation in cooperatives. The present study investigates the determinants of farmers' decisions to participate in agricultural cooperative types in Vietnam by using a multinomial logit regression model. The structure of the article comprises six sections: introduction, literature review and hypothesis development, methodology and data, results, discussion, and conclusion and policy implications.

2. Literature review and hypothesis development

An agricultural cooperative is a group of farmers who pool their resources together in certain areas of activity to facilitate optimal production through the efficient use of these resources. This pooling of resources includes the joint purchase of farm inputs such as seed and farm machinery, aiding members both morally and financially during cultivation, and seeking marketing channels for farm products to ensure better and fairer prices (Coltrain, Barton, & Boland, 2000). According to Ortmann and King (2007), agricultural cooperatives could be classified into three categories: marketing cooperatives, farm supply cooperatives, and service cooperatives.

In Vietnam, the model of an agricultural cooperative has developed since 1954 as a result of various evolutions (Tran, 2014). The transitional process of collective farming in Vietnam was not straightforward but was a trial and error process (Sultan & Wolz, 2012). Currently, agricultural cooperatives in Vietnam operate according to two main models, including the cooperative model (agrarian service cooperatives, model of farming services and integrated business cooperatives, and model of specialized organizations) and farmer groups. The primary duty of agricultural cooperatives is to provide essential services to their members, including preparing lands and providing seeds, fertilizers, and pesticides; technical guidance; methods of preservation and harvesting; organizing the processing and distribution of products; supporting funds for their members; and organizing the production of crafts and other sectors (Cox & Le, 2014).

The collaborative farmer group model promotes structural changes in market power; improvement in access to resources, inputs for production, and public services; the fulfilment of community functions; improvements in community resistance and risk sharing; enhancing the power of individual farmers; increasing social capital for poor/disadvantaged groups; and increasing community-based social security (Tran, 2014). The significant difference between the legal status of farmer groups and cooperatives typically has a psychological impact on enterprises rather than assuring contract compliance and increasing dispute resolution, especially with small-scale contracts and alliances. The cooperative linkage is successful when farmers have a high demand for collaborative production, supply quality products, and achieve mutual benefit and risk-sharing (Cox & Le, 2014).

Helmberger and Hoos (1962) were the first researchers to complete a mathematical model of the behavior of an agricultural cooperative. The authors use the neo-classical theory of the firm to establish short-term and long-term models of a cooperative, including behavioral relations and positions of equilibrium for a collective and its members under different sets of assumptions using traditional marginal analysis. In their model, the cooperative's optimization objective is to maximize benefits to members by optimizing the per-unit value or average price by distributing all earnings back to members in proportion to their patronage volume or use.

Recent empirical studies have emphasized the following variables as the main determinants of farmers' participation in agricultural cooperatives: farmer's gender, age, education level, farmland size, off-farm income, credit access, social capital, extension access, perceived trust, land tenure status, and market access (Agbonlahor, Enilolobo, Sodiaya, Akerele, & Oke, 2012; Arayesh, 2011; Fisher & Qaim, 2012; Gijselinckx & Bussels, 2014; Gyau et al., 2016; Karlı et al., 2006; Mojo et al., 2017; Nugusse et al., 2013; Zheng, Wang, & Awokuse, 2012).

The human capital of farmers, namely the education level of the head of the household, in addition to their age, agricultural knowledge, and experience, may affect decisions to participate in cooperative actions because of the imperfect markets. The educational level of a farmer positively correlates with participation decisions because of

the assumed link between education and knowledge. Education is likely to have a positive influence on participation because well-educated farmers are more likely to possess the skills and networks necessary to initiate and manage an association (Gyau et al., 2016). Mojo et al. (2017) indicated that the probability of farmers' membership increases with education level. Gender also influences farmers' participation in collective action because group activities can be time-consuming, thereby lowering the incentive for women to participate (Weinberger & Jütting, 2001). Ownership of assets is strongly influenced by gender, reflecting existing gender norms and limiting women's ability to invest in more profitable livelihood strategies (Quisumbing et al., 2015). Economic, social, and cultural factors, including access to natural and other productive resources, have significant effects on the participation of both male and female members in producer organizations (Bacon, 2010; Kaaria, Osorio, Wagner, & Gallina, 2016). Studies concluded that young heads of households are more likely to acquire new knowledge and learn new techniques than others (Arayesh, 2011; Gyau et al., 2016; Kidane et al., 2018; Mojo et al., 2017; Weinberger& Jütting, 2001).

