PRODUCTION PERFORMANCE AND EFFICIENCY OF RICE FARMING IN SUBURBAN AREAS OF BANGKOK, THAILAND

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ABSTRACT

Given the pressing concerns of urbanisation in the suburban areas in Thailand, rice farmers' production performance and efficiency remain below the national target and are not seen to improve unless research-based policies are formulated and fully enforced. This study employed cost and return, and stochastic frontier analyses to measure rice production's performance and technical efficiency in the suburban rice areas of Bangkok, Thailand, considered as appropriate zoning locations for rice cultivation. Data were obtained from 365 rice farmers. The parameters of the stochastic production function were estimated using the maximum likelihood technique. Results showed that farmers' rice production is fairly profitable, with major expenditure allotted on variable costs such as labor, fertiliser, seeds, and fuel. Technical efficiency analysis showed that individual farmers had an efficiency score ranging from 37 to 98 percent, indicating high variations of production performances among farmers. Farmers' availability of arable land for rice production in suburban areas significantly affects technical efficiency. The study suggests that preserving zoning areas and extending available areas for cultivation while providing farming assistance could improve farmers' technical efficiency and profitability.

Keywords: Rice Production; Suburban Farmers; Technical Efficiency; Cost and Return Analysis; Thailand.

INTRODUCTION

Rice production worldwide is about 160 million hectares, of which 90% are found in the Asia-pacific region (Prasad et al., 2017). Thailand is one of the top rice-producing countries in Asia, ranked as the sixth-largest after China, India, Indonesia, Bangladesh and Vietnam (FAO, 2018). Rice remains the dominant agricultural industry in Thailand, accounting for 51% of cultivated area and contributing 15% of agricultural GDP (Pongsrihadulchai, 2018). The dominance of rice farming in Thailand's agricultural sector reflects the suitability of the natural

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environment for rice production not just in the rural areas but also in the urban areas. This makes rice the crop grown in all provinces in Thailand (Suebpongsang et al., 2020).

Rice farming in Thailand has changed since the country's economic crisis in 1997 (Kramol & Ekasingh, 2020). Urbanisation has contributed a lot to this change. The widespread adoption of modern technologies has entailed intensive farming systems such as heavy use of pesticides and chemical fertilisers, and farm machinery to maximise yield from available land (Nguyen et al., 2021). Urbanisation has increased to almost 50%, and this change has created a growing labor scarcity in rice farming (Cramb, 2020b). In addition, increased income has brought a decline in average rice consumption in Thailand. With the rise of improved infrastructure in the suburban areas, land use for rice farming faces high competition with the non-agricultural sector (Van Kien et al., 2020). So, the key issues with all these urbanisation concerns in rice farming are whether farmers in the suburban areas are earning profitably and are ensuring technically efficient rice farming operations. Such problems can be addressed by examining the cost structures and technical efficiency of farmers.

Technical efficiency refers to farmers' effectiveness in achieving the maximum attainable output given a fixed level of input and available technology (Dam et al., 2019). An analysis of farmers' technical efficiency will help determine the necessary improvement in farmers' productivity through a more efficient allocation of available resources (Shahul Hameed et al., 2021; Sunge & Ngepah, 2020; Tavva et al., 2017). Likewise, analysing the cost and return structures is vital in identifying viable farming strategies since production costs and their components have major implications in agricultural competitiveness and farmers' income (Suwanmaneepong et al., 2020). Using technical efficiency and cost and return analyses would give a better view of farmers' current situation in light of the suburban areas' issues. Ultimately, increasing production efficiency and profitability are fundamental goals in implementing agribusiness economic policies to areas suitable for rice cultivation in Thailand.

Many studies have investigated the technical efficiency, costs and return of rice production in Thailand. For instance, Panpluem et al. (2019) studied rice-producing farmers' efficiency in Yasothon province, Thailand, and found that farmers can reduce machinery use, fertiliser, seed and labor to improve their efficiency level. Kerdsriserm et al. (2018) analysed rice farms' technical efficiency in eastern Thailand and revealed that high-quality seeds and organic fertilisers could improve farmers' efficiency levels. In terms of cost and return, Suwanmaneepong et al. (2020) studied the cost structure of conventional farmers in Chachoengsao province, Thailand, and showed that farmers' current farming system was input-intensive, heavily relying on chemical fertilisers and pesticides. Although these studies have independently demonstrated the importance of studying efficiency and rice production costs, little has been explored in the interaction of these two aspects. Most importantly, there has been dearth of research conducted in particular in Thailand's suburban areas.

