MPOB Initiatives in Oil Palm Mechanisation Adoption Increment and Towards Agriculture 4.0

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INTRODUCTION

Agriculture mechanisation is a field activity that combines technology as a prime power and human operator as the manipulator. Improving the worker's productivity by increasing speed of work is a significant to agricultural practices. The implementation of farm mechanisation in Malaysian oil palm plantation has increased the land to labour ratio. The ratio represents the requirement of human labour to operate the palm area. Currently, overall land to labour ratio for Malaysian oil palm plantation is 1:10 ha (Kushairi *et al.*, 2019). However, the figures for individual operations such as harvesting and evacuation are typically higher, such as 1:20 ha or 1:30 ha, which are similar for estates that practice total mechanisation. The system which employs field operation also determined the land to labour ratio. The tasking work system could usually reach higher percentage of land to labour ratio as compared to communal work system (Ludin *et al.*, 2014). In the tasking work system, labour is assigned with specific work. Thus, the endeavour could achieve better productivity since the labour focused on only specific job. Similarly, This is similar for mechanisation practice, where usually a machine or a tool focuses on a specific job. This makes mechanisation much more productive.

Several factors are used to consider machinery or tools selections for the oil palm plantation applications, such as age of palms, type of soil, terrain conditions, and also arrangement of the planted plot (Muhamad and Aziz, 2018). Strategic planning is also required, such as preparation of the mechanisation path, shelter for machinery, fuel bay, and also support in place before commencing the practice. These factors are essential to ensure successful implementation of mechanisation practice in the field. Therefore, mechanisation practice is not just about owning the machinery in the field but also managing the system properly for typical plantation operation in Malaysia.

The efficiency of mechanisation practice is measured by how much the field area could be covered. It reflects the productivity of the operator and the assistant. Thus, labour requirement is reduced. Since Malaysia is highly dependent on imported labour for manual labour operation, hence, reducing the requirement for imported labour could subsequently create a positive microeconomic condition locally (Azwan *et al.*, 2016).

Besides direct economic impact on utilisation of machinery or farm tools in the field, mechanisation could also produce other economic impacts for Malaysia such as creating new specialised jobs, *i.e* skilled operator, field technician, operation analyst and many more. Many new businesses such as manufacturing of farm machinery and its spare parts, service providers, sales and distribution, consultations and many more could also emerge. Other than that, engineering university graduates could also involved in this sector by utilising high technology equipments for field mechanisations such as drones, robotic and other mechatronic technologies. The positive impact of embracing Forth Industrial Revolution (IR4.0) technologies in farm mechanisation is huge.

Agriculture 4.0 is a technological revolution that involves sensors, big data analysis, artificial intelligence and several other components embedded in farm

machinery or also refers to as smart machinery (King, 2017). The smart machinery in the field will provide advantages such as lesser chemical used, precise input to the field requirement, tracking and tracing capability, as well as more environmentally friendly field practice due to overall integrated decision and application process. Even though smart machinery is expensive, it is viable for oil palm plantation practices in the long run. Thus, research, development and commercialisation of local oil palm mechanisation technologies should incorporate these advanced technologies (Rose and Chilvers, 2018).

RESEARCH AND DEVELOPMENT IN OIL PALM MECHANISATION

Malaysian Palm Oil Board (MPOB) as a custodian of the oil palm industry in Malaysia, has embarked in research and development (R&D) of oil palm mechanisation and automation engineering (Shuib *et al.*, 2018). Since 1980s, more than 48 technologies and services have been produced, as depicted in *Table 1*. *Figure 1* illustrates the technologies in the list. The products and services availed are not limited to the list but also on similar products researched and commercialised by other parties. To-date, almost 50 products of the oil palm utility vehicles are available in the market.

