

INCREASING PERFORMANCE OF OIL PALM NPK FERTILIZATION WITH RISK MANAGEMENT AND ANALYTIC HIERARCHY PROCESS (AHP)

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ABSTRACT

This research is intended to improve the performance of oil palm fertilization by examining the fertilizer procurement process. The research design that will be carried out in this study is based on the problems studied using descriptive analysis methods. Measurement of priority risk using FMEA and formulation of mitigation strategies using AHP (Analytic Hierarchy Process) by collecting data through observation, questionnaires with stakeholders who have expertise in their respective fields at the research site. One of the plantation crops that are widely cultivated by large plantation companies is oil palm. The moratorium on oil palm plantation permits for the addition of new land for 3 years encourages companies to increase crop productivity on existing plantation lands, one of which is fertilization. Constraints experienced in fertilizing on mature plants are the incompatibility of the fertilizer applied to the planned one. So that the increase in fertilization performance can be done through improvements in the procurement process.

The purpose of this research is to study the risk priorities in the planning process to the acceptance of fertilizers in the procurement of fertilizers. The results showed that the priority risk of fertilizer procurement planning is that the budget availability is not in accordance with the recommendations (RPN 27), the supplier selection process is the announcement of the old tender (RPN 18), the dropping/delivery process is a late contract signed (RPN 18), the acceptance process is that the fertilizer is accepted. past the time period (RPN 18). The criteria are fertilizer procurement planning, supplier selection, fertilizer delivery and fertilizer receipts with successive values of 0.575, 0.214, 0.134, 0.077. The alternatives are ensuring budget adequacy, adding fertilizer suppliers, improving communication between fertilizer providers and users, determining the timing of fertilizer application, increasing the frequency of fertilizer quality inspections and using information technology in fertilization. Improving the performance of fertilizer procurement can be done with three main strategies, namely improving the budgeting system, improving procurement documents, selecting suppliers with a multi-winner system.

Keyword: Performance oil Palm, Risk Management, Analytic Hierarchy Process

1. INTRODUCTION

Plantation is one of the agricultural sub-sectors that have a contribution to the state. According to data from the Central Statistics Agency for 2020, the contribution of the plantation sub-sector in 2019 was 3.27 percent

(517,507.80 billion rupiah) to total GDP (15,833,943.40 billion rupiah) and 25.71 percent to the Agriculture, Forestry and Fisheries sector. (2,013,626.90 billion rupiah) or is the first in the sector (Dirjenbun, 2019). One of the most widely cultivated types of plantation crops by large plantation companies is oil palm. Large plantations are plantations that are commercially organized or managed by a company that is a legal entity. Large plantations consist of State Large Plantations (PBN) and National/Foreign Large Private Plantations (PBS). Based on data from the Central Bureau of Statistics 2020, in the period 2017 to 2019 oil palm plants were mostly cultivated by large plantations, followed by rubber and coconut plants. In 2017 oil palm plantations were cultivated by 1695 large plantation companies, in 2018 there were 2165 large plantation companies and in 2019 (temporary figures) were cultivated by 2165 large plantation companies.

The more large plantation companies that are engaged in oil palm plantations, the competition between these large plantations is getting tougher. The moratorium on oil palm plantation permits as stipulated in Presidential Instruction No. 8 of 2018 (Secretariat of the Republic of Indonesia Cabinet, 2018) dated 19 September 2018 concerning Suspension and Evaluation of Oil Palm Plantation Licensing and Increasing Productivity of Oil Palm Plantations which is valid for 3 (three) years makes coconut plantation companies Palm oil cannot get permission to add new land, so it will make it difficult for oil palm plantation companies to expand. This encourages oil palm plantation companies to increase the productivity of oil palm plantations on plantation lands that are currently controlled.

Fertilizers/fertilizers greatly affect the productivity of oil palm plants. According to (Pranata & Afrianti, 2020) based on research results in Afdeling I Kebun Adolina PT Perkebunan Nusantara IV partially or simultaneously labor factors, rainfall factors, rainy days and fertilizer factors have a positive effect on oil palm productivity, while the theft of fruit bunches Fresh fruit has a negative effect on oil palm productivity. In line with this research, Santoso et al. (2017) have conducted research on the study of rainfall and fertilization on oil palm productivity at company and obtained the results that annual oil palm productivity is not affected by the amount of rainfall, but is influenced by fertilization in the same year.

Procurement of fertilizers starts from the decline in fertilizer recommendations from research institutions, namely the Palm Oil Research Center (PPKS). Fertilizer recommendations issued by PPKS are based on the results of leaf analysis or soil analysis. Recommendations are in the form of alternative types and doses of fertilizers to be applied to oil palm plants. Based on the results of these recommendations, each PT XYZ which has oil palm commodities then determines what type of fertilizer is chosen to be used as fertilizer for oil palm plants including determining how much fertilizer is needed. PT XYZ is one of the state-owned enterprises engaged in plantations with the main commodities of oil palm and rubber plants paying great attention to fertilization in order to achieve optimal performance. One of the obstacles experienced by PT XYZ in NPK fertilization of Palm Oil plants on mature plants is the incompatibility of the fertilizer applied to the plan. This discrepancy can be seen in Figure 1, the realization of NPK fertilization from 2016 to 2019 on oil palm producing plants at PT XYZ as follows:

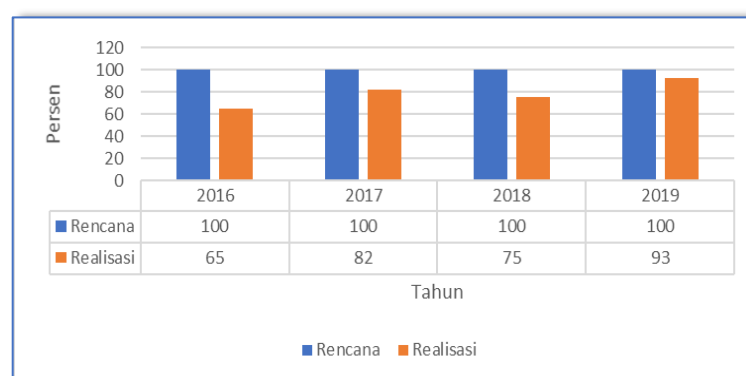


Figure 1. Realization of NPK Fertilization for