Input Factor Affecting Rice Seed Production in Thamai Sub-district, Nakhon Sawan Province, Lower Northern, Thailand

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ABSTRACT

The objectives of this investigation were to determine existing condition of rice seed production in the study areas and also input factor affecting rice seed production. The 66–selected sample of rice farmers in Thamai sub-district, Chumsaeng district, Nakhon Sawan province was estimated using the formula developed by Arkin (1974) through multistage sampling technique. Data collection was obtained by interview schedule under closely observation and also in-depth discussion with key persons in the research site. Cobb-Douglas production function by means of ordinary least square (OLS) was employed to test the hypothesis of input factor affecting yield. The results revealed that most population in this community cultivated rice as major or minor occupation. The average number of owned land for seed cultivation was 3.36 hectares. Total seed cultivation land, accounting for 74.88% was farmers' owned land that they received from their parents. These can reduce the risk in farming because of its their own land. The findings of OLS analysis confirmed that the positive combination input factors affecting rice seed production were fertilizer and rice seed land at the statistically significant level of 0.001 and 0.01, respectively. The coefficient of determination (R^2) was 0.308.

Keywords: Agricultural input, rice seed production, lower northern Thailand

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INTRODUCTION

Rice is an important economic crop because it is the staple food for a large part of the world's human population, especially in Asia. It is significantly impact on the country's food security. Rice is cultivated in more than a hundred countries with a total cultivated area in 2013 of approximately 162 million hectares by producing more than 700 million tons annually. This volume is approximately around 470 million tons of milled rice. Furthermore, over 90% of the world's rice is produced and consumed in Asia. (USDA, 2014a; Hossain and Narciso, 2004)

In Thailand rice is vital major economic crop. Land use in crop year 2013/2014 was around 70.28 million rai (11.24 million hectares, 1 ha = 6.25 rai), accounting for at least 50% of farm holding land in 2013. Total product in the same year was 36.84 million tons (OAE, 2015). In each year, domestic consumption is around 55% of total production. The rest was exported around 45% as the main export commodity of the whole kingdom.

According to Ministry of Commerce (2015), the average value in the past two decades was around 100,554.97 million baht (3,351.83 USD, 1 USD = 30 baht). The average export was around 7.14 million tons. Thailand is always the leading rice exporter of the world except in 2012 with market share was around 25.33%. The rest were India, Viet Nam, Pakistan and United States, accounting for 25.19, 14.61, 8.31 and 6.92%, respectively (USDA, 2014b). On the contrary, the average yield of Thailand is less than other countries. Regarding the causal of low yield in Thai rice production, Mutert and Fairhurst (2002) pointed out that the main contributing factors are the lower yield potential of the dominant rainfed system, greater use of traditional varieties instead of modern varieties and less efficient management of water and nutrients.

In regards to factor affecting rice production efficiency, according to the investigation of Oris (2001), Sachchamarga and Williams (2004), Kouser and Mushtaq (2007), Huy (2009), Rahman *et al.* (2009), Thibbotuwawa *et al*. (2012) found that factors affecting rice production were some general background of farmers including age, education, knowledge of increasing rice productivity, female labor participation, land, type of owner area, labor, family labor endowment, hired labor, ownership, own tractor, seed supporting, paddy rice price income, seed quality, cost of seed, seed preparation, fertilizer, plant distance, the annual amount of rainfall, water security, irrigation and also saline soil problems.

Recent trend analysis also indicated the growth of the rice sector has become completely dependent on yield improvement. According to Pate and Cruz (2007), yield improvement can come in either of two ways towards shifting the yield frontier (breeding varieties that have significantly higher yield potential more than current varieties) and also through the developing and the promoting yield enhancing technology, such as the use of high quality seed and efficient fertilization.

In terms of efficiency study on rice production, Khan *et al.* (2010) who studied on technical efficiency of rice production, the study revealed that there is potential for increasing rice production by increasing the level of farm area, pesticide, power tiller and irrigation cost.

In addition, Hassim (2012) also studied on socio-economic analysis on rice based farming system towards efficiency input use in Malaysia. The result of Ordinary Least Square for the Cobb-Douglas production function founded that major factor determining the yield were the amount of fertilizer input used, the amount of pesticide input used, and the amount of machinery input used.

