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Cost and Benefit Analysis of Healthy Rice Production Comparing with Other Rice in Upper Northern of Thailand

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Abstract: This research aims to examine rice production costs and returns as well as to focus on reducing inputs used by farmers who plant healthy rice and other rice. By studying the optimal use of agricultural inputs, excessive inputs are used to create a model of expected cost and return in terms of the budgeting analysis. The samples of farmer were selected by purposive sampling from 900 farmers. The research result showed that, the average net return of rice farmers was lower than that of healthy rice farmers at all levels of efficiency. The highest average return was obtained from rice farmers with high efficiency at 4,296.92 Baht per Rai. When the excess factor is adjusted in accordance with the performance analysis, the net return is higher. The most effective rice growers were farmers at the level of 7,170.76 Baht / Rai. The number of laborers was statistically.

Keywords: Production, Healthy Rice, Organic Agriculture, Cost and Benefit, Input slack

Introduction

Rice has been an important economic crop of Thailand for a long time, cultivated throughout the country. In the cultivation year 2014/2015, there were 60.79 million rais of rice cultivation area, with a total yield of approximately 26.27 million tons of paddy. In 2015, remarkably, Thailand had a total export volume of 9.795 million tons of rice to foreign countries, equivalent to 155,912 million baht (Department of Foreign Trade, 2016). It can be seen that the rice produced each year, in addition to

domestic consumption, can also be exported to bring about lots of income into the country. However, it is noteworthy that farmers still face losses as a result of increased production costs and the uncertainty of returns. Consequently, farmers turn to working in other fields. This causes a significant decrease in rice cultivation area of the whole country.

As organic or healthy rice is a good source of nutrients, the consumption of healthy rice has increased steadily, accounting for an average of 3.91 percent per year. It is also noteworthy that the domestic healthy rice market has slightly continued to expand, up to only 4 percent of the volume of rice produced. On the other hand, the demand for healthy rice in overseas markets tends to hike by an average of 15-20% per year. For this reason, 96% of organic rice produced each year is exported to foreign countries, especially European countries.

Overall, the most popular variety of healthy rice, both in the country and overseas, is jasmine rice (Office of Agricultural Economics, 2014). 80% of the healthy rice cultivation areas are in the Northeast and the rest are in the North. However, the area for cultivating healthy rice tended to decline in 2011, which was 0.14 million rais. Besides, in 2012 and 2013, it decreased to 0.12 and 0.11 million rais respectively (Office of Agricultural Economics, 2014). The lower supply of rice resulted in the higher price of organic rice as a market mechanism. The price of organic paddy was about 10% higher than that of general paddy, while the price of bagged organic rice was about 20% higher than that of the general rice. Also, the price of bagged organic paddy rice in the foreign markets was 25-30% higher than that of general milled rice (Kasikorn Research Center, Thailand, 2013).

It is interesting why healthy rice has not been produced on a larger scale while the rice demand is relatively high. Rice growers might have not received enough returns which results in less motivation. Therefore, the study of costs and returns of healthy rice production in comparison with those of the production of other general varieties determines which is most cost-effective. The study results can somehow become guidelines to balance rice yield and prices to efficiently meet the demand.

Research Objectives

1. To study the costs and returns for producing healthy rice and other varieties of rice grown in the upper northern region.
2. To determine the most reasonable costs and returns of the production of healthy rice and the rice production of other varieties.

Research Methods

1. Research Tools

To achieve research objectives, structured questionnaires, based primary data, were used to survey the farmers' cost and return, consisting of selling price, yield, cost of production factors, and labor cost.

2. Data Collection

This study collected data from 300 samples of healthy rice growers and 600 samples of general rice growers, using a specific sampling method and being conducted in Chiang Mai, Chiang Rai and Phayao as the top three most rice cultivation areas in the upper North.

3. Data Analysis

Step 1: Find out the technical Efficiency (TEF) of farm households, by using non-parametric technique based on DEA (Coelli et al., 1996).

Step 2: Divide the technical efficiency (TEF) of rice production by farmers into 5 levels. And, compare, to see differences and similarities, the efficiency of Healthy Rice and Other Rice.

Step 3: Analyze costs and returns from the usage of inputs in rice farming. Study the costs and the returns of rice production by considering their production practices: Healthy Rice and Other Rice, and the efficiency levels of their production. And, compare, to see the difference, the costs and the returns using t-statistic.

Step 4: Analyze the optimal use of inputs to reduce costs and increase yields for farmers, by reducing the inputs derived from the estimation in the model to calculate the potential costs and returns with both types and to see whether they are significantly different when using the t-statistic.

