

## Determination of the Harvesting factors of Independent Smallholder Oil Palm Estate

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### Abstract

#### Keywords:

*Oil palm fruit bunch,  
Harvesting; Handling,  
Small Holder Estate,  
Bruising.,*

This study investigates the factors of oil palm fruit harvesting management. Focus was given to the Independent Smallholder Estate (ISE) and the data was collected through survey on the farmers, dealers and processing mill. It is found that the major factors that affect palm oil quality are harvesting method, harvesting intervals and transportation delay time. To analyse different factors the data was collected on fruit quality such as ripeness, fruit bruising during harvesting from different estates. It was found that over ripe fruit produces more bruising and loose fruit which results higher free fatty acid content in the oil which is the major factor for oil quality. On the other hand under ripe fruit produces low yield of oil. Harvesting method such as manual or using mechanical tools makes a difference on fruit bruising and also on the harvesting cost.

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### 1. Introduction

Oil palm provides the highest yield of all oil crops. Modern high-yielding varieties developed by breeding programs, under ideal climatic conditions and good management, are capable of producing more than 20 tons of bunches/ha/yr, consisting oil palm in bunch content of 25 percent [1]. This is equivalent to a yield of 5 tons oil/ha/yr (excluding the palm kernel oil), which far outstrips any other source of edible oil [1]. However, such high yields are rarely achieved in practice because climatic conditions are usually not always ideal. The management of costly inputs of labour, imported fertilizers, pesticides and harvesting machinery, is also a difficulty that hampers the yield of plantations. So, high range of yield depends of soil

types, variety of plants, climate condition, labour, imported fertilizer, pesticides, harvesting machinery, variety of farms, transportation, handling, oil extraction etc.

Quality control begins whilst the fruit is still on the palm and very closely connected with harvesting standards and practice. Maintaining the optimum ripeness is very important to have controlled free fatty acid (FFA). Normally harvesting circle starts at the age of 2.5 years to 3 years old plantation [2]. According to ripeness standard, when there is before cutting one loose fruit appeared on the ground per pound of bunch weight. Normally every 10 days interval mature fresh fruit are being harvested using different types of manual and motorize cutter [2]. After harvested the loose and

FFB are collected and gathered to send the processing mill. FFB are loaded manually and send the mill by using lorry, track.

The adverse effect from harvesting, handling and transportation may results low quality and low yield fruit [3]. It is the function of the field staff to ensure that certain critical standards which influence both quality and quantity of oil are maintained. Regular supervision is necessary to ensure that correct standards of work of the harvesters are achieved. Optimum ripeness of fruit, harvesting tools (e.g. harvesting, grabbing, collecting tools, machines, and vehicles) and quality of FFB will affect the quality and yield of palm oil. A number of transportation systems are available. Lorries and tractors with tippers are the common ones. In some plantations with flat terrain, cages are sent by rail to the estates to transport the FFB to the palm oil mills. The FFB is normally unloaded onto a ramp and then to sterilizer cages. After harvesting the fruit are sent to mill for extraction of oil and mill receive FFB at reception ramp that is an open space and store them for sterilization. Delays in transferring unloaded FFB into sterilization case for early processing will result in build-up of FFA [4].

In Independent Smallholder Estate (ISE) practice, harvesting of FFB, handling and transportation of FFB is more affected than other practice such as Government estate, Private estate (e.g. Federal land development authority (FELDA), Federal land consolidation and rehabilitation authority (FELCRA) etc.) which results low quality and low yield of palm oil. Independent Smallholder Estate owner's insufficient investment inputs low quality maintenance. As they use their savings or income from the estate for maintenance and harvesting, they cannot afford short interval harvesting. As a result when they harvest, some FFB becomes

overripe and also harvest some under ripe, few optimum ripe bunch. When harvested over ripe bunch the fruitlet become easily bruise and loosen. They cannot afford motorise cutter instead of use manual Sabit, Pahat which gives low worker efficiency, more loose and bruise fruit.

