The Planter, Kuala Lumpur, ***97*** *(1145):527-535 (2021)*

Use of Betor for In-field Crop Collection and Semi-mechanised Upkeep Works in an Oil Palm Estate: A Case Study at PT LNK, Medan, Indonesia

JAYA RAJ, B
PT LNK Kecamatan Selesai, Kabupaten Langkat, Medan

Betor is a combination of traditional rick-shaw with a motorcycle. It is widely used in PT LNK for in-field collection of fresh fruit bunches (FFB). It improved the harvester's productivity by 43 per cent when compared with the usage of conventional wheel barrow. In addition to crop evacuation operations, the betor can also be modified and used for semi-mechanised pest and disease (P&D) spraying and palm circle spraying in immature fields. The semi-mechanised spraying of P&D using betor improved labour productivity by 150 per cent and reduced the cost per hectare by 35 per cent when compared with conventional knapsack spraying. For palm circle weeding, the semi-mechanised betor system resulted in a 32 per cent increase in worker's productivity and concomitantly reduction of cost by 9 per cent when compared with the conventional knapsack spraying. Betor is the preferred choice by estates and smallholders for in-field crop collection and upkeep works due to its low cost and ease of implementation.

Keywords: *Betor, in-field crop collection, pest and disease spraying, palm circle spraying.*

Betor (short form for *beca motor*) is a combination of traditional rick-shaw with a motorcycle which originated from Gorontalo, Sulawesi, Indonesia (Nur Amalia, 2019). It is a three-wheel vehicle transportation used as a paratransit system on the island of Sulawesi and Sumatra, Indonesia (Frazila & Russ, 2001). Betor is also locally known as Bentor or Bemo and its usage has grown quite rapidly over the years since 2003 as a popular alternative mode of transport vehicle, which can carry two to three passengers (Fakhri & Aslinda, 2018). The humble betor has also been modified to transport goods such as cement bags, tiles, and other building materials due to its cheap transportation costs (Ketut & Dwi, 2018).

Similarly, betor has been used in oil palm estates in Indonesia, but mainly to carry out general field work such as weeding, fertiliser application, and also for in-field transportation of fresh fruit bunches (FFB). This paper is written to share the experience on the successful implementation of betor for in-field collection of FFB and semi-mechanised upkeep works in PT Langkat Nusantara Kepong (LNK), Medan, Indonesia. Betor is successfully implemented mainly because of its good mobility, maneuverability and causes less compaction on the soil making it an efficient means of FFB transport. At present PT LNK has 423 units of betor deployed over 10 624 hectares for this purpose. The betor is owned by the harvester himself and the cost of one unit of betor is approximately RP 6 500 000 (USD 447) which is inclusive of the motorcycle and the trailer. Besides crop evacuation, the betor, with modifications, can also be used to assist in semi-mechanised pest and disease as well as circle

email: jayaraj.b@klk.com.my

spraying operations including in immature oil palm fields.

IN-FIELD COLLECTION OF FFB

The harvester will harvest the FFB, cut the stalk and arrange the fronds. After that, the same harvester will ride the betor along the harvesting path to collect the FFB as seen in *Figure 1*. The FFB will be transported out and arranged on the bunch platform situated along the shoulder of collection roads as shown in *Figure 2*. Then a 5-tonne tipper lorry will collect the FFB and loose fruits which have been pre-bagged and transport them to the palm oil mill.

When compared with conventional wheel barrow, the betor is more efficient and effective. This is mainly because the betor has a higher load capacity and does not require the harvester to utilise excessive energy to push the load compared with the wheel barrow. The betor can carry 200-250 kg of FFB per trip compared with 80-90 kg per trip when the wheel barrow system is used (*Table 1*). With the use of the betor, the labour to land ratio for harvesters improved from 1:19 to 1: 25 and productivity of the harvesters increased by 43 per cent resulting in 21 per cent saving in labour (*Table 1*). It is a known fact that the harvesters' wages are positively correlated to their productivity i.e. the higher their productivity, the higher the wages. With the higher productivity of the betor system (*Table 1*), wages would increase in tandem. In addition, the betor is also a form of transportation for the harvesters going and from their assigned workplace which gives them mobility and flexibility compared with the need to rely on estate arranged transportation. From the estate's point of view, this ingenious transportation system also saves cost and negates the need for additional tractors to ferry the harvesters; these cost savings are then channelled and shared as allowances with the harvesters.

