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Design of Supplier Selection of Fresh Fruit Bunches (FFB) of the Palm Oil Industry

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Abstract: The research aims to identify the optimal strategy for selecting suppliers, analyse criteria priorities, and rank the best suppliers in PT X, Paser Regency. The research method uses quantitative approach with data collection through questionnaires based on the ANP (Analytical Network Process) model. The sample was determined using purposive sampling of three employees of PT X. The analysis was conducted in three stages: descriptive, ANP using super decision software, and TOPSIS to rank the FFB suppliers. The results on ANP showed that the design of selection of FFB suppliers in PT X is based on 5 criteria and 16 sub-criteria. Price criteria include payment method, low price, easy agreement, and price stability. The claim policy criteria include quick response, assistance, and warranty. Quality criteria involve technical conformity, quality consistency, and defect rate. Geographical location criteria consider climate, distance, road conditions, and delivery time. The delivery criterion prioritises the sub criteria of the accuracy of the number of deliveries. The conclusion from TOPSIS showed that the highest ranking of FFB suppliers is given to UD. Naila Naufal Jaya, superior on price, quality, delivery, geographic location, and warranty criteria.

Keywords: Bunches; Fresh fruit; Industry; Palm oil; Suppliers.

Introduction

Indonesia is rich in natural resources spread throughout the region, with the agricultural sector playing an important role in the economy (Saqdiah et al., 2022). One important subsector is plantations, with leading commodities such as oil palm (Darmawan, 2013). The palm oil industry produces crude palm oil (CPO) (Mangoensoekarjo & Semangun, 2005), which relies heavily on the supply of fresh fruit bunches (FFB) from nucleus, plasma, smallholder plantations, and suppliers for the production process at Palm Oil Mills (PKS). Supply chain management integrates suppliers, producers, warehouses, and distribution to minimise costs and improve the competitiveness of companies. Indonesia experienced an 8-level drop in the 2020 global competitiveness ranking to 40th place (imd.org, 2020). The supply chain includes suppliers, manufacturers, distributors, stores, and support companies (Pujawan, 2010). One of the important elements in supply chain management is the purchasing and distribution of raw materials from suppliers. As explained by Mulyani et al. (2021), distribution aims to facilitate the distribution of goods or services from producers to consumers. The availability of raw materials from suppliers affects the smooth running of the production line, which plays an important role in producing quality products. Therefore, companies need to choose suppliers who are able to supply quality raw materials to support production operations. This is in line with the importance of an optimal supplier selection strategy as implemented at PT X.

Supplier selection must be done objectively to avoid disruption to the production process (Hasrat & Rosyadah, 2021). The main objectives of supplier selection are to reduce purchasing risk, build long-term

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relationships with suppliers, and maintain and improve the quality of raw materials and products (Pujawan, 2010). Saputra & Kania (2022) emphasise that the selection of the right cooperation partner is the core of supply chain management, because the raw material provider is closely related to the sustainability of the company. Problems in the supply chain, such as delays in raw materials, can result in unstable production, decreased product quality, and complaints from customers. Several palm oil mills in Paser District, East Kalimantan, are facing problems, such as the mills' core plantations not being able to supply FFB optimally due to the age of the plants being over 30 years old (Asriwandari et al., 2024). In addition, competition among palm oil mills has intensified due to the emergence of new mills without expansion of plantation land. Licensing, security, and environmental constraints also hamper the growth of new land. Other factors include mismatches between the amount of FFB delivered by suppliers and the company's needs, unstable FFB prices, as well as problems in quality and inappropriate timing of fruit deliveries (Azmi & Richasdy, 2023).

Fluctuations in FFB prices from the Journal of Oil Palm and Prices (2023) known that decline in FFB prices during August 2017-July 2019. The price of FFB aged 3-9 years fell from Rp 1.572/kg to Rp 1.182/kg, FFB aged 10-20 years fell from Rp 1.810/kg to Rp 1.341/kg, and FFB above 20 years fell from Rp 1.685/kg to Rp 1.249/kg. This price decline was triggered by the decline in world CPO prices. Independent smallholders experienced a sharper price decline, with FFB aged 3-9 years falling from IDR 943/kg to IDR 709/kg, and FFB aged above 20 years from IDR 1,011/kg to IDR 750/kg. The fluctuation of FFB prices also occurred in East Kalimantan Province as described in Figure 1.