The financial resources of farm operations include off-farm income, farmland size, and commercial credit accessibility. It is justifiable for people to join cooperatives to obtain financial support (Nugusse et al., 2013). Farmland size, on the other hand, refers to the total land available to a farmer for agricultural production. Feder et al. (1985) demonstrate that given the uncertainty and the fixed transaction and information costs associated with technologies, there may be a critical lower limit on farm size which prevents smaller farms from deciding to participate in cooperatives. Farmland tenure is a descriptor differentiating self-owned land from a property that is rented from a third party. A farmer is more likely to positively manage self-owned land than leased land in a cooperative action (Isgin, Bilgic, Forster, & Batte, 2008; Teklewold et al., 2013) because the benefits of long-term practices accrue over time.

Social capital means membership in farmers' associations, the number of relatives that a household can rely on for critical support, and the number of traders that a farmer knows in and outside the village (Maertens & Barrett, 2012). Social capital literature treats social networks as a means to access information, secure a job, obtain credit, protect

against unforeseen risks, enter the information exchange market, reduce information asymmetries, and enforce contracts (Liang, Huang, Lu, & Wang, 2015). Gijselinckx and Bussels (2014) found that social capital and the legacy of communism have a significant effect on the attractiveness of the cooperative sector for farmers. Agricultural cooperatives can develop social capital, and theoretically the amount of social capital within the organization may enhance economic efficiency and long-term success (Miao, Heijman, Zhu, & Lu, 2015).

The extension is a source of information for many farmers, either directly through contact with extension agents or indirectly through farmers who have prior exposure to transmitting data to other farmers. With increased responsibility, the average farmer seeks ways to enhance his farming business through regular extension contact and access to farm-related information, credit, exchange of ideas, and access to affordable inputs (Gyau et al., 2016). Access to information through training, information tools, and exposure visits is also an essential factor in motivating rural people to join cooperatives (Nugusse et al., 2013).

The role of cooperatives is to reduce the transaction costs associated with producing, marketing, and distributing products and mitigating the risks faced by small farmers such as low farm prices (Nugusse et al., 2013). Trust in and positive attitudes towards collective actions are also likely to be necessary. There is experimental evidence revealing that individuals are willing to take action towards a group's shared goals when they believe that other group members might also take such action (Fehr & Gachter, 2000). Similarly, within groups, the intensity of participation and commitment could vary given the different motivations, perceived benefits, and trust in collective action (Meier zu Selhausen, 2016). The key variables used by previous studies were centered on the knowledge gained from group activities, perception of trust, benefits in terms of technology, and economic gains from collective action (Gyau et al., 2016).

Access to the market can influence farmers' decisions concerning cooperative action in various ways. Access to the market is directly associated with the transaction costs that occur when households participate in input and output marketing activities. Transaction costs are barriers to market participation by smallholder farmers and are one of the factors

responsible for significant market failures in developing countries (Dimara & Skuras, 2003; Pretty, Toulmin, & Williams, 2011). Farmers participate in agricultural cooperatives to overcome barriers, including poverty, market failure, missing services in the production process, decreased income, to reduce transaction costs with traders, and to contribute to the development of the cooperative communities (Msimango & Oladele, 2013). Hovhannisyan and Gould (2012) identified that cooperative organizations are supportive of overcoming barriers that impede farmers' access to assets, information, services, and input and output markets. Participation in cooperatives may require updated information on the activities of unions and operations. Therefore, the farmers have a better chance of getting reliable information related to agricultural production and management from a cooperative member than farmers far away (Kidane et al., 2018).

3. Methodology and data

The logit models adopted in the choice of behavioral studies are based on the theory of Maximum Likelihood suggested by Ben-Akiva and Lerman (1985) (Esayas & Gecho, 2017; Gyau et al., 2016; Karlı et al., 2006; Nugusse et al., 2013; Zheng et al., 2012). The logit model is classified into two major categories, including the logit model of binary and multinomial models. Tabachnick, Fidell, and Osterlind (2001) argued that the multinomial logistic regression technique has various significant advantages relative to other regression models. Multinomial logistic regression is typically adopted to predict categorical placement in or the probability of category membership on a dependent variable based on multiple independent variables. Similarly, to binary logistic regression, multinomial logistic regression uses maximum likelihood estimation to evaluate the probability of definite membership.