From our experience, the maintenance cost of the betor is IDR 13 200 (USD 0.91) per day and the running cost is IDR 20 000 (USD 1.38)

Figure 1 a: Harvester loading FFB into the betor trailer, b: Side view of betor, c: Front view of betor

Figure 2 a. Betor loaded with FFB: b. Harvester riding the loaded betor to road side bunch platform: c. Harvester arranging the FFB at the bunch platform (total number of bunches and crop quality are checked and recorded by bunch counter prior to loading in tipper lorry).

TABLE 1
COMPARISON BETWEEN THE USAGE OF WHEEL BARROW AND BETOR FOR IN-FIELD COLLECTION OF FFB IN BASILAM ESTATE, PT LNK

Parameters	*Wheel barrow*	*Betor*	*Betor-wheel barrow variance*	
	Total		*Value*	*%*
Mature area (ha)	2572	2572	-	-
Total harvesters (no.)	130	103	27	21
Worker ratio (no./ha)	19	25	-	-
Productivity/harvester/day (tonne/manday)	1.4	2	0.6	43
Load capacity - topography flat to undulating (kg/trip)	80-90	200-250	120-160	150-177

per day (*Table 2*) totalling IDR 33 200 (USD 2.30) per day and it is borne by the harvesters. Nevertheless, harvesters who are using the betor system are paid IRD 150 000 (USD 10.35) per month as an allowance as cost sharing by the company.

Semi-mechanised pest and disease (P&D) spraying using betor in an immature oil palm area

The most common pest in immature oil palm areas is *Oryctes rhinocerous* which damages

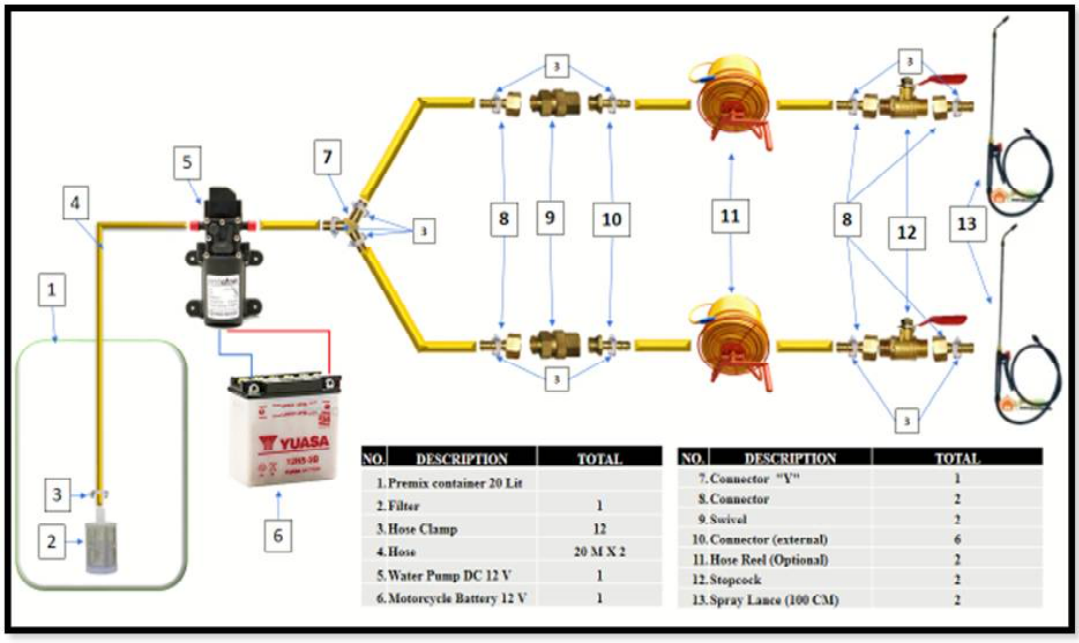
TABLE 2
THE MAINTENANCE AND RUNNING COST FOR BETOR FOR IN-FIELD COLLECTION OF FFB

