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DIGITAL MONITORING AND REPORTING SYSTEM OF OIL PALM FRESH FRUIT BUNCH (FFB) TRANSACTIONS: A CASE STUDY AMONG SUSTAINABLE OIL PALM GROWER COOPERATIVE IN PENINSULAR MALAYSIA

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ABSTRACT

Currently, there is a gap in Fresh Fruit Bunches (FFB) traceability among smallholders until it reached the oil palm mill via dealers. ICT-based intervention at the FFB dealers to record their daily transactions is able to address these issues. The need for this system arises due to the current limitation on getting more accurate and systematic data on the FFB transactions among smallholders. This article presents the development of an information technology (IT) system known as Kebolehjejakan Informasi Pekebun Kecil Sawit (KIPS) phase 2 to address the current gap in collecting data on FFB transactions among smallholders by linking dealer fruit (DF) via technology. Other than that, a case study and survey methodology among 14 Sustainable Oil Palm Grower Cooperative (KPSM) in Peninsular Malaysia was carried out to assess the adoption, challenges and effectiveness of the system as well as the understanding of their current record-keeping practices. KIPS portal system was developed with three user modules of admin, dealer fruit and smallholder. KPSM found KIPS is generally easy to use. However, the limiting factors were the time, performance and productivity in using KIPS which might hinder their attitude and behavioural intention to use KIPS. Lack of time and resources emerges as the main problem in using the KIPS system. Overall, most of the KPSM were able to submit their report through KIPS within the stipulated period. The findings of this study can serve as a basic framework for the development of a traceability system for various related industries.

Keywords: digitisation, monitoring system, oil palm fruit dealers, traceability, smallholders.

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INTRODUCTION

Malaysia is well known as one of the major world players in the palm oil industry. Malaysian palm oil is mainly exported to India, China and the European Union (EU) (Parveez *et al.,* 2022). Apart from internal production challenges, the palm oil industry also faces external challenges such as changes in policy by importing countries, trade barriers and adverse campaigns. There have been various conditions established over the years for palm oil, especially for the export market to the EU. The announcement from the EU which is committed to only buying certified sustainable and traceable palm oil from 2020 onwards has increased the commitment towards sustainability in Malaysia. The heightened requirement imposed by importing countries had driven the sustainability effort by producing countries in the global trade. Malaysia, as one of the major palm oil exporters, has introduced various strategies to fulfil the requirement imposed by the importing countries. One of the efforts is the introduction of Malaysia's certification standard known as Malaysian Sustainable Palm Oil (MSPO) (Parthiban *et al.,* 2021a). MSPO implementation in Malaysia has been made mandatory by the government since 2017. However, the mandatory

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implementation of MSPO for smallholders has been extended given the various challenges affecting their production.

The oil palm fruit dealers (DF) are the intermediaries in the upstream supply chain linking oil palm producers with oil palm mills. Dealer's activities such as purchasing, moving and selling FFB are registered and licensed under the Malaysian Palm Oil Board (MPOB) licensing regulations. According to MPOB (2021), there are around 3460 registered DF in Malaysia as of 2021 (*Table 1*).

The government's initiatives toward empowering smallholders resulted in the establishment of cooperatives to group smallholders together and establish a business model (Parthiban *et al*., 2021b). Through these initiatives, MPOB assisted independent oil palm smallholders in establishing Sustainable Oil Palm Grower Cooperative (KPSM) all over the country. One of the immediate business opportunities recommended by MPOB is to establish an oil palm fresh fruit bunch (FFB) collection centre to initiate the business of buying and selling FFB. MPOB provide an initial financial grant and assistance to set up the business to help smallholders to sell FFB directly to the oil palm mill.

MPOB via the extension services has been tasked to assist independent oil palm smallholders to be certified under MSPO Certification. Independent oil palm smallholders in Malaysia are categorised as those who own oil palm land of less than 40 ha. Based on MSPO Part 2 (2013) for independent smallholders, there is a requirement under principle 2 to keep records of FFB sales. However, there is a gap in MSPO implementation among oil palm smallholders in retrieving the yield data of each smallholder. Not all smallholders can keep consistent records of their FFB yield. Therefore, it poses challenges to the extension agent to efficiently retrieve the FFB yield record of each smallholder, especially to comply with the MSPO requirement on traceability (Parthiban *et al.*, 2022b). Currently, FFB yield records are gathered manually by extension agents either through smallholder records or with the help of dealers in preparation for the MSPO audit. This poses a huge manual task for extension agents especially when the number of smallholders increases for each surveillance audit. Therefore, there is an urgent need to digitalise the reporting of FFB transactions among smallholders and dealers.

TABLE 1. NUMBER OF OIL PALM FRUIT DEALERS (DF) IN MALAYSIA ACCORDING TO STATES AS OF DECEMBER 2021

State	Number of DF
Johor	908
Melaka	62
Negeri Sembilan	110
Selangor	316
Wilayah Persekutuan	7
Kelantan	60
Pahang	406
Terengganu	121
Kedah	94
Perak	585
Perlis	0
Pulau Pinang	18
Sabah	490
Sarawak	283
Malaysia	3 460

Source: MPOB (2021).

This article presents the development of an information technology (IT) system known as *Kebolehjejakan Informasi Pekebun Kecil Sawit* (KIPS) version 2 to address the current issues in collecting data on FFB transactions among smallholders by linking Dealer Fruit (DF) via technology. This study is a continuation of a previous study conducted by Parthiban *et al.* (2017a) with further improvement to the overall system. The previous study has shown that a similar system known as KIPS version 1 is able to improve FFB yield recording and monitoring by minimising the gap related to traceability. However, it needs improvements in the method for data entry to enable a more efficient way of gathering FFB yield data among smallholders. The use of a QR Code embedded smartcard was proven not to be an effective method for data entry as most of the smallholders were not able to be present and bring the card for every FFB transaction. Therefore, the main objective of the current study is to identify and develop an effective method and system to record the daily FFB transaction data by KPSM which also acts as the DF. Other than that, this study aims to assess the adoption and acceptance of the system as well as the understanding of their current record-keeping and FFB transaction practices.

