Research article

A Study on Cambodian Rice Farming: Comparative Analysis on Aromatic and Non-Aromatic Rice Farming in Voatkor Commune, Battambang Province

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Abstract Cambodian agriculture is now in midst of transition from the traditional subsistent to modern commercial one. With respect to rice farming, more farmers are shifting from non-aromatic to aromatic rice production. Currently, aromatic rice accounts for about 10% of total rice cultivated area, and 30% of total rice production. Furthermore, the competitiveness of non-aromatic rice has worsened recently. By observing this trend, this study aims to grasp the differences in characteristics and profitability between non-aromatic and aromatic rice production, and to discuss the factors affecting the variety selection from farmers' viewpoint. This study is based on the survey conducted in Voatkor commune, Battambang province in 2017, one of the biggest rice producing areas in Cambodia. In the survey, random sampling method was applied, and 82 rice farmers were interviewed. Among the sample, 59 farmers adopted non-aromatic rice, and 61 farmers adopted aromatic rice, including farmers adopted both aromatic and non-aromatic. Study farmers generally cultivated only once a year, mainly in wet season. The result of the study showed that aromatic rice was not commonly used for home consumption, and that more than 80% of the production was for sale, considering greater demand from international market. On the other hand, the non-aromatic rice was mainly used for home consumption and domestic market. The costs of aromatic rice production were higher on material and labor costs, but farmers were able obtain higher yield in comparison with the non-aromatic rice. Despite higher production costs, aromatic rice was found to be more profitable in gross value added, gross margin and net profit, thanks to higher yield and favorable paddy price. In addition, this study also identified non-economic factors affecting the farmers' decision-making on varieties. Finally, some recommendations are offered.

Keywords aromatic rice, non-aromatic rice, production costs, profitability, Cambodia

INTRODUCTION

Rice is a staple food in Cambodia, cultivated all over the country. It contributes more than 10% to the national GDP with more than 50% of employment. After 30-years hiatus caused by civil war, Cambodia has been slowly recovering its status as a major rice producer and exporter. Currently, Cambodia stands as the World 6th rice exporter and second largest exporter of Premium Jasmine Rice (USDA, 2013).

With the achievement of rice self-sufficiency in 1990s, the Cambodian government has set a goal to export one million tons of milled rice by 2015. For this goal, aromatic rice was strategically important, since it has a great potential for exportation pulled by the increasing demand from international market. As World Bank (2015) pointed out, many farmers were shifting from non-

aromatic to aromatic rice production. Currently it is estimated that aromatic rice accounts for about 10 percent of cultivated area, and 30% of total production. However, most farmers still stick to non-aromatic rice farming partly due to the constraints of socio-economic factors, land condition, and partly due to the farmers' preference. It is important to clarify the obstacles from field data, which hinder the shift of rice production to more rational direction.

This study aims to grasp the differences in characteristics of production as well as differences in cost and return, among several types of rice farming. Also, it aims to point out the factors affecting the variety selection, based on interviews with rice farmers.

METHODOLOGY

This survey was conducted in Voatkor commune, Battambang province. It is one of the biggest rice producing areas in Cambodia, also known as "Cambodian Rice Basket". The total number of farm household is around 82 households in 2017, and the total agriculture land is around 164.53 ha, which consists of 159.44ha of rice field. The water resource of this commune is provided by Kampingpouy reservoir, and Kahout irrigation. The irrigation situation in this study area is considerably poor. Rice field located inside the village, cannot access to the irrigation system fully throughout the year, and rice farming there is heavily dependent on rainfall.

This study is based mostly on primary data, collected through direct interviewing with rice farmers in the commune. Interviewed farmers were selected by random sampling method. The survey was conducted two times in March and September 2017. Totally 82 rice farmers were interviewed and they categorized into three groups: group A (21 non-aromatic rice adopter), group B (22 aromatic rice adopter), and group C (38 farmers adopted both).

