COST–BENEFIT ANALYSIS OF ORGANIC AND TRADITIONAL RICE PRODUCTION IN MEKONG RIVER DELTA: THE CASE OF CA MAU PROVINCE, VIETNAM

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Abstract. The objective of this study is to analyze the benefits and costs of the organic rice production model compared to traditional rice production in the years 2020 and 2021 in Ca Mau province in Mekong Delta, Vietnam. The survey sample consisted of 72 households growing organic rice and 95 households growing traditional rice randomly selected for the survey with questionnaires. Descriptive statistics and cost–benefit analysis were used for the economic performance models of the two production models. The results show that both models are profitable with a benefit to cost ratio greater than 1. Fertilizer and labor costs in the organic model are significantly higher than in the traditional model, while revenue per hectare of the organic model is significantly higher than that of the traditional model. However, the profitability of the organic rice model is higher than that of the traditional model. The main challenges in converting traditional rice to organic include lack of market information, technical support and access to key purchasing points. Therefore, it is critical for farming households receiving supports from provincial agricultural management agencies, agricultural extension centers as well as information channel development based on social networks to improve famers' organic production capacity and market access.

Keywords: *organic rice farming, organic food, revenue, profit market access, farming household, production cost*

Introduction

Globally, organic farming has been growing quickly and reaching a wide acceptance by consumers, farmers, policymakers and market actors (European Commission, 2015; Chinvarasopak, 2015; Bello, 2018). According to FAO (2021), nearly 80 million hectares are now under organic agricultural production, accounting for 1.5% of global agricultural land. Also, the demand for organic products has increased significantly due demands for protecting health of consumers whether in developed or developing countries (Eurostat, 2018; Arkolakis et al., 2018). As a result, the market for organic products grew at an average rate of 10% to 15% in the period 2011-2020 globally (Willer et al., 2020). Rising health concerns because of growing number of chemical poisoning cases globally is acting as a driving force in the organic food market. Currently, around 200,000 people die every year due to toxic effects of pesticides in food products (Adamtey et al., 2016). This causes consumers shifting their focus towards organic food products (Doucha et al., 2012; Cechura, 2010; FAO, 2020).

In Vietnam, according to the Ministry of Health, in 2019 there were 258 cases of food poisoning with 5,668 impacted people and 59 deaths, of which 20% of the cases had been caused by bad quality rice consumption. Niggli et al. (2020) and Huy (2020) showed that today health and food continue to be the top concerns of Vietnamese

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consumers; in which 44% of people surveyed said that health is their greatest concern. Therefore, the need to consume safe foods to ensure health is becoming more and more important for people. In fact, using organic food has become a new trend in Vietnam. Even in the past few years, organic products have been creating a fever for a part of consumers. Organic rice, vegetables, fish, meat, and fruits are all on the list of foods chosen by many households (Le and Nguyen, 2019).

Because of that, organic food is increasingly appearing from supermarket to a series of clean food store chains in big cities and even in rural areas in Vietnam. There are supermarkets that have established separate stalls for organic, natural foods. The common feature of products being sold on the market is clear origin, mostly from recognized organic production areas, with a barcode on each product. A survey of the Market Administration (2020) indicated that organic food costs 20%-40% more than traditional food.. However, consumers are still willing to pay these higher prices to protect their health and that of their families. Despite many positive developments, there are still many challenges for the organic food market in Vietnam to develop to its full potential (Ministry of Agricultural and Rural Development – MARD, 2020; FAO, 2021). Vietnam is a country with a high proportion of young population with people's income is increasing day by day. This is one of the favorable conditions for the development of the organic food market. However, the country currently has less than 200,000 ha of agricultural land that is recognized for organic production. Some organic products have guaranteed quality but have not yet found a place in supermarkets due to high prices. Therefore, it is necessary to expand the organic food production area, at the same time, businesses need to improve more. about design and product communication, along with quality improvement to develop the market. In addition, it is necessary to apply new production technologies to reduce production costs, contribute to reducing the cost of products, thereby helping organic food to be affordable for a larger part of people (Le and Truong, 2019; MARD, 2020).

