

**Research Article****DIFFERENCE IN ECONOMIC, SOCIAL AND ENVIRONMENTAL EFFICIENCY BETWEEN INDIVIDUAL FARMERS AND FARMERS ENGAGING IN COOPERATIVES: A CASE STUDY IN VIETNAM****<sup>1</sup>Ho Dinh Phi, <sup>2</sup>Trang Quach Thi Minh, <sup>3</sup>Thuong Vo Khac, <sup>4,\*</sup> Minh Bui Quang and <sup>5</sup>Lan Nguyen Thi Ngoc Le**<sup>1</sup>Phan Thiet University, Vietnam<sup>2</sup>Politics and Administration Faculty, Vietnam National University, Ho Chi Minh City, Vietnam<sup>3</sup>Phan Thiet University, Vietnam<sup>4</sup>Department of Industry and Trade of Binh Phuoc Province, Vietnam<sup>5</sup>School of Politics of Binh Phuoc Province, Vietnam**Received 18<sup>th</sup> July 2021; Accepted 15<sup>th</sup> August 2021; Published online 20<sup>th</sup> September 2021**

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**Abstract**

The cooperative model in agriculture including farming cooperatives, “4-house” model, large field model, and the supply chain model is interested in practice because it has brought more profitable and higher income results than individual production farmers. Understanding the economic - social - environmental effectiveness of the cooperative model compared with the traditional household production model is a challenge for researchers and policy makers in Vietnam. Based on the theoretical framework and practice in Vietnam, the researchers team conducted a direct survey of 520 rice farming households in the Cuu Long River Delta and used the Independent Sample t-test method and Chi-square tests for analysis. The results show that the farmer households in the cooperative model are more effective than the traditional farm households in terms of economic - social - environmental efficiencies in rice production.

**Keywords:** Cooperative model, Economic - social and environmental efficiency, Independent Sample t-test, Chi-square test, Cuu Long River Delta, Vietnam.

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**INTRODUCTION**

The most outstanding achievement of agricultural development in recent years is the development of rice farming. From an annual average food import of 900,000 tons for the period 1976-1980 (Ministry of Agriculture and Rural Development, 2014). Vietnam has become the world's leading rice exporter (second position after India). In 2020, Vietnam exported 6.15 million tons of rice, reaching a turnover of 3.07 billion USD, and interested in sustainable production for rice (Ha Anh, 2021). The rice supply of Vietnam (VN) is not only determined for domestic demand but also plays a role in meeting food demand for the whole world. Contributing to this achievement, the Cuu Long River Delta, Vietnam plays a decisive role with 50% of rice farms, 95% of rice yield, and 90% of the Vietnam rice exports (Duyen, 2021). However, rice producers still have to cope with fluctuations in prices, income and risks of abnormal conditions after environment - weather events and especially the fierce competition on the world import market in the context of the global economic crisis. One of the main causes of the above problem is that most of the farmers are still small-scaled producers, scattered production under the form of household production. Since 1990, cooperative models such as cooperatives, “4-house”, large field and supply chain models have been interested in practice because they have brought higher profit and income than individual producers. However, few studies have systematically examined the nature of the efficiency of cooperative versus individual production. In the context of global integration associated with sustainable development, improving competitiveness and stabilizing the income of farmers, especially rice farmers, is a national challenge, in which development of an effective and appropriate cooperation model plays a significant role in confronting these challenges.

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This article focuses on two main contents: (1) Providing a theoretical foundation for the development of cooperation models and measuring economic - social - environmental performance; (2) Policy implications to develop cooperation models.

**THEORY OVERVIEW**

**Cooperative economy:** According to the Ministry of Agriculture and Rural Development (2014), cooperative economy is the process of linking, engaging and cooperating with each other between economic entities on the basis of voluntariness, equality and mutual benefit, helping each other to achieve general purposes. Economic cooperation brings into individual strengths of each member to form the collective strength, to jointly carry out production and business issues in order to achieve the economic benefits of the cooperative and of each member.

**Forms of cooperative economy in the agricultural sector:** In the agricultural sector, the forms of cooperative economy include: (i) the collective economic sector in the form of cooperatives of producers; (ii) the private economic sector includes forms of economic linkages through economic contracts between enterprises providing input and output services of agricultural production for producers (individuals, farmers, ranchers) or cooperatives.

