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LABOUR EFFICIENCY IN THE MALAYSIAN OIL PALM PLANTATIONS: A DATA ENVELOPMENT ANALYSIS (DEA) APPROACH

Marlia Musa[1*], Amin Mahir Abdullah[1,2], Mohd Mansor Ismail[1,3], Mohd Yusof Saari[3], Ilmas Abdurofi[3,4]

[1]*Department of Agribusiness and Bioresource Economics, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia*
[2]*Institute of Plantation Studies, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia*
[3]*Institute of Agricultural and Food Policy Studies, Universiti Putra Malaysia, Putra-Infoport, Jalan Kajang – Puchong, 43400 UPM Serdang, Selangor, Malaysia*
[4]*Department of Agricultural Socio-Economics, Faculty of Agriculture, Universitas Gadjah Mada, Yogyakarta, Indonesia*
Corresponding Author: marliamusa267@gmail.com

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ABSTRACT

Low levels of efficiency and productivity of the Malaysian oil palm plantations are associated with a persistent labour shortage. Hiring foreign labour is often seen as a feasible solution to support their intensifying oil palm production. However, their skills and experiences in the sector are crucial in sustaining the plantation efficiency and productivity. The study aims to analyse the level of labour efficiency and identify factors influencing labour efficiency in the Malaysian oil palm plantations. The cluster sampling was used to employ about 40 plantations from five plantation companies. Data were collected from the estate managers and analyzed using Data Envelopment Analysis (DEA). The findings revealed that the means of total technical efficiency (TECRS) and pure technical efficiency (TEVRS) were 0.7608 and 0.8573, respectively. A slack variable analysis reveals that the plantations had excessive labours from India (69%), Nepal (22.24%) and Bangladesh (14.39%). The study concluded that labour efficiency could be improved through hiring skilled labour and enhance on-field job training. Recruitment of labour by sourcing country could also help in selecting the best labour to recruit.

Keyword: Data Envelopment Analysis; efficiency; labour; oil palm plantation; slack-variable analysis

INTRODUCTION

Oil palm industry has been significantly contributing to the Malaysian socio-economic development and trade for more than fifty years. The commodity continues to contribute significantly to the national economy through its contribution to the gross domestic product (GDP). In 2016, the agricultural sector contributed 8.1 per cent to Malaysia's GDP growth (Department of Statistics, Malaysia, 2017). Of this figure, oil palm became a major contributor of this sector, which accounted for 43.1 per cent or 3.48 percent share of the total GDP. At the end of 2016, total fresh fruit bunches (FFB) yielded 15.91 tonnes per hectares producing 17.32 million tonnes of crude palm oil (CPO) (Malaysian Palm Oil Board, later use MPOB, 2017). By trade, the oil palm had generated RM64.2 million in annual export revenue for the last five years. The total planted areas also increase along with the increasing global demand for the palm oil-based products. In 2016, the total planted areas recorded 5.74Mha, a 1.66 percent increase from 5.64Mha in the previous year (MPOB, 2017). The 5.68 percent annual growth in the total planted areas is a manifestation of 38 years of planting (Abdullah, 2014). The persistent growth has gained an increasing concern of labour requirement from the industrial players to cater the labour-intensive palm oil production.

Currently, there is approximately 78 percent of the total workforce in the plantations represented by the foreign labours. Most of them are initially unskilled (Ismail *et al*., 2015). This figure suggests that the Malaysian plantation sector has a high dependency on the foreign labour especially in the field production. Based on the statistics reported by the Ministry of Home Affairs (MoHA) (2016), there are 300, 770 foreign labours employed in this sector, of which 78% were Indonesians while the rest include Bangladeshi, Indian, Nepalese, Vietnamese and others. The share of foreign labour is higher among the large plantations companies as opposed to the small and medium plantation companies. The former accounted for 98.6% of the total hired labour as compared to 68% in the latter (Del Carpio *et al*., 2015).

There are two categories of foreign labour employed in Malaysia namely skilled and semi/ unskilled labour (Mohd Palel *et al*., 2016). Majority of the foreign labours working in the plantations are unskilled and, thus, hired as general workers. According to Thayaparakanthan (2017), the categories of labour in oil palm plantation falls into three groups based on acquired skills; the harvester (cutter), the pruner and the new arrival. The harvester is an experienced and skilled labourer who is assigned to cut the fruit, while pruner does pruning and stacking the frond. For the new arrival, they have no experience and skills on to the jobs in the plantation. Initially, they were trained as pruners by experienced and the best harvesters within three months. The unqualified pruners will be reassigned job to other categories such as field worker, frond stacker and loose fruit collector (Thayaparakanthan, 2017). However, as soon as they have acquired the skills and gathered the experience, their working permits will have expired, and they are required to return to their home countries. Thus, the plantation has started to recruit new labour again, and this situation keep on repeating for each time recruitment process. This vicious cycle of hiring unskilled labours and providing on-the-job training greatly affects the productivity and efficiency of the plantation companies significantly. This situation will adversely affect the plantation's revenues and profits both at micro (company) and macro (national) levels.

