JPPIPA 9(12) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Preliminary Results of Relationship between Oil Palm Harvest Losses and Harvest Interval in Riau and West Kalimantan, Indonesia

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Received: October 2, 2023
Revised: November 14, 2023
Accepted: December 20, 2023
Published: December 31, 2023

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DOI: 10.29303/jppipa.v9i12.6120

Abstract: Oil palm smallholders, in particular non-plasma independent smallholders, experience significant yield gaps. Closing this yield gap is important to enhance sustainable livelihoods for oil palm smallholders and reduce the risk of yield increase through expansion. One of the key factors influencing yield is the harvest interval (number of days between two harvesting rounds). Although standards for Good Agricultural Practices regarding oil palm prescribe a harvest interval of 7-10 days, independent smallholders often maintain a harvest interval of 12-30 days. A longer harvesting interval not only reduces the number of fresh fruit bunch harvested per hectare per month but also leads to a larger harvest loss from overripe fruits falling to the ground, deteriorating quickly (harvest loss). We followed an interdisciplinary research approach, combining insights from agronomy and anthropology, to better understand farmers' practices, and drivers and challenges underlying decision-making. The approach consisted of field audits, farmer surveys, and qualitative interviews to explore which factors impact harvest interval. The harvest interval of smallholders in Riau and West Kalimantan ranged from 11 to 30 days. Farmers followed long harvest intervals (>16-d) due to the low fresh fruit bunch yield. However, longer harvest intervals increased potential harvest losses.

Keywords: Harvest interval; Harvest losses; Mineral land; Oil palm

Introduction

Global demand for palm oil has led to a rapid increase in the plantation area and production of palm oil over the last three decades. It is evident from the data displayed by the Directorate General of Plantations, Ministry of Agriculture in 2020. Data collected in Riau Province showed an increase in land clearing occurred from 2,706.9 hectares in 2018 to 2,853.8 hectares in 2020 (Direktorat Jenderal Perkebunan, 2020). As a consequence of this vast increasing in global demand for *Elaeis guineensis* (palm oil), massive expansion of land for palm oil plantation is inevitable and it causes severe environmental impacts in the form of land use, deforestation, and loss of biodiversity (Jelsma et al., 2017; Srinivas & Koh, 2016; Wilcove et al., 2013).

The average yield of *Elaeis guineensis* (oil palm) in Indonesia does not reach the maximum potential figure that should be able to be obtained. The average farmers only reach 42% of the achievable yield. Moreover, the development of the palm oil industry with the large-scale land expansion is considered not in line with the principles of sustainable development (Krishna et al., 2017). Therefore, closing this yield gap is deemed essential to achieve the dual objective of meeting global demand for palm oil without further expansion of agricultural land to avoid deforestation and greenhouse gas emissions (Bayona Rodríguez et al., 2015; Austin et

How to Cite:
Nurfalah, L., Dwiyahreni, A. A., Winarni, N. L., Mizuno, K., & Grassini, P. (2023). Preliminary Results of Relationship between Oil Palm Harvest Losses and Harvest Interval in Riau and West Kalimantan, Indonesia. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 10721–10726. https://doi.org/10.29303/jppipa.v9i12.6120

al., 2017; Monzon et al., 2021), as well as strengthening rural economies through higher incomes for smallholders (Monzon et al., 2021; Santika et al., 2019). These require solution that will increase palm oil production in existing plantation without increase environmental impacts, especially due to expansion of plantation environment (Monzon et al., 2021; Oil Palm, 2021).

Method

The study was carried out in Riau Province (Tandun Sub-district) during January-March 2022 and West Kalimantan Province (Sembelangaan Simpang Tiga Village and Sei. Kelik Village) during May-July 2022. We conducted field surveys (audit). The audit is a systematic process of obtaining and evaluating evidence objectively and for the purpose of providing an opinion on a particular report. Three different treatments in palm oil plantation were applied: Best Management Practice (BMP), Reference (REF), and Non-Field Trial (NFT). BMP is an innovative approach to intensify yields in underperforming mature oil palm stands (IPNI Canada, 2019). REF is a reference block, where current standard practices were maintained, the other became the NFT is a Non-Field Trial without any intervention (Donough et al., 2009). In Riau Province, we audited a total of 21 farmers. There were 6 farmers for BMP and REF and 15 farmers for NFT. In the province of West Kalimantan, we selected 20 farmers of which 5 for BMP and REF, and 15 for NFT.

