Analysis of Palm Oil Cost of Production Survey, 2002

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ABSTRACT

A cost of production survey of the Malaysian palm oil industry was undertaken in mid 2003. The analysis of the data revealed a number of strategies to reduce cost of production. These are the exploitation of the economies of scale, economies of scope, reducing on certain costs in the high cost companies and integrating the estate and mill.

INTRODUCTION

Since 1998, Palm Oil Research Institute of Malaysia (PORIM) and Palm Oil Registration and Licensing Authority (PORLA) had jointly embarked on an annual palm oil cost of production survey aimed at estimating the national palm oil cost of production. The work has continued until today but now it is known as the Malaysian Palm Oil Board (MPOB) palm oil cost of production survey. The data gathered were analysed in order to arrive at the yearly estimate of the average cost of production. The estimate is hoped to be a benchmark for the industry.

Under good market condition that we are now experiencing, there would be little problem with earning reasonable profits. The problem arises when prices are low. In the oils and fats market, the business cycle is very pronounced due to the annual crop component of the oil-bearing crops such as soyabeans, rapeseed, sunflower seed, peanuts and *etc*. Their production is highly elastic due to the flexibility of land usage. When prices are high, farmers tend to reallocate their land resource to the oil crops rather than grains. With oil palm, the change-over is very slow. Land once locked on oil palm would be difficult to be turned into other uses in the short-term.

In this paper, the total cost and cost components in palm oil production are related against cost influencing factors such as size of production facility, types of business organization, type of terrain on which the oil palms are cultivated and the degree of vertical integration practiced.

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SURVEY RESPONSE

A total of 3582 questionnaires were mailed out to oil palm estates throughout the country. The 1676 respondents representing 47% of estates had returned the questionnaires on time for the analysis. The returned questionnaires represent 1.6 million hectares or 43% of the total oil palm area (3.7 million hectares) in 2002. About 67% of the respondents are from Peninsular Malaysia and the remainder are from Sabah and Sarawak. In percentage terms, the response from Sabah and Sarawak had improved.

The response from the mills was outstanding. Out of 365 questionnaires sent to the mills, 70.1% were returned on time (compared to only 62% in 2001). Respondents, who had participated in the survey, processed more than 47 million tonnes of fresh fruit bunches (FFB) in 2002. They produced 9.3 million tonnes of crude palm oil (CPO) or two-thirds of the total national CPO output of 11.9 million tonnes in 2002.

THE SIGNIFICANCE OF COST OF PRODUCTION

Cost of production refers to all cash and non-cash expenses incurred in the production of palm oil and processing of FFB. Cost of palm oil production is the ringgit value of inputs used in the production of palm oil. Knowing the production cost enables the management to evaluate how efficiently resources are being utilized.

Cost of production can be divided into direct operating cost and imputed costs. Valuing direct operating costs which include fertilizer usage, pest and diseases control, general farm upkeep, transportation of fruits *etc.* is relatively straightforward. Valuing imputed costs, which include among others interest charges, insurance and depreciation, is more demanding.

The key to competing in a commodity-based market is to be a low cost producer. Similarly in palm oil, those who can produce at the lowest cost win. The economic key to profitability is the cost per tonne of output. It is the single most important index number that a palm oil producer can possibly calculate. Cost per unit area of land resource used in the production of palm oil merely measures cost without referring to the total output, the main objective of the production activity. Cost per tonne of FFB and cost per tonne CPO however measures cost in relation to physical production.

Trends in the Palm Oil Prices and Cost of Production

Fry (2003) noted that in the European Union (EU), the long-term inflation corrected palm oil prices from 1950 to 2003 indicated a declining trend amidst short-term relatively violent fluctuations. The price and cost data were adjusted for inflation by using the producer price index (1989=100) published by the Department of Statistics (2003) had indicated an increasing price trend while cost is unchanged. This is indicated in *Figure 1*. In both instances, net unit cost stayed well below the price indicating that the industry earned a very comfortable margin.

In the Malaysian market, prices in nominal ringgit show a similar trend. Price fluctuations were however especially volatile in the more recent years especially after the ringgit depreciation in 1997. Palm oil prices rose to its highest in 1999 and dropped to its lowest in 2001.

Net unit cost of FFB and CPO however shows a relatively horizontal trend despite the price fluctuations. The small variations observed were due to changes in the oil palm productivity as well as the reactions of estate managers to the changing prices. Managers juggle around with their expenditures in their effort to keep profits positive and on target or generally referred to in the industry as the *bottom-line*. During lean times, their strategy is cost cutting. During good times, managers are more generous with their expenditure especially in the farm improvement projects.