Among organic foods in Vietnam today, organic rice is one of the most popular products (MARD, 2020). Provinces in the Mekong Delta, including Ca Mau, are currently developing strongly organic rice farming systems. This is the province with the largest organic rice production area in the country. According to the Agricultural Development Plan of Ca Mau for the period of 2020-2030, rice is still identified as the main crop, accounting for most of the local area and output, and gradually increasing the rate of rice production. organic in production structure. Therefore, Ca Mau has been building and replicating organic rice fields, producing clean rice, mainly in Tran Van Thoi and Thoi Binh districts (Ca Mau Provincial Office, 2021). In these districts, to grow organic rice, farmers choose ST24, ST25, Jasmine rice varieties with high quality, high yield, good quality, carefully prepare the soil, creating a flat surface with drainage before sowing. In addition, they also ensure that the seeds are soaked in the correct technique, regularly checking the sprouts. Seeds are sown by row sowing tool, the amount of seed sown for 1 *sao* (1,000 m^2) is 3.5 kg of seed. Organic fertilizers are used for lining and during the growth and development of rice plants, absolutely no chemical fertilizers or chemical pesticides are used. Scientific irrigation water regime, suitable for the growing needs of rice plants. Although the organic rice production model has been achieving initial success, due to the fact that in the early periods, when switching from traditional farming to organic farming, the crop productivity is not high, making production less profitable. There are not many farmers, and the experience of farmers is still weak, leading to the effectiveness of this model is not high. However, this is a

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production model with great potential in terms of socio-economic efficiency, especially organic rice production that significantly limits the use of chemical fertilizers, growth stimulants, chemicals. pesticides, contribute to environmental protection and improve people's health. Therefore, the development of organic rice cultivation is now an urgent issue not only of Ca Mau province but also of the entire Mekong Delta region.

Empirical evidence worldwide shows that encouraging farmers to invest into organic farming requires relevant information to support their producing decisions. One important tool providing this information is "cost and benefit analysis." This critical technique is employed to analyze alternative farming production options, thereby helping farming households solve practical issues (Mazzoncini et al., 2000; Wollni et al., 2014; Kostlivy et al., 2017). Generally, the cost of production is an crucial economic variable determining production performance of farms (Kumbhakar et al., 2009). This variable might help farming households with decision making since it examines the methods of risk solving coming along with agricultural production (Kahan, 2009; Khunthongjan et al., 2016; Lawanprasert et al., 2017; IFOAM, 2017). Jierwiriyapant (2012) indicated that both organic and traditional rice farming can bring about profitability with different levels. Under this hypothesis, it is of much interested to further consider the economics of organic farming, which integrate the analysis of benefit - cost structures of organic farms (Coelli et al., 2005; Ciaian et al., 2013; Cechura, 2014).

Benefit - cost structures of production have crucial implications for organic agricultural development farming households' income and farming model selection (Brožová, 2010; Ciaian et al., 2013). A comparison taking into consideration the economic and technical efficiency of the two production systems could produce useful information for management solutions and strategies and farming improvement (Bravo et al., 2010; Trinkova et al., 2012; Chinvarasopak, 2015).

This study aims at analyzing the benefits and costs of organic rice production model compared with traditional rice production model in Ca Mau province, Vietnam in the period of 2020-2021. The study provides an empirical evidence on the economic efficiency of organic rice production in a developing country in Mekong Delta, Asia. At the same time, it provides some input information for the planning process of plans and solutions to develop organic rice in the study area. In addition to the introduction and conclusion, the study includes the main contents including materials and methodology, results and discussion as well as recommendations for the development of organic rice in Ca Mau province and Vietnam.

Materials and methods

Overview about the study area

Ca Mau is a coastal province in the southernmost part of Vietnam, located in the Mekong Delta region. The entire territory of Ca Mau province is located on the Ca Mau Peninsula. Ca Mau is a lowland area, often flooded, with 5 main soil groups including: alkaline soil, peat soil, alluvial soil, saline soil and canal soil. Ca Mau forest is mangrove distributed along the coast with a length of 254 km. Besides, Ca Mau also has a melaleuca forest ecosystem located deep in the continent in the districts of U Minh, Cai Tan, Thoi Binh with a scale of 35,000 ha. The area of mangroves in Ca Mau accounts for 77% of the mangrove forests of the Mekong Delta (MARD, 2020).

Ca Mau province is characterized by a sub-equatorial monsoon tropical climate, with the average high temperature in all provinces of the Mekong Delta. Ca Mau's climate is

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divided into two seasons: the rainy season and the dry season. In which, the rainy season is from May to November, the dry season is from December to April next year. The average rainfall in Ca Mau has 165 rainy days/year, with 2,360 mm. The annual average humidity is 85.6%, the average annual temperature is 26.5 °C. In which, the highest average temperature of the year is in April, about 27.6 °C, the lowest average temperature in January, about 25 °C (Ca Mau Provincial Office, 2021).

Ca Mau province has 9 district-level administrative units, including 1 city and 8 districts, divided into 82 communes, wards and townships. In 2019, Ca Mau was the 26th most populous province in Vietnam with 1,229,600 people, and ranked 41st in terms of Gross Regional Product (GRDP) -53.229 billion VND (2.4 billion USD), the GRDP growth rate in 2019 reached 7.0% (Ca Mau Provincial Office, 2021).