We selected Riau (RI) and West Kalimantan (WK) as case studies to represent the two main palm oil-producing islands in Indonesia. Moreover, the harvest interval (HI) in these locations was significantly different, including a more regular two-weekly interval in RI and a longer, more variable interval in WK (Donough et al., 2009). These audits were conducted after each harvest during 3 months at each site: between Jan and Mar in RI and May to Jul in WK. Data gathered for each harvest audit were harvested bunches (HB), un-harvested ripe bunch (UHB), harvested bunch left in the field (HBL), and loose fruits (LF).

Two conditions must be met in this audit process, i.e. the number of harvesting paths and the number of harvested bunches. Harvest audits are carried out alternately, with the first rotation being carried out on all odd harvesting paths. The next harvest audit rotation is carried out on all even harvesting paths. The minimum number of harvested bunches that must be audited is 20 harvested bunches. However, if the harvest marks harvested by the harvest worker that day were less than 20 bunches, then all the palms in the selected harvesting paths must be checked, it should not be missed. The items audited were harvest bunches (HB), un-harvested ripe bunch (UHB), harvested bunch left in the field (HBLF), and loose fruit (LF) detailed in Figure 1. Researcher recorded all the audit data results on the observation sheet, which every time researcher finished from the field we transferred to the computer and organized them better for analysis.

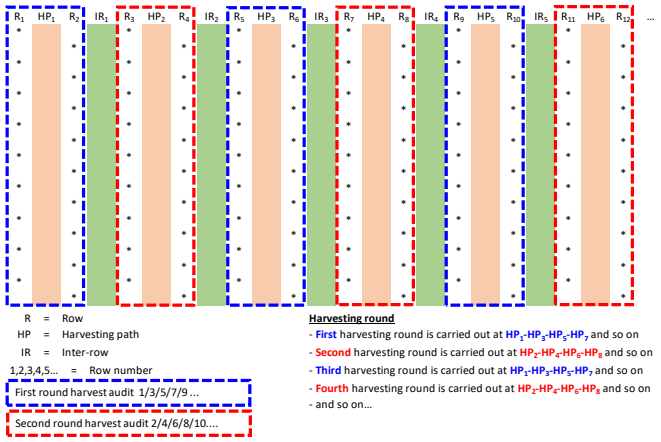

Figure 1. Schematic diagram of alternate harvesting path for auditing

Result and Discussion

Data collected in Riau and West Kalimantan shows that harvest interval in Riau and West Kalimantan are in the range of 11 to 30 days. The average harvest interval on each plantation treatments in each province is shown in Figure 2.

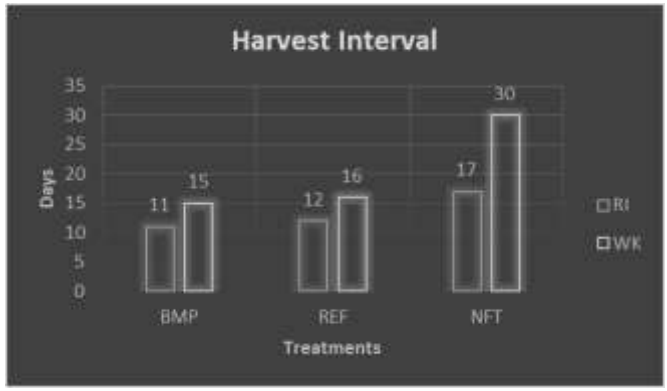

Figure 2. Average of Harvest Interval on the Best Management Practice (BMP), Reference (REF), and Non-Field Trial (NFT) studied plantation in Riau (RI) and West Kalimantan (WK)

Loss fruit (LF) audits during the harvest period in RI and WK showed different results. Non-Field Trial in RI has more LF than other treatments. Whereas in WK, BMP has more losses compared to other treatments (Figure 3).

