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Oil Palm Motorised Cutter Evo 2

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Abstract
MPOB has introduced an oil palm motorised cutter called 'Cantas Evo' that works effectively for palms with harvesting height of below 7-metres. Cantas which is powered by a small petrol engine has been proven to double up harvesting output compared to manual harvesting. Even though Cantas Evo has shown very positive results in-terms of productivity and quality, but the R&D has never stopped as to improve its performance and cost-effectiveness. Over the past two years, a new generation motorized cutter has been designed, developed and tested. The prototype employs gear-box at the bottom of the machine which brings down the point centre of gravity that helps the handling become more convenient. Almost 50% of the components have been cut-off which brings to the saving on components of about RM306.06/machine. Results of the laboratory tests showed that the prototype passed all the required tests, i.e. functional, fatigue and vibration test.. A field trial conducted in Banting Selangor for 4-5-metres palms' height revealed that the machine was able to harvest about 3 t day-1(4 working hours). As for the economics, based on the estimated machine price of RM3100 per unit plus its operational, repair and maintenance costs, the cost effectiveness is calculated to be RM1.72 t-1 FFB.

Keywords: new generation oil palm motorised cutter, oil palm cutter

Introduction

The total oil palm planted area in Malaysia was about 5.85 million hectares, contributing the gross income of about RM67.58 billion to the country (MPOB, 2019). It was reported on December 2016 the statistics foreign workers that about 340,283 in this industry which accounts for about 77.8% of the total field workers in the plantation sector (MPOB website, 2016). The problem is become more serious as 90% of the harvesting operations in the oil palm industry are performed by the foreign workers. The alternative way to address that issue is through mechanisation.

Harvesting is one of the main activities in plantations. Harvesting history begins with the use of bamboo as a pole mounted on top of a sickle. Bamboo was the first harvesting pole used for harvesting FFB for tall palms. However, due to its low productivity and scarcity of getting it, other options have to be identified. Later PORIM (now MPOB) had developed a harvesting pole made of aluminum alloy that gave better strength and durability, and lightweight (Razak et al., 1998). In 2007, MPOB has moved a step forward with the introduction of oil palm motorised cutter known as the Cantas.

Difficulty in getting skilled harvesters has been a real issue, and ways on how to improve harvesting productivity has become a necessity. Manual harvesting (using a sickle or chisel) can only produce about 1t of FFB-man-1day-1 (Azman et al., 2015). Estates are now looking for more efficient harvesting tools which can double up this productivity in order to increase individual daily harvesting productivity and ultimately reducing the number of workers. The harvesting productivity needs to be increased to about 4 t/man-day if the country wishes to reduce labour requirement significantly.

Efficient harvesting can be achieved by at least two means; i.e. efficient harvesting tool and sufficient harvesters to cater to harvesting rounds of the recommended 10 to 12 days' interval. Harvesting activities required about 60% of the workforce for the whole plantation area in Malaysia. In order to reduce labour dependent and increase productivity, labour saving approach has to be introduced such as mechanisation. This could be achieved through the introduction of efficient and economical harvesting technology.

The current mechanical harvesting of oil palm fresh fruit bunches (FFB) or popularly known as 'Cantas Evo' employs a small 2-stroke petrol engine and transmission shaft to activate the sickle. Cantas consists of four main components i.e. 2-stroke petrol engine, extendable aluminium pole, pole gripper and the cutting head. The current Cantas Evo can reach up to 7m palms. Usage in plantations proving that Cantas Evo could improve workers' productivity by 70 – 80% and reducing labour requirement by 40 – 60% compared to manual sickle (Razak et al., 2008). Cantas Evo increases harvesting productivity which improves harvesters' earning besides reducing workers on the payroll, currently dominated by foreign workers (Razak et al., 2013).

Cantas (*Figure* 1) is a motorised cutter specifically designed for harvesting FFB and cutting fronds. It is powered by a small petrol engine and utilises either a specially designed C-sickle or chisel as the cutting knife. MPOB is the owner of the technology with patents filed in Malaysia, Indonesia, Thailand, Brazil, Costa Rica and Columbia. Cantas helps workers to speed up harvesting operation thus increasing harvesting productivity. This paper is aim to describe development process a new generation oil palm motorized cutter. The cutter should be able to carry out harvesting FFB and pruning efficiently and effectively.

Figure 1 : Oil palm motorised cutter (Cantas) (current version)

Materials and methods

The development of Oil Palm Motorised Cutter Evo 2 was carried out at Research Station MPOB/UKM and time motion study and field trial was conducted in Banting, Selangor.

The novelty of the technology can be described as follows:

- This design reduces the number of parts used which is only seven parts instead of 17 parts for previous version.
- The gear-box is placed at the bottom of the pole instead of at the top (as in the engine powered Cantas). This can bring down the point of centre of gravity of the pole which makes the handling of the tool is much easier and convenient for the operator. The gear box is used to convert rotational motion from the engine into a linear motion for the purpose of cutting.
- Higher reach as the pole length can easily extended.

The Prototype

Specifications:

Total length	: 4.00 m
Total weight	: 7.1 kg
Specific weight	: 2.56 kg/m
Cutting Knife	: C-sickle

Table 1 dan Figure 2 shows the technical comparison between Oil Palm Motorised Cutter Evo 2 and the prior art (Cantas).

