Harvesting and Mechanized Infield Collection of FFB

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RINGKASAN

Tiga jenis penuaian dan pengutipan hasil ladang secara berjentera atau sistem pengangkutan BTB di ladang-ladang tepi pantai dikaji bagi menentukan apakah faktor yang mempengaruhi kos. Jenis-jenis sistem yang dikaji ialah:

Sistem Penuai — Pemandu
Sistem Penuai — Pemandu — Pemunggah
Sistem Penuai — Pemandu — Pemungut Buah Lerai

Ciri tiap-tiap sistem, pengendalian sistem berkenaan dan pembayaran dihuraikan. Baik dan buruk tiap-tiap sistem dari segi produktiviti, kos, pendapatan pekerja, kebosanan kerja dan mutu BTB dikaji. Sistem yang paling jimat dari segi kos ialah Sistem Penuai — Pemandu. Salah satu rumusan yang didapati, menunjukkan bahawa keperluan tenaga kerja boleh dikurangkan sebanyak 20% — 30%. Kos pengendalian traktor mini adalah murah jika ia dijaga dengan baik tetapi akan menjadi mahal jika tidak dijaga. Kos penuaian dan pemungutan dalam ladang yang dibantu oleh sebuah traktor mini merupakan 3% — 9% dari jumlah kos.

Kos langsung bagi penuaian dan pengangkutan BTB dalam ladang dari pokok ke tempat memungut di tepi jalan (tidak termasuk faedah sampingan) adalah sekitar $10.58 hingga $11.09 setan metrik. Pertambahan $4.50 setan metrik dianggarkan bagi faedah sampingan.

Cadangan bagaimana cara untuk mengurangkan kos penuaian dan pemungutan BTB dalam ladang dengan menggunakan jentera bagi sesuatu keadaan ladang, juga diberikan.

INTRODUCTION

Harvesting and in-field collection of FFB together constitutes one of the major cost elements in the production of palm oil. The rapid development of the Malaysian oil palm industry, both in terms of area planted and palm oil production has also resulted in a labour shortage situation. In view of the increasing labour costs, mechanically-assisted means of in-field FFB collection using mini-tractor/trailer were introduced and evaluated to reduce labour dependence.

Traditionally, transportation of FFB from palms to the roadside collection points was carried out manually using kanda stick, bicycle, wheelbarrow or hand cart. The use of animal draught power such as the buffalo/sledge has also been reported on various estates but such system can only be implemented in areas with suitable terrains. However in the early eighties, the introduction of mini-tractor-cum-trailers with payloads of one tonne had gained popularity among the harvesters particularly those working in well-managed estates. Besides improving harvesters' productivity and earnings, the use of mini-tractor/trailers had resulted in overall improvement in harvesting standards (Yaakob and Toh, 1987 and Ling Ting Hang, 1988). Comparable performance on the use of mini-tractor/trailers over a period of 9—24 months have been reported by Anon (1988) and Malek (1988).

This paper examines the economics of three operational systems involved in implementing the mini-tractor/trailer system of in-field FFB collection on three coastal estates over a period of 32—48 months. Details on harvesters' productivity, earnings and harvesting costs are also presented.

DESCRIPTION OF MINI-TRACTOR/ TRAILER UNIT

The mini-tractor/trailers used for FFB evacuation has been described by Yaakob and Toh (1987). There are several makes which are currently in operation on the estates. However, in this study, the performance of a fleet of eight IHI-Shibaura SP 1840 (18 hp) mini-tractors operating on three coastal estates were evaluated. These mini-tractor/trailer units are priced between $13 000 – $14 000. They are easy to operate and do not require a skilled driver. Loads of one tonne are easily transported by open-end trailers which are fitted with double wheels.

The trailers are designed to maintain minimum loading height, maximum manoeuvrability and are equipped with hydraulics for rear tipping.

During the trial periods, several modifications were carried out in an effort to further improve the machines' performance. This includes installation of double rear wheels and mini An-T-Flip hitch onto the mini-tractors.