In Ca Mau, organic rice started to be grown in 2015 in Tran Van Thoi district and is currently being grown in other districts (*Fig. 1*). However, organic rice is still grown the most in 2 districts of Tran Van Thoi and Thoi Binh (total area is about 1,500 ha in 2020) (Ca Mau DARD, 2021). To grow organic rice, farmers choose ST24, ST25, Jasmine rice varieties with high quality, high yield, good quality, carefully prepare the soil, creating a flat surface with drainage before sowing. The biggest difference between organic rice and conventional rice in CA Mau is that organic rice is grown completely naturally, following environmentally friendly farming methods. Organic rice will be of good quality according to certain standards of organic agricultural product censorship agencies, must not use chemical fertilizers, pesticides and growth stimulants in the cultivation process. The fertilizer used for organic rice is organic, and the soil is specially improved according to strict requirements to achieve a pollution-free standard. Together with fully specialized and modern rice milling machinery and equipment, to achieve high quality effect in terms of aroma, plasticity and impurity-free.

Economic model for analysis

Cost-benefit analysis (CBA) is a technique that helps decision makers, businesses, and households know the costs and benefits of a development activity, so that they can critically make decisions about how to use their scarce resources for achieving efficiency (Boardman et al., 2018). Several studies have been implemented to compare the benefits and costs of organic and traditional rice production. Researches by Adhikari (2011) and Lawanprasert (2017) showed that organic farming has higher production costs than traditional farming. Regarding output, Mendoza (2004) indicated that organic productivity are significantly lower than that of conventional model. Similar findings were also found by Nemes (2009), Samie et al. (2010) and Gailhard (2015). However, contradictory results were revealed by Teresa (2009) and Suwannakit (2016), indicating that organic rice productivity was higher than conventional rice productivity. In terms of return and net profit, Tashi (2016) showed higher values for organic rice production model. Similarly, Lawanprasert (2017) indicated higher profit of organic farming with smaller production costs. Tashi et al. (2016) studied the benefit and cost structures of organic and traditional rice production in Bhutan. The results showed that under organic rice farming, production costs were higher and productivities were lower. In spite of this, organic rice farming is more profitable than traditional production as a results of higher market price of organic rice. This indicates the importance of price differences across market segments within the distribution channel and the profitability of rice production between the two rice farming systems (Pattanapant, 2013; Sauer et al., 2019).

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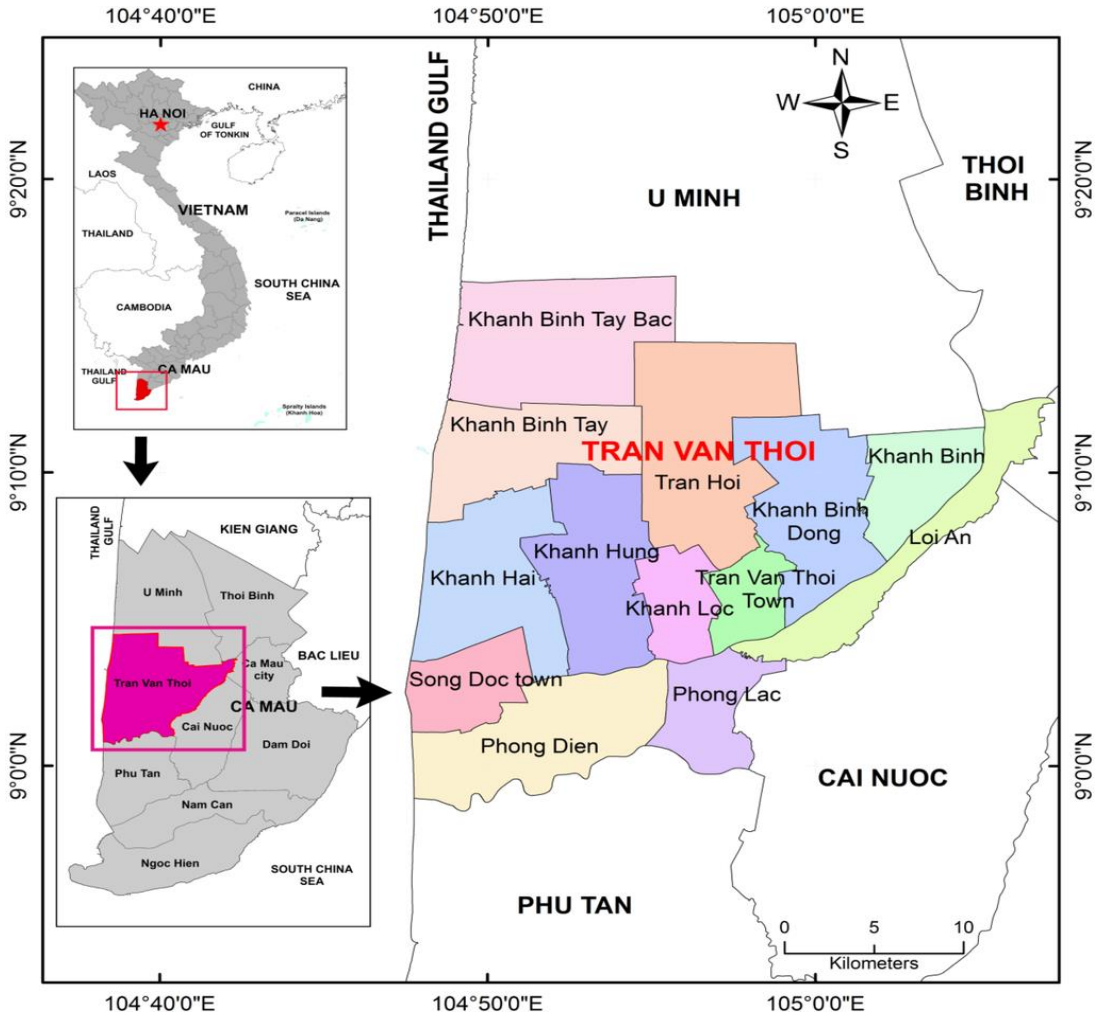

