UNIVERSITI PUTRA MALAYSIA

EFFECTS OF AGRICULTURAL EXTENSION AND ENVIRONMENT-RELATED PRACTICES ON TECHNICAL EFFICIENCY OF PADDY FARMERS IN THE CENTRAL REGION OF THAILAND

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By

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EFFECTS OF AGRICULTURAL EXTENSION AND ENVIRONMENT-RELATED PRACTICES ON TECHNICAL EFFICIENCY OF PADDY FARMERS IN THE CENTRAL REGION OF THAILAND

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September 2012

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Rice is among the cereals that share a leading role as important food sources for mankind. It is not only a staple food for a large part of the world population but also a main cash crop in the Thai economy. Of the total 24.86 million households in the Thai agriculture sector, 3.71 million represented paddy farmers. (Office of Agricultural Economics, 2010)

Rice production in Thailand has increased over the past decade due mainly to the expansion of planting areas. However, the last few years saw a decline in planting areas and yields from 11.23 million hectares in 2007 to 11.10 million hectares in 2009. This could be attributable to the planting of energy crops and other cash crops in place of paddy. The high cost of inputs was

another important problem confronting Thai farmers. As a result, the average yield in Thailand amounts to 2.88 metric tons per hectare, a comparatively lower capacity within each variety and among other rice producing countries.

The objective of this study is to investigate technical efficiency and identify the factors affecting technical inefficiency of paddy farmers for the crop year 2009/2010 in the Central region of Thailand. Data collection was based on stratified random sampling from 384 farmers who used broadcasting method in operating their farms. Collected data was categorized into four sets of variables: 1) production variables, 2) demographic and socioeconomics variables, 3) agricultural extension variables, and 4) environmental variables. Both non-parametric (Data Envelopment Analysis: DEA) and parametric (Stochastic Frontier Analysis: SFA) techniques were applied in the analysis. The former explored the determinants for farm inefficiency through Tobit regression model, and the latter identified the factors influenced by inefficiency effect model by Battese and Coelli (1995).

Descriptive statistic results showed that most farms are small-sized of about 4.70 hectares each. Of the total area, 75.30 percent were rented for cultivation. About 77.80 percent of production inputs were procured by credits while the rest were self-financed. Most farmers (77.50 percent) are male of about 51 years old in average. About 77.20 percent of the farmers received only

compulsory education but had more than 30 years' experience in rice farming.

The technical efficiency level obtained by Data Envelopment Analysis varied between 0.30 to 100 percent. The mean technical efficiency equals to 51.60. This implied that on average, farmers could reduce their input use by 48.40 percent to enhance efficiency level. The empirical finding indicated that there was a positive relationship between farm efficiency and family labor as well as farm size.

Stochastic Frontier Analysis ranged between 49.99 to 97.17 percent with the mean efficiency at 85.32 percent. Although 76.30 percent of farms showed their performances above 80 percent, hypotheses testing indicated that there was still inefficiency effect in rice farming. The factors which statistically and significantly contributed to higher performance were gender, farming experiences, land tenure, Good Agricultural Practices (GAP) and cropping intensity.

In conclusion, technical efficiency can be different depending on which estimated techniques were used. Both DEA and SFA affirmed that there is an inefficiency effect on rice farming. However, farm efficiency level can be improved by reducing input use and eliminating the factors affecting technical inefficiency. Farmer should gain knowledge on Good Agricultural

Practices (GAP) and adopt the GAP in their farm activities. Accessible linkages to extension officers should also be made available for continuous exchange of knowledge and experience, especially between successful farmers to general farmers in order to improve farm efficiency. In irrigated areas, government support should be provided to ensure that farmers can increase their planting capacity to more than once a year, and to use certified seeds which are high-yielding varieties in order to enhance their income and contribute to the overall rice production.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KESAN PENGEMBANGAN PERTANIAN DAN AMALAN BERKAITAN PERSEKITARAN TERHADAP KECEKAPAN TEKNIKAL PETANI PADI DI KAWASAN TENGAH THAILAND