LITERATURE REVIEW

Digitisation in Agriculture Sector

Over the years, digitisation has evolved and changed how people communicate and interact. Digitisation has affected every industry including agriculture in driving advances in labour productivity, increasing farmers' income, addressing traceability issues, connecting producers and consumers and others. Information and Communication Technology (ICT) is defined as the use of a range of technologies for gathering, storing, retrieving, processing, analysing and transmitting information (Geraldine, 2020). ICT application in agriculture can provide both direct and indirect benefits. The direct application involves the use of ICT which can contribute to improvements at the farm level such as an increase in productivity and yield. Indirect application of ICT involves the use of information by farmers gathered through ICT tools to make a quality decision which can lead to efficiency in management. While ICTs can significantly affect efficiency, resilience and inclusion in developing countries, new emerging innovations such as the Internet of Things, Cloud Computing and Big Data are increasingly revolutionising agriculture in developed economies (FAO, 2018). A digital revolution such as of Internet of Things (IoT), sensor technologies, big data and cloud computing has a very promising application in agriculture (Bronson and Knezevic, 2016; Himesh *et al.*, 2018). However, it is often not fully adopted by the agriculture industry, especially small-scale farmers and dealers. Data collection in farming still lacks the application of digitisation to make use of the huge data available to predict and direct future agriculture production practices (Bronson and Knezevic, 2016). ICT has been a significant tool in elevating socio-economic development in various sectors where they are well-adapted and integrated (FAO, 2018). ICT intervention is able to support efficient data collection which can be used for decision-making by farmers and policymakers (Delerce *et al*., 2016) and tools for farm management for efficient recording and analysis of data (*Rossi et al.*, 2014). ICT intervention is known to be more cost-effective for data collection, monitoring and evaluation of agriculture-based projects compare to traditional methods (Hammond *et al.*, 2017).

Digitisation in Palm Oil Industry

A comprehensive traceability system linking all the stakeholders within the supply chain is necessary to further incorporate sustainability in the palm oil industry in Malaysia. Traceability solutions are important especially for smallholders to lessen the burden of data keeping and collection (Shukla *et al.*, 2017). Most of the independent smallholders in Malaysia are selling FFB via the middle man known as oil palm fruit dealers (DF) rather than directly selling to oil palm mills due to the small scale of FFB production. DF plays an intermediate role between producers/smallholders and mills (Parthiban *et al.*, 2022a; Rahman *et al.*, 2009). DF collects and buys from smallholders and sells to mills in bulk (Ishak *et al.*, 2016). MPOB has been tasked to provide licenses and regulate the industry including DF. MPOB has established certain guidelines on the type of records to be kept by dealers such as daily and monthly records, payment vouchers and many others. However, most of the DF is using manual methods such as books or paper for record-keeping rather than a computerised or digital approach (Parthiban *et al.*, 2017a). As for farmers, most of them are not keen on record keeping unless it is encouraged and facilitated by external groups such as NGOs and farmer's associations and it normally involves simple data gathering for a specific purpose (Kuteesa & Kyotalimye, 2019; Minae *et al*., 2008). Despite the requirement of certification to keep documents and records, most of the smallholders did not keep the relevant records (Brandi *et al*, 2015; Nurhayati *et al*, 2020). The lack of record keeping is mainly attributed due to illiteracy level, time constraints, size of landholding and lack of awareness (Annette *et al*, 2019). This has resulted in inefficiency in record keeping and retrieving the data among smallholders and dealers. Therefore, there is an apparent gap in FFB traceability starting from the smallholder's plot until it reached the mills through middlemen. From mills onwards, most of the FFB is traceable as they have their traceability mechanism in place. ICT-based market information helps farmers to avoid exploitation by middlemen (Anoop *et al*., 2015). Oil palm plantations including independent oil palm smallholders are vulnerable to FFB theft, especially during the period of the high price of oil palm (Vermeulen *et al*., 2006). FFB losses due to theft in Cameroon are estimated to be between 36%-45% (Ajambang *et al*., 2016). The stolen FFBs are normally sold illegally to middlemen using the unauthorised license of other smallholders (Parthiban *et al.*, 2017a). Currently, there is no effective mechanism in place to address these issues at the buyer's end except to lodge a police report. Therefore, the application of technology can address these issues by triggering an automated report of unusual or substantial FFB yield records based on the size of the landholding. This is relatively hard to achieve using manual reporting.

Stanton (2000) emphasises the role of locally based agribusiness to fill the diminishing role of government for the development of small-scale producers such as smallholders. Locally based agribusiness typically operates in rural areas to provide services to smallholders by combining the production and relying on the scale. The establishment of cooperative structures such as Sustainable Oil Palm Grower Cooperative (KPSM) among oil palm smallholders in Malaysia has seen various growth over the years. As of 31 March 2022, 69 KPSMs have been established all over the country with 60 of them having already conducted the business of selling FFB directly to the mills. From 2016 till February 2022, they have transacted a total of 1 119 362.63 tons of FFB which are spearheaded by smallholders themselves with the help of MPOB. Azman *et al.* (2015) reported an increase in income among smallholders who sell directly to mills via KPSM due to better prices from mills.

There have been various efforts to address traceability issues in the palm oil supply chain in Malaysia. Roundtable on Sustainable Palm Oil (RSPO) has developed *PalmTrace* as a traceability system for certified palm oil products from mill onwards. Similarly, the Malaysian Palm Oil Certification Council (MPOCC) has launched an IT platform known as MSPO Trace to achieve 100% traceability of the palm oil supply chain (MPOCC, 2019). Recently, Malaysian Palm Oil Council (MPOC) have announced it is developing blockchain technology to improve the traceability of the Malaysian palm oil supply chain (MPOC, 2020). Most of these initiatives do not have detailed traceability information established from smallholders to dealers. On the other hand, bigger oil palm plantations can implement traceability systems within their ecosystem. Malaysia's biggest palm oil producer, Sime Darby Plantation (SDP) has developed publicly accessible data that allows anyone to trace their product down the mill, plantation and third-party plantations. However, this is not the case for independent oil palm smallholders. Currently, there is no defined way to trace or monitor FFB yield among smallholders who are normally selling via middlemen such as dealers and cooperatives. Small farmers are still lacking in the effective use of technology in managing their farms. Intervention and influence of dealer fruit or middlemen have been significant in the supply chain to connect smallholders with millers. Hence, there is a need for an information technology (IT) system to address the gap and provide an efficient way to gather FFB transaction records among smallholders.

ICT applications can play a major role in efficient data collection and generate fast information for decision-making (Delerce *et al*., 2016). Therefore, ICT-based intervention at the middlemen or better known as oil palm DF is one of the efficient ways of gathering the FFB transaction data and as a means of traceability among smallholders. This is because FFB dealers are the crucial traceability point connecting the smallholders and millers. DF can provide the information needed especially for traceability among smallholders. The information management system can be classified into different groups (Varga *et al.*, 2010):

- Internal management system (within actors): traceability within the internal business connected to the final product.
- External (among actors): traceability between external authors within the supply chain.
- Whole chain system: traceability spanning across different sectors.