**Agricultural cooperatives:** Agricultural cooperatives are a form of cooperation of independent farmers. Cooperatives were formed to protect members against monopolistic commercial and/or industrial companies. In Western Europe, such as the Netherlands and Denmark, these cooperatives emerged on a voluntary basis (Meulenberg, 2000). Cooperatives have a distinct set of characteristics: Cooperative activities are tied to the market, but the surplus - generated by

the cooperative - goes to the farmer members of the cooperative, in proportion to their product being delivered/purchased to/from cooperatives, after deducting the cooperative's operating expenses and the reserve fund. In general, the main economic objective of agricultural cooperatives in the economic market is to improve the income of the members through advantages such as reducing production costs and also reducing and internalizing the transaction costs, with better information flows about consumer and cooperative needs, can also lower the risks of economic and technological uncertainties and thus reduce transaction costs (Harte, 1997; Ollila and Nilsson, 1997; Royer, 1999; Hendrikse and Verman, 2001; Szabó and Fertó, 2004). According to the Law on Cooperatives in Vietnam (National Assembly, 2012), a cooperative is a collective economic organization, jointly owned by legal entities, established by at least 7 members voluntarily and cooperating with each other in production, business, and job creation to meet the common needs of members on the basis of autonomy, self-responsibility, equality and democracy in management of the cooperative.

#### **Forms of economic linkage through economic contracts between enterprises providing producers input and output services for agricultural production**

In Vietnam, there are 3 main forms of economic linkage: "4-house", large field and rice supply chain.

Model "4-house": Linking "4-house" includes: State, scientists, farmers and entrepreneurs.

State: includes local government and departments

Scientists: includes scientists from the institute/school and local research camps

Farmers: includes individual farmers and cooperative production groups

Entrepreneurs: including input agents, traders, food companies, plant protection companies, processing factories

Farmers have conditions to access capital, scientific and technological advances, are provided with agricultural materials and are able to consume according to contracts signed with enterprises, they feel secure to invest in expansion of production scale, raising the level of intensive farming. The entrepreneur has a place for input supplies, fertilizers, gasoline, and disease control drugs, has a stable source of raw materials, and is proactive in processing and consuming products in domestic and foreign markets. The State organizes association, implements support policies and enhances the management role. Scientists have conditions to research and transfer scientific and technical advances into the production and processing of agricultural products, gradually bringing farmers into the process of international integration and competition. In this linkage model, the important order of each "4-house" is Entrepreneurs, State, Farmers and finally Scientists. Entrepreneurs play the most important role in the production and consumption of products because they perform two functions: supplying materials and consuming products (Nguyen Duy Can *et al.*, 2011). The model attracts businesses to directly participate in the production process and product consumption, helping farmers to apply science and technology

to production more efficiently. Model "Large field": Large fields are fields that can have one or more owners but the same production process, the same product consumption plan, and uniform and stable supply in quantity and quality required by the market. The key point of the union is that farmers practice production together with a common process in all stages, from production, technical processes, production management, harvesting, preservation and product consumption. In order to do that, farmers must organize the unified collective action of each large field instead of individual activities. The production, harvesting, preservation and trading processes are established on the basis of the requirements of enterprises and the market in terms of supply volume and quality (Do Kim Chung, 2012; Vu Trong Binh and Dang Duc Chien, 2012). Large field is a way to organize production on the basis of cooperation and association between farmers and enterprises, representative organizations of farmers in production associated with agricultural produce processing and consumption in the same area, with a large land area, with the aim of creating concentrated and high-quality agricultural products, increasing the competitiveness of agricultural products in the market in order to improve production efficiency, increase income for farmers and participating partners.

The cooperative model has brought positive results in agricultural production: (i) For farmers: Increase profits and income, stabilize output, benefit from receiving support policies of the State: technical training, credit support and cooperation policy support; (ii) On the side of enterprises: High profits, stable supply of raw materials, participation in the market of production factors and agricultural services, benefits from receiving support policies of the State such as interest rates, exchange rates, new technology and etc. The model "rice supply chain": The model of chain-linked rice production is expanding in the Cuu Long River Delta region. In particular, implementing the supply chain model is considered an appropriate solution to the problem of control and management of traceability clearly. The issue of traceability of agricultural products cannot be done with each individual farmer household, in the condition of scattered and fragmented production, but can only be carried out for a concentrated production area with a large scale, have a purchase contract. This will help the actors make the link convenient and tight. According to Ganesham and Harrison (1995), a supply chain is a network of production and distribution options that perform the functions of procuring raw materials, converting materials into semi-finished and finished products, and distributing them for customers. Sunil and Meindl (2001) introduced a more complete concept: Supply chain includes all stages related, directly or indirectly, to the fulfillment of customer needs. The supply chain includes not only manufacturers and suppliers, but also carriers, warehouses, retailers, and the customers themselves. A supply chain is a system of organizations that are linked and cooperated, communicating with each other to operate together, and manage resources related to materials and products from suppliers to end customers together (Christopher, 2010). Products made from the supply chain will be traceable to the product's origin, will be responsible for the situation of floating goods of unknown origin, not ensuring the health of consumers, and no one is responsible for the goods delivered to the market is defective. The basic feature of the supply chain is that there is a main agent in the chain (central enterprise) - associated with a chain brand that plays a dominant role in the chain. Rice is produced from farmers to