ISE harvester normally harvest small amount of FFB at one time so they cannot sell their FFB direct to the processing mill. Normally farmers do not have own transportation to send the FFB to the mill. They sell their FFB to the FFB collector who sells the FFB to the dealer, finally dealer sell the FFB to the mill. Dealer and the collector have their own FFB transporter or they arrange the transporter. In this long chain of selling FFB, the FFB are subjected to handle several times. The handling is carried out in using different methods for example manual and use of machinery. In the estate, fruit are collected and grabbed using manual tools (Lifter, J hook) after grabbing FFB are loaded in track manually by using hand (just pick the FFB and through inside truck) and manual grabbing tools. When the FFB reached in the dealers ramp, FFB are unloaded by using crane, again for sending them to the mill loaded into the trailer or rail truck using crane and unloaded in the mill ramp.

Due to the limitation of facilities the ISE farmers normally practice long harvesting cycle and harvest some over ripe FFB. When they harvest over ripe bunch the fruitlet get bruised and loosen easily. The more the fruit bruises; the FFA will be produce in the oil. Loose fruit also affected easily by enzymatic reaction, which means increase of FFA. Loose fruit are not collected 100% and not properly (collected with dirt and rubbish) which in result decrease yield and increase impurity of oil. For Independent Smallholder Estate, as they follow a long chain of fruit selling the fruit reached in the mill 24 to 48 hours, sometimes even more than

that. But for high yield good quality oil, fruits need to sterilize as soon as possible after harvesting.

The following factors such as ripeness of fruit, harvesting round, loose fruit collection, supervision of harvester, labour, level of mechanization, transportation, handling fruit may affect largely on the quality and yield. Very little work was found to be carried out on harvesting, handling and transportation of FFB. So, this study will investigate on the current practice of the ISE to determine the factors, which affect the quality FFB quality.

## 2. Methods

### *General Survey for Independent Smallholder Estate (ISE):*

To do the general survey for ISE, survey was conducted on farmer's age, input source, investment source, knowledge of palm cultivation and harvesting, farmer's association connectivity, harvesting time, harvesting tools and machine, transportation vehicles; and method using survey questionnaires with farmers, harvester. Batu Pahat was selected for this study. About 60 owners, 60 harvesters or dealers were selected. Survey questioner was based on farming information source, input source, plant sepsis, harvesting interval, harvester mode, labour availability, labour

experience, loose fruit collection, harvesting and farming difficulties and so on. All collected data are then analyzed and presented by percentage.

### *Determining the Fruit Ripening Level at Different Harvesting Interval:*

To determine fruit ripening level at different harvesting interval data were collected from the Independent Smallholder Estate and FELDA Estate. Ten estates were selected from ISE, which are labeled as E1 to E10, and 5 estates were selected from FELDA based smallholder estate, which are labelled as E11 to E15 to compare and find better practice. From each types of estate 20 oil palm fruit bunches were selected randomly. Bunches are categorized as unripe, ripe and overripe as main category and cat eye, unripe; ripe 1, ripe 2, ripe 3; overripe 1, overripe 2 as sub category (Table 1) as stated by [5]. After taking each category data, the percentage and average value of each category was calculated. In this way the unripe, ripe and overripe percentage and also average percentage for each estate was calculated. According to Table 1 fruitlet off bunch' means fruitlet that fall from bunch while ripen the bunch. Criterion is set depending on fruitlet, which is off from bunch because of ripeness; cat eye means no fruitlet off from bunch.

Table 1: Ripening standard criteria for bunch of oil palm fruit [5].

Ripening Level	Fruitlet off bunch	Criterion
<b>Unripe</b>	No fruits	Cat eye
	1-12.5% outer layer fruits	Unripe
<b>Ripe</b>	12-25% outer layer fruits	Ripe
	25-50% outer layer fruits	Ripe 1
	50-75% outer layer fruits	Ripe 2
<b>Overripe</b>	75-100% outer layer fruits	Overripe 1
	Several inner layer fruits	Overripe 2

*Loss analysis in terms of FFB rejection:*

To find out the farmers loss in terms of FFB rejection by processing mill, 3 months FFB rejection data was collected from FELDA palm oil processing mill.