The different perspective within the stakeholder's category offers different challenges and views on applying new technology, especially traceability solution. The benefits of applying new technology from an operational perspective are always easy to visualise. However, there are many hesitance and challenges within the different perspectives. From a financial perspective, an organisation might reluctant to share or make public any information as they have spent cost in gathering the information and they might view it as a strategic advantage over their competitor. From a human perspective, people might reluctant to adopt new changes to their concerns which might add additional workload or losing their strategic value within the organisation (Hirbli, 2018). Small and medium enterprises (SMEs) in Malaysia have a low adoption level of technology (Alam *et al*., 2007). Introducing technology need to be supported with enough resource such as adequate and competent staff to enable a better adoption level (Nor Hazana *et al*., 2013). Higher literacy levels on information technology and the intention to increase production in the future are two driving factors among farmers in adopting new technology in farm management (Lima *et al*., 2018). In Malaysia, most of the oil palm smallholders are between 50 and 70 years old which might pose some challenges in adapting to new technology (Parthiban *et al*., 2017b). Most of the non-internet users (51.8%) in Malaysia are 60 years old and above (MCMC, 2020). Therefore, the active involvement of the younger generation within the community with ICT knowledge can help farmers access information through ICT (Muktar *et al*., 2015). Non-internet users in Malaysia were not using the internet due to a lack of interest, being too old to learn and having no device (MCMC, 2020). Other than that, the majority of internet users in Malaysia went online for social purposes such as communicating by text and visiting social networking platforms compare to getting information or reading online publications (MCMC, 2020). Adoption and application of ICT in agriculture are still poor among many farmers due to a lack of internet connectivity, missing capacity building and low usability of ICT applications (Eitzinger *et al., 2019).*

A better understanding of the benefits provided by new technology has shown a positive effect on farmers' willingness to pay for new technologies (Stephen *et al.*, 2020). Lack of incentives and low awareness of the benefits of adopting new technology might pose a strategic challenge to users (Hoyer *et al.*, 2019). However, the costs and benefits of traceability alone might not influence small businesses and small-scale farmers to participate in the traceability system (Meuwissen *et al.*, 2003). The quickest way for users to uptake any new technology would be if they are required by legislation or market requirements. Parthiban *et al.* (2022b) reported that the lack of commitment among FFB dealers to use ICT based approach at the initial adoption might be due to a lack of legislative requirements. However, a softer approach would be to incentivize use by demonstrating how new tools might add value to their business or through financial incentives such as grants or subsidies (Rose *et al.*, 2016).

METHODOLOGY

Materials

This research comprised various planning, development, testing and assessment process (*Figure 1*). In the planning and user requirement assessment, field visits to five KPSMs with different existing software platforms were conducted to check their existing system and to gather feedback on the proposed idea of the KIPS system. Agricultural ICT development for smallholders needs to be designed with inputs from farmers and other stakeholders involved (Eitzinger *et al.*, 2019). Based on the feedback and review from the previous study, a process flow of the system was developed. The main system then was developed involving various modules. Two of the KPSMs were selected to further test the system for any further improvements and fine-tune the final system. Furthermore, a security penetration test was conducted to assess the security vulnerability of the system. Two sessions of training were conducted to train all 14 managers of KPSM on how to use the system. After the training, all the KPSMs were allowed to try the system for 1 week before commencing the pilot project for 2 months.

Gap and Intervention

The proposed intervention by the KIPS system at the dealer will address the traceability gap between smallholders and millers (*Figure 2*). Dealers will be the main intervention point to provide information on FFB transactions between smallholders and millers.

The current process of weighing FFB at the weighbridge involves a series of the process (*Figure 3*). The vehicle transporting FFB will be weighed once it enters the weighbridge area before it goes to the FFB collection platform to unload the FFB. Once the FFB is completely unloaded, the empty vehicle will be weighed again to determine the net weight of the FFB. The data on the net weight will be recorded by the existing weighbridge system with other basic information. However, other relevant data, *e.g.*, MPOB license number, acreage and FFB price are mostly stored and synchronised manually depending on individual dealers. Therefore, the proposed intervention by the KIPS system will allow data recording to be digitalised where all the basic non-variable information such as acreage, GPS coordinates and other relevant data are readily uploaded into the system and synchronised automatically without the need for manual intervention.

Specification of KIPS System

Currently, most of the DF is using the integrated weighing software that is often delivered as a package with the weighbridge infrastructure. This software varies between DF based on the type of weighbridge infrastructure. Initially, we considered developing fully integrated software by tapping into the Application Programming Interface (API) of the existing weighbridge system to enable direct communication with KIPS. However, there are different models of weighbridge with different weighing software used by dealers. Given the funding limitation, integrating with all the different weighing software and hardware will translate to higher development costs as it requires various changes in both software and hardware across the different models. Furthermore, it will be troublesome for technical support services to cater to individual complaints for nationwide applications; hence we decided not to use this method. Any traceability system must be simple, cost-effective and reported in harmonized format to receive widespread adoption across the network (Bhatt *et al.*, 2013). Therefore, it is proposed to use a portal system with a module to upload data using Comma Separated Values (CSV) format for easier data entry and data upload (*Figure 4*). This similar application has been incorporated into a smart farming platform for pig livestock where user can export existing data in Excel files into the system which eliminate the duplication of work (Zimpel *et al*., 2020). ICT development should identify the local issues of connectivity, user capacities and cultural background to reduce the gap with marginal groups of smallholders driven into digital poverty (May and Diga, 2015). Based on the pre-assessment, some of the weighing software used by KPSM can generate reports of FFB transactions in excel spreadsheet format. Therefore, using the existing report generated via the excel spreadsheet and directly uploading this data with other additional information will reduce time and error during data entry.

The three-tier architecture of the KIPS system is shown in *Figure 5*. The presentation tier (front) is a web-based user interface for all the stakeholders to feed data and view information. The Frontend uses Bootstrap with the Progressive JavaScript Framework (VueJS) as its UI framework solution. The Backend system was built using the PHP Laravel framework and MVC (model-view-controller) architecture with MariaDB. The business logic (application) is executed by NGinX Web Server with Debian OS.

User Module

The KIPS system contains 3 user modules of admin, dealer fruit and smallholder with different

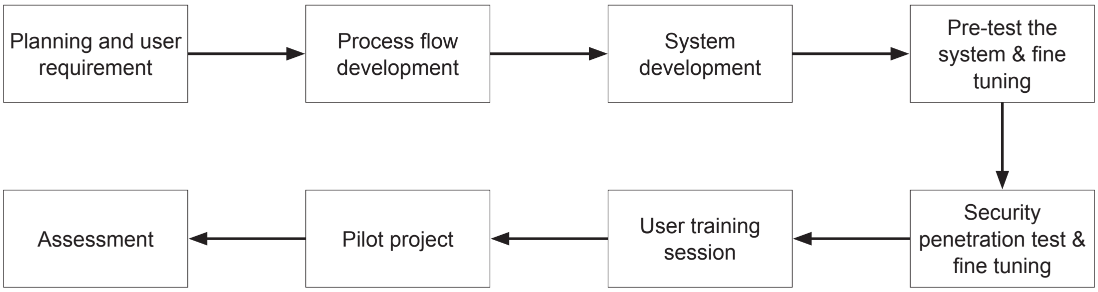

Figure 1. General flowchart of the research methodology.