Moreover, Donkoh *et al.* (2013) who studied on the technical efficiency level of rice farmer at the Tono Irrigation Project in Ghana. The technical efficiency was 0.81 with the majority of the farmer recording efficiency level above 0.60. The conventional input that significantly in determining output were land, seed, labor and crop expenditure.

In order to develop seed production towards appropriate input use for farmers in the research site and related cases, this investigation aimed to determine existing condition of rice seed production in the study areas and input factor affecting rice seed production.

MATERIALS AND METHODS

Study Areas

This study was conducted in Thamai sub-district, Chumsaeng district, Nakhon Sawan province in the lower northern of Thailand because the research site is ranking as the top one of the northern region in terms of rice cultivated areas and yield, accounting for around 17% and 15% of the total region, respectively. Besides that, this research site is keeping carried out efficiency production technology dissemination towards intervention program on rice seed production standard and community empowerment by Nakhon Sawan Rice Seed Center, Rice Department, Ministry of Agriculture and Cooperatives since 2006 until currently (Figure 1). The climatic condition in the study areas is tropical savanna (Am) with 3 seasons including rainy season, hot season and cool

season. The average temperature was 28.42°C. The average relative humidity was 74.03%. The average evaporation was 133.41 millimeter. The average number of rainy days was 8.25 days per month. The average total amount of rainfall was 95.53 millimeter per month with 2.88 millimeter per day. Majority of the land, accounting for 64.56% of the total land is suitable for rice cultivation.

The period of study was in crop year 2013/2014. There were 15 villages with 2,479 households. Total population was 8,147 persons with female 51.44% and male 49.56%, respectively. The population density was 138 persons per square kilometer. The major occupation was rice cultivation (48.37%). The second was fruit and vegetable cultivation (22.63%). The rest were labor (15.61%), trader (1.82%), sugar palm reaper (1.41%), livestocks (1.25%) and others (8.91%), respectively.

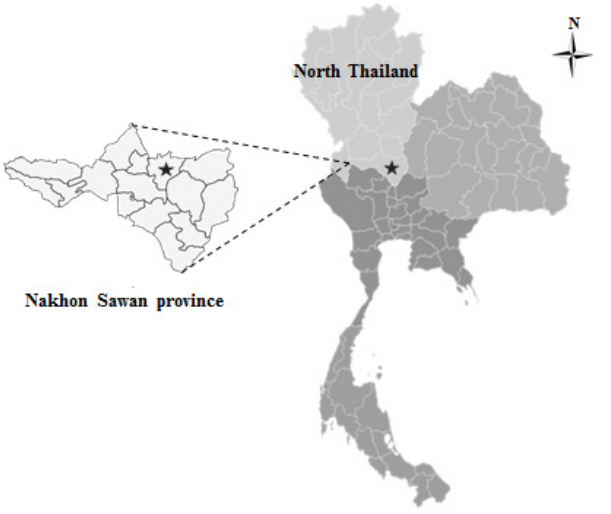

Figure 1 Location of the study areas
Source: Complied from Land Development Department (2017)

Population and Sampling Technique

Population of study consisted of 736 rice farmers in Thamai sub-district, Chumsaeng district, Nakhon Sawan province in crop year 2013/2014. Studied sample was 66 selected rice farmers that estimated by using the formula of Arkin (1974) through multistage sampling technique in each village.

Data Collection

Data collection was obtained in major rice crop year 2013/2014 from respective selected rice farmers by means of an interview schedule under closely observation and also in-depth discussion with key persons in the research site. The interview schedule was tested with 30 rice seed farmers in Chedi Hak sub-district, Mueang district, Ratchaburi province. Testing of reliability coefficient (KR20) with the reliability value was 0.89 (Kuder and Richardson, 1937) before data collection. After tried out, the interview schedule was improved into appropriate form for gathering data in the research site.

Statistical Analysis

The analysis utilized both descriptive and inferential statistics. Frequencies, percentages, arithmetic means and standard deviations were used to describe existing rice seed production.

Cobb-Douglas production function by ordinary least square (OLS) was employed to test the hypothesis of input factor affecting yield.

