

## Cost and Benefit Analysis of Rice Production between Transplanting and Direct Seeded Method for Rice in Upper Northern Region

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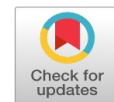
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**Abstract:** This research aims to examine rice production costs and returns as well as to focus on reducing inputs used by farmers implementing rice transplanting and direct seeding approaches. By studying the optimal use of agricultural inputs, excessive inputs are used to create a model of expected cost and return in terms of the budget procedure. The research result showed that costs and returns of the farmers reducing the production inputs were higher than those of the farmers not reducing their inputs. Simultaneously, the net return of the first group of farmers was statistically significantly lower. However, when the inputs had been reduced, the production cost of rice growers became lower. Also, the return was slightly higher due to the high production quality. Regarding the research findings, rice growers are suggested that they encourage household members give more importance to rice production in order to increase the potential for rice production with transplanting method which will result in higher production efficiency and higher return.

**Keywords:** Rice production, Transplanting, Direct seeding, Costs and returns

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### INTRODUCTION

Rice is a grain and has been a major economic crop of Thailand for a long time. It is cultivated throughout the country. In the 2013/14 crop year, a total of 20.50 million tons of paddy were produced from the total cultivated area for rice of 69.9 million rais (Ayuningrat, Noermijati, & Hadiwidjojo, 2016; Nuansoi, Suntinyompukdee, & Tahlah, 2017; Office of Agricultural Economics, 2015a), which was used for domestic consumption of 10.90 million tons; and the remaining was exported to the overseas market, valued at 174,851 million baht (Bilog, 2017; Office of Agricultural Economics, 2015b; Wartika, Surendro, Satramihardja, & Supriana, 2015; Willy, 2017). It can be said that rice has been consumed domestically and can also be exported to bring in a large amount of income each year. Thailand also has the highest share in the world's rice market, although it lost market share to India in the 2012/13. It is noteworthy, nevertheless, that Thai farmers still suffer from losses. That is due to the cost of production which is likely to increase and the uncertainty of economics. Many farmers turn to mercenaries because of the certainty of their income. That brings about the potential decline in the cultivation area for rice production.

In rice cultivation, there are essential inputs namely land, labor, management, as well as new inputs such as seeds, fertilizers, pesticides and various machinery. These factors, when properly allocated, can help increase productivity. When considering the farming practices, main practices are transplanting and direct seeding; and the direct seeding method also covers pre-germinated direct-seeding and direct seeding. The obvious difference between transplanting and the direct seeding is that the soil preparation procedure of transplanting is more refined than that of the direct-seeding. And, transplanting needs

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more labor. That is, direct-seeding can solve the shortage of labor (Janprasert, 1975). However, the disadvantage of direct-seeding or sowing is that it requires more seed by 8-10 kg/rai to be used and produces lower (Planning and Research Department of Agriculture, 2018). Significantly, the number of agricultural workers has been declining steadily since 1990, from 63.3% of total employed workers to only 42.1% in 2012 (Bank of Thailand Northeast office, 2013). Consequently, there is currently a shortage of agricultural workers.

The northern region is the second largest rice growing area after the Northeast. Even though the average rice yields per rai are lower than those of the central region, they are still higher than the national average. Significantly, the shortage of labor has become an issue. One of the causes of the shortage of labor is that farmers want their children to get high education and work comfortably in other fields. Farmers in the North, therefore, have turned to direct-seeding method. In addition, having a misconception about labor reduction, rice growers assume that it helps reduce production cost. Instead, they have to increase the use of chemicals to eliminate weeds and pests; whereas the rice is not strong enough.

It has become an interesting question: how are transplanting and direct-seeding different from each other in terms of production efficiency and which method is most efficient? It also raises the issue concerning the difference between cost of each production practices. All these questions are to bring about the best way to produce rice to rice growers in the upper northern region.