Figure 1. *Map of study area in Ca Mau Province, Vietnam*

(I) In this study, we adapt the CBA approaches by Tashi and Wangchuk (2016), Suwannaki et al. (2016), Boardman et al. (2018) and use the following economic models to calculate the costs, benefits and economic efficiency of organic rice production compared to conventional rice in the study area. Then, descriptive statistics and difference test (dependence sample T-test) were used to evaluate the difference in benefit and cost variables in organic farming and traditional farming. Total revenue represents the total income farming households receive from selling rice per season which is determined by the formula:

$$TR_T = P_{T\ x}\, Q_T \qquad \text{(Eq.1)}$$

TR_T: total revenue (thousand VND/ha/year) of rice produced by technology T (T = 0: traditional farming, T = 1: organic farming); P_T: market price of rice (thousand VND/kg/year) grown by technology T; Q_T: yield of rice grown by technology T (kg/ha/year).

(II) Total cost of rice production is determined by the formula:

$$\text{Total cost} = \text{Fixed cost} + \text{Variable cost} \qquad \text{(Eq.2)}$$

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Variable costs are costs incurred along with rice production including: seed costs, labor (including family labor), fertilizers, harvesting costs, land preparation costs (and other costs).

Fixed costs are costs that do not depend on production output but create a premise for production including: land tax and depreciation of fixed assets (plows, tillers), with:

$$TVC_T = \sum_{n}^{i=1} P_{X_i} X_{iT} \quad \text{(Eq.3)}$$

TVC_T: total variable cost (thousands of VND/ha/year) for rice grown by technology T; PX_i: cost of input i for rice production (thousands of VND/unit); X_{iT}: the ith input amount (over 1 ha/year) for rice production by technology T.

(III) Gross profit of rice production is determined by:

$$GP_T = TR_T - TVC_T \quad \text{(Eq.4)}$$

GP_T: gross profit (thousand VND/ha/year) for rice grown by technology T.

Net profit of rice production is calculated as follows:

$$NP_T = TR_T - TC_T \quad \text{(Eq.5)}$$

NP: Net profit (thousand VND/ha/year) for crop according to technology T, with

$$TC_T = TVC_T + TFC_T \quad \text{(Eq.6)}$$

TFC_T: total fixed costs (thousands of VND/ha/year) for rice cultivation by technology T.

(IV) Benefit–cost ratio (BCR) is the final indicator for comparing the economic efficiency of organic and traditional rice farming. BCR/ha was calculated by dividing the total revenue for the total variable cost of rice production.

$$BCR_T = (TR_T / TVC)_T \quad \text{(Eq.7)}$$

BCR_T: benefit/cost ratio per hectare for rice produced by technology T.

Data collection

Primary and secondary data were collected to evaluate the economic efficiency of organic and traditional rice production in Ca Mau. The study data is collected through the process below:

Farming household survey

Primary data was collected through direct survey of organic and traditional rice farming households in Tran Van Thoi district, Ca Mau province. According to Department of Agriculture and Rural Development of Tran Van Thoi District (2020), there are nearly 400 households growing organic rice, concentrated in the communes of Khanh Binh, Khanh Binh Dong, Khanh Binh Tay, Khanh Binh Bac and Khanh Hai (on average each household has 1.8 ha of organic rice). We use the following formula (Greene, 2005) to estimate the number of survey samples:

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$$n = \frac{N}{1 + Ne^2}$$

n is the sample size, N is the total number of households in population, e is accepted errors. With *e* = 0.05 (the estimated error is 5%), and for a total of 420 organic farming households, the estimated number of samples for reliability is 72 (17%). Therefore, 72 organic households were chosen for survey. The households participating in the survey were randomly selected from the list of organic rice farmers provided by the commune authorities. To ensure representation, in each commune, the researchers selected 17% of organic rice farming households for the survey. At the same time, 95 traditional rice growing households were also selected for the comparative study (*Table 1*).