Maintenance	*Frequency*	*Cost per year (*IDR)*
Tire replacement	6 Monthly	840 000
Tube changing (anticipated)	Monthly	360 000
Replacement of worn out bearing	Monthly	920 000
Replacement of damaged gear	Monthly	300 000
Engine cylinder boring	Annually	500 000
Changing engine oil	Monthly	480 000
General service	Monthly	360 000
Total		3 760 000
Running	*Unit*	*Cost per day IDR*
Petrol	2 L	20 000

**IDR - Indonesian Rupiah. Exchange rate- 1 IDR: 0.000069 USD*

the emerging shoots. It is normally treated by drenching of the palm spear bundle with synthetic pyrethroid at 10-day intervals. The main issue with this insecticide treatment is that it is normally carried out manually and therefore is labour intensive, requires tight supervision, prone to missing out palms, not hitting the target (spear bundle), and under application of insecticide solution. Above issues are normally reduced when they are semi-mechanised which prompted the switch to using the betor assisted spear drenching system. In the latter system (betor assisted), insecticide premix drums are placed on the betor and a 12-volt DC water pump (320 PSI) powered by a motorcycle battery is used to pump the solution to two spray lances *via* a 20 m hose as seen in *Figure 3*. One unit of semi-mechanised betor is normally paired with three workers inclusive of one operator and two sprayers. The driver or operator will ride the betor that carries the premix drum along the harvesting path while the sprayers walk behind the betor drenching the shoots of the palms. Each sprayer will cover one row to the left or to the right of the path until the last palm on each row is drenched as shown in *Figure 4*. Once the row is completed, the betor team will move to the next row of palms (the harvesting path is connected to the next at the end) and the similar operation continues. An extended spray lance (1 m length) is used to ensure that the insecticide can be directed to the shoots whilst the 20 m hose enables the sprayers to reach palms at low lying areas that are not able to be accessed by the betor. The workers can cover a large area because they no longer need to carry the heavy knapsack spray pump which can be also hazardous if there is any leakage.

The output per worker with the betor system (including the betor operator) is 10 hectares and it is 150 per cent higher than manual spear drenching using knapsack sprayers (*Table 3*). A single betor with three workers can cover 30 hectares per day which is translated into 10 hectares per worker. In comparison, a single



NO.	DESCRIPTION	TOTAL
1.	Premix container 20 Lit	
2.	Filter	1
3.	Hose Clamp	12
4.	Hose	20 M X 2
5.	Water Pump DC 12 V	1
6.	Motorcycle Battery 12 V	1

NO.	DESCRIPTION	TOTAL
7.	Connector "V"	1
8.	Connector	2
9.	Swivel	2
10.	Connector (external)	6
11.	Hose Reel (Optional)	2
12.	Stopcock	2
13.	Spray Lance (100 CM)	2

Figure 3 The schematic module of semi-mechanised betor sprayer

Figure 4 Spear drenching using betor in immature oil palm field

TABLE 3
COMPARISON BETWEEN MANUAL AND SEMI-MECHANISED BETOR SPEAR DRENCHING TO CONTROL *ORYCTES RHINOCEROS* BEETLE IN BEKIUN ESTATE, PT LNK

Parameters	*Manual*	*Betor*	*Betor* vs *Manual spraying variance*	
	Total		*Value*	*%*
Immature area-14 months old (ha)	250	250	-	-
Spray area/day - 3 rounds/month (ha)	30	30	-	-
Productivity/worker/day (ha)	4.0	10	6	150
Labour requirement (manday)	8	3	5	62
Labour cost/ha (IDR)	28 220	11 300	16 920	60
Material cost/ha (IDR)	18 000	18 000	-	-
Vehicle cost/ha (IDR)	550	1100	-	-
Cost/ha (IDR)	46 770	30 400	16 370	35

**IDR - Indonesian Rupiah. Exchange rate- 1 IDR: 0.000069 USD*

manual (using knapsack) sprayer can cover only 4 hectares, which clearly indicates the productivity of workers using the betor is much higher than the manual system. Labour saving with the semi-mechanised betor system is 62 per cent and translates to a cost saving of 35 per cent (*Table 3*). One unit of this semi-mechanised betor system can cover 250 hectares of immature oil palm areas at three rounds of spraying per month.