**3. Results and Discussion:**

*3.1 General survey for independent smallholder estate*

The survey data which has been collected through the direct questionnaire from the ISE is presented in Table 2. The collected data has been divided into different variables such as farming information, plant species and harvesting techniques and its impact.

*Information Source about Farming*

As presented in Table 2, it can be seen that about 61% farmers which is majority, get information and knowledge about cultivation, harvesting and maintenance of estate from their family or other farmers who are cultivating oil palm fruit generation to generation. Only about 22% get knowledge from RISDA which is well organised smallholder development association. RISDA provides subsidies, and manages basic infrastructure and processing of the crop. RISDA also provides social development activities through its Smallholders Development Centers [6]. Another 8% get information from farmers association and the rest 7% get information from input suppliers, local nursery, agriculture institute or knowledge from own study. The response shows that there is a

lack of scientific knowledge on oil palm cultivation, harvesting and transportation as mostly the knowledge is based on previous experience and former family members.

*Harvested Plant Species and Input Source*

The majority, about 66% farmers (See Table 2) do not know what types of species they planted on their estate. Farmers do not have proper knowledge about plant species, they just plant whatever they get from local nursery or other input suppliers. About 22% (Table 2) planted Tenera species, which gives more productivity than others (Dura, Pisifera), this is a hybrid variety of Dura and Pisifera. Tenera has a high commercial value than others. Most commercial plantations are established on the basis of Tenera palms. Dura and Pisifera are only 11% (Table 2). This result indicates that farmers need more knowledge and education about palm plantation. They need to know which species gives more productivity and which are suitable for their plantation. To give details knowledge about plantation farmers association can play a vital role. Farmers association can arrange workshop about plantation or arrange documentary show, which will be more attractive way to get knowledge.

Most of the farmers 58% (Table 2) buy the plant and fertilizer from local nursery and few of them 31% buy from RISDA. As mentioned earlier, RISDA is a well-organized smallholder development association who supply good quality inputs.

Table 2: Survey data on harvesting

Variables Response (%)	No of Respond (out of total respond 60)	(%)
Farming Information Source		
<b>Family and other Farmers</b>	37	61.67
<b>RISDA</b>	13	21.66
<b>Farmers Association ( Pladan)</b>	5	8.33
<b>Others</b>	5	8.33
Harvested Plant Species		
<b>Tenera</b>	13	21.66
<b>Dura Or Pisifera</b>	7	11.66
<b>Don't Know</b>	40	66.67
Input Source		
<b>Local Nursery</b>	35	58.33
<b>RISDA</b>	19	31.67
<b>Others</b>	6	10.00
Harvesting Intervals		
<b>18 to 25 days</b>	36	60.00
<b>11 to 17 days</b>	20	33.33
<b>8 to 10 days</b>	4	6.66
Harvester mode		
<b>Hired labour</b>	43	71.67
<b>Farmer</b>	17	28.33
Variables Response (%) Labour Mode		
<b>Experienced</b>	39	64.3
<b>Inexperienced</b>	21	35.7
Loose fruit Collection		
<b>50-60% Collected</b>	4	6.67
<b>60-70% Collected</b>	23	38.33
<b>70-80% Collected</b>	30	50.00
<b>Above 80%</b>	3	5.00
Most Critical Problems for Harvesting		
<b>Labour (Yearly 3 to 6 times)</b>	27	45.00
<b>Waiting time for sending FFB at dealer or Mill ramp</b>	22	36.67
<b>Weather</b>	7	11.67
<b>Tools</b>	4	6.67

*Harvesting Intervals*

As can be seen in Table 2, the majority group of farmer (60%) harvests their fruit every 18 to 25 days of harvesting interval. About 33% do harvesting on 11 to 17 days interval and only 7%

do 7 to 10 days interval harvesting. This indicates that a major percentage of farmer do late harvesting which results an average of 50% overripe fruit, 9% under ripe fruit. For standard harvesting interval is

7 to 10 days [7]. FELDA normally do their harvesting every 10 days [8].