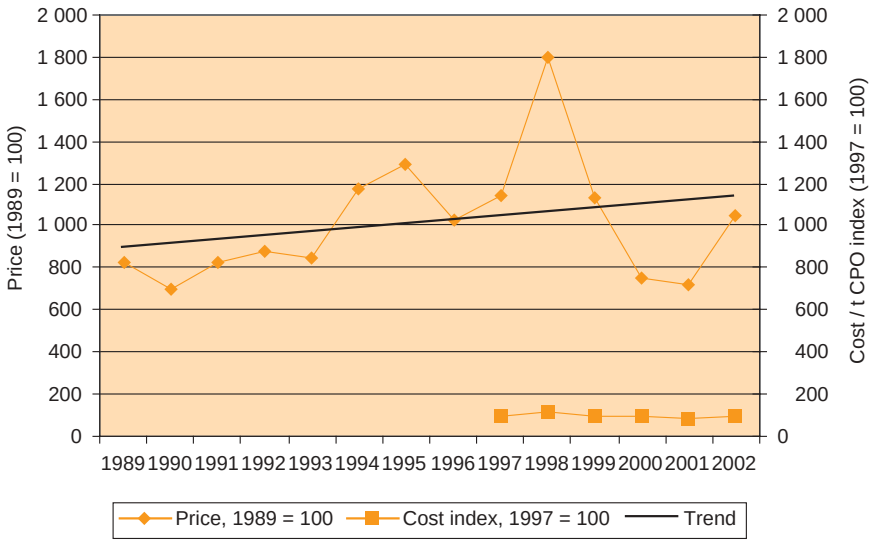

Figure 1. Real crude palm oil (CPO) cost index (1997 = 100) and price, 1989-2002, (1989=100).

Estate Costs

The cost of FFB production is comprised of upkeep, fertilizer, harvesting, transportation and joint estate costs (JEC). The share of these major cost components is shown in *Figure 2*. The cost of estate upkeep and cultivation makes up about 12% of the total cost. The bulk of the cost is embodied in the remaining four components; led by fertilizers and its application and followed by transportation, harvesting and collection, and JEC. Operational costs involving fertilizer and its application alone constitute 22% of the unit cost of production. Transportation and harvesting operations each make up 19% of the cost. JEC makes up the remainder 28%.

Cost of Processing

As indicated in *Figure 3*, the largest share of FFB processing cost is the sales cost which accounts for 24% of the total. Sales cost consists of sales expenses which include commission, sales tax (for Sabah and Sarawak producers only) and cost of CPO delivery.

The second most important cost item which commanded 18% of the total cost of FFB processing is the cost of management. Included in this broad cost category are estate management costs and head office cost widely known in the industry as the *Agency Cost*. Maintenance or repair accounts for 17% whilst depreciation makes up another 16%. Labour absorbed 11% of the cost of FFB processing. Fees take up the least share of 2%.

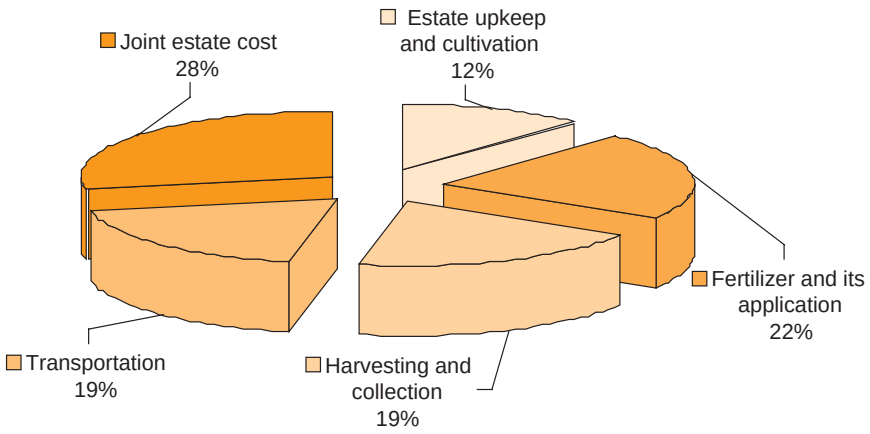

Figure 2. Cost share in fresh fruit bunches (FFB) production.