To determine the cost of production per unit, the prices of rice sold by farmers were compared in order to provide a break-even point. In addition, the analysis of returns on key inputs, such as labor, was made using the budgeting procedure (budgeting analysis) with the calculation method as follows.

$$TR = Y.P \quad (1)$$

$$NR = TR - TVC \quad (2)$$

as TR = total revenue per rai (Baht per rai)

Y = total rice yield (Kg per rai)
P = price of rice produced by farmers (Baht per kg)
TVC = total variable cost per rai (Baht per rai)
NR = net return on variable cost (Baht per rai)
The analysis uses t-statistic, mean, and percentage

Result

In the costs and benefits analysis, farmers were divided into groups of production efficiency levels from lowest to highest (five levels). They were divided into two groups: healthy rice growers with low to the highest production efficiency (4 levels), with no farmers with the least efficiency. Simultaneously, general rice growers were divided into groups of production efficiency ranging from moderate to the highest (3 levels), with no farmers in groups of low to the lowest production efficiency (Table 1).

Table 1: Level of Efficiency

Efficiency		*Healthy Rice*			*Other Rice*		
Level of Eff.	*Meaning*	*Amount*	*Percent*	*Average TE*	*Amount*	*Percent*	*Average TE*
0.8001-1.0000	Highest	224	74.67	0.9495	552	92.00	0.9644
0.6001-0.8000	High	44	14.67	0.6932	44	7.33	0.7178
0.4001-0.6000	Medium	22	7.33	0.5310	4	0.67	0.5980
0.2001-0.4000	Low	10	3.33	0.3254	-	-	-
0.0000-0.2000	Lowest	-	-	-	-	-	-
Total		**300**	**100.00**	**0.8604**	**600**	**100.00**	**0.9439**

Source: Calculation

Remark: Read more in Aree *et al.* (2019)

1. Actual costs and returns

This analysis is based on the data obtained from real farmers in order to analyze the cost-effectiveness of rice production. The details are as follows.

1.1. Cost of production of healthy rice farmers

The major production cost was labor cost. When the production efficiency was low, the cost was likely to become higher. To be more specific, the average cost of farmers with the highest production efficiency was 2,564.15 baht per rai, followed by that at

the high level with an average of 2,223.11 baht per rai, while the production cost at the low level had an average of 2,910.38 baht per rai. In the meantime, growing healthy rice, farmers did not use any chemicals, but organic fertilizers which did not cost much. It was found that farmers with the highest production efficiency faced the cost of fertilizer at 245.94 baht per rai, while those of other groups spent 186.34 to 198.44 baht per rai. On seed, the group of low productivity spent 357.14 baht per rai on the average. Last but not least, in terms of the labor cost, most of the cost was for cultivation since most of the farmers chose transplanting paddy sprouts as a method to maintain high quality and to receive high price of rice. This method required proper care, but they did not have to face high cost for the repair later. (Table 2).

1.2. Benefits of healthy rice production

Based on the analysis of the return of healthy rice production, it was found that the prices of rice were slightly different. The farmers with the highest production efficiency were able to sell their rice at a price of 11.69 baht per kilogram, while those with high efficiency received 13.08 baht per kilogram of rice. The rice prices of the farmers with moderate and low efficiency were only 12.73 and 12.28 baht per kilogram, respectively. However, it was worth noting that the average yield tended to increase when the productivity had decreased. To clarify, the average yield of the most efficient farmers was 543.95 kilograms per rai, and those with high efficiency had an average yield of 498.58 kilograms per rai, followed by an average yield of low efficiency farmers which was only 418.86 kilograms per rai. As a result, the low efficiency rice growers had the lowest income of 5,143.57 baht per rai. The moderate efficient farmers earned 6,022.22 baht per rai, as the high and the highest efficient farmers earned 6,520.03 baht per rai and 6,358.38 baht per rai, respectively (Table 2).

1.3. Net returns of healthy rice production

According to the analysis of the net returns of healthy rice growers, it was found that farmers with high efficiency had the highest net return of 4,296.92 baht per rai, followed by the farmers with the highest level of efficiency with a net yield of 3,794.24. baht per rai. The moderately efficient farmers received a net return of 3,109.39 baht per rai, whereas low efficient farmers earned a net return of only 2,233.18 baht per rai (Table 2).