The method of analysis of this paper is mainly descriptive, but considering the wide differences in the characteristics and economic performance of rice production among various rice cultivating systems, this paper tries to compare the above-mentioned differences not only between aromatic and non-aromatic rice production but also among rice cultivating systems.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Aromatic and Non-Aromatic Rice Producers

Table 1 Socio-economic characteristics of aromatic and mon-aromatic rice producers

	Non-aromatic farmers	Aromatic farmers	Farmers adopted both[1]	T-test (p value)		
				NA & A	NA & Both	
Number of household (HH)	21	22	38			
Number of male head of HH	20	21	38			
Average family size (person)	5.05	4.91	5.37	0.78	0.45	
Average age (years old)	54.71	51.52	51.89	0.41	0.44	
Year of education (years)	5.57	7.48	7.89	0.08	0.01	*
Average owned land per HH (ha)	1.13	1.54	3.01	0.24	0.04	*
Average planted area per HH (ha)	1.48	1.93	4.05	0.17	0.07	

Source: Field survey, 2017
1: Farmers adopted both means farmers who produced both aromatic and non-aromatic rice varieties.
**Indicates statistical significance at 0.05 level*

Basic features of interviewed farmers are presented in Table 1. Table 1 shows that farmers of group C had longer career of education in comparison to farmers in group A and B. In addition, farmers in group C had bigger size of owned and as well as planted rice area. The difference between owned and planted land can be regarded as rented land and this was around one hectare (one third of total planted area) for farmers in group C. On the other hand, rented land of group A and B farmers was not so much, suggesting they were mostly using their owned land. With respect to family size and age of respondents there was no significant difference among these 3 group farmers.

Rice Farming System in the Study Area

In Cambodia, there are many types of rice farming in accordance to seasons, land type, and water condition. The main crop is rain-fed rice farming in rainy season, primarily harvested in November to January, using local varieties. It should be noted that the performance of rice faming, such as yield, cost of production, profitability and so on, are ranging widely depending on land condition, availability of water, and variety use. Thus, before discussing the difference in production cost and return of rice farming, it is needed to examine the existing rice cultivation system in the study area.

Four different types of rice farming system were observed in the study area (Table 2): medium non-aromatic rice, late non-aromatic rice, medium aromatic rice, and early aromatic rice.

Table 2 Typology of rice farming systems in the study area

Rice cultivating system by length of maturity	Local variety		Modern variety	
	Non-aromatic	Aromatic	Non-aromatic	Aromatic
Early	**X**	**X**	**X**	**O**
Medium	**O**	**O**	**X**	**X**
Late	**O**	**X**	**X**	**X**

Source; field survey 2017 by the first author
Note 1). o: Observed in studied area
x: Not observed in studied area

Medium non-aromatic rice farming: 29 respondents adopted this farming system. Using local varieties, farmers started in May to June and harvest in November to December (around 6 months). This rice system is extensive with a bag of fertilizer (50kg/bag) and only a limited insecticide and weedicide were applied. This farming is fully dependent on rainfalls, so irregular rainfalls might damage or delay the process of farming, resulting the decreasing in the paddy yield. The average yield per hectare is around 2.74 ton, and the purpose of this production is mainly for home consumption.

Medium aromatic rice faming: 45 farmers were found to adopt this farming system. The varieties that farmers used are local ones with 2.82 tons of average yield per hectare. The cropping period is the same as medium non-aromatic rice. This rice system is also an extensive type with a limited use of weedicide, insecticide, and fertilizer (commonly 1 bag). It fully depends on rainfalls, and only shallow depth-rice field is suitable to this system. The purpose of this rice production is partially for home consumption and for sale.

Late non-aromatic rice farming: 30 farmers revealed to adopt this farming system. Same as the earlier farming system, the varieties of this farming system consist of local varieties. The average yield of adopted farmers is around 2.78 ton per hectare. The cropping period is 8 months, starting from May to June, and finishing in December to January. This rice system is an extensive one as medium rice farming, and faces the same risk. The main purpose of this production is for home consumption as well as for sale.

