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PALM OIL FRESH FRUIT BUNCH LOSS AND POST HARVEST RISK ANALYSIS AT KOPERASI PETANI SAWIT MANDIRI (KOPSA-M) PANGKALAN BARU, SIAK HULU, KAMPAR, RIAU

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ABSTRACK

Post-harvest oil palm that does not comply with the Factory standart can cause losses in reducing the production of fresh fruit bunches. The objectives of this study are 1) To analyze he stages of harvest and the sources that result in the risk of harvesting oil palm FFB in each post-harvest chain that is traversed to the TPH at the Koperasi Petani Sawit Mandiri (KOPSA-M), Pangkalan Baru Village, Kampar Regency. 2) To analyze the amount of yield loss and the possible risk of harvesting oil palm FFB in each post-harvest chain that is traversed from the land to the TPH at the Koperas iPetani Sawit Mandiri (KOPSA-M) Pangkalan Baru Village, Siak Hulu District, Kampar Regency. The data analysis was descriptive quantitative research analysis. Sources of loss post-harvest of oil palm FFB at the Pangkalan Baru Village Independent Farmers Cooperative (KOPSA-M), Siak Hulu sub-district, Kampar district is the percentage of post-harvest loss of fresh fruit bunches (FFB). It is equal to 5.21 percent of the total average FFB produced per plot (2 hectares) and the losses are in the land, TPH, checking raw FFB and mill sorting. The percentage of losses in the land area is 1.73 percent of the total FFB yield. Meanwhile, the number of losses in the factory sorted amount was 2.70 percent and became the most significant loss for post-harvest FFB losses at KOPSA-M. The sources of post-harvest loss of FFB at KOPSA-M are harvest time, harvesting techniques. Implemented by harvesters, cleanliness of plantation land, harvesting places (TPH),and sunlight fruit and plant maintainers, and human resources (HR) from oil palm harvesters.
Keywords :FFB, Losses, KOPSA-M

INTRODUCTION

Indonesia is the largest palm oil-producing country in the world. Riau is a province with the largest oil palm plantation area in Indonesia. The area of oil palm plantations in Riau province is 2.21 million hectares or 17.84 percent of Indonesia's total area of oil palm plantations (Badan Pusat Statistik, 2018). One of the districts that has oil palm plantations is Kampar District. The oil palm plantation area in 2019 was 226,085 ha, and production was 540,709 tonnes (Badan Pusat Statistik, 2020).

Oil palm (*Elaeisguineensis*Jacq.) Is originated from Nigeria, West Africa. Some other opinions state that oil palm is originated from South America, namely Brazil. because more oil palm species are found in Brazilian forests than in Africa. Oil palm plants thrive outside of their home areas, such as Malaysia, Indonesia, Thailand, and Papua New Guinea. The main product of the oil palm is the fruit bunches. These fruit bunches will be processed to produce crude palm oil (CPO) and palm kernel oil (PKO)(Fauzi *et al.,* 2006).

The use of palm oil is mainly for CPO and PKO. CPO is the pulp (mesocarp)

released by boiling and pressing it, known as crude palm oil. Meanwhile, PKO is oil derived from palm kernel oil, known as palm kernel oil. All of the two products are made from oil palm plants. They are processed by private palm oil mills and state-owned enterprises.

Palm oil mills (PKS) process palm oil with specific methods and rules to produce Crude Palm Oil (CPO) and Kernel. In the process, the company always strives to optimize the yield of Crude Palm Oil (CPO) and Kernel. One of the management systems applied to obtain the optimal outcome is to suppress oil losses in Crude Palm Oil (CPO) and loss of kernels during the production process. In Crude Palm Oil (CPO) production process, the palm oil mill tries to optimize the yield. Thus, palm oil mills also strive to minimize oil losses. Oil loss usually occurs at workstations on the production floor (Delpis *et al*., 2020).

The independent oil palm farmer cooperative (KOPSA-M) is a plantation community that has a foster father, PT Perkebunan Nusantara V (Persero) (PTPN V), which was formed based on PP No.8 of 1996, dated 14 February 1996, in the context of restructuring State-Owned Enterprises (BUMN) plantation sector. One of the oil palm farmer cooperatives (KOPSA-M) is a garden in Pangkalan Baru village, Siak Hulu, Kampar Regency.