1.4. Production cost of general rice farmers

The analysis of the costs in conventional rice production showed that, similarly to that among the healthy rice growers, the cost during production among the general rice growers was higher than the cost of production factors. And, the cost of producing rice of general varieties was higher than that of healthy rice production. The most efficient farmers bore a total cost of 2,177.98 baht per rai, while the most efficient farmers faced a total cost of 2,914.16 baht per rai, followed by that of the moderately efficient farmers amounting to 3,800.00 baht per rai. Moreover, to mention fertilizer cost, it was seen that the most efficient farmers had fertilizer cost of up to 555.40 baht per rai, while that of the moderately efficient group was 310.00 baht per rai. Although this group had low fertilizer cost, they spent on cultivation for 1,550.00 baht per rai on the average, while the most efficient farmers only spent 431.89 baht per rai. (Table 2).

1.5. Returns of general rice production

According to the analysis of the returns of general rice production, it was seen that farmers with the highest production efficiency were able to sell their rice at a price of 8.88 baht per kilogram. Simultaneously, the farmers with high efficiency sold their rice for 7.68 baht per kilogram, while those with moderate efficiency could only receive 5.50 baht per kilogram. In terms of yield, it appeared that there was no significant difference at each efficiency level. To clarify, the average yield of the most efficient farmers was 578.51 kilogram per rai. The farmers with high efficiency had an average yield of 590.57 kilogram per rai. And, those with moderate efficiency had an average yield of 600.00 kilogram per rai. It could be said that the higher the production efficiency, the higher the price of rice, while the quantity of output remained similar. As a result, low efficiency farmers had the lowest income of 3,300.00 baht per rai, On the contrary, highly efficient farmers earned 4,536.66 baht per rai, while the most effective farmers earned 5,137.88 baht per rai. (Table 2)

1.6. Net returns for general rice farmers

According to the net returns analysis among general rice growers, it was evident that the farmers with the highest efficiency had a net return of 2,959.90 baht per rai, while the farmers with high efficiency had a net return of 1,622.50 baht per rai, followed by the group of moderate efficiency with a net return of 500.00 baht per rai. This could be seen that the net return of general rice farmers tended to decline when the efficiency level became lower. (Table 2)

Table 2: Actual Average Costs and Returns of Farmers (Baht per Rai)

Cost – Benefit	*Healthy Rice*				*Other Rice*		
	Highest	*High*	*Medium*	*Low*	*Highest*	*High*	*Medium*
Revenue	**6,358.38**	**6,520.03**	**6,022.22**	**5,143.57**	**5,137.88**	**4,536.66**	**3,300.00**
• Prices	11.69	13.08	12.73	12.28	8.88	7.68	5.50
• Yields	543.95	498.58	473.17	418.86	578.51	590.57	600.00
Total costs	**2,564.15**	**2,223.11**	**2,912.83**	**2,910.38**	**2,177.98**	**2,914.16**	**3,800.00**
Costs of inputs	**586.40**	**463.04**	**615.66**	**660.38**	**860.58**	**913.57**	**640.00**
• Seed cost	232.73	174.91	255.55	357.14	189.86	242.56	270.00
• Fertilizer	245.94	198.44	186.34	197.52	555.40	505.12	310.00
• Chemicals	0.00	0.00	0.00	0.00	51.12	104.23	0.00
• Fuel and lubricants	107.72	89.68	173.76	105.71	64.20	61.67	60.00
Costs in production procedure	**1,977.75**	**1,760.08**	**2,297.18**	**2,250.00**	**1,317.40**	**2,000.58**	**3,160.00**
• Soil preparation	217.11	344.08	405.54	549.52	166.34	227.42	400.00
• Planting and sowing/growing	569.09	327.56	758.19	400.48	431.89	763.09	1,550.00
• Added planting	70.44	47.26	58.51	118.57	70.31	168.61	300.00
• Fertilization	455.81	511.60	401.15	357.14	269.68	324.58	300.00
• Spraying herbicides and insecticides	228.48	341.09	306.54	348.57	99.86	181.05	300.00
• Harvest	348.32	119.65	242.07	373.81	186.22	254.22	250.00
• After-harvest management	88.50	68.83	125.17	101.90	93.10	81.61	60.00
Net Return per Rai	**3,794.24**	**4,296.92**	**3,109.39**	**2,233.18**	**2,959.90**	**1,622.50**	**-500.00**

Source: Calculation

2. Reasonable costs and returns

In the analysis of the reasonable costs and returns among the two groups of rice growers, prices of rice were determined unchanged. Findings about target returns arose from a close look at the use of inputs and the outputs. Hence, for the utmost benefits, costs should be reduced to determine input slack and increase productivity derived from the efficiency analysis. The analysis of reasonable costs and net returns is detailed below.

