The Malaysian Palm Oil Supply Chain: The Role of the Independent Smallholders

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ABSTRACT

The Malaysian palm oil industry is made up of interrelated sectors that produce various palm products for their end-users. To ensure an efficient supply chain, all sectors should operate efficiently; this includes the independent smallholders. An efficient production system by the smallholders is deemed necessary in producing quality fresh fruit bunches (FFB) which can then produce quality palm oil for meeting the rising global demand. Inefficiencies can affect the whole supply chain. This article investigates the efficiency level of this sector and the structural changes that it has undergone. It was found that there is plenty of room for improvement among independent smallholders to increase their FFB yield and income so that their future can be sustained.

INTRODUCTION

Background

The Malaysian palm oil supply chain consists of many sectors. The oil palm smallholder sector, being part of the supply chain, is positioned at the upstream level, responsible for producing quality fresh fruit bunches (FFB) for the mills. There are two types of smallholders, namely the organized and the unorganized smallholders. The former consists of those participants under Federal Land Development Authority (FELDA), Federal Land Consolidation and Rehabilitation Authority (FELCRA), and Rubber Industry Smallholders Development Authority (RISDA) as well as various state schemes, while the latter consists of independent ones.

The independent smallholders owned 471 991 ha, representing 11% of the total oil palm planted area in 2007. Oil palm areas under independent smallholders had increased by 3.76% over 2006 compared to the national increase of 3.4% (*Table 1*). However, this is lower than the increase for estates (4.96%). Federal government schemes, as a whole, recorded a marginal increase of about 1.28% in contrast to the negative growth of 3.1% for state-owned schemes.

In 2007, there were about 120 341 registered independent oil palm smallholders in Malaysia (*Table 2*). Johor had the largest number of 47 783 smallholders with the largest area of 150 808 ha. Perak and Sabah had the second and third largest numbers of smallholders, respectively. However, the average holding in Perak was smaller than in Sabah. On a per person basis,

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TABLE 1. DISTRIBUTION OF OIL PALM PLANTED AREAS BY CATEGORY

Category	2006		2007		Growth in area (%)
	ha	%	ha	%	
Private estates	2 476 135	59.45	2 598 859	60.30	4.96
Government schemes:					
FELDA	669 715	16.08	676 977	15.70	1.08
FELCRA	159 780	3.83	163 891	3.80	2.57
RISDA	81 169	1.95	81 486	1.90	0.39
State schemes	323 520	7.77	313 545	7.30	-3.08
Independent smallholders	454 896	10.92	471 991	11.00	3.76
Total	4 165 215	100.00	4 306 749	100.00	3.40

Source: MPOB.

TABLE 2. INDEPENDENT SMALLHOLDERS OWNERSHIP BY STATE (2007)

State	Smallholders		Areas		Average holding size (ha)
	Number	%	ha	%	
Johor	47 783	39.71	150 808.70	31.95	3.16
Perak	23 512	19.54	72 243.62	15.31	3.07
Sabah	15 689	13.04	106 157.33	22.49	6.77
Selangor	13 593	11.30	32 619.06	6.91	2.40
Pahang	6 319	5.25	29 213.37	6.19	4.60
Sarawak	4 620	3.84	29 214.15	6.19	6.32
Kedah	2 797	2.32	15 663.56	3.32	5.60
Negeri Sembilan	2 326	1.93	15 229.89	3.23	6.55
Melaka	1 240	1.03	6 419.32	1.36	5.18
Pulau Pinang	1 218	1.01	7 053.52	1.49	5.79
Terengganu	884	0.73	5 434.88	1.15	6.15
Kelantan	353	0.29	1 873.13	0.40	5.31
Perlis	7	0.01	60.69	0.01	8.67
Total	120 341	100.00	471 991.00	100.00	3.92

Source: MPOB (2007).

a smallholder in Perak owned on average about 3.07 ha compared to 6.77 ha in Sabah in 2007. A smallholder in Sarawak, on average, also owned more than 6 ha, similar to Sabah. Perlis had the smallest number of independent smallholders of seven persons with a total area of 61 ha. At the national level, the average holding size of independent smallholders was 3.92 ha in 2007.

