

Determinants of Technical Efficiency of Cocoa Farmers in Malaysia

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Abstract- The study of the determinants of technical efficiency among smallholder cocoa farmers has been well studied and still attracts more studies in the agricultural literature. Among the factors attract attention are the demographic characteristics that affect farmers' decision-making process and the ability of farmers to execute the decision effectively. Cocoa production in Malaysia faces a multiplicity of problems which results into low productivity, thus leading a continuous fall in percentage share of cocoa output since 2001. Currently, no study has focussed on the investigation of this issue from the supply perspective. This study will deal with the determinants of technical efficiency among cocoa farmers in Malaysia during the year 2013 production season using the Tobit estimator. Questionnaires were administered to 323 smallholder cocoa farmers throughout Malaysia and data were collected. The results of the analysis showed that ratio, number of clones, record keeping, status of farmers (either part-time or full-time basis), knowledge, farming course and plant location affects efficiency. This finding suggests that policies that would directly affect these identified variables be pursued.

Keywords- Cocoa, technical efficiency, Tobit analysis

1. Introduction

Malaysia was ranked 13th in the world in 2010 after having been the fourth largest cocoa producing countries in the world in 1990 after Ivory Coast, Ghana and Brazil. This decline as a major exporter of cocoa in the world was due to the reduction in the local production of cocoa beans. The Malaysian Cocoa Board (MCB hereafter), to attributed this decline of small-scale farmers to their preference to grow oil palm and rubber trees instead of cocoa, which preference for oil palm and rubber trees according to them was due to the simplicity in the plantation process. They noted, about 90 percent of cocoa production in Malaysia is managed by small-scale farmers

(Malaysian Cocoa Board). Despite the initiatives taken by MCB to increase the efficiency among the small-scale farmers, the industry has not been able to reach its targeted production level of 40,000 tonnes of cocoa per annum. The industry only managed to produce 2,665 tonnes of dry cocoa beans in 2014. Thus they observe that there is a need to encourage farmers to increase cocoa production through a number of incentives which include among others the Cocoa Smallholder Development Program), Consolidated Group Development Program, Entrepreneur Development Cocoa Program and Capacity Building Program.

The main objective of these programmes is to improve production efficiency among small-scale farmers from the average of 0.5 tonnes (per hectare / per year) to 1.5 tonnes (per hectare/per year). If this output level is reached, the farmers are considered efficient by MCB definition. Nevertheless, production efficiency can also be measured by decomposing the production efficiency into its technical and scale components. This is important because the production efficiency can also be influenced by factors such as age, education level and family size [3]. Therefore, this study investigates the sources of technical efficiency among cocoa farmers in Malaysia. To achieve this objective, the study utilized Tobit estimator to investigate the determinant factors of technical efficiency.

This study is organized in the following sequences. Section 2 highlights on the research problem followed by section 2 which reviews measures of technical efficiency and literatures on determinants of production efficiency, while Section 3 presents the empirical model and data, section 4 discusses the empirical results finally section 5 concludes.

2. Research Problem

Attractive cocoa prices and subsidies on inputs and Malaysia's fertile land are favourable factors for a high cocoa production. Unfortunately, this is not so as the cocoa sector faces problems which results into a critically low domestic cocoa production, in spite of the increasing

demand. This is a bothering situation, and one wonders why? This decline of cocoa production may be related to land size, price and an uncertain poor weather. To overcome the problem of land size, the government has projected an increase of cocoa cultivation area of 2,000 hectares each year such that the cultivation land will be increased for cocoa planting up to 40,000 hectares by 2020.

However, [4] pointed out that the increase in the cultivation land will be costly, according to them, every farmer should reach maximum production by optimizing the use of available resources. [7] agrees with [4] by confirming that agricultural production to a greater extent depends on the ability of farmers' use of crop inputs. Farmers who use crop inputs efficiently are capable of producing output at the maximum level thus maximizing their profits. Hence, the question of efficiency to help in increase the cocoa production is very significant consequently requires to be examined.

As a result, this study will examine the various factors that influence efficiency in the production of cocoa in Malaysia. These factors include (i) demography (farmer, age, household and marital status); (ii) land characteristics (the number of trees, the size of the land, labor, farm age, age of trees, number of clones, records and farmer's status); (iii) human resources (education, supervision and knowledge); (iv) technology (plant and equipment); (v) farm location and (vi) plant diversity.

3. Technical Efficiency Measures and its Determinants

3.1 Technical Efficiency Measures

Parametric frontier models and non-parametric methods have monopolized the recent literature on productive efficiency measurement. Parametric approach involves testing procedures that are based on a number of assumptions. It requires the construct of a production function to describe the level of technology, normality assumptions that need to be met and mathematical modeling in the form of time series analysis. The measurement efficiency can be categorized in two functions; the stochastic frontier production and cost functions [10].