Early aromatic rice farming: 34 farmers adopted this farming system. This farming system is the main practice when the irrigated water can reach to the rice field during dry season and short dry in wet season. Early aromatic rice farming is an intensive farming with high use of fertilizer (3 to 4 bags) and of weedicide and insecticide. The varieties for this farming system are the modern ones, and the yield per hectare (around 3.56 tons) is higher than the local varieties. The cropping period for this farming system is only 3 to 4 months (around 105 to 115 days). The purpose of this type of rice production is mainly for sale, and finally export to international market.

Total Production Cost of Rice Farming

From above analysis, it was found that in the study areas, there were four types of rice farming, and that the system differed much in variety selection, production purpose, and input use among them. Thus, in the analysis of cost and returns of rice farming, it is necessary that diversified aspects of rice farming among farming systems should be fully took into the account.

In this study two different comparison are adopted. First, comparison between medium non-aromatic and medium aromatic rice farming was compared, since those two shared the same cropping period. Second, late non-aromatic rice farming and early aromatic rice farming was compared. Those two types are currently the most common rice farming system in the study area.

Concerning the cost analysis, this study followed the method of World Bank (2015). Additionally, the analysis calculated the cost not only of cash payment, but also imputed cost such as cost of organic fertilizer, family labor costs, cost of owned land, and depreciation of farm assets. To check the significance of difference in cost items between farming systems, T-test with two-sampled assuming unequaled variances is applied in this study as well.

Table 3: Total production cost of aromatic and non-aromatic rice production

Item	Non-aromatic rice		Aromatic rice		T statistic			
	Medium (a)	Late (b)	Medium (c)	Early (d)	(a) & (c)		(b) & (d)	
Number of HH (HH)	29	30	45	34				
Paid seed	9.90	7.08	23.58	22.17	-1.72	*	-1.25	
Imputed cost of keeping seed	27.76	28.71	18.08	37.14	-13.91	*	-2.14	*
Chemical fertilizer	73.35	77.49	82.85	117.41	-1.88		-6.99	
Paid organic fertilizer	2.07	0.00	0.00	0.00	1.00		-	
Imputed cost of organic fertilizer	3.36	0.00	0.00	0.00	2.29	*	-	
Pesticide	4.60	0.08	3.39	28.86	0.52		-12.53	*
Weedicide	21.08	14.23	17.55	24.13	0.85		-3.38	*
BC Cost	**142.12**	**127.59**	**145.45**	**229.71**	**-11.91**	*	**-9.41**	*
Fuel	8.97	16.00	14.78	52.48	-1.60		-7.80	*
Water charge	0.00	0.78	1.60	2.70	-2.52	*	-1.20	
Material cost	**151.09**	**144.37**	**161.83**	**284.89**	**-12.36**	*	**-11.87**	*
Paid land preparation service	33.91	23.93	30.78	27.79	0.86		-0.64	
Imputed cost of land preparation	40.95	50.89	42.85	32.21	-0.44		2.11	*
Total land preparation cost	**74.86**	**74.82**	**73.63**	**60.00**	**0.95**		**2.69**	*
Paid harvesting service	87.69	93.27	87.00	68.38	0.56		2.34	*
Imputed cost of harvesting service	21.72	29.17	18.00	6.62	-1.77		1.33	
Total harvesting cost	**109.41**	**122.44**	**105.00**	**75.00**	**-13.15**	*	**41.48**	
Total service cost	**184.27**	**197.26**	**178.63**	**135.00**	**-0.76**		**10.19**	*
Hired labor	34.40	36.78	44.77	51.29	-2.06	*	-2.07	*
Family labor	89.35	73.50	75.36	55.48	4.12	*	3.08	*
Total labor cost	**123.75**	**110.28**	**120.13**	**106.77**	**1.12**		**0.71**	
Rented land	17.67	51.25	37.06	74.17	-1.28		-0.86	
Total variable cost	**266.07**	**262.56**	**282.72**	**373.04**	**-1.97**	*	**-7.20**	*
Total production cost	**476.78**	**503.16**	**497.65**	**600.83**	**-6.09**	*	**-3.38**	*