the place of transportation, processing and packaging to enter the market through supermarkets, convenience stores, markets or export, and finally to consumers. This is a closed chain process in which there are many agents involved such as farmers, input suppliers, traders, factories, outsourcing companies, product processing manufacturers and consuming customers. Finally, in a closed chain system with many links and many cooperatives, there will be one main organization or enterprise responsible for bringing products to the market with clear brands and labels. Consumers can easily trace the origin and standard contents on product packaging. This is also a new sustainable direction for Vietnam's rice industry, and from here, it will maintain the connection between agents, improve the value of Vietnamese rice brand and increase income for the associated parties. Currently, there are many enterprises and companies participating in the implementation of typical rice supply chains in Vietnam such as Loc Troi Group (An Giang Province), Tan Thanh Trading Co., Ltd (Hoa Lua Rice - Can Tho City), Minh Tam Rice Trading Co., Ltd (Ho Chi Minh City), Tien Giang Food Company (Tigifood), Northern Food Company (Vina Food 1), Que Lam Joint Stock Company (Thua Thien Hue Province), Truong Huong Agricultural Seed Company Limited (Dien Bien Province), Thanh Tin Trading Company Limited (Soc Trang Province - ST24 Rice).

**The theory of division of labor:** According to Smith (1997), division of labor and labor cooperation are two sides that overlap each other in a labor using process. The division of labor must help labor cooperation can take place, and labor cooperation must be based on the division of labor. If you want the labor using process to be closely linked and increase labor efficiency, the division of labor must be reasonable. The greatest improvement in labor productivity and much of the skill, ingenuity, creativity, and good judgment appears to be due to the division of labor. Inheriting Smith's theory of division of labor, Marx (1988) said that division of labor is divided into two basic types: social division of labor and division of labor in craft sites. These two forms of division of labor have a close relationship, serving as a common basis for all commodity production. The way labor is organized with a reasonable division of labor will promote the production process of craft sites to be many times more productive than before and form production specialization.

**Theory of cooperation:** The process of labor and more people teaming together, each in charge of a division of work will shorten the production time. Individual workers lack of cooperation, alone will not likely achieve the result of teaming together, or it can only be achieved in a very long time period, or with a very small scale. The production process has no linkage and cooperation of many people with the guidance and direction of the organization or the commander does not improve productivity individuals, without creating labor productivity higher (Marx, 1988).

**Theory of links:** The economic linkages that form of cooperation and coordinate activities of economic entities conducted on a voluntary basis taken to accelerate the process manufacturing, business development towards the best interest of the parties associated in the framework of state law. The purpose of linking economic mutual assistance between the parties linked to create stability for economic activity, which is done through the operating regulations to conduct production division, sales order exploit the potential advantages of the parties linked to create the general consumer market, protect

the interests of each other. In terms of the market economy, the cooperation model is essentially a form of economic linkage. Linking forms include: horizontal link; vertical link and integrated link. Horizontal linkages are the cooperation of actors in the same stage of the production process in the same or different industries (Rehber, 2000; Gibbon and Ponte, 2005). In agriculture, horizontal linkage represents the link between farmers such as production cooperation groups, agricultural production and trading cooperatives. The benefits of the form of cross-linking are exploiting the advantages of production scale, reducing production costs, increasing profits for stakeholders and especially increasing the bargaining power of the market compared to producing individual farmers. Vertical linkages are links between actors at different successive stages in the production process (Rehber, 2000; Gibbon and Ponte, 2005). In agricultural production, vertical linkage represents the link between farmers and suppliers of seeds, agricultural materials, plant protection, credit, processing and product consumption. This form of association in Vietnam is popular with the model of the 4-house and large field model. The benefits of vertical linkage are reduction of chain costs, risk reduction, farmers' access to market information and capital resources, science and technology, and assurance of product consumption markets. specialization in the division of labor (Christopher and Jonathan, 2009). Vertical - horizontal linkages are the linkage that coordinates both vertical and horizontal, links between subjects at different stages and links between subjects at different successive stages of a during production (Rehber, 2000). This form of association in Vietnam is popular with cooperative models and specific product supply chains. The above background theories are relevant to this study in explaining the effectiveness of models of cooperation, association of production rather than individual production because exploitation is specialized in division of labor, profit advantage in terms of scale, access to resources: capital, technology, improve market bargaining power, have a market for agricultural products and also explain the reasons that individual farmers participate in cooperative models.