Table 1. *Distribution of survey sample by communes*

Commune	Number of households with organic rice farming surveyed	Number of households with traditional rice farming surveyed
Khanh Binh	18	20
Khanh Binh Dong	17	23
Khanh Binh Tay	14	18
Khanh Binh Bac	11	15
Khanh Hai	12	19
Total	72	95

Questionnaire

A questionnaire is a crucial tool in collecting information and data for analysis. In this study, the research team designed a questionnaire according to the information collected from key informants meetings (farmers, local agricultural managers and organic rice farming experts). The questionnaire consists of 3 main parts.

- Part1: Social-economic and demographical characteristics of households
- Part 2: Rice production process, costs and benefits of production
- Part 3: Attitude of farming households about organic rice production challenges and some recommendations

Secondary data and in-depth interview

Secondary data were collected from Ca Mau Provincial Statistics Office, Ca Mau Statistical Yearbook, DARD Ca Mau and relevant domestic and foreign articles. The authors also conducted in-depth interviews with farming stakeholders including managers from the Ca Mau People Committee, DARD Ca Mau, Center for Agricultural Extension of Ca Mau province, organic farming households and local agricultural civic organizations. The interview contents are related to the actual implementation of organic farming, challenges and possible solutions.

The survey and interviews were implemented during November and December, 2021.

Research results

Socio-economic characteristics and rice production of farming households

Table 2 summarizes the socio-economic characteristics of the sample. The men and women rates are fairly balanced (58% male and 42% female in the organic farm group

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and 56%-44% in the traditional group). In terms of age, the 31-50 age group dominated in both interview groups with more than 80% of the interviewees in this group. This is also the common age of household leaders in Ca Mau and Vietnam. The majority of farmers in the study area are Kinh people (accounting for 88% of the interview sample), the rest are Khmer people (accounting for about 12%).

Table 2. *Socio-economic characteristics of sample*

Indicators	Organic farms	Traditional farms
Gender (%)		
Male	58.1	55.9
Female	41.9	44.1
Age (%)		
20–30	10.1	9.5
31–40	50.3	51.8
41–50	31.4	29.2
51–60	4.8	4.0
> 60	3.4	3.5
Ethnic group (%)		
Kinh	89.9	88.2
Khmer	10.1	11.8
Number of people/household	5.1	5.3
Number of people in labor age/household	2.7	2.9
Education level (%)		
Primary	9.5	11.3
Secondary	58.5	55.4
High school	27.5	29.1
College and university	4.5	4.2
Years of organic rice production		
1–3 years	22.9	
4–10 years	35.2	
Production area (1 sao = 1,000 m^2)		
< 10	28.0	8.1
10–20	56.0	28.2
21–30	12.8	40.7
> 30	3.2	25.3
Economic condition of household (%)		
Very low income (poor)	1.3	1.5
Low income (nearly poor)	5.4	6.2
Average income	74.7	70.1
Fairly high income	16.3	19.2
High income	2.3	3.0

Regarding education level, in general, the level of household head is low with about 28% of the households reaching the tertiary level, the majority (nearly 60%) reaching the secondary level and about 10% reaching the secondary level. The percentage of interviewers with university and college degrees is almost negligible (less than 5%).

Regarding economic conditions, the percentage of middle-income households accounts for the majority (from 70% to 75% of the sample), high-income households

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account for about 16-20%. Ca Mau is a province in the Mekong Delta with fairly developed economic conditions, so the percentage of poor and near-poor farmers is low (less than 10% of the total number of households studied).

The average organic and traditional rice area of each household in the sample is 2.8 ha and 0.81 ha resspectively. The yield of each crop in 2020-2021 is about 5.5-6.1 tons/ha. Because farmers grow according to a production process, the output of each crop is quite stable. The majority of organic rice growers consider that organic rice production is more profitable than other crops, the product is easy to sell and the local land is suitable for organic rice cultivation.

About the planting season, farmers produce 2 rice crops/year including winter-spring crop and summer-autumn crop. After harvesting the winter-spring crop, the soil is allowed to rest for more than 1 month in order to limit the loss of nutrients due to continuous operation.

The rice varieties planted by the farmers are ST24, ST25 and Jasmine. Organic fertilizers are mainly imported by farmers. Organic fertilizers are used according to the organic rice process of the rice exporting countries (such as the US, Europe and Japan).

Comparison of production costs of organic rice model and traditional rice model

Table 3 shows the results of comparison of production costs of organic and traditional rice farming models. In general, the cost of organic rice production is higher than that of conventional rice cultivation.