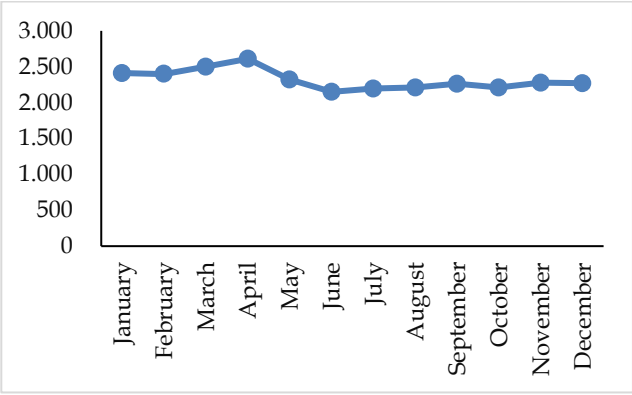

Figure 1. East Kalimantan Palm Oil Fresh Fruit Bunch Prices (2023)

Figure 1 shows the decline in oil palm FFB prices in East Kalimantan in 2023 (Disbun Kaltim, 2023). The price decline occurred in January-February from IDR 2,401/kg to IDR 2,346/kg, April-May from IDR 2,667/kg to IDR 2,298/kg, May-June from IDR 2,298/kg to IDR 2,128/kg, and July-August from IDR 2,162/kg to IDR 2,143/kg. Climate change factors, such as changing rainfall patterns and climate extremes, affect oil palm productivity. A water deficit of 200-300ml/year causes a 21-32 per cent reduction in FFB production, and if it reaches 500ml/year, the reduction can reach 60 per cent (DG Plantation, 2007). Drought also increases the risk of land fires, which have a direct impact on FFB production. As illustrated in Figure 2.

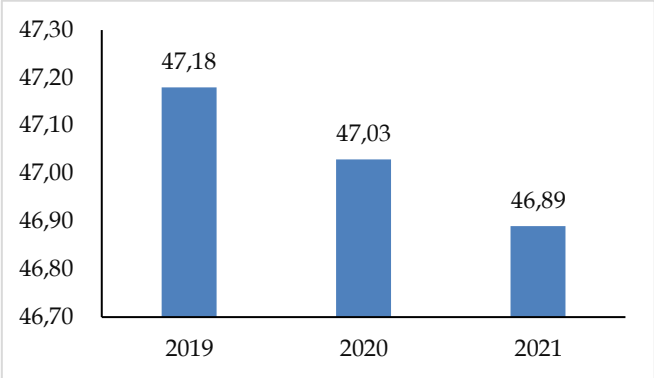

Figure 2. Indonesia CPO Production and Export (2019-2021)

Figure 2 shows the impact of El Niño on Indonesia's palm oil production, with CPO production falling from 47.18 million tonnes in 2019 to 46.89 million tonnes in 2021, and exports declining from 37.4 million tonnes to around 34 million tonnes. Chairman of the Indonesian Palm Oil Association (Gapki), Eddy Martono, explained that El Niño caused an extreme dry season, disrupting production and delaying harvest. Controversy over the safety of palm oil also continues among international health organisations. The threat of substitute products for palm oil occurs in importing countries such as China, America and the European Union in the form of soya oil and oil derived from rapeseed plants (Aripin & Paramarta, 2023). The demand for CPO in the Indian market has led to competition between vegetable oil producing countries. Indonesian CPO is experiencing a negative trend, while substitute products, such as Crude Soybean Oil (CSBO) from Argentina, have increased 105 per cent since 2010, worsening market competition. In China, soya oil consumption accounts for 49 per cent and palm oil only 20 per cent. In the United States, soybean oil dominates at 72 per cent and palm oil at 9 per cent, while the European Union consumes rapeseed oil at 42 per cent and palm oil at 29 per cent.

The current performance of suppliers still has many shortcomings, which results in not achieving optimal CPO production targets. The mismatch between supplier performance and company criteria is the main cause of this problem. To overcome this, supplier

performance evaluation needs to be carried out with research to select raw material suppliers that match the company's criteria, so as to produce the best supplier. Supplier selection is based on performance conformity with criteria and sub criteria which include Price, Quality, Delivery, Service, and Location. This selection process is very crucial in purchasing activities, because the right supplier supports the achievement of company output. General criteria in supplier selection include fruit quality, stable price, fast delivery, good service, and a favourable environment. This effort is important so that the company's CPO competitiveness does not lose in the international market, given the competition with other producing countries such as Malaysia, Thailand, Colombia, and Nigeria. Determining the best supplier uses a multi-criteria decision-making (MCDM) tool that helps in evaluating and selecting suppliers.

The novelty of this research lies in developing a comprehensive and objective supplier selection model specifically tailored for Fresh Fruit Bunches (FFB) in the Indonesian palm oil industry. Indonesia, as a significant player in the global palm oil market, faces challenges in maintaining the reliability and quality of FFB supply due to various issues, including aging plantations, intensified competition, and fluctuating prices. These challenges highlight the need for an optimal supplier selection strategy to ensure a stable and high-quality supply chain. This study aims to address the gaps in current supply chain practices by designing a systematic approach for evaluating and selecting FFB suppliers. This model is intended to mitigate supply risks, enhance production stability, and strengthen long-term supplier relationships, thus boosting the competitiveness of palm oil mills and ultimately supporting the industry's growth. To consider or calculate the interrelationship of existing factors in the company using the Analytical Network Process (ANP) method (Murnita et al., 2024). In making decisions, several alternatives usually appear and the decision maker must choose the alternative that has the least risk and the greatest benefit, so that the decision taken becomes the ideal solution in overcoming the existing problems so that the Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) method is used.