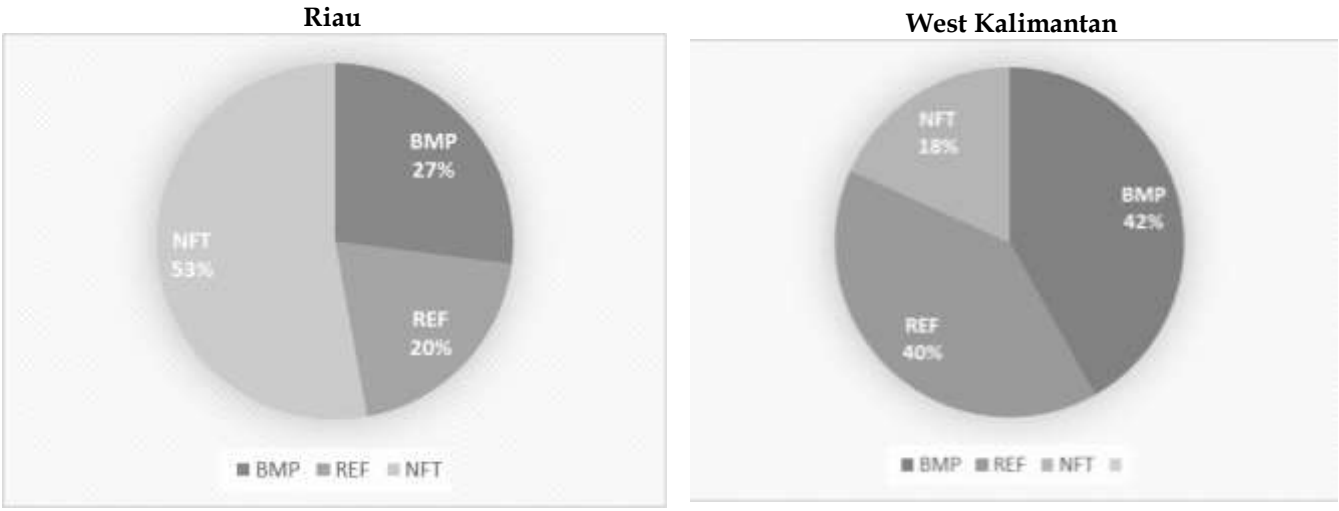

Figure 3. Percentage of Losses Fruits (Ha) on Best Management (BMP), Reference (REF), and Non-Field Trial (NFT) studied plantation in Riau (RI) and West Kalimantan (WK)

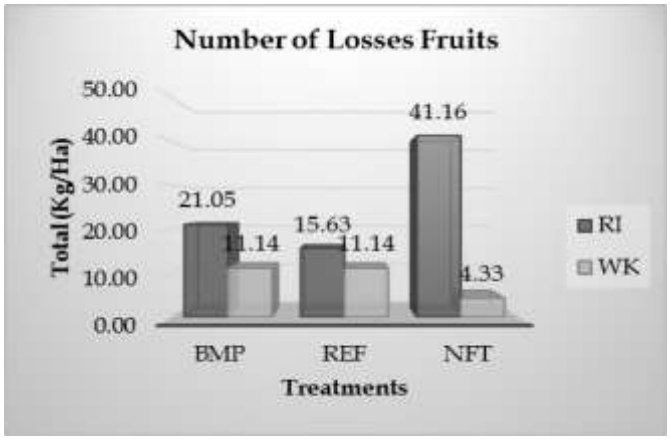

Figure 4. Number of Losses Fruits (Kg/Ha) on Best Management Practice (BMP), Reference (REF), and Non-Field Trial (NFT) studied plantation in Riau (RI) and West Kalimantan (WK)

Losses fruit occurs due to many factors. The length of the interval also affects the number of LF from the bunches. However, this current study did not focus on explaining this. The results of the LF in Riau and West Kalimantan are detailed in Figure 4.

