# EVALUATING EFFICIENCY OF PLANTATION COMPANIES BY USING DATA ENVELOPMENT ANALYSIS APPROACH: A CASE STUDY IN MALAYSIA

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## ABSTRACT

This paper presents a comparative study on the efficiency of companies from plantation industries. Using Data Envelopment Analysis (DEA) under input oriented approach, technical and scale efficiency measure are obtained for a combined set of 30 companies in oil palm industries. The evaluation of efficiency is based on shareholder equity, long term asset and current asset. The results show that the mean of CRS and VRS technical efficiency was 0.48 and 0.68 respectively. There were 6 and 11 companies were proved to efficient under CRS and VRS respectively. This means that there were companies that were using their inputs optimally. The rest of the companies have difficulty in making themselves efficient. It is proposed that the plantation companies in Malaysia can reduce their inputs without any reduction of output.

**Keywords**: Data Envelopment Analysis, efficiency, plantation companies

## 1. Introduction

The palm oil industry has experienced rapid growth during the last three decades to become an important source of oil and fats in the world today. The rapid emergence of palm oil in the world's oil and fats scenario is attributable to Malaysia's success in the cultivation of oil palm on a massive scale. The aggressive pursuit of oil palm cultivation which began in the mid-sixties in Malaysia was basically to reduce the heavy economic dependence on rubber and tin and at the same time to enhance the country's economic resilience in the face of wide price fluctuation in the world's commodity markets. The Malaysian plantation industry is also an integral part of the agricultural sector because rubber and oil palm are included in the twelve key economic areas that the Malaysian government is promoting. Moreover, due to the fact that the demand for biofuels in the EU is rising and 50 per cent of all products in European supermarkets contain palm oil, Malaysia palm oil plantation industry has now become known as the fastest growing large-scale agricultural product in the world and also rank second in the world in terms of palm oil production accounting for about 41 per cent of global production (MARC, 2012).

Besides that, this sector is one of the large contributors to the national income and at the same times maintains a quite large sector of employment. This sector also acts as a complementary to other sectors of the economy such as the industrial sector and the service sector. Besides that, the ranges of oil palm companies sizes are vary from a few hundred hectares to more than 100,000 hectares (MPOB, 2016). According to Fang (2015) most of the private plantation companies are listed on the Main Board of the Bank Negara such as Sime Darby Bhd, IOI Corporation, Kuala Lumpur Kepong and Genting Plantation.

Kuala Lumpur Kepong Berhad and Highlands & Lowlands Berhad stands out as a prime examples of large company that are also listed on the London Stock Exchange while United Plantations Berhad is listed on the Copenhagen Stock Exchange (Ramasamy et al, 2005). Furthermore, companies such as Kumpulan Guthrie Berhad, Golden Hope Plantations Berhad, Kuala Lumpur Kepong Berhad, and IOI Corporation Berhad are listed as a largest plantation company based on their planted area (Etawau, 2016).

Despite the crucial role of Malaysian palm oil industry in enhancing country' development associated with economic development, this sector is at crossroad. However, preference for palm oil due to is highest yield per hectare and the lowest cost of production has led to the replacement of rubber and other crops of its planted area (Basiron and Chan, 2004). R&D efforts undertaken by both public and private sector have contributed significantly to the impressive development of the Malaysia palm oil industry. Of the total planted area in 2016, private estates accounted for 3.5 million hectares, representing 61.2 per cent of the total oil palm area and were by far the largest grower of oil palm (MPOB, 2016). However the intense competition among oil palm companies in private sector put pressure on one another and limits each other's profit potential. There is prevalence of labor shortage, lower contribution to labor shortage, export earning, price fluctuation and global dependency issues among the private listed companies.

Since 1980's, the export performance for palm oil in certain markets has adversely been affected by the sales of other vegetable oils which are below the market price. Moreover, during 2000's in respect to palm oil export, Malaysia was also facing a stiff competition from Indonesia due to the drop in rupiah (News Straits Times, 2016). In 2014, the export earnings slightly decreased due to pressure from prices of competing soybean oil and rapeseed oil, lower global demand as well as decline in price of palm oil (MOF, 2014). In addition, Malaysia is increasingly relying on immigrant labour on plantation, particularly from Indonesia and Bangladesh (Ismail and Yuliyusman, 2014). It is estimated that some 1 million immigrants are presently working in Malaysia mostly in the plantation and construction industry most largely they are low or unskilled workers (Ministry of Home Affairs Malaysia, 2011). Moreover, the decreasing of labour in the private sector companies resulting from the implementation of New Economic Model in Malaysia during 2010 and other labour migration policy such as foreign worker quota and work permit restriction (Harkins, 2016). The underlying issues is that how does efficiency of companies affect the oil palm industry? It is important to measure how effectively a plantation company can earn a higher return on its investment asset. Moreover, total asset of a company have to be always greater compared to total liability to ensure the stability of their ongoing operations (Jamian, 2017).

