

Performance Study of an Oil Palm Fresh Fruit Bunch Three Wheeler Evacuation Machine

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Abstract: A case study to determine performance of Three Wheeler evacuation machine was done at Felda Plantation. Using 20kg (average) of fresh fruit bunch (FFB), A machine was tested at different topography where the area are 0.7 hectares (terrace), 1.5 hectare flat area, 1.5 hectare mild undulating and 1.5 hectare heavy undulating. Method of optimum was used to determine performance three wheeler where the performance between 73% to 77% efficiency measured. From experiment also shows three wheeler can access all train in oil palm plantation.

Keyword: Oil Palm Fresh Fruit Bunch, evacuation, topography, three wheeler

Introduction

Oil palm area production of oil palm fresh fruit bunch (FFB) for last 5 year was increased to 5.05 million MT, as FFB improved to 19.59 MT per hectare (ha) from 19.12 MT per ha in 2012(Media released) . This data showed a good tool must have to harvest and evacuate oil palm FFB and loose fruit (LF). Tool in oil palm plantation was used to do a job for harvesting and evacuating include cutting and loading a FFB. Starting with the use of the sickle/chisel, cut the bunch will be identified after ripening. Sickle and chisel is a sharp instrument made of steel. Normally sickle and chisel will be affixed on the end of bamboo, round timber, steel and aluminium are also called pole. The length of the pole and timber depends on tree height and tree age. After FFB cut using the equipment will be transported by wheelbarrow or any powered machinery. In mechanization term, applied of machine or any tool in assist of work in field collection of oil palm plantation with indicator of production in tonne/day. In history of harvesting oil palm FFB, FFB and loose fruit will be loaded in wheelbarrow the number 2-4 of FFB, will be wheeled through the path of tree harvesting in the number of 10-15 trees up to the platform. From the platform of FFB will be sent to the factory for processing. Wheelbarrow that were originally made of wood and mounted of end a chassis with wheel. Wheel barrow is the easy way to evacuate the FFB because the maintenance is free and very cheap to buy but need a lot of labour to do work and low production of FFB. Ahmad Hitam (1999) study a system approach to mechanization in oil palm plantation. Figure 1 show a schematic diagram and connection from harvesting and mill. It show a related to FFB harvesting, pruning, evacuation and transportation of FFB to the mill. As for the evacuation of FFB and also mainline transport to mills, there have been tremendous improvements. Three wheeler is an important interface machine between harvester and in field collection to evacuate FFB to platform. This activity also to ensure FFB can send to mill in 24 hour to process and produce highly quality of crude palm oil.