Table 3. *Comparison of production costs of organic and traditional rice farming models (unit: VND/ha)*

Costs	Organic rice model		Traditional rice model		Cost difference between 2 models	
	2020	2021	2020	2021	2020	2021
Labor	5,180,200	5,697,400	4,682,100	5,048,400	**498,100	**649,000
Fertilizer	15,820,400	16,380,200	8,670,300	9,127,100	**7,150,100	**7,253,100
Seed	1,830,400	1,921,300	1,708,200	1,758,400	122,200	162,900
Harvest	2,430,100	2,512,000	2,349,800	2,468,000	80,300	44,000
Other expenses (land preparation)	1,531,800	1,592,700	1,630,100	1,648,300	98,300	55,600
Total variable costs	**26,891,200**	**28,159,200**	**18,942,200**	**19,994,600**	**7,949,000**	**8,164,600**

**Significantly different at 5% error level

1 USD = 24,000 VNDIn 2020, the total variable cost of organic rice production is 26.82 million VND/ha, traditional rice is 18.94 million VND/ha. The cost of organic rice production is higher than that of traditional rice at VND 7.5 million VND/ha. This cost difference comes mainly from the difference in fertilizer and labor costs between the two farming models. Specifically, farmers use organic fertilizers and microbiological drugs that are significantly more expensive than chemical fertilizers in the traditional model (7.15 million VND/ha). Meanwhile, the cost of labor in organic rice model is 5.18 million VND/ha, higher than that of traditional model (4.68 million VND/ha). Statistical analysis showed that the difference of about 500,000 VND/ha for labor cost between two production models is significant.

In 2021, the total variable cost of organic rice production is still higher than that of traditional rice, at VND 8.16 million VND/ha. In which, the labor cost of both production models increased by about 500,000 VND/ha and a similar figure to the increase in fertilizer cost. Total cost of organic rice production is 28.15 million VND/ha, traditional rice is 19.99 million VND/ha.

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The results also show that there is no significant difference in seed cost, harvest cost and land preparation cost in the two models. The organic production model uses ST24, ST35 and jasmine rice varieties, which has a higher seed cost than the traditional model of 100,000 VND/ha; however this difference is not statistically significant.

For agricultural tax (fixed cost), in 2003 the 11th Vietnamese National Assembly issued Resolution No. 15/2003/QH11 on exemption and reduction of agricultural land use tax from 2003 to 2010. In 2010, the National Assembly continued to issue Resolution No. 55/2010/QH12 on exemption and reduction of agricultural land use tax from the end of 2020 for most agricultural land use tax payers. On June 10, 2020, the National Assembly passed Resolution 107/2020/QH14 onextending the exemption of agricultural land use tax until the end of 2025. According to the above regulations, currently, farmers in Vietnam are not pay agricultural land use tax. Therefore, the fixed cost in rice production is insignificant.

Comparison of economic efficiency of organic and traditional rice models

Table 4 presents the results on benefit and production cost structure of the two rice farming models. The research results show that the organic rice production model has higher economic efficiency than inorganic rice, which is reflected in important indicators including selling price, revenue, gross profit and BCR.

Table 4. *Comparison of economic efficiency of organic and inorganic rice models*

Indicators	Organic rice model		Traditional rice model		Difference between 2 models	
	2020	2021	2020	2021	2020	2021
Total revenue (VND/ha)	58,580,000	64,050,000	36,720,000	39,220,000	21,860,000**	24,830,000**
Productivity (kg/ha)	5,800	6,100	7,200	7,400	-1,400	-1,300
Sale price (VND/kg)	10,100	10,500	5,100	5,300	-5,000	-5,200
Variable cost (VND/ha)	26,891,200	28,159,200	18,942,200	19,994,600	7,949,000	8,164,600
Gross profit (VND/ha)	31,688,800	35,890,800	17,777,800	19,225,400	13,911,000**	16,665,400**
Benefit Cost Ratio - BCR	2.18	2.27	1.94	1.96		

**Significantly different at 5% error level

In 2020, the total revenue per hectare of organic rice is 58.58 million VND, while the revenue per hectare of traditional rice is 36.72 million VND. The difference in revenue between the two farming models is significant (21.86 million VND/ha). Although the yield of traditional rice is higher than that of organic rice (7.2 tons/ha compared with 5.8 tons/ha), the selling price of 1 kg of organic rice is almost double that of inorganic rice. High selling price can be an important factor to promote organic rice production by farmers. The gross profit per hectare of organic rice is also higher than that of traditional rice (31.68 million/ha compared to 19.22 million/ha).

The BCR benefit-cost ratio of both rice models is greater than 1, indicating that both models are economically viable. In which, organic rice farming model has higher profitability (BCR = 2.18) than traditional rice (BCR = 1.94). This means that in 2020, 1 VND of production cost will help organic rice farmers earn 2.18 VND in profit - this is a good signal to encourage farmers to switch to organic rice because the effect The return on investment of organic rice farming model is higher than that of inorganic rice.