Based on the statistics of foreign workers in the plantation sector from 2000 – 2016 (MoHA, 2016), the number of foreign labours is on the rise and suggested a heavy dependence on the foreign labour in the plantations. The push and pull factors mostly drives the foreign labours who work in Malaysia occurring in the origin and destination countries. There are five factors identified in the push and pull factors that influencing people to migrate namely; economic, political, demographic, environment and social factors (Bustami *et al.*, 2016). For example, employment opportunities, high unemployment rate, political refugee, population density, nature disaster (earthquakes, war), family and cultural expectation. However, in the past literatures, economic and demographic factors were highlighted as the main driven factors for international migration (International Organization for Migration, 2010; Djafar and Hasan, 2012; Jajri and Ismail, 2014). Some work on a voluntary basis while some are involuntary. Voluntary means they are interested and want to work in the plantation sector, and vice versa. The latter suggests that their work performance and quality of work will be adversely affected. For some foreign labours i.e. Indonesians, they are quite familiar with the employment in the local plantation sector and they do not seem to cause any problem in the plantations. In contrast, foreign labours from other countries (e.g. Pakistan and Bangladesh) donot have required skills and experiences about plantation work. Consequently, they have to deal with difficulties in doing their jobs. This situation will indirectly affect their efficiency and productivity.

The plantation companies have to delegate the plantation work reasonably to address the problem. The Indonesian workers are assigned to do fruit harvesting and fruit collection activities while the rest, including the local workers, will be assigned to farm maintenance tasks such are fertilizer application, pesticide spraying, land clearing and work at the nursery. Nevertheless, the plantations always find an alternative to cope with the unskilled labour and at the same time, trying hard to increase labour efficiency and productivity. Shuib *et al.*, (2004) stated that the labours' productivity and efficiency could be enhanced when the use of mechanization in the field work is applied. Such technologies and machines introduced are mechanical spraying technology, FFB detaching machines (Ishak *et al.,* 2011a, 2011b) and technology in detecting the maturity of FFB (Ishak and Hudzari, 2010). Nonuse of these technologies and machines in plantations due to high maintenance cost, issues associated with health and security, labourers are reluctant to use the machines and productivity deterioration as its slow their movement (Mohd Nawi *et al*., 2015). The endless issues that revolve around labour shortage, dependence on foreign labour and low labour efficiency and labour productivity in the oil palm plantations necessitate aproper and adequate solution. The plantation managers must be sensitive to the emerging labour issues in the plantation and must be effective in solving them to prevent any potential disturbance to the production. In Malaysia, there are few studies carried out to estimate the labour efficiency in the plantation sector. Most of the studies instead focusedon the firm and other farm inputs efficiencies. Moreover, there are limited studies on labourefficiency in oil palm plantations. Accordingly, this study aims to measure the labour efficiency in the oilpalm plantation and to identify the potential sources of inefficiency.

LITERATURE REVIEW

Studies on input or production factor efficiency come in many approaches. However, the similar objective remains, that is, to determine the relationship between the output(s) and inputs used in the production of a given good. The resultant of the relationship provides researchers with some useful information on the variable efficiency levels of production units, which would be helpful in recommending feasible solutions to improve firm performance. Murthy *et al.*, (2009) estimated the technical efficiency and its determinants in tomato production in India using Data Envelopment Analysis (DEA). They found that all farms were facing inefficiency technically in the used inputs due to improper input application as compared to the recommended quantity. While in Philippines, Fernandez and Nuthall (2009) examine the inputused efficiency in sugarcane production. The result shows that labour shortage is the primary constraint faced by the farmers that led to inefficient. A study conducted by Oren and Alemdar (2006) in Turkey, they try to identify the efficiency of wheat growing farms by using a DEA approach. They recommended improvement of the current efficiency level through improved farmers specific factor and increase access to extension service.