The independent oil palm smallholder sector is a small-scale production entity. Thus, it is generally perceived that this sector is inefficient and unproductive as compared to the large-scale production system of the estate sector. However, the existence of independent smallholders is important and has played a significant role in the development of the agricultural industry in the country. They need to be efficient producers of FFB. If they slacken in their operation and no correction effort is made, this will affect the overall supply chain because their cumulative size is comparatively large.

Issues related to independent smallholders discussed in this article are as follows:

- is this sector operating in an efficient manner?;
- what are the structural changes that this sector has undergone; and
- what are the inefficiency factors?

The issues of the oil palm smallholders have been studied by several researchers. Malek and Barlow (1988) investigated

the production structure of the Malaysian oil palm industry with special reference to smallholders in terms of their ownership, geographical location, holding size, age of stands, employment, yield, processing and economic performance. They found that the main problems faced by this sector were high production costs, scarcity of labour and land, poor extension and lack of access to finance for planting.

Meanwhile, Mohd Arif *et al.* (1998) investigated the feasibility of a planned approach towards future development of the oil palm smallholders in Malaysia. A minimum land size was proposed to provide a comfortable living for smallholders who rely on the farm as their only source of income. They found that most independent smallholders planted oil palm on their own initiative, and on small plots of land which were uneconomic.

A study by Azman *et al.* (2003) examined the economic performance of smallholders in Johor and their production cost structures compared to their counterparts, the organized smallholders as well as estates. They found that the production cost of FFB by independent smallholders in 2000 was lower than for the estates. This was due to the difference in the cost structures between the two production entities.

Concept of Supply Chain

Supply chain as defined by Kalakota and Whinston (1997) refers to a collection of interdependent steps that, when followed, accomplish a certain objective such as meeting customer requirements. Meanwhile, Aitken (1999) defined it as a network of connected and interdependent organizations mutually and co-operatively working together to control, manage and improve the flow of materials and information from suppliers to end-users. Tan and Shaw (1999), however, described the supply chain in a slightly different manner, *i.e.* "a supply chain is a network of business units and facilities that produce raw materials, transform them into intermediate goods and the final products, and deliver the products to customers through a distribution system".

Handfield and Nicols (1999) emphasized the importance of managing the whole supply chain, which encompasses all activities associated with the flow and transformation of goods from the raw material stage (extraction) to the end-user. Poirier and Reiter (1996) concentrated on the optimization of the supply chain. As such, the supply chain should be an error-free, totally efficient network, from original supply to final consumption.

METHODOLOGY

Survey

A study was done through a questionnaire-guided face-to-face interview followed by an econometric analysis of the data obtained from the survey. The survey was conducted in all states in Malaysia. Selected smallholders were gathered at the dealers' offices where the interviews were carried out.

In 2007, there were 1860 FFB dealers and more than 120 000 smallholders in the country. A sampling technique was utilized to determine the total sample sizes of dealers and smallholders based on the Yamane (1967) formula[1].

The sample size of dealers (n_d) visited was:

$$n_d = 1860/\{1+1860(0.10)^2\}$$
$$= 94.89 \text{ or } 95 \text{ dealers}$$

The sample size of smallholders (n_s) interviewed was:

$$n_s = 120\,341/\{1+120\,341(0.05)^2\}$$
$$= 398.68 \text{ or } 399 \text{ smallholders}$$

The distribution of dealers visited and the smallholders interviewed in each state was determined basically by the stratification formula[2] (*Table 3*). Then the selection of the dealers to be included in the sample in each state was carried out based on the simple random sampling technique[3]. For the success of this project, it was always ensured that the recommended sample sizes of dealers and smallholders in each state were adhered to. From *Table 3*, it is clear that the number of dealers that were visited and the number of smallholders that were interviewed exceeded the numbers statistically recommended for them.

Econometric Analysis

An econometric analysis was used to examine significant

[1] The general formula of Yamane (1967) is: $n = N/\{1+N(1-e)^2\}$, where n = total sample size of smallholders to be interviewed (n_s) or total number of dealers (n_d) to be visited in Malaysia, N = total number of smallholders in Malaysia (N_s) or total number of dealers in Malaysia (N_d), and e = degree of confidence.

