

# Efficiency of Rice Production and Thai Farmers Poverty

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## Abstract

The study aimed to investigate the relationship between rice production efficiency and poverty among Thai farmers using panel data from 77 provinces over the period of 2012-2020. By using a stochastic frontier model, the study found that various factors such as agricultural area, seed utilization rate, fertilizer application rate, labor force, and rainfall have an impact on rice yield. The findings also revealed that more than half of Thai farmers are inefficient in their rice production and this inefficiency trend is on the rise. To understand the relationship between rice production efficiency and poverty, a Panel Quantile Regression Model was employed to analyze poverty levels among farmers, ranging from low to high. The results indicated that increasing rice production efficiency leads to a reduction in poverty among rice farmers, particularly among those in lower income groups.

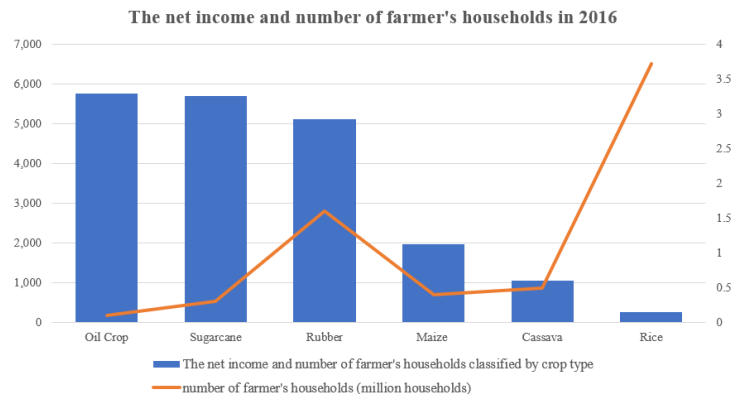
**KEYWORDS:** Farmers Poverty, Efficiency, Rice Production, Stochastic Frontier Model, Thailand

## 1 INTRODUCTION

In developed countries, the industrial sector is a major contributor to economic development. On the other hand, in developing countries like Thailand, agriculture plays a crucial role in the economy, particularly with rice production being a key product for farmers. However, Thai farmers have been facing challenges such as low rice prices, inconsistent output, and debt which can lead to persistent poverty issues. These problems can negatively impact their standard of living and limit opportunities for improvement, ultimately affecting the overall economy. (Saardchom, 2010)

In 2016, the income of Thai farmers was reported to be among the lowest among all sectors of agriculture, according to the Agricultural Economic Survey. Rice cultivation accounted for a large portion of the agricultural sector, with other crops having a much smaller presence. The survey also found a negative correlation between the income of farmers and the quantity of their production. Additionally, the report revealed that farmers were only earning a net income of 271 baht per rai per year, leading to a high percentage of farmers living below the poverty line. (Office of Agricultural Economics of Thailand, 2017)

Moreover, there are many studies revealed that among people who have experienced poverty, those who work as farmer are more likely to be poor than others (Trakoonkusri, 1998) and the study of Tangiam (2001) showed that the household who facing the most poverty is in the household of farmer and livestock. It leads to the core issue of rice production. The



Source: The Strategic Studies Center, 2016

**Figure 1:** The net income and number of agricultures classified by crop type

rice department of Thailand reported that poor and indebted farmers are one of the obstacles in rice production in Thailand. As well as another limitation that is a big issue is Farmers' rice production is still inefficient.