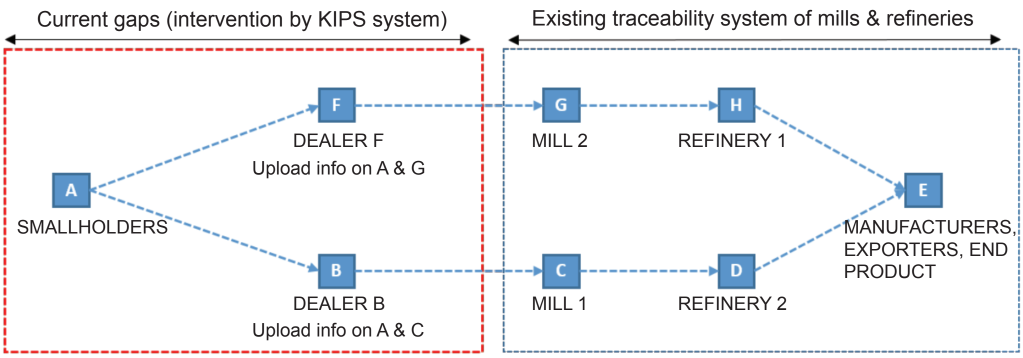

Figure 2. The flow of information for traceability using the KIPS system.

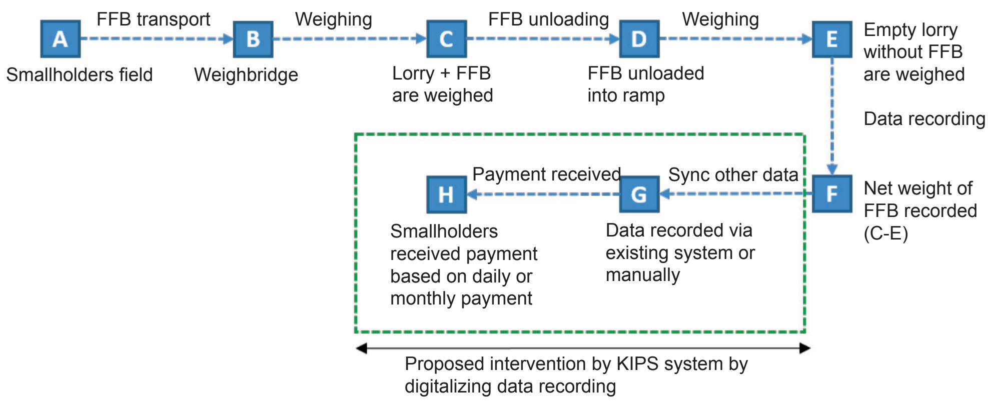

Figure 3. Existing process flow at the weighbridge and the proposed intervention by the KIPS system.

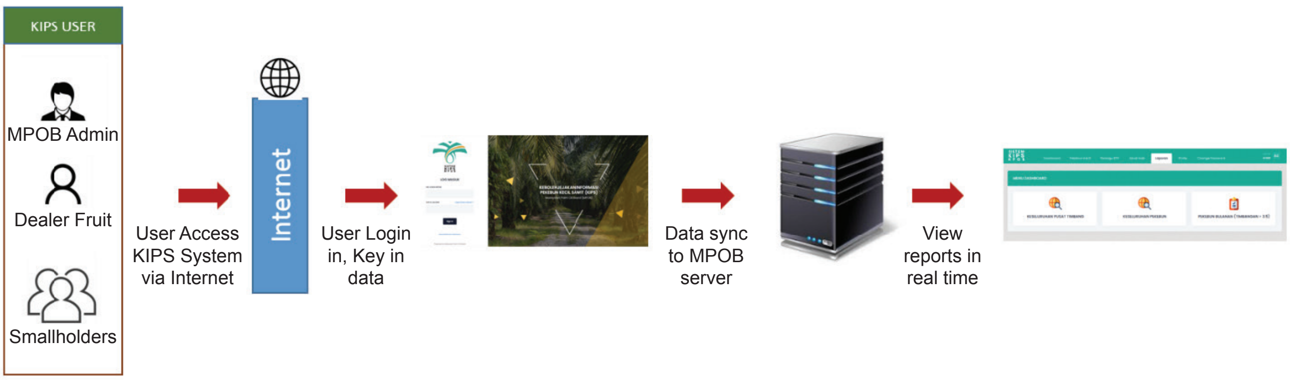

Figure 4. The operational flow of the KIPS system.

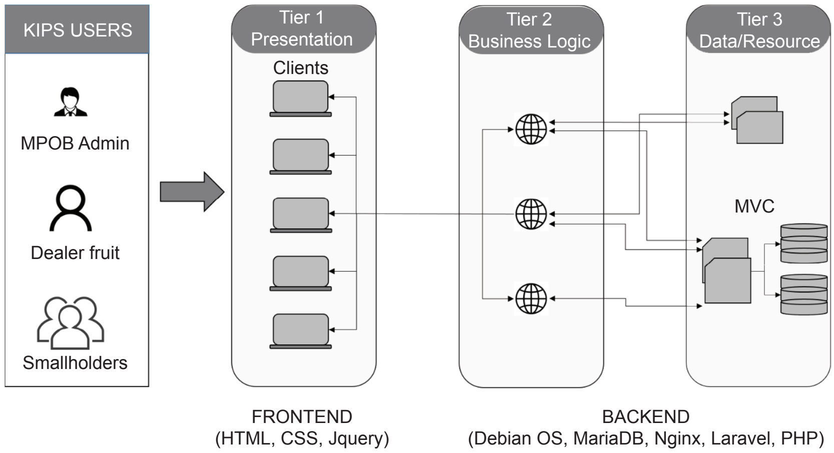

Figure 5. The three-tier architecture of the KIPS web system.

levels of access (*Figure 6*). Admin can view the entire transaction records while DF and smallholders can only view their respective transactions. Each user can register using their unique MPOB license number as the user's name to start using the system.

Data Entry

Data entry modules were developed either as individual data entries for each transaction or as group uploads as a whole (*Figure 7*). Individual data entry requires DF to key in the transaction for each smallholder while group upload allows DF to upload the entire daily transaction as a whole using the CSV file format. CSV file was used as it allows data to be saved in a tabular format, making them easier to open with most spreadsheet programs regardless of the software used. This method offers flexibility to DF as they can use their existing report generated from their weighing software and upload it with some additional inputs and formatting. However, it requires more attention from KPSM to make sure the correct data are uploaded compared to individual data entries. Ideally, data collection must occur regularly or if possible, as soon as it has happened (Bhatt *et al*., 2013). The data on the system will be near real-time as we proposed that each KPSM upload their daily FFB transaction data within 24 hr or latest before 3 pm on the next day. This method will allow them to upload the data from anywhere, especially in places that lack internet connectivity.