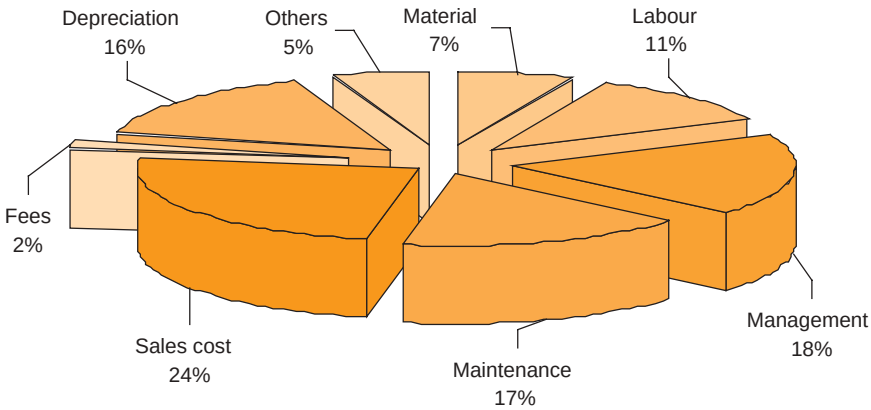

Figure 3. Cost component of fresh fruit bunches (FFB) processing and sales.

PRODUCTIVITY AND COST IMPLICATIONS

The survey found that the average oil palm yield in 2002 was 18.4 t/ha. From the regional perspective, the average yield in Peninsular Malaysia was 18 t/ha, lower than the average yield of 19.1 t/ha in Sabah and Sarawak. In 2001 and earlier however, the average yield in Sabah and Sarawak was consistently lower than in the Peninsular. From *Table 1*, the yield data obtained from this survey are slightly higher than the result obtained from another study by MPOB. The difference is expected since the latter considered both the estate and organized smallholders, while in the present study, the organized smallholders were excluded.

FFB yield in 2002 had decreased by about 6% from the previous year. Regionally, it was found that Sabah and Sarawak oil palm estates decreased in yield by 4%. The yield in the Peninsular had declined by about 7%. A discussion with a few estate managers revealed that the reduction in yield had been due to their reaction to the low CPO prices in 2001 where inputs, especially fertilizers were reduced. The result is a reduction in yield in the year 2002. This has been a bitter lesson to the planters that trying to reduce cost by reducing on fertilizer input can be costly to the oil palm operation.

Productivity has a vital implication on the cost of production since unit cost is computed as the total cost over the total quantity of output. When output is reduced due to a fall in productivity, cost per tonne FFB increases.

FFB Processing

As shown in *Table 2*, the oil extraction rate (OER) had increased substantially to 19.6% in

TABLE 1. YIELD OF FRESH FRUIT BUNCHES (FFB) BY REGION, 2001-2002

Source	Yield of FFB (t/ha)		
	2001	2002	% Change
MPOB Cost of Production Survey			
Malaysia	19.55	18.39	-5.93
Peninsular Malaysia	19.40	17.98	-7.32
Sabah & Sarawak	19.89	19.11	-3.92
MPOB Published Statistics*			
Malaysia	19.26	17.97	-6.70
Peninsular Malaysia	19.61	17.45	-11.01
Sabah & Sarawak	18.51	18.70	1.03

Note: * Inclusive of organized smallholders.
Source: MPOB (2002b).

2002 compared to 19.3% in the year 2001. The figures are rather consistent with another study by MPOB. Like in the previous years, OER in Sabah and Sarawak is consistently higher than in Peninsular Malaysia. In Sabah and Sarawak, the average OER in 2002 was 21.7% compared to only 18.9% in the Peninsular. Although oil palm plantations in Sabah and Sarawak returned a lower FFB yield as compared to the yield in 2001, the better OER helped offset yield decline and cost setbacks, if any. Thus, producers in Sabah and Sarawak performed slightly better because with a better OER, high cost at the estate level can, to a limited extent be recovered at the processing stage. A hectare of oil palm in Sabah and Sarawak was found to produce an average of 3.6 t of CPO in 2002 compared to 3.4 t in Peninsular Malaysia.

COST AND TOPOGRAPHY

The topography of an oil palm estate can affect the relative difficulty of fieldwork to be undertaken and subsequently may affect the cost. With certain aspects of FFB production, the land terrain, due to the difficulty in some field operations can raise the cost. In this study, land terrain is broadly measured as the percentage of the estate area that is hilly.

In *Table 3*, shows the linear relationship between the cost of selected estate work and the condition of the estate terrain. The linear relationship, if found to be statistically significant would imply that land terrain of an estate do affect the cost of the estate work under examination. The linear relationship is measured by the Pearson correlation analysis between cost of estate work and land terrain. Correlation coefficients show linear relationship between two variables. It is an index number where completely linear relationship is indicated by a correlation coefficient of unity while no linear relationship is indicated by a correlation coefficient of zero. Positive coefficients indicate unidirectional relation while negative signs show opposite relationship.