SYSTEMS OF OPERATION AND EARNINGS DISTRIBUTION

In this study, three systems of operation using mini-tractor/trailer units for mechanized in-field FFB collection have been evaluated under varying field conditions, cropping levels and labour situations over a period of 32—48 months. The three systems are as follows:-

Harvester-Driver-Loader (HDL)
Harvester-Driver (HD)
Harvester-Driver-Loose Fruits Collector (HDLFC)

Details on the operational systems and recommended proportion of basic earnings are briefly described as follows:-

HDL System

A mini-tractor/trailer team comprising a driver and loaders cater for a group of harvesters. When only one loader is involved, as in the case of low cropping periods, the loading operation is carried out by the driver/loader team on a rotational basis. The harvesters are responsible for cutting bunches, cutting and stacking of fronds and collecting loose fruits. Normally, unofficial helpers assist in the loose fruits collection. A total of three mini-tractors were studied under the system. The apportionment of earnings is as follows:-

Harvesters/Loose fruit collectors	75%
Driver/Loaders	18.75%
Vehicle maintenance	6.25%

HD System

Harvesting operations are undertaken by cutter/carrrier teams whose functions are to harvest bunches, cut and stack fronds, collect loose fruits and load bunches into trailers. No specific loaders are involved. The mini-tractor is operated by a team of three drivers who are appointed from within the harvesting team. They usually work on a rotational basis. For each group there is a group leader who is responsible for overall supervision as well as upkeep and maintenance of the tractor. Only two mini-tractors are involved in the study. The distribution of earnings is as follows:-

Harvesters/Driver	90%
Vehicle maintenance	10%

HDLC System

A mini-tractor/trailer driven by a specific driver who caters for a group of cutter/carrier team. The cutters are responsible for cutting bunches and fronds as well as loading of bunches into trailers. No specific loaders are involved. The carriers assist in stacking fronds and collecting loose fruits. Three mini-tractors were used in the study. The apportionment of earnings is as follows:-

Harvesters (cutters)	50.4%
Loose fruits collectors (carriers)	33.6%
Driver	6%
Vehicle maintenance	10%

The choice of operational systems will of course vary from estate to estate but the basic requirement is to gain the harvesters' acceptance. It is important that the concept of mechanized in-field FFB collection must be disseminated to every harvester and its potential long term benefits highlighted.

VEHICLE'S AND HARVESTERS' PRODUCTIVITY

Productivity is defined as output produced per unit resource of input. In this study, three aspects of productivity are measured. They are:-

* Monthly vehicle productivity (tonnes FFB/month)
* Daily vehicle productivity (tonnes FFB/day)
* Labour productivity (tonnes FFB/man-day)

Data on vehicles' and harvesters' productivity for the three operational systems studied are presented in *Table 1*. Highest vehicle output rates have been recorded under the HD system with an average daily and monthly vehicle output of 23 tonnes and 506 tonnes FFB respectively. However, as the various systems were not implemented under controlled conditions, variations in the vehicle output among systems could also be due to differences in cropping levels, individual harvester's output, size of harvesting team, total area covered, number of working days per month and total operating hours per day.

Results also indicate that the average daily vehicle output does not correspond with the monthly output rates. This is mainly due to the variations in the total days worked per month as indicated in the footnotes of *Table 1*. However, in order to ensure that the mini-tractor/trailer system is an economically viable operation, an annual average daily output rate of about 20 tonnes per day should be maintained. On monthly basis an average monthly vehicle

TABLE 1.
A COMPARISON OF PRODUCTIVITY OF HARVESTING AND IN-FIELD TRANSPORT SYSTEM OF FFB (tonnes/FFB)

	Systems of Operation		
Items/Systems	**HDL**	**HD**	**HDLFC**
Average Monthly Vehicle output of FFB Per Machine	413.76	506.08	437.91
Average Daily Vehicle's Output	19.46	22.77	18.89
Harvester's Productivity	1.48	1.46	1.49

Notes:
1. Harvesting rounds ranged from 10—15 days per month.
2. Number of workers per harvesting team varies among system.
3. Cropping level was 25 tonnes/ha — 30 tonnes/ha.
4. Presence of unofficial helpers in estates is common occurrence.
5. Average days worked per month was 21, 22 and 23 for HDL, HD and HDLFC respectively.

output of 400 tonnes — 500 tonnes of FFB would accordingly be harvested and evacuated.