Semi-mechanised palm circle spraying using betor in an immature oil palm area

The circle spraying in the immature oil palm areas with the betor uses the same mechanism as in the semi-mechanised betor sprayer for P&D. The weed species in the palm circles are mainly made up of soft grasses and legumes such as *Mucuna bracteata*. During the immature phase of the oil palm, the circle is normally weeded once a month using glufosinate ammonium. Phytotoxicity problems due to chemical drift during spraying is drastically reduced with the semi-mechanised betor because the sprayer can lift the lowest fronds that are touching the ground with his/her free hand while spraying the circle as he/she does not need to manually pump the otherwise cumbersome knapsack sprayer. By using an extended lance (90 cm length) the sprayer can cover a larger area of the circle without much movement as shown in *Figure 5*. This method improves the ergonomics of the work resulting in less complaints from the workers regarding back aches, thus improving the work productivity and quality.

The output per worker is 3.3 hectares when using the semi-mechanised betor system or 32 per cent higher than the manual spraying system (*Table 4*). One unit of betor with three workers can spray 10 hectares per day which is translated into 3.3 hectares per worker per day. This betor sprayer system can cover 200-250 hectares of immature oil palm areas per month. Labour savings by implementing this semi-mechanical circle spraying with the betor is 40 per cent (*Table 4*). Cost of labour is reduced in tandem by 9 per cent since the workers can cover a larger area.

Figure 5 Circle spraying in an immature oil palm field using betor

TABLE 4
COMPARISON BETWEEN MANUAL AND SEMI-MECHANISED BETOR CIRCLE SPRAYING IN BEKIUN ESTATE PT LNK

Parameters	*Manual*	*Betor*	*Betor* vs *Manual spraying variance*	
	Total		*Value*	*%*
Immature area-14 months old (ha)	250	250	-	-
Spray area per day - 1 round/month (ha)	10	10	-	-
Nozzle	Orange cone	Orange cone	-	-
Spray volume/ha (L/ha)	180	180		
Productivity/worker/day (ha)	2.5	3.3	0.8	32
Labour requirement (manday)	5	3	2	40
Labour cost/ha IDR)	45 150	34 200	10 950	24
Material cost/ha (IDR)	58 200	58 200	-	-
Vehicle cost/ha (IDR)	1 500	2 960	-	-
Cost/ha (IDR)	104 850	95 360	9 490	9

Exchange rate- 1 IDR: 0.000069 USD

DISCUSSION

From the experiences in PT LNK, the various betor systems were able to improve the productivity of harvesters by 43 per cent, P&D spraying by 150 per cent, and circle spraying by 32 per cent in comparison with the conventional in-field collection and manual

spraying system. Those improved work productivity resulted in labour savings of 21 per cent in harvesting in terms of crop evacuation operations and 62 per cent and 40 per cent respectively in P&D spraying and circle spraying operations. In other words, the usage of the various betor systems improved the land to labour ratio by increasing the productive work of each person, reduced labour cost and enhanced workers' ergonomics.

It should be noted that land preparation during re-planting or new-plantings plays an important part in ensuring successful implementation of mechanisation system. Construction of roads and drainage must first be well planned prior to commencement of land preparation. In the above systems, the preferred distance between the collection roads is 200 m and the average length of carry is 100 m. This enables the harvesters to bring out the crop from both sides of the road to the bunch platforms efficiently. Roads in hilly terrain areas must also be carefully planned with the use of a contour map for efficient connectivity and to avoid steep inclinations during road construction. In general, higher chainage of roads is required in hilly areas to achieve the average length of carry of 100 m. In addition, these roads should be constructed prior to cutting of terraces to avoid the situation of hanging terraces (terraces that are not connected to the road).