TABLE 1. LIST OF TECHNOLOGIES PRODUCED FROM MPOB'S R&D

No.	Year	Technology or Service
1.	1987	Harvesting pole.
2.	1991	The Grabber [mechanical fresh fruit bunch (FFB) loader].
3.	1995	Super Crawler (track type machine).
4.	1995	Automatic Grabber.
5.	1995	Loose fruit collector.
6.	1995	Wakfoot (the infield machinery with halftrack).
7.	1999	Mechanical loose fruit collector (MK II).
8.	1999	Soil stabiliser for plantation roads.
9.	1999	Oil palm mechanical cutter.
10.	1999	Mobile ramp (for mainline loading of oil palm FFB).
11.	2000	Wakfoot MK II (an infield FFB transporter for peat area).
12.	2000	Hi-Reach harvesting pole.
13.	2001	Motorcycle cart for smallholders.
14.	2001	Motorised wheelbarrow for in-field FFB evacuation.
15.	2001	Sprayer for young palms.
16.	2002	Mechanical fertiliser spreader for young palm.
17.	2002	Half-track machine for in-field FFB collection.
18.	2003	Hand-held mechanical cutter.
19.	2004	Mechanical trunk injection for control of *Ganoderma*.
20.	2004	Development of machine for harvesting tall palm.
21.	2004	Cableway system for oil palm FFB evacuation.
22.	2005	Air-assisted loose fruit separating machine.
23.	2006	Hovercraft for in-field operation in oil palm estates with soft ground.
24.	2006	Compact transporter for in-field activities.
25.	2007	High reach oil palm motorised cutter (CANTAS 7).
26.	2008	CT-spray (compact transporter for field spraying operation).
27.	2008	Otowey (in-field FFB transporter with an electronic weighing mechanism).
28.	2008	C-kat (motorised chisel for short palm harvesting).
29.	2009	Loose fruit picker.
30.	2009	Six wheel drive (6WD) with four-wheel steering (4WS).
31.	2009	Evaluation of vehicle performance for R&D (service).
32.	2009	Diesel vehicle and engine gas emission assessments for R&D (service).
33.	2010	CANTAS MK III.
34.	2011	Prime mover for soft ground area.

No.	Year	Technology or Service
35.	2011	Application of traction aid for transporter in peat.
36.	2011	Evaluation of fuel performance for research and development (service).
37.	2012	Beluga (track-type transporter for oil palm field activities in peat area).
38.	2012	Oil palm loose fruit collector (MK III)
39.	2013	Rhyno (multipurpose wheeled transporter for oil palm activities on undulating terrain and soggy areas).
40.	2014	Tractor mounted trunk injector for control of basal stem rot (BSR) disease.
41.	2015	Quality testing laboratory for the oil palm motorised cutter (services).
42.	2016	Hydra-porter (hydraulically powered 4WD FFB transporter for soft structured soil and steep terrain).
43.	2017	Loose Fruit Collecting Mark IV (oil palm loose fruit collecting machine with elevated discharge mechanism).
44.	2017	Battery powered harvesting tool.
45.	2018	Vibration isolator for the oil palm motorised cutter.
46.	2018	EVO2 (oil palm motorised cutter).
47.	2020	Hybrid power herbicide sprayer vehicle.

Realising the fact that automation engineering could increase the efficiency of mechanisation practices, MPOB is currently embarking on high technology application. Among the research carried out are, ultrasonic transducer and laser for fresh fruit bunches cutting, application of drones for chemical spraying, robotic arm, radio controlled vehicle, smart vehicle with sensor and data analysis, exoskeleton and others. A few projects are conducted in a collaborative effort with other institutions to produce better research outcome. Even though the outcome can only be obtained few more years to come, the initiative has been put forward for the betterment of the industry. Besides R&D, other initiatives have been carried out to increase mechanisation adoption in the industry. This effort is made since labour scarcity is becoming more rampant.

INITIATIVES TO INCREASE OIL PALM MECHANISATION ADOPTION

The implication of low mechanisation adoption in the country could be devastating due to labour sources scarcity and could jeopardise overall operation in the field (Azwan *et al.,* 2017). Reason for lack of mechanisation adoption has been identified as due to the high cost of machinery ownership as well as maintenance costs. In this regard, the government has provided various incentives to further increase the ownership of mechanisation technology to the industry, such as the Machinery Ownership Incentive Scheme (OPIMIS) and CANTAS Discount Scheme (SKIDIC).

OPIMIS is an incentive scheme in the form of grant implemented in the 11th Malaysia Plan (11th MP) from 2016-2020. It is aimed to increase the ownership of oil palm machinery to plantation operators in Malaysia. A total budget of RM4.5 million has been approved in the 11th MP. This has funded up to 20% of the machinery production price, and has funded almost 1780 units of farm machinery and equipments by June 2020. These farm machinery and equipment can increase worker's productivity and reduce dependence on foreign labour which is estimated to amount to up to 5000 people. OPIMIS applications consist of 80% estate, and 20% are smallholders, contractors and

Figure 1. MPOB R&D products.

cooperatives as depicted in *Figure 2*. Machinery applied is mostly utility type vehicle, such as three-wheeler, track type mover and also farm maintenance equipment's such as sprayer and spreader.