[2] The general stratification formula is: $n_i = n \times (N_i/N)$, where n_i = total sample size of smallholders to be interviewed (n_{is}) or dealers (n_{id}) to be visited in state I, n = total sample size of smallholders to be interviewed in Malaysia (n_s) or total sample size of dealers to be visited in Malaysia (n_d), N_i = total number of smallholders in state I or total number of dealers in state I, and N= total number of smallholders in Malaysia (N_s) or total number of dealers in Malaysia (N_d).

[3] All the dealers were numbered in each state and random numbers were generated for them. The dealers with the numbers that corresponded to their generated numbers were selected and visited. Each selected dealer invited as many smallholders as he could for the interviews at the dealer's office.

factors that influenced the yield of FFB produced by independent smallholders. The econometric model developed was:

$$YFFB = a + b_1AMFET + b_2COST + b_3AGED + b_4AREA + e \quad \ldots\ldots\ldots\ldots(1)$$

where YFFB = yield of FFB,
AMFET = amount of fertilizers applied per palm,
COST = cost of FFB production incurred by each smallholder,
AGED = age of oil palm, and
AREA = size of oil palm holding.

In addition, correlation and Granger Causality Tests were also undertaken to examine economic relationship among selected variables for which data were gathered from the study.

RESULTS AND DISCUSSION

Observations from Primary Data Collection

Face-to-face personal interviews revealed the followings:

Yield of fresh fruit bunches (FFB). The survey showed that the yield of FFB produced by the smallholders varied, ranging from 8.90 t to 38.40 t/ha/yr, while the mean/average yield among the smallholders was 18.82 t and the median was 18.16 t/ha/yr.

Labour cost. The survey identified four components of labour cost, namely, labour costs for harvesting and collecting FFB, pruning, manuring and spraying.

i. Cost of harvesting and collection. The oil palm smallholders sometimes hired workers for harvesting and collecting their FFB. The lowest labour cost for harvesting and collection was RM 20/t, while the highest was RM 70/t. The mean/average rate of harvesting and collecting of FFB was RM 35.38/t and the median was RM 35/t.

ii. Cost of manuring. Smallholders also engaged labour for manuring. The cost of manuring varied, ranging from RM 0.80 to RM 5 per 50 kg bag of fertilizer. Based on the survey, it was found that the mean/average cost of manuring paid by smallholders was RM 2.14 per bag and the median was RM 2 for 50 kg of fertilizer.

iii. Cost of spraying. Another major activity of the smallholder was spraying, which was also done by other workers. The cost of spraying ranged from RM 25/ha to RM 99/ha. The mean cost of spraying incurred by smallholders was RM 55.50/ha and the median was RM 20.

iv. Cost of pruning. The cost of pruning paid by smallholders to their workers depended on palm height. Normally, a lower rate was paid for shorter palms and *vice versa*. The cost of pruning ranged from RM 0.50 to RM 3.50/palm. The mean cost of pruning was RM 1.38 and

TABLE 3. SAMPLE SIZES OF DEALERS AND SMALLHOLDERS IN EACH STATE

State	Dealers		Smallholders	
	Recommended sample size	Visited	Recommended sample size	Interviewed
Johor	30	32	158	163
Perak	18	20	78	80
Selangor	15	16	45	51
Sabah	9	10	52	64
Pahang	8	14	21	26
Terengganu	4	5	3	6
N. Sembilan	4	6	8	11
Kedah	3	4	9	10
Melaka	2	5	4	9
Sarawak	2	3	15	18
Kelantan	2	2	1	6
Pulau Pinang	2	2	4	5
Total	95	119	399	449

the median was RM 1.20/palm.

Input Cost

The survey also identified two major costs of agricultural inputs incurred by smallholders, namely, the cost of chemical fertilizers and herbicides.

i. Cost of chemical fertilizers. The cost of chemical fertilizers depended on the brand used (*Table 4*). The most common brands were *MPOB F1, MPOB F2, Kuda Singa, Cap Kepala Ayam, MOP, CCM* and *Daun*. The survey showed that the prices of chemical fertilizers in 2007 had increased substantially compared to the previous year. In 2006, the prices of chemical fertilizers ranged from RM 42 to RM 68 per 50 kg bag. However, in 2007 the prices ranged from RM 55 to RM 85. In 2008, it had increased further to about RM 71 to RM 120 per bag.

ii. Cost of herbicides. Similar to the cost of chemical fertilizers, the brands of herbicides also determined the cost of weeding. Various brands were used by smallholders, such as *Round-up, Ikomex, Ken-tex, Paraquat, Basta* and *Gramoxone* (*Table 5*). Based on the survey, it was shown that the prices of herbicides in 2006 varied from RM 34 to RM 98 for 4 litres, while in 2007, those prices had increased to a range from RM 45 to RM 120 for the same bottle size, and until July 2008, they had increased further to a range between RM 55 and RM 135.