Source: Field Survey, 2017 *Unit: USD/ha*

**Indicates statistical significance at 0.05 level*

Table 3 shows production costs (cost per ha) of four types of rice faming. The result revealed that the total production cost of medium non-aromatic rice was 476.78 USD/ha, while the total production cost of medium aromatic rice was 497.65 USD/ha, suggesting that production cost of medium aromatic rice was significantly higher than that of medium non-aromatic rice due to higher costs of seed, fertilizer, fuel, and water cost. The result also showed the total production cost of early aromatic rice (600.83 USD/ha) was significantly higher than total production cost of late non-aromatic rice (503.16USD/ha), resulted from higher spending in seed, fertilizer, pesticide, weedicide, fuel, service cost, and family labor. The production cost of both aromatic rice farming systems was reported to be much higher in comparison to the non-aromatic rice farming systems.

Economic Returns of Rice Farming

Regarding economic returns, this study examined several indicators, like gross value added, gross margin, total cash income, and net profit of rice farming in each category. Gross value added was the deduction from gross revenue and intermediate inputs. Gross margin was obtained by deducting gross revenue deducting intermediate inputs and hired labor. Total cash income was calculated by deducting total cash expense from gross revenue, and finally net profit was calculated by deducting costs of family labor, costs of owned land, and depreciation cost from gross margin. In addition, T-test analysis with two-sampled assuming unequal variances was applied in this study as well.

Table 4 shows the comparison of cost and returns per hectare among four rice faming system in the study in each category. The production of aromatic rice was more profitable in whatever model used. As the extensive farming system, both medium non-aromatic and medium aromatic

rice had similarity of input used and yield. But, the result revealed that net profit of medium aromatic rice is 90% higher and more profitable than medium non-aromatic rice in every indicator. However, it is important to note that the net profit of medium aromatic rice was not significantly higher than medium non-aromatic rice.

Table 4 Net profit of aromatic and non-aromatic rice production

Item	Non-aromatic rice		Aromatic rice		T statistic			
	Medium (a)	Late (b)	Medium (c)	Early (d)	(a) & (c)		(b) & (d)	
Number of HH (HH)	29	30	45	34				
Paddy yield (ton/ha)	2.74	2.78	2.82	3.56	-0.06		7.00	*
Paddy price per ton (USD)	236.77	239.06	253.54	267.42	-5.76	*	-4.75	*
Paid material Cost	119.97	115.66	143.75	247.75	-1.93		-9.64	*
Total material Cost	151.09	144.37	161.83	284.49	-12.36	*	-11.87	*
Hired labor cost	34.40	36.78	44.77	51.29	-2.06	*	-2.07	*
Family labor cost	89.35	73.50	75.36	55.48	4.12	*	3.08	*
Total labor cost	123.75	110.28	120.13	106.77	1.12		0.71	
Total job commission	121.60	117.20	117.80	96.17	-0.35		1.48	
Cash land rent	17.67	51.25	37.06	74.17	-1.28		-0.86	
Owned land Rent	170.83	170.83	178.63	280.2	0.00	*	0.00	*
Depreciation	44.04	28.50	20.06	6.94	-0.32		1.57	
Total cash expenses	293.64	320.89	343.38	469.38	-2.26	*	-4.67	*
Total expenses	611.31	571.18	598.45	774.57	-2.22	*	-4.57	*
Gross revenue	**648.75**	**664.59**	**714.98**	**952.02**	**-2.02**	*	**-8.01**	*
Gross value added	**528.78**	**548.93**	**571.23**	**704.27**	**-0.22**		**-4.30**	*
Gross margin	**372.78**	**394.95**	**408.66**	**556.81**	**-1.24**		**-4.10**	*
Total cash income	**355.11**	**343.70**	**371.60**	**482.64**	**0.92**		**-2.69**	*
Net profit	**50.89**	**70.87**	**97.55**	**140.02**	**0.04**		**-1.62**	

Source: Field Survey, 2017 *Unit: USD/ha*

**Indicates statistical significance at 0.05 level*

Concerning the comparison of cost and returns between late non-aromatic and early aromatic rice, this analysis confirmed the significant difference in terms of production cost and yield between two categories. It was found that early aromatic rice was significantly more profitable than late non-aromatic rice. Higher yield and higher paddy price resulted the higher economic performance of aromatic rice than late non-aromatic rice. This implied that farmers who adopted aromatic rice both medium and early rice farming system made greater profit than farmers who adopted only non-aromatic rice. This result also realized the reasons behind the occurrence in diversities in rice farming in the study area as well.