Method

The purpose of this study is to identify and develop an optimal supplier selection strategy and describe the FFB supplier selection design, analyse the priority order of the criteria and sub criteria for selecting FFB suppliers and rank the best FFB suppliers at PT X in Paser Regency. The type of research used in this research is descriptive quantitative research with the object of research in the form of PT X which is determined by purposive method, this is because the phenomenon that exists at that location, namely PT X, is still experiencing problems in supplier selection design and the benefits of research obtained when carried out at that location. This search location is intended to facilitate or clarify the target location in the study. The following is a research flow diagram in the Figure 3.

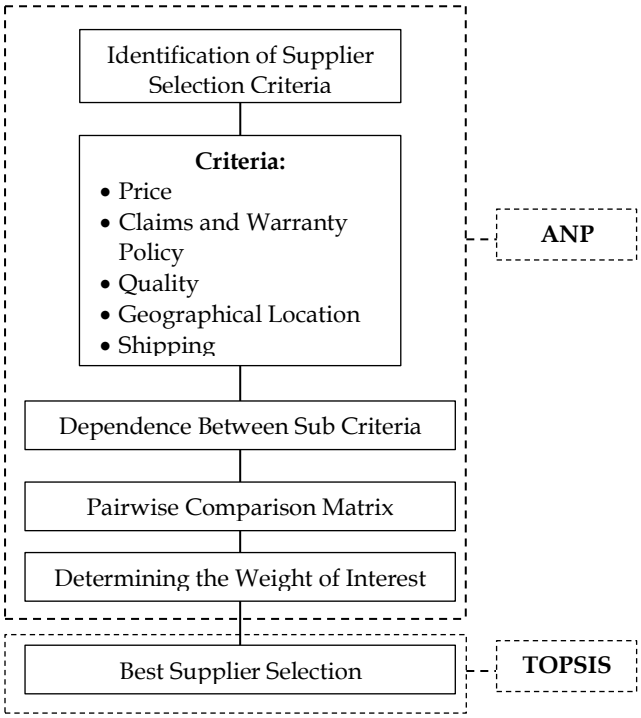

Figure 3. Research Flow

The research flowchart explains that there are two steps in data processing, namely using the analytical network process (ANP) method to determine the importance of supplier selection sub-criteria to be used as a reference in determining the best supplier, the next step is using the Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) method which is used to determine the best supplier. The method of determining the sample in this study using purposive sampling method, namely respondents who understand the company's FFB suppliers, the respondents in this study consisted of three people, respondent 1 is aged 31 years with the position of PSAM Kaltim and Kalsel, respondent 2 is aged 52 years with the position of Partnership Support Officer Area, and respondent 3 is aged 39 years with the position of Partnership Operation Officer PT X. The data collection technique in this study uses interviews and questionnaires related to criteria, sub criteria and alternatives in supplier selection. The variables in this study are focused on selecting the best FFB supplier with 5 criteria in the form of price, claim and guarantee policy, quality, geographical location and

delivery. The description of the criteria and sub criteria is described in Table 1.

Table 1. Supplier Selection Criteria and Sub Criteria

Criteria	Sub criteria	Code	Explanation	References
Price	Payment procedure	A	Procedures and agreements regarding payment issues	Widianti (2016)
	Affordable price	B	The price set by PT X has a positive impact on supplier revenues	Zahra et al. (2015)
	Ease of price negotiation	C	How suppliers cooperate to achieve a suitable price agreement	Zahra et al. (2015)
	Price stability	D	Stability of TBS prices over time, preventing losses for both parties	Zahra et al. (2015)
Claim and Guarantee Policies	Responsiveness	E	The supplier's ability to provide a quick response to the company's TBS needs	Yusuf & Prassetiyo (2022)
	Assistance provision	F	The supplier's ability to provide large quantities of TBS as needed by the company	Pebriana et al. (2023)
	Guarantee provision	G	Protective services related to the TBS delivered	Yusuf & Prassetiyo (2022)
Quality	Technical compliance	H	Compliance of the supplied TBS with the company's standard specifications	(Widianti, 2016)
	Consistent quality	I	Consistency in the quality of TBS provided by the supplier in each delivery	(Widianti, 2016)
	Defect rate	J	Minimising defective TBS to ensure usability	(Widianti, 2016)
Geographical location	Climate/weather	K	Weather conditions faced by suppliers during their journey to the destination	Sinaga (2017)
	Distance	L	The distance between the supplier's location and the destination company	Saskia & Rispianda (2021)
	Road conditions	M	Road conditions encountered by suppliers on their way to the destination	Sinaga (2017))
	Travel time	N	The time it takes for the supplier to reach the destination company	Sinaga (2017)
Delivery	Delivery speed	O	TBS is delivered according to the agreed-upon time	Widianti (2016)
	Accuracy of quantity	P	Accuracy in the quantity of TBS delivered	Widianti (2016)

The data analysis technique in this study was carried out with three main steps, namely descriptive analysis to describe the general description of the research location, characteristics of respondents, and supplier selection criteria at PT X. Furthermore, the Analytical Network Process (ANP) technique to analyse the priority order of the criteria and sub criteria for selecting FFB suppliers at PT X in Paser Regency, finally the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) analysis to rank the best FFB suppliers at PT X in Paser Regency.