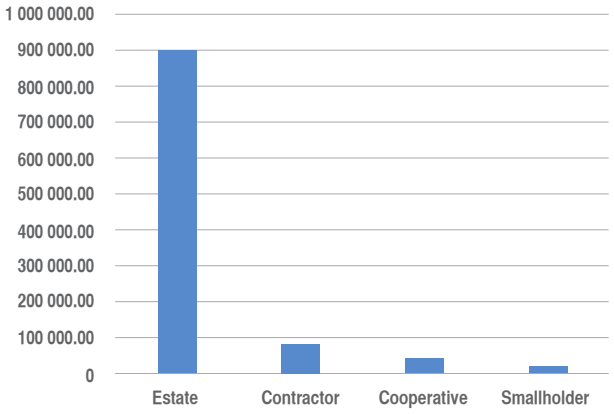

Figure 2. Status of OPIMIS application in 2020.

SKIDIC, on the other hand, was implemented to encourage the industry to use motorised palm fruit harvesting machines (CANTAS) to reduce labour requirements. A total of RM5.3 million is allocated for the implementation of this scheme. The grant provides the assistance of RM1000 for each unit of CANTAS purchased. The use of CANTAS has been proven to increase labour productivity and oil palm harvesting efficiency with almost double the harvest productivity from 1.8 t to 3.2 t per bunch per worker compared to manual harvesting (Jelani *et al.*, 2008). Since its launch in 2010 until March 2020, the total number of CANTAS units that have been funded through this scheme is almost 4500 units to date.

Besides ownership grants to the industry, the government also created special farm mechanisation research fund known as 'Mechanisation Fund'. RM15 million funds from government were set in place since 2018 to ensure the industry could involve directly in the research programme. Selected industry players were selected to participate in the assessment process and monitor work progress. A technical committee (TC) was established, comprising experts from government and industry sectors to evaluate the fund applications. Included were representatives from Sime Darby Plantation Berhad, United Malacca Berhad, Sawit Kinabalu Sdn. Bhd., Genting Plantations Bhd., Sarawak Oil Palm Bhd., FGV Holdings Berhad as well as from MPOA, MPOB and MPIC.

The TC meeting is held quarterly. To date, 23 submissions have been received and evaluated, in which 13 projects were rejected, seven projects were approved, and another three projects are being evaluated. It is envisaged that the mechanisation fund focuses on the latest technology. The implementation of the Mechanisation Fund is managed based on several approaches, terms and conditions. It includes acting as a matching grant that requires a 60% financial commitment from successful applicants to fund the project.

Besides financial initiatives, MPOB also conducts information dissemination and technical training activities to encourage broad adoption on farm mechanisation. It includes bi-annually seminar of mechanisation, operators training course, short term training course and also several other engagement activities. The activities started since ten years ago and received enormous support from the industry. However, customised training for the industry is still required as the industry is still reluctant to pursue full mechanisation adoption due to several factors. Most technologies are only suitable or applicable to certain plantation conditions. Thus, it imposes a challenge for broader mechanisation adoption.

CONCLUSION

Due to prolonged issues and challenges, mechanisation technologies are introduced into the oil palm plantation. With the additions of mechanisation elements, the number of imported labour workforce can be significantly reduced. This, in turn, will lead to less social problem associated with foreign workers. Also, the lack of foreign workers flooding the workforce market will enable locals to fill in the void left by these foreign counterpart. Hence, the issue of currency outflows can be tackled as well. The other benefits that the plantation industry gains from mechanisation are increase in productivity, reduction of operational cost, achieving operational sustainability and improved working timeline. Mechanisation could also provides benefit to the workers, such as higher take-home pay due to higher expertise needed, hasten fieldwork and increase safety and limit hazardous elements in the plantation. Due to vast plantation sector, the market for mechanisation is proportionally vast as well. With the addition of the IR4.0, mechanisation can be further improved, and its effectiveness and efficiency can be increased as well.

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