Regarding to the report from an office of Agricultural Economics, the average rice production in the crop year 2010/11 is 441 kilograms per rai which can be concluded that Thailand has low efficiency in rice production comparing to the data as of March 2012, demonstrated by the United States Department of Agriculture that the world average rice production in the crop year 2010/11 is 688 kilograms per rai, 1,206 kilograms per rai in United Sated of America, 1,048 kilograms per rai in China and 885 kilograms per rai in Vietnam. The issue of the low efficiency of rice production indicates the unsuitability of the usage of production factors which leads to problems of loss or a return that is not worth the loss which means the portion of the income that the farmer should receive but they do not. Conversely, if they have more efficiency in rice production, they will get more opportunities to earn more profit and income together with the reduction of the poverty issue. Generally, we consider the poverty from the human capital or the demography factors but if we consider the farmer poverty in the agriculture section, we must consider the production of agricultural products. Therefore, it is essential to know which process of rice production gets to how many kilograms of the output and as well as the measurable efficiency to explain if these levels of efficiency can affect the farmer poverty. In developing countries, there are many summations that increasing productivity can reduce the poverty much more than the effect of another factor. Furthermore, the study about the relationship between production efficiency the farmer poverty has shown that an increasing in productivity and output can lead to higher income and lower debt. (Norman 1975; Ajibefun 2000 b; Ajibefun 2002; Ajibefun and Daramola 2003; Ater 2003). Moreover, the result of the study of Asogwa, Umeh, and Okwoche (2012) shows that the more productivity of production the lower poverty which the policy meaning is reducing poverty in farming households are linked to improving efficiency. If poverty is to be eradicated in farming households agricultural activities must also be efficient. However, in Thailand, there is little empirical work on the relationship between poverty and efficiency among farming households including the study of poverty. Although there are many studies, the issue of

poverty is still there, especially the poverty problem of Thai farmers which has been a chronic problem for a long time and has not yet been able to resolve the problem Despite the government's policy that came out to help the farmers directly.

As per the evidence above, the problem of farmer poverty is one of the important issues which can cause a change in the economy. The greater the poverty prevailing among farmers, who are more vulnerable than other occupational groups will inevitably cause problems to follow more easily and more severely. As we know that a large portion of the occupation in Thailand is the farmer, if this group is affected, the majority of the population is likely affected or we can summarize as a whole economy is affected. In this study, the author aims to study the effect of efficiency in rice production on Thai farmer poverty. The study is divided into 2 parts which are 1) The analysis of the efficiency of Thai farmer production and 2) The relationship between the efficiency in rice production and Thai farmer poverty.

## 2 RESEARCH OBJECTIVES

1. To study the efficiency of rice production by Thai farmers.
2. To examine the relationship between rice production efficiency and Thai farmers poverty.

## 3 LITERATURE REVIEW

### 3.1 Factors affecting rice production efficiency.

The factor of production has been considered the main factor affecting rice production efficiency and has been studied in many research studies in Thailand. For example, Pitipanya (1996) studied the factor affecting rice production and the technical efficiency of farmer skills. The data used is collected from the agriculture survey in Supan Buri in 2020. The result found that the size of the farm, the number of laborers, the expenses of machines, the quantity of chemical fertilizer, and the problem of water issue which effect the output during the off-season rice time. On the other hand, during the rice season in 2020 found that the size of farm, the number of laborers, the expenses of machines, the pesticide, the number of seeds, the problem of water, and the problems with diseases and insects are the factor that causes the change of quantity of the output which corresponds to the study of Rayasawat (2018) which analyzes the technical efficiency of the rice production in Nakhon Ratchasima. The result shows that the number of seeds is affecting the quantity of rice output as well as the planation in the irrigation area, the number of laborer and the numbers of used pesticide. Moreover, the study of Sansri (2014) which has an objective to study the efficiency of production factors and to measure the technical production efficiency of Khao Dawk Mali 105 rice production. The result found that the number of seeds, the numbers of used pesticide and the land condition are the significant explanation of the change in quantity of Khao Dawk Mali 105 rice. Conversely, the study of Thipbharos (2018) has the result both likely and different from others. They study the influence of planting area factors, factors of production and the cost factors. The study found that the land condition has the significant effect to the production of colored organic rice both separated grown and together with the white rice. While the production of white grain rice found that the planting area factor had no influence on white

rice yield both in single white rice planting and with white rice in combination with milled rice. There are also other factors that have been taken into account in some studies as well. For example, Kongtanajaruanun and Cheamuangphan (2018) has analyzed the efficiency of rice production between the field where seeding rice is transplanted and the paddy-sown field in the Northern Area of Thailand. Including the factor affecting the rice production. The result shows that the number of family members in household farmer and the private cash investment have the negative significant effect to the efficiency of rice production. Moreover, the process of the production and the level of education have the positive relationship with the efficiency of the rice production. Next, Thipbharos (2018) has predicted the efficiency of rice production by studying the influence of land condition, production factors, cost factors and the farmers characteristics. The study was summarized that the farmer's characteristics has no significant effect to the efficiency of rice production.