Gul *et al.*, (2016) studied technical efficiency of goat farming in Turkey and found that the technical efficiency is range between 0.13 and 1.00. The result of slack variable analysis reveals that excessive used of labour and feed concentration are the significant sources of inefficiency. On the other hand, Oladimeji and Abdulsalam (2013) proved that farming experience and labour significantly affect the rice farm efficiency in Nigeria. As rice farming is labour intensive, increasing the number of labour in the rice farm would increase the output. Kaneva (2016) investigated the technical, allocative and economic efficiency of Bulgarian farms and the analysis reveals that an extensive labour use had led farm to be inefficient. While in Nigerian, Idumah *et al.*, (2016) in their study found that majority of food crop farmers were not efficient and hired labour is the main contributor to inefficiency with mean slack 19.2 percent.

In general, most studies have used a variety of farm inputs such as land, labour, fertilizer and farm size in measuring the technical efficiency. However, this study aims to measure the labour efficiency of labour from difference country of origin. Thus, we use one input category, which is labour. Labour are then aggregated into six measures namely local labour, Bangladeshi, Indonesian, Indian, Nepalese and Others. The similar approached also has been applied by Shimsak, Lenard and Klimberg (2009) in studying the incorporating quality into DEA of nursing home performance. They use labour as the primary input categories and aggregated into six measures; (1) registered nurses; (2) licensed practical nurses; (3) nursing aides; (4) ancillary non-nursing professional staff; (5) ancillary non-nursing non-professional staff; and (6) administrative staff. The earlier studied applied one category of input by Nyman and Bricker (1989). They determine the characteristics of the efficiently operated nursing home using DEA. There are four types of labour hours used as their input which are nursing hours, social service workers hours, therapist hours and other worker hours, and five outputs.

METHODOLOGY

Analytical Framework

This study was carried out based on the production theory that relates plantation output(s) to plantation input(s), which also served as the foundation for computing efficiency. In practice, several analytical methods have been developed to measure efficiency (i.e. parametric and non-parametric approaches). The parametric approach uses the concept of the frontier production and is based on a respectively modified regression analysis, as studied by Aigner and Chu (1968). Another approach was initiated by Farrel (1957) and related with the development of all data points with a non-parametric frontier function.

Technical efficiency refers to the firm's ability to produce the maximum possible output from a given combination of inputs and technology. It relates to the degree to which the firm produces the maximum feasible output from a given amount of inputs or uses the minimum feasible amount ofinputs to produce a given level of output. These two definitions of technical efficiency are known as output-oriented and input-oriented measurement. Farrel (1957) defined efficiency of the firm as the actual productivity of firm relative to maximal potential productivity. This efficiency measures the success of the firm in producing as much as possible output from a given set of inputs. A firm is said to be technically efficient if it produces the maximum output from the minimum quantity of inputs, such as land, labour, capital and technology.

As clarified by Ajibefun and Daramola (1999), the fundamental idea underlying all efficiency measures is that the output of goods produced per unit of inputs must be attainable without waste. The production frontier defines the efficiency of a farm. The farm is efficient if the farm operates on the production frontier, those who operate under the production frontier, it is known as inefficient farm. Collie et al., (2002) suggested that selecting between an input-oriented or output-oriented DEA model is based on which quantities the manager of the farm has more control over. As the plantation managers have more control over inputs than output(s), thus input-oriented DEA model was used in the present study.

Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a linear mathematical programming that provides a way to construct the production frontiers to calculate the efficiency scores relative to the constructed frontier. It does not require specification of functional or distributional form and can accommodate scale issues (Murthy et al., 2009). Besides that, DEA does not require the distributional assumption of the inefficiency term (Collie, 1995).

In the present study, DEA was applied under the constant return to scale (CRS) and variable return to scale (VRS) assumptions concerning input-

Minθ, λθ,

Subject to

$$-y_i + Y\lambda \geq 0$$
$$\theta x_i - X\lambda \geq 0$$
$$\lambda \geq 0, \quad \ldots (2)$$

where,

y_i is a vector (*m x 1*) of fresh fruit bunch (FFB)(yield) of *i*th plantation, x_i is a vector (*k x 1*) of inputs of the *i*th plantation, Y is a FFB matrix (*n x m*) for n plantations, X is a plantation's input matrix (*n x k*) for n plantation, θ is *i*th plantation's technical efficiency score. If θ = 1, the plantation will be efficient; otherwise, it will be inefficient, and λ is a vector of constant *n x 1*, whose values are calculated to obtained the optimum solution.