For the analysis, a multinomial logit model might be adopted. In a multinomial model with M categories, one value of the dependent variable is designated as the reference category. In applying the multinomial logit model to agricultural cooperatives of rice farmers, the probability of membership in cooperatives and farmer groups is compared to the probability of membership in the reference category (non-member).

The probability of membership in cooperative model j is given by:

$p_j = \exp(X' \beta j)/D$, $j = 1,2,\ldots, m-1$

$p_m = 1/D$

where $D = 1 + j = \sum_{j=1}^{m-1} \exp(X'\beta j)$, (j = 1, 2, …, m) is the different alternative, p_j is the probability of membership in cooperative model j, X is a vector of characters, and βj is the vector of coefficients pertaining to model j.

Table 1: Definition of variables

Variable	Definition	Expected signs
Dependent variable:		
Y	Dummy, cooperative participation: 2 = cooperative member; 1 = collaboration farmer group member; 0 = non-member.	
Independent variables:		
Gender	Dummy, gender of household head: 1= male, 0= female	-/+
Age	Continuous, age of household head (years)	-
Education level	Continuous, the number of formal education years of household head	+
Farmland size	Continuous, total farmland (1.000m^2)	+
Access to credit	Dummy, household's access to credit in cooperative action: 1= yes, 0 = otherwise	+
Off-farm income	Dummy, off-farm income of household: 1= yes, 0 = otherwise	+
Social capital	Continuous, the number of traders that the farmer contacts	+
Access to extension	Continuous, the number of agricultural knowledge sources that the farmer accesses by extension (television-radio, agricultural paper-book, smartphone, extension officer, extension-education courses, others)	+
Perceived trust	Dummy, perceived trust in cooperative action: 1=yes, 0 = otherwise	+
Land tenure	Land tenure status: 1=secure, 0 = otherwise	+
Constraint to market	Continuous access to markets (distance to input/product market, km)	-

A sample size requirement for the multinomial logistic regression indicates a minimum of 10 cases per independent variable (Schwab, 2002). According to Yamane (1967), the minimum sample size in the study should be:

$$n = \frac{Z^2 p(1-p)}{e^2} = \frac{(1.96)^2 0.5(1-0.5)}{0.05^2} = 384.16$$

where Z is the significance level of 95%, the value of the distribution table Z = 1.96, P is the estimate of the correct prediction of *n* for *p* = 0.5, *e* is the sampling error allowed with +/- 0.05 (5%).

The Mekong Delta, located in the south west, is the largest rice production area in Vietnam. The Delta covers 39,000 km^2, with approximately 600 km of coastline; it is divided into 12 provinces (Long An, Tien Giang, Ben Tre, Tra Vinh, Vinh Long, Dong Thap, An Giang, Kien Giang, Hau Giang, Soc Trang, Bac Lieu, and Ca Mau) and one central city, Can Tho. The sample areas, illustrated in Figure 1, include eight provinces (An Giang, Dong Thap, Long An, Tien Giang, Can Tho, Kien Giang, Soc Trang, and Bac Lieu) which were randomly chosen from each of the three major water resource zones: the highly flooded zone (Long Xuyen and Plain of Reeds), the freshwater zone (upper lands between the Tien and Hau Rivers), and the saline intrusion zone (East Sea Coastal, Ca Mau Peninsula) (Tuan, Hoanh, Miller, & Sinh, 2007).

The cross-sectional data of 640 rice farmers based on face-to-face interviews using a structured questionnaire were selected. The respondents were selected based on the support of village leaders and extension officers from the official household list of each commune in the sample area.

