

THE EFFICIENCY OF CROP STRUCTURE CONVERSION FROM RICE-BASED TO FRUIT TREES IN THE MEKONG DELTA

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Abstract

The Mekong Delta is a key rice development area of the country, but the region also faces many challenges. Growing rice brings lower efficiency to farmers than other crops on the same area. The government has a policy to allow households to switch from rice-growing land to other crops. Based on survey data of 72 households in 3 provinces of Hau Giang, Dong Thap and Long An, the analysis results show that when changing the crop structure from rice to fruit trees, the profit of fruit trees is higher 9 times that of rice. But the conversion faces environmental problems as growing fruit trees uses four times more fertilizers and pesticides than rice. People change crop structure due to profit, price level of fruit and market demand. Therefore, in parallel with the policy to allow the conversion, it is also necessary to strictly control and form concentrated conversion areas for fruit trees in order to improve efficiency and ensure a balance of economic, social, and environmental benefits.

Keywords: *rice, fruit trees, efficiency, crop structure conversion*

1. Introduction

The Mekong Delta region has many natural conditions of soil and climate, rich resources and favorable Vietnam. The economic development of this area depends heavily on the development of agricultural, forestry and aquaculture activities. This is the largest agricultural production center of Vietnam, contributing 50% of rice production, 65% of aquaculture production and 70% of fruits of the country; 95% of rice exports and 60% of

fish exports (Government, 2017). This is an area suitable for the development of fruit trees, with alluvial soil, fresh water all year round, mild climate, lush four-season fruit trees, forming many famous specialty tree growing areas (Nguyen Bao Ve, 2019). However, there are many challenges such as the impact of climate change, in addition to the developments in the upstream, which will cause great impacts and changes to the hydrology. These impacts and their consequences are geographically distributed, presenting specific opportunities and constraints in land and water use and economic development in the upstream region in the Mekong Delta (Government of Vietnam and Government of the Netherlands, 2013). Climate change and sea-level rise are happening faster than forecast, causing many extreme weather events, affecting people's livelihoods. The exploitation of water resources in the upstream of the delta, especially the construction of hydroelectric dams, has changed the flow, reduced the amount of alluvium, decreased aquatic resources, and deeply penetrated the interior of the region, causing negative impacts on the environment, and the socio-economic development of the region (Government, 2017). In addition, the region is facing internal problems such as water management, industrial and urban intensification, accompanied by pollution of soil, water, ecosystems and resource depletion (Le Anh Tuan, 2020). According to the “Mekong Delta Plan – Long-term vision and strategy to develop a safe, prosperous and sustainable Mekong Delta” in 2013, the Mekong Delta region is divided into 3 sub-regions: (1) Region upstream (including Dong Thap, An Giang and Long An provinces); (2) The middle region (including the provinces of Tien Giang, Vinh Long, Hau Giang, Can Tho city and part of the area of Ben Tre, Tra Vinh, Soc Trang, and Bac Lieu); (3) Coastal area (including part of Tien Giang, Ben Tre, Tra Vinh, Soc Trang, Kien Giang provinces, and most of Bac Lieu and Ca Mau province).

Over the past 30 years, the above trend has helped to rapidly increase the area of fruit trees in the Song Tien and Hau River areas, starting from Dong Thap, Tien Giang, Vinh Long, and Hau Giang, then expanding to areas with high-quality systems. The dyke system is closed and less affected by floods. Between 2010 and 2016, the total area of fruit trees in the Mekong Delta increased by 53% with 323,000 fruit trees (Bui Ba Bong et al., 2018). From 2015 to 2019, the government issued 3 Decrees on the management and use of rice land, which stipulate the order, conditions, and procedures for converting crops from rice to other crops of economic high economy. Many farmers in the Mekong Delta region have converted from rice to high economic value crops such as cash crops and fruit trees.



Figure 1. Map of zoning of the Mekong Delta

Source: Mekong Delta Plan - Long-term vision and strategy To develop a safe, prosperous and sustainable Mekong Delta (2013)

The Ministry of Agriculture and Rural Development issued Decision No. 586/QĐ-BNN-TT on formulating a plan to change the crop structure on rice land, in which the area converted from rice to other crops of the Mekong Delta accounts for about approximately 67% of the converted area of Vietnam. The main converted crops are annual crops, which are cash crops (accounting for 94%), and perennial plants are mainly fruit trees and industrial plants. The change of land use purpose or crop structure of people depends on the market, especially on the price of agricultural products. The replacement of low-yield, low-efficiency rice production areas with cash crops and fruit trees initially achieved efficiency and development prospects (Le Tran Thanh Liem, 2020).