Independent oil palm farmer cooperative (KOPSA-M) has adequate natural and human resources. Natural resources include oil palm plantations, based on PTPN V's letter to KOPSA-M No. 55-PTPN-V/5.D5/05.13/6/2002, dated June 12, 2002. Regarding to the development of KKPA-style farms, it was agreed that the distribution of the area comprised 500 ha for social gardens, and social welfare and community area lied on 1500 ha, and cooperative members inhabited the area of area of 2000 ha. The human resources in the organization into a particular field of management science are known as human resource management. Human resource management is critical and has many challenges because humans have very different characteristics than other resources. Human resource management is a program. Activities like obtaining human resources, developing, maintaining, and utilizing them to support the organization to achieve its goals. The availability of human resources is needed to carry out the tasks in the future. It is essential to ensure that company activities can be carried out properly. Employee performance is one of the factors that influences the success of an organization or company. With optimal performance, procedural, and optimal, results can be obtained. The workload imposed on workers occurs in three conditions, namely normal workload (fit), excess workload (overload), and underload (Matiro *et al*., 2021).

One of the losses gotten from post-harvest oil palm is the loss of Fresh Fruit Bunches (FFB). It is from each chain that is passed to the final processing (loss post-harvest) (Yulistriani *et al.,* 2014). Harvesters and loading workers (human resources) affect the FFB losses. Good harvest work results in high production at minimum costs. A good harvest is done by minimizing potential losses to increase harvest efficiency. Harvest management is carried out to improve harvest efficiency through planning, implementing, and evaluating harvest activities to transportation of fresh fruit bunches (FFB) to the factory (Anugrah dan Wachjar, 2018).

In the early part of harvesting, the activities that do not comply with the standards result in less optimal FFB yields such as losing fruits and harvesting raw FFB, causing losses in the form of reduced production yields. FFB reports carried out by employees are still managed in a simple way (Lisnawanty *et al.*, 2019). The objectives of this study are analizyng the harvest stages and sources that result in the risk of harvesting oil palm FFB in each post-harvest chain that is traversed to the collection point (TPH), TPH at operasi

Petani Sawit Mandiri (KOPSA-M), Pangkalan Baru Village, District Kampar, and analyzing the yield loss and the possible risk of harvesting oil palm FFB in each post-harvest chain that is traversed from the land to the TPH at Koperasi Petani Sawit Mandiri (KOPSA-M) Pangkalan Baru Village, Siak Hulu District, Kampar Regency.

MATERIALS AND METHODS

This research was conducted for two months, starting from 27 January to 27 March 2021 at Koperasi Petani Sawit Mandiri (KOPSA-M), Pangkalan Baru Village, Siak Hulu District, Kampar Regency. The data analysis was descriptive quantitative analysis. Descriptive research is a research that is intended to collect information about the status of an existing symptom, namely the state of the symptoms according to what they were when the research was conducted (Arikunto, 2009). Descriptive analysis is used to identify sources of risk and factors that influence post-harvest FFB loss such as fruit maturity, restraint FFB, plate cleanliness, land area, and Loss of Production at the Collection Place (TPH). Descriptive analysis is carried out based on existing objective assessments of harvesting activities, harvesting techniques, and following post-harvest activities. This kind of process. The followings are to clarity

1. Oil palm FFB harvest stages. Harvest is one of the critical factors determining the quality and quantity of production. Harvest work includes harvesting preparation (calculating harvest density figures), cutting FFB bunches, reducing fruit loss transporting them to TPH, and monitoring the monitoring the harvest (Sunarko, 2009).
2. Sources of risk of production loss. Sources of the risk of production loss are known by direct observation in the field when harvesting is carried out. The sources of risk that were observed were the sources that caused FFB production loss when the harvest was done until the FFB arrived at the TPH.
3. Measurement of FFB yield loss. This measurement of FFB yield loss is calculated according to the path that the FFB passes from the farmer to the final processing place (mill). This measurement will describe how much FFB loss in each pathway. It will be analyzed by using a formula based on Nugraha et al. (2007) in (Sunarko, 2009), namely the amount of losses during harvesting. It is seen as follows:

Loss of production = $\frac{G1}{G1\ G2}$ x 100%

RESULTS AND DISCUSSION

The Post-harvest risk analysis

Makmur Farmers Cooperative (KOPSA-M) is located in Pangkalan Baru Village, Siak Hulu District, Kampar Regency. The cooperative land area is around 2050 hectares. In carrying out its activities, oil palm plantations in KOPSA-M experience several risks. One of them is the risk in handling the FFB post-harvest from the harvesting process to the final processing place (factory). Oil palm post-harvest activities are one of the activities that significantly affect the state or condition of FFB production. The handling of the harvest of oil palm to the final FFB processing site (factory) has several stages . Of all the stages, several places or chains caused post-*harvest loss from* losing fruit production and harvesting raw FFB. Loss of production in the post-harvest process of oil palm will affect the amount of fresh fruit bunch (FFB) production. It is less than optimal so that it directly affects to farmers reduce income. This research discussed the sources of post-harvest risk, namely the loss of FFB production in each place (post) from the harvesting process to the factory (FFB processing), and described the distribution of production losses in each chain.

The post-harvest process of oil palm fresh fruit bunches at KOPSA-M is through several stages. The first stage is harvesting oil palm fruit in the form of

fresh fruit bunches (FFB). Harvesting is carried out by both oil palm harvesters and the farmers themselves. The second stage is the transportation of FFB that has fallen in the tree ring area or around the oil palm land to the collection point (TPH) using the rickshaw. The third stage is checking the harvested FFB before it is compiled to the TPH. At this stage,the raw FFB harvested by harvesters can be seen. The fourth stage is the weighing process, in which the FFB that has been compiled at the TPH will be weighed and brought to the oil palm transport car or truck. In the fifth stage, the FFB in the truck is then taken to the processing plant or palm oil mill (PKS). The sixth or final stage is that the FFB brought to the mill will be selected in the sorting place. This sorting process is carried out by factory employees who are in charge of selecting the FFB so that the farmers will obtain the clean FFB. Based on the description of these stages, it was found out that after harvesting, the places where FFB was delivered to Pangkalan Baru Village, Siak Hulu District, Kampar District were oil palm land (plates), a place for collecting produce (TPH), transportation (transport cars/trucks) and factories (factory sorting).

Based on the observations and interviews with Pangkalan Baru truck drivers, the loss of production in TBS cars or trucks are relatively small and can be considered zero (non-existent). The average capacity of FFB carried by trucks are 7 to 8 tonnes. After emptying the dump box, the truck drivers usually found less than 10 pieces of palm oil seeds left. Sometimes, they did not see a piece of them dropped. Based on these observations, losses in FFB transportation at KOPSA-M are considered non-existent.

Based on field observations, the post-harvest loss of KOPSA-M oil palm FFB in Pangkalan Village is only found in the land, TPH (the place for sorting the seeds and checking the dropping seeds), and mill sorting. There are several sources of risk from the three places that result in the loss of fresh fruit bunch (FFB) production(Yoga, 2017).

Loss of Production on the Land

In the oil palm harvesting process, the main thing that a harvester must prepare is harvesting equipment by the criteria for oil palm trees. The oil palm plants in KOPSA-M are 10/15 years old, so the tool for harvesting fruit is *egrek.* It is a sickle-shaped harvesting tool with a pieces of bamboo as the handle the length of the bamboo is as high as the plants. Another important thing to prepare is determining the oil palm plant's crop rotation. In general, in oil palm plantation companies, there is an estimation data (estimation) and other data regarding the condition of oil palm in the field so that the distribution of the estimated harvest for each block to be harvested can be determined (crop rotation). The crop rotation helps determine (in the form of an estimate/forecast) how much FFB will be harvested in each plot or block. Another benefit for crop rotation is to target FFB to be harvested.