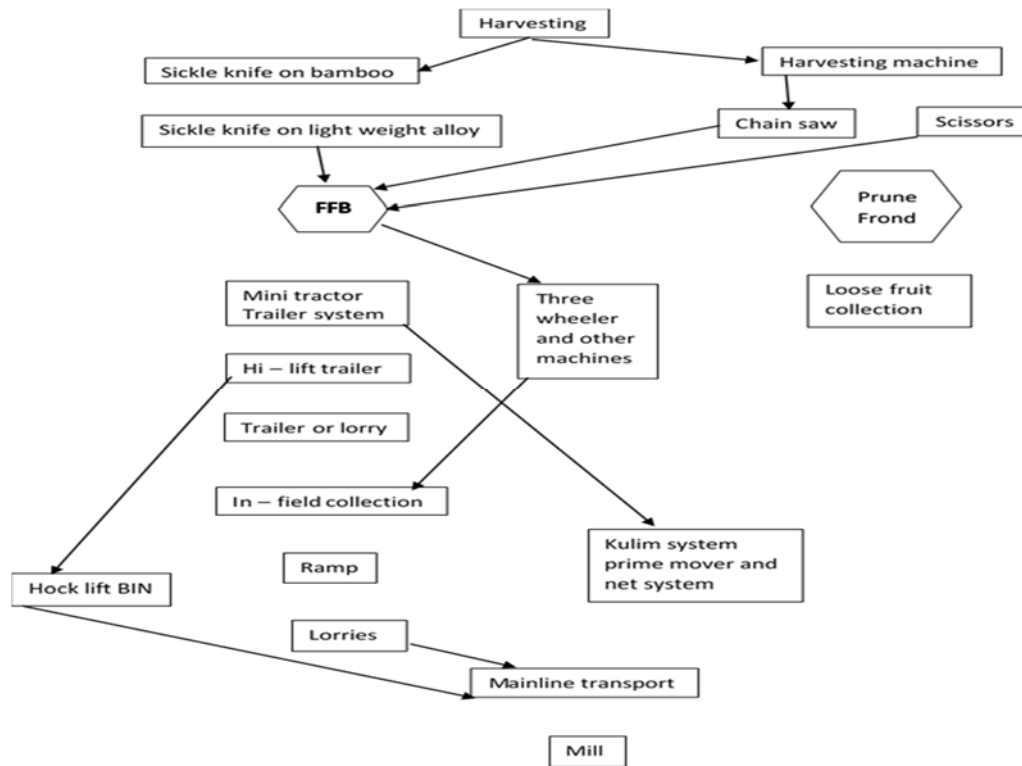


Figure 1: System approach to mechanization

In Malaysia, the demand for labour is a major issue, and now includes the use of mechanized equipment. If the matter is not resolved, FFB production will drop drastically and will give impact on the country's export commodities. Harvesting of FFB is presently an operation not amenable to mechanization, but infield fresh fruit bunch (FFB) collection especially on flat to undulating terrain has been mechanized with varying degree of success(Kamarudzaman Ali 1994), (Mohd Ali 1995) and (Cunnigham 1969). To overcome this problem, Azali Awaludin (2011) study the machinery used for the production of FFB were compared in terms of machinery, land use, the amount of labour used, the total production of FFB (MT) and the costs involved. Below in table 1 shows

Table 1: Mechanization comparison

Machine	First Capital (RM)	Maintenance (Monthly)(RM)	Usage of worker	Productivity (ton/hour)	Area Coverage (hectare)
Wheelbarrow	60 - 150	none	3	6t	6 -8h
Mini Tractor	60,000 -70,000	300 -500	3	30 -40t	10 -15h
Eco Rider	26,000	200	2	10 - 12 t	8 -10h
Buffalo	2,000	100	2	6t	6 -8h
Grabber	75,000	500 -1000	1	30 -40t	

This study focus to all machinery currently used in FELDA plantation, machinery application or farm mechanization in the production of FFB can accelerate when the harvesting work is done. Besides reducing of foreign labour, mechanization also reduce damage on FBB during transportation to the mill. FFB delivery to the mill will increase double if managed properly. Mechanization requires a large amount of capital, yet effective mechanization of returns to factors of work efficiency, quality of FFB produced, labour utilization and management of an effective oil palm plantations. While a recent study has been done on the three-wheeler to get

information related to the same information such as test equipment before. This testing purpose machinery to minimize costs, reduce labour and higher FFB productivity.

Problem statement of Oil Palm Fresh Fruit Bunch Evacuation

1. Requirements labour intensive to harvest. The ratio of workers to the acre is between 1:16 to 1: 18
2. Individual Task - harvester workers divided according to individual tasks ranging from 8-10 rows harvested per harvester. This causes the day to harvest a large area and difficult job of quality control that works with supervision.
3. Load BTS - Evacuate FFB from the base of the tree requires people or wheelbarrow. This work can reduce production of FFB because energy is used manually to evacuating FFB.
4. Loose collection -. To collect loose fruit for energy focusing to transport FFB bunches must be brought to the factory within 24 hours after harvest, resulting in a loose net seeds are not collected.
5. Acquisition costs - to bear the burden of additional costs of unskilled workers.