2.1. Cost of production of healthy-rice growers

It was evident that the average cost of production among the most efficient farmers was 2,145.56 baht per rai, which could be reduced by 418.59 baht per rai. Meanwhile, the most efficient farmers faced the cost of 1,916.76 baht per rai, which was reduced by 306.35 bath per rai. As for farmers with moderate and low efficiency, the average production cost was 2,519.51 baht per rai and 2,723.78 baht per rai, which could be cut by 393.32 and 186.60 baht per rai, respectively. Most of the cost was for fertilizer. Also, it was found that the farmers with low efficiency would only reduce the cost for seed. (Table 3).

2.2. Returns of healthy-rice farmers

With regard to the analysis of the returns of healthy rice farmers, it was found that farmers with the highest production efficiency were able to manage their production to increase the yield to 797.00 kilograms per rai. The farmers with high production efficiency were also able to increase the yield to 601.68 kilogram per rai, while those with moderate efficiency were able to improve their production for a slight increase to 502.44 kilogram per rai. Nonetheless, the farmers with low efficiency still could not manage to increase their yield. (Table 3).

2.3. Net returns of healthy-rice farmers

While the target value of returns increased, some of the costs could be reduced as well. The results showed an increase in the net returns of all groups of healthy rice growers. Those with the highest efficiency had the highest net return, totaling 7,170.76 baht per rai, followed by that of the highly efficient farmers with a net return of 5,951.57 baht per rai, while those with moderate efficiency had a net return of 3,875.20 baht per rai. Last but not least, the average net return of the moderate efficiency group amounted to only 2,419.79 baht per rai. (Table 3).

2.4. Cost of production of general rice growers

Despite the satisfying decrease in the cost of general rice production, the farmers still spent a similar amount of money on fertilizers, which also happened in the production of healthy rice. The average cost of production of farmers with the highest efficiency was 1,740.77 baht per rai, which was reduced by 437.21 baht per rai. The high efficiency group spent 2,478.65 baht per rai, which could be reduced by 435.51. As for the farmers with moderate efficiency, the average production cost

was 3,665.00 baht per rai, which could be cut only by 135.00 baht per rai. Similar to the cost when transplanting paddy sprouts, the most cost derived from the analysis appeared to be fertilizer cost as well. (Table 3)

2.5. Yield of the production of other rice varieties

From the analysis of the farmers' yield, it was found that the farmers with the highest production efficiency were able to manage to increase the yield of 802.12 kilogram per rai. The farmers with high efficiency were able to manage to increase the yield of 631.73 kilogram per rai, whereas those with moderate efficiency could not manage to increase their yield. (Table 3)

2.6. Net return for rice growers of other varieties

By reducing the cost of production, farmers' net returns increased. The farmers with the highest efficiency had a net return of 5,382.98 baht per rai, while the most efficient farmers had a net return of 2,374.21 baht per rai. Moderately efficient farmers had a net return as a loss in a smaller amount, equivalent to 365.00 baht per rai. (Table 3).

Table 3: Reasonable Average Costs and Returns of Farmers (Baht per Rai)

Cost – Benefit	*Healthy Rice*				*Other Rice*		
	Highest	*High*	*Medium*	*Low*	*Highest*	*High*	*Medium*
Revenue	**9,316.32**	**7,868.33**	**6,394.71**	**5,143.57**	**7,123.75**	**4,852.86**	**3,300.00**
• Prices	11.69	13.08	12.73	12.28	8.88	7.68	5.50
• Yields	797.00	601.68	502.44	418.86	802.12	631.73	600.00
Total costs	**2,145.56**	**1,916.76**	**2,519.51**	**2,723.78**	**1,740.77**	**2,478.65**	**3,665.00**
Costs of inputs	359.82	284.29	384.13	473.78	601.77	670.66	505.00
• Seed cost	32.71	38.47	91.13	170.54	23.29	49.65	135.00
• Fertilizer	219.39	156.13	119.24	197.52	487.43	461.94	310.00
• Chemicals	0.00	0.00	0.00	0.00	26.84	97.41	0.00
• Fuel and lubricants	107.72	89.68	173.76	105.71	64.20	61.67	60.00
Costs in production procedure	**1,785.74**	**1,632.48**	**2,135.38**	**2,250.00**	**1,139.00**	**1,807.99**	**3,160.00**
• Soil preparation	209.32	343.72	402.70	549.52	148.08	217.58	400.00