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Beras ialah bahan makanan bijirin, yang berperanan utama sebagai sumber makanan untuk manusia. Ia bukan hanya merupakan makanan ruji bagi sebahagian besar penduduk dunia, tetapi juga merupakan tanaman utama dalam ekonomi Thailand. Daripada 24.86 juta isi rumah dalam sektor pertanian Thailand, sebanyak 3.71 juta merupakan petani padi. (Pejabat Ekonomi Pertanian, 2010)

Pengeluaran padi di Thailand telah meningkat sejak beberapa dekad yang lalu disebabkan peningkatan keluasan tanaman padi. Namun, sejak beberapa tahun kebelakangan ini, keluasan sawah padi dan hasil padi telah mula menurun dari 11.23 juta hektar pada tahun 2007 kepada 11.10 juta hektar pada tahun 2009. Ini mungkin disebabkan pertukaran penanaman

padi kepada tanaman lain. Kos input yang tinggi juga merupakan masalah utama yang dihadapi petani. Akibatnya hasil purata di Thailand ialah 2.88 tan per hektar yang jauh lebih rendah, jika dibandingkan dengan kapasiti pengeluaran setiap varieti padi lain dan juga kadar hasil negara pengeluar padi yang lain.

Objektif kajian ini adalah untuk mengetahui kecekapan teknikal dan menentukan faktor-faktor yang mempengaruhi ketidakcekapan teknikal petani padi untuk musim tanaman 2009/2010 di kawasan tengah Thailand. Sampel data dikutip secara rawak berstrata daripada 384 orang petani padi yang mengamalkan kaedah tabur terus. Maklumat yang dikumpulkan terdiri daripada empat kategori; 1) hasil pengeluaran, 2) demografi dan sosio ekonomi, 3) pengembangan pertanian, dan 4) faktor alam sekitar. Kedua dua kaedah *Stochastic Frontier Analysis* (SFA) dan *Data Envelopment Analysis* (DEA) telah diaplikasikan untuk mengkaji tahap kecekapan teknikal. Kaedah DEA menggunkan Model Tobit dalam penentuan faktor ketidak kecekapan manakala SFA menggunakan model Battese dan Coelli (1995).

Keputusan analisis deskriptif menunjukan kebanyakan kawasan sawah padi adalah bersaiz kecil iaitu 4.70 hektar dan 75.30 peratus petani menyewa tapak sawah padi. Sebanyak 77.80 peratus bahan input dibeli dengan kredit manakala bakinya menggunakan dana sendiri. Kebanyakan petani ialah lelaki sebanyak 77.50 peratus, dan umur purata ialah 51 tahun. Hanya 77.20

peratus petani menerima pendidikan formal, tetapi mereka berpengalaman menanam padi selama 30 tahun.

Peringkat kecekapan teknikal yang didapati mengikut model DEA ialah antara 30-100 peratus. Kecekapan teknikal purata bersamaan 51.60 peratus. Ini menunjukkan bahawa petani boleh mengurangkan penggunaan input yang digunakan sebanyak 48.40 peratus untuk memastikan tahap kecekapan tersebut. Keputusan empirik pula menunjukkan pertalian positif antara kecekapan ladang dengan buruh keluarga dan saiz ladang.

Tahap kecekapan teknikal ialah antara 49.69 hingga 97.17 peratus dengan nilai purata tahap kecekapan teknikal sebanyak 85.32 peratus. Walaupun, 76.30 peratus petani mempungai kecekapan teknikal melebihi 80 peratus, ujian hipotesis tetap menunjukkan masih terdapat ketidakcekapan di sektor ini. Faktor yang menggalakkan kecekapan ialah jantina, pengalaman, Amalan Pertanian Baik dan intensiti penanaman.