Material and Method

The methodology of evaluation includes 3 items are background of topography, the system works and test procedure. In Malaysia, Felda Global Ventures have 258,000 hectare of plantation area. Yong (2013), presented a data topography for Felda Global Venture Plantation Malaysia, there is 26% of area is Flat to gentle undulating (below 4° slope), moderately hilly is 49% (slope 5° -12°) and hilly is 25% (slope over 12°). Below in figure 2 shows a distribution of topography.

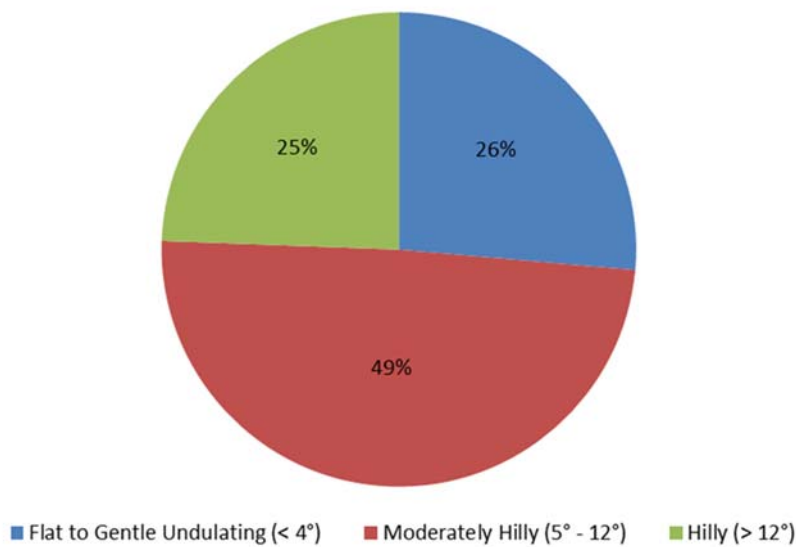


Figure 2: A distribution of topography for FGVPM

Based on above information, three wheeler evacuation machine evaluation will be focused to different train as mention in table 1.

Table 2: Information area of testing

Type of topography	Harvesting row	Area (hectare)	Slope (°)
Flat	7	1.5	0°
Undulating (mild)	7	1.5	5° - 8°
Undulating (heavy)	11	1.5	6° - 11°
Terrace	7	7	0°

In oil palm plantation, system of work implement to worker based on area coverage and job description. Works was divided based on area and total of labour. Ramesh Veloo (2010) proposed ratio 1 labour to 7 hectare for activities in plantation. To get same situation activities between actual working in plantation and this evaluation, 3 labour divided to do works as:-

1. Driver
2. Bunches loader
3. Loose fruit collector

Information of Three Wheeler



Figure 3: Three Wheeler Evacuation

Three wheeler was designed to suit with harvesting work. Equip with large bucket can contain 33 FFB at one time. Three wheeler evacuation machine also design with basic mechanical equipment and easy to drive and manoeuvre in harvesting path. Below in table 2 shows a specification of three wheeler evacuation machine.

Table 2: Information of Three wheeler evacuation machine

Description	Three wheeler machine
BODY AND CHASSIS	
Body Length (mm)	2510
Body width (mm)	1125
Body Width – tire to tire (mm)	1330
Carrier Type	Manual Tip - Off
Carrier Width (mm)	1120
Carrier Length (mm)	1295
Ground Clearance (mm)	Front – 290mm,Rear-325mm
Vehicle weight (kg)	415
ENGINE	
Engine	Yanmar Air – Cooled Engine
Hp	10hp
Model	L100N6 - MTMR
Fuel	Diesel
Fuel Consumption/Hour (estimated)	0.25lt/hour – 0.44lt/hour
Fuel Consumption / Day (estimated)	2.0lt – 3.5lt/day
Clutch Type	Tension Pulley

The evaluation was based on time recorded where time was recorded during FFB evacuation. A total of 200 bunches arrange at base of palm for topography of flat, mild undulating and heavy undulating. While the terrace area of 99 bunches are required. The three wheeler evacuation machine, will entered the harvesting path and 2 labour collecting FFB and loose fruit as normal/daily operation into the bucket of three wheeler. Time will recorded for this activity based on 2 repeated evacuation for each topography. Below in figure 4 shows a flow of three wheeler movement during evacuation and table 4 shows information - area of testing.