Result and Discussion

Description of PT X FFB Supplier Selection Design

On the price criterion, interviews with PT X's Partnership Management Division identified several sub-criteria: mode of payment, competitive price, ease of price agreement, and price stability. Payment is made through periodic transfers every week for large FFB purchases, which increases transparency and security for both parties, in line with the research of Afandi (2021) on trust in transfer methods. Competitive prices reflect mutually beneficial price offers, taking into account supplier satisfaction and FFB stock availability for CPO production, as emphasised by Lim et al. (2021). Early price agreements between suppliers and PT X are important to prevent losses, using market price references as a guide (Prasodjo, 2023). PT X's price stability policy aims to maintain supplier profits by setting a stable FFB selling price in Pasir Belengkong Sub-district (Goh et al., 2020).

In the claims and guarantee policy criteria, there are several sub-criteria: responsiveness, providing assistance, and providing guarantees. First, the responsiveness sub-criterion covers the supplier's ability to respond quickly to the company's FFB needs. This is important because supplier readiness affects the continuity of the collaboration, as stated by Sipayung et al. (2023). The second sub-criterion is assistance, which refers to the supplier's capacity to provide large quantities of FFB. Only some suppliers, such as UD

Naila Naufal Jaya (NNJ), are able to fulfil this need due to their role as middlemen. Rubinsin et al. (2020) emphasised the importance of middlemen in the marketing of FFB to Palm Oil Mills (PKS). The last sub-criterion, providing warranty, relates to the protection provided by the supplier on the quality of FFB delivered to PT X. PT X conducts sorting of FFBs, rejecting those that do not meet quality standards, as an evaluation for suppliers. This is in line with MacArthur et al. (2021), who stated the importance of supervision to improve the quality of CPO.

The third criterion in PT X's FFB supplier selection design is the quality criterion, which includes the sub-criteria of technical suitability, consistent quality, and defect rate. The first sub-criterion, technical conformity, emphasises the importance of FFB delivered by suppliers conforming to the company's standard specifications. PT X needs to apply quality standards to the FFB received to maintain the sustainability of the mutually beneficial cooperation. According to Silvia et al. (2024), focusing on the fulfilment of raw materials that match the quality of consumer demand is key in the palm oil production supply chain. The second sub-criterion, consistent quality, shows that PT X requires FFB that is always of good quality and according to specifications. MacArthur et al. (2021) stated that CPO companies must establish FFB acceptance criteria so that the quality of the CPO produced is maintained. The last sub-criterion, defect rate, focuses on the supplier's efforts to minimise FFB defects that can disrupt production. Suhartini et al. (2022) highlighted the importance of harvest age, fertiliser quality, and seasonal considerations in producing quality FFB.

The geographical location criterion in FFB supplier selection includes the sub-criteria of climate, distance, road conditions, and length of delivery time. The climate sub-criterion refers to the weather that suppliers face during delivery. The biggest challenge arises during the rainy season, when roads become slippery (Suhartini et al., 2022). The distance sub-criterion shows that PT X's suppliers generally come from one sub-district, Pasir Belengkong, which has the largest oil palm land area in Paser District, at 27,716.42 ha (Agustira et al., 2019). The condition of the roads travelled by suppliers is mostly damaged, with 38.83% in a bad condition, according to (Milasari, 2022). This requires attention from the local government to improve road access. Finally, delivery times between suppliers do not differ much, although the rainy season can slow down the FFB transport process due to more difficult road conditions (Suhartini et al., 2022).

The last criterion used by PT X in selecting FFB suppliers is the delivery criterion, which includes the speed of delivery and the accuracy of the FFB quantity. Delivery speed reflects whether FFBs arrive within the agreed time, which is important for efficient production time and timely marketing of CPO. Prior to purchase, PT X and suppliers agree on the delivery time, as timeliness greatly affects the sustainability of the palm oil agroindustry supply chain (González et al., 2021). The accuracy of the delivery quantity reflects the supplier's ability to deliver FFB in the agreed quantity. Quantity mismatches can force PT X to adjust production management, which negatively impacts production quantity and cost (Asdidi et al., 2018). Both are crucial aspects in achieving CPO production efficiency.

Priority Order of Criteria and Sub Criteria for Selection of FFB Suppliers at PT X

The ANP model in this study uses the results of a questionnaire conducted by researchers with PT X employees, which continues to be used as a reference for making the ANP model in Superdecision software. The ANP model in the study can be seen in Figure 5.