Hence, this study explores the cost and return and technical efficiency of farmers in Bangkok's eastern suburban areas. The Ministry of Agriculture and Cooperatives has identified this area as a suitable zoning location for rice cultivation in Bangkok, which consists of Sai Mai, Nong Chok, Khlong Sam Wa, Lat Krabang, and Min Buri districts. These areas collectively account for approximately 117,891 rai (about 97%) of Bangkok's total rice cultivation area (Bangkok, 2014). Zoning is considered a guideline to optimise land use and its conditions to reduce production costs and increase farmers' income (Boonyanam, 2020). However, despite these areas' distinction as an appropriate zoning location for rice cultivation in Bangkok, its

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agricultural lands are drastically decreasing, as it sits in one of the centres of urbanisation in the country (Lang et al., 2021). The study would assess the current farm profitability of farmers and the efficiency level and give insights into improving farm productivity.

This study aims to contribute to the mainstream literature on profitability and technical efficiency in a suburban farmers' context in three-folds. First, using cost and return and stochastic frontier analyses, this study investigates the profitability and technical efficiency of rice farmers in the suburban areas of Thailand. Previous studies on efficiency of rice production have mainly focused on rural areas (Jirarud & Suwanmaneepong, 2020; Kerdsriserm et al., 2018; Llones et al., 2022; Panpluem et al., 2019) and there are limited number of studies about rice production in the suburban areas of Thailand.

Second, this study intends to be the first to analyse the profitability and technical efficiency of rice production using a sample of suburban farmers in Bangkok, Thailand, which supplies to the literature distinctively. Despite the areas' distinction as appropriate zoning locations for rice cultivation in Bangkok, its agricultural lands are drastically decreasing, as it sits in one of the centres of urbanisation in the country (Lang et al., 2021). This is an important contribution since increasing production efficiency and profitability are fundamental goals in implementing agribusiness economic policies to areas suitable for rice cultivation (Cavite et al., 2021; Fakkhong et al., 2018; Llones & Suwanmaneepong, 2021; Radović-Marković et al., 2019; Utaranakorn & Yasunobu, 2016). This study's findings will help improve the production performance and profitability of suburban rice farmers and define better strategies to cope with urbanisation. Moreover, this study will provide insights to policymakers and urban planners about setting resource allocation priorities in agriculture.

Finally, this study intends to contribute to the literature on technical efficiency of suburban rice farmers while exploring farmers' production performance at the same time. This study will be a source of useful information for future empirical studies aiming to improve the technical efficiency and profitability of suburban rice farmers. Moreover, there is insufficient literature on the technical efficiency and profitability performance of suburban rice farmers despite their noteworthy contribution to the rice industry of Thailand. Suburban rice farming forms a significant part of the occupation of most residents in Central Region, Thailand (Kramol & Ekasingh, 2020; Van Kien et al., 2020).

The remainder of this paper is organised as follows: first, the cost and return and technical efficiency analytical methods employed have been introduced. Second, results and discussion of the gathered data are presented. Lastly, conclusion of the findings are given.

METHODOLOGY

The study was conducted in Bangkok (13°45'22.7916" N,100°30'6.3432" E), the capital city of Thailand. The city is located in the lower central part of the country, with terrains in the northern lowland and slopy landscapes going towards the Gulf of Thailand and the Chao Phraya River basin (Kotera et al., 2016). This strategic location of the Chao Phraya River basin makes the neighbouring areas fertile and suitable for cultivating rice and various crops (Cramb, 2020a). Agricultural land use in suburban farming areas mainly produces rice.

The study area has a total population of 3,907 smallholder rice farmers based on the available data from the Office of Agricultural Economics (2018). Using Yamane's (1973) formula, the sample size was computed at a 5% sample tolerance level, giving a target sample of

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365 rice farmers. These farmers were randomly sampled from Eastern Bangkok's four districts, namely, Nong Chok (13°51'21.56 "N, 100°51'43.09"E), Min Buri (13°48'19.51"N, 100°44'36.99"E), Khlong Sam Wa (13°51'36.37"N, 100°42'14.26"E), and Lat Krabang (13°43'24.16"N, 100°47'1.98"E). The distribution of farmers from these four areas are the following: Nong Chok (n=91), Min Buri (n=91), Khlong Sam Wa (n=91), and Lat Krabang (n=92).