The cost of drain upkeep has a significant negative correlation coefficient with land terrain. This is consistent because of the lower requirement for drain maintenance in hilly areas. Greater percentage of hilliness is also negatively related with yield, pruning and sanitation and the cost of pest and disease control. However, upkeep of roads and bridges as well as in-field transportation is more costly in hilly areas. Other cost items show no significant correlation with the land terrain of an oil palm estate. However due to the positive linear relationships between some of the cost items and land terrain, had also affected total unit cost. Hence, total cost per tonne FFB was found to be higher with greater degree of hilliness of the land terrain.

TABLE 2. OIL EXTRACTION RATE (OER) BY REGION, 2001-2002

Source	OER		
	2001	2002	% Change
COP Survey:			
Malaysia	19.3	19.6	1.5
Peninsular Malaysia	18.6	18.9	1.6
Sabah & Sarawak	20.7	21.7	4.8
MPOB's Data:			
Malaysia	19.2	19.9	3.6
Peninsular Malaysia	18.5	18.8	1.6
Sabah & Sarawak	20.7	21.7	4.8

Source: MPOB (2002a, b).

ECONOMIES OF SCOPE

The production system when it is more economical to produce two or more products jointly compared to separately producing the same products is termed an economy of scope (Clarke and McGuinness, 1990). To further explain the phenomenon let us assume a two good case where quantities of Good 1 and Good 2 produced are q_1 and q_2 respectively. An economy of scope exists if the minimized cost

TABLE 3. CORRELATION COEFFICIENTS BETWEEN COST OF SELECTED FARM OPERATIONS AND ESTATE TERRAIN (percent hilliness)

Parameters	Correlation coefficient
Yield	-0.18**
Total cost/t FFB	0.08**
Upkeep drains	-0.06**
Pest and disease control	-0.05**
Pruning and sanitation	-0.05*
In-field transportation	0.07**

Notes: * Significant at 95% level; ** Significant at 90% level.

of producing q_1 of Good 1 and q_2 of Good 2 is lower in joint production rather than in separate production. If C is the minimized cost of production, then the economies of scope model can be formally represented as:

$$C(q_1,q_2) < C(q_1,0) + C(0,q_2)$$

In palm oil production, there is traditionally a natural by-product which had contributed to the economies of scope. This is the palm kernel component of production. Total cost of CPO production had included the cost of producing palm kernel. In the computation of cost, the kernel is considered as a by-product credit and subtracted from the total cost of CPO production in order to arrive at the net cost per tonne CPO. Hence:

Net cost per tonne CPO=total cost/t CPO–revenue from palm kernel/t CPO

The average price of palm kernel in 2002 obtained from the survey was RM 647.25/t. In a tonne of FFB processed, on average 0.0567 t of kernel were recovered. At the mentioned price, the national average credit to the processing cost per tonne of FFB was RM 36.70. Taking into account the average OER of 19.6%, the credit involved from palm kernel sale per tonne of CPO produced was estimated at RM 187.24.

In addition to the palm kernel, economies of scope in the palm oil industry can be expanded through more commercialization of other by-products. The oil palm biomass, although currently has no developed market, but the technology for its increased use are currently available and continuously being developed. When the oil palm biomass is commercialized, the cost of palm oil production can be additionally reduced through a bigger by-product credit deduction from the total cost of CPO production.

ECONOMIES OF SCALE

The relationship between cost of production and size in economics is the classic economies of scale concept. In the practical sense, this concept is often referred to the notion of the minimum efficient scale (MES). This is the minimum size of an operation where further increases would only result in only marginal cost decrease. The decrease in cost with size is mainly explained by the greater spread of the fixed cost over total output. Other advantages are that with bigger operation, the entity has greater bargaining power in the inputs market and therefore able to purchase cheaper input through bulk purchase arrangement.

Survey data was analysed with respect to the relationship between unit cost of production and the size of the production units. First, the size of an oil palm estate is related to the unit cost of FFB production. Then the unit cost of FFB processing is related to the size of the palm oil mills.

Cost of Fresh Fruit Bunches (FFB) Production and Size of Estates

The estate respondents are sub-divided into nine size classes ranging from less than 100 ha to larger than 3500 ha. The cost of production per tonne of FFB was computed for each size class. The respective costs are plotted against the size classes as shown in *Figure 4*.