Sebagai kesimpulan, anggaran kecekapan teknikal menunjukkan terdapatnya ketidakcekapan dalam penanaman padi. Walaubagaimanapun, tahap kecekapan boleh ditingkatkan dengan pengurangan penggunaan input dan mengelakkan faktor yang mempengaruhi ketidakcekapan teknikal. Petani yang cekap patut memahami dan mengaplikasi amalan pertanian yang baik dalam aktiviti pertanian mereka. Pertalian yang rapat

dengan pegawai pengembangan mesti diujudkan untuk pertukaran pengetahuan dan pengalaman. Hubungan ini juga harus diterapkan dengan petani yang berjaya supaya kecekapan ladang petani secara amnya dapat ditingkatkan. Di kawasan pertanian dengan pengairan yang cukup, kerajaan sepatutnya menggalakan petani menanam lebih dari sekali setahun dengan penggunaan varieti benih padi yang tinggi hasilnya supaya pendapatan petani dapat ditingkatkan melalui sumbangan kepada pertambahan dalam pengeluaran padi keseluruhannya.

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Lastly, I wish to avail myself of this opportunity, express a sense of gratitude and love to my beloved parent and family for their support, encouragement and belief in me, in all my endeavours.

I certify that a Thesis Examination Committee has met on 25th September 2012 to conduct the final examination of Kallika Taraka on her thesis entitled "**Effects of Agricultural Extension and Environmental-Related Practices on Technical Efficiency of Paddy Farmers in the Central Region of Thailand**" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

_____

KALLIKA TARAKA

Date: 25 September 2012

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LIST OF ABBREVIATIONS

BAAC	Bank of Agriculture and Agricultural Cooperatives
BOT	Bank of Thailand
CRS	Constant Return to Scale
DEA	Data Envelopment Analysis
DOAE	Department of Agricultural Extension
FAO	Food and Agriculture Organization
GAP	Good Agricultural Practices
GDP	Gross Domestic Product
MOAC	Ministry of Agriculture and Cooperatives
MOC	Ministry of Commerce
PWO	Public Warehouse Organization
RD	Rice Department
SFA	Stochastic Frontier Analysis
TE	Technical Efficiency
THB	Thai Baht (Approximately THB 33 = USD 1)
USD	U.S. Dollar
USDA	United States Department of Agriculture
VRS	Variable Return to Scale

CHAPTER 1

INTRODUCTION

1.1 Introduction

"Agriculture is the heart of Thailand". This fact reflects the way of life among Thai people. Meanwhile, Thailand's mission of being the "Kitchen of the world" is witnessed by its current status as the world's fifth largest food exporter. On the other hand, it is a net food exporting country currently ranked sixteenth in the global food and agricultural exporting arena (Ministry of Agriculture and Cooperatives, 2009).

Of the total population of 63.52 million, 24.86 million have been involved in the agricultural sector. This includes 3.71 million paddy farming households growing a staple food for a large part of the world's population as dubbed in the slogan: "Farmers are the backbone of the nation" (Office of Agricultural Economics, 2010).

Rice production in Thailand represents a significant part of the country's economy. Not only that the yields are large enough to meet domestic consumption, but their excess has been sent around the globe to acclaim the country as the world's largest rice exporter since 1981. In 2008, Thailand had a 30.14 percent market share, exporting 10.22 million metric tons of rice worth USD 6.16 million (Office of Agricultural Economics, 2010).

1.2 Thailand's Current Rice Cultivation Situation

Thailand is an agricultural country. Of the total area of 51.30 million hectares, 21.08 million hectares have been used for agricultural proposes. Besides rice which is Thailand's cash crop, there are several other crops planted such as rubber trees, cassava, corn, sugarcane and palm oil.

As the world's largest rice production and exporting country, Thailand has keen concern over rice planted area which decreased by 0.60 percent over the last 3 years from 11.23 million hectares in 2007 to 11.10 million hectares in 2009. On the contrary, planted areas for other agricultural crops such as rubber, cassava, corn and palm oil have been increasing by 5.92, 6.43, 4.39 and 8.91 percent respectively (Table 1.1).