RESULTS AND DISCUSSION

Existing Condition of Rice Seed Production in the Study Areas

As presented in Table 1, the average year of seed cultivation experience was 4.36 years. The average number of household labor force in seed cultivation was 2 persons. From closely observed and more in depth interviewed, the majority of household labor force were parent. The children were in school or work outside. Some households had labor force more than 2 persons. These labors were their children who graduated with junior high school or higher and they also wanted to become a farmer as well. In terms of land tenure status, the average land tenure for seed cultivation was 3.83 hectares per household that was similar size of northern Thailand in 2013 that was 4.00 (OAE, 2014). Land use in the research site is suitable for rice cultivation. Most population in this community cultivated rice as major or minor occupation. The average number of owned land for seed cultivation was 3.36 hectares. Total seed cultivation land, accounting for 74.88% was farmers' owned land that they received from their parents. These can reduce the risk in farming because of its their own land. Concerning number of rented land, most of farmers (66.67%) did not have rented land for seed cultivation. The average number of rented land was 2.59 hectares.

Average total cost per hectare in seed cultivation was 1,497.70 USD. Variable cost was 1,266.25 USD. Fixed cost was 231.44 USD. Total cash cost was around 76.15%. Total non-cash cost was around 23.85%. The highest variable cost was labor cost (38.64%). The highest fixed cost was opportunity cost of land used (6.56%). Nearly 80% of major cash cost was spent for labor cost and material cost. Most of non-cash cost (50.67%) was opportunity cost of land used and labor force. The findings revealed that majority of respondents had high cost of labor force. Both household labor force and hired labor force were used for all farm activities. In terms of material cost, farmers spent their cash cost for seed, fertilizer, chemical and others material cost such as seed tray and sack or bag. Total income was 2,537.55 USD/hectare. Net income was 1,240.84 USD /hectare.

Table 1 Existing condition of rice seed production in the study areas in crop year 2013/2014 (n = 66)

Items	Minimum	Maximum	$\bar{x}$	S.D.
Experience in rice seed cultivation (year)	1	14	4.36	3.31
Number of household labor in rice seed cultivation (person/household)	1	4	1.83	0.74
Number of total land tenure for seed cultivation (hectare/household)	0.48	12.80	3.83	15.90
Number of owned land for seed cultivation (hectare/household)	0.48	12.80	3.36	16.80
Number of rented land for seed cultivation (hectare/household)	0.96	6.88	2.59	9.95
Total cost (USD/hectare)	1,002.24	2,424.30	1,497.70	1,616.19
Total variable cost (USD/hectare)	841.25	2,086.70	1,266.25	1,258.45
Total fixed cost (USD/hectare)	44.77	1,285.33	231.44	847.31
Total income (USD/hectare)	1,500.00	5,022.29	2,537.55	2,941.62
Net income (USD/hectare)	225.21	3,332.29	1,240.84	2,732.33

Source: Survey (2015)

Input Factor Affecting Rice Seed Production

The Cobb-Douglas production function by means of OLS was employed to test the hypothesis of input factor affecting yield. The form and variables will be described and shown as below:

$$Y_i = \beta X_{1i}^{\beta_1} \beta_1 X_{2i}^{\beta_2} X_{3i}^{\beta_3} X_{4i}^{\beta_4} X_{5i}^{\beta_5} X_{6i}^{\beta_6} e^{u_i} \quad (1)$$

where, Y = Yield of seed; β = Constant; X_1 = Total rice seed land used (hectare); X_2 = Total seed used (kg); X_3 = Total of fertilizer used (kg); X_4 = Total of pesticide used (baht); X_5 = Total of labor force (man day); X_6 = Total of machinery used (hour) and = Error term.

The Cobb–Douglas production function was estimated by using ordinary least square (OLS) approaches after converting it into log linear form. It will be in linear form as:

$$\ln Y_1 = \beta_o + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + u_i \quad (2)$$

$$\ln Y_1 = 2.340 + 0.047 X_1 + 0.330 X_3 \quad (3)$$
$$(2.349)^{**} \quad (5.063)^{***}$$

$$Y = 10.3812 X_1^{0.047} X_3^{0.330} \quad (4)$$

In equation 3 two factors positive affecting seed yield were fertilizer and rice seed land at the statistically significant level of 0.001 and 0.01, respectively. The coefficient of determination (R^2) was 0.308. It pointed out that the combination of rice seed land and fertilizer could determine some change of seed yield at 30.80%. However, the coefficient of determination is not necessarily high. It is because the data were obtained by field survey.

From the results of OLS analysis as presented in Table 2, the coefficient of fertilizer (X_3) and rice seed land (X_1) had positively statistically significant on seed yield at 0.001 and 0.01 level, respectively. In addition, the regression coefficient of variable was also the production elasticity of variable in the Cobb-Douglas production function.