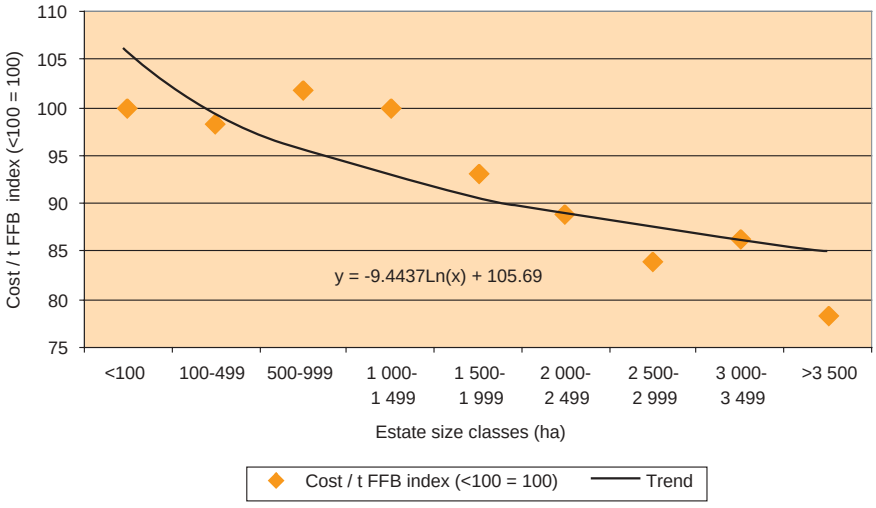

Figure 4. Relation between estate size and cost index (<100 = 100) of fresh fruit bunches (FFB) production 2002.

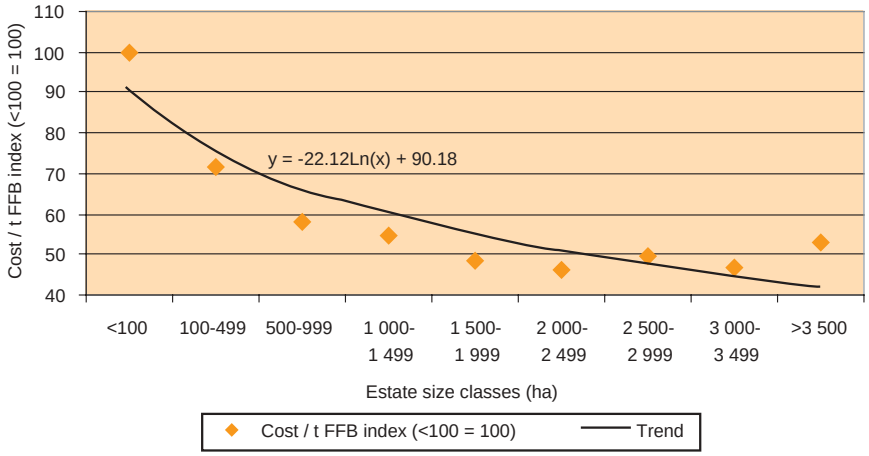

Figure 5. Relation between estate size and cost index (<100 = 100) of fresh fruit bunches (FFB) production 2001.

The shape has not shown the typical textbook U- or L-shape average cost curve. However, it does indicate the reducing effect of increasing size on the cost of production of FFB. When the curve is fitted using the logarithmic function, there is the typical L-shape curve, consistent with the minimum efficient scale concept, an offshoot of the economies of scale notion. The average cost data can be fitted to a curve described by y = -9.4437Ln(x) + 105.69, where y represent cost per tonne FFB produced and x is the size of a producing unit measured in hectares.

The analysis between cost of FFB production and estate size is consistent with the economic theory on MES. The unit cost declined the fastest at the size of between 2000 to 2500 ha. This indicates that the MES for oil palm estates in Malaysia is about 2000 ha.

The same analysis was undertaken on the 2001 survey data and the result is as shown in *Figure 5*. The graph shows the typical textbook MES curve. In both instances, the reduction in cost was relatively drastic when the size is small until when the size per estate is about 2000 ha. The result clearly shows that the MES in the oil palm estates is about 2000 ha. Oil palm estates with size smaller than 2000 ha can expect higher cost of production. Hence for new estates, it is recommended that the size should be at least 2000 hectares. For smaller estates, expansion to the MES will facilitate cost reduction.

Cost of Processing by Size

In FFB processing, plant size can be measured by two methods. First is the installed or built capacity approach. Palm oil mills are built based on capacity to process FFB per hour. The other approach is the actual processing for the year. In this report, both measures are considered as shown in *Figures 6* and *7*.

As shown in *Figure 6*, ex-mill cost of processing decreases with bigger built mill capacity. The cost decrease continues until 50 t FFB/hr and the trend continues on a downward direction thereafter. This indicates that mills that are capable of processing more than 50 t of FFB are more efficient cost-wise.