Cost of Transportation

The smallholders were charged for two types of transportation cost by the FFB dealers. First, the cost was based on the distance between the dealer's ramp and the smallholder's farm, which ranged from RM 15 to RM 35/t of FFB. Second was the cost of transportation from the dealer's ramp to the mill. This second cost was usually fixed for all smallholders under the same dealership, and ranged from RM 20 to RM 40/t depending on the distance between the ramp and the mill.

FFB Cost of Production

The cost of FFB production was based on the analysis of the various cost components, such as average yield, labour cost for each activity, and the costs of chemical fertilizers, herbicides and transportation. The average yield of FFB produced by smallholders was 18.82 t/ha/yr. The average labour costs for each activity are shown in *Table 6*. For harvesting and collection of FFB, the labour rate was RM 35/t or RM 658.70/ha/yr, while that for spraying was RM 3/t of FFB or RM 55.50/ha/yr. The

TABLE 4. PRICES OF SELECTED BRANDS OF CHEMICAL FERTILIZER

Brand	Price (RM/50 kg)			Usage by smallholders (%)
	2006	2007	2008*	
MPOB F1	54	62	92	9.5
MPOB F2	57	63	95	5.7
Kuda Singa	68	85	120	12.0
Cap Kepala Ayam	53	65	78	13.3
MOP	42	55	72	2.0
CCM	51	62	83	8.1
Cap Daun	45	60	71	1.6
Others	50	65	88	47.7
Total/average	52	65	85	100.0

Note: *Until June 2008.

TABLE 5. PRICES OF SELECTED BRANDS OF HERBICIDE

Brand	Price (RM/4 litres)			Usage by smallholders (%)
	2006	2007	2008*	
Paraquat	48	54	62	17.6
Ikomex	43	50	58	16.4
Round-up	39	48	52	20.7
Basta	98	120	135	1.4
Ken-tex	48	52	60	3.6
Ken-up	42	55	67	11.7
Mosanto	34	45	55	4.3
Gramoxone	40	55	64	1.6
Spark	47	54	61	0.9
Others	45	52	63	21.8
Average/total	48	58.50	68	100.0

study also revealed that the average rate for manuring was RM 2.14 per 50 kg bag of fertilizer. This means that the labour cost of manuring was RM 2.05 for each tonne of FFB, or RM 38.52/ha/yr. Lastly, the average rate for pruning was RM 1.40 per oil palm tree which can be translated to RM 11/t of FFB or RM 207.20/ha/yr.

It can be concluded from *Table 6* that the average cost of labour (for harvesting and collecting, spraying, manuring and pruning) was RM 51.05 for each tonne of FFB produced by smallholders. This is equivalent to RM 959.92/ha of oil palm farm.

The average cost of transportation from the farm to the dealer's ramp was RM 15/t, or RM 282.30/ha/yr, while the average cost of transportation from ramp to mill imposed by the dealers was RM 20/t, or RM 376.40/ha/yr. Hence, the total cost of transportation was RM 35/t.

Smallholders applied an average of 6 kg of chemical fertilizer to each palm. This means that they needed around 890 kg or 18 bags for each hectare of oil palm per year. With the price range of RM 55 to RM 85 per 50 kg bag (*Table 7*), and averaging at RM 65 per bag, the average cost of chemical fertilizer was RM 61.81 for each tonne of FFB produced, or RM 1163 for each hectare in a year.