#### *Harvesting Tools*

It was found that 100% harvester use manual harvesting tools, which is cutter, grabber, loose fruit collector and loader. Low investment and low maintenance cost is the main reason to use manual cutter. Harvesters (haired labour or farmer) earn a little amount for which they cannot or do not want to invest a big amount to buy the motorize cutter or machines that used for gabbing, loose collecting or loading truck. Also they cannot bear the maintenance cost of those machines and motorize tools. Manual chisel, sickle, hook, lifter, wheeled trolley are more convenient for them.

#### *Harvester Mode*

About 71% farmers do the harvesting by hiring labour and 28% harvested themselves. It indicates that a large percentage of farmers need to pay labour for harvesting. Labours are paid RM 30-35/ton of FFB harvesting. Farmers sell their FFB RM 320-360/ton. And large percentage of farmers depends on haired labour. If labours are not available they will late for harvesting.

#### *Labour Mode*

The efficiency of the labour is an important factor. About 64% (Table 2) labour are experienced who had been doing harvesting for 2 to 5 years and they only work for palm estate. Rests 35% are inexperienced labour who does not have any previous experience to work as a harvester. They are mainly seasonal worker. Study discovers that experienced labours availability vary on area.

#### *Loose Fruit Collection*

This study explores that about 15 to 25% fruit become loosen when harvested FFB and

approximately 70-80% of those loose fruit are collected and rest 20-30% are not collected but MPOB rule is to collect 100% loose fruit. FELDA normally collect 95% loose fruit.

#### *3.2 Determining the fruit ripening level at different harvesting time:*

Table 1 shows the ripening standard criteria for bunch of oil palm fruit. According to Table 1 'fruit let off bunch' means fruitlet that fall from bunch while ripen the bunch. Criterion is set depending on fruitlet, which is off from bunch because of ripeness; cat eye means no fruitlet off from bunch.

Table 3 shows that the average highest 42% overripe bunch which were harvested from the estates E1 to E5 and were harvested between 18 to 25 days interval of harvesting. Highest 50-60% overripe bunches were harvested from E4 which was harvested on 22-25 days harvesting interval. Study shows that only average 43% ripe bunches are harvested and rest 57% unripe and overripe bunches are harvested on 18 to 25 days.

When bunches are harvested in 11 to 17 days harvesting interval, the % of overripe bunch harvesting was reduced to average 23%. E6 to E10 are more ripe bunches harvested estates which are harvested average 68% ripe bunches. In this group of harvester E10 is the lowest overripe 10% and under ripe 5% bunch harvester and E6, E7 are the highest overripe 35%, 30% and under ripe 15%, 15% bunch harvester which are harvested on 11<sup>th</sup> and 17<sup>th</sup> days interval.

Table 3: Fruit ripening level in different harvesting interval

Harvesting Interval	Estate	Fruit Ripening Level									
		Unripe			Ripe			Overripe			
		Cat eye	Unripe	%	Ripe	Ripe 1	Ripe 2	%	Overripe 1	Overripe 2	%
18 to 25 Days	E1	0	2	10	4	4	5	65	4	1	25
	E2	1	4	25	2	3	3	40	5	2	35
	E3	0	3	15	1	2	5	40	6	4	50
	E4	0	3	15	0	1	4	25	7	5	60
	E5	0	2	10	2	4	4	50	6	2	40
<b>Average</b>				15				43			42
11 to 17 Days	E6	1	2	15	2	4	4	50	4	1	35
	E7	0	3	15	3	4	4	55	5	1	30
	E8	0	1	5	5	4	5	70	3	2	25
	E9	0	2	5	6	6	4	80	3	0	15
	E10	0	1	5	6	5	6	85	2	0	10
<b>Average</b>				9				68			23
8 to 10 Days	E11	1	0	5	7	7	4	90	1	0	5
	E12	0	0	0	7	7	5	95	1	0	5
	E13	0	1	5	6	8	5	95	0	0	0
	E14	0	0	0	6	8	6	100	0	0	0
	E15	0	1	5	7	7	5	95	0	0	0
<b>Average</b>				3				95			2

Study also shows that average harvested bunch quality which are harvested on 8 to 10 days interval, are better than 11 to 17 days and 18 to 25 days interval harvested bunches. This group of harvester E11 to E15, harvested average 95% of ripe bunches and only 5% of overripe and under ripe bunches. This harvesting % is achieved by benchmark harvester, FELDA.