Based on the Cobb-Douglas production function analysis, the findings revealed that the coefficient of rice seed land was 0.047. It implied that 1% increase in the rice seed land applied would increase the rice seed yield at 0.047% by holding other factors constant. The coefficient of fertilizer was 0.330. It indicated that 1% increase of fertilizer could increase the rice seed yield at 0.330% by holding other factors constant.

In terms of the other variables that was non-statistically significant, these were seed, pesticide, labor and machinery. It is because almost of farmer strictly practice in seed, pesticide, labor and machinery application except fertilizer application according to DOAE recommendations. They also applied the same technique, the same cultivar and the same pattern to control pest. Then, they got high yield because they gain a lot of knowledge and skill from these concern agencies. Moreover, from the closely observe and more in-depth interviewed, the farmer who applied higher fertilizer and more land were prototype farmers.

The results revealed that rice seed yield will increase if combination of increasing in rice seed land and fertilizer are applied. These findings are supported by more recent studies about rice production efficiency. The recent study was conducted by Oris (2001), Sachchamarga and Williams (2004), Kouser and Mushtaq (2007), Oniah *et al*. (2008), Huy (2009), Rahman *et al*. (2009), Thibbotuwawa *et al*. (2012), Donkoh *et al*. (2013) and Ohaka *et al*. (2013), it confirmed that the land has significantly positive effects on yield.

In addition, Oniah *et al*. (2008), Rahman *et al*. (2009), Hassim (2012) and Ohaka *et al*. (2013) also pointed out that fertilizer was positive factor affecting yield.

In accordance with coefficient of rice seed land used from the above results, the study implied that respondent had capability to cultivate good quality rice seed because they can increase the yield by increasing their rice seed land used.

Besides that, concerning Good Agricultural Practice (GAP) of rice seed (RD 2014), the good qualification of rice seed cultivation land should consider in the full irrigated and water level control, convenience transportation and also located in near seed processing plant, almost of the land has

the continuity soil fertile, non-risk in loss quality yield and the same cultivar in nearby areas. In terms of fertilizer used, farmer applied fertilizer on their plots to improve soil fertility and increase yield. Increasing the quantity of fertilizer, highly affecting higher rice seed yield. Therefore, farmer should enhance their crops by applying appropriate combination of fertilizer. In addition, farmer should increase the fertilizer application on their plot by based on RD recommendation.

Table 2 Factors affecting seed production by the OLS method

Variables	Coefficient	Standard Error	t	Sig.
(Constant)	2.340	0.114	20.489	0.000
Rice seed land used (X_1)	0.047	0.020	2.349	0.022**
Seed used (X_2)	-0.100	–	-0.944	0.349
Fertilizer used (X_3)	0.330	0.065	5.063	0.000***
Pesticide used (X_4)	-0.024	–	-0.226	0.822
Labor force (X_5)	0.171	–	1.476	0.145
Machinery used (X_6)	-0.024	–	-0.226	0.822
R^2 = 0.308				
Adjusted R^2 = 0.286				
F–value = 14.025				
Durbin–Watson = 1.551				

***statistically significant level at the 0.001, **statistically significant level at the 0.01
Source: Compiled from data survey (2015)

CONCLUSIONS

The average year of seed cultivation experience was 4.36 years. The average number of household labor force in seed cultivation was 2 persons. From closely observed and more in depth interviewed, the majority of household labor force were parent. Most of farmers have been cultivated in their own land that can reduce the risk in farming. The average household labor force was 2 persons that were parent. Concerning factors affecting seed production through Cobb–Douglas production function by means of OLS, the findings indicated that the crucial factors affecting seed production were fertilizer and rice seed land, respectively.

From the investigation, the recommendations were 1) research and development on technology of cost reduction is necessary, particularly cost of labor force and material cost. Because the findings found that the highest cost of majority respondent is cost of labor force, 2) improving of rice seed production and enhancement income generating of the similar cases, the concern factors affecting rice seed yield were fertilizer and rice seed land, respectively and also 3) focusing on the inspiration building for children, in particular new generation who engaging in rice farming. The school should offer rice production improvement activities as compulsory activity and inspiring them to interest in agriculture, in particular rice seed production program that is the successful occupation in their community. The young farmers should concern to help their family as household labor as successor. This is because the findings revealed that only few households have children that can help their parents in rice farming.

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