In the parametric approach, the stochastic frontier production is based on the Cobb-Douglas production function incorporated into various estimation methods such as ratio analysis, Ordinary Least Square (OLS), Total Factor Productivity and Stochastic Frontier Analysis (SFA). Of these three methods, SFA is the most commonly employed technique in literatures. The non-parametric method that is commonly employed in literature on productive efficiency is Data Envelopment

Analysis (DEA). It is a linear programming model, assuming no random mistakes, used to measure technical efficiency of decision making units (or DMUs).

3.2 Determinants of Production Efficiency

Studies on factors affecting the level of efficiency are as important as the study of estimating the level of efficiency [10]. Efficiency of cocoa farmers could be improved if the factors influencing the efficiency are determined. In practice, it is rather difficult for farmers to reach the desired level of efficiency even with the optimum combination of technology and inputs available. This is because the final output is not only dependent upon the optimum combination of inputs available but also is subject to internal and external factors that would ultimately affect the final output produced [11].

It is important to note that the systematic record keeping significantly affects efficiency of farmers [20]. Similarly, previous studies found that good record-keeping practices greatly influence the efficiency of dairy farming in California [22]. Hence, knowledge of good farming techniques are important factor which influence efficiency [13], [19], [12], [1]. In another related study, [21] analyzed the technical efficiency of 150 farmers using DEA method. The study showed that the coefficient on years of schooling is a positive indicator that the farmers with more years of schooling tend to be more technically efficient in agricultural production. [6] on the other hand found that the education level among farmers is significant in reducing production inefficiency but it leads to increased productivity and total output.

In addition, [17] found that demographic factors such as age, gender and education level have a positive influence on efficiency. Another related work by [4] found that age of farmers greatly influenced cocoa output in Ghana. They therefore recommend that there should be greater involvement of young households in farming activities to help increase cocoa output.

4. Data and Empirical Model

4.1 Sampling Method and Data Collection

This study used cross-section data for the production year 2013. The data for this study was collected through a cross sectional survey of cocoa farmers in the West and East Malaysia involving 323 smallholder cocoa farmers using simple cluster random sampling. Information were gathered using face-to-face interview via structured questionnaire designed for collecting information on output, inputs, prices of variables, and some important socio economic variables about the farmers. These included characteristics of farmers such as age, education level, experience, and other relevant information. Prior to

data collection, a pilot study was conducted to test the understanding of cocoa farmers on questions pertaining to the use of input and output produced. From the 323 samples collected, 65% were obtained from Peninsular Malaysia and the remaining 35% were sourced from Sabah.

3.2 Empirical Model: Tobit Estimator

In technical efficiency literatures, the Tobit estimator is usually applied in a two-stage analysis procedure; the first stage normally involves estimating a parametric or non-parametric measure such SFA or DEA. The results from the first stage analysis (in this case the efficiency score index) enters the second stage analysis to determine sources of technical efficiency among cocoa-producing farmers. This study will not discuss result from the first stage analysis to conserve space¹. The maximum likelihood Tobit regression specified for Malaysian cocoa farmers is as follows:

$$PTE_{it} = \beta_0 + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \beta_4 x_{4it} + \beta_5 x_{5it} + \beta_6 x_{6it} + \beta_7 x_{7it} + \beta_8 x_{8it} + \beta_9 x_{9it} + \beta_{10} x_{10it} + \beta_{11} x_{11it} + \beta_{12} x_{12it} + \beta_{13} x_{13it} + \beta_{14} x_{14it} + \beta_{15} x_{15it} + \beta_{16} x_{16it} + \beta_{17} x_{17it} + \beta_{18} x_{18it} + \beta_{19} x_{19it} + \beta_{20} x_{20it} + \mu_{it} \quad (1)$$

where:

- PTE : Technical Efficiency
 - X₁: Sex
 - X₂: Age
 - X₃: Household
 - X₄: Marital status
 - X₅: Number of trees
 - X₆: Farm size
 - X₇: Ratio of labor usage to land size (Ratio)
 - X₈: Farm age
 - X₉: Tree age
 - X₁₀: Farm distance
 - X₁₁: Number of clones
 - X₁₂: Records
 - X₁₃: Farmer's status
 - X₁₄: Level of education
 - X₁₅: Supervision
 - X₁₆: Knowledge
 - X₁₇: Farming course
 - X₁₈: Equipment
 - X₁₉: State location
 - X₂₀: Variety of plants
- Farmers' demographic characteristics
 - Farm characteristics
 - Human resource
 - Technology
 - Location
 - Variety of plants

In Table 1 shows that the variables **ratio, numbers of clone, record, farmer's status, knowledge, farming course and plant location** are statistically significant.