### **3.2 Factors affecting the agricultural poverty.**

Recently, there are many micro studies of factor affecting to agriculture's household poverty. The study of Hanphichai (2021), aims to study the nature and the root of the agriculture's household poverty and to purpose the strategy to eliminate the poverty issue of the cultivator in Chaiyaphum. The result shows that the primary cause of the poverty is affected from these factors- gender, the level of education, the number of members in family, the number of labors per household, administrative district, the land's size, the type of cultivation, the source of water, working and lifestyle attitude, the acceptance of technology, the flexible to change and the attitude of personal loan. Moreover, there are also many studies of this issue in various countries. The study of Omonona, Udoh and Adeniran (2008) in Nigeria has objective to study the factor which determine the poverty in Nigerian household. They found that the level of poverty is increasing according to the greater level of the age of householder, the household's size and the increasing of dependency ratio. On the other hand, the level of poverty is decreasing due to the higher level of householder's education. Moreover, the result of the study of Asogwa, Pkwoche and Umeh (2012) said that economics efficiency, household's revenues, dependency ratio, the ratio of food expenditure to total household expenditure, farm size, access to credit household, the production organizational structure, the scope of household production distribution and the scope of production are factors that determine the severity of poverty. In condition, they also studied factors reducing poverty in depth among urban farmers in Nigeria. The study found that factors that significantly influenced agricultural poverty were the total economic efficiency of the farm, household income, farm size, household size, age, education, farming experience access to credit employment that generates income for household members of Farmer's Association Membership and agricultural property. However, the overall economic performance of the farm and per capita income continues to improve through employment opportunities that benefit household members. As well as redistributing household income to reduce income inequality, it can alleviate deep poverty among farmers. Nguyen and Nguyen (2019) investigated the causes of poverty among the Khmers and proposed policy implications to help the Khmers escape poverty in Tra Vinh and the Mekong Delta. The results showed that several reasons affect household poverty, including lack of capital to produce; lack of production

tools, poor health and labor shortages, family size, lack of job opportunities or unemployment including a lack of willingness to escape poverty and education.

### **3.3 Efficiency of production and Farmer Poverty.**

There are many research study of the relationship of production efficiency and farmer poverty foreign research. For example, Ater's (2003) study in Nigeria found that the best approach to sustainable development for farmers in poor rural areas with low productivity and dependence on agriculture which must be developed at the farmer's production efficiency. Moreover, the results of Ajibefun (2000b) were the same. The research aims to alleviate farmers from poverty, farmers' productivity and efficiency should be improved. In the same way, it also found another study that Improving farmer productivity and productivity leads to income growth and consequently, poverty reduction (Norman 1975; Ajibefun 2000 b; Ajibefun 2002; Ajibefun and Daramola 2003; Ater 2003). Next, the study by Asogwa, Umeh and Okwoche (2012) also showed that when the average efficiency increases poverty will decrease which the policy meaning is Reducing poverty in farming households is linked to improving production efficiency. If poverty is about to be eradicated in farming households Agricultural activities must also be efficient.

## **4 RESEARCH METHODOLOGY**

### **4.1 Data**

Secondary data collected from the Office of Agricultural Economics, Statistical Data of National Park, Wildlife, and Plant, Office of the National Economic and Social Development Council, Office of Agricultural Economics, and the Annual Report of the Bank, from estimation, including related research and articles, using the years 2012-2020 and panel data analysis, and are provincial data for all 77 provinces in Thailand. The total amount of rice, the cultivation area, the seed utilization rate, the fertilizer application rate, the number of laborers, and the amount of annual rainfall are all used to assess farmer efficiency. For GPP per capita for the agriculture sector which represents the poverty of farmers, the number of labors, the number of branches, and the technical efficiency score (from the estimation) are used in the analysis of the relationship between production efficiency and farmer's poverty. In this study, the focus is on examining the relationship between rice production efficiency and poverty, specifically in terms of low agricultural gross domestic product per capita (GPP) in the lower quantiles (0.1-0.3). Agricultural GPP per capita is used as a proxy for income in the agriculture sector and is used to represent poverty in this context. However, it is important to note that the proxy for rice poverty in this study may not encompass the entire agriculture sector. Additionally, it should be acknowledged that a significant portion of GPP per capita in the agricultural sector is derived from Thai farmers' income. Due to limitations in available data, agricultural GPP per capita is used as a proxy for farmer income.