Based on the alternative measure of mill size by CPO output per year, *Figure 7* shows a similar trend in cost. A trend line was fitted to the cost data where C represents average processing cost and Y the CPO output per year. The fitted line indicated that cost decreased as the quantity of CPO produced increases. Observing the graph, cost reduction is greatest until 30 000 t CPO/yr. It can be deduced from the graph that the MES for palm oil mills in Malaysia is more than 30 000 t CPO/yr.

TYPE OF BUSINESS ORGANIZATION FACTOR

Cost of Fresh Fruit Bunches (FFB) Production and Types of Estate Ownership

Different types of estate ownership relate to differences in management style and probably linked to promptness in decision-

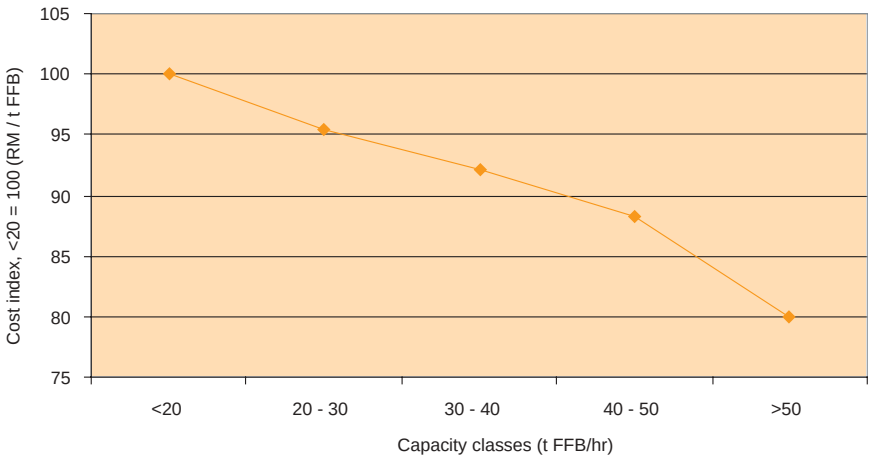

Figure 6. Graph showing ex-mill cost index (<20 = 100) per tonne fresh fruit bunches (FFB) and built mill capacity.

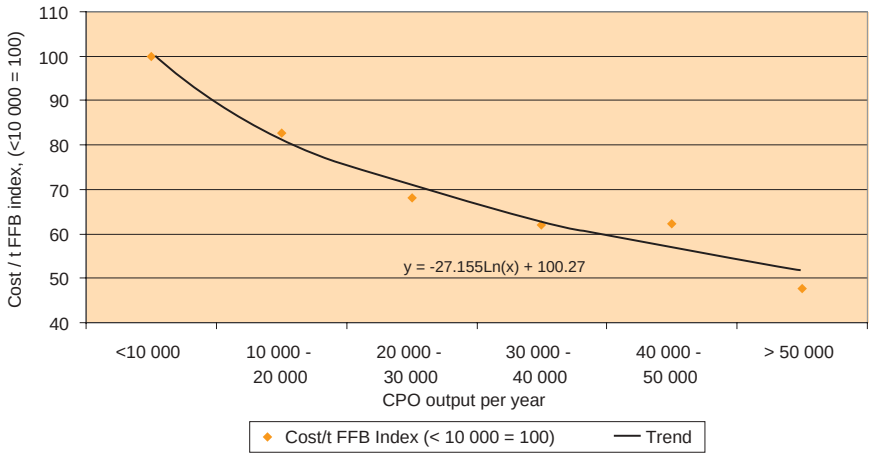

Figure 7. Ex-mill processing cost index per tonne fresh fruit bunches (FFB) and crude palm oil (CPO) output per year.

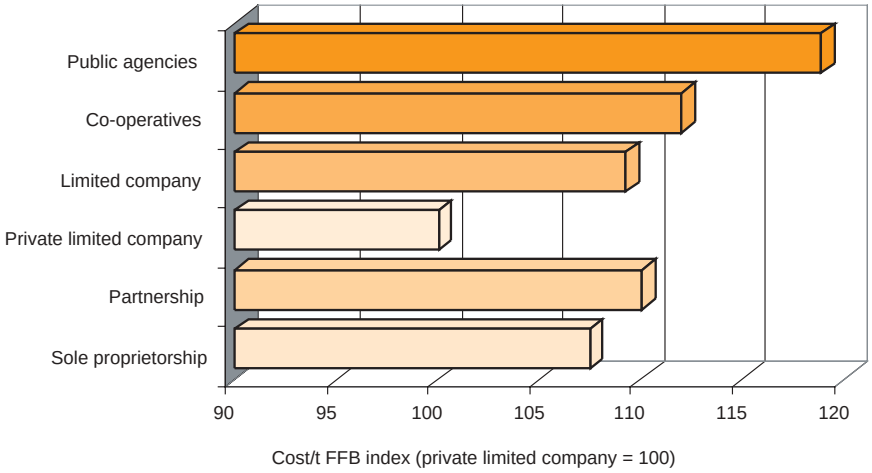

Figure 8. Relation between ownership types and cost index of fresh fruit bunches (FFB) production.