Data Synchronisation

Basic non-variable information on smallholders such as name, area, lot number, phone number, identity card number and Global Positioning System (GPS) coordinates are readily uploaded into the system. Similarly, non-variable information on DF and mill such as the GPS coordinate of the weighbridge location, the GPS coordinate of the mill and the license number were uploaded into the system. Dealers only need to upload daily FFB transaction data based on the license number of smallholders as a reference point. Other non-variable basic data will be synchronised automatically by the system to generate the relevant report (*Figure 8*). As an example, the system will auto-assign the GPS location of the weighbridge, palm oil mill and smallholder's plot based on the identification of the user login, and list of the palm oil mill and smallholder's plot respectively. The overall movements of FFB based on the destination from farm to DF to mill can be viewed on a map based on OpenStreetMap® offers visual traceability. In addition, an algorithm has been introduced into the system to trigger a report of unusual or substantial FFB yield records based on the size of the landholding. This information helps MPOB to identify license holders with substantial recorded FFB yields of more than the normal average yield in relation to their farm size. Further verification of the reported data can be conducted with particular smallholders or dealers as a way to curb the sales of stolen FFB via the unauthorised use of smallholder's licenses or sales made without a license.

Methods

This study was conducted among 14 KPSM in Peninsular Malaysia which have conducted the business of selling FFB via a weighbridge system (*Figure 9*). The KPSM in Peninsular Malaysia was purposively chosen compared to Sabah and Sarawak as it is nearer to MPOB headquarters for frequent monitoring. The pilot project was conducted for a period of two months in November and December 2021. During the pilot project, KPSM is required to upload their daily FFB transaction before 3 pm the next day into the KIPS portal. The data entry

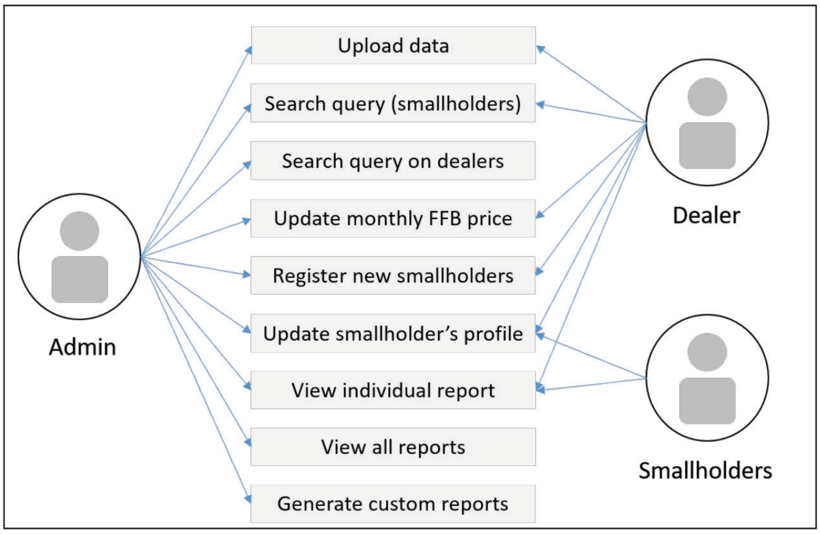

Figure 6. User module of the KIPS system with the respective feature.

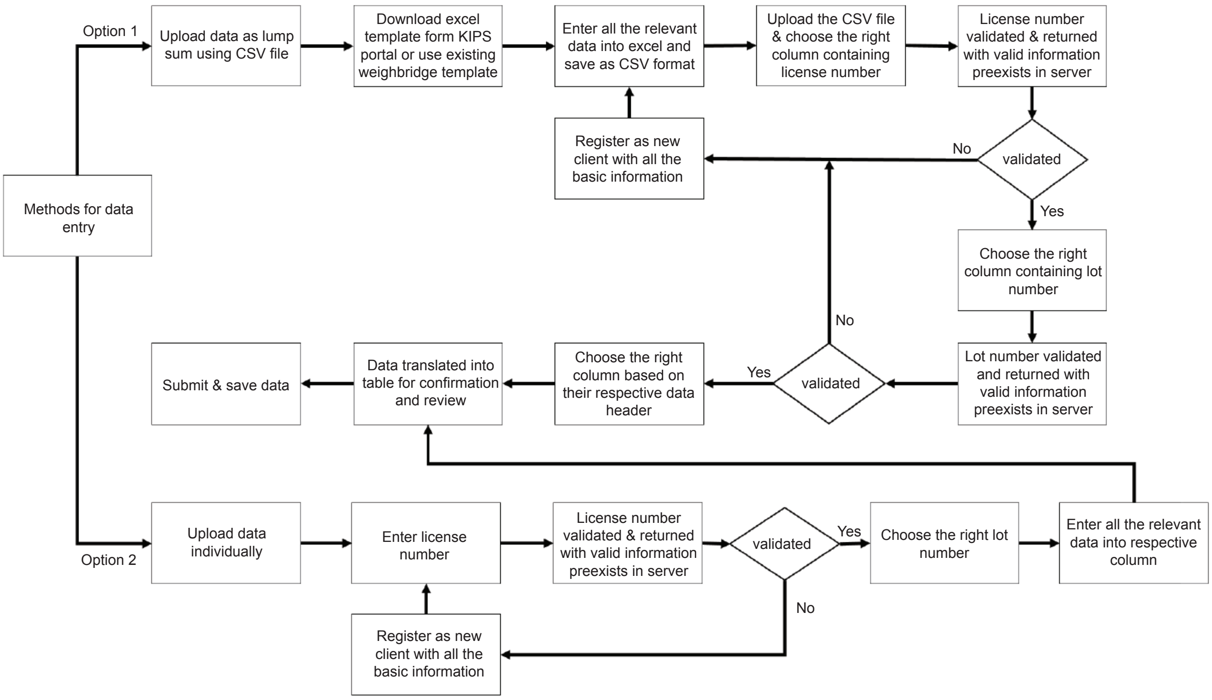

Figure 7. Process flow for data entry.

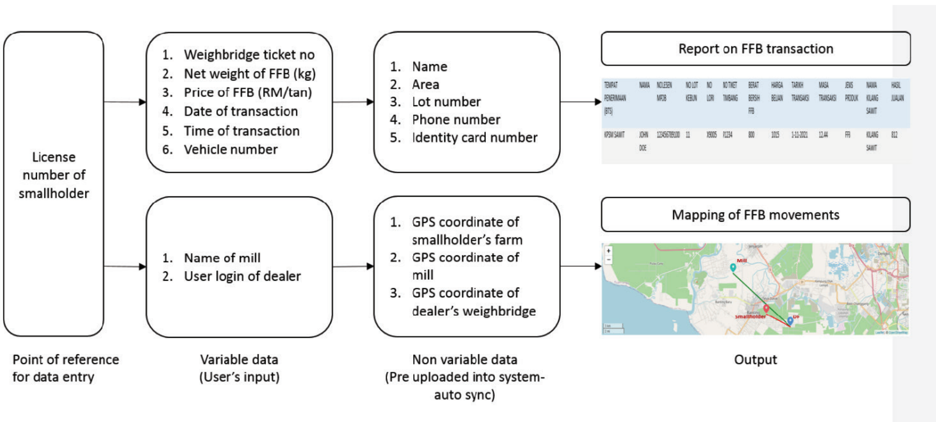

Figure 8. Flow for data synchronisation and report output.