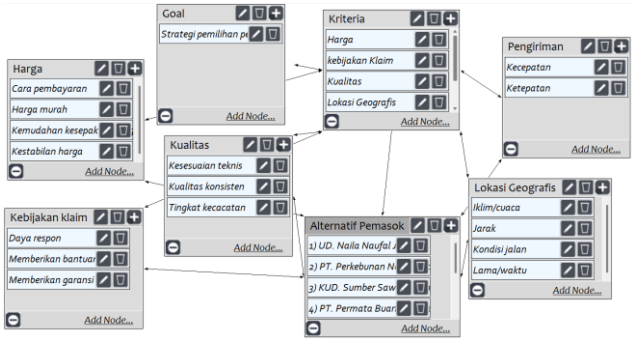

Figure 4. FFB Supplier Selection Design

The design process starts with identifying the main criteria and sub-criteria that are relevant to the company's objectives. Next, pairwise comparisons are made to determine the relative importance weight of each criterion. The Analytic Network Process (ANP) model includes internal and external dependencies (Syafirullah et al., 2024). This study shows that the criteria used have external dependence, without inner dependence. The FFB supplier selection criteria-price, claim policy, quality, geographic location, and delivery-are generally interrelated, such as the responsiveness sub-criterion that relates to the ease of price agreement. In ANP (Analytical Network Process) analysis, the ratio consistency test ensures that the pairwise comparison judgements are consistent (Gultom & Sinaga, 2023). Consistency is assessed through the inconsistency ratio output in the super model application. The test value should be less than or equal to 0.1, which indicates the inconsistency does not exceed 10%. If it exceeds the limit, the judgement needs to be revised to ensure the

reliability of the analysis. The results are outlined in Table 2.

The results of the ratio consistency test show that the inconsistency ratio value below 0.1 (IR<10%) fulfils the requirements for pairwise comparisons between criteria and sub-criteria. This low value indicates consistency in judgement, as stated by Putra (2023). By fulfilling this requirement, ANP analysis is considered valid and reliable for decision making. Furthermore, the results of the ANP analysis of the priority order of the criteria and sub-criteria for selecting FFB suppliers at PT X in Paser Regency are described in Table 3.

Table 2. Ratio Consistency Test Results

Test	N	IR	Explanation
Between criteria	5	0.07	< 0.10: Consistent
Price	4	0.01	< 0.10: Consistent
Claim and Guarantee Policies	3	0.02	< 0.10: Consistent
Quality	3	0.07	< 0.10: Consistent
Geographical location	4	0.04	< 0.10: Consistent
Delivery	2	0.00	< 0.10: Consistent

The results of the ANP analysis of the FFB supplier selection design at PT X in Paser Regency show that delivery criteria and quality of oil palm FFB are the top priorities. Delivery criteria ranked first with a value of 0.082, emphasising the importance of reliability and timeliness. FFB quality ranked second with a value of 0.068, important to ensure optimal production output, as high-quality FFB yields better crude palm oil. The third-ranked price criterion (0.053) is determined by internal policies, not suppliers, following Danasari et al. (2023) who states that service quality reduces operational risk. Ranked fourth is geographical location (0.045), which affects cost and delivery time. This is in accordance with (Putri et al., 2024)submission that by considering location, companies can ensure that the selected supplier is able to fulfil operational needs consistently and on time, although this factor does not have as much weight as other factors. Finally, the fifth-ranked claims policy criterion (0.044) is important for handling complaints, but is considered less important than other criteria.

Table 3. Priority of Criteria and Sub Criteria

Criteria	Matrix value	Rank (Between criteria)	Sub criteria	Matrix value	Rank (between sub criteria)
Price	0.05	3	Payment procedure	0.01	16
			Affordable price	0.01	13
			Price negotiation	0.02	11
			Price stability	0.03	4
Claim policies	0.04	5	Responsiveness	0.02	10
			Assistance provision	0.02	7
			Guarantee provision	0.03	5
Quality	0.07	2	Technical compliance	0.02	8
			Consistent quality	0.04	2
			Defect rate	0.02	9
Geographical location	0.05	4	Climate/weather	0.01	14
			Distance	0.01	15
			Road conditions	0.02	12
			Travel time	0.03	6
Delivery	0.08	1	Delivery speed	0.04	3
			Accuracy of quantity	0.05	1

The price criterion, with a matrix value of 0.053, is ranked third, including the subcriteria of price stability (0.029), ease of price agreement (0.016), low price (0.014), and payment method (0.013). Price stability is PT X's (PT X) top priority in selecting Fresh Fruit Bunch (FFB) suppliers, as it is important to ensure price consistency over a period of time. With stable prices, PT X can plan its budget better, avoiding financial risks due to price fluctuations. It is important to note that FFB prices are determined by PT X, not by suppliers, allowing full control over production costs. Price stability supports predictable business relationships, reduces the risk of future disputes, and ensures smooth supply. This research is in line with Febrianti et al. (2024) who emphasised the importance of price stability in budget planning and innovation.