Table 1. Results of Tobit regression analysis

Variable		coefficients
Farmers demographic characteristics	Sex	0.0060 (0.0474)
	Age	0.0004 (0.0016)
	House hold	0.0021 (0.0092)
	Marriage status	-0.0462 (0.0588)
Farm characteristics	Number of trees	0.00006 (0.00002)
	Farm size	-0.0250 (0.02019)
	Ratio	0.02349 (0.0091)*
	Farm age	-0.0015 (0.0014)
	Tree age	0.00064 (0.0021)
	Farm distance	-0.00009 (0.0043)
	Number of clones	-0.0154 (0.0079)*
	Record	0.07467 (0.0394)**
	Farmers' status	0.0814 (0.0336)***
Human resource	Level of Education	-0.0008 (0.0104)
	Supervision	0.0048 (0.0035)
	Knowledge	0.0095 (0.0046)**
Technology	Farming course	0.0910 (0.0389)**
	Equipment	-0.0297 (0.0708)
Location	Plant location	0.09336 (0.0425)**
Variety	Variety of plants	0.0077 (0.0356)
Constant		0.2916 (0.1734)*
Respondents		323
Prob>Chi2		0.0001
Pseudo-R ²		0.2471

Note: *, **, *** denotes significance level at 10 %, 5% and 1% respectively. Standard errors are in parentheses

4. Results

This section presents a discussion of the demographic and socio economic factors that influence the efficiency of cocoa farmers in Malaysia. Results from Tobit regression

Ratio variable refers to the number of cocoa farmers working on a particular farm relative to land size. The labors may be among family and non-family members or simply individuals working for pay or for free. Interestingly, the results showed a positive relationship between ratio and efficiency. In other words, the score of efficiency should be in line with increased in labor use

¹ This study uses DEA method to estimate the technical efficiency index of Malaysian cocoa farmers. Results are available upon request from the authors.

that corresponds to land size. This is because there will be sufficient labor force to take care of the farm, hence an increase in production.

In addition, proper record keeping in cocoa farming results in increased efficiency of smallholder cocoa farmers. Results of Tobit regression indicated that record keeping has a statistically significant relationship with the efficiency of cocoa farmers at one per cent significance level. This implies that cocoa smallholders who have a good track of record keeping tend to be more efficient than the farmers without. Based on the information gathered, farmers who keep track on farming activities record at least five important elements. These include records of farm history, farm maintenance, cocoa pods yields, receipts of government assistance and subsidies and other related information.

The above finding was in line with the findings by [18]. In his study of a small group of cocoa farmers, he found that less than 10 per cent of respondents of smallholder cocoa farmers in the west of the peninsula, had a record of research and analysis, this implies that these factors influence the efficiency of the production of cocoa farming. From the results of the interviews conducted, it was found that 243 persons or 64.8 per cent of smallholder cocoa farmers never had any records of at least one important matter related to cocoa that they have produced, while less than 10 respondents had a record of 10 issues related to cocoa production.

Moreover, full-time smallholder cocoa farmers tended to be more efficient (with a score value of efficiency of almost 1) compared to part-time cocoa farmers. This is evident from the statistically significant relationship between farmers' status and efficiency score at 1% significance level. Full-time farmers tended to be more efficient compared to part-time farmers due to differences in their work style, which can be seen from the angle of the total time allocated to work on the cocoa farms and the impact of high dependence on income from cocoa. The rationale for this is that full-time farmers will allocate more time to work at their farm thus taking better care of their farm as compared to part-time farmers who work less time. This finding is consistent with the results of efficiency of analysis that have been carried out by the [9] and [5].

As for the determinant of human resources component, the analysis showed that knowledge variable influences the efficiency of production for cocoa smallholder farmers. Amusingly, a randomized study showed that farmers could not answer technical or theoretical questions related to spacing of crops, the size of land, the radius of plant holes and pruning. In spite of that, the average farmer practically inclined to answering practical questions correctly like the use of pesticide, weeding activity, taking care of cocoa plants, the proper way of picking the ready fruit, its fermentation and drying

process. It is interesting to note that the Tobit regression showed a positive statistical significant relation of the level of efficiency with knowledge. This means that the more practical and theoretical knowledge farmers acquire about cocoa farming the more efficient they became. These findings are in agreement with those reported by [13], [19] and [1].

The analysis showed that the variable of the farming course has a positive and significant correlation with the level of production efficiency at the five percent significance level. Normally, smallholder cocoa farmers have to follow short courses offered by the MCB twice during their cocoa growing. The first course is related to the basic knowledge about cocoa cultivation technology. While the second course is a continuation of the first course and exposes cocoa farmers to harvesting techniques and the processes prior to drying the cocoa beans. Each farmer must attend both courses which are practically carried out at selected farms.

It should be brought to our attention that the location of cocoa farmers in this study consisted of respondents from states in Peninsular Malaysia and Sabah. The results showed the existence of a statistically significant relationship between location and efficiency at 5 percent level of significance. This indicated the existence of differences in efficiency between cocoa farmers in Peninsula Malaysia and cocoa farmers in Sabah.

5. Conclusion

The efficiency of smallholder cocoa farmers in Malaysia can be improved by understanding the sources of efficiency for these farmers. This study investigated this issue that was last studied by Othman [17] in 1990. The results from Tobit regression showed that factors such as **ratio, number of clone, record, farmer's status, knowledge, farming course** and **plant location** are significant determinants of efficiency among smallholder cocoa farmers in Malaysia. Based on the findings, formulation of policies and programs from governing agencies such as MCB should focus on these elements, in order to ensure that cocoa farmers benefit and ultimately increase their efficiency and output level.

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