In the process of achieving progress in the country, a variety of effective strategies taken by plantation companies to further enhance the productivity and efficiency. The Plantation Industries and Commodities Minister Datuk Amar Douglas Uggah Embas also said that the government recognize the importance of the palm oil sector and has taken measures to enhance its performance from the upstream to the downstream sub-sections towards generating economic growth and higher income for the country. In order to achieve higher income and economic growth of a country, various actions have to be taken to improve the performance of oil palm sector from the upstream to downstream sub-sections (Zakariah, 2016).The objective of this study is to evaluate the operating efficiency based on the efficiency strength and scale returns In this paper, we want to extend on previous studies of efficiency of plantation companies, in particular palm oil by incorporating a customized input oriented DEA model to measure the efficiency and productivity level of the private listed companies in Malaysia.

## 2. Literature Review

The Malaysia palm oil industry has made positive contribution to the country's resource based industrialization through setting up of palm oil industries. It is foremost in terms of palm oil, accounting 39 per cent of world's production of palm oil and 44 per cent of world export (MPOC, 2015).This study is directed towards the analysis of private listed palm oil companies.

Wee and Talib (2009) investigated the efficiency and productivity of 40 plantation companies listed in Kuala Lumpur Stock Exchange. They found that that only 21 plantation companies achieve Total Factor Productivity Changes (TFPC) while19 companies have no changes in the TFPC. In comparison to technological changes, the companies' performance was more dependent on changes of technical efficiency. The value of equity, assets and cost of labor are significant in influencing the companies' earnings.

Mohamad and Said (2010) analyzed the relative performance of 100 largest listed companies in Malaysia by using output-oriented DEA model under the assumptions of CRS and VRS. They found that only 6 per cent and 19 per cent are fairly efficient under CRS and VRS respectively. Meanwhile, based on revenue only 6 per cent of the top-ranked companies were considered efficient and the rest of the companies showed severe scale inefficiencies.

Abdullah et al. (2012) used input oriented DEA approach to examine the efficiency of 189 top perfoming companies that are listed on the Kuala Lumpur Composite Index from seven industries seven industries listed on the Kuala Lumpur Composite Index. The results shows that the companies achieved 75 per cent efficiency level approximately and half of the companies were operating below average efficiency level while the rest will confront challenges in making themselves productive in short term. Half of the considerable numbers of companies are believed to work without wastage as they can accomplish the highest amount of yield with least cost.

Mohamad et al. (2013) discuss the management performance efficiency of selected plantations in the palm oil industry. To measure the efficiency, the DEA method was used in this study by using window analysis DEA solver. There is a significant correlation among resource used and production. This method also captured that only plantation C and B achieved highest efficiency score while plantation A was less efficient.

Abdul Wahab and Abd Razak (2015) applied financial ratio based DEA approach to measure the efficiency of 31 plantations companies in Malaysia. Data on return on equity, total asset turnover, account receivable turnover, inventory turnover, current ratio and quick ratio were collected from Emerging Markets Information Services (EMIS) database. The result of the study reveals that only 5 companies in this industry are found to be efficient. High efficiency ratio is also determined by a company's financial ratio relative to other companies.

## 3. Methodology

The study used secondary data which was cross sectional data for the year 2014 of 30 plantation companies. The data for each variable such as shareholder equity, fixed assets and current assets and sales were gathered from Stock Performance Guide Malaysia 2014. The method used in this study is Data Envelopment Analysis (DEA). Through the method, firstly correlation analysis is employed. The correlation analysis was conducted by using the software Eviews for testing the relationship between input and output variables. Secondly, after all the input and output are found positive and correlated with one another, the data were then analyzed using DEAP computer program.

DEA is considered non parametric because it requires no assumption on the shape or parameters underlying function. Input oriented model is chosen using Variable Return to Scale (VRS) and Constant Return to Scale (CRS). Input oriented is chosen because many DMU's have particular orders to fill and input quantities appear to be the primary decision variables (Coelli, 1996). Input oriented approach emphasizes on how DMUs decrease the input resources by maintaining certain level of output. The efficiency score of efficient DMUs is equal to 1 while inefficient DMUs are relatively determined by comparing them with the efficient DMUs (Coelli et al, 2002).