contd. table 3

Cost – Benefit	*Healthy Rice*				*Other Rice*		
	Highest	*High*	*Medium*	*Low*	*Highest*	*High*	*Medium*
• Planting and sowing/growing	520.66	292.72	612.10	400.48	354.35	597.54	1,550.00
• Added planting	65.55	40.17	57.90	118.57	60.37	168.61	300.00
• Fertilization	407.37	447.43	396.28	357.14	252.75	314.75	300.00
• Spraying herbicides and insecticides	205.28	319.96	300.45	348.57	90.10	173.67	300.00
• Harvest	294.29	119.65	241.84	373.81	146.75	254.22	250.00
• After-harvest management	83.27	68.83	124.11	101.90	86.60	81.61	60.00
Net Return per Rai	**7,170.76**	**5,951.57**	**3,875.20**	**2,419.79**	**5,382.98**	**2,374.21**	**-365.00**

Source: Calculation

3. Incremental Returns

When considering the efficiency, it was shown that the farmers with low efficiency were able to sell at a price lower than those with higher efficiency. To paraphrase, if farmers were able to increase their productivity and reduce production cost, they were likely to greatly increase their income and net returns. The relatively high cost was due to the use of seed and fertilizers which appeared to be the most easily controlled factors. Better than that, controlling the use of such factors could increase profits. Thus, surplus factors obtained from the technical efficiency study were taken into account with the costs and returns analysis. It illustrated that a net return of healthy rice farmers increased by 1,932.33 baht per rai. An average increase in return of general rice production was by 1,103.26 baht per rai. It is noteworthy that after reducing excess inputs, overall, the farmers' net return increased by an average of 1,834.40 baht per rai. This indicated that the major issue in the production of healthy rice was likely to arise from the inability to utilize production factors to their full potential.

Conclusion

Conventional rice growers gained lower returns than healthy rice farmers because of the difference in rice prices they received. Meanwhile, there was no significant difference in terms of cost of production. It was also found that the production

cost of most healthy rice farmers was lower than the production cost of the conventional rice farmers. It also appeared that conventional rice growers with moderate efficiency suffered losses. However, by reducing costs and determining input slack, the farmers were able to reduce their production cost and increase their net yield in the same amount. Nonetheless, a decrease in costs among the conventional rice farmers was smaller than that among the healthy rice growers. Consequently, the group of moderately efficient farmers still suffered losses. In addition, when comparing the productivity of general rice growers within their own groups, farmers were considered efficient. In contrast, if compared with other groups, they were not efficient. Hence, it was suggested that farmers placed emphasis on their production following the agricultural development model "Kaset Praneet" or Intensive Farming in order to control both production inputs and outputs for most cost-efficiency.

Discussion of research findings

The study of costs and returns of healthy rice production compared with those in the rice production of other general varieties in the upper northern region of Thailand has brought about remarkable findings to be discussed as follows.

1. The cost of healthy rice production is higher than the cost of producing rice of other varieties. However, the higher price healthy rice is sold at has resulted in higher income and net returns of healthy rice farmers, compared with the conventional rice growers. This finding is consistent with the study conducted by Jutatip and Suwanna (2010) which compares the costs and returns of organic and chemical-based rice cultivation of farmers in Lam Luk Ka district, Pathum Thani Province by analyzing the breakeven point in rice production. The study states that organic rice production had an average cost of 3,718.10 baht per rai, while chemical-based rice production had an average cost of 4,534.08 baht per rai. Moreover, the study of Wanthana et al (2010) mentions that growing rice using chemicals has a higher cost than using biological substances. Using chemicals in the production is said to cause losses as well. And, as in the rice cultivation of other varieties, farmers prefer to cultivate using the sowing method, it leads to difficulty to maintain the fields when it comes to removing weeds or pests. Therefore, more chemicals will be used, and the cost is subsequently increased.
2. Although the results of this study contradict the Inthira's cost study (2004), which states the cost of organic rice production in Surin province is 1,917

baht per rai, higher than the general rice production cost of 1,828.57 baht per rai, they appear to be consistent in terms of net returns. A net return of the organic rice production is 1,177.03 baht per rai, while that of other general rice varieties was only 425.51 baht per rai, due to high labor cost labor in organic rice production. Fortunately, the farmers earn satisfying net returns over total costs.

Suggestions

1. Government agencies are to educate and guide farmers of healthy rice so that they are capable of managing to lower production costs and generating higher returns.
2. Farmers are to work together to generate bargaining power for purchases of inputs and prices of rice.

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