Data were collected through household survey in 2018. The questionnaire was developed based on the reviewed theoretical concepts and related studies. Data gathered mainly involved the production costs (input) and yield (output) data of farmers during the 2016/2017 cropping season. Data were analysed using cost and return, and technical efficiency analysis. The methods are as follows:

Cost and Return Analysis

To understand rice production cost components, this study employed the procedure followed by Suwanmaneepong et al. (2020). Cost items were divided into Variable Costs (VC) and Fixed Costs (FC). These two items comprised the Total Cost (TC), defined as the final value of all cash and non-cash inputs used by farmers during the cropping cycle. VCs represent the costs that change with the production level, while FCs are independent (Dwivedi, 2016). The VCs and FCs are further classified into cash (explicit) and non-cash (implicit) costs. The Total Revenue (TR) is the total income of rice farmers for that particular cropping cycle. The profit is the difference between TR and TC and then expressed into a percentage by dividing the computed value by the amount of TR. All cost components are expressed on a per rai basis. Equations 1 to 4 represent the analysis:

TC=Total VC + Total FC (1)
TR=Total output (Q) x Selling price (P) (2)
Profit=TR - TC (3)
% Profit=Profit / TR (4)

Technical Efficiency Estimation of the Suburban Rice Farms

In evaluating the production efficiency of rice farms in suburban areas, the study applied a parametric approach using a stochastic frontier analysis (SFA). The use of SFA in efficiency estimation captures both the measurement component and the random errors such as weather conditions and other farming risks. This feature became one of the primary considerations of using SFA as an efficiency estimation tool in agricultural research settings (Vortia et al., 2021). The SFA function is expressed in Equation 5.

$$Y_i = f(X_{ji}, \alpha) \exp(\varepsilon_i) \quad (5)$$

Wherein the Y_i is the output of the suburban farm i; f(·) refers to the Cobb-Douglas form considered in the study; X_{ji} is the amount of the input j in the production of the suburban rice farm i; whereas α refer to the set of parameters to be estimated and ε_i is the error term expressed as $\varepsilon_i = V_i - U_i$. The V_i captures the statistical noise (i.e., measurement error component) and U_i is the random error (e.g., weather conditions and farming risks) associated with technical inefficiency.

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The Cobb-Douglas stochastic frontier production function employed in the study is expressed in Equation 6. The summary of the input-output variables used in this model is shown in Table 1.

$$\ln Y_i = \beta_0 + \sum_{j=1}^{6} \beta_{ji} \ln X_{ji} + V_i - U_i \qquad 6)$$

Where:
ln Y_i= log rice yield in kg
ln X_1 = log of cultivated area in rai
ln X_2= log of seed quantity in kg
ln X_3 = log of quantity of fertiliser applied in kg
ln X_4= log of quantity of pesticides applied in litre
ln X_5= log of fuel used in litre
ln X_6 = log of labour in hour unit
β_j = parameters to be estimated

The stochastic frontier production function parameters defined in the equation were estimated using a maximum likelihood estimation (MLE). Whereas the variance of the model is parameterised as follows:

$$\sigma^2 = \sigma_V^2 + \sigma_U^2 ; \gamma = \sigma_U^2/\sigma^2 (0 \leq \gamma \leq 1) \qquad 7)$$

Table 1
SUMMARY OF THE INPUT-OUTPUT VARIABLES USED IN THE COBB-DOUGLAS SFA MODEL

Variable	Unit	Mean	Std. Dev.	Min.	Max.
Yield	Kg (kg rai^{-1})	23,860 (771.04)	14,845.93	2,500.00	80,000
Cultivated area	rai	30.76	17.48	4.00	94
Seed	kg. (kg rai^{-1})	555 (18.13)	352.03	48.00	1909
Fertilizer	Kg (kg rai^{-1})	1,538 (49.45)	984.60	50.00	4,700
Herbicide and pesticide	L (L rai^{-1})	3.79 (0.12)	4.33	0.50	50
Fuel	L (L rai^{-1})	363 (12.80)	203.02	47.00	1,252
Labour	Hr (hr rai^{-1})	78.21 (2.47)	55.52	9.50	295

In Equation 7 the σ^2 refers to the aggregation of random events and technical inefficiency, whereas γ explains the impact of technical inefficiency on rice production on a scale of 0 to 1. The closer the value of γ to zero indicates a variation of real output from the frontier output mainly derived from the stochastic effects. In contrast, a value near 1 implies that the randomness of variables is caused by inefficiency.