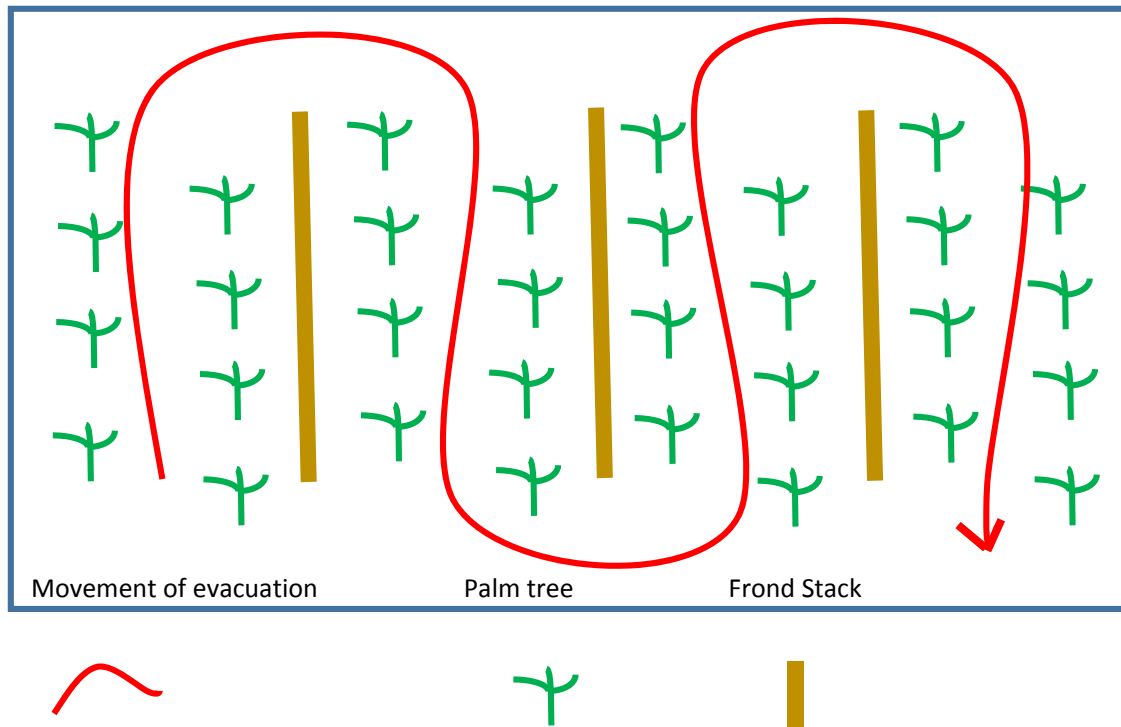


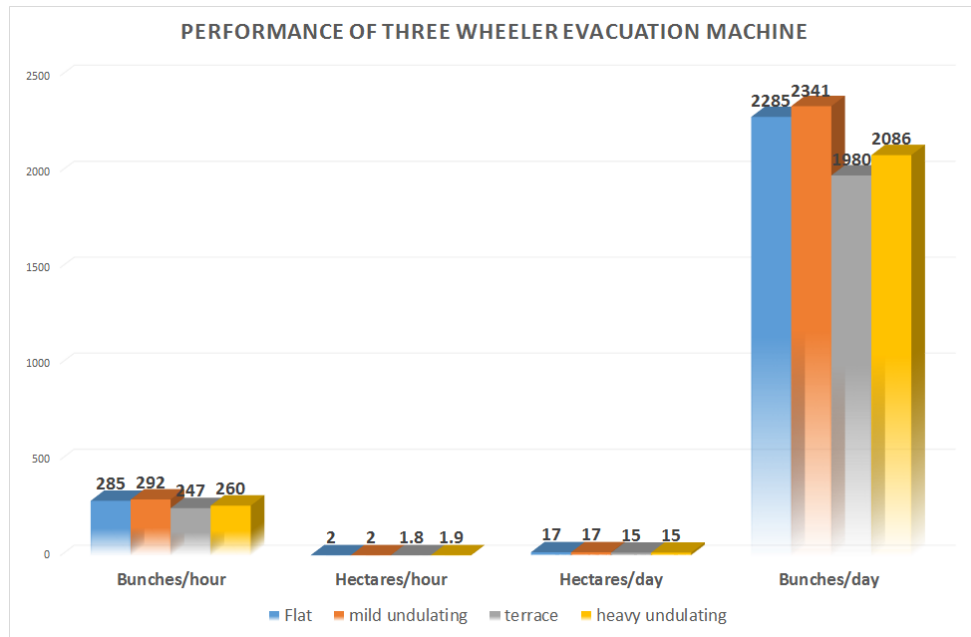
Figure 4: Movement of evacuation

Table 4: Information of topography, area and number of FFB

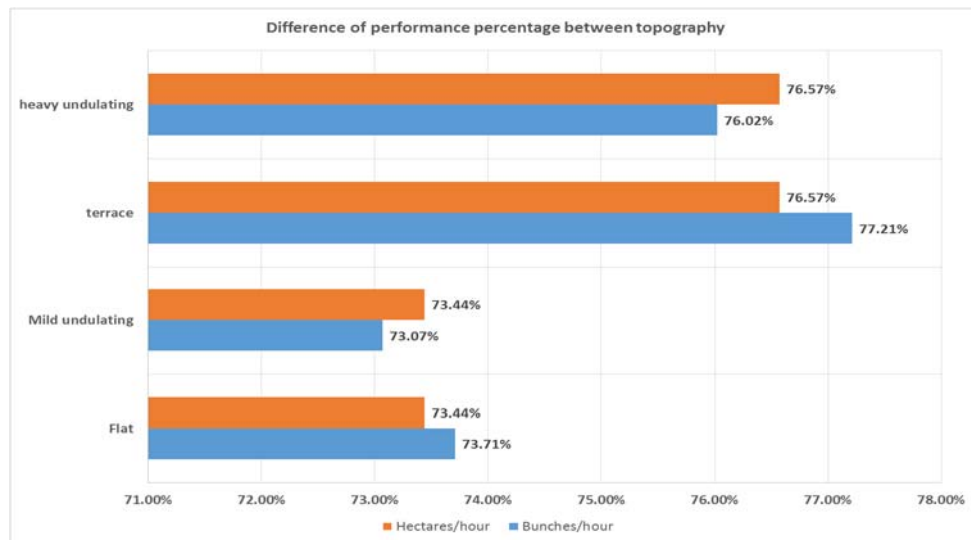
Topography	Area (Ha)	No of FFB
Flat	1.5	200
Mild Undulating	1.5	200
Heavy Undulating	1.5	200
Terrace	0.7	99

Result

From results, this machine can evacuating 1980 to 2341 bunches of FFB per day or the equivalent of 39.6 tons to 46.8 tons per day with the use of 0.5 liter of diesel to 1 liter. The average number of tons per worker per day was 14.4 tonnes per hectare while the employee is 5.42 hectares per day. This machine also can operating in all topography testing. Below in graph 1 and graph 2 shows the performance result of three wheeler during the experiment.



Graph 1: Performance of three wheeler evacuation machine



Graph 2: Different of performance between topography

Discussion

Abdul Rahim Shuib (2010) claimed their FFB collection and evacuation machine productivity was found between 2.4 tonnes to 3.6 tonnes per hour. This FFB production are same (three wheeler) but this machine have no traction problem on shallow peat. Using Halftrack, this machine can carried weight about 500kg of FFB and using 18 hp diesel engine. Compared to three wheeler FFB evacuation machine, this three wheeler can carried load about 750 kg and using 10 hp engine more than 50% performance with halftrack machine. Abdul Rahim Shuib (2010) also promote evacuation machine named ‘Grabbie’ which specially designed grapple attached to chassis. The machine requires a team of eight FFB harvester and one machine operator. With production of FFB 18 -25 tonne per day and coverage an area of 25 hectare but not same with three wheeler because three wheeler can produce more FFB with same labour uses. Below in figures 3 shows halftrack and ‘Grabbies’.