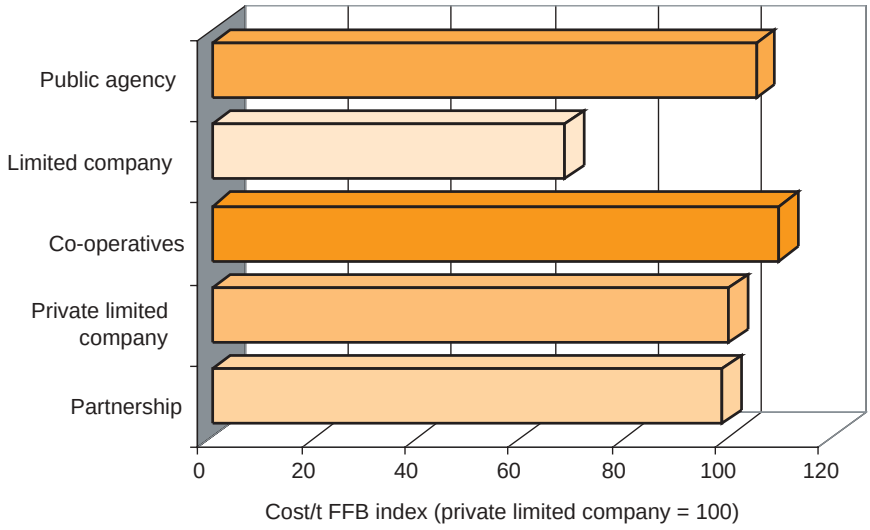

Figure 9. Relation between ownership types cost index of fresh fruit bunches (FFB) processing.

making. In this survey, unit FFB cost data were collected with respect to the different types of estate ownership types or organizations. These were 1) sole proprietorship, 2) partnership, 3) private limited company, 4) co-operatives, 5) public limited companies and 6) public agencies. The results are shown in *Figure 8*.

The results indicate that in general, the lowest cost producers are private limited companies. The highest cost producers are the public agencies. Upon examination of the detailed cost data, the source of the high cost is in the transportation and JEC.

Cost of Fresh Fruit Bunches (FFB) Processing and Types of Mill Ownership

As indicated in *Figure 9*, the least cost palm oil mill ownership type is by the public limited companies. These are usually large corporations, often belonging to organizations that are listed in the stock exchange. These organizations usually are well managed and financially capable. The second lowest cost producers belong to partnership and private limited companies with the most expensive being the public agencies and co-operatives. The source of the difference in cost in different types of mill ownership is the higher cost of maintenance and repairs.

Impact of Vertical Integration

Forward vertically integrated estates are characterized by a secure market for the FFB since the palm oil mill is part of the organization. The mill is often located relatively close to the estate.

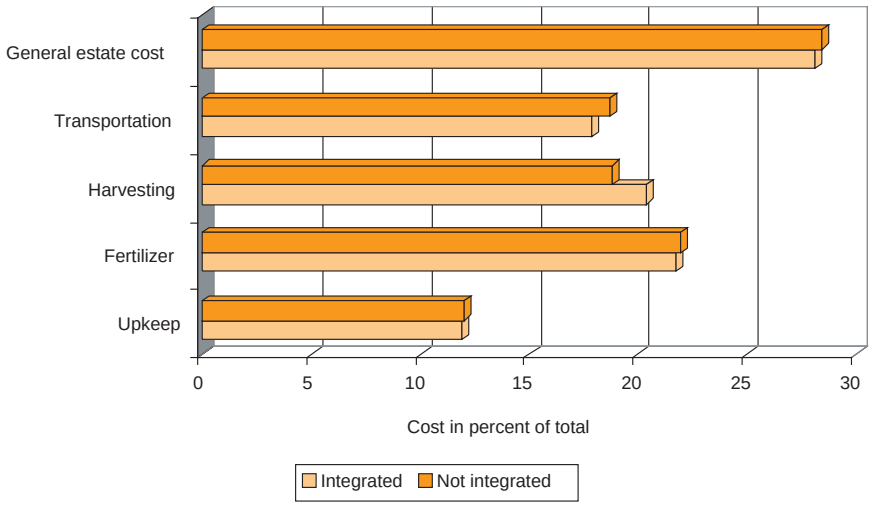

Figure 10. Cost comparison between integrated and non-integrated oil palm estates, 2002.