Losses of bunches during the harvest period in Riau and West Kalimantan also showed different results. NFT in RI has more bunches loss than other treatments. Whereas in WK, REF has more losses compared to other treatments (Figure 5).

Loss of bunches was calculated from the accumulation of bunches left on the trees and left on the land, so they were also unsold products. We found losses of bunches on each plantation treatment which could happen due to a lack of thoroughness in work. As we know that loose fruits and missed bunches were collected by others in Riau. The losses of bunches in Riau are detailed in Figure 6.

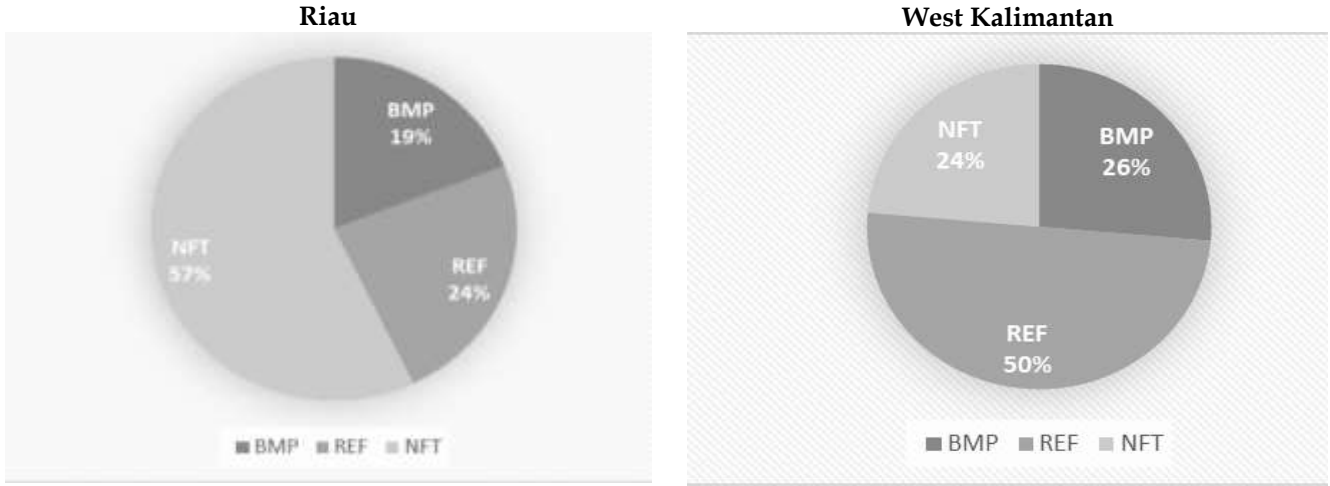

Figure 5. Percentage of Losses Bunches (Ha) on Best Management Practice (BMP), Reference (REF), and Non-Field Trial (NFT) studied plantation in Riau (RI) and West Kalimantan (WK)

The losses of LF and bunches are one of the factors in the yield gap obtained by independent smallholders as compared to company-owned oil palm plantations (Herdiansyah et al., 2020). The yield gap requires a proper solution in order that it will not to become a protracted problem in independent oil palm plantations at the national level. This research based on agronomy and anthropology contributes to the explanation of the yield gap in independent oil palm plantations. Therefore, we believe that this research is valuable to provide a better understanding of oil palm plantation management practices in Indonesia.

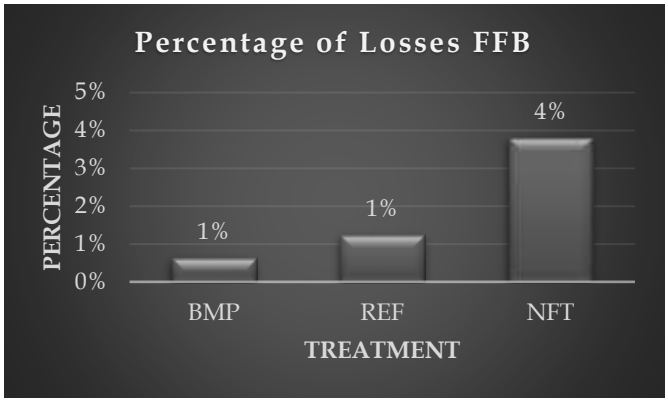

Figure 6. Percentage of Losses Fresh Fruit Bunches (FFB) on Best Management Practice (BMP), Reference (REF), and Non-Field Trial (NFT) studied plantation in Riau (RI)