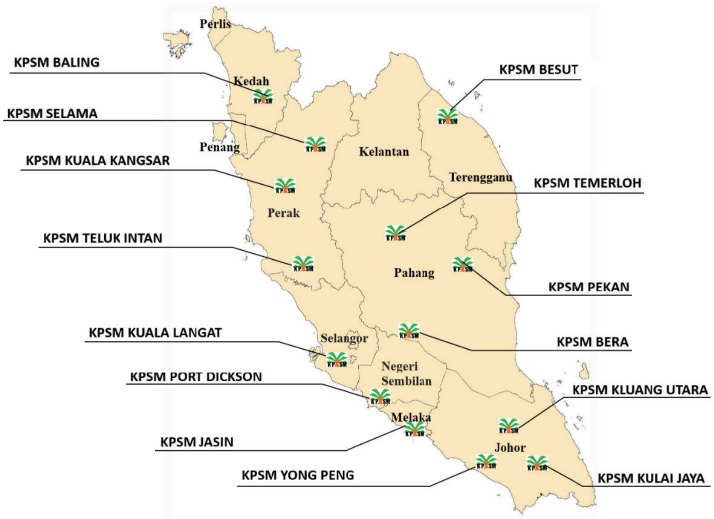

Figure 9. Study area and distribution of Sustainable Oil Palm Grower Cooperative (KPSM) in Peninsular Malaysia.

progress of each KPSM within the stipulated time was monitored and recorded daily along with other responses and feedback. After the pilot study, assessments using a survey questionnaire were conducted on all KPSMs to gather their feedback on the usage of the KIPS system. Alongside, the data collection was supplemented by secondary data from related agencies mainly from MPOB. Descriptive statistics are used to analyse and describe the data.

RESULTS AND DISCUSSION

An early assessment among 31 KPSMs in Peninsular Malaysia, Sabah and Sarawak reported 10 different models of weighbridge with different weighing software used by KPSM which translates to 32% variability in the type of system used (*Figure 10*). This shows the sheer amount of variability among the weighbridge system in Malaysia. Therefore, integrating directly with all the different weighing software and hardware for seamless transactions might require a different approach in the future.

Further assessment and evaluation were carried out on five of the KPSMs in Peninsular Malaysia which have a different model of the weighbridge system. Four of the KPSMs with different models can generate reports in spreadsheet files (excel or csv). However, the data generated are basic and contain different report formats across the different models (*Table 2*). 80% of the KPSMs are not aware that their existing system was able to generate reports therefore they are not fully utilising this function.

Table 3 describes the demographics of the respondents among the 14 KPSMs. A relatively large proportion of the 14 respondents were male (71.4%), aged between 31 and 40 years old (64.3%) and have experience in managing weighbridge operations between 2 and 4 years (57.1%). Most of them (57.1%) reported no internet facility provided by KPSM at the weighbridge centre. Most of them (71.4%) access the internet via mobile data. This is consistent with the report from MCMC (2020) and MCMC (2021) which reported that most of the internet users in Malaysia are using mobile broadband for accessing the internet compared to fixed broadband. Therefore, the coverage of mobile data is one of the aspects that need to be investigated when introducing any technology that requires an internet connection, especially in rural areas.

Table 4 shows the practices of FFB transactions by KPSM. Most of the KPSM (57.1%) provide additional services other than selling and buying FFB such as transportation and selling of agricultural inputs. Smallholders prefer the daily price for the FFB sold (64.3%) with cash payment as their main choice (78.6%). Cash payments have been one of the ways to attract and retain smallholders to continue selling their FFB (Parthiban *et al*., 2017a). More awareness of the benefits of cashless transactions and user-friendly systems is needed to further encourage the use of technology among smallholders especially elderly farmers (Ukoha *et al*., 2017). KPSM representatives usually meet with smallholders during the payment for the FFB sold (85.6%).

Based on *Table 5*, all the KPSMs are practising record keeping of their FFB transactions with most of them (57.1%) using a computer to record. A total of 42.9% said they retain records for more than 4 years. The higher adoption of record keeping might be due to the requirement under the MPOB licensing act which requires DF to keep records of their transactions. In addition, all the records are recommended to be kept at a minimum of not less than 2 years. Lack of time has been the biggest (42.9%) constraint for record-keeping among respondents.

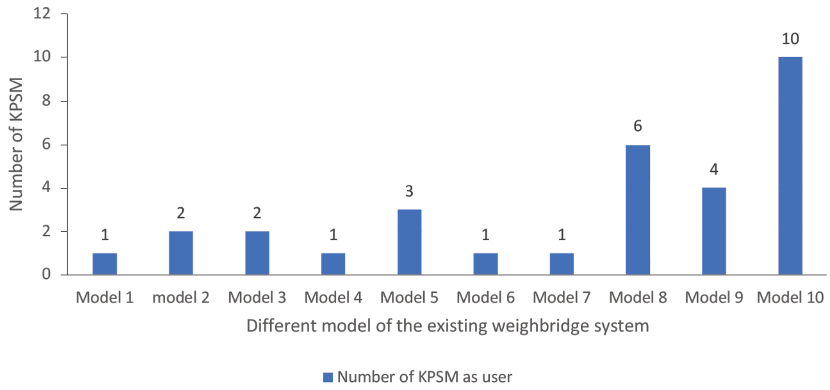

Figure 10. Number of KPSM using the different models of weighbridge system.