TABLE 6. LABOUR COST ESTIMATE FOR INDEPENDENT OIL PALM SMALLHOLDERS

Activity	Average cost (RM/t)	Average cost (RM/ha/yr)
Harvesting and collecting	35.00	658.70
Spraying	3.00	55.50
Manuring	2.05	38.52
Pruning	11.00	207.20
Total	51.05	959.92

Smallholders used around 7.4 litres of chemical herbicide for each hectare of their oil palm holding, implying that about 22.2 litres (7.4 x 3 times) for each hectare of oil palm per year were used. As the cost of herbicide depended on the brand, assuming an average price of RM 58.50 for a 4-litre bottle, the average cost of chemical weeding in general was RM 17.25 for each tonne of FFB, or RM 324.68/ha in a year (*Table 8*).

Based on the above cost components, the total cost of FFB production in a year was RM 165.11 for each tonne of FFB (*Table 9*). This means that the total cost of FFB production for smallholders was RM 3106.30 for each hectare of oil palm holding, the largest cost component being the cost of fertilizer.

TABLE 7. COST OF USING VARIOUS BRANDS OF CHEMICAL FERTILIZERS (2007)

Brand	Average price (RM/50 kg)	Number of smallholders	Average cost (RM/t)	Average cost (RM/ha/yr)
MPOB F1	62	42	59.30	1 116
MPOB F2	63	25	60.26	1 134
Kuda Singa	85	53	81.30	1 530
Cock's Head	65	59	62.17	1 172
MOP	55	9	52.60	990
CCM	62	36	57.30	1 116
Cap Daun	60	7	57.39	1 080
Others	65	211	62.17	1 170
Total	-	442	-	-
Average	65	-	61.81	1 163

TABLE 8. COST OF USING SELECTED BRANDS OF CHEMICAL HERBICIDES (2007)

Brand	Price (RM/4 litres)	Number of smallholders	Average cost (RM/t)	Average cost (RM/ha/yr)
Paraquat	54	78	15.92	299.70
Ikomex	50	73	14.75	277.50
Round-up	48	92	14.16	266.40
Basta	120	6	35.38	666.00
Ken-tex	52	16	15.34	288.60
Ken-up	55	52	16.22	305.25
Mosanto	45	19	13.27	249.75
Gramoxone	55	7	16.22	305.25
Spark	54	4	15.92	299.70
Others	52	97	15.33	288.60
Total	-	444	-	-
Average	58.50	-	17.25	324.68

TABLE 9. COST OF FRESH FRUIT BUNCHES (FFB) PRODUCTION BY INDEPENDENT SMALLHOLDERS (2007)

Relevant cost component	Average cost (RM/t)	Average cost (RM/ha/yr)
Harvesting and collection	35.00	658.70
Pruning	11.00	207.20
Manuring	2.05	38.52
Spraying	3.00	55.50
Cost of transportation	35.00	658.70
Cost of fertilizer	61.80	1 163.00
Cost of herbicide	17.25	324.68
Total cost	165.10	3 106.30

ECONOMETRIC ANALYSIS

Correlation Analysis[4]

The correlation analysis produced a correlation index matrix showing the relationships between selected variables in this study (*Table 10*). The first row shows the correlation indices between yield of FFB (YFFB) produced by independent smallholders and selected variables, namely the amount of fertilizers applied to each palm (AMFET), the age of oil palm (AGED), the cost of FFB production incurred by each independent smallholder (COST), oil palm planted area (AREA) and the rate of herbicide used in liters (RWD).

There was a stronger relationship between yield and amount of fertilizers applied to each palm as compared to other variables. The correlation coefficient was 0.5312. This was followed by the age of oil palm trees, cost of FFB production, oil palm planted area and rate of herbicide.

Granger Causality Tests[5]

Table 11 shows the results of the Granger Causality Test and the reported F-statistics (the Wald statistics for the joint hypothesis) for each equation. It is clear that both null hypotheses (YFFB does not Granger-cause AMFET and AMFET does not Granger-cause YFFB) can be rejected. Therefore it appears that YFFB can have an effect on AMFET and *vice versa*. *Table 11* also shows similar two-way causal effects between YFFB and AGED and between YFFB and COST. The relationship between YFFB and AREA indicates that the null hypothesis that YFFB does not Granger-cause AREA can be rejected, but not the null hypothesis that AREA does not Granger-cause YFFB. Therefore it appears that only AREA influenced YFFB but not the other way round.