To eliminate variances and ensure stationarity, all of the variables were converted into natural logarithms. Table 1 has a description of each variable.

In this study, farmers' poverty is represented by GPP per capita for agriculture sector since farmers account for the largest group of agricultural GPP in Thailand.



**Table 1:** Research's study variable

Variable	Variable Definition	Source
RICE	Total actual of rice (kg. /rai)	Office of Agricultural Economics
AREA	Cultivation Area (Rai)	Office of Agricultural Economics
SEED	Seed utilization rate (kg. /rai)	Office of Agricultural Economics
FER	Fertilizer application rate (kg. /rai)	Office of Agricultural Economics
LABOR	Number of labors / Number of farmer (Household)	Office of Agricultural Economics
RAIN	The amount of annual rainfall (Millimeters)	Statistical Data of National Park, Wildlife and Plant
GPP	GPP per capita for agriculture sector (million baht)	Office of the National Economic and Social Development Council
EFF	Technical efficiency score	From the estimation
LABOR	Number of labors / Number of farmer (Household)	Office of Agricultural Economics
BRANCES	Number of Branches (Branches)	Annual Report of Bank for Agriculture and Agricultural Cooperatives BAAC

## 4.2 Methodology

In this study, the author started by testing the efficiency of rice production by using the stochastic frontier model to derive production efficiency. Then, the production efficiency obtained from the first stage was used in the Panel Quantile Regression model to study the relationship between efficiency of rice production and poverty of Thai farmers. The concepts and methods of studying each step can be described as follows.

### 4.2.1 Stochastic frontier Analysis (SFA)

The SFA model has been widely used internationally in both emerging and developed countries as a tool to measure agricultural technical performance since it can predict the technical efficiency (TE) score of producers or farmers on how much production efficiency. (Kumbhakar and Lovell, 2000; Coelli et al., 2005).

The SFA is an econometric model developed by 3 papers in 1997: Meeusen and Van den Broeck (1977); Aigner et al. (1977) and Battese and Corra (1977). The SFA model was shown by Equation (4) which is similar to the model Deterministic frontier analysis (DFA). The DFA model was developed by Aigner and Chu (1968) uses the Cobb-Douglas equation as the product function, represented by equation (3), which is called the Cobb-Douglas frontier production function, unless there is a linear tolerance.

Symmetric random (noise) error;) added to the model (Coelli et al., 2005; Orgaundari et al., 2010; Backman et al., 2012; Rhaman, 2013; Rhaman and Barmon, 2013). In addition, all 3 research papers have also considered the discrepancy that occurs in 2 components that are always independent of each other, i.e., value and. In addition, each work has developed a frontier production line and formulated an assumption on the distribution of values., also

in the SFA model (Kumbhakar & Lovell, 2000; Majumder et al., 2016). Normally, the Cobb-Douglas production function is used as the production function in SFA model. It takes form as

$$q_{it} = \exp(\mathbf{x}_{it}; \boldsymbol{\beta} + v_{it}) \cdot TE \quad (1)$$

where  $TE < 1$ , called technical efficiency. By taking logarithm on equation 1, we have

$$\ln q_{it} = \sum_{k=1}^K \beta_k \mathbf{x}_{k,it} + v_{it} - \mu_{it} \quad (2)$$