The Independent Koperasi Petani Sawit Mandiri (KOPSA-M) (KOPSA-M) in Pangkalan Baru Village generally harvests oil palm fruit using a manual tool. It is e*grek*. The farmers use it to reach the high FFB. One thing that distinguishes the harvesting process at KOPSA-M is that harvesters do not use the principle of harvest rotation. Harvesters choose the fruit they harvest based on their observations and feelings (habits). To harvest the crop, the harvesters rely on their own observation in the field at the current time they do not use any prior calculations or estimates. This kind of way can be used to get the maximal gain if the harvesters choose the ripen seeds only.

Conversely, if the harvester is not maximal in seeing the ripe fruit, it will cause losses. the ripe FFB is left on the tree. As a result, the fruit that should be harvested is not harvested by the harvester and will be harvested in the next harvest period to pop the oil palm fruit. There is another FFB loss. That kind

of fruits should be harvested in the next harvest period. This raw FFB will be detected by the officer who will weigh the production when the FFB is at the collection point (TPH).

Based on direct observations in the field and interviews with KOPSA-M farmers, it is known that the loss of FFB production that occurs in oil palm land is in the form of loose fruit. It is released from the bunch (palm bunches) while harvesting. Another loss is harvesting the raw FFB. It is harvested by harvesters. Some other causes contribute the lost of the loose fruits in the farmers' land are stated below:

1. The harvest time for ripe

FFB is marked by loosing two palm fruits per kilogram of FFB (Pahan, 2008). If they are not harvested, will increase the percentage of loose fruit. It could be seen after loosing all the seeds from the bunch. It becomes a loss of FFB production (losses). The oil palm harvest cycle in Tanah Datar Village is carried out twice for one month. The interval from the first harvest to the next harvest is 14 days, but sometimes not for rainy conditions or peak harvest periods. In general, the interval from the first harvest to the next harvest can be more than 14 days, and some are less than 14 days. Damaged / muddy roads cause the harvest time lasts more than 14 days. Due to the rainwater, the paths are flooded. It hampers the process of harvesting. As a result, ripe fruit that is not harvested will increase the percentage of Also, in the peak harvest season, there are too many ripe FFBs in the trees so that the harvest time is accelerated from the previous harvest time (Satria et al., 2018)

2. Harvesting techniques and human resources

One of the sources of loosing oil palm fruit fromis the harvesting technique. Oil palm smallholders have different harvesters. Some harvesters the farmer group harvesters are hired individually (individually). Of the existing harvesters, not all of them have the same skills or ability to harvest. Therefore, the FFB harvesting at KOPSA-M does not use a harvest rotation system (harvest forecasting) where harvesters harvest FFB with direct vision in the field. The ability and harvesting techniques significantly affect the condition and shape of the FFB that is successfully harvested. For example, cutting the FFB that is between the fronds (2 fronds clamp FFB), if the harvester does not have a good cutting technique, the fruit bunch stalks will not be cut completely, resulting in loose fruit palms scattered (released) when the FFB falls into the soil. The harvested raw FFB fruit is also caused by the harvester's accuracy and knowledge in determining whether the FFB can be harvested or not. Moreover, the oil palm plants in KOPSA-M are more than ten years old, where the tree height has reached more than 6 meters, so good observation is needed in the harvesting process. Also, sunlight hitting the oil palm fruit will cause the fruit to look very flash and reddish so that if the harvester is unable to know the characteristics of the ripe fruit, it will cause the raw FFB Losses due to cutting unripe fruit include losing part of the potential production of palm oil (MKS), disrupting production preservation, and injuring the stem so that it experiences stress (Pahan, 2008) Another incident that harvesters at KOPSA-M often do is that ripe fruit is not harvested because the harvesters are not careful in seeing the FFB harvest. The ripe fruit that is not harvested willthe next harvest time and become losses from the FFB production (Setiawan and Ananda, 2020)

3. Clean the weeded circle around the trees and land area

Plantation crops are the forest plants where several wild plants are easy to grow and develop quickly around the plants. Weeds that often attack oil palm plants are weeds. They are hazardous and absolutely must be controlled. The development of weeds is speedy because of the reproduction process with flowers and rhizomes (roots). Also, weeds absorb

nutrients stored in the rhizome, which are detrimental to the oil palm plants .