Harvest losses due to harvest interval can occur due to many factors (de Vos et al., 2023). According to de Vos et al. (2023), the main obstacles to shortening HI are the availability of trusted harvest workers, minimum FFB tonnage requirements to guarantee sufficient income for harvesters, and poor road conditions. For independent farmers, it may not be easy to shorten the harvest distance (Ernawati et al., 2021). Various challenges can hamper harvest, such as poor harvest trail maintenance (Rhebergen et al., 2020), lack of pruning (Maat, 2018), limited access due to poor infrastructure or weather conditions, and labour shortages (Jelsma et al., 2019). In addition, harvesting decisions can be influenced by the absorption capacity of intermediaries, quotas set by mills (Anggraini & Grundmann, 2013), and estimated costs in relation to the benefits of selling FFB at a certain price. However, on the one hand, there is an urgent need to further improve the sustainability of the oil palm plantation sector, so that it can provide income for producing countries and farmers without causing social conflict or permanent damage to important ecosystems (Ernawati et al., 2019; Cordaro & Desdoigts, 2021).

Crop yields can be increased by implementing Good Agricultural Practices standards (especially fertilizer and harvest distance) (de Vos et al., 2023; Lim et al., 2023). Previous studies show that harvest spacing, i.e. the number of days between two harvest cycles, is an important factor in determining yield (Euler et al., 2016; Lee et al., 2014; Woittiez et al., 2017; Sokoastri et al., 2019). Experiments on large-scale plantations have shown that short harvest intervals (7-10 days) stimulate plant recovery, ultimately resulting in higher yields per hectare per year (Corley & Tinker, 2016; Donough et al., 2010). However, independent farmers in Indonesia often maintain a harvest interval of 14-30 days (De Vos et al., 2021; Jelsma et al., 2019; Lee et al., 2014). Similarly, Rhebergen et al. (2018) reported an average harvest interval of 17 days on plasma plantations in Ghana. Long harvest intervals can not only reduce the number of fresh fruit bunches (FFB) harvested per hectare, but also cause greater crop losses because overripe fruit falls to the ground, spoils quickly, or sprouts into weeds (Corley & Tinker, 2016).

Conclusion

Our study shows that independent oil palm smallholders have a longer harvest interval. On average, they harvest once to twice in a month, which ranges from 11 to 30 days. This long harvest interval is one of the factors causing yield discrepancies in independent oil palm plantations. Improvements on harvest management practices need to be carried out to minimize the yield discrepancies. Confidently, better practices can increase the yield productivity of independent oil palm plantations in Indonesia.

Acknowledgments
This project was supported by the Norwegian Ministry of Foreign Affairs (grant INS-19/0008 to P.G.), with some additional funding from the Global Engagement Office at the Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln. We thank the following collaborators: Muhammad Ali Imran, Zulhamdani, Suparmono, and Zamzami (FPSS Semarak Mudo) and Antonius Purwanto Tito, Saly Sanjaya, and Asmadi (Bentang Kalimantan).

Author Contributions
Lisa Nurfalah conceptualized the research idea, designed of methodology, management and coordination responsibility; Asri A. Dwiyahreni and Nurul L. Winarni analyzed data, conducted a research and investigation process; Kosuke Mizuno and Patricio Grassini conducted literature review and provided critical feedback on the manuscript.

Funding
This project was supported by the Norwegian Ministry of Foreign Affairs (grant INS-19/0008 to P.G.), with some additional funding from the Global Engagement Office at the Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln.

Conflicts of Interest
The author declared no conflict of interest.

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