Meanwhile, the null hypothesis that YFFB does not Granger-cause RWD and RWD does not Granger-cause YFFB cannot be rejected because of insignificance of the F-statistics. Therefore, it appears that YFFB did not have any effect on RWD or *vice versa*.

In summary, the preceding paragraph attempts to identify relevant factors causing the fluctuation of FFB yield. The result shows that the amount of fertilizers, age of oil palm, cost of FFB and the size of oil palm holding have a causal effect on yield. Their effects will be quantified in the relationship explained in the next section.

TABLE 10. CORRELATION MATRIX BETWEEN FRESH FRUIT BUNCHES (FFB) YIELD AND SELECTED VARIABLES

	AMFET	AGED	COST	AREA	RWD
YFFB	0.5312	0.4929	0.2339	0.0964	0.0898
AMFET	-	0.3535	0.2309	0.2152	0.0333
AGED	-	-	0.1268	0.4355	0.0422
COST	-	-	-	0.1622	0.7501
AREA	-	-	-	-	0.0786

Establishing Relationships

The technique of econometric analysis was used to examine the significant factors that influenced yield of FFB produced by independent smallholders. The independent variables that were included in the model were identified using their correlation-

[4] Correlation analysis is a statistical technique used to determine the linear relationship between two or more variables. It is a quantitative value represented by correlation coefficient, *r*, which can range from +1.00 to –1.00. If *r* equals to 1, it is a perfect correlation and if it equals to 0 there is no correlation at all.

[5] The Granger Causality Test (1969) was used to closely examine the causation effects between variables. This approach is used to answer the question of whether one variable (*y*) is caused by other variable (*x*). The *y* is said to be Granger-caused by *x* if *x* helps in the prediction of *y*, or equivalently if the coefficients on the *x*'s are statistically significant. It can also be a two-way causation, *x* Granger causes *y* and *y* Granger causes *x*. The null hypothesis is therefore that *x* does not Granger-cause *y* and the alternative hypothesis is *x* does Granger-cause *y*.

TABLE 11. RESULTS OF GRANGER CAUSALITY TESTS

Null hypothesis	F-statistic	Probability
YFFB does not Granger-cause AMFET	17.6188	0.0000**
AMFET does not Granger-cause YFFB	8.6698	0.0069**
YFFB does not Granger-cause AGED	20.2304	0.0000**
AGED does not Granger-cause YFFB	3.0001	0.0839*
YFFB does not Granger-cause COST	14.0992	0.0002**
COST does not Granger-cause YFFB	10.5799	0.0012**
YFFB does not Granger-cause AREA	3.5122	0.0835*
AREA does not Granger-cause YFFB	1.5122	0.2093
YFFB does not Granger-cause RWD	0.0002	0.9893
RWD does not Granger-cause YFFB	0.0802	0.7771

Note: (**) and (*) indicate the levels of significance at probability 99% and 90% respectively.

based relationships and results from the Granger causality analysis. Based on those analyses, it was shown that there existed relationships between yield of FFB produced by independent smallholders (YFFB) and the amount of fertilizers applied to each oil palm (AMFET), the cost of FFB production incurred by each independent smallholder (COST), the oil palm planted area (AREA), and the age of the oil palm (AGED). The result of this regression is shown below:

$$YFFB = \underset{(19.437)^*}{6.8157} + \underset{(9.997)^*}{0.6454AMFET} + \underset{(11.030)^*}{0.3821COST} + \underset{(4.617)^*}{0.3462AGED} + \underset{(2.791)^*}{0.0697AREA} \quad \text{.....(2)}$$

R^2 = 0.8392; Durbin Watson Statistics = 1.728

Note: All coefficients are in logarithm form and (*) indicate the levels of significance at 99%. Value of t-statistic in parenthesis.

Equation (2) shows the result of the estimated model for FFB yield. Based on this result, it is shown that the amount of fertilizers applied to each oil palm (AMFET) was an important factor in influencing the yield of FFB. When the amount of fertilizers increased by 1%, the yield of FFB is expected to increase by 0.64%, and this coefficient is the strongest among all the coefficients in that equation. This result is consistent with those of the correlation index and Granger Causality Test that showed a strong relationship between FFB yield and amount of fertilizer applied. At the same time, when the cost is increased by 1%, the yield of FFB is expected to increase by 0.38%. The other significant independent variables were the age of the oil palm and the area of oil palm, with coefficients of 0.3462 and 0.0697, respectively.