## LITERATURE REVIEW AND RELATE THEORIES

### Concepts and theories of cost and revenue

To study economic feasibility of rice farming, the focus will be on the net return on total variable cost of rice cultivation and will also be on the rice production cost per unit. To clarify, the cost-per-unit study will provide a break-even point. In addition, the analysis will be of return to most important inputs such as labor, by adopting a budgeting analysis with a calculation method provided below.

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

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

$TR$  = Total revenue per rai (baht/rai)

$Y$  = Total rice yield (Kg / rai)

$P$  = Price of rice sold (baht/kg.)

$TVC$  = Total variable cost per rai (baht/rai)

$NR$  = Net return on variable cost (baht/rai)

### Studies related to costs and benefits

Production costs consist of variable costs and fixed costs. In the analysis of costs and returns of production, costs are usually classified into two types: cash cost and non-cash cost. Variable costs include labor cost, cost of agricultural materials, expenses for agricultural equipment repair, and the opportunity cost for requesting funding. Fixed costs cover land use fees and land tax. The study found that the cost of organic rice production in Surin province was 1,917 baht per rai, which was higher than the average production cost of 1,828.57 baht per rai. However, the net return on organic rice production was 1,177.03 baht per rai. In the meanwhile, the net return of rice is only 425.51 baht per rai (Intan, 2016; Pali, 2012). Additionally, the costs of rice production using chemicals and of organic rice in Chiang Rai were compared. The organic rice production cost was up to 2,765.95 baht/rai.

Simultaneously, the rice production cost using chemicals was approximately 2,639.03 baht/rai. Nonetheless, the net return of organic rice production accounted for 127.11 baht/rai (Anjani & Baihaqi, 2018; Arayarattanakul, 2003). Moreover, regarding the comparison of costs and returns of organic rice production and rice production using chemicals in Lam Lukka district, Pathumthani, by analyzing the break-even points in the productions, it was disclosed that organic rice production had an average cost of 3,718.10 baht per rai. Organic rice farmers had an average income of 8,350.20 baht per rai. Meanwhile,

the average cost of rice production using chemicals equaled 4,534.08 baht per rai with the average income of 9,710.52 baht. Furthermore, the break-even point of organic rice production was 761.97 kg/rai, while that of the other type of production practice was 890.87 kg/rai. In other words, the break-even point of the organic rice production was lower than that of the rice production using chemicals (Coelli & George, 1996). In addition, when comparing the cost of organic rice and the cost non-toxic rice, it was revealed that organic rice had an inflated cost of 2,432.93 baht per rai, while the cost of organic rice production was 2,145.97 baht per rai. It is noteworthy that the organic farmers had a net income of 373.81 baht per rai; whereas those who farmed non-toxic rice lost 482.18 baht per rai. Besides, the level of yield and the price at the break-even point of non-toxic rice were higher than those of organic rice (Coelli & George, 1996).

In addition, according to the results of the cost and return analysis of rice production using chemicals and biological agents among farmers in Uttaradit province, it was evident the cost of chemical-adopting rice production amounted to 7,450 baht per rai. The cost of rice production with biological agents were 4,600 baht per rai. The non-biological farmers, as a result, wasted up to 1,990 baht per rai, as non-monetary cost which was household labor. However, when considering only cost and revenue in monetary terms, it was said that farmers who used chemicals still had lower net profits than farmers using biological agents (Ruangsang, Tewtrakul, & Reanmongkol, 2010). Another important study was on the concept of cost, return and break-even point of rice farming in Chiang Rai. Rice growers were divided into 6 groups with the consideration of their assets, which include tractors, and land tenure. The study found that farmers without plowed tractors, but with their own fields, had the lowest production costs. The highest income was for the group of farmers who had a tractor but rented a farm. Moreover, it was discovered that production problems were mainly caused by high fertilizer prices, expensive fuel prices, and decline of paddy prices (Janprasert, 1975). Last but not least, the comparison of costs and returns of rice production of cooperative and non-cooperative farmers, it was found that the farmers who were members of a cooperative had a greater net return than that of non-member farmers by 27 baht per rai (Supapan, 2012).