The assumption of CRS-DEA is correct when the plantation work at the optimum scale (Coelli et al., 1998). Otherwise, the estimation of technical efficiency can be mistaken for scale efficiency. Therefore, the VRS-DEA model (as proposed by Banker et al., 1984) reformulation and modification sprung from CRS-DEA through the addition of a convexity constraint. The measure of technical efficiency obtained in the model with variable returns is also known as 'pure technical efficiency' because it allows the calculation of technical efficiency free from the effect of scale efficiencies. Adding the constraint $N1\lambda$ to CRS-DEA model as follows (Coelli *et al*., 1998):

Minθ, λ θ,

Subject to

$$-y_i + Y\lambda \geq 0$$
$$\theta x_i - X\lambda \geq 0$$
$$N1\lambda = 0$$
$$\lambda \geq 0$$
$$\lambda \geq 0, \quad \ldots (1)$$

where,

θ represents the pure technical efficiency of *i*th plantation. The new constraint $N_{1\lambda}$ is equal to 1 ($N_{1\lambda}$ = 1) and N_1 is a vector of (*n x 1*) ones. This constraint makes comparison of plantations of similar size possible, by forming a convex hull of intersecting plane, thus data is enveloped more tightly.

The scale efficiency of plantation calculation involves a ratio between the scores for technical efficiency with the constant and variable return to scale, Coelli et al., (1998) suggested this method and is given as follows:

Where,

$\theta_{CRS}\ (X_K, Y_K)$ = Technical efficiency for the model with constant returns,

$\theta_{VRS}\ (X_K, Y_K)$ = Technical efficiency for the modelwith variable returns,

θ_S = Scale efficiency

K = Number of Plantation Company

If the calculation value obtained from equation (3) is equal 1 (θs = 1), the plantation is operating with constant return to scale. however, if the value is less than 1(θs < 1), increasing or decreasing return can occur.

Definition of Inputs and Output Variables

In this study, the basis for estimation of labour efficiency was on one output and seven inputs variables, that labours by country of origin are as follows:

- Y = Fresh Fruit Bunches (FFB) yield (MT/ ha)
- X_1 = Local labour (Number of labour hired)
- X_2 = Bangladeshi (Number of labour hired)
- X_3 = Indonesian (Number of labour hired)
- X_4 = Indian (Number of labour hired)
- X_5 = Nepalese (Number of labour hired)
- X_6 = Others (Number of labour hired)

Other scholars (Shimsak, Lenard and Klimberg, 2009) applied the same approach while incorporating quality into DEA of nursing home performance, where one input category was used (labour) and then aggregated into six measures.

Data

This study was carried out at oil palm plantations in the Peninsular Malaysia across five states, namely Kedah, Perak, Negeri Sembilan, Johor and Terengganu. The study employed convenience random sampling from five oil palm plantation companies i.e. Boustead Plantation, Tradewind Plantation, Tabung Haji Plantation, and RISDA Plantation (ESPEK). Although there are other plantation companies currently in service, the selection of the companies was based upon their willingness to cooperate in the study. For the estimation of efficiency, the study selected a total of 40 plantations from five companies. The respondents (i.e. the plantation managers) provided the desired information through structured questionnaires. Also,a face-to-face interview with the estate managers was subsequently conducted to obtain additional information beyond scope of the questionnaire, covering a period from June 2015 to February 2016. Finally, the study analyzed the collected data.

Slack Variable Analysis

The study first conducts a disgnostic test which is slack variable analysis to get a clearer picture on which of the used inputs contribute to low efficiency. This analysis determines the excess of labour inputs used. It reveals the extent to which labour inputs used should be reduced given that a plantation has alreadyreached the frontier of the production. Plantation canreduce their expenditure on an input and reduce hiring of the labours by the number of slacks withoutreducing its output. Kocisova (2015) and Bhatt and Bhat (2014) followed the same approach in their studies. The presentation of the model is as follows:

Min

$$\theta_q - \varepsilon \left[\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+ \right]$$

Subject to

$$\sum_{j=0}^{n} x_{ij}\lambda_j + s_i^- = \theta_q x_{iq}$$

$$\sum_{j=0}^{n} y_{rj}\lambda_j + s_i^+ = y_{rq}$$

$$\sum_{j=0}^{n} \lambda_j = 1$$

$$\lambda_j; s_i^-; s_i^+ \geq 0$$

Where,

θq = the efficiency of plantation q, ε is the non-Archimedean

$s^+, s^- ri$ = the input or output slacks

λj = the weight assigned to DMU_j (j=1, 2, …, *n*)

The plantation is considered fully efficient (100%) if and only if both; 1. θ* = 1, and 2. All slack $s_r^+ = s_i^- = 0$. In the case of when the slack variables give *i* the zero slack but the plantation's efficiency (θ_q) is less than 1, this is the sign of inefficiency. It can be corrected by reducing or eliminating all the inputs used of the plantation by (1 - θ_q), and then shift the efficiency towards the frontier. If the slack variables indicate non-zero value and θ_q less than 1, the nonradial shift expressed by slack variables is necessary to achieve efficiency.