Table 1.1 Planted Areas of Main Agricultural Products in 2007-2009

Unit: Million hectares

Type of Plant	2007	2008	2009	Percentage Change
Rice	11.23	11.17	11.10	-0.60
Rubber	2.46	2.67	2.76	5.92
Cassava	1.17	1.18	1.33	6.43
Corn	1.02	1.07	1.11	4.39
Sugarcane	1.01	1.05	0.96	-2.19
Oil Palm	0.51	0.58	0.61	8.91
Total	**17.40**	**17.73**	**17.85**	**1.29**

Source: Office of Agricultural Economics (2010)

These other crops and energy plants have become the new cash crops for farmers due to their higher prices and government support. Oil palm and sugarcane are used as raw materials for alternative energy production to replace pure natural fuel. Palm oil is used to produce biodiesel by blending with pure petro diesel, while sugarcane is used to produce ethanol when mixed with gasoline. Some agricultural products are under the threat of price fluctuations including cassava and corn. The government has provided support to these farmers by launching new schemes such as price guarantees.

Other problems faced by farmers were fluctuating output and input prices which generally caused increases in the production cost and decreases in the returns. Variable and fixed costs have continually increased while farm-gate prices have been fluctuating. In the last 2 years, the government launched a new scheme: "Farmers' income guarantee project", which led to higher farm-gate prices. However, the production cost was still considerably high and the returns were unstable.

The average total production cost for paddy was USD 468.47 per hectare which consisted of the variable cost of USD 408.71 and the fixed cost of USD 59.76. The average total cost of metric ton equaled to USD 212.52. Farmers obtained farm-gate prices of USD 235.35 per metric ton on average, with an average net return of USD 22.82 per metric ton (Table 1.2).

Table 1.2 Cost, Price and Return for Rice Farms in 2005-2009

Unit: USD per hectare

	2005	**2006**	**2007**	**2008**	**2009**	**Average**
Variable Cost	390.10	402.25	418.48	601.14	591.57	408.71
Fixed Cost	41.76	41.76	41.76	86.74	86.79	59.76
Total cost (per hectare)	**431.86**	**444.01**	**460.24**	**687.88**	**678.36**	**468.47**
Total cost (per metric ton)	169.76	178.94	181.36	268.45	264.09	**212.52**
Farm-gate Price	200.21	197.97	199.61	298.42	280.52	**235.35**
Net Return	**30.45**	**19.03**	**18.24**	**29.97**	**16.42**	**22.82**

Source: Center of Agricultural Information (2010)

1.3 Problem Statement

Although Thailand is a leading rice exporting country, it still has some production problems. Domestic rice production cannot yield actual outputs that reach the maximum capacity in each variety. As shown in Figure 1.1, there are gaps between the yields obtained by farmers and the maximum potential that could be gained from those rice varieties. Agronomists attempted to develop rice varieties that are pest tolerant and suit with the environment for distribution to farmers. Most varieties are planted for maximum yield per acreage in order to earn higher revenue.