For this reason, each oil palm tree needs a weeded circle in the shape of a circle around the area of the oil palm tree. It is 2 meters in radius from the stem of the immature plants (TBM) and 2.5 meters for mature plants (Putrie and Pramana, 2017). The weeded circle function is to control grass and weeds, to facilitate control and to spread of fertilizers, and to provide areas where ripen fruits and loose fruit fall. The weeded circle must be cleaned regularly. Another effort to maintain the weeded circle is to clean it from the growth of weeds and wild grass. It helps the farmers to collect the loose fruits. The presence of weeds and other grass will cover the ground around the stem. It hampers the farmers to see the scattered seeds. It could add to the level of loss. This willbecause loose fruit will become losses from oil palm fruit production (Putrie and Pramana, 2017).

Loss of Production at the Collection Place (TPH)

After the FFB harvesting process, harvesters will carry the FFB that has been successfully picked from the tree by using a rickshaw to the collection point (TPH). Arranged the crops in lines in the TPH area to make it easier to calculate TPH is a collection point for all FFB that has been harvested before being transported by truck/dump truck to the palm oil mill (PKS). The TPH is located near the oil palm land or, to facilitate the process of loading the truck or dump truck with FFB. The shape and size of the TPH are in the form of a rectangle with a size of 4 x 7 meters.

is susceptible to grass or weeds. the TPH area will be slightly damaged when it rains. In the weighing process, the fruits arranged on TPH are moved to palm oil weighing. After completing the weighing process, the farmers put them on the truck.

When transporting FFB from TPH to the trucks, some loose fruits are released from their bed (TBS). they fall or scatter in the TPH area. TPH with flat, clean and dray surface, the process of collecting loose fruits will be easy to do. The loose fruits cattered in TPH were taken by using raking tools the loose fruit collector helps the farmers collect all the loose fruits to be loaded in the truck box. However, not all TPHs at KOPSA-M are clean and flat. In fact, some TPHs are easily flooded. The loose fruit in the TPH area is not taken up optimally, and the loose fruit left in the TPH becomes a loss of FFB production for farmers in KOPSA-M.

Nevertheless, the large number of loose fruits left in the TPH are caused by the delay shipment to the factory. The fruit that has been arranged in TPH will be transportedto the following day. It causes the shrinkage of FFB and loose fruit. It happens due to being left there for one day. The falling loose fruits are caused by the free fatty acid (FFA). It can be found in palm oil seeds. If the amoun of it increases, it will affect the palm oil quality.

Loss of Production at the Mill (FFB sorting)

After the weighing process at the collection point (TPH), the FFB will be transported into the truck and immediately taken to the palm oil mill (PKS). (Setiawan and Ananda, 2020). Arriving at the PKS, the fresh fruit bunches (FFB) will be taken to the sorting place where the milling employee will reselect the fruit. The sorting process is carried out by sorting officers (factory employees). They observe the unloaded fruits from the truck to move to the stylized station. The number of sorting officers is around 2 or 3 people per truck. They take FFB from KOPSA-M.This kind of sorting process results in the reduction of the FFB. To decide the percentage of the reduction, the party discusses it to reach an agreement. The quality of fruits is the main reason to determine the percentage of reduction. Based on interviews with several sorting officers in the palm oil mill (PKS), farmers' maximum reduction is 5%, and the minimum is 1% of the total fruits. After the FFB selection process is

completed, the net weight of production will be determined. Meanwhile, the sorting officer's percentage reduction becomes production losses for the farmers. (Jelliani et al., 2020).