## Objectives

1. To study the efficiency of rice production by transplanting and direct-seeding method of rice growers in the upper North.
2. To examine the costs and benefits of rice production, as well as the approaches to reduce the use of inputs in rice farming with both transplanting and direct-seeding method.

## Research scope

The survey was conducted with sampling among rice farmers, who were divided into two groups according to their production practices: transplanting and direct-seeding, in the most rice-growing area in the upper North covering Chiang Mai, Chiang Rai and Phayao.

## RESEARCH METHOD

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

Step 2: Divide the TEF of rice production by farmers into 5 levels. And, compare, to see differences and similarities, the efficiency of rice transplanting and direct-seeding.

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: transplanting and direct-seeding, 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 adopting transplanting and for those employing direct-seeding method, by reducing the inputs derived from the

estimation in the model to calculate the potential costs and returns with both cultivation methods 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.

$$TR = Y.P \quad (3)$$

$$NR = TR - TVC \quad (4)$$

*TR* = Total revenue per rai (baht/rai)

*Y* = Total rice yield (Kg / rai)

*P* = Price of rice sold (baht/kg.)

*TVC* = Total variable cost per rai (baht/rai)

*NR* = Net return on variable cost (baht/rai)

## RESEARCH FINDINGS

### Actual costs and returns

The actual cost and return analysis (Table 1) was based on the data obtained from the farmers in order to analyze the worthiness of rice production.

#### *Production cost of rice farming with transplanting*

The average cost of production of farming with the medium level of efficiency was 4,973.48 baht/rai, while the lowest average cost, only 3,103.35 baht/rai, was for the group of farmers with the highest level of efficiency. The average cost of production of farmers in the groups, with high efficiency level and with low efficiency level, and was 3,762.34 baht/rai and 4,227.43 baht/rai, respectively. To be more specific, the highest cost was the cost of cultivation and transplanting which had been included in the cost of production. This is because the farmers chose the transplanting method that led to inflated cost. However, the cost of cultivating and transplanting, of the farmers with low and medium efficiency was higher than that of the farmers with high and highest efficiency levels. Additionally, the cost of inputs was mostly the cost of fertilizer. It was found that the farmers with low level of production efficiency spent up to 1,033.00 baht per rai on fertilizer. That is, the farmers were more accustomed to using fertilizer and tended to rely more on fertilizer every year. Besides, as using fertilizer results in soil mineral depletion, higher demand on fertilization rises every year.

#### *The revenue of rice farmers*

Based on the analysis of the revenue of the farmers, the price of rice was not significantly different. That is, firstly, the farmers with the highest production efficiency were able to sell rice at the price of 9.84 baht per kilogram. Secondly, the farmers with high efficiency were able to sell their rice at the price of 9.33 baht per kilogram. Meanwhile, those with the medium efficiency sold their rice at only 8.19 baht per kilogram. And, the farmers with less efficiency farmers sold their product at 9.00 baht per kilogram. It is noteworthy that the average yield was likely to increase as productivity decreased. To clarify, the average yield of the most efficient farmers was 761.29 kilograms per rai; whereas the average yield of the farmers with high efficiency was 827.79 kilograms per rai. Meanwhile, the farmers with low production efficiency had an average yield of 961.67 kilograms per rai. As a result, the least efficient farmers had the highest income, which was 8,655.03 baht per rai; and the lowest income was for the farmers with medium efficiency totaling 7,136.36 baht per rai. Plus, the high and highest efficient farmers income accounted for 7,723.28 baht per rai and 7,491.09 baht per rai, respectively.

#### *Net return of transplanted rice farmers*

With respect to the analysis of net return of transplanted rice farmers, it was found that the farmers with most and less production efficiency had the similar numbers of net return, which were 4,387.74

and 4,427.60 baht per rai in order. Simultaneously, the net return of the farmers with high efficiency totaled 3,960.94 baht per rai. And, the moderately efficient farmers earned only 2,162.88 baht per rai.