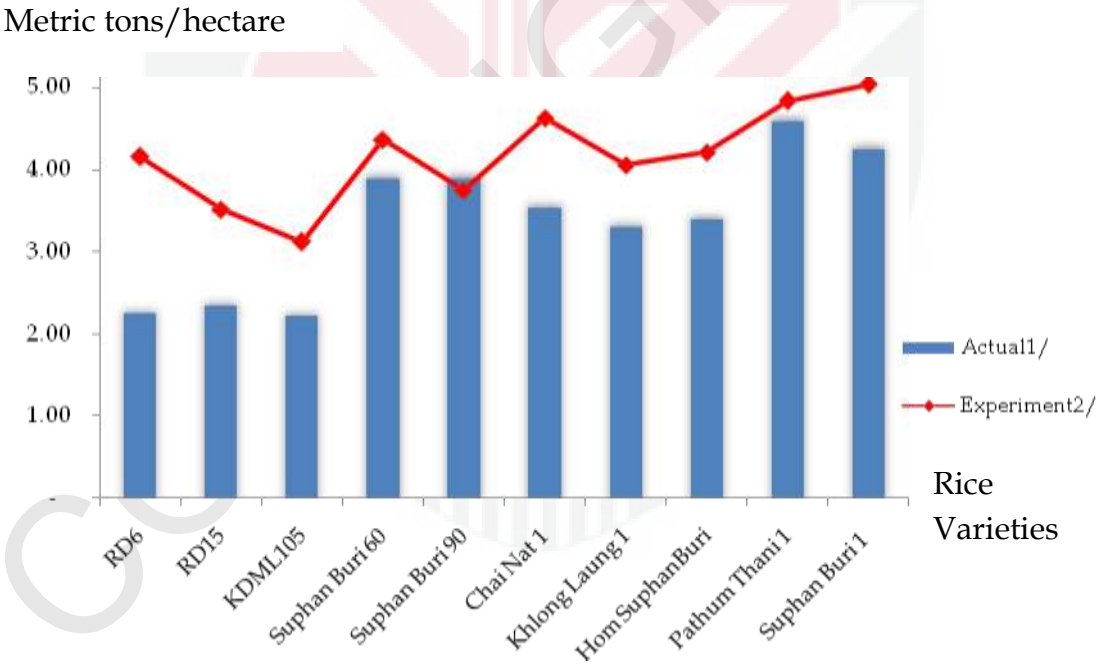

Figure 1.1 Average Thai Rice Actual Yields for Each Variety between 2006-2008 and their Capacity from Experimental Field

Source: 1/ Center of Agricultural Information (2010)
2/ Rice Department (2010)

In reality, farmers could not control the environment conditions in the same way as in the experimental fields. Some used more inputs, such as excess fertilizer that affects growing condition of rice plants and leads to pest infestation.

However, since the green revolution era in rice cultivation, Thailand has reaped benefits by increasing its paddy yield from 2003 to 2007. As shown in Table 1.3, Thailand's average rice yield was 2.88 metric tons per hectare. Egypt registered the highest average rice yield, followed by United States, Korea, and Japan at 9.99, 7.71, 6.46 and 6.35 metric tons per hectare respectively. Likewise, Vietnam which has become competitive in rice exporting also had higher average rice yield compared to Thailand with an increasing trend in yield per acreage. The variation in yield per acreage results in different productivity. The higher the yield per acreage, the better competitiveness it provides. Accordingly, the country which is more efficient and productive in rice cultivation will enjoy more competitive edge in the trading arena.

Table 1.3 Average Rice Yield for the Major Producing Countries, 2003-2007

Unit: Metric tons per hectare

Countries	Year					Average
	2003	2004	2005	2006	2007	
China	6.06	6.31	6.25	6.28	6.42	6.26
India	3.12	2.98	3.15	3.19	3.30	3.15
Indonesia	4.54	4.54	4.57	4.62	4.71	4.60
Bangladesh	3.58	3.54	3.78	3.85	4.01	3.75
Viet Nam	4.64	4.86	4.89	4.89	4.98	4.85
Myanmar	3.55	3.78	3.62	3.76	3.98	3.74
Thailand	2.65	2.86	2.96	2.92	3.01	2.88
Philippines	3.37	3.51	3.59	3.68	3.80	3.59
Malaysia	3.36	3.33	3.42	3.39	3.33	3.37
Japan	5.85	6.42	6.65	6.34	6.51	6.35
USA	7.48	7.83	7.44	7.73	8.09	7.71
Pakistan	2.96	2.99	3.17	3.16	3.30	3.12
Egypt	9.75	9.84	9.99	10.07	10.29	9.99
Cambodia	2.10	1.98	2.48	2.49	2.62	2.33
Korea	5.92	6.73	6.57	6.71	6.35	6.46
Nepal	2.68	2.86	2.78	2.72	2.56	2.72
Madagascar	2.30	2.45	2.71	2.70	2.77	2.58
Iran	4.76	4.16	4.36	4.14	5.56	4.60
Nigeria	1.41	1.42	1.43	1.48	1.30	1.41
Sri Lanka	3.37	3.65	3.55	3.71	3.93	3.64
Brazil	3.25	3.56	3.37	3.88	3.83	3.58
Rest of the world	3.35	3.45	3.47	3.54	3.58	