RESULTS AND DISCUSSION

Oil Palm Plantations Company's Profile

Table 1 shows information pertaining oil palm plantations that participated in this study. The table presents the frequency distribution of plantations from the five oil palm plantation companies. Plantation Company A was represented by 10 plantations (25.0%). Plantation Company E, on the other hand, constituted 27.5 percent followed by Plantation Company B with nine plantations (22.5%). There were four (10.0%) and six (15.0%) plantations represented by Plantation Company C and Plantation Company, respectively.

Table 1. Oil Palm Plantation Company's Profile

Variables	Frequency (No. of plantations)	Percentage
Plantation company		
Plantation Company A	10	25.0
Plantation Company B	9	22.5
Plantation Company C	4	10.0
Plantation Company D	6	15.0
Plantation Company E	11	27.5
Plantation		
Plantation size		
Less than 1000 ha	4	10.0
1001 – 1500 ha	8	20.0
1501 – 2000 ha	13	32.5
2001 – 2500 ha	7	17.5
2501 ha and above	8	20.0

Hired labour (no. of labour)		
Local labour	1659	24.5
Foreign labour	5117	75.5
Hired foreign labour (no. of labour)		
Indonesia	4469	87.3
Bangladesh	439	8.6
Nepal	92	1.8
India	92	1.8
Others	25	0.5

Source: Field survey (2016)

Regarding plantation size, this study found that the plantation size was in the range between 916ha and 3919ha. As exhibited in the *Table 1*, the majority of the plantations had a plantation size ranging between 1501ha and 2000ha. Besides that, 10.0% of the plantations had a plantation size of less than 1000ha. Finally, eight plantations (20.0%) in the study had a plantation size ranging 1001 – 1500ha and size larger than 2501ha respectively.

Regarding use of labour, this study revealed that the plantations employed both local and foreign labours. Unsurprisingly, local labours only accounted for 24.5% of the total labours while foreign labours represented 75.5%. The distribution of local and foreign labours was almost equal with the statistics (78 %) reported by the Department of Statistics Malaysia (2017). The distribution was also in agreement with another study by Abdullah et al. (2011) who found that the number of foreign labours employed in the Malaysian oil palm plantations was twice of the local labours. *Table 1* also provides specific information on the distribution of foreign labour by country of origin. Based on *Table 1*, this study found that 87.3% of the foreign labours were Indonesian, 8.6 percent were Bangladeshi and the remaining 4.1 percent were Nepalese, Indians and other nationalities combined.

Labour Efficiency Analysis

Table 2 presents the results of the labour efficiency analysis. The mean technical efficiency (TE_{CRS}) and pure technical efficiency (TE_{VRS}) assumptions were 0.7608 and 0.8573, respectively.

Table 2. Labour Efficiency Estimates Disaggregated According to CRS, VRS and Scale Efficiency Assumption Based on Dea Estimator

TE Range	TE_{CRS}	TE_{VRS}	Scale Efficiency
0 – 0.099	-	-	-
0.1 – 0.199	-	-	-
0.2 – 0.299	1	-	-
0.3 – 0.399	-	-	-
0.4 – 0.499	2	1	-
0.5 – 0.599	5	3	-
0.6 – 0.699	8	6	1
0.7 – 0.799	6	3	2
0.8 – 0.899	6	5	4
0.9 – 0.999	4	6	10
1.000	8	16	23
Total	40(100)	40(100)	40(100)
Minimum	0.2495	0.4706	0.3701
Maximum	1.000	1.0000	1.0000
Mean	0.7608	0.8573	0.8872

On average, plantations were only utilizing 76% (CRS) and 86% (VRS) of labour input of best-practices to produce the same level of output. This finding implies that the plantations should improve about 24% and 14% of the efficiency in the labour input used at the same level of production.