Table 1. Plan to change crop structure from rice to other crops of provinces in the Mekong Delta in the period 2017-2020

No	Province	Total	Annual tree	Perennial tree
Total		741.868,90	652.464,40	44.702,30
Mekong Delta		504.160,30	447.683,10	28.238,60
1	Long An	10.400,00	8.000,00	1.200,00
2	Dong Thap	106.550,00	97.450,00	4.550,00
3	An Giang	23.200,00	13.000,00	5.100,00
4	Tien Giang	65.090,00	56.160,00	4.465,00
5	Vinh Long	112.417,80	103.827,20	4.295,30
6	Ben Tre	2.523,00	1.243,00	640
7	Kien Giang	86.625,00	86.625,00	0
8	Can Tho	6.000,00	6.000,00	0
9	Hau Giang	5.618,50	333,1	2.642,70
10	Tra Vinh	73.130,50	66.462,80	3.333,90
11	Soc Trang	7.945,50	3.922,00	2.011,70
12	Bac Lieu	4.660,00	4.660,00	0
13	Ca Mau	0	0	0

Source: Decision No. 586/QĐ-BNN-TT (2017)

The conversion of land use purposes will help people increase profits on the same area of use, but also face many challenges. The conversion from rice land to other crops increases the net profit of agriculture significantly, but this conversion also increases the pollution to the environment due to the use of agricultural products. more fertilizer than

growing rice (Wenjun Jiao et al., 2016). Research results of Nguyen Quoc Hau et al (2018) in Vinh Long show that the group of Fluvisols (alluvial soil) reduced the area of 25,944.38 hectares, the group of Gleysols (the gley soil) increased by 13,759.87 hectares, the Anthrosols group (the soil factors) increased by 12,184.51 ha, the Arenosols group (sand soil) did not change in area and type of soil, mainly due to the change in crop structure in the year from 2 rice to 3 rice and land for perennial crops. The model of growing fruit trees has a negative impact on the environment for the soil and water environment (Nguyen Thi Ngoc Lan et al., 2018; Asnelly Ridha Daulay et al., 2015) pointed out that when converting from rice land to palm oil and rubber in East Tanjung Jabung Regency, the high revenue along with some difficulties faced by rice farmers made the system of sustainable land use is difficult to achieve. Balancing economic, social and environmental goals is necessary to ensure a sustainable agriculture (Pham Thanh Vu et al., 2016).

In this paper, the efficiency of converting crops from rice to fruit trees will be evaluated. Correspondingly, some sustainable development orientations are proposed when converting rice land to fruit trees in the Mekong Delta.

2. Method

In studies using qualitative and quantitative research methods. Research space selected here is 3 provinces with large conversion area including Hau Giang, Dong Thap and Vinh Long. These are provinces in 2 regions, the upper and middle are 2 regions with favorable areas and conditions to convert from rice to fruit trees. The study will conduct in-depth interviews at the provincial level to select the location with the largest converted area, and the type of fruit trees to be converted to ensure the characteristics of the province. Then, the authors conducted in-depth interviews with officials of the district's agriculture department selected for the study, then conducted in-depth interviews with officials of the Commune People's Committee where the study was conducted. Thus, there will be 9 in-depth interviews conducted. Corresponding to the 3



Figure 2. Location of the surveyed provinces in the study area

selected provinces for the study, each province will select 3 districts, and each district will select 2 communes, each commune will select 1 village with a large conversion area to conduct the survey. There will be 6 interviewees corresponding to 6 communes in 4 districts of 3 provinces selected for research. There will be 13 in-depth interviews conducted from the province to the commune level, of which the provincial level has 3 in-depth interviews, the district level has 4 in-depth interviews and the commune level has 6 in-depth interviews.

The research team selected a stratified random sample, corresponding to locations with an area converted from rice to fruit trees, randomly selected 12 converted households in a closed dike system.

Table 2. Details of selected villages for the survey

No	Research location			Typical type of conversion tree	Number of households interviewed
	Village, commune	District	Provinces		
1	Hamlet 2, Tan Hiep Commune	Thanh Hoa	Long An	Lemon, Durian, Soursop, Jackfruit, Grapefruit	12
2	Hamlet 1, Tan Tay commune			Durian, Lemon, Jackfruit, Grapefruit	12
3	Hamlet 1, Tan My commune	Thanh Binh	Đông Thap	Mango	12
4	Binh Hoa Hamlet, Binh Thanh Commune				12
5	Hamlet 8, Long Tri Commune	Long Tri Town	Hau Giang	Tangerine	12
6	Trau Hoi Hamlet, Thanh Xuan Commune	Chau Thanh A		Durian, grapefruit, longan, lemon, orange, jackfruit, rambutan	12
Total					72

The study selected each location 12 converted households, corresponding to 24 households in each province, and 3 provinces corresponding to 72 interviewing households based on the questionnaire. Data collection period is from November 2020 to April 2021.