RESULTS

Cost and Return of Rice Production in Eastern Suburbs of Bangkok

Cost and return data show that the total rice production cost in the eastern suburbs of Bangkok amounted to 3,504 THB/rai (730 USD/ha) (Table 2). Of this cost, 89% are cash costs, while 11% are non-cash. Of the total variable costs, rice farmers were found to depend mainly on labour (28%), chemical fertilisers (17%), seeds (14%), and fuel (12%) costs. Other variable costs

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such as herbicides, pesticides, and other expenses were less than 10%. Further data classification reveals that the majority (80%) of the total costs were variable, and only about 20% were fixed.

Regarding the fixed cost structure, expenses were primarily incurred on land rent (12%), while only less than 1% was spent on land tax and opportunity costs. Meanwhile, farmers' average yield was 771.04 kg/rai (4.9 tons/ha) with a prevailing average market price of 7.26 THB/kg (0.22 USD/kg). This gives farmers an average total revenue of 5,588.75 THB/rai (1,164 USD/ha). Deducting the total costs yielded a profit of 2,084.25 THB/rai (434 USD/ha) for the rice farmers or 37.29% of the farmers' total revenue per rai.

Table 2
COST OF RICE PRODUCTION IN EASTERN SUBURBS OF BANGKOK (THB/RAI)

Items	Cash cost	Non-cash cost	Total cost	
	THB	THB	THB	%
Variable cost				
Labor	979.00	8.75	987.75	28.19
Seed	413.50	75.00	488.50	13.94
Fertiliser	600.00	0.00	600.00	17.12
Herbicides	214.75	0.00	214.75	6.12
Pesticides	9.75	0.00	9.75	0.28
Fuel	419.75	0.00	419.75	11.98
Other expenses	67.75	0.00	67.75	1.93
Total variable cost (TVC)	2,704.50	83.70	2,788.25	79.56
Fixed cost				
Land tax	0.25	0.00	0.25	0.01
Land rent	424.50	0.00	424.50	12.11
Opportunity cost	0.00	19.50	19.50	0.56
Depreciation cost	0.00	272.00	272.00	7.76
Total fixed cost (TFC)	424.75	291.50	716.25	20.44
Total cost (TVC+TFC)	3,129.25	375.25	3,504.50	100.00
Total cost (TC) (THB/rai)			3,504.50	
Total revenue (TR) (THB/rai)			5,588.75	
Total output (kg/rai)			771.04	
Selling price (THB/ kg)			7.26	
Profit (gross margin) (THB/rai)			2,084.25	
% Profit			37.29%	

Technical Efficiency Estimates and Distribution

The parameter estimates of the Cobb-Douglas stochastic frontier production model are summarised in Table 3. The input coefficient of the production model suggests a positive association between the level of input used in production among sampled suburban rice farms. At the same time, the estimated variance parameter specified in Equation 7 equals 9.53%, while the variance ratio γ is significant. Moreover, the model accounted for 89% of the variations in the observed estimates of technical efficiencies among sampled farms. This indicates a potential 21% of increase in suburban farmer's production efficiency when inefficiencies are addressed.

Regarding input elasticity, the results show that the first-order coefficients satisfy the monotonicity condition wherein inputs positively contribute to production. Among inputs used in

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production, the quantity of seeds used has the highest and significantly contributes to rice production in suburban farms. Although not significant, the input seeds are followed by labour and chemical fertilisers. The size of the cultivated area was found to be significant input in production among suburban farms. The results confirm how important the land area among suburban farms is given the incapability of expanding the production area coupled with the threat of land conversion.