where  $q_{it}$  is the level of the output of province  $i$  at time  $t$ ,  $\mathbf{x}_{it}$  is the vector of input of province  $i$  at time  $t$ ,  $v_{it}$  is a random error, and  $\mu_{it}$  is the level of efficiency, which is a non-negative random variable.  $\boldsymbol{\beta}$  is an unknown parameter to be estimated. It can be seen that there are two components of the error ( $v, \mu$ ) which are assumed to be independence. In this study, we apply this model evaluate the inefficiency of the rice production of Thai farmer. Thus, the empirical model used in this study can be expressed as follows:

$$\ln ICE_{it} = \beta_0 + \beta_1 \ln AREA_{it} + \beta_2 \ln SEED_{it} + \beta_3 \ln FER_{it} + \beta_4 \ln LA_{it} + \beta_5 \ln RAIN_{it} + v_{it} - \mu_{it} \quad (3)$$

where  $i$  is the province,  $t$  denotes as time. As this study aims at measuring the technical efficiency (TE), it can be defined as the ratio of the producer's actual output to the maximum possible output (Ogundari et al, 2010). Thus, it can be defined as

$$TE = \frac{\exp(\ln AREA, \ln SEED, \ln FER, \ln LA, \ln RAIN; \boldsymbol{\beta} + v - \mu)}{\exp(\ln AREA, \ln SEED, \ln FER, \ln LA, \ln RAIN; \boldsymbol{\beta} + v)} = \exp(-\mu) \quad (4)$$

From above, it is a predictable output boundary model, which assumes that producers can measure technical efficiency by using the least available inputs to produce a fixed amount of output. (Ogundari et al. 2010). This study uses the JLMS estimator proposed by Jondrow et al. (1982). to assess farmer production inefficiencies (Johnson and Kuosmanen, 2015).

#### 4.2.2 Panel Quantile Regression Model

To study the relationship between rice production efficiency and farmer poverty. This study uses the Panel Quantile Regression (PQR) model. The basic idea of PQR is similar to that of simple linear regression, but it has better properties due to the distribution of the dependent variables can be completely considered (Koenker and Bassett, 1978), the PQR model can describe the relationship between the different quantiles of the dependent variables in each quantile. The general equation form of the PQR model can be shown as follows.

$$Q_Y(\tau | Z) = Z' \theta(\tau) + \varepsilon \quad (5)$$

where  $Q_Y$  is the quantile function of the dependent variable ( $Y$ ),  $Z$  is the matrix of independent variable,  $\theta$  is vector of  $J \times 1$  of coefficients,  $\tau$  is the quantile level and  $\varepsilon$  is  $NT \times 1$  vector of the error with  $\varepsilon \sim \text{IID}(0, \sigma^2)$ . The Panel Quantile Regression with Fixed effect model as follows:

$$y_{it} = \sum_{j=1}^J \theta_j(\tau) z_{j,it} + \alpha(\tau) + \varepsilon_{it}, \quad i = 1, \dots, N; t = 1, \dots, T \quad (6)$$

where  $y_{it}$  is dependent variable of province  $i$  at year  $t$ ,  $z_{it}$  is  $J \times 1$  vector of independent variable of provinces province  $i$  at year  $t$ . From equation 6, it can be seen that there is one additional parameter, the individual effect variable, which is an unobservable value. Therefore, this parameter is also estimated. For  $\alpha(\tau)$ , it is assumed to be constant and does not change depending on the nature of the data. Moreover, in this case, different provinces have no different characteristics. Therefore, under this assumption, the model can be estimated by fixed effects.

In estimating the parameters or coefficients of the model shown in equation 6, it cannot be estimated using the Least Squares (LS) method because there is an individual effect ( $\alpha(\tau)$ ) occurred in the model. Therefore, such variables must be eliminated first. Then, the method chosen this time is the demeaning method, so equation 6 is transformed into the following form.

$$y_{it} - \bar{y} = \sum_{j=1}^J \theta_j(\tau) (z_{j,it} - \bar{z}_j) + \tilde{\varepsilon}_{it}, \quad i = 1, \dots, N; t = 1, \dots, T \quad (7)$$