The percentage of the cut was taken based on observations by the sorting officer on several aspects. This aspect is a source of the risk of losing yields for the farmers. The sources are as follows:

1. Grass, sand, and garbage carried by TBS. Grass, sand, and garbage are carried along with the TBS is caused by the TPH's condition. Moreover, the surface of the TPH is susceptible to grass, weeds, and garbage growth.
2. Long stem stalks. In theory, fruit stalks should not exceed firm 2 cm at the base of the fruit tip or FFB. If it is not cut, it will be the disadvantage for the PKS. the stalk will affect the weight of the FFB and will be processed with the FFB so that it becomes waste for the palm oil mill (PKS)
3. Empty or raw bunches are carried away by the farmers. Although the FFB has been selected by the weighing staff at the farmer's TPH, sometimes the bunches are still empty (no oil palm fruit) and the raw FFB are carried to the factory. the officers who select FFB sin the field are not careful to see the fruit in the TPH. This usually occurs when there are a lot of FFB's in the TPH and peak harvest times. the lack of accuracy of the weighing officers who select FFB in the field and farmers commit human error by deliberately inserting empty bunches into the transport car so that the FFB yields look more and increase their income.
4. Yield target set by the mill. Each mill has a target yield of palm oil produced in a certain period. If the factory yield is not achieved, the factory will experience a loss, and if the factory reaches the specified yield target or even exceeds the target, the company will experience a surplus of income. This yield will be achieved if the processed FFB meet the factory standard like. The shape , cleanliness, and maturity of the fruits. This also affects the percentage of cuts given to farmers on their FFB yield. If the factory yield target is achieved, farmers' cut is relatively smaller. While the factory yield target has not been achieved, the farmers' cut is relatively high.

Based on the identification results, the post-harvest loss of FFB in the KOPSA-M farmers' oil palm plantations is land, TPH, and mill sorting. At the fruiting stage at the yield collection point (TPH), there are two activities like inspecting raw fruit and weighing FFB activities. the farmers experienced some lossess. They harvested raw fruit and lost some FFB in the TPH (Putrie and Pramana, 2017). The following is the percentage of loss of fresh fruit bunches (FFB) production at each post (loss post-harvest) as seen in Table 1.Table 1.Losses percentage

Treatment	% loss of production (Losses) per 2 Ha
Losses on the ground	1.73
Losses checking for raw FFB	0.51
Losses lumpy at TPH	0.27
Losses at factory sorting	2.70
Total	**5.21**

The yield losses described in Table 1 are obtained by dividing the average number of losses in oil palm production in each post-harvest chain by the sum of the average yields of the respondent farmers with the average loss of production in each post-harvest oil palm chain. So with this calculation, it is found that the amount of production loss on land is 1.73 % of the total oil palm production produced by farmers. The loss of production due to harvested raw FFB and loose fruit left in the TPH are 0.51 % and 0.27 % from the total amount of production yield. Then, the loss of palm oil production that occurs in the factory sort is 2.70 %. it is the stage that experiences the most production

losses. Based on the known loss of oil palm production at Koperasi Petani Sawit Mandiri (KOPSA-M) in Pangkalan Baru Village, furthermore, the amount of post-harvest loss that occurs in oil palm plantations in KOPSA-M is 5.21 % of the total average. The average FFB production produced by oil palm farmers is 4405.36 kg per month. This loss continues to occur every post-harvest process carried out by farmers in Independent Koperasi Petani Sawit Mandiri (KOPSA-M) and many farmers do not know it.

CONCLUSION

The loss post-harvest of oil palm FFB in Independent Farmers Cooperative (KOPSA-M), in Pangkalan Baru Village, Siak Hulu sub-district, Kampar district 5.21 % of the total average FFB produced per plot. Each plot is about 2 Ha it is about the percentage of FFB losses. The losses are located in the land section, TPH, checking raw FFB and sorting mills. The percentage of losses in the land area is 1.73 % of the total FFB yield. When the FFB was in the TPH, there were two processes carried out by the farmers checking the raw FFB and weighing the FFB. each has the percentage of losses 0.51 % and 0.27 %, respectively. Meanwhile, the number of losses in the factory sorted amount was 2.70 % it is the most significant loss for post-harvest FFB losses at KOPSA-M. The sources of post-harvest loss of FFB at KOPSA-M are harvest time, harvesting techniques , cleanliness of plantation land and harvesting places (TPH), sunlight, human resources (HR) from oil palm harvesters, and fruit quality and yields.

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