Factors Affecting Farmers' Decision-making

Understanding the differences in cost and returns between aromatic and non-aromatic rice farming, it is needed to examine farmers' socio-economic characteristics factors, affecting their decision-making on varieties selection.

The result of estimated probit model of factors influencing group A and B farmers on varieties selection is presented in Table 5, which value 1 represented aromatic rice and 0 was non-aromatic rice. This study was examined farmers by farmers, and some of the variables had significant effects on the probability of adopting aromatic rice and some for non-aromatic rice. As result showed, the adoption of rice varieties was likely to be influenced by some factors. For instance, land condition appeared to be the most crucial factor in adopting decision of group A and B farmers. The significant of land condition indicated that well condition factor was likely important in increasing aromatic rice adoption. Similar studies suggested that the endowment of land field was critical for farmers' decision-making on varieties adoption. Farming experiences also appeared to be another important factor affecting on farmers' decision. The study pointed that the more experienced the farmers is, the more likely farmers will adopt aromatic rice. Eating preference was added in the model in order to capture the farmers' preference on home consumption rice varieties, and the result, on the other hand, indicated that eating preference and age of interviewed farmers showed

negative significant effect on adoption of aromatic rice. This suggested that eating preference and age of respondents were more likely to influence on adoption of non-aromatic rice.

Table 5 also shows the result of estimation of probit model of factors impacting group C farmers' decision-making. This analysis was examined plot by plot, and it also proved that land condition and farming experience factor showed the propensity toward adopting aromatic rice. The result indicated that the better land condition is and the more farming experiences farmers have, group C farmers were likely to produce more aromatic rice. It was possibly explained that group C farmers were mostly consisted of big size or farm oriented farmers, which proved that this farmers group was more responsive toward varieties with better yield and market.

Table 5 Estimated probit model for factors affecting farmers' varieties selection of aromatic, farmers adopted non-aromatic, and farmers adopted both aromatic and non-aromatic rice

Variable	Farmers adopted aromatic and farmers adopted non-aromatic rice only				Farmers adopted both aromatic and non-aromatic rice			
	Coefficient	Z-statistic		Average marginal effect	Coefficient	Z-statistic		Average marginal effect
Age	-0.08	0.07	.	-0.02	0.02	0.41		0.01
Family size	-0.09	0.63		-0.02	-0.07	0.53		-0.02
Level of education	0.09	0.26		-0.02	-0.04	0.48		-0.01
Farming experience	0.07	0.05	.	0.02	0.04	0.06	.	-0.01
Land size	0.04	0.89		0.01	3.81e-03	0.90		1.05e-03
Land condition	1.47	0.01	*	0.32	1.98	1.05e06	***	0.55
Eating preference	-0.98	0.09	.	-0.22	0.46	0.20		0.13
Constant	1.70	0.37		0.37	-0.11	0.93		-0.03
Percent of right predictions	83.33				64.78			

Source: Field survey, 2017
*Significant codes: 0'***' 0.001'**' 0.01'*' 0.05'.'*

CONCLUSION

The result of the analysis of production cost and returns revealed that all indicators including gross value added, gross margin, total cash income, and net profit of medium and early aromatic rice varieties received higher income and more profitable from economic view point in comparison to medium and late non-aromatic rice. The result also revealed that land condition was the most crucial factor in determining farmers' decision, specially toward producing aromatic rice because suitable land condition was needed in producing aromatic rice. It is indicated that in the future, the non-aromatic rice might lose its status as the major rice production in Cambodia, and more farmers will shift to grow more aromatic rice in the study. This study also suggested that in order to improve the production of aromatic and non-aromatic rice, two majoring issues are needed to address such as reduction domestics production cost and minimizing the marketing and trade related costs and barriers.

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