TABLE 2. VARIATION AMONG THE DIFFERENT MODELS OF WEIGHBRIDGE SYSTEM BASED ON PRELIMINARY ANALYSIS OF FIVE KPSM IN PENINSULAR MALAYSIA

Information/KPSM	KPSM 1	KPSM 2	KPSM 3	KPSM 4	KPSM 5
The current system can generate reports into a spreadsheet file	✔	✔	✔	✖	✔
The record generated contains basic information on the transaction (name, date, time, vehicle)	✔	✔	✔	✔	✔
The report generated contains additional information (license number, lot no, area)	✖	✖	✖	✖	✖
Existing computers have the relevant software to open and edit the spreadsheet file	✔	✔	✖	✖	✔
KPSM is aware of and utilizes the report generated from the existing weighbridge system	✖	✖	✖	✖	✔

Indication: ✔- Yes, ✖- No

TABLE 3. SOCIO-DEMOGRAPHIC PROFILE OF RESPONDENTS

Characteristics	Category	Frequency (n)	Percentage (%)	Average
Gender	Male	10	71.4	
	Female	4	28.6	
Age (yr)	≤30	3	21.4	34.1
	31-40	9	64.3	
	>40	2	14.3	
Experience in weighbridge operation (yr)	2-4	8	57.1	4.4
	5-7	5	35.7	
	8-10	1	7.2	
Internet facility provided by KPSM	Yes	6	42.9	
	No	8	57.1	
Access to internet	Broadband	4	28.6	
	Mobile data	10	71.4	

TABLE 4. PRACTICES OF FFB TRANSACTION

Characteristics	Category	Frequency (n)	Percentage (%)
Provide additional services other than buying and selling FFB	Yes	8	57.1
	No	6	42.9
The main method of FFB price favoured by smallholders	Daily price	9	64.3
	Monthly price	5	35.7
The main method of payment	Cash	11	78.6
	Electronic bank transfer	3	21.4
Time of meeting with smallholders	During harvesting	1	7.2
	During transportation	1	7.2
	During payment	12	85.6

TABLE 5. RECORD-KEEPING PRACTICES

Characteristics	Category	Frequency (n)	Percentage (%)
Practice record keeping	Yes	14	100.0
	No	0	0.0
The main method of record keeping	Book/paper	6	42.9
	Computer	8	57.1
Period for retaining records (yr)	1-2	5	35.7
	3-4	3	21.4
	> 4	6	42.9
The main constraint in record keeping	Lack of training	5	35.7
	Time constraint	6	42.9
	Forget to record	3	21.4

Table 6 shows the practices of the KIPS system among respondents during the pilot project. Most of the respondents (78.6%) used the computer to access the KIPS system. Most of them (71.4%) upload the transaction data into the KIPS the following day when the weighbridge reopens. Lack of time and resources (57.1%) emerges as the main problem in using the KIPS system. Based on the feedback from respondents, this might be due to the extra workload during the pilot project to upload data into the KIPS while continue maintaining their existing records.

Table 7 shows the overview of KIPS transactions conducted during the pilot project between November and December 2021 (2 months) by 14 KPSM. The daily average of FFB transactions is 54 tonnes per day involving an average of 42 customers with 61 ha per day. Overall, the total value of FFB transactions for two months is RM3.4 million with an average transaction value of RM246 310 for each KPSM. The daily average FFB purchase value is RM56 530. The sheer number of transactions requires a digital platform to make use of the huge data effectively.

Figure 11 shows the response received from KPSM on the report submission during the pilot project for two months. The progress of report submission using KIPS by each KPSM was recorded daily. Additionally, the response from each KPSM if they do not have any transaction on a particular day or if it is closed for a holiday or any other reason

TABLE 6. PRACTICES OF THE KIPS SYSTEM

Characteristics	Category	Frequency (n)	Percentage (%)
The main device used for accessing KIPS	Computer	11	78.6
	Smartphone	3	21.4
The time when data is uploaded into KIPS	The following day when the weighbridge reopens	10	71.4
	When back home	3	21.4
	Right after a business hour during the day	1	7.2
The main problem in using KIPS	Lack of time and resources	8	57.1
	Poor internet connection	4	28.6
	Others	2	14.3

TABLE 7. OVERVIEW OF KIPS TRANSACTION BY KPSM DURING THE 2 MONTHS PILOT PROJECT

Item	Total	Daily average	Average based on KPSM
Fresh fruit bunch (FFB) (t)	3 308	54	236
Number of customers	2 536	42	181
Hectarage (ha)	3 743	61	267
FFB purchase value (RM)	3 448 341	56 530	246 310

was also recorded. Based on this, an average of 72% of KPSM were able to submit their report through KIPS or at least able to give responses on the status of their report submission. It is assumed that the lack of commitment among certain KPSMs might be due to the voluntary basis of this project as well as a lack of time and resources.

KPSM are required to upload their daily FFB transaction before 3 pm the next day into the KIPS portal. The data entry progress of each KPSM within the stipulated time was monitored and recorded daily. 37% of KPSM were able to send their report through KIPS within the stipulated time of 3 pm the next day in November while this figure slightly increased to 44% in December (*Figure 12*). On average, 41% of KPSM were able to send their reports within the stipulated time between November and December. Only a small percentage of 14% and 8% of KPSM were not able to adhere to the given time respectively in November and December. Continued engagement to remind KPSM to send their reports within the time limit is important to create awareness during the early stage of implementation. An automated reminder within the KIPS system might be an extra improvement that can be considered in the future.

The acceptance of KIPS among KPSM has been divided based on usefulness, ease of use, attitude to use and behavioural intention with a 5-point Likert scale with 5 being the most agreed (*Table 8*). KPSM scored neutral on the usefulness of KIPS 3.29, especially on time, performance and productivity. This might be due to the extra workload during the pilot project to upload data into the KIPS while continue maintaining their existing records. KPSM generally agree that KIPS is easy to use with a score of 4.01. However, since this pilot project is conducted voluntarily, the extra workload to use KIPS has slightly hindered their attitude and behavioural intention to use KIPS with a score of 3.42 and 3.49 respectively. Mandatory usage might be important in influencing initial adoption among users while voluntary usage is mainly influenced by the personal relevance of the system (Agarwal *et al.*, 1997; Hartwick *et al.*, 1994). Other than that, cultural willingness to move beyond traditional methods has influenced technology adoption among organisations (Hossain *et al.*, 2015).

CONCLUSION

KIPS system was developed using a three-tier architecture and contains three user modules of admin, dealer fruit and smallholder with different