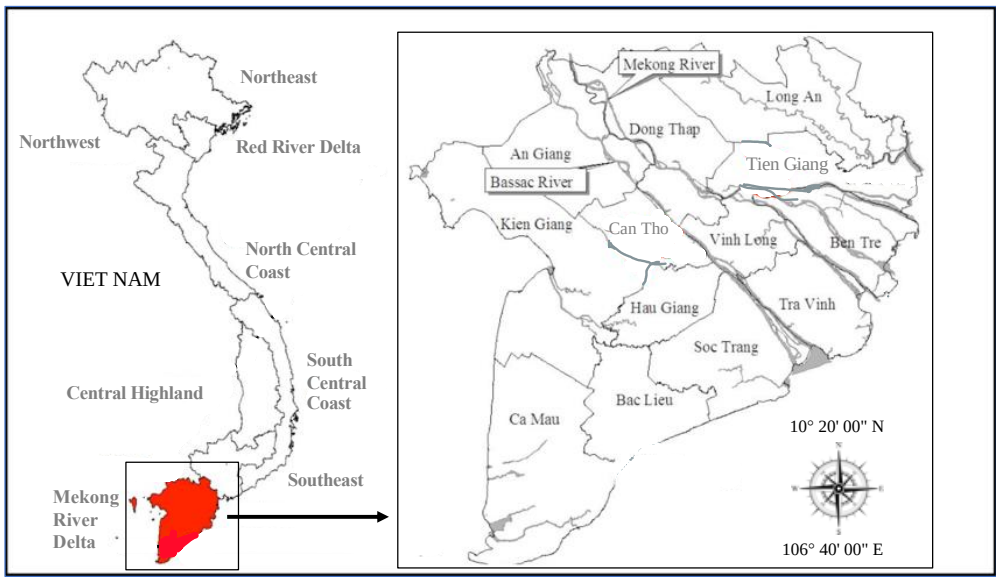

Figure 1: Map of the study area.

Source: Ho and Shimada (2019)

4. Results

The survey data revealed that 222 participants (34.7%) were involved in cooperation and collaboration groups, while 418 (65.3%) were not. Among the cooperative members, 108 participants (16.9%) adopted agricultural cooperatives, and 114 (17.8%) selected collaboration groups. Additionally, 94.1% of the farming households, both participants and non-participants, were headed by men. Other characteristics of the respondents in the survey sample are presented in Table 2.

Table 2: Respondent characteristics (All cases)

	Min	Max	Mean	S. D
Gender	0	1	0.94	0.25
Age	20.00	63.00	39.88	11.28
Education level	1.00	16.00	8.57	4.14
Farmland size	0.50	11.00	4.02	2.30
Access to credit	0.00	1.00	0.57	0.50
Off-farm income	0.00	1.00	0.79	0.40
Social capital	1.00	7.00	3.27	0.93
Access to extension	2.00	5.00	2.68	1.01
Perceived trust	0.00	1.00	0.73	0.45
Land tenure	0.00	1.00	0.78	0.41
Constraint to market	1.00	13	4.32	1.94

Source: Author's calculation

Table 3 indicates that farmers who have favorable resources are more likely to participate in cooperative actions than farmers without such assets.

Table 3: Comparisons of the means of explanatory variables among categories

	Non-members	Cooperative member	Farmer group member	*p*-value	
				F-test	Chi-Square test
Gender	0.81	0.97	0.99		0.005
Age	41.01	40.40	39.54	0.144	
Education level	5.33	10.00	10.19	0.000	
Farmland size	2.07	4.08	4.44	0.000	

Access to credit	0.44	0.56	0.66		0.000
Off-farm income	0.16	0.88	0.88		0.000
Social capital	0.22	0.22	0.84	0.000	
Access to extension	0.54	0.87	2.90	0.000	
Perceived trust	0.45	0.74	0.77		0.000
Land tenure	0.64	0.84	0.89		0.000
Constraint to market	5.12	4.45	4.33	0.000	

Source: Author's calculation

The results in Table 4 show the logistic coefficient for each independent variable and for each alternative category of the dependent variable. The chi-square results demonstrate that likelihood ratio statistics are highly significant ($p < 0.0001$), suggesting the model has the power to reliably explain behavior that leads to participation in cooperative forms. The distribution in Table 4 reveals that the value of pseudo R^2 is 0.3516, suggesting that 35.16% of the variability of the dependent variable is explained by this set of variables used in the model.