#### *Production cost of rice farming with direct-seeding method*

Based on the cost estimates of rice production, it was found that when the production efficiency decreased, the cost of rice production was likely to increase. To be clear on this point, the most efficient farmers bore the production cost of only 2,604.73 baht per rai, while the more efficient group of farmers had the higher cost of 2,890.76 baht per rai. The farmers with the production efficiency at moderate and low levels, their costs of production were 4,386.87 and 5,132.17 baht per rai, in order. Significantly, most of the cost during the production procedure was for harvesting and soil preparation as the key factors.

#### *Return on rice farming with direct-seeding method*

Regarding the return analysis of direct-seeding farming, it was revealed that prices of rice produced at various levels of production were different. That is, the farmers with the highest production efficiency were able to sell their rice at 10.59 baht per kilogram, when those with the efficiency at high level efficiency sold their product at a price of 10.67 baht per kilogram. Meanwhile, the farmers with medium efficiency could sell the product at 9.89 baht per kilogram; and less efficient farmers sold the product at a price of 8.33 baht per kilogram. Plus, the average yields fluctuated at each efficiency level. To clarify, the average yield of the most efficient farmers equaled 748.52 kilograms per rai. At the high level of efficiency, the average yield of the farmers was 630.32 kilograms per rai. Meanwhile, the farmers with low productivity had the average yield of 990.91 kilograms per rai, when the least efficient farmers had the highest income, which was 8,254.28 baht per rai. Moreover, the farmers with high efficiency earned the least the lowest income, accounting for 6,725.51 baht per rai. And, the farmers with moderate efficiency and with high efficiency earned 7,531.93 baht per rai and 7,926.83 baht per rai, respectively.

#### *Net return on rice farming with direct-seeding method*

According to the analysis of net return of rice farmers implementing direct-seeding, it was unveiled that rice-growers with medium and low production efficiency had similar numbers of net return, of 3,145.06 and 3,122.11 baht per rai, respectively, which appeared to be quite low when compared to that, totaling 5,322.10 baht per rai. At the same time, those with high productivity level had the net return of 3834.75 baht per rai. It seemed to be obvious that the net return on rice farming with the direct-seeding method was likely to increase when the level of productivity of direct-seeded became higher.

### **Reasonable costs and returns**

In the cost and return analysis of the two group of rice growers (Table 2), the level of the farmers income was fixed. Instead, the cost of input slack, derived from the efficiency analysis, were reduced. The results of the cost and net return are detailed as follows.

#### *Production cost of transplanted-rice farmers*

The average cost of production of the most efficient farmers was 3,097.16 baht per rai, which was lowered by 6.19 baht per rai. In the meantime, the farmers with high efficiency spent 3,693.44 baht per rai, which could be reduced by 68.90 baht per rai. Moreover, the average production cost of those with the medium and the low level of efficiency equaled 4,464.25 baht per rai and 3,777.77 baht per rai, respectively, and were reduced by 509.23 and 449.66 baht per rai, respectively. In addition, cost of inputs was mainly cost of fertilizers. The farmers with low efficiency did not reduce fertilizer use since fertilization appeared to be the only factor that contributed to their productivity. Yet, less efficient farmers could reduce the seed cost by up to 103.04 baht per rai.

#### *Net return of transplanted rice farmers*

Based on the net return analysis of rice-transplanting farmers, it was uncovered that all groups of farmers were able to increase net return. To be detailed, the farmers with the lowest level of efficiency

had the highest net return, which was 4,877.26 baht per rai. The second highest income, equaling 4393.94 baht per rice planters, was for those with productivity at the highest level. And, the farmers with high efficiency had a net return of 4,029.84 baht per rai, while that of those with medium efficiency was only 2,672.11 baht per rai.