Table 3
STOCHASTIC FRONTIER PARAMETER ESTIMATES OF SUBURBAN RICE FARMERS USING MLE

Variables	Parameters	Coefficient	Std. Error	T-ratio
Constant	β_0	7.41***	0.22	32.32
ln Cultivated area (rai)	β_1	1.20***	0.08	13.74
ln Seed (kg)	β_2	6.81*	3.86	1.76
ln Chemical fertiliser (kg)	β_3	3.25	3.31	0.98
ln Herbicide and pesticide (L)	β_4	0.94	0.64	1.46
ln Fuel (L)	β_5	1.81	2.44	0.74
ln Labor (hr)	β_6	3.70	3.89	0.95
Variance Parameters				
Sigma-squared	σ^2	9.53***	1.12	8.15
Gamma	γ	0.89***	0.03	29.37
Log-likelihood		51.23		

$*** \; p < 0.01; ** \; p < 0.05; * \; p < 0.1$

On the other hand, Figure 1 shows the distribution of the estimated TE score and its summary statistics. The result shows that farmers' technical efficiency ranged from 37% to 98%, with a mean efficiency of 81%. The result implies that the majority of the sampled farmers have the potential to increase the level of efficiency by 19%, given the current technology and input quantity level of sampled suburban farmers. Most of the sampled farmers show an efficiency level of 81% to 90%, followed by a group of farmers with 61% to 80% and a few exhibiting exceptional levels of efficiency with above 91%.

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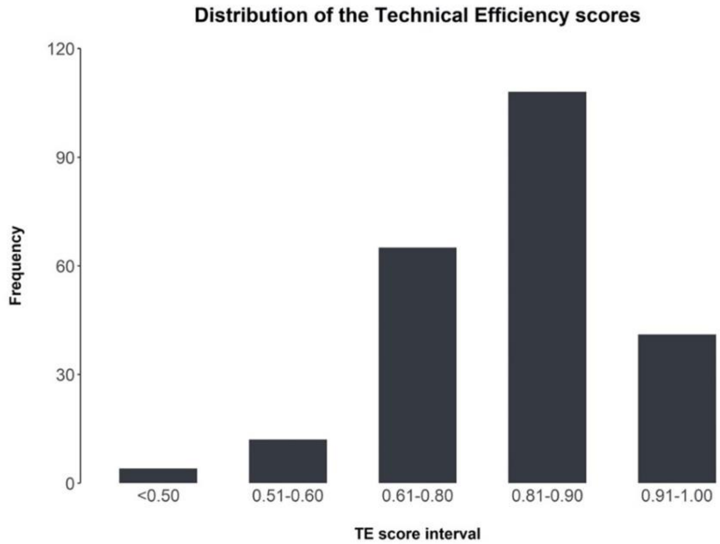

FIGURE 1
TECHNICAL EFFICIENCY DISTRIBUTION AND SUMMARY STATISTICS

(Summary statistics: Mean TE=0.81; Std. Deviation=0.12; Minimum TE=0.37; Maximum TE=0.98)

DISCUSSION

The study found that the variable costs incurred in the rice production of suburban farmers were considerably high. This amount can be reduced through subsidies from the government in terms of chemical fertilisers and seeds, as these inputs are seen as the highest contributors to variable costs, apart from labour. Subsidy lowers producers' costs and leads to economic efficiency (Qian et al., 2020). On the other hand, since Thailand's agriculture is dominated by rice, this explains the widespread use of chemical fertilisers and pesticides (Cramb, 2020a).

In previous studies, Ebers et al. (2017) and Suwanmaneepong et al. (2020) have also found that rice farmers' productivity in Thailand is greatly affected by expenditures on seeds and fertiliser inputs. Although statistically not significant, the level of fertiliser usage and the amount of labour applied in production have a close magnitude of influence on the output. Several studies also found similar observations on seeds and fertiliser having the largest share in the production cost (Kea et al., 2016; Kerdsriserm et al., 2018). We considered these results plausible, particularly in the context of rice farming in a suburban setting. Farms situated in urban and suburban areas in Thailand are often experiencing conversion of agricultural land into industrial and residential use. Thus, the scale of production may also depend on the ability of farmers to expand their farming operations (Chandio et al., 2019; Nguyen et al., 2021).