The harvesters' productivity for the systems being studied ranges from 1.46 tonnes — 1.49 tonnes FFB per man-day which indicates only marginal correlation between harvesters' output rates and the systems employed. However, when compared with manual systems, mechanized in-field FFB collection generally improves overall harvesters' productivity as more time is being allocated for collection of bunches. The mechanized FFB collection system also eases the physical effort required to remove a large amount of crop especially during peak cropping periods. The competitive spirit generated within and between the teams by peer pressure also helps to improve the overall productivity of the harvesters.

In general, the overall productivity does not seem to show any marked difference among the systems. A good system should achieve between 400 tonnes — 500 tonnes of FFB per vehicle per month whereas daily vehicle output should be about 20 tonnes. Harvesting rounds, task size and number of work force per team should be organized to achieve the above parameters. Harvesting rounds should be maintained at 10—15-day round so that the quality of FFB do not suffer.

COST OF HARVESTING AND IN-FIELD FFB COLLECTION

Direct cost of harvesting and mechanized in-field collection of FFB consists of the following components:-

* Total basic earning
* Mini-tractor's net contribution and
* Management/supervision

The mini-tractor's cost is made up of the following:-

* interest repayment
* running and repairs
* depreciation (at 20%) and
* amount recovered by management to cover for the running and repairs of mini-tractor/trailer.

The total direct cost of harvesting and mechanized in-field collection of FFB ranges from $10.58 to $11.09 per tonne. Results indicate that the HD system is most cost effective. However the difference in cost among the three system is not significant (See *Table 2*).

The total basic earnings is the first and major component of the cost of the three systems. These range from $8.83 to $9.74 per tonne and constitute between 81.6% — 87.2% of the total cost. The wage rate is mainly a function of price of CPO per tonne as published by PORLA and expected yield bracket of the fields harvested. The differences in the wage rates for the three systems indicate the average effect of PORLA price and yield bracket.

The second component contributing to cost is the mini-tractor. The net cost of using mini-tractors over the three systems ranges from $0.35—$1.00 per tonne. The cost of running and repairs over the three systems was $0.50—$0.73 per tonne as shown in *Table 2*. There are five major factors contributing to the net cost of using mini-tractor.

Firstly, it is important that the vehicle productivity is fully maximized in order to reduce the overall harvesting costs. Low vehicle throughput would result in higher mini-tractor's cost.

Secondly, expenditure on running and repairs of mini-tractor/trailer could be reduced by having a proper maintenance schedule and assigning a specific driver to operate the vehicle. The policy of having a

TABLE 2.
COST OF HARVESTING AND MECHANIZED IN-FIELD COLLECTION OF FFB BY TYPES OF SYSTEM

Item \ System	Harvester-Driver-Loader ($/tonne)		Harvester-Driver ($/tonne)		Harvester-Driver-Loose Fruit-Collector ($/tonne)	
Total Basic Earning (Basic Harvesting Cost)	8.83	(81.6)	9.23	(87.2)	9.74	(87.8)
Mini-Tractor	1.00	(9.2)	0.35	(3.3)	0.35	(3.2)
Interest Repayment	0.33		0.27		0.31	
Running and Repairs	0.73		0.50		0.65	
Depreciation (at 20%)	0.54		0.44		0.51	
Amount recovered from gross earnings of labour	–0.60		–0.86		–1.12	
Management/Supervision	1.00	(9.2)	1.00	(9.5)	1.00	(9.0)
Total	10.83	(100.0)	10.58	(100.0)	11.09	(100.0)

fixed driver should be encouraged to reduce cost of running and repairs and eventually the net cost of utilizing mini-tractor. Proper vehicle maintenance and care would delay the need to overhaul it.

The third and fourth factors are interest repayment and depreciation costs. These costs can be reduced by increasing vehicle output per month.

The fifth factor *i.e.* the amount recovered which ranges from 7%–11% could be reduced or increased depending on company policy. An increase in the recovery rate of 1%, would reduce total harvesting cost by a corresponding 1%.