3. Results

3.1. Water demand of fruit trees

When changing the crop structure from rice to fruit trees, it will reduce the amount of water for crop irrigation. This helps the region cope with problems related to drought, water shortage and saltwater intrusion and climate change. The average water demand for rice according to national standards is about 18,600 m³/ha-year, this amount of water is 18.6 times higher than that for mango and 13 times more than for orange. In fact, according to local people's experience, the level for crops irrigated from time to time may be lower or higher than the prescribed or theoretical level of irrigation. Faced with the challenge of reducing water resources, people in the Mekong Delta have switched from inefficient rice to fruit trees. According to the Government (2020) to change the mindset on food security, to develop agriculture in the Mekong Delta based on rice; strategic pivot to fisheries - fruits - rice in line with the market, based on the established farming system and gradually adjusted according to the roadmap, avoiding disturbance affecting people's lives. When converting from inefficient rice to fruit trees, it helps to reduce water use, and at the same time, with the orientation to expand the fruit area by 2030, the total fruit area is expected to reach about 650 thousand hectares (increasing an additional 150 thousand ha in the transition zone and the flexible zone).

Table 3: Amount of irrigation water used for some crops

Type of tree	Amount of water for irrigation	Average irrigation level (m ³ /ha-year)
Mango	According to Tran Hung et al (2021), the amount of irrigation water is 900-1,100 m ³ /ha. Including, the flowering stage is irrigated from 238-301 m ³ /ha and the fruiting stage is 674-759 m ³ /ha	1,000
Oranges	Directorate of Water Resources (2013), the amount of incoming water includes: irrigation level for orange trees: (1) Basic construction phase: total irrigation rate from 1000 m ³ /ha/year to 1,500 m ³ /ha/year; (2) Fruiting stage: the amount of water for irrigation is from 1,500 m ³ /ha/year to 1,800 m ³ /ha/year.	1,400

Durian	According to Kemchart Cheyehom et al (2019), the amount of incoming water for durian trees is about 600-800 m ³ /rai, equivalent to 3,750 – 5,000 m ³ /ha	4,375
Rice	<p>According to the National Standard No. TCVN 8641: 2011 the irrigation regime with sown rice for 3 crops a year includes:</p> <ul style="list-style-type: none"> - Winter-spring crop: The total amount of water for irrigation for the whole crop is from 7,500 m³/ha to 8,000 m³/ha - Summer-autumn crop: The total amount of irrigation water for the whole crop is from 5,700 m³/ha to 6,000 m³/ha - Autumn-winter crop: The total amount of water for irrigation for the whole crop is from 4,500 m³/ha to 5,500 m³/ha 	18,600

Farms often install irrigation equipment for crops according to experience, and larger than the irrigation needs of the crops in terms of theoretical requirements. This causes a waste of irrigation costs for households growing crops. The amount of water used to irrigate rice is about 8 times higher than that of fruit trees. In fact, the amount of water used to irrigate fruit trees is higher than theoretically. Farmers in Dong Thap, Long An and Hau Giang provinces have about 10%-40% of the theoretical amount of water, about 30% for orange trees and about 20% for durian trees. Similar to rice cultivation, the amount of water used in individual management is lower than in the collective in all seasons (Le Canh Dung et al., 2015). This will cause water waste, and cause water pollution when this water source is polluted by fertilizers and pesticides. It also causes costly irrigation pumping for farmers who grow fruit trees.

3.2. Results of converting to fruit trees from rice plants

In the period from 2017 to 2020, households in 3 provinces converted their total area to fruit trees about 29,284.19 ha. In which, the converted area is mainly citrus such as oranges, lemons, grapefruits and tangerines with a total area of 14,509.62, accounting for 49.55% (Table 4). The converted area of each province is increasing year by year. Depending on the characteristics of each province, the converted area is usually concentrated in some key areas in the area that are drought, saline or inefficient. Converted crops are those with high selling prices, high profits and market demand, which are three factors that help farmers decide to convert.

Table 4. Total charge converted from rice-based to fruit trees in the period 2017-2020

Unit: ha

No	Type of tree	Dong Thap	Long An	Hau Giang	Total
1	Oranges	1,112.30	37.08	328.96	1,478.34
2	Lemon	334.07	11,030.12	326.66	11,690.85
3	Grapefruit		181.8	337.03	518.83
4	Tangerine	819.10		2.50	821.60
5	Dragon fruit	301.5	3,466.42		3,767.92
6	Mango	2,175.20	791.65	72.73	3,039.58
7	Jackfruit	724.10	1,561.56	454.8	2,740.46
8	Logan	441.17		252.44	693.61
9	Other tree	2,090.99	2,176.05	1,342.61	5,609.65
	Total	7,557.26	19,198.67	2,528.26	29,284.19

Source: Sub-Department of Cultivation and Plant Protection of Dong Thap, Long An and Hau Giang provinces (2021)