Different harvesting interval shows that bunch ripening level depends on harvesting interval. Bunch ripening level increases if harvesting interval is more. Highest overripe bunch was harvested on 25<sup>th</sup> days interval and lowest overripe bunch was harvested on 8<sup>th</sup> and 10<sup>th</sup> days interval. When harvested overripe bunches are more than harvesting of under ripe bunches trend is more to minimise overripe bunches but this trend do not give any logical result on oil extraction rate. Overripe fruit gives poor quality oil and under ripe fruit means less oil. This study shows on paragraph

4.3 that 18 to 25 days interval harvester group is 59.7% which is highest harvester group.

Fruit bunches are produced throughout the year although there is a distinct peak and off peak in the annual cycle. Harvesting of ripe bunches is therefore a year round activity done at intervals of 8-14 days. Harvesting at intervals of 7 days or less is usually not economic especially during at off peak period [9]. On the other hand, harvesting intervals exceeding 15 days will result in an excessive number of lose-fruit, incurring higher labour costs in lose-fruit collection. Any ripe bunches missed will become seriously over ripe or rotten by next harvest [2]. Harvesting intervals of 10 days are recommended but may be extended to 15 days during peak yield cycles [9].

As Independent Smallholder estate is a small scale estate (some estate found 1 hectare and sometimes

even less than one hector), so they do late harvesting because of small amount fruit harvested on short interval harvesting. So they wait until maximum bunch ripen. Overripe fruit gets easily bruises and rotted which in a result increase the FFA level and also get contaminated with dirt and other metal [10].

According to [11] the presence of impurities favour bacteria growth in oil high, dirt content was found to be related to high iron and copper content. Palm oil is said to be reasonably clean if the impurity content is less than 0.020%.

### 3.3 Loss analysis in terms of FFB rejection:

The amount of fruit received and rejected from FELDA and dealer (which from Independent Smallholder Estate) to a processing mill is presented in Table 4. It can be seen that the percentage of rejection is between 0.49-1.20percent for FELDA whereas for dealer the rate is 1.74-2.48% which is rejected for bad quality, damage and rotten FFB. So the rejection is 3 times higher for dealer than that of FELDA. This is mainly due to late and overripe FFB harvesting, more damage fruit due to excessive handling, delay time to send FFB to mill due to long FFB collecting and selling chain.

Table 4: Loss due to fruit rejection

		<b>Total Fruit (ton)</b>	<b>Price/ton (RM)</b>	<b>Fruit reject (ton)</b>	<b>Reject (%)</b>	<b>Loss due to reject (RM)</b>
<b>Month 1</b>	FELDA	3590.28	478.05	17.80	0.49	8509.29
	Dealer	2937.72	432.69	51.17	1.74	22140.75
<b>Month 2</b>	FELDA	6019.99	490.53	46.74	0.77	22927.37
	Dealer	4525.73	447.40	112.66	2.48	50404.08
<b>Month 3</b>	FELDA	5475.65	448.64	65.98	1.20	29601.27
	Dealer	2605.17	409.02	55.67	2.14	22770.14

## 4. Conclusion

To identify the factors affecting the FFB quality on harvesting, handling and transportation survey and interview was carried out. It was found that about 61.5 % farmers get information and knowledge about cultivation, harvesting and maintenance of estate from their family or other farmers who are cultivating oil palm fruit generation to generation. So, lesser percentage of farmers gets the proper scientific and recent information about oil palm plantation, harvesting, handling etc. Most of the

farmers do know about the species which they cultivate; so they do not know whether there is any other species which may have high yield or high productivity. The majority group of ISE farmer harvests their fruit every 18 to 25 days of harvesting interval which means they harvest overripe fruit, as the standard harvesting interval is about 10 days.

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