Table 4: Parameter estimates and marginal effects of the explanatory variables from the multinomial logit adoption model

Variables	Cooperative member		Farmer group member	
	Estimated coefficients	Marginal effects	Estimated coefficients	Marginal effects
Gender	-0.575	-0.066	14.44	0.170
	(0.977)		(806.26)	
Age	-0.008	-0.0004	-0.020	-0.0013
	(0.013)		(0.012)	
Education level	0.154***	0.010	0.022	0.0007
	(0.039)		(0.033)	
Farmland size	0.361***	0.023	0.287***	0.018
	(0.076)		(0.067)	
Access to credit	1.378***	0.087	0.655**	0.037
	(0.469)		(0.308)	

Off-farm income	0.881	0.048	0.413	0.023
	(0.609)		(0.445)	
Social capital	0.578***	0.036	0.656***	0.042
	(0.162)		(0.144)	
Access to extension	0.695***	0.045	0.513***	0.032
	(0.145)		(0.131)	
Perceived trust	0.411	0.033	0.361	0.026
	(0.399)		(0.357)	
Land tenure	0.429	0.025	0.464	0.027
	(0.475)		(0.396)	
Constraint to market	-0.358**	-0.024	-0.114	-0.006
	(0.096)		(0.078)	
Constant	-8.100***	-	-20.55	-
	(1.563)		(586.68)	
Number of observations = 640; LR chi^2(22) = 398.61; Prob > chi^2 = 0.0000				
Log likelihood = -367.608; Pseudo R^2 = 0.3516				

, **, and * denote significance at 10%, 5%, and 1%, respectively; standard errors in parentheses; reference category is non-member.*

Source: Author's calculation

The estimation results also reveal that the probability of the Chi-square model (398.61) is 0.005, and so less than the 0.05 ($p< 0.05$) level of significance. This implies that the effects of many independent variables in the model are statistically significant at 5% or higher, and the signs on most variables are as expected. An assessment of Table 4 reveals that there is a statistically significant relationship between education level, farmland size, access to credit, social capital, access to extension, and constraint to market and the dependent variable, cooperative participation among farmers.

5. Discussion

The findings align with other research results (Arayesh, 2011; Fisher & Qaim, 2012; Gijselinckx & Bussels, 2014; Gyau et al., 2016; Kaaria et al., 2016; Karlı et al., 2006; Mojo et al., 2017; Nugusse et al., 2013; Zheng et al., 2012). Farmers participate in cooperative

organizations because they perceive them as institutions that can help them to reduce production costs and marketing risks, ultimately enhancing their chances of expanding their business operations and raising their income levels. The cooperative membership probability increases with more education, farmland size, access to credit, social capital, access to extension, and access to market.

The coefficients of each independent variable in the model may not represent its impact on the dependent variable in terms of magnitude or size. Thus, marginal effects are adopted to effectively interpret the results of the multinomial logit model, which show the probabilities of membership related to the changes in each explanatory variable.

The education level of the household was found to be positively and significantly correlated with cooperative membership at $p < 0.01$ relative to the base category. A one-unit increase in the education level of farmers may, in turn, increase the probability of participation of a cooperative member by 1%, relative to the base category (non-member).

Farmland size appears to be positively and significantly correlated with cooperative membership and farmer group membership at $p < 0.01$, relative to the base category. A unit increase of 1,000 m^2 per household would increase the probability of adopting cooperative membership and farmer group membership by 2.3% and 1.8%, respectively, higher than those households whose farmland size is small. Farmers with large production scales are more financially capable and therefore have a higher probability of becoming cooperative members and farmer group members in production. The area of agricultural land per capita in Vietnam is 0.25 ha, below the world and regional averages of 0.52 ha and 0.36 ha, respectively (GSO, 2018), which hinders efforts to apply technology, collaborate with enterprises, and establish concentrated production areas in the context of intensive global integration and climate change.

Access to credit presents a positive and significant correlation with cooperative membership and farmer group membership at $p < 0.01$ and $p < 0.05$, respectively, relative to the base category. Farmers who have credit accessibility are more likely to adopt cooperative membership and farmer group membership by 8.7% and 3.7%, respectively, which is higher compared to those who do not have access to credit. Credit accessibility

might encourage farmers to participate in cooperative action if they face legal constraints or additional investments related to agricultural production.

Social capital is positively and significantly correlated with a household's decision to become a cooperative member or a farmer group member at $p < 0.01$, relative to the base category. An increase of a single trusted trader in a farmer's trading network might increase the likelihood of the farm participating in two cooperative actions by 3.6% and 4.2%, respectively, relative to the base category. Farmers' social capital can affect the probability of cooperative action in many ways, namely information exchange, market access, labor exchange, and capital access, as well as coping with risks in production and the market.