Similarly, Polling et al. (2017) emphasise that preference for crops grown for urban or suburban farming includes not land-intensive, high-yielding, and high-value crops. Often grown in urban areas are vegetables that target specialised markets like hotels and restaurants. Nonetheless, even rice as a staple food shows high potential to grow, especially in suburban areas or the urban buffer. In addition, the findings discussed in the result section indicate that

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suburban farms perform reasonably at par with farms located in rural areas in Thailand. For instance, Kerdsriserm et al. (2018) reported a technical efficiency score ranging from 29% to 99%. At the same time, technical efficiency estimates in other provinces in Thailand range from 40 to 98 per cent (Ebers et al., 2017). However, the comparable performance of suburban rice farms in the area can be partly attributed to the existence of the Chao Phraya River basin that secures water for rice cultivation. The existence of the river allows a secure source of water for rice production, even in suburban areas. In addition, suburban farms' location allows greater access to agricultural technologies for rice production, given their proximity to metro cities (Cramb, 2020b).

In the observed level of efficiency among sampled farmers, the majority, as shown with the higher percentage frequency, has the potential to increase the level of efficiency by 19%. Thus, suggesting that suburban farms can achieve a considerable efficiency level. Furthermore, the findings indicate significant potential for land efficiency, especially for agricultural use for suburban and urban areas, given that land is controlled less than in rural areas. Although suburban farming may be constrained when expanding its farming operation in larger cultivation areas, its location entails some advantages (Radović-Marković et al., 2019; Shahul Hameed et al., 2021). For instance, the suburban location allows nearby large populations, lower transportation and packaging cost, and lower post-harvest losses due to its proximity to the metro city (Pereira et al., 2021). Thus, the profitability and sustainability of rice farming in a suburban setting may depend on its ability to manage its potential advantages.

Furthermore, as the population trajectory of Thailand continues to concentrate around urban areas, this gives a vital role to suburban and peri-urban farming to meet increasing food demand (Kamalul Ariffin et al., 2021). This highlights the vital role of urban and suburban farming in contributing to Thailand's policy on food sufficiency, especially in sustaining the local food system. However, despite the potential of suburban farming, there has been a declining interest of the younger Thai generation to engage in farming when income from non-farm activities such as job opportunities in urban areas are comparable (Faysse et al., 2020; Tajpour et al., 2020). This could impact the future of the country's agriculture since the current population is mainly of the older generation.

CONCLUSION

Although there are several studies examining the technical efficiency of rice production, there is thin literature on the application of suburban farming. Most technical efficiency studies focus mainly on rice production in a rural setting. In contrast, this study contributes to the limited literature and the theory of technical efficiency in a suburban setting. The study found suburban farming profitable, indicating the viability of farming in urban and suburban areas in contributing to the country's policy on food sufficiency. In addition, the average technical efficiency of the farms was approximately 80% indicating a potential 20% increase in production when inefficiencies in production were addressed.

On the other hand, policy development and action planning to support suburban farming should involve various sectors and disciplines due to its multi-functional nature. This may crosscut across agriculture, waste management, health, community development and others. Moreover, farmer's participation in planning, defining, and identifying priorities in the action plan would be a critical aspect of strategic urban planning that would support suburban and peri-

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urban farming. Consequently, these strategic activities promoting urban and suburban planning are iterative, participatory, and flexible. Hence, the study also has a practical contribution as policy support on promoting suburban farming to support food sufficiency in Thailand. This is imperative to note since agricultural policies are mostly tailored to rural communities.

Similarly, the study's main limitation is that observed results may differ when applied to other suburban areas. This is expected given that farmers are heterogeneous or characterise with dynamic behaviour across regions and countries. Hence, a similar study can be conducted in other suburban areas to reach a consensus on appropriate policies to support farming in suburban or urban areas, given the different characteristics of farmers across geographical locations.

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REFERENCES

Bangkok, A.L.U.S.C. in. (2014). *Bangkok Agricultural Area Management Measures (Zoning)*. International Affairs Office, Thailand.

Boonyanam, N. (2020). Agricultural economic zones in Thailand. *Land Use Policy, 99*(1), 102774.

Cavite, H.J.M., Kerdsriserm, C., & Suwanmaneepong, S. (2021). Strategic guidelines for community enterprise development: a case in rural Thailand. *Journal of Enterprising Communities: People and Places in the Global Economy, Ahead-of-p,* 1-20.