#### **Empirical studies related to the effectiveness of cooperation models and measures of economic - social - environmental performance**

A study on "the impact of farmer membership on income in cooperatives - General business associations in Anambra State, Nigeria" by Ezeokafor *et al.* (2019) shows income of members before and after joining the cooperative, there are significant differences in the direction of additional income. A study on "the impact of agricultural cooperatives on the technical efficiency of farmers in China" by Qu *et al.* (2020) shows that the technical efficiency results of the cooperative group with marketing are higher than that of the group of cooperatives with marketing and cooperatives have no marketing. The study on "Benefits of farmers in cooperatives for rice cultivation" by Sedana (2020) shows that cooperatives are a basic tool or a pillar of agricultural development to achieve food security. Farmers who are members of cooperatives are highly involved in supporting cooperatives to produce products and business activities. Subak's cooperative in Guama can meet the production needs of the market (certified seeds) and farmers' needs for agricultural inputs. Farmers benefit from the cooperative's business activities in the form of input supply (fertilizers, pesticides...), credit or loans; and collective marketing. Cooperatives have been successful in sharing profits for members in addition to supporting food security

through increased productivity. Research on “Measurement of economic, environmental, social and sustainability of short-term food supply chains” by Malak-Rawlikowska *et al.* (2019). The authors use indicators reflecting the three main pillars of sustainability (economic, environmental, social) such as economic value added, pollution, labor. Value added is defined as the difference between revenue and direct costs of production. Environmental performance is related to the amount of carbon dioxide (CO<sub>2</sub>) that represents greenhouse gas emissions during the transportation of production inputs to the farm and the transport of outputs from the farm to markets and ports. Social efficiency is shown through (i) Number of employees/working day/working hour engaged in production and business activities; and(ii) Female sex ratio of workers. The team surveyed 208 supply chains in Norway and the UK, using statistical analysis to measure the above indicators. Supply chains ensure economic - social - environmental performance. Research on assessing the sustainability performance of agricultural cooperatives by Marcis *et al.* (2018). The research results show that there are three groups of measurement indicators: economic, social and environmental. Economic measurement: Return on Asset (ROA); Return on Equity (ROE), and Return on Investment (ROE). Social measurement: Income of cooperative members, educational and professional qualifications of cooperative members, number of employees working in the cooperative. Environmental measurement: Health of cooperative members, maintenance of air and water pollution and degradation of land resources used by cooperatives. The study of Hao (2018) on cooperatives of farmers and smallholder farmers in China said: Farmers in cooperatives are more productive and profitable than non-cooperative farmers; Farmers in cooperatives have more favorable access to distribution channels than non-cooperative farmers. Research on typical cooperatives in Western Iran by Gholam *et al.* (2010) said: Cooperatives play a role in social development, poverty alleviation, and job creation. Cooperatives provide a means through which the disadvantaged groups in society work together, share risks and solve problems such as disparities in production scale, coping with competition and variables. market movement. Through cooperation, farmers receive economies of scale, improve production standards, market their products, access credit unions, transportation, professional services, and non-agricultural job creation.

The study of Khuong Luc (2020) on an effective new model of cooperatives in the Mekong Delta shows the following results: The operation of a new type of cooperatives is to provide services such as pumping irrigation, exploiting and managing markets, and consuming products and output products, providing inputs for members in the field of rice production; Effective cooperatives have brought many benefits to members compared to non-member farmers such as: increased profits on products, stable prices and increased income for members through using services. Research on the “4-house” linkage in rice production and consumption by Nguyen Duy Can *et al.* (2011) shows that: The role of the link is evaluated by the author through 6 criteria, which are: supporting policies, organizing linkages, supplying materials, providing techniques, providing capital and consuming rice. The roles of each household are shown in order of importance: enterprise, government, farmer and scientist. Research on large sample fields in agriculture by author Do Kim Chung (2012) shows that households participating in “large fields” achieve economic benefits (yield; income; cost; reduction in number of

spraying times) than non-participating households. Research on large rice fields in An Giang Province by author Le Nguyen Doan Khoi and Nguyen Ngoc Vang (2012) shows that farmers participating in cooperatives have more economic efficiency (income, profit) than farmers. not engaged. Research on the large field model by Dinh Phi Ho and Quach Thi Minh Trang (2017) using measures to assess the socio-economic and environmental performance of the large field model including: (i) Efficiency economic: Production cost, profit, profit rate. (ii) Social efficiency: Income, family labor, hired labor; (iii) Environmental efficiency: Awareness of chemical protection for bottles and packaging, handling residual chemicals, cleaning spray bottles, using tools to protect health when spraying and It is confirmed that farmers participating in large fields have more economic - social - environmental efficiency than farmers who do not participate in large fields. Research on the forms of linkage in the agricultural product consumption chain by Vu Duc Hanh (2015) said that the forms of linkage include: The central core form (farmers - enterprises); Multi-subject form (farmers - cooperatives - enterprises); Informal form (farmer - dealer - enterprise: no formal contract). Research on the supply chain of the rice industry by Tran Hong Dan Yen and Bui Van Trinh (2017) said that the actors in the rice supply chain include: Farmer households, wholesalers, and consumption affiliates, business wholesalers, supermarkets - retailers. The limitation of the chain is the existence of intermediaries (terminals, 70% of output sold from farmers) to share profits, without creating added value for the chain and without a rice brand.