Source: Food and Agriculture Organization of the United Nations (2009)

One of the questions that have been raised is: Why the disparity in production efficiency still exists both within country and among these major producing countries? If the farmers faced the same situations and conditions as in the experimental fields and other countries, would the differences in their yield still exist?

The differential could be broadly classified into two types of gaps: a technology gap and a management gap. The former involved additional investment and higher recurring cost (e.g. use of farm machinery, high-yielding seeds) whereas the latter might offer the farmers with improved management practices. These two gaps are the manifestation of the difference in the knowledge that farmers possess and the best practices knowledge that exists at any point of time. (Anderson and Feder, 2003; Byerlee, 1988; Feder, Lau and Slade, 1987)

Agricultural Extension could be the answer of the above question. It is broadly accepted that farmers' performance is affected by human capital, which encompasses both innate and learned skills, including the ability to process information. Extension services are an important element that provides human-capital enhancing inputs as well as flow of information that can improve farmers' and other rural people's welfare (Anderson and Feder, 2003).

Another element, which could bridge the gap between potential and actual yield, is the management practices on environment. The success or failure of crop production is closely linked with environmental conditions. The farmers who properly practice on their farm management will become better farm managers and also reduces the management gap.

Agricultural extension and Environment parameters are usually studied. In this study, the focus is placed on delivery of information to farmers via Agricultural Organization, visits from extension officers as advisors, and Good Agricultural Practices (GAP). For the environment variables, burning rice straws is the proxy variable for soil fertility while number of planting time is the proxy variable used for reflecting the farmers' adaptation in managing their farms. Better planting practices would help prevent disasters such as drought during dry season and flood during rainy season.

Therefore, the purpose of this study is to estimate the technical efficiency for the inputs and the factors affecting the technical inefficiency of paddy farmers in the Central region of Thailand with emphasis on Agricultural Extension variables and Environmental variables.

1.4 Objectives of the Study

The main objectives of this study are to investigate the technical efficiency for the inputs, and the factors affecting the technical inefficiency of paddy farmers in the Central region of Thailand. The specific objectives are as following:

1) To examine the general characteristics of farms and the current situation of rice farming in Thailand.

2) To measure the technical efficiency of input use on farm level for paddy farmers and estimate the elasticity of production.

3) To explore the factors affecting the technical inefficiency with emphasis on agricultural extension and environmental factors.

4) To provide recommendations for policy implications based on efficiency estimates.

1.5 Significance of the Study

In this study, the technical efficiency would be measured from the sampled farmers in the Central Thailand which is one of the important rice growing areas of the country. Moreover, the factors affecting the technical inefficiency in demographic and socio-economic aspects, agricultural extension aspects and environmental aspects would be investigated.

It would be better for policy makers to know their position in the technical efficiency level so that they could improve their resource utilization especially in terms of inputs. At the same time, the farmers, with cooperation

from related government agencies, should exert their effort to cope with the barriers resulting from the determinants found in this study in order to optimize their outputs while minimizing the production cost.

1.6 Organization of the Study

This study is divided into 6 chapters. Chapter 1 presents an introduction to the current rice farming situation and the statement of problems. Chapter 2 demonstrates data related to the paddy and rice industry in Thailand and the world. Chapter 3 provides a review of literature on the efficiency, techniques of efficiency measurement for Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) approaches, the pros and cons between these two techniques, and the previous empirical studies. Chapter 4 is the methodology used in this study, and Chapter 5 presents the results and discussion. Lastly, the summary of the study and the conclusion are discussed in Chapter 6.

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