Assume there are n DMUs, where each DMUi (i = 1 . . . n) produces q outputs yij (j = 1. . . q). Let αi be the decision variable or the DEA coefficient associated with DMUi. The DEA model is the following linear programming problem.

$$\text{Min } \lambda_0$$
$$\text{Subject to}$$
$$\sum_{i=1}^{n} \alpha_i = 1$$
$$\sum_{i=1}^{n} y_{ij}\ \alpha_i \geq i_0\ \lambda_0 \quad j = 1, \ldots$$
$$\lambda_0 \geq 0, \alpha_i \geq 0, \forall I$$

A convexity constraint (N1'λ) is added into CRS linear programming problem to develop VRS model.

$$\text{Min}_{\theta,\lambda},\ \theta$$
$$\text{Subject to}$$
$$-y_i + Y\lambda \geq 0$$
$$\theta_{xi} - X\lambda \geq 0$$
$$N1'\lambda = 1$$
$$\lambda = 0$$

In basic DEA models, θ DMU is obviously efficient if and only if θ=1. N1 is an N x 1 vector of ones. To find N technical efficiency score, this model has to be solved N times for each DMU.

## 4. Results

Table 1 shows the descriptive analysis of the financial variables used in the form of mean, maximum, minimum values, standard deviation and sum for all selected input and output variables for the year 2014.The values are in Malaysian Ringgit (RM). A study conducted by Charnes and Cooper (1985) found that all input and output need to be related to validate DEA model.

| | Shareholder equity | Long term asset | Current Asset |
|---|---|---|---|
| Original value | | | |
| Minimum | 296.01 | 303.14 | 21.27 |
| Maximum | 7751.71 | 12233.78 | 7208.7 |
| Mean | 1840.989 | 2517.896 | 1085.472 |
| Std. Dev. | 1997.194 | 3072.042 | 1996.826 |
| Projected value | | | |
| Minimum | 296.01 | 303.14 | 21.27 |
| Maximum | 7751.71 | 12233.78 | 7208.7 |
| Mean | 1285.744 | 1806.653 | 938.8555 |
| Std. Dev. | 2012.561 | 3077.044 | 2018.047 |

*Table 1*. Descriptive Statistics

The given table 2 shows the correlation analysis among three inputs (shareholder equity, long term asset and current asset) and outputs (sales). All variables are all positive and show a high correlation. Sales and current asset had the highest positive correlation coefficient of 0.9763. Sales and long term asset also had a high positive correlation of 0.9247. The correlation between sales and shareholder equity is positive that 0.8778 and significant. According to Ben (2005), correlation coefficients that are > 0.8 considered as very strong correlation. Therefore the inclusion of the inputs and outputs was justified.

| | Sales | Shareholder equity | Long term asset | Current asset |
|---|---|---|---|---|
| Sales | 1.0000 | 0.8778 | 0.9247 | 0.9763 |
| Shareholder equity | 0.8778 | 1.0000 | 0.9396 | 0.8784 |
| Long term asset | 0.9247 | 0.9396 | 1.0000 | 0.9092 |
| Current asset | 0.9763 | 0.8783 | 0.9092 | 1.0000 |

*Table 2*. Correlations

Table 3 illustrates the technical efficiency (TE) score for 30 plantation companies in Malaysia under input oriented approach. 48% operating at fully technical efficient in the case of variable return to scale (VRS) and 68% scale efficient (CRS).

From the analysis of return to scale, only 6 (20%) out of 30 plantation companies which are BLD Plantation Bhd (DMU2), Harn Len Corporations Bhd (DMU6), Kwantas Corporation Bhd (DMU13) , NPC Resources Bhd (DMU15) , Felda Global Ventures Holding Sdn Bhd (DMU20), and Sarawak Oil Plams Bhd (DMU23) are efficient. This implies that these companies are using their input efficiently.

Meanwhile, the result also shows that there are 20 or 66.7% companies which are Batu Kawan Bhd (DMU1), Chin Teck Plantation Bhd (DMU3), Far East Holding Bhd (DMU4), Genting Plantations Bhd (DMU5), Harn Len Corporations Bhd (DMU6), Kim Leong Resources Bhd (DMU8), Kluang Rubber Co (Malaya) Bhd (DMU9), Kretam Holdings Bhd (DMU10) , Negeri Sembilan Oil Palm (DMU14), Rimbunan Sawit Bhd (DMU16), Riverview Rubber Estates Bhd (DMU17), Cepat Wawasan Bhd (DMU18), Dutaland Bhd (DMU19), Hap Seng Holding Bhd (DMU21), IJM Plantation (DMU22), Sarawak Plantation Bhd (DMU24),Sungei Raban Rubber Company (Malaya) Bhd (DMU25), TDM Bhd (DMU26), TH Plantations Bhd (DMU27), United Malacca Bhd (DMU29) and United Plantations Bhd (DMU30) are fall under increasing return scale (IRTS). The proportion of input is greater than the output which implies that they were operating on a scale that was too small in efficiency terms.