Furthermore, the criteria for claims and warranty policies at PT X are ranked last with a matrix value of 0.044. These sub-criteria consist of providing warranty (0.027), assistance (0.023), and responsiveness (0.018). Providing warranty is the most important, indicating that PT X values suppliers who can guarantee product quality. The warranty ensures that the FFB received meets specifications and reduces the risk of losses due to defective products. In addition, the warranty serves as a quality control, encouraging suppliers to be more careful in the production process. Suppliers who offer a warranty demonstrate a commitment to a long-term partnership, which strengthens

the business relationship. By guaranteeing quality, PT X can maintain its good reputation as a high-quality palm oil producer, attract new customers, and manage operational risks (Darmansah, 2024).

The Quality criterion ranks second with a matrix value of 0.068, indicating the importance of the quality of FFB delivered by suppliers. According to Suhendar et al. (2021), the good quality of FFB raw materials affects production yields. The sub-criteria in the quality aspect, in order, are consistent quality (0.037) and technical suitability and defect rate (0.021). Consistent quality is the main focus, because in the palm oil industry, stability in FFB quality is important to maintain efficiency and product reputation. Companies look for suppliers that guarantee stable quality so that each delivery meets specifications. This is in line with (Yoga & Subagyo, 2022) that consistency supports cost efficiency and sustainability. In addition, Kumbara et al. (2024) emphasises that consistent quality reduces the need for inspections and potential losses. By working with quality suppliers, PT X can focus on improving efficiency and competitiveness in a competitive market.

The geographical location sub-criteria ranks fourth with a matrix value of 0.045. These sub-criteria consist of travelling time (0.025), road conditions (0.015), and climate or weather and distance (0.014). The results show that the travelling time from the supplier to PT X is the most important, as efficient delivery time is crucial in the palm oil industry. Any delay can delay the complex production process. By choosing suppliers who can deliver FFB on time, PT X can avoid disruptions in production schedules, maintaining productivity and operational efficiency. In addition, short delivery times allow the company to plan resource use more effectively, avoid overstocking, and optimise production processes. Delivery speed also helps meet customer expectations, build a reputation as a reliable and responsive partner, and open up opportunities to attract new customers.

The delivery criterion has the highest matrix value of 0.082, indicating that delivery is the most crucial factor in supplier selection. The delivery sub-criteria are divided into quantity accuracy (0.052) and delivery speed (0.035), where PT X prioritises quantity accuracy. This emphasis is important because inappropriate quantities can cause serious problems in the production chain. Zahraee et al. (2019) explained that prioritising quantity accuracy can maintain smooth operations and production efficiency. If the quantity of FFB received does not match, the company faces challenges in inventory management and production scheduling, which can disrupt the process and incur financial losses (Asdidi et al., 2018). In addition, speed of delivery helps PT X adapt to changes in market demand. Good speed allows the company to be responsive to sudden needs, enhancing reputation (Zailan et al., 2021).

Best FFB Supplier Ranking at PT X in Paser District

The selection of the best Fresh Fruit Bunch (FFB) supplier at PT X in Paser Regency was conducted through an in-depth analysis using the TOPSIS method based on five main criteria: price, claims and warranty policy, quality, geographic location, and delivery. Through the strategy of prioritising suppliers that consistently meet these standards, PT X can maximise operational efficiency and minimise the risk of supply chain disruptions. In addition, the use of structured and objective evaluation methods as seen in this ranking results table, helps in making more informed and strategic decisions related to the selection and maintenance of FFB suppliers (Putra et al., 2023). Selection of the best supplier or FFB supplier at PT X Paser Regency using TOPSIS analysis as shown in Table 4.

Table 4. Ranking based on TOPSIS Analysis

Supplier Alternatives	Preference	Rank
UD. Naila Naufal Jaya	1.00	1
PT. Perkebunan Nusantara 13	0.21	4
KUD. Sumber Sawit Makmur	0.19	6
PT. Permata Buana Ekspressindo	0.18	7
Basran	0.20	5
GAPOKTAN Laburan Bersatu	0.22	2
Koperasi Sawit Sungebatu Sejahtera	0.00	8
PT. Semesta Cahaya Kemilau	0.21	3

The results in Table 4 above show that the supplier that obtained the highest score and occupies the first ranking position in this analysis is UD. Naila Naufal Jaya, indicating that this supplier meets PT X's expectations in terms of competitive pricing, clear and fair claim policies, high FFB quality, favourable geographical location, and accuracy and efficiency in delivery. This perfect score reflects that UD. Naila Naufal Jaya is the ideal and most desirable supplier for the company. One of the key aspects is UD. Naila Naufal Jaya to fulfil PT X's requests in large quantities, in accordance with the technical specifications set by the company. This capability is crucial given the large scale of PT X's operations and their need for a stable and reliable supply. In addition, consistent FFB quality was also an important factor in the selection of UD. Naila Naufal Jaya. Research shows that UD. Naila Naufal Jaya is able to maintain FFB quality consistently in accordance with the standards expected by PT X. This consistent quality not only supports the production of high-quality palm oil, but also ensures that PT X can meet the high quality standards for their end products. This is important to maintain the company's reputation and meet the expectations of customers who want a reliable and consistent product.