To estimate the parameters in the above model, it can be done by

$$\hat{\theta}_{\theta}(\tau)_{FE} = \min_{\theta(\tau)} \sum_{it}^{NT} (\rho(\tau) (\varepsilon_{it}))^2 \quad (8)$$

where  $\tilde{\varepsilon}_{it}$  is the expected residuals,  $\rho(\tau) (\tilde{\varepsilon}_{it}) = \tau \max \{\tilde{\varepsilon}_{it}, 0\} + (1 - \tau) \max \{-\tilde{\varepsilon}_{it}, 0\}$  is the loss function (Koenker, 2005). The empirical PQR model can be expressed as follows.

$$\ln GPP_{it} = \beta_1(\tau) \ln EFF_{it} + \beta_2(\tau) \ln LABOR_{it} + \beta_3(\tau) \ln BRANCES_{it} + \varepsilon_{it}, \quad (9)$$

This study divided peasant farmers into 3 groups for estimation based on the level of agricultural GPP per capita: farmers with low agricultural GPP per capita (10<sup>th</sup>, 20<sup>th</sup>, 30<sup>th</sup> quantiles), farmers with GPP per capita was in the middle (40<sup>th</sup>, 50<sup>th</sup>, 60<sup>th</sup> quantile) and farmers with high agricultural GPP per capita (70<sup>th</sup>, 80<sup>th</sup>, 90<sup>th</sup> quantile).

## 5 EMPIRICAL RESULT

**Table 2:** Estimated performance measurement results by Stochastic Frontier Production

Variable	Parameters	Coefficients
AREA	$\beta_1$	0.814***
SEED	$\beta_2$	0.055***
FER	$\beta_3$	-0.070***
LABOR	$\beta_4$	0.122***
RAIN	$\beta_5$	0.017***

According to table 2, shows the analyzes the efficiency of farmers in Thailand. It is found that agricultural area (AREA), seed utilization rate (SEED), fertilizer application rate (FER), labor force (LABOR), and rainfall (RAIN) are all production factors affecting rice yield (RICE). When considering the coefficient, it was found that the agricultural area, seed utilization rate, fertilizer application rate and number of laborers as a production factor had a significant



positive effect on rice yield. Conversely, fertilization rate had a significant negative influence. We can summarize that an increase in agricultural area of 1%, the yield of rice will increase by 0.814%, and an increase in the seed utilization rate of 1% will increase the yield of rice by 0.055%, and when the number of labor and quantity increases by 1%. As a result, the rice yield increased by 0.122% and 0.017%, respectively, while the fertilizer application rate of the farmers. If the fertilizer application rate increased by 1%, the yield of rice decreased by 0.070%.

From the study of a sample of all 77 provinces in Thailand since 2012- 2020 found that when looking at the overall picture of the country in every academic year. In the Table 3, the inefficiency in rice production of Thai farmers ranged from 0.026 to 0.999, with an average inefficiency of 0.890. Moreover, the result was found that more than 61 percent had an inefficiency greater than the average inefficiency. When considering the annual inefficiency, it was found that the average value of inefficiency increases every year as well. We can summarize in overall that more than half of Thai farmers in the country are inefficiently using their inputs to grow rice and the trend of this inefficiency is increasing as well.

**Table 3: Results of TE along 2012-2020**

Variable	Quantile								
	Low agricultural GPP per capita group			Medium agricultural GPP per capita group			High agricultural GPP per capita group		
	10th	20th	30th	40th	50th	60th	70th	80th	90th
Constant	-0.554*** (0.025)	-0.425*** (0.016)	-0.338*** (0.018)	-0.248*** (0.017)	-0.161*** (0.022)	-0.050* (0.029)	0.110** (0.042)	0.670*** (0.090)	0.782*** (0.004)
EFF	0.406*** (0.128)	0.320*** (0.106)	0.377*** (0.093)	0.395*** (0.115)	0.341*** (0.098)	0.311*** (0.096)	0.249** (0.123)	0.131 (0.123)	0.001 (0.0475)
LABOR	-0.153*** (0.019)	-0.169*** (0.023)	-0.217*** (0.022)	-0.191*** (0.015)	-0.183*** (0.020)	-0.145*** (0.028)	-0.066* (0.037)	0.085*** (0.025)	0.000 (0.005)
BRANCES	-0.095 (0.093)	-0.201** (0.098)	-0.185** (0.100)	-0.332*** (0.079)	-0.286*** (0.101)	-0.393*** (0.123)	-0.712*** (0.141)	-0.361 (0.239)	-0.000 (0.019)