In 2021, the economic efficiency of organic rice farming is similar to 2020 when the revenue per hectare of organic rice is VND 64.05 million, significantly higher than the revenue/hectare of inorganic rice (39.22 million VND). The difference between the total

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revenue per hectare of the two models is approximately 24 million VND. In 2021, the yield of organic rice and inorganic rice will both increase by about 3-5% compared to 2020 while the selling price of rice will also increase slightly by about 3%. Therefore, the gross profit in 2021 per 1 ha of organic rice increased to 35.89 million VND/ha and was still significantly higher than the gross profit per 1 ha of traditional rice (19.22 million VND). The 2021 BCR cost benefit ratio of organic rice increased to 2.27 (up 7% compared to 2020), while the BCR of the traditional rice model increased 2% to 1.96. Both models show economic efficiency but organic rice has a higher return per unit cost than conventional rice.

Discussion

This study analyzes the economic costs-benefits of two traditional and organic rice farming models. In both models, variable costs are the main cost group in the production cost structure. The organic rice model has a higher variable cost per hectare than the traditional rice model due to the difference between fertilizer cost and labor cost. Organic rice uses chemical fertilizers of good quality, imported, and has a higher cost than traditional fertilizers in the inorganic rice model. In the total cost structure, fertilizer cost accounted for the highest proportion in both farming models (about 58% in the organic model and 45% in the traditional rice model). This result is consistent with the study of Mendoza (2004), Chinvarasopak (2015) and Tashi et al. (2016). However, this study gives contradictory results to Adhikari (2011) and Suwannakit et al. (2016) (which shows that labor costs account for the largest proportion of total rice production costs of both models. A common point of this study with the studies of Brozova (2010), Jierwiriyapant (2012) and Tashi and Wangchuk (2016) is that labor costs in organic rice model are higher than conventional rice; The reason is that organic rice requires more monitoring because it is more vulnerable to diseases. This result is consistent with the observations of Serra and Goodwin (2009), Pattanapant and Shivakoti (2013) and Tashi and Wangchuk (2016). However, in Vietnam, the fixed cost of rice farming is negligible because the government subsidizes farmland tax to farmers to encourage agricultural production.

In both 2020 and 2021, the rice yield of the traditional model is significantly higher than that of the organic rice model (about 20%). Traditional rice has a lower input cost than organic rice and has a higher output per hectare. Even so, the revenue of organic rice is significantly higher than that of conventional rice per hectare as the selling price of organic rice is approximately double that of conventional rice.

BCR, an important economic performance indicator, also shows that organic rice is more profitable than conventional rice with higher BCR for both 2020 and 2021. Thus, the selling price can be said to be the most important factor determining the economic efficiency of the organic model compared with the traditional model. The high market price of organic rice helps to offset the high production costs and low yield of this model. This result is consistent with the study of Pattanapant and Shivakoti (2013), Chinvarasopak (2015) and Lawanprasert et al. (2017). Similar to Nemes (2009) and Samie et al. (2010), consumers' willingness to pay a higher price for organic products will be an important factor driving the development and expansion of organic production. However, market prices need to be regularly communicated to farmers to motivate them to calculate and convert production to an organic model—proven in this study to be more cost-effective.

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This study also collected feedback on the challenges faced by farmers when growing and developing organic rice production. *Figure 3* shows the main challenges.

The biggest difficulty was identified as the lack of market information when 55% of the farmers said that they lacked a participation mechanism to capture information on the price of organic products in the world and domestic markets. Prices are usually provided through local organic rice purchasing points, some farmers participate in local agricultural civil organizations and collect information on production and selling prices of rice. organically through these organizations. People suggested that there should be social networking sites built by the agricultural management agencies of the province or MARD, which regularly provide information on selling prices, markets, techniques, and experiences to people. people caught it in time. Social networking is a very popular tool in Vietnam and this should be recognized in the development of a mechanism for providing information by management agencies to households.

Technical difficulty in organic rice farming is also one of the challenges identified by 33% of households as the biggest difficulty. Organic rice farming is a new farming method that requires more advanced techniques, from seed selection and tillage to fertilization, crop monitoring, especially the use of chemical fertilizers in the field. throughout the life cycle of rice production. Farmers are used to traditional farming and when converting to organic farming, they need technical support, especially from local extension agencies. Therefore, strengthening the capacity and support capacity of agricultural extension agencies is a priority to promote organic production in Ca Mau as well as in Vietnam (*Fig. 2*).