Table 1: Technical Comparison
New Generation Oil Palm Motorized Cutter Vs Cantas

Description	Oil Palm Motorised Cutter Evo 2	Prior art (Cantas)
Activator	Petrol engine	Petrol engine
Power source	Fuel (petrol)	Fuel (petrol)
Gear box placement	At the bottom of pole	At the top of pole
Transmission	Nil	Mechanical – shaft & bearings
Cutting knife	Chisel / sickle	Chisel / sickle
Length (m)	4	4
Weight (kg)	7.1	7.4

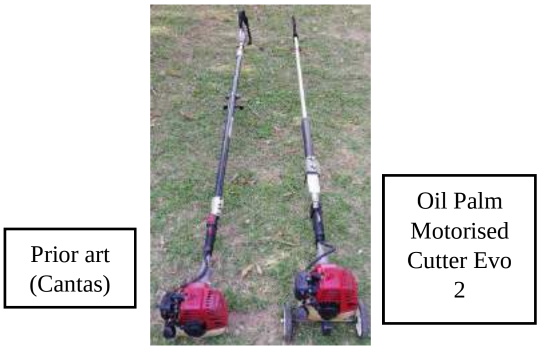

Figure 2 : Technical Comparison Oil Palm Motorised Cutter Evo 2 Vs Cantas

Figure 3: Prototype Oil Palm Motorised Cutter Evo 2

Results and discussion

Time and Motion Study (TMS)

Time and motion study was conducted in two different operations, *viz.* (i) harvesting FFB and (ii) pruning fronds. The purpose of TMS was to determine the performance of the prototype in the harvesting and pruning activities. For harvesting, the total time taken was the time required to cut fronds, cutting FFBs and walking. While for pruning, the total time was the time required to cut fronds and walking only. The number of palms, fronds and FFB were counted. The results are tabulated in *Table 2* and *3*.

Table 2 : Time And Motion Study For Harvesting Ffb

	Palm/ hour	Frond/ hour	FFB/ hour
Test 1	37	86	55
Test 2	31	62	65
Test 3	30	60	33
Average	**33**	**69**	**51**

Table 3 : Time And Motion Study For Pruning Frond

	Palm/hour	Frond/hour
Test 1	64	356
Test 2	65	286
Test 3	64	348
Average	**64**	**330**

Results of the performances of the machine are as follows:

<u>Harvesting FFB</u>

- 51 FFB/hr

<u>Pruning Frond</u>

- 64 palms/hr
- 330 fronds/hr

The overall performances of the machine for harvesting FFB and pruning fronds are 51 FFB/hour and 330 fronds/hour, respectively.

Field Trial

The field trial of the prototype was carried out by a smallholder plot at Banting, Selangor. The total area was about 50 ha with two rounds harvesting per month. The palms were about 3 to 5 metres height with flat topography.

Trial conducted showed that the average harvesting productivity was about 3 t FFB/day (4-hrs working a day).

Table 4: Field Trial Results From July 2017 To December 2017

Month	Total days	Total hours	FFB	
			Bunches	Tonnage
July 2017	15	60	2989	45
August 2017	16	64	3187	48
September 2017	15	60	2937	47
October 2017	14	56	2866	43
November 2017	15	60	2933	44
December 2017	13	52	2821	42
Total	**88**	**352**	**17733**	**269**

Average performance:

Bunches	:201 FFB/day @ 50 FFB/hour
Tonnage	: 3 t/day
Harvesting performance	: 3 to 4 ha/day

ECONOMIC ANALYSIS

User Perspective

From the user perspective, the fixed cost is the cost to own the machine while variable costs are labour and repair and maintenance. The operational cost per tonne FFB was calculated using a straight-line depreciation method. The details of the calculation are shown in *Table 5*.

Assumption

Machine selling price	: RM3100/unit
Life span	: 2 years
Performance	: 3 tonne/day
Labour cost	: RM50/day

Table 5: Cost Analysis Of New Generation Mototrised Cutter Using Straight Line Depreciation Method

Description	Calculation	Cost (RM/day)
Depreciation (price/(life span x 300 days)	3,100/(2 yrs x 300d)	5.17
Fuel Cost	0.0625 l/hr x RM2.30/l x 4 hr	0.575
R&M cost @ 10% per year of purchase price	10% x 3,100 / (300d)	1.03
Total		**6.775**
Cost per tonne = total cost/productivity	(RM6.775/day) / (3 tonne/day)	RM2.26/t FFB

Therefore the operational cost per tonne FFB comes to about RM2.26/t (harvest only).

In term of cost-effectiveness (CE) of the technology the lower the CE, the more the technology will likely to be adopted by the industry. The cost-effectiveness is calculated by the following formulae (Stanners, 1992):

Cost effectiveness (CE) =
Tool or machine price (RM)
______________________… (1)
Total bunches harvested (tonne FFB)
=RM3100/(3t FFB/day x 300day/yr x 2yrs)
=**RM1.72/t FFB**

Therefore, the cost effectiveness of new generation mototrised cutter tool is RM1.72/t FFB

Conclusion:

The introduction of this technology is expected to increase take up rate as it offer a better performance, better quality, user friendliness and low repair cost. This will increase profit margin to the harvester or the owner of the machine. The cost-effectiveness has been increased significantly as a result of high productivity and low repair cost. Based on the estimated machine price of RM3100 plus its operational, repair and maintenance costs, the cost effectiveness is calculated to be RM1.72 t-1 FFB.

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