Based on empirical studies, the authors measure the socio-economic and environmental efficiency of agricultural producers mainly through 3 groups of measures:

Economic: including (i) Profit; (ii) Profit-to-cost ratio; and (iii) labor productivity.

Social: includes (i) Producer’s income and (ii) Labor and employment.

On the environment: through farmers’ behavior towards the use of chemicals and technologies related to the impact on the natural and living environment.

## RESEARCH MODEL

Theoretical review and empirical research are needed for further research to extend the theory, provide more empirical evidence and theoretical policy implications related to the assessment of socio-economic - environmental performance between farmers in the cooperative model and individual farmers. Previous studies highlight insights into the performance of cooperatives, large farms, 4-house, supply chain and measure performance mainly by qualitative and descriptive statistics, independent of each type, but not yet provides a complete basis for a comprehensive framework for analyzing the effectiveness of the partnership model. Therefore, the aim of this study is to extend the findings from previous studies and integrate the analysis of socio-economic effects on the Chi-squared and t-test analysis with independent samples. The research team selected the research model for the Cuu Long River Delta as follows:

Fig. 1 shows, comparison of socio-economic - environmental efficiency between farmers in cooperative production models (cooperatives, 4-house linkage, large field, supply chain) and individual farmers.

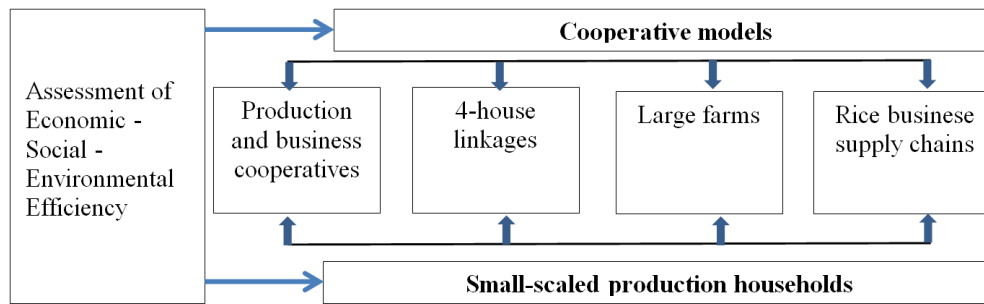


Fig. 1. Assessment of economic - social - environmental performance

Table 1. Hypotheses

Content	Hypothesis
I	ECONOMIC EFFICIENCY ASSESSMENT
H1	H <sub>0</sub> : There is no difference in economic efficiency between individual farmers and farmers in the cooperative model.
H1.1	There is a difference in “profit” between individual farmers and farmers in the cooperative model.
H1.2	There is a difference in “rate of profit” between individual farmers and farmers in the cooperative model.
H1.3	There is a difference in “labor productivity” between individual farmers and farmers in the cooperative model.
II	SOCIAL EFFICIENCY ASSESSMENT
H2	H <sub>0</sub> : There is no difference in social performance between individual farmers and farmers in the cooperative model
H2.1	There is a difference in “income” between individual farmers and farmers in cooperative model
H2.2	There is a difference in “number of employees” between individual farmers and farmers in cooperative model
III	ENVIRONMENTAL EFFICIENCY ASSESSMENT
H3	H <sub>0</sub> : There is no difference in environmental performance between individual farmers and farmers in cooperative model
H3.1	There is a difference in “consciousness to protect chemicals for bottles and packaging” between individual farmers and farmers in cooperative model
H3.2	There is a difference in “residual chemical treatment” between individual farmers and farmers in cooperative model
H3.3	There is a difference in terms of “cleaning the sprayer” between individual farmers and farmers in cooperative model
H3.4	There is a difference in “using tools to protect health when spraying pesticides” between individual farmers and farmers in cooperative model

Based on the research model, there are 3 groups of hypotheses (in Table 1).

## STUDY DESIGN

### Statistical test

In the research model with the hypothesis mentioning the difference between farmers in cooperative models and individual production farmers (qualitative variable) with respect to environmental performance (qualitative variable), the study should use the test. Chi-squared determination to test hypothesis 3 (Greenwood and Nikulin, 1996). In a hypothetical research model mentioning the difference between farmers in cooperative models and individual production farmers (qualitative variable) on economic and social performance (quantitative variable), it is recommended to study used the Independent Sample T test to test hypotheses 1 and 2 (Kendall and Stuart, 1979).