Labour efficiency under CRS and VRS assumptions ranged between 0.2495 and 1.000, respectively. Under the CRS assumption, eight plantations were found to be sufficiently efficient in term of labour utilization while 16 plantations were found to be technically efficient under the VRS assumption. This finding suggests that the plantations that achieved full labour efficiency were higher in the VRS than that under the CRS. This higher technical efficiency score explains the flexibility of VRS model compared with CRS model. It also provides the backing as to the reason why the enveloping surface is way tighter under the CRS model (Gabdo *et al.*, 2014). At the same time, the effort to boost the labour efficiency also should concomitant with the application of technology and machineries in the field operation.

The scale efficiency estimates indicate that the efficiency was in the range from 0.3701 to 1.000 with the mean scale efficiency, SE = 0.8872. Of this, 23 plantations were found to be adequately efficient. The mean scale efficiency was also relatively high (SE = 0.8872) in comparison with the mean of pure technical efficiency (VRS), this result indicates that pure technical efficiency predominately influenced labour efficiency compared to scale efficiency. Also, this result telling us that although most of the plantation in the study area are experiencing labour shortage while the planted area is expanding, the scale of plantation operation does not affect the labour efficiency as their mean of scale efficiency is high. Hence, poor management practices and labour-used utilization had a stronger influence on the labour efficiency than plantation size. This result lends support to a similar finding by Rosli *et al.,* (2013).

Input Slacks and Number of Plantations Using Excess Labour Input

Slack variable analysis refers to either excess or deficit in input(s) used in their field operation (Bhatt and Bhat, 2014; Iliyasu, Mohamed and Terano, 2016). In this study, the slack variable refers to the surplus or shortage of the labours employed in the plantation, measured in percentage. This analysis provides an information and recommendation to help the inefficient plantations identify which input variable (i.e. labour) had contributed to a low level of labour efficiency. The study conducted a slack variable analysis on the data from the inefficient plantations only. The reason for analysis of the inefficient plantations is because the plantations that achieved full efficiency of labour suggested zero or no slack in the labour input used.

Table 3 shows the mean labour usage and labour excess in the plantations, reported in percentage. As illustrated in the *Table 3*, the plantations had excessive labours from India accounting for about 69%, Nepal (22.24%) and Bangladesh (14.39%). The results imply that the plantations should reduce the number of foreign labours from these countries of origin or their labour outsourcing in the next recruitment exercise.

Table 3. Slack Variable Analysis for Inefficient Plantations

Labours	Mean labour usage (no. of labour)	Mean labour slack (no. of labour)	Percentage (%)	No. of plantations using labour
Bangladesh	10.97	1.579	14.39	7
Indonesia	111.7	0.444	0.40	3
India	2.3	1.598	69.48	9
Nepal	2.275	0.506	22.24	4
Others	0.65	0.032	4.92	6
Local	41.48	6.423	15.48	12

The estimated slack for the local labour was 15.48%. This scenario indicates that most of thehired local labours in the plantations reflected low efficiency and skills. Practically speaking, they are likely unable to perform the tasks effectively which indirectly contribute to the low efficiency level. Local labour participation in the oil palm plantation is low. Previous studies also found a high number of the locals working in this sector because they are inherent to the work from their previous generation. As studied by Mohammad Amizi *et al.,* (2015) found that locals currently working in the plantations remain working in this sector because they have no suitable jobs that match with their qualification, have limited work choice, have no qualification and they have low education level. However, none of these reasons indicates their participation because they are interested. Thus, these factors have contributed to their low efficiency and skills. Meanwhile, foreign labours from Indonesia (0.40%) and other countries of origin (4.92%) combined recorded low slack estimates. This result reflects the reason why the Indonesian labours did not affect the total labour efficiency in the plantation industry. Moreover, 12 plantations indicated that they were facing local labour surplus. Another nine plantations were having foreign labour surplus from India while seven plantations reported the same labour surplus from Bangladesh. Finally, three and four plantations excessively employed Indonesian and Nepalese labours respectively.

CONCLUSIONS

The results concluded that almost half of the plantations in the observed study achieved full labour efficiency. While, based on the scenarios of minimum and mean labor efficiency, the hired labour in the plantation had a low level of productivity and efficiency. Indeed, the labour efficiency can be increased by employing more skilled labours and using technological tools in the field operation. Further analysis found slack or over-utilization of the labours on the ground. Following the result on slack, the inefficient plantations can reduce the number of labour from the countries of origin. The findings also reveal, labours from India and Nepal were the main slack in the workforce. The study, however, suggests that the hiring process of recruitment should be done based on labour experience, skills and the labour sourcing countries of origin in order to improve labor efficiency.

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