#### *Production cost of direct-seeded rice growers*

Despite the reduction in the cost of rice production, it was still found that the cost of rice production was likely to increase, when the production efficiency decreased. The average cost of production of the most efficient farmers was 2,583.76 baht per rai, which could be reduced by 20.97 baht per rai; whereas the cost of the rice planters with high efficiency amounted to 2,754.61 baht per rai, which was reduced by 136.15 baht per rai. Simultaneously, the average cost of farmers with medium efficiency and with low efficiency totaled 3,708.44 baht per rai and 4,218.48 baht per rai, in order, which meant the production cost decline by 678.43 and 913.69 baht per rai, respectively. Furthermore, it was obvious that the cost of inputs covered mostly fertilizer, as the same as in the rice production with the transplanting method. However, the less efficient farmers could reduce their fertilizer cost and seed cost by 131.38 and 294.60 baht per rai, respectively.

#### *Net return of direct-seeded rice farmers*

By reducing the cost of rice production, the farmer's net return increased. The farmers with the highest efficiency had a net return of 5,343.07 baht per rai; whereas the high-efficiency farmers had a net return of 3,970.90 baht per rai. Additionally, those with medium efficiency earned 3,823.49 baht per rai. And, the rice growers with low productivity showed a net return of 4,035.80 baht per rai.

#### **Additional returns**

At the diverse levels of rice production efficiency, it was found that less efficient rice farmers were able to sell their rice at the lower price than that of the farmers at the other levels, except for the directed-seeded rice growers who could sell their product at higher prices than those sold by the medium-efficiency group. If these two groups of farmers could increase their productivity and reduce their production costs, they would be able to increase their income and profit. Again, the most cost shouldered by the farmers was high due to the use of fertilizers, chemicals, soil preparation cost, and wages paid for labor helping with planting and harvesting. These were the easiest controlled inputs. In fact, controlling use of fertilizers and chemicals was easier than increasing the yield and could increase profits. Therefore, the excessive inputs obtained from the technical efficiency test were considered together with the cost and return analysis, as the farmer's income remained the same. The results showed that the net profit of the transplanted rice farmers increased by an average of 84.51 baht per rai. Meanwhile, the net profit of the direct-seeded rice growers was an average of 289.68 baht per rai. It is noteworthy that, reducing the total use of excessive inputs helped increased the net return of the farmers by 383.77 baht per rai. Thus, it can be said that the reduction of lavish use of inputs will genuinely enhance the profits.

When the costs and the returns were analyzed together with the guidelines for reducing production inputs, it was found that direct-seeded rice growers could be more profitable than the transplanted rice farmers, particularly those who minimized the use of up to three types of inputs used for their production which could bring about an increase of their net return by 1151.55 baht per rai. Meanwhile, the rice farmers who lessened two types of inputs were able to lift their net returns by 696.02 baht per rai. And, the rice-transplanting farmers who cut the use of two inputs could raise their net return by 361.88 baht per rai.

Table 1: Actual average costs and returns of farmers (Baht per rai)