From the above analysis, it is clear that the four factors influencing the yield of FFB were the amount of fertilizers applied to each of oil palm (AMFET), the cost of FFB production (COST), the oil palm planted area (AREA) and the age of the oil palm (AGED). The results of the econometric analysis were found to be consistent with the survey output. This is because when more fertilizers were applied by the smallholders, their yield would be much higher as compared to those who applied insufficient amounts of fertilizer (*Table 12*). The yield of FFB increased from 11.96 t/ha/yr (no manuring) to 23.09 t/ha/yr when the amount of fertilizers applied was increased to 12 kg per oil palm per year.

ELEMENTS OF INEFFICIENCY

Based on the interviews with the independent smallholders, there were some elements of inefficiency which not only affected their performance but also affected the

TABLE 12. COMPARISON BETWEEN THE AMOUNT OF FERTILIZERS APPLICATION AND YIELD

Fertilizer application (kg/palm/yr)	Number of smallholders	Yield (ha/yr)	Percentage increase
0	7	11.96	-
1	12	12.52	4.68
2	49	14.48	7.51
3	54	15.60	8.62
4	72	17.26	8.89
5	29	19.12	9.48
6	59	20.43	9.75
7	57	21.32	8.47
8	28	21.85	6.17
9	32	22.17	3.13
10	26	22.78	1.14
11	11	22.89	0.91
12	7	23.09	0.60
Above 12	6	23.93	0.34
Total/average	449	18.82	-

performance of other sectors within the supply chain. Inefficiencies could reduce FFB yield, increase the cost of FFB production and reduce the quality of FFB. The elements of inefficiency were:

Maintaining Old Oil Palms

The findings show that about 17.18% of the independent smallholders still maintained their old oil palms (25 years old and above), based on their reasoning that those palms were still productive. Economically, such old palms are not productive anymore because palms with age profiles of 26 to 30 and 31 to 35 years (*Figure 1*) can only produce about 16.964 t and 15.388 t of FFB yield per hectare per year, respectively. These old palms will also increase the cost of FFB production, especially in terms of harvesting and collection. Costs for harvesting and collecting can reach RM 70/t as compared to the average cost which is around RM 35 to RM 40/t.

Applying Insufficient Amounts of Fertilizer

The study found that the low yield of smallholders could be attributed to insufficient fertilizer applications. Seven out of 449 independent smallholders (or 1.15%) did not manure their oil palms while about 9.99% applied fertilizers only once a year and only 28.22% twice a year. On the other hand, about 34.35% and 26.29% of them applied fertilizers thrice and four times in a year, respectively.

Insufficient fertilizer application can be defined as applying fertilizer less than twice a year. It was found that about 39.36% or 177 of the smallholders fell into this category, and this should send a signal to the industry about the seriousness of this element of inefficiency among the smallholders.

Harvesting Unripe Fresh Fruit Bunches (FFB)

It was found that about one-third of the smallholders still harvested unripe FFB. It was not known whether this was done on purpose or otherwise. Nevertheless, about 22.04% of the smallholders used colour as an indicator to determine the ripeness of FFB instead of loose fruit number. Those unaware of this important fact would lose out as their dealers will pay them for a low oil extraction rate (OER), and finally the mills will reject their FFB either sourced from the dealers to whom they sold, or from themselves for those who sold directly to the mills. The other 77.96% of the smallholders used the right method for indicating ripeness of their FFB, *i.e.* the number of loose fruits. If the number of unripe bunches can be reduced further, their level of efficiency can be improved.

Using Their Own Oil Palm Seedlings

The survey found that some independent smallholders raised their own oil palm seedlings at their holdings. However, this element of inefficiency was not very crucial because only 0.6%, or three out of 449 smallholders, did that while 99.4% of them purchased seedlings from oil palm nursery operators who had licenses issued by MPOB. By raising their own seedlings, it is definite that they will get low crop yields and low returns on investment which can harm the industry. Furthermore, these unlicensed nurseries should not be allowed to exist due to a lack of quality seeds and poor potential yields. As there are provisions in the regulations to counter this problem, appropriate measures should be taken.