### Data collection and processing

We conducted a survey on 3 provinces representing typical ecological sub-regions and where there are many models of cooperation - association in the Cuu Long River Delta: An Giang, Can Tho, Soc Trang. Soc Trang Province with alluvial freshwater ecosystem, mangrove ecosystem and sand dune ecosystem in estuary and coastal areas; Can Tho City with an alluvial freshwater ecosystem, the cradle of the Cuu Long River Delta. An Giang Province with alluvial freshwater ecosystem, Long Xuyen Province quadrangle melaleuca forest. The study surveyed 580 farming households across 3 provinces representing the Cuu Long River Delta. In each area, choose to survey 50% of observations as individual producers and 50% of observations as rice-farming households in the cooperative

models: Cooperatives; 4-house linkage; Large Field; and Rice supply chain. Distribution of observations according to 4 models: cooperative (135 observations); 4-house linkage (155); large farms (145); rice supply chain (145). All respondents were identified as heads of households, with convenient stratified sampling, conducted from March 2018 to March 2019. After data processing, 520 observations were made, ensure suitability and use for data analysis. All data processing was carried out based on SPSS software version 21.0. Data were collected through direct interviews with detailed questionnaires to test the research model and hypotheses.

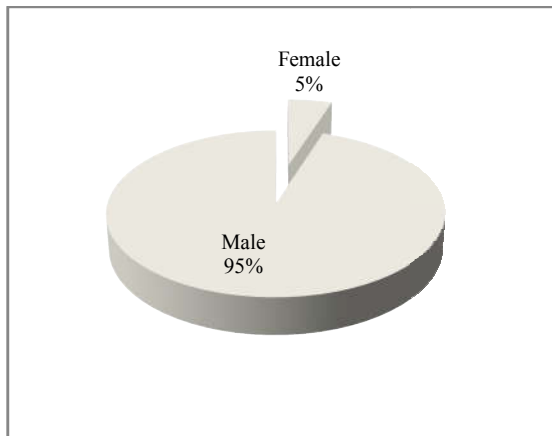
## RESULTS

### Describe the characteristics of the survey object

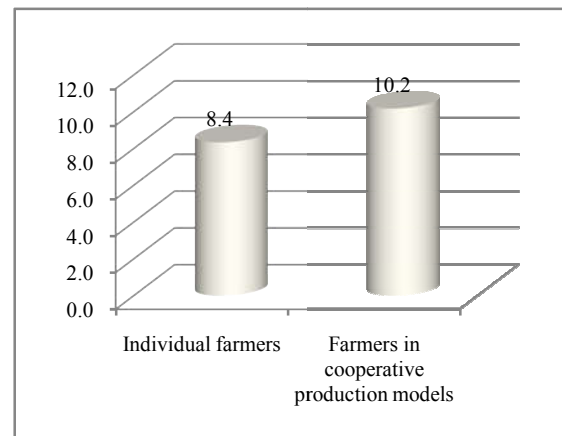
**Gender and area of rice cultivation:** The head of household is mainly male (95%); The area of rice cultivation of households in the cooperative scheme (10,200 m<sup>2</sup>) is higher than that of the households in the cooperative production (8,400 m<sup>2</sup>). Number of employees of the household: In Fig. 4, the number of household workers involved in rice production of the cooperative model (4 people) is larger than that of individual farmers (3 people). It is noteworthy that the number of hired labors of the cooperative models (2 people) is higher than that of the production farmers (1 person). In Fig. 5, for cooperative models, the model 4-house and large farms has the highest number of employees (4 people) followed by cooperatives and supply chains (3 people). Household income: In Table 2, the average income in the year of farmers in the cooperative model (18,070,620 VND) is higher than that in the production households (14,733,630 VND). Among the cooperative models, the model of large farms has higher income than the model of 4-house and the highest cooperative is the cooperative model (17,549,240 VND).