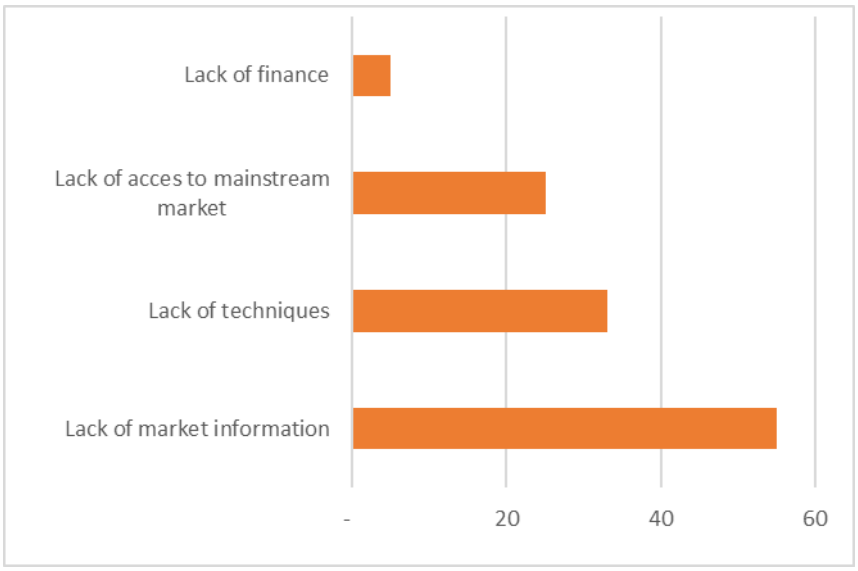

Figure 2. *Main challenges for organic rice development by farmers (% response)*

Difficulty in accessing the mainstream market was also identified by 25% of households as the biggest challenge. In-depth interviews with farmers showed that organic rice is often purchased locally by local cooperatives, in which although prices are based on the market, there are still cases of pressure on the prices of purchasing companies due to information. Market information is incomplete. Farmers want more direct interaction mechanisms with a variety of purchasing partners to ensure a fairer and more favorable selling price for them.

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Only 5% of households reported that lack of capital is their biggest obstacle in organic rice production. This is quite consistent with the fact that the cost of organic rice production, although higher, is still within the financial capacity of the farmers. They learn that the more expensive the investment, the more profitable it will be. And the costs are often incurred in the short term along with the rice production (from 3-5 months until the time of harvest and sale), so finance is not a significant pressure for households. in organic rice production.

Conclusions and recommendations

Now and in the future, rice is still the main crop in Ca Mau. The production area and output will increase, including an increase in the percentage of organic rice. The cost-benefit analysis of local rice production shows that the actual profit and return of organic rice production is quite high, and significantly higher than those of traditional rice in both 2020 and 2021. Currently, the yield of organic rice is lower, the production cost is higher, but the selling price of organic rice is significantly higher than that of traditional rice. This leads to higher profits and profitability of organic rice. However, the production of organic rice in the province is currently facing difficulties including lack of market information, lack of knowledge and organic farming techniques, and lack of competition in product purchasing channels. These difficulties require the participation of central and local authorities and agricultural management agencies with the following proposed solutions to increase organic rice production:

At macro level, the government needs to issue specific and feasible policies to support the development of organic agriculture. Policies should focus on (i) planning, protection of land and water sources that are not or are less polluted, and are still suitable for organic farming; (ii) perfecting the system of standards and regulations on production, processing, quality certification, inspection and supervision related to organic agriculture in general and organic rice in particular; (iii) Organic production requires guaranteed inputs. Most of the organic fertilizers are now imported, increasing production costs for the people. Therefore, the State needs to support domestic organic fertilizer production companies to reduce production and fertilizer costs; (iv) support farmers and localities to build organic rice brands, develop markets and promote organic rice products at home and abroad.

At local level, the Provincial DARD should cooperate with the Agricultural Extension Center to come up with a unified and regularly updated organic rice production process to disseminate to farmers through the training sessions directly or through activities of local agricultural civil organizations such as Farmers' Unions, Women's Unions and agricultural cooperatives.

Regarding production techniques, farmers need to be provided with adequate information from agricultural management and extension agencies to control and strictly follow the production process according to advanced food safety techniques. certified by USDA, EU, JAS), while ensuring the quality and yield of rice. Localities should also promote the conversion of high-quality rice varieties such as ST24, ST25, Jasmine, Huong Chau, Dai Thom in production. Because these rice varieties are now favored by domestic and foreign markets, the market price of rice is also higher than other rice varieties, contributing to improving farmers' incomes.

Production and market information can be provided directly through seminars and training sessions, but can also be through social networks because this is a powerful and

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popular tool in Vietnam, including rural areas. People need to have access to social networking pages that disseminate knowledge, techniques, market information and product prices which help them understand and adjust production towards higher economic efficiency. In addition, local authorities should also seek and link up with strong enough organic rice consuming units to contribute to price stabilization and protect the interests of farmers.

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