|                                      | Transplanted Rice |         |         |         |        | Direct-Seeded Rice |         |         |         |        |
|--------------------------------------|-------------------|---------|---------|---------|--------|--------------------|---------|---------|---------|--------|
|                                      | Highest           | High    | Medium  | Low     | Lowest | Highest            | High    | Medium  | Low     | Lowest |
| Revenue                              | 7491.09           | 7723.28 | 7136.36 | 8655.03 | -      | 7926.83            | 6725.51 | 7531.93 | 8254.28 | -      |
| Prices                               | 9.84              | 9.33    | 8.19    | 9.00    | -      | 10.59              | 10.67   | 9.89    | 8.33    | -      |
| Yields                               | 761.29            | 827.79  | 871.35  | 961.67  | -      | 748.52             | 630.32  | 761.57  | 990.91  | -      |
| Total                                | 3103.35           | 3762.34 | 4973.48 | 4227.43 | -      | 2604.73            | 2890.76 | 4386.87 | 5132.17 | -      |
| costs                                |                   |         |         |         |        |                    |         |         |         |        |
| Costs of inputs                      | 1084.82           | 1287.30 | 1197.72 | 1711.67 | -      | 902.86             | 1071.98 | 1238.17 | 1783.32 | -      |
| Seed cost                            | 277.36            | 176.63  | 189.71  | 140.00  | -      | 174.52             | 209.03  | 254.19  | 509.95  | -      |
| Fertilizer                           | 602.58            | 833.11  | 700.55  | 1033.00 | -      | 577.52             | 648.64  | 820.24  | 989.70  | -      |
| Chemicals                            | 162.06            | 230.73  | 202.70  | 534.67  | -      | 100.89             | 115.77  | 99.16   | 219.56  | -      |
| Fuel and lubricants                  | 40.44             | 43.35   | 92.75   | 0.00    | -      | 34.49              | 95.68   | 60.35   | 53.44   | -      |
| Ditch maintenance                    | 2.38              | 3.48    | 12.01   | 4.00    | -      | 15.44              | 2.86    | 4.23    | 10.67   | -      |
| Costs in production procedure        | 2018.53           | 2475.04 | 3775.76 | 2515.76 | -      | 1701.87            | 1818.78 | 3148.70 | 3348.85 | -      |
| Soil preparation                     | 367.82            | 454.47  | 736.73  | 66.67   | -      | 474.94             | 359.21  | 746.18  | 1455.45 | -      |
| Planting and sowing/growing          | 623.74            | 668.45  | 1063.56 | 1044.95 | -      | 168.68             | 189.00  | 351.70  | 306.67  | -      |
| Added planting                       | 67.68             | 99.71   | 139.31  | 310.00  | -      | 52.74              | 67.71   | 252.29  | 146.06  | -      |
| Fertilization                        | 60.77             | 77.68   | 251.31  | 80.00   | -      | 59.79              | 153.14  | 196.44  | 183.13  | -      |
| Spraying herbicides and insecticides | 116.20            | 116.90  | 243.85  | 40.00   | -      | 51.63              | 108.99  | 148.57  | 178.49  | -      |
| Water use management                 | 38.21             | 67.87   | 92.26   | 310.00  | -      | 23.89              | 45.73   | 239.55  | 149.90  | -      |
| Harvest                              | 570.19            | 616.68  | 702.07  | 316.67  | -      | 645.95             | 697.90  | 732.90  | 634.44  | -      |
| After-harvest management             | 173.92            | 373.28  | 546.67  | 347.47  | -      | 224.25             | 197.10  | 481.07  | 294.71  | -      |
| Net Return per Rai                   | 4387.74           | 3960.94 | 2162.88 | 4427.60 | -      | 5322.10            | 3834.75 | 3145.06 | 3122.11 | -      |

Table 2: Reasonable average costs and returns of farmers (Baht per rai)