**Table 2. Household income (1,000 VND/year)**

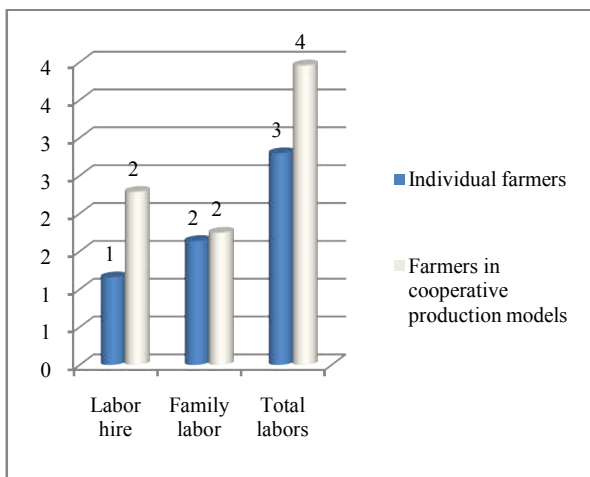
	Income from rice production	Income other than rice in agriculture	Non-agricultural income	Total income
Individual farmers	9361.754	1872.351	3499.521	14733.630
farmers in cooperative production models	11772.78	1884.185	4413.662	18070.620
Sort by cooperative model				
Cooperatives	9445.902	1807.050	3393.423	14646.370
4-house	10041.390	1889.959	3749.019	15680.370
Large farms	11250.160	1897.635	4446.451	17594.240
Supply chain	11485.810	1912.050	4210.121	17607.980
Average household income from rice production	10567.27	64		
Income other than rice in agriculture	1878.268	11		
Non-agricultural income	3956.592	25		
Total income	16402.13	100		



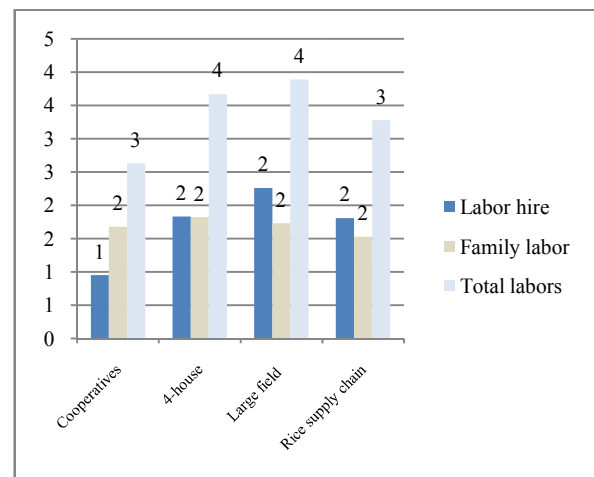
**Fig. 2. Gender of household head (%)**



**Fig. 3. Area of rice cultivation (1,000 m2)**



**Fig. 4. Number of household workers involved in rice production (person)**



**Fig. 5. Number of household workers engaged in rice production according to the model (person)**

In Table 2, the average household income/year is 16,402,125 VND, of which 64% is from rice production, 11% is income other than rice in agriculture and 24% is non-agricultural income.

**Hypothesis test results**

**+ For hypothesis 1**

In Table 3, the difference in profit between the cooperative farmers and individual farmers is 1,487,620 VND, with Levene test and t test, significance level = 0.000 ≤ 0.05. The difference between the profit margin between the cooperative farmers and individual farmers is 36.8%, with Levene test and t-test, significance level = 0.000 ≤ 0.05.

The difference in labor productivity between the cooperative farmers and individual farmers is 1,835,830 VND, with Levene test and t-test, significance level = 0.000 ≤ 0.05. Thus, we reject the hypothesis H0, accept the hypothesis H1.1, H1.2, H1.3 there is a difference in profit, profit margin and labor productivity of farmers in the cooperative model and the individual farmers with confidence level above 95%.

**+ For hypothesis 2**

In Table 4, the difference between the number of employees in the cooperative model and individual households is 1 person, with Levene test and t-test, significance level = 0.000 ≤ 0.05. The difference in income of households in the cooperatives and individual households is 3,337,000 VND, with the combination

Table 3. Economic efficiency differences

Group Statistics		
	Household type	Mean
Profit (1000 VND/year)	Individual famer	7955.625
	Farmer in cooperative model	9443.245
Profit margin (Rate of profit/cost, %)	Individual famer	113.325
	Farmer in cooperative model	150.188
Labor productivity (total income per labor)	Individual famer	10656.54
	Farmer in cooperative model	12492.36

Independent Samples Test								
		Levene's Test for Equality of Variances			t-test for Equality of Means			
		F	Sig.	t	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
							Lower	Upper
Profit	Equal variances assumed	36.949	0.000	-12.017	0.000	-1487.62	-1730.8	-1244.4
	Equal variances not assumed			-12.017	0.000	-1487.62	-1730.92	-1244.3
Profit margin (%)	Equal variances assumed	24.458	0.000	-14.594	0.000	-36.8	-41.8252	-31.900
	Equal variances not assumed			-14.594	0.000	-36.8	-41.8259	-31.899
Labor productivity	Equal variances assumed	29.598	0.000	-4.236	0.000	-1835.83	-2687.23	-984.42
	Equal variances not assumed			-4.236	0.000	-1835.83	-2687.33	-984.32

Notes: When Sig. > 0.05 in Levenve test, choose Sig. in the row "Equal variances not assumed" of the t-test. If Sig. ≤ 0.05, conclude that the difference is statistically significant.