Figure 3 and figure 4: Halftrack and Grabbies

From topography testing, three wheeler can enter all the topography with evacuating include terraced areas. Three wheeler has a chassis width is 1330 mm. With a minimum capacity of 33 bunches FFB, three wheeler can easily move between harvesting path. Below shows factor influencing during experiment:-

- **Labour**
FFB evacuating job and collect loose fruits into the bucket machinery using manpower, total use of labour energy will increased and lead to worker fatigue.
- **Weather**
During the experiment period, the rain dampened the ground in the harvesting path. This will cause the surface to become slippery and affect the amount of time recorded.
- **The degree of slope**
Degree slope measured is in the range of 5° to 11° resistance to evacuation equipment in the FFB issue of harvesting path. Three wheeler evacuation have a special specification for climbing hills called 'differential gear lock "which can grip the surface better.
- **Loose fruit**
Loose fruit collecting will influencing a lot of time recorded. This is because the FFB dropped at ground trash loose fruit because of the impact. It takes 1 minute to 2.5 minutes to collect loose fruit.

Conclusion

The factor of time is the most frequently used operations in the optimization method to obtain the efficiency of a machine. This method is based on time parameter changes, while keeping the others parameter at a constant level. Experiment show, three wheeler evacuation machine perform FFB evacuate work better than mini tractor because an efficiency show machine 70% and above. From topographic testing result, three wheeler evacuation machine can access all terrain of topography where this machine easily manoeuvre between harvesting path and terrace area. All result shows, three wheeler evacuation machine can help yield FFB increase and increase an oil extraction rate at mill.

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References

- Abd Rahim Shuib, Abdul Razak Jelani, Salmah Jais, Mohd Ramdhan Khalid and Mohd Solah Deraman. (2010). *Innovation and Technologies in Enhancing Oil Palm Mechanization* 4th National Seminar On Oil Palm Mechanization, PalmMech 2010 GEARED FOR FULL THROTTLE, page 13 -14, Kuala Lumpur
- Ahmad Hitam, Ariffin Darus and Chan Kok Weng (1999). *System approach to mechanization in oil palm plantation*, PORIM International Palm Oil Congress, page 325 -353, Kuala Lumpur
- Azali Awaludin, Syed Salim and Mohd Rosdi Ngah.(2011). *Fresh Fruit Bunch Evacuation Using Mechanization*, 2nd Technical Workshop 2011, page 1 – 15, Jerantut, Pahang
- Cunningham, W M (1969). *A container system for transport of oil palm fruit*. Progress in Oil Palm (ed P.d. Turner). Incorporated Society of planters, Kuala Lumpur.
- Media release – *FGV Register Improved Q4 PAT of RM510.72 million*, Thursday, 27 February 2014.
- Kamarudzaman, A, Mohd Ali, Aand Mohd Hashim, T (1994). *Mechanized in- field FFB for improved productivity*. Proc.1994 International Planters Conference, 22 – 26 Oct. 1994. Kuala Lumpur
- Mohd Ali, A (1995). *Mechanization of plantation operations*. PORIM National Oil Palm Conference, 11 -12 July 1995. Kuala Lumpur
- Ramesh Veloo, Jaai Haron and Zainudin Mohd Yatim (2010) , *Economic of Mechanisation- Estate Experience*, 4th National Seminar On Oil Palm Mechanization, PalmMech 2010 GEARED FOR FULL THROTTLE, page 227 -246, Kuala Lumpur
- Yong Kian Keong (2013), *Site yield potential of Felda Global Ventures Plantation Malaysian*, Mini R & D Seminar, Kuala Lumpur