The accuracy of the quantity and speed of FFB delivery is also the main reason why UD. Naila Naufal Jaya was chosen as the best supplier. PT X emphasises the importance

of receiving FFB on time and in quantities that match their production schedule. UD. Naila Naufal Jaya proved to be able to deliver FFB within a short period of time and ensure sufficient stock availability to support PT X's operations without a hitch. This speed of delivery helps PT X to maintain smooth operations and avoid potential disruptions that could arise due to delays in supply. The interview with PT X also confirmed that of the 8 suppliers evaluated, only UD. Naila Naufal Jaya is able to fulfil all the criteria set by the company. Selection of UD. Naila Naufal Jaya as the best supplier for FFB by PT X is based on their commitment to provide consistent, high quality, timely and adequate supply. That companies need suppliers who can support operational objectives to maintain efficiency and productivity, and build a strong foundation for the company's long-term growth and success in the processed palm oil products industry.

The second place is occupied by GAPOKTAN Laburan Bersatu, although this score is far below the perfect score, GAPOKTAN Laburan Bersatu stands out in the geographical location criterion, indicating that this supplier is located very close to PT X, thus reducing transport costs and delivery time. Furthermore, GAPOKTAN Laburan Bersatu's near-optimal claims policy also gives PT X additional confidence. This is in line with the submission of Lamefa et al. (2020) that an effective claims policy ensures that any problems or complaints that arise can be resolved quickly and efficiently, thereby reducing potential disruptions in company operations.

Good quality that is close to optimal also strengthens GAPOKTAN Laburan Bersatu's position in the second rank. In addition, GAPOKTAN Laburan Bersatu also performed well in terms of quality. Although not as superior in location, the quality of FFB supplied by GAPOKTAN Laburan Bersatu meets the standards set by PT X, helping the company maintain stability in the production process. This good quality shows that GAPOKTAN Laburan Bersatu has a commitment to high production standards, which is one of the reasons why they managed to rank second.

Furthermore, PT Semesta Cahaya Kemilau is ranked third, this supplier is quite optimal in the quality criteria but has some shortcomings in the delivery aspect, excellence in product quality and geographical proximity to the company can cover these shortcomings, so it is still considered a good supplier. Geographical proximity to PT X provides significant strategic advantages, especially in terms of cost efficiency and delivery time. This is in line with Kurniawan (2023) submission that close location allows for faster delivery of goods and lower costs, thus helping to reduce potential disruptions in the supply chain. Although the company has some shortcomings in the delivery aspect, this geographical proximity helps to make up for these shortcomings. With its strategic location, PT Semesta Cahaya Kemilau is able to maintain a good relationship with PT X, which sees value in the ease of logistics and reduced transport costs.

Then PT Perkebunan Nusantara 13 ranks fourth, this supplier performs quite well in most criteria, but still has some areas that need improvement to compete with the top three suppliers. For example, although PT Perkebunan Nusantara 13 scores quite well on claims policy and geographical location, the reason why it ranks fourth is because its sub-optimal performance on quality and price shows that there is room for improvement in these aspects. The sub-optimal quality aspect shows that the FFB products supplied have not fully met the high standards expected by PT X. This is due to the age of the plants, which are said to be still new, which has an impact on the quality of FFB yields. According to Suhartini et al. (2022), the age of oil palm trees determines the quality of the FFB produced and also has an impact on the selling price level whether it is still in the form of FFB or has been processed into CPO. In the palm oil industry, quality is a crucial factor that has a direct impact on production efficiency and final yield. Therefore, PT Perkebunan Nusantara 13 needs to improve the quality of their products in order to compete more effectively with other higher ranked suppliers. In addition, uncompetitive pricing is also a challenge for this company. With prices that are higher or not proportional to the value offered, PT Perkebunan Nusantara 13 may struggle to attract more attention from PT X. This is in line with the submission from Rambe et al. (2023) that it is very important in business to pay attention and follow up on areas that still need improvement, so as to strengthen their competitiveness and approach or even surpass other suppliers who are currently ranked higher.

Then the FFB supplier Basran is ranked fifth, this supplier performs quite well in most of the criteria, but still has some areas to improve in terms of FFB quality to compete with the top four suppliers. FFB quality is a crucial aspect in the palm oil industry, as it affects production efficiency, yield, and ultimately customer satisfaction. The sub-optimal quality aspect of supplier Basran suggests that the FFB supplied by Basran may not fully meet the high standards set by PT X. This is because there are variations in the quality of FFB delivered. Basran is a farmer who owns a large area of oil palm plantation but in terms of seedling selection for planting then maintenance and harvesting still uses traditional methods and lacks knowledge related to oil palm cultivation. Therefore, improvement in quality is key for Basran to be able to increase their competitiveness in this competitive market. To compete with the top four suppliers, Basran needs to focus on improving the quality of the FFB they supply. These improvement measures could include improving the harvesting process, to FFB transportation to ensure that each delivery meets quality standards. This is in line with the submission of Sholikin et al. (2024) that in supplier evaluation it is necessary to build a stronger

reputation as a reliable and quality supplier. This will open up opportunities for Basran to move up the rankings and compete more effectively with other suppliers who are currently in higher positions.