Table 4. Social efficiency differences

Group Statistics		
	Household type	Mean
Total labor (person)	Individual famer	2.8
	Farmer in cooperative model	3.96
Total income (1000 VND/year)	Individual famer	14733.63
	Farmer in cooperative model	18070.62

Independent Samples Test									
		Levene's Test for Equality of Variances			t-test for Equality of Means				
		F	Sig.	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Total labor	Equal variances assumed	21.999	0.000	-8.128	0.000	-1.159	0.143	-1.439	-0.878
	Equal variances not assumed			-8.006	0.000	-1.159	0.145	-1.443	-0.874
Total income	Equal variances assumed	0.146	0.702	-19.614	0.000	-3337	170.1333	-3671.	-3002.
	Equal variances not assumed			-19.614	0.000	-3337	170.1333	-3671.	-3002.



Table 5. Environmental efficiency differences

	Individual famer	Farmer in cooperative model	Chi-square test Asymp. Sig. (2-sided)
Plant protection consciousness			0.000
Throw it right away from the field	27.3	13.1	
Thrown in the canal	45.4	8.5	
Leave it around the garden	10	8.8	
To enter the reservoir	17.3	69.6	
Chemical treatment			0.000
Continue spraying until the end	32.3	29.2	
Throw away	45.4	6.2	
Keep in spray bottle	11.2	11.2	
No excess spray	11.2	53.5	
Cleaning the sprayer			0.000
Yes	49.6	71.9	
No	50.4	28.1	
Use tools to protect your health when spraying			0.000
There are protective equipment	40.4	64.6	
There are not protective equipment	59.6	35.4	

of Levene test and t-test, significance level =  $0.000 \leq 0.05$ . Thus, we reject the hypothesis  $H_0$ , accept the hypothesis  $H_{2.1}$ ,  $H_{2.2}$  there is a difference in the number of employees, farmers' income in the cooperative model and the individual farmers with a confidence level of over 95%.

### + For hypothesis 3

In Table 5, it is shown that the households in the cooperative system have better awareness of plant protection and chemical handling skills, cleaning sprayers, and better health protection than individual households. Chi-squared test for significant difference =  $0.000 \leq 0.05$ . Thus, we reject hypothesis  $H_0$ , accept hypothesis  $H_{3.1}$ ,  $H_{3.2}$ ,  $H_{3.3}$ ,  $H_{3.4}$  have different confidence level over 95%.

## CONCLUSIONS AND POLICY IMPLICATIONS

Firstly, the research has determined that the farmer households in the cooperative model have higher economic, social and environmental efficiency than the cooperative farming households. This result is similar to the study on cooperatives and smallholder farmers in Western Iran by Gholam *et al.* (2010); in China by Hao (2018); Research on supply chains in the UK and Norway by Malak-Rawlikowska *et al.* (2019); the study of Do Kim Chung on Coalition in Vietnam (2012); and Le Nguyen Doan Khoi and Nguyen Ngoc Vang (2012). This result suggests that the cooperation models have economic - social - environmental efficiency. Therefore, depending on the geographical region, local culture and socio-economic characteristics of each locality, farmers can participate in any model of cooperation. The more individual farmers participate in cooperative models, the higher the farmer's living standards, better environmental protection, and the closer the farmers get to sustainable agricultural development. Second, cooperative models (cooperatives, 4-house, large farms, supply chain) are more economically, socially and environmentally effective than individual production. However, it should be noted that Experience in the world, in the long-term development of the cooperative model; The model of a rice supply chain associated with a specific brand will meet the high demands of the market because domestic and international consumers are always interested in the origin of the product. Therefore, it is necessary to have policies to support capital and apply new technologies in rice production and processing for the development of cooperative models and supply chains. Third, all effective cooperation models have the role of enterprises in linking with individual farmers in terms of input supply,

production technical guidance, product processing, product consumption, and especially affects farmers who have to convert products according to market requirements. Therefore, it is necessary to have a policy to support enterprises to borrow loans from banks, to finance and to exempt and reduce taxes for the part of training and education expenses, research and application of new technologies in production and processing rice and training agricultural extension staff of enterprises.

## CONCLUSION AND RESEARCH LIMITATIONS

The present study aims to expand the theoretical framework and provide evidence in empirical results on the socioeconomic-environmental performance of individual farmers and farmers in the models. in collaboration with evidence from the Cuu Long River Delta, Vietnam. The findings highlight the strong role of cooperative models through the use of statistical tests. The study has certain limitations. The survey subjects were only taken from three provinces in the Cuu Long River Delta, which limits the generalizability of the study. Future research should examine different provinces and regions in Vietnam and make comparisons to improve the generalizability of the findings. Moreover, this study only considers 3 groups of measures to evaluate the socio-economic efficiency, there are other dynamic measures and criteria that this study has not mentioned.

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