Careful design of collection drains so that they do not obstruct the movement of the betor within the field must be given due importance and this includes avoiding, the need of collection drains adjacent to collection roads. The harvesting path must be levelled for ease of mobility of the betor and this can done by using a mini bulldozer (D3) or back bucket. During the levelling, it is preferable that the harvesting paths are also inter-connected to each other at the end of the row to avoid the need to double back for more efficient in-field travelling. In immature oil palm areas the harvesting paths are mowed at 45 days interval to ensure ease of movement of the betor.

One of the downsides of the betor system is that it is not suitable to be used in hilly areas, unless the area is properly terraced. In such areas the terraces must be broad (4.2-4.5 m) enough for ease of movement of the betor.

The betor that is currently being used in PT LNK uses a side-trailer that is constructed from light materials. The trailer floor is made using timber planks instead of iron plate and the average weight of the empty betor is around 150 kg. This ensures maximum mobility of the betor even in more challenging terrain and slippery road conditions be it loaded or unloaded.

Challenges faced at the initial stage of implementation of the betor in PT LNK were mainly, related to workers lacking the interest in investing in the betor system. Harvesters are not convinced with the possible increase in wages if they opted for the use of the betor for FFB in-field collection. Therefore the management introduced the betor on a pilot scale with assisted finances to prove its effectiveness. Financial aid in the form of loans was given to interested harvesters to purchase a motorcycle and to construct the side trailer.

The harvesting task for harvesters using the betor system was also increased because they can cover crop evacuation of FFB faster and over wider areas compared with the conventional method. This increased their productivity and in tandem, their earnings. In addition to that, the social standing of the workers also improved with the purchase of the betor because they are also able to use it to commute to/from the field instead of waiting for estate transport, as well as use it for other social purposes and for transporting their

personal agricultural produce from their farm to the nearest farmers' market. This significant paradigm shift motivated other harvesters to also invest in the betor and therefore enabling PT LNK to scale up this humble yet practical system to many other estates within the group.

CONCLUSION

The betor is a very practical system and pragmatic approach in improving productivity of estate operations resulting in major labour savings. This innovation is low in cost and easy to implement in estates and also by smallholders. There are no difficulties in getting the spare parts or in requiring skilled mechanics to repair the betor as the base motorcycle and side trailers are commonly found in many parts of Indonesia. With its ease of implementation, low investment cost and high productivity, the betor has high potential to be used in oil palm estates and for smallholders. The system also attracts local youngsters to work in the plantations and with this, it also creates job opportunities. Nevertheless, the betor's main drawback is that it is not suitable to be used in hilly terrain areas, unless the area is suitably terraced and the terraces are properly integrated to the estate's road network.

ACKNOWLEDGEMENT

I am thankful to Mr Nasrudin Bin Ismail, President Director PT LNK for sharing the data and Mr C V Rajah Padman (Managing Director PT IKS/IKSJ, Papua) for his comments and suggestions. I would also like to thank Kuala Lumpur Kepong Bhd (KLK) for permission to publish this paper.

REFERENCE

FAKHRI KAHAR and ASLINDA. 2018. Management of Transportation Land (Study on Becak Motor Transportation in Tempe District of Wajo Regency. In: *Proceedings of the 1st International Conference on Social Science (ICSS 2018)*. Advance in Social Science, Education and Humanities Research, Volume 226.

FRAZILA and RUSS BONA DKK. 2001. Studi Karakteristik Operational Angkutan Becak di Kota Bandung. *Prosiding Simposium IV,* FSTPT, Universitas Udayana Bali.

KETUT MUDANA and DWI HERIWIBOWO. 2018. Operation Study Pedicab Motor (Bentor) in the Region of Gorontalo. *Warta Penelitian Perhubungan* **28**(2):130.DOI:10.25104/warlit. v28i2.691

NUR AMALIA. 2019. Implementasi Kebijakan Pengendalian Becak Motor (Bentor) Di Kecamatan Tamalate Kota Makassar. Diploma thesis, Universitas Negeri Makassar. 14pp.