Oil Palm Estate

As a result, in addition to the secure market and faster FFB processing, there can be other factors that could cut cost of production. The proximity to the mill would certainly reduce transportation cost.

In the upkeep and cultivation cost category, total average cost in integrated estates was about RM 2 higher than in non-integrated estates (*Figure 10*). The higher costs in non-integrated estates continue with fertilizers, harvesting, transportation and JEC.

Processing

Vertically integrated palm oil mills are often associated with the better supply of FFB both in quantity and quality. In these aspects, the palm oil mills are able to have uninterrupted operation as well as operating with a much better OER. It is therefore expected that palm oil mills that are backward integrated with the plantations will be more efficient. This is shown in *Figure 11* where in many instances, non-integrated mills are more costly in many cost components. However, the differences in cost in these cost categories are less pronounced than what is experienced in the plantations.

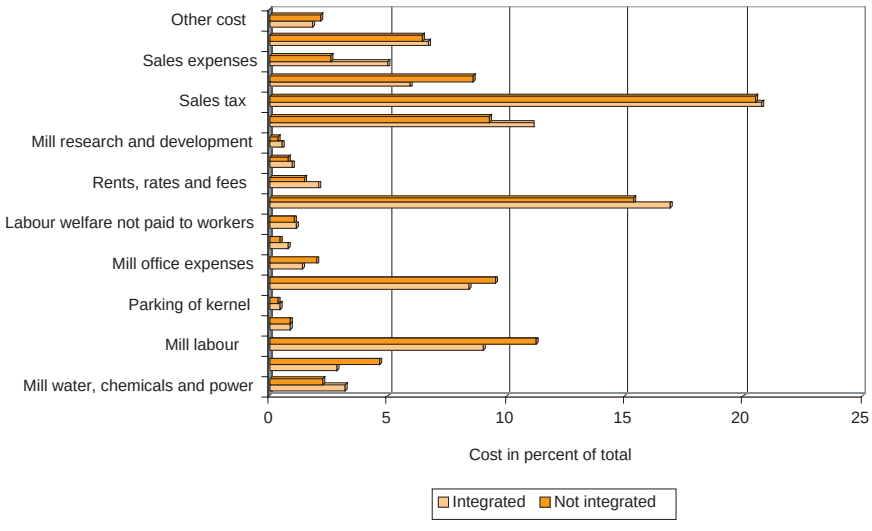

Figure 11. Fresh fruit bunches (FFB) processing cost by mill integration types, 2002.

CONCLUSION AND RECOMMENDATIONS

Unit cost is the single most important performance indicator in palm oil production. Over time, cost in ringgit value remained stable while price is on the upward trend, widening margin in the long run.

At the farm (estate) level, the main cost items were found to be the JEC and fertilizer cost. FFB handling comprising harvesting and collection cost as well as transportation command 38% of total cost. At the mill, the important cost items are sales, management, maintenance and depreciation which together command 75% of total cost.

In the determination of cost of production, productivity is of great importance. Productivity is measured as yield at the farm level and OER at the processing stage. Other factors that determine cost of production in palm oil production are topography, economies of scale and scope, types of organization and the degree in which production entities are vertically integrated. Topography of an estate affects cost by lowering yield, high cost of upkeep of drains, pest and disease control, pruning and sanitation and in-field transportation.

On the economies of scope, cost can be reduced with more by-product output, the potential in the palm oil industry being the development of products and services from the biomass sources. From the point of view of the economies of scale, the cost of production at the estate level becomes low when the size is 2000 ha or more. At the mill level, costs

are low at the capacity of more than 50 t/FFB/hr or an output of more than 30 000 t of CPO.

The type of business organization too affects cost. The limited company and public agencies are relatively high cost producers. At the estate level, the sources of the high cost are the joint estate and transportation costs. At the mill level, limited companies, public agencies and co-operatives are relatively higher cost producers mainly due to the higher cost of mill repairs and maintenance.

When estates and mills are integrated, there are cost advantages present. The cost advantages in integrated estates are in the lower cost of fertilizers, harvesting, transportation and JEC. In the mill however, the cost advantage is not so pronounced. OER is better due to the coordination of FFB harvest between the estate and mill.

There are a number of alternative strategies for the reduction of unit cost in palm oil production. By keeping to the efficient size, use of biomass and reducing on excessive costs in the high cost types of business organization and taking advantage of vertical integration, costs in the palm oil industry can be effectively reduced.

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