Extension contact sources are positively and significantly correlated with the likelihood of choosing to be a cooperative member or farmer group member at $p < 0.01$, relative to the base category. A one-unit increase in the extension contact source is likely to increase the probability of the farmer engaging in the two cooperative actions by 4.5% and 3.2%, respectively, which is higher than those households that do not access extension services. Agricultural extension is the official source of information for farmers in agrarian production. Official information about markets, advances, or technical solutions may help to minimize risks, uncertainties, and asymmetric information and thereby play a key role in increasing cooperative actions.

Constraint to market is negatively and significantly correlated with a household's decision to pursue cooperative membership at $p < 0.05$. A one-kilometer increase in the distance to the agricultural input/output market can decrease the probability of participating in cooperative action by 2.4%. Furthermore, a farmer's accessibility to input and output markets likely affects the transaction costs and subsequently the likelihood of cooperative action.

In terms of emerging markets, cooperation between producers and businesses might increase advantages to the market. The form of interaction is expressed through horizontal and vertical links or industry links. A vertical link exists between buyers, distributors, corporations, local businesses, and small and medium enterprises to form product value chains. Horizontal linkage, on the other hand, is the link between enterprises

in the industry with other related sectors (providing materials, products, and support services for business development). Economic relations are a form of cooperation and coordination conducted by voluntary industrial units to promote and benefit business development. The goal is to create a stable commercial relationship through economic contracts or operational regulations to undertake production assignments, exploit the potential of each unit to join or to create market power together, and protect each other's benefits.

The study has certain limitations. First, the study only considered farmers' participation as the dependent variable in the research model. Other alternative variables—farmer commitment and intensity in cooperative action and the performance of agricultural cooperatives—were not considered in this study. Second, the datasets were collected only in the Mekong Delta area; therefore, the model might not be representative of Vietnam's other regions or indeed the country as a whole. In the future, studies should concentrate on other regions and different types of agricultural cooperative models.

6. Conclusion and policy implications

The Mekong Delta is facing challenges because of climate change; therefore, there should be a shift from traditional agricultural production methods to modern alternatives to aid sustainable socioeconomic growth to meet consumer demand. Farmers play a significant role in the supply chain of the farming sector, and their participation in cooperatives likely determines the sustainability of agricultural development on the economic, environmental, and social levels. Based on the survey data of 640 farmers in the Mekong Delta, the study analyzed the factors that determine the probability of the adoption of cooperative models among rice farmers in Vietnam using multinomial logit regression. The estimation results indicate statistically significant relationships between education level, farmland size, access to credit, social capital, access to extension, and constraints to market and the dependent variable—cooperative participation among farmers.

Based on the results, the policy recommendations are as follows: 1) organizing a propaganda campaign aimed at cooperative members and farmers to increase knowledge and inform them about the State's legal policies regarding cooperatives and to encourage

farmers and members to visit and learn about advanced and profitable cooperative models. This initial step should help members and farmers change their awareness of cooperatives; 2) the government needs to promulgate a more explicit policy on farmland expansion. It should increase farmers' land ownership and allow them to expand their fields. This would likely foster large-scale production and mechanization and modernize the agricultural sector; 3) strengthening the formation of optimal combinations of the various dimensions of social capital for the long-term economic success of the groups and the communities. There should be a shift in the extension approach and programming to highlight and enhance the role of social capital in rural and agricultural development in order to promote sustainable rural livelihoods. Accordingly, organizational leadership and staff need to be made more aware of the importance of social capital in rural communities, and their capacity to recognize, build, and strengthen it needs to be promoted through specific training; 4) strengthening agricultural advisory and extension services; 5) the government shall assist agricultural co-operatives in building the necessary infrastructure for production, such as in-field lanes, irrigation canals, roads, and an electrical system, which could have a massive impact on the community in the area when all or the majority of the residents are cooperative members. There should also be a focus on training human resources and instruction on legal regulations for developing cooperatives, which creates favorable conditions for cooperatives to access support policies on advanced techniques and build brand names and trade promotions; and, finally, 6) relevant agencies should pay attention to practical measures to improve cooperatives' activities in the region in the context of climate change and integration with the world. These bodies should petition for more policies to support infrastructure, the consumption and processing of the produce of cooperatives, as well as the training of managers and members.

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