Furthermore, KUD. Sumber Sawit Makmur ranks sixth, this supplier has weaknesses in several criteria so they need to improve their overall performance to become a more competitive supplier, some aspects that need to be improved include delivery and FFB quality. The delivery criteria show that KUD Sumber Sawit Makmur faces problems in terms of timeliness, quantity, or reliability of delivery. In the palm oil industry, efficient and timely delivery is essential to ensure smooth operations and maintain product quality. KUD. Sumber Sawit Makmur is categorised as a new KUD so it still has few FFB supplier members, so it sometimes takes a long time to collect FFB as required. If FFBs are not delivered in the right condition or on schedule, this can cause disruption in the production process at PT X. Therefore, KUD Sumber Sawit Makmur needs to identify and address the bottlenecks that affect their delivery efficiency, be it through improved logistics, infrastructure upgrades, or a review of the supply chain management process. Besides delivery, the quality of FFB supplied by KUD Sumber Sawit Makmur is also an area that requires special attention. This is in line with Zulfa et al. (2024) that the quality of FFB is a critical factor that affects the final product yield, so it is important for the new KUD to improve the quality of FFB supplied and needs to meet the expected quality standards.

Then PT Permata Buana Ekspressindo (PT PBE) ranks seventh, indicating that the supplier needs to improve their overall performance to become a more competitive supplier. This can be seen from PT Permata Buana Ekspressindo's sub-optimal pricing and claims policy, indicating that these aspects will be the main obstacles in the collaboration with PT X. This indicates that PT Permata Buana Ekspressindo's offer may not be as competitive or meet the price expectations of PT X. In the palm oil industry, price is a key factor influencing supplier selection decisions. High or uncompetitive prices can be a major deterrent to co-operation, especially if other suppliers offer better value at more competitive prices. In addition, a low claims policy suggests that this company may have problems handling complaints or issues that arise regarding the quality or quantity of FFB. This is in line with Branstad & Solem (2020) submission that a poor claims policy can disrupt business relationships and cause customer dissatisfaction, potentially harming the company's production process and reputation. This is because PT PBE is experiencing internal company problems, where there is a split in company ownership. So that it causes disruption in the focus of PT PBE's work.

Finally, Sawit Sungebatu Sejahtera Cooperative is ranked last, which shows that many things need to be improved from Sawit Sungebatu Sejahtera Cooperative as a supplier, some of the improvements that need to be made are related to quality and price stability as a supplier. These results show that many things need to be improved in order for Sungebatu Sejahtera Palm Oil Cooperative to meet the expectations of PT X. One of the main areas that needs serious attention is the quality of FFB. This is in accordance with the low quality can cause various problems in the production process, including disruption in the final product yield and increased operational costs. In the palm oil industry, product quality is very important as it affects the efficiency and consistency of the production process. This is because the majority of members of Sawit Sungebatu Sejahtera Cooperative are farmers, so the quality of the initial planting seedlings affects the quality of FFB yield. Then some farmers only have small plantation land so that it has an impact on the number of FFB deliveries. In terms of distance and road conditions, it is also less supportive, because the distance from the Cooperative to PT.BIM is so far coupled with the condition of the steep rocky road that increases the length of FFB delivery to the company and slows down the speed of delivery. This is in line with the submission of Suhartini et al. (2022), namely the inadequate quality of the road can slow down the transportation time of FFB to the factory from the plantation location.

The ranking of suppliers in this study aims to find out the best supplier based on the specified criteria. This indicates that the best supplier is the best partner and can be made a priority supplier compared to other suppliers and can extend the work contract agreement with the supplier. Meanwhile, the bottom supplier indicates that this supplier can be re-evaluated for its performance and reconsidered by the company to supply raw materials and work contract extension agreements.

Conclusion

The conclusion of this study is that there are 5 criteria and 16 sub-criteria in the design of selecting TBS suppliers, the price criteria consist of sub-criteria of payment method, low price, ease of price agreement and price stability. The claim and guarantee policy criteria consist of responsiveness, providing assistance and providing a guarantee. The quality criteria consist of technical suitability, consistent quality and level of defects. The geographic location sub-criteria include climate or weather, distance, road conditions and duration or time. The delivery criteria include speed of delivery and accuracy of quantity. Furthermore, the priority order of the criteria with the highest ranking is in the criteria of delivery, quality, price, geographic location and claim policy, while the delivery sub-criteria prioritizes accuracy of delivery quantity, the quality criteria prioritizes consistent TBS quality, the price

criteria prioritizes price stability, the geographic location criteria prioritizes duration or time of delivery, the claim policy criteria prioritizes warranty. The final conclusion of TOPSIS shows that UD. Naila Naufal Jaya is the best TBS supplier ranking, with superior matrix values in the criteria of price, claim policy, quality, geographic location and delivery.

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