TABLE 8. ACCEPTANCE OF KIPS AMONG KPSM

Item	Statement	Frequency						
		SD	D	N	A	SA	Mean	SDv
1.0	**Usefulness of KIPS**				**Mean: 3.29**			
1.1	KIPS helps to keep records more systematically than manual methods	0	1	4	9	0	3.57	0.6
1.2	KIPS helps in retrieving transaction data faster than manual methods	0	2	4	8	0	3.43	0.8
1.2	KIPS reduces the time needed for recording compared to manual methods	0	3	6	5	0	3.14	0.8
1.4	KIPS able to increase performance for record-keeping practice	0	3	6	5	0	3.14	0.8
1.5	KIPS can increase productivity in record keeping	0	3	6	5	0	3.14	0.8
2.0	**Ease of use of KIPS**				**Mean: 4.01**			
2.1	KIPS is easy to use	0	0	5	4	5	4.00	0.9
2.2	The menu in KIPS is clear and easy to understand	0	0	2	5	7	4.36	0.7
2.3	KIPS is easy to learn	0	0	5	6	3	3.86	0.8
2.4	It's easy to become skilled in using KIPS	0	0	6	8	0	3.57	0.5
2.5	It's easy to retrieve information from KIPS	0	0	3	5	6	4.21	0.8
2.6	The procedure for data entry is fast and easy	0	0	5	6	3	3.86	0.8
2.7	I have the skills to use KIPS	0	0	3	5	6	4.21	0.8
3.0	**Attitude towards using KIPS**				**Mean: 3.42**			
3.1	KIPS can overcome the problem of selling FFB without a license/theft	0	1	5	8	0	3.50	0.7
3.2	The use of KIPS for traceability is important for the palm oil industry, especially the weighbridge centre	0	0	3	3	8	4.36	0.8
3.3	The use of KIPS to record FFB transactions is a good idea	0	1	3	9	1	3.71	0.7
3.4	Satisfied with using KIPS to record FFB transaction	0	3	7	4	0	3.07	0.7
3.5	KIPS can help in record-keeping practices	0	0	4	10	0	3.71	0.5
3.6	KIPS reduces the workload among dealers	7	0	5	2	0	2.14	1.2
4.0	**Behavioural Intention to use KIPS**				**Mean:3.49**			
4.1	More frequent use of KIPS for record-keeping	0	7	2	4	1	2.93	1.1
4.2	Continue the use of KIPS throughout operating the weighbridge centre	0	7	2	4	1	2.93	1.1
4.3	The cost of using KIPS will be an important factor in deciding on the use of KIPS in future	0	2	5	5	2	3.50	0.9
4.4	Comprehensive use of KIPS by all the weighbridge centres is important in deciding on the use of KIPS in future	0	0	2	7	5	4.21	0.7
4.5	The use of KIPS should be made mandatory by the authority to all weighbridge centres in ensuring transparency in FFB transaction	1	3	6	4	0	2.93	0.9
4.6	Lack of complete enforcement in the use of KIPS will result in customers migrating to other weighbridge centres to avoid detection.	0	0	1	6	7	4.43	0.6

Note: KIPS - *Kebolehjejakan Informasi Pekebun Kecil Sawit*; FFB - fresh fruit bunch; SDv - standard deviation.
Likert scale interpretation: 1.00-1.80=Strongly disagree (SD), 1.81-2.60=Disagree(D), 2.61-3.40 =Neutral(N), 3.41-4.20=Agree(A), 4.21-5.00= Strongly Agree(SA).

levels of access. Data entry modules were developed either as individual data entries for each transaction or as a group upload using Comma Separated Values (CSV) format. Non-variable information is synchronised automatically by the system to generate relevant reports. Overall movements of FFB from farm to DF to the mill can be viewed on a map based on OpenStreetMap®. Overall, most of the KPSM were able to submit their report through KIPS within the stipulated period. KPSM generally

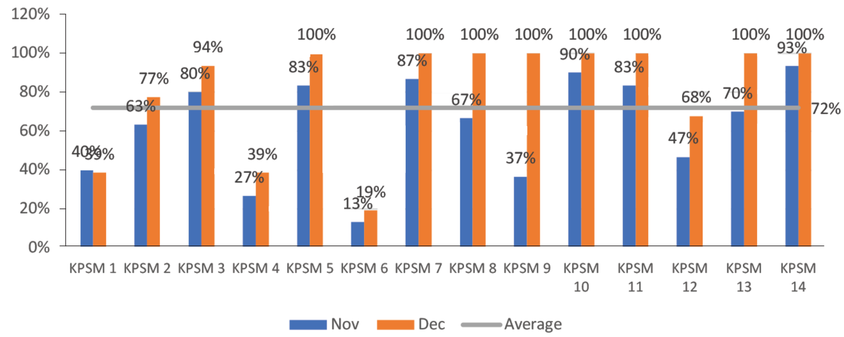

Figure 11. Progress of response on report submission by KPSM during the pilot project.

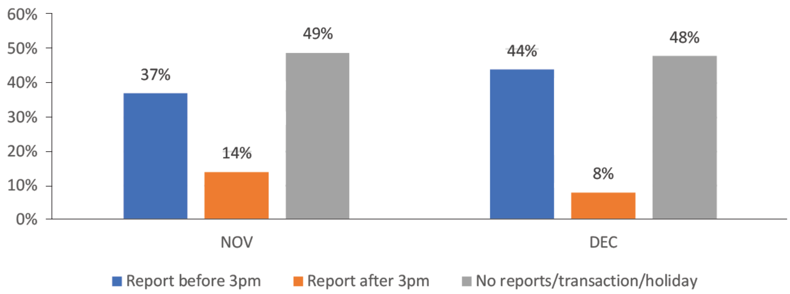

Figure 12. Progress of reporting using KIPS among KPSM within the stipulated time.

agree that the KIPS portal as being easy to use with a clear menu and easy to understand and learn. However, their attitude and behavioural intention to continue using the KIPS is slightly low given the high workload, lack of resources and voluntary basis of the implementation. Coverage of mobile data is one of the aspects that need to be looked into when introducing any technology that requires an internet connection, especially in rural areas. Government's intervention to make mandatory the use of a traceability system among industry players might be an important factor in influencing initial adoption. Other than that, changes in cultural willingness to make the transition from traditional methods to adopting new technology are important to increase the adoption level.

LIMITATIONS OF THE STUDY

One of the limitations of this study includes the generalisability of the findings due to the nature of the case study. In this study, the respondents are chosen only from the Sustainable Oil Palm Grower Cooperative (KPSM) which might not represent all the dealers as a whole, especially the private individual dealers. During the pilot project, the extra workload to use KIPS while continuously using the conventional method for record-keeping might have introduced some bias in the response among KPSM.

RECOMMENDATION

The developed pilot system and the findings of this study can serve as a basic framework for the development of a more comprehensive traceability system. It provides an opportunity for the industry to address the current gap in traceability among oil palm smallholders and dealers via technology. It was also able to provide analytical information to help in decision-making for an effective enforcement activity to minimise the problem of unauthorised use of smallholder's licenses or sales made without a license in the industry. In the future, a more comprehensive traceability system can be developed based on this study to further optimise the flow of information by linking dealers and smallholders through a two-way communication to include services such as harvesting, transportation and payment transfer. Further initiates to integrate information flow from end-to-end supply chain right from production until the end-user would provide a comprehensive palm oil traceability. Harmonisation between different readily available platforms across the different organisations for the palm oil supply chain should be proposed. Government policy and regulatory requirements should liaise with the main objective of bringing different organisations together for the common benefit of the industry. The application of blockchain technology needs to be intensified in palm oil supply chain management together with sustainability certifications such as MSPO, RSPO and others. Incorporating all the data on the supply chain using technology such as blockchain, the IoT and physical supply chains such as robots, sensors and drones will further elevate the traceability of the Malaysian palm oil industry.

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