Chandio, A.A., Jiang, Y., Gessesse, A.T., & Dunya, R. (2019). The Nexus of Agricultural Credit, Farm Size and Technical Efficiency in Sindh, Pakistan: A Stochastic Production Frontier Approach. *Journal of the Saudi Society of Agricultural Sciences, 18*(3), 348-354.

Cramb, R. (2020a). The Evolution of Rice Farming in the Lower Mekong Basin. In: Cramb, R. (eds) *White Gold: The Commercialisation of Rice Farming in the Lower Mekong Basin*. Palgrave Macmillan, Singapore.

Cramb, R. (2020b). *White gold: The commercialisation of rice farming in the lower Mekong basin*. Palgrave Macmillan.

Dam, T.H.T., Amjath-Babu, T.S., Zander, P., & Muller, K. (2019). Paddy in saline water: Analysing variety-specific effects of saline water intrusion on the technical efficiency of rice production in Vietnam. *Outlook on Agriculture, 48*(3), 237-245.

Dwivedi, D.N. (2016). *Microeconomics: Theory and Applications* (3rd Editio). Vikas Publishing House.

Ebers, A., Trung, Nguyen, T., & Grote, U. (2017). Production efficiency of rice farms in Thailand and Cambodia: a comparative analysis of Ubon Ratchathani and Stung Treng provinces. *Paddy and Water Environment, 15*, 79-92.

Economics, O. of A. (2018). *Agricultural statistics of Thailand*. Ministry of Agriculture and Cooperatives.

Fakkhong, S., Suwanmaneepong, S., & Mankeb, P. (2018). Determinants of sustainable efficiency of rice farming in peri-urban area, evidence from Ladkrabang district, Bangkok, Thailand. *World Review of Entrepreneurship, Management and Sustainable Development, 14*(3), 389-405.

FAO. (2018). *Country fact sheet on food and agriculture policy trends (Thailand)*. Food and Agriculture Organization of the United Nations.

Faysse, N., Aguilhon, L., Phiboon, K., & Purotaganon, M. (2020). Mainly farming … but what's next? The future of irrigated farms in Thailand. *Journal of Rural Studies, 73*, 68-76.

Jirarud, S., & Suwanmaneepong, S. (2020). Technical efficiency of rice farmers under the large agricultural plot scheme in Khlong Khuean District, Chachoengsao Province, Thailand. *World Review of Entrepreneurship, Management and Sustainable Development, 16*(2), 228-240.

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Kamalul Ariffin, S., Ng, F., & Abdul Mohsin, A.M. (2021). Examining the Influencing Factors of Consumer Purchase Intention toward Fast Food with Health Concerns as a Moderator. *Journal of Entrepreneurship, Business and Economics, 9*(2), 39-71.

Kea, S., Li, H., & Pich, L. (2016). Technical Efficiency and Its Determinants of Rice Production in Cambodia. *Economies, 4*(4), 22.

Kerdsriserm, C, Suwanmaneepong, S., & Mankeb, P. (2018). Comparative analysis of the technical efficiency of different production systems for rice farming in Eastern Thailand. *Asian Journal of Scientific Research, 11*(4), 480-488.

Kotera, A., Nagano, T., Hanittinan, P., & Koontanakulvong, S. (2016). Assessing the degree of flood damage to rice crops in the Chao Phraya delta, Thailand, using MODIS satellite imaging. *Paddy and Water Environment, 14*(1), 271-280.

Kramol, P., & Ekasingh, B. (2020). Evolution of rice farming in Ubon Ratchathani Province. In R. Cramb (Ed.), *White gold: The commercialisation of rice farming in the lower Mekong basin* (pp. 69-83). Springer Singapore.

Lang, W., Pan, M. Z., Wu, J.M., Chen, T.T., & Li, X. (2021). The patterns and driving forces of uneven regional growth in ASEAN countries: A tale of two Thailands' path toward regional coordinated development. *Growth and Change, 52*(1), 130-149.

Llones, C., & Suwanmaneepong, S. (2021). Influence of perceived risks in farmer's decision towards sustainable farm practices, Evidence from Northern Thailand. *International Journal of Agricultural Technology, 17*(6), 2143-2154.