3.3. Efficiency of farmers when converting from rice to fruit trees

The transformation process has helped farmers increase income, improve living standards, and develop socio-economic in these areas. When changing the structure of crops from rice land to fruit trees, people will increase profits on the same area. The survey results of 72 households showed that the profit of fruit trees on the land converted from rice land was 9 times higher than that of rice. Among the most converted crops is mango (mainly concentrated in Dong Thap province), the profit of growing mango each year is nearly 12 times higher than that of rice on the same hectare. However, at present, households are not concentrated, and farmers do not form cooperative farmer organizations such as cooperative groups or cooperatives, so profits are not stable. Research results on rice for farmer households that are members of a cooperative organization or cooperative group will have an average profit of 30.3% higher than that of individual farmer households (Le Canh Dung et al, 2019). Households involved in growing tangerines in the Long Tri tangerine cooperative of Hau Giang province showed that participating in the cooperative will help members organize synchronous production, access production techniques, and reduce costs of product. In addition, it is easy to register the trademark of the crop and easy to associate with consumer businesses. At the same time, the applied cooperative is produced according to organic methods to protect the environment and ensure the health of users.

Table 5. Revenue and cost of fruit crops per hectare

Unit: million VND/year

Indicator	Rice*	Tangerine	Mango	Other tree **
Number of households		12	24	36
Revenue	97.320	536.730	659.750	597.057
Cost	53.329	239.241	125.425	193.658
Cost of seedlings	4.779	96.600	11.600	51.773
Cost of fertilizer	11.645	72.816	43.379	51.781
Cost of pesticides	9.578	2.477	1.933	2.416
Irrigation cost	10.398	5.135	4.008	5.371
Labor cost	6.383	49.540	46.400	66.929
Other cost (Land rental, machinery and equipment, ...)	10.547			
Initial construction cost when converting from rice land to fruit trees (investment cost of premises and irrigation systems)		12.673	18.105	15.389
Profit	43.991	297.489	534.325	403.399

Source: Calculations of the authors (2021)

Note: *) According to Nguyen Tuan Kiet (2017), with 3 crops, each crop has an average profit of 14,664 million VND/crop

**) Including lemon trees, custard apple, durian, jackfruit, pomelo, longan, toad, rambutan, strawberry.

Although the amount of irrigation water for fruit trees is about 8 times lower, the annual investment and operating cost of the irrigation system is higher than that of rice. The initial investment cost for a water-saving irrigation system usually ranges from VND 69,926 million to VND 87,654 million per hectare (calculated according to state regulations). In fact, people invest in the initial construction costs ranging from 40 to 50 million VND depending on the value of each type of converted fruit tree. Corresponding to the life expectancy of mango tree is 7 years and tangerine tree is 10 years, the annual allocation cost for mango tree and tangerine tree is about 18,104 million VND/year and 12,673 million VND/year, respectively. The annual cost of irrigation for fruit trees is about 40% higher than that of rice, mainly due to electricity bills for irrigation. Converted households often build irrigation systems for fruit trees according to their experience and depending on the type of

converted crops, thereby affecting neighboring rice growing households. When changing the structure of crops from rice to other crops, it will affect the soil environment because when converting from rice to fruit trees, the rice land must be improved to suit fruit trees. The amount of fertilizers and pesticides used for fruit trees is higher than that of rice, and the cost of fertilizer for fruit trees is four times higher than that of rice. The amount of fertilizers and pesticides for fruit trees will gradually seep into the soil and water sources, causing cumulative pollution, which will affect the coastal provinces.

This leads to a great impact on the soil environment in the future when converted, or when converting back to the original rice land. The cost to convert back from fruit-growing land back to rice-growing will be enormous. Besides, due to the spontaneous conversion of people according to experience and market, some places have formed conversion zones with mixed fruit trees. People change according to the market, as well as by experience, so the management agencies face many difficulties in formulating policies to develop crop structure for each region. At the same time, it is difficult to control the quality of fruits according to domestic and international standards.

4. Discussion and Conclusion

The Mekong Delta has many favorable conditions in terms of nature, climate and resources for agricultural development, but the region also faces many challenges. Although people have actively changed the structure of crops to increase their incomes and at the same time cope with challenges. But when converting the crop structure from rice to fruit trees, the profits are higher. At the same time, the requirements and costs for irrigation of fruit trees are also higher than that of rice. People convert from rice land to fruit trees according to the profit, the price level of the fruits and the market demand, thus leading to inefficient production efficiency. Especially when converting the structure to fruit trees, it will affect the environment in the future. Therefore, it is necessary to strictly control and form concentrated conversion areas for fruit trees to help improve efficiency and ensure a balance of economic, social and environmental benefits. In addition, it is necessary to form centralized production association organizations to help farmers organize synchronous production, apply production techniques that will ensure quality standards and easily link with enterprises, and increase product value.

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