Note \*\*\*, \*\*, \* indicate the statistical significance at the 0.01, 0.05 and 0.10 levels, respectively and the value in () is the standard error

The results from Table 4 indicate that the efficiency of rice production and its relationship to poverty, as represented by GPP per capita, and other variables were analyzed. The results show that production efficiency (EFF) and the number of BAAC branches (BRANCES) have a significant effect on farmers with low and medium agricultural sector GPP per capita. However, they have little to no significant impact on farmers with high agricultural sector GPP per capita. In contrast, the number of workers (LABOR) has a significant impact on per capita agricultural sector GPP at all levels.

The analysis of the coefficients from Table 4 indicates that production efficiency has a positive impact on agricultural GPP per capita at all levels, with greater effects among farmers with low and medium agricultural GPP per capita compared to those with high agricultural GPP per capita. Specifically, at the 70th quantile, a 1% increase in efficiency results in a 0.249% increase in agricultural GPP per capita. This demonstrates that an increase in production efficiency improves the overall agricultural economy of a province, and as a result, leads to an increase in farmer income and a decrease in poverty, particularly among low-income farmers. Additionally, the results show that an increase in the number of workers has a significant negative effect on agricultural GPP per capita at low and middle levels. However, it has a

positive influence on the high-level group. The number of BAAC branches has a low negative impact on per capita agricultural GPP, with a moderate effect of the coefficient ranging from 0.185-0.201% in the low-level agricultural GPP per capita and 0.286-0.393% in the middle. For the high GPP group, the agricultural sector per capita has only a slight negative effect that is significant.

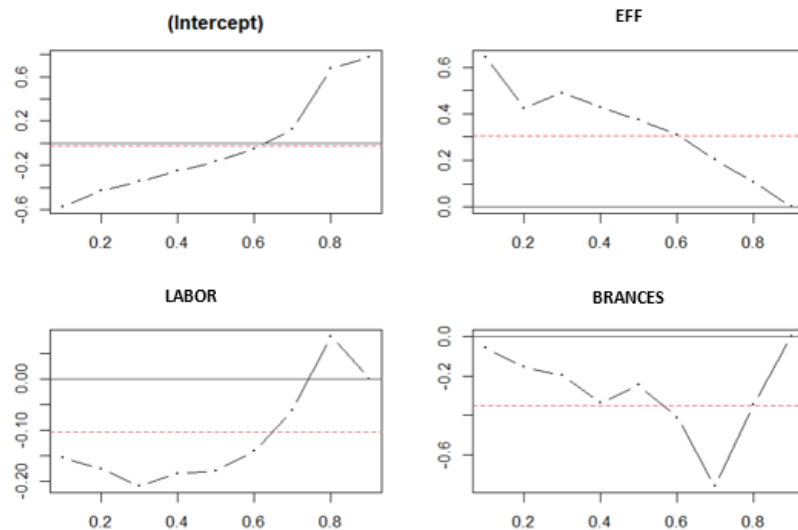


Figure 2: the coefficients of the variables from the 10<sup>th</sup>-90<sup>th</sup> quantile.

As depicted in Figure 2, the coefficients of each variable at different quantiles from the 10th to 90th are presented. The black line illustrates the coefficient across the entire range of quantiles, while the red line represents the mean influence on per capita agricultural GPP levels. The results indicate that as agricultural GPP per capita increases, the effect of the EFF variable on per capita agricultural GPP tends to become less positive. Additionally, the impact of the BRANCES variable on per capita agricultural GPP appears to decrease at higher levels of agricultural GPP per capita. Conversely, the LABOR variable tends to have a greater negative influence on per capita agricultural GPP at higher levels of agricultural GPP per capita.