Finally cost of supervision is standardized at $1.00 per tonne. This cost is calculated based on the average supervision costs for the three estates involved in the study.

INCOME OF HARVESTING TEAM

Income of harvesting team was in accordance with recommended rates as indicated earlier. However, in practice, daily variation, rounding errors *etc.* resulted in the distribution of earning among the harvesting team as shown in *Table 3*. The apportionment of earnings however differs slightly from the recommended rates.

TABLE 3.
PROPORTION OF TOTAL BASIC EARNINGS AMONG HARVESTING TEAMS (%)

Items	Systems of Operation HDL[a]	HD[b]	HDLFC[c]
Harvester	73	91	50
Driver	9		6
Loader	11	–	–
Loose Fruit Collector	–	–	33
Mini-Tractor	7	9	11
Total	100	100	100

Notes:

a – Harvester-Driver-Loader
b – Harvester-Driver
c – Harvester-Driver-Loose Fruits Collector

A comparison of average income per month among the labour and machine components of the harvesting teams under the three systems are shown in *Table 4*. The average workers' income ranges between \$206—\$395 per month. Relatively more income was earned under the HD system because of the higher monthly vehicle output. It should be noted that the above income does not include fringe benefits.

DISCUSSION

Mechanized in-field collection of FFB in the context of a well-organized estate, high cropping level and full workers' cooperation offers positive scope for increasing vehicle and labour productivity. During peak season, the present team of workers is well able to cope with the increase production of FFB by using mini-tractor/trailers to assist in in-field collection.

During low season, however, a high deduction on cost recovery for mini-tractor may cause dissatisfaction among workers. This could be overcome by reducing the vehicle recovery rate. On the other hand, a higher recovery rate could be implemented during high cropping periods.

If the objective is to fully recover the running and repairs cost, depreciation and interest repayment it is estimated that a recovery factor of 20% of the total basic earnings at the given productivity rates and cropping levels would be sufficient to recover all. However, such a high deduction percentage is not acceptable by the workers as it would adversely affect their earnings.

Acceptability of the system by workers is of paramount importance. They have to be made aware that mechanized in-field collection results in high monthly throughput as well as high individual output with less drudgery felt. The team's monthly productivity of 400 tonnes — 500 tonnes per month or 1.5 tonnes per man-day could not

TABLE 4.
COMPARISON OF AVERAGE BASIC INCOME PER MONTH (\$/M) AMONG LABOUR COMPONENT OF HARVESTING TEAM

Year System	Nov. '84 — Apr. '88 HDL[a]	Aug. '85 — May '88 HD[b]	Jun '84 — May '88 HDLFC[c]
Harvester	205.81 (13)	249.30 (17)	301.74 (7)
Driver	336.68 (1)		238.44 (1)
Loaders	394.79 (1)	—	—
Loose Fruit Collector	—	—	237.58 (6)
Mini-Tractor	246.60	434.72	489.45

Notes: Figures in bracket ( ) refer to the number of workers.
a — 3 mini-tractors (111 machine-months)
b — 2 mini-tractors (66 machine-months)
c — 3 mini-tractors (137 machine-months)

be sustained over almost four years by manual in-field collection.

The average running and repairs cost of the three systems was about $0.63 per tonne. This would be equivalent to $283.50 per month. Based on a monthly vehicle output rates of 450 tonnes and zero interest rate, the capital can be recovered in four years. This however assumes that the mini-tractor/trailer is properly maintained and the depreciation and interest repayments are borne by the company.

It is important to keep the running and repairs cost of mini-tractor/trailer low within the range of $0.65—$0.73 per tonne. It is anticipated that this cost could be maintained until the fifth year of the mini-tractor's operation.

CONCLUSION

The mini-tractor/trailer system of in-field FFB collection has been introduced and developed successfully into an economically viable operation on the estates. It offers the scope of improving harvesters' productivity and enhancing overall harvesting efficiency. Mini-tractor operational costs are low and output levels acceptable. During peak cropping periods, reasonable harvesting intervals were maintained without increasing the existing workforce, thus resulting in superior crop and oil quality. Morever the lower labour force associated with mechanized in-field collection of FFB ensures a lower expenditure in terms of fringe benefits.

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