The remaining 4 or 13.30% companies which are IOI Corporation Bhd (DMU7), Kuala Lumpur Kepong Bhd (DMU11), TSH Resources Bhd (DMU28) and Kulim (M) Berhad (DMU12) have been operating below average efficiency score. These companies need to further improve in managing their inputs for operations.

| DMU | CRS efficiency | VRS efficiency | Return |
|---|---|---|---|
| 1 | 0.965 | 0.97 | irs |
| 2 | 1 | 1 | - |
| 3 | 0.173 | 0.8 | irs |
| 4 | 0.345 | 0.422 | irs |
| 5 | 0.309 | 0.31 | irs |
| 6 | 1 | 1 | - |
| 7 | 0.924 | 1 | drs |
| 8 | 0.94 | 1 | irs |
| 9 | 0.034 | 0.665 | irs |
| 10 | 0.44 | 0.477 | irs |
| 11 | 0.826 | 1 | drs |
| 12 | 0.227 | 0.263 | drs |
| 13 | 1 | 1 | - |
| 14 | 0.188 | 0.89 | irs |
| 15 | 1 | 1 | - |
| 16 | 0.294 | 0.381 | irs |
| 17 | 0.088 | 1 | irs |
| 18 | 0.481 | 0.716 | irs |
| 19 | 0.084 | 0.411 | irs |
| 20 | 1 | 1 | - |
| 21 | 0.293 | 0.305 | irs |
| 22 | 0.315 | 0.334 | irs |
| 23 | 1 | 1 | - |
| 24 | 0.572 | 0.701 | irs |
| 25 | 0.033 | 1 | irs |
| 26 | 0.237 | 0.258 | irs |
| 27 | 0.228 | 0.26 | irs |
| 28 | 0.529 | 0.556 | drs |
| 29 | 0.179 | 0.248 | irs |
| 30 | 0.429 | 0.443 | irs |
| Mean efficiency | 0.489 | 0.68 | |
| Minimum | 0.033 | 0.248 | |
| Maximum | 1 | 1 | |

*Table 3*. Efficiency of Plantation Companies

Table 4 shows the comparison between original and projected values between companies in the plantation sector. The average original value input of shareholder equity (RM 1840.99), long term asset (RM 2517.89), current asset (RM 1085.47) are higher compare to average projected input of shareholder equity (RM 1285.74), long term asset (1806.65) and current asset (RM938.85).

By overall, companies in plantation sector need to reduce their input of shareholder equity, long term asset and current asset by RM 555.25, RM 711.24 and RM 146.62 respectively to be efficient.

| | Shareholder equity | Long term asset | Current Asset |
|---|---|---|---|
| Original value | | | |
| Minimum | 296.01 | 303.14 | 21.27 |
| Maximum | 7751.71 | 12233.78 | 7208.7 |
| Mean | 1840.99 | 2517.89 | 1085.47 |
| Std. Dev. | 1997.19 | 3072.04 | 1996.82 |
| Projected value | | | |
| Minimum | 296.01 | 303.14 | 21.27 |
| Maximum | 7751.71 | 12233.78 | 7208.7 |
| Mean | 1285.74 | 1806.65 | 938.85 |
| Std. Dev. | 2012.56 | 3077.04 | 2018.05 |

*Table 4*. Original and Projected Value of Plantation Companies

## 5. Conclusion

This study has utilized input oriented DEA methodology to evaluate the efficiency of 30 plantation companies. The input variables for this study were shareholder equity, long term asset and current asset. The outcome of this study signify, about 80 per cent and 64 per cent of plantation companies operating at low efficiency of CRS and VRS respectively. With regards to the return to scale, only 6 companies are technically fully efficient in using their resources. Thus technical efficiency was lower than the degree of scale efficiency. According to Ismail (2004) the main source of the plantation company's inefficiency was caused by inappropriate scale operation. This implies that the plantation companies have difficulty in finding an optimal combination between various inputs to produce the desired output**.** The findings should help the management of the plantation companies to reviews their resources to increase performance and efficiency. More companies should be included in the study and other input and output could be used in the future work.

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