Not Having a Good Data Management System

Smallholders were found to have poor data management as about 85.05% or 384 smallholders did not have a proper system of keeping data and records for their oil palm farm activities. This formed another element of inefficiency. As a result, they did not know whether their costs of FFB production and their FFB yields were high or not over time. Having no records; they showed no initiative to increase their yield or to reduce their cost of FFB production.

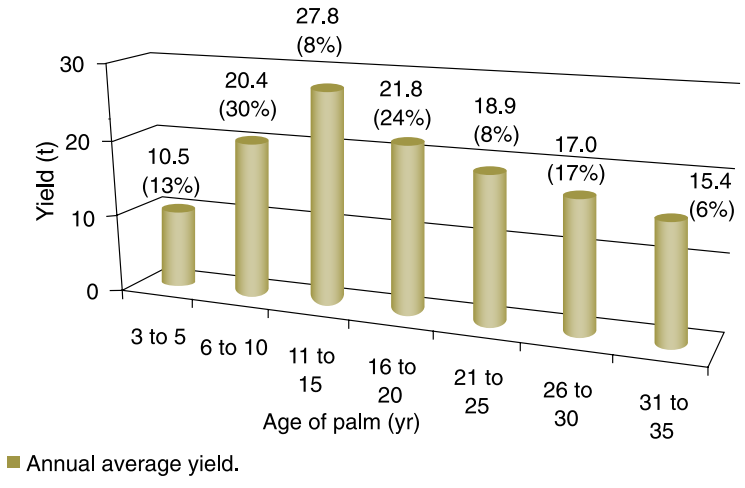

Figure 1. Yield of fresh fruit bunch (FFB) based on age profile (2006/2007).

Not Having Proper Planning for All Activities at their Oil Palm Holdings

About 65% of the smallholders did not plan their activities. This led to unorganized and unsystematic farming activities. For example, they did not plan the right time for manuring, and this led to insufficient fertilizers being applied because manuring was often not frequent. This element of inefficiency can also contribute to low FFB yield.

The Changing Structure of Oil Palm Smallholders

The independent smallholders had also changed the way they managed their oil palm holdings. Some of them had moved forward by reducing their cost of FFB production, overcoming their own problems, and also increasing their incomes. These changing structures had directly increased their efficiency level.

Using Mini Tractors with Trailers

Some smallholders were using mini tractors or motorcycles with trailers for in-field transportation. This mode of transportation reduced their cost of hiring workers and as a result labour productivity per day increased. The change had also reduced their cost of transportation and alleviated the problem of labour shortage.

Co-operation among the Independent Smallholders

Some smallholders showed some kind of co-operation among themselves. The study observed that they worked together by sharing their workers. This can reduce their cost of hiring workers and finally their cost of FFB production. Furthermore, good agriculture practices (GAP) can be practiced as all activities were properly scheduled at their oil palm holdings.

Sending their Own Fresh Fruit Bunches (FFB) to Dealers

Some smallholders sent their FFB to dealers on their own. This approach allowed them to get extra income from the dealers and avoided the deduction of transport fee by the dealers. They received around RM 10 to RM 25 more, depending on the distance, for each tonne of their FFB sent to the dealers.

Hiring Indonesian Workers for their Farms

Due to labour shortage, some smallholders hired Indonesian workers as their harvesters and collectors of FFB. This method reduced the cost of hiring workers, as the hiring cost for Indonesian workers was normally lower compared to hiring local workers.

Using Alternative Inputs for Manuring Oil Palm

As a result of the high price of chemical fertilizers in the market, some independent smallholders used organic fertilizer (chicken dung) to manure their oil palm. This practice can also reduce their cost of fertilizer application.

CONCLUSION

On average, the yield of FFB by the independent smallholders can be considered low and this affects their income. Independent smallholders were found to be quite inefficient in certain aspects of their activities, despite the structural changes that they had undergone. Thus, there is room for improvement for them. Increases in yield of FFB will result in better income. To increase the yield of FFB, they need to continue with the changes and make further improvements to their daily activities. They probably cannot do this by themselves but need further assistance and guidance from government agencies to increase their efficiency. Once their problems are resolved, their efficiency and productivity can be improved.

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