Llones, C., Mankeb, P., Wongtragoon, U., & Suwanmaneepong, S. (2022). Production efficiency and the role of collective actions among irrigated rice farms in Northern Thailand. *International Journal of Agricultural Sustainability*, 1-11.

Nguyen, C.T., Diep, N.T.H., & Iabchoon, S. (2021). Direction of urban expansion in the Bangkok metropolitan area, Thailand under the impacts of a national strategy. *Vietnam Journal of Earth Sciences, 43*(3), 380-398.

Panpluem, N, Mustafa, A., Huang, X.L., Wang, S., & Yin, C.B. (2019). Measuring the technical efficiency of certified organic rice producing farms in Yasothon province: Northeast Thailand. *Sustainability, 11*(24), 16.

Pereira, J., Braga, V., Correia, A., & Salamzadeh, A. (2021). Unboxing organisational complexity: how does it affect business performance during the COVID-19 pandemic? *Journal of Entrepreneurship and Public Policy, 10*(3), 424-444.

Pongsrihadulchai, A. (2018). Thailand's rice industry and current policies towards high value rice products. *In proceedings of International Seminar on Promoting Rice Farmers' Market Through Value-Adding Activities* (pp. 1-11).

Prasad, R., Shivay, Y.S., & Kumar, D. (2017). Current status, challenges, and opportunities in rice production. In B. S. Chauhan, K. Jabran, & G. Mahajan (Eds.), *Rice production worldwide*. Springer International Publishing.

Qian, J. R., Ito, S., & Zhao, Z.J. (2020). The effect of price support policies on food security and farmers' income in China. *Australian Journal of Agricultural and Resource Economics, 64*(4), 1328-1349.

Radović-Marković, M., Salamzadeh, A., & Vujičić, S. (2019). Selection of organisation models and creation of competences of the employed people for the sake of competitiveness growth in global business environment. International Review, 1-2, 64-71.

Shahul Hameed, N.S., Salamzadeh, Y., Abdul Rahim, N.F., & Salamzadeh, A. (2021). The impact of business process reengineering on organisational performance during the coronavirus pandemic: moderating role of strategic thinking. *Foresight, Ahead of Print*.

Suebpongsang, P., Ekasingh, B., & Cramb, R. (2020). Commercialisation of rice farming in Northeast Thailand. In R. Cramb (Ed.), *White gold: The commercialisation of rice farming in the lower Mekong basin* (pp. 39-68). Palgrave Macmillan.

Sunge, R., & Ngepah, N. (2020). Agricultural trade liberalisation, regional trade agreements and agricultural technical efficiency in Africa. *Outlook on Agriculture, 49*(1), 66-76.

Suwanmaneepong, S., Kerdsriserm, C., Lepcha, N., Cavite, H.J.H.J., & Llones, C.A.C.A. (2020). Cost and return analysis of organic and conventional rice production in Chachoengsao Province, Thailand. *Organic Agriculture, 10*, 369378.

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Tajpour, M., Hosseini, E., & Salamzadeh, A. (2020). The effect of innovation components on organisational performance: Case of the governorate of Golestan Province. *International Journal of Public Sector Performance Management*, *6*(6), 817-830.

Tavva, S., Aw-Hassan, A., Rizvi, J., & Saharawat, Y.S. (2017). Technical efficiency of wheat farmers and options for minimising yield gaps in Afghanistan. *Outlook on Agriculture, 46*(1), 13-19.

Utaranakorn, P., & Yasunobu, K. (2016). Rice farmers' attitudes toward farm management in Northeastern Thailand. *Journal of Agricultural Science*, *8*(8), 21-31.

Van Kien, N., Hoang Han, N., & Cramb, R. (2020). Trends in rice-based farming systems in the Mekong delta. In R. Cramb (Ed.), *White gold: the commercialisation of rice farming in the lower Mekong basin* (pp. 347-373). Springer Singapore.

Vortia, P., Nasrin, M., Bipasha, S.K., & Islam, M.M. (2021). Extent of farm mechanisation and technical efficiency of rice production in some selected areas of Bangladesh. Geojournal, 86(2), 729-742.

Yamane, T. (1973). *Statistics and introductory analysis*. (2nd ed). Harper and Row.

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