|                                      | Transplanted Rice |         |         |         |        | Direct-Seeded Rice |         |         |         |        |
|--------------------------------------|-------------------|---------|---------|---------|--------|--------------------|---------|---------|---------|--------|
|                                      | Highest           | High    | Medium  | Low     | Lowest | Highest            | High    | Medium  | Low     | Lowest |
| Revenue                              | 7491.09           | 7723.28 | 7136.36 | 8655.03 | -      | 7926.83            | 6725.51 | 7531.93 | 8254.28 | -      |
| Prices                               | 9.84              | 9.33    | 8.19    | 9.00    | -      | 10.59              | 10.67   | 9.89    | 8.33    | -      |
| Yields                               | 761.29            | 827.79  | 871.35  | 961.67  | -      | 748.52             | 630.32  | 761.57  | 990.91  | -      |
| Total                                | 3097.16           | 3693.44 | 4464.25 | 3777.77 | -      | 2583.76            | 2754.61 | 3708.44 | 4218.48 | -      |
| costs                                |                   |         |         |         |        |                    |         |         |         |        |
| Costs of inputs                      | 1084.15           | 1264.52 | 1056.97 | 1608.63 | -      | 895.83             | 1055.09 | 1121.57 | 1357.34 | -      |
| Seed cost                            | 276.75            | 168.90  | 166.05  | 36.96   | -      | 173.41             | 197.57  | 222.85  | 378.57  | -      |
| Fertilizer                           | 602.52            | 818.06  | 583.46  | 1033.00 | -      | 571.60             | 643.21  | 734.98  | 695.10  | -      |
| Chemicals                            | 162.06            | 230.73  | 202.70  | 534.67  | -      | 100.89             | 115.77  | 99.16   | 219.56  | -      |
| Fuel and lubricants                  | 40.44             | 43.35   | 92.75   | 0.00    | -      | 34.49              | 95.68   | 60.35   | 53.44   | -      |
| Ditch maintenance                    | 2.38              | 3.48    | 12.01   | 4.00    | -      | 15.44              | 2.86    | 4.23    | 10.67   | -      |
| Costs in production procedure        | 2013.01           | 2428.92 | 3407.28 | 2169.14 | -      | 1687.93            | 1699.52 | 2586.87 | 2861.14 | -      |
| Soil preparation                     | 367.00            | 451.43  | 699.44  | 62.50   | -      | 467.80             | 343.36  | 621.53  | 1243.64 | -      |
| Planting and sowing/growing          | 622.14            | 628.36  | 879.35  | 869.14  | -      | 168.47             | 188.77  | 322.42  | 287.52  | -      |
| Added planting                       | 67.26             | 99.30   | 126.14  | 269.11  | -      | 51.89              | 63.11   | 180.89  | 126.10  | -      |
| Fertilization                        | 60.57             | 77.35   | 235.81  | 75.01   | -      | 59.42              | 136.11  | 169.75  | 164.24  | -      |
| Spraying herbicides and insecticides | 116.00            | 116.48  | 220.28  | 37.50   | -      | 50.37              | 100.32  | 138.32  | 147.72  | -      |
| Water use management                 | 37.59             | 67.75   | 79.26   | 269.11  | -      | 23.63              | 40.59   | 141.42  | 119.55  | -      |
| Harvest                              | 569.36            | 616.00  | 666.56  | 261.00  | -      | 643.28             | 645.86  | 626.94  | 534.43  | -      |
| After-harvest management             | 173.09            | 372.25  | 500.44  | 325.77  | -      | 223.07             | 181.40  | 385.60  | 237.94  | -      |
| Net Return Per Rai                   | 4393.93           | 4029.84 | 2672.11 | 4877.26 | -      | 5343.07            | 3970.90 | 3823.49 | 4035.80 | -      |



## DISCUSSION AND CONCLUSION

The income of transplanted rice farmers was higher than that of direct-seeded rice farmers. At the same time, the cost of transplanted rice production was higher than that of transplanted rice. However, the net return of transplanted rice farmers was higher than that of direct-seeded rice farmers. Besides, regarding the t-statistic test, it was demonstrated that the net returns of the two group of rice growers were significantly correlated with the efficiency level at the statistical significance level of 0.05, with a direct variation. To clarify, if the farmers have high efficiency, they will have a high return. On the contrary, if the farmers have lower productivity levels, a net return of the farmers will be lower. Moreover, it was revealed that most of the production cost is mainly the expenses during the production procedure. By reducing unnecessary costs, therefore, it was evident that the net returns were lifted. Furthermore, when efficiency decreased, the net returns increased. In addition, the low efficiency farmers were required to cut more production inputs than those of the high efficiency rice planters. And, as the rice growers had used a lot of excessive inputs, with the reduction of production inputs, the average yield of the direct-seeded rice farmers was higher than that of the transplanted rice farmers. Plus, based on the t-statistic test to examine the correlation between the net returns after the reduction of excessive inputs and the production efficiency, it was unveiled the net returns were correlated, in the same direction, with the production efficiency at the statistical significance level of 0.10.

## SUGGESTIONS

1. Farmers are suggested that they adjust their use of inputs to suit their production conditions and to reduce unnecessary costs.
2. Officials in related agencies, such as agricultural cooperatives and Provincial Agricultural Offices, are suggested that they give advice to farmers on a proper use of rice production inputs for production worthiness.

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