## 6 CONCLUSION AND DISCUSSION

This study examines the relationship between poverty and the efficiency of rice production among Thai farmers. The researcher has reviewed previous studies that have shown that improving efficiency in farming households can lead to a reduction in poverty. According to a study by Asogwa, Umeh and Okwoche (2012), there is a correlation between improving production efficiency and reducing poverty in farming households. However, in Thailand, there is a lack of research on this topic. As such, the study aims to investigate the efficiency of rice production among Thai farmers and its relationship to poverty in the country.

The results of the first part of the study to measure the efficiency using Stochastic Frontier Analysis found that the agricultural area, seed utilization rate, fertilizer application rate, number of workers and rainfall all are production factors that affect rice production. All of them

had a positive effect on rice yield. Except for the rate of fertilizer application. The higher the fertilizer application rate, the lower the yield of rice. In the first part of this study, the TE was obtained. These TE were used to investigate the relationship between rice production efficiency and farmer poverty. For the efficiency production of Thai farmers It shows a trend of increasing inefficiency in production every year. More than half of the country's farmers are found to be inefficient in production. However, a study by Asogwa, Umeh and Okwoche (2012) shows that reducing poverty in farming households is linked to improving productivity. Therefore, if Thai farmers can improve and increase production efficiency, not only increased rice yields, but also increased farmer incomes and consequently reduced farmer poverty (Norman 1975; Ajibefun 2000 b; Ajibefun 2002; Ajibefun and Daramola 2003; Ater 2003)

For studying the relationship between rice production efficiency and farmer poverty. The Panel Quantile Regression model was used in 77 provinces in Thailand. The farmers were grouped according to the agricultural GPP per capita, which was divided into farmers with low agricultural GPP per capita (10th-30th quantile), farmers with medium agricultural GPP per capita (40th-60th quantile) and the peasant group at high agricultural GPP per capita (70th-90th quantile). The results of the study showed that production efficiency have a positive influence on GPP of the agricultural sector per capita, which this study provides, represents the poverty of the peasants. Especially, among farmers with low and moderate agricultural GPP per capita, the magnitude of the effect was greater than high. As for the increasing in the number of workers, it was found that it significantly affected the agricultural sector's GPP per capita at all levels. Most of them had a negative influence on GPP of agricultural sector per capita. Finally, the number of BAAC branches had a low and moderate negative impact on agricultural sector GPP per capita. At the high level, there was little influence. For studying the relationship between rice production efficiency and farmer poverty. The Panel Quantile Regression model was used in 77 provinces in Thailand. The farmers were grouped according to agricultural GPP per capita, which was divided into farmers with low agricultural GPP per capita (10th-30th quantile), farmers with medium agricultural GPP per capita (40th-60th quantile) and the peasant group at high agricultural GPP per capita (70th-90th quantile). The results of the study showed that production efficiency have a positive influence on GPP of the agricultural sector per capita, which this study provides, represents the poverty of the peasants. Especially, among farmers with low and moderate agricultural GPP per capita, the magnitude of the effect was greater than high. As for the increasing in the number of workers, it was found that it significantly affected the agricultural sector's GPP per capita at all levels. Most of them had a negative influence on the GPP of the agricultural sector per capita. Finally, the number of BAAC branches had a low and moderate negative impact on agricultural sector GPP per capita. At the high level, there was little influence. This may be caused by credit management, since one of the reasons that makes farmers poor is selling rice at a price lower than its cost. So, the next issue to focus is how these farmers are able to live. The answer is incurring debt (Sombat, 2016). As a result, the growing number of bank branches, which provides more credit, has no effect on farmer income or GPP per capita. From the results of this study, almost all the affected farmers are those with low and moderate GPP per capita or it is the country's low-income farmers, also known as poor farmers. They are all those who are truly affected by these variables.

## 7 POLICY RECOMMENDATION

In summary, the study found that increasing rice production efficiency can lead to an improvement in farmers' income and a reduction in poverty. Factors such as agricultural area, seed utilization rate, fertilizer application rate, number of workers, and rainfall were found to affect rice production. The research suggests that the government should provide support in the form of knowledge and training to help farmers improve their efficiency in these areas. Additionally, the government should also provide assistance in water management, as this can also affect rice production efficiency. Overall, by addressing these factors, the government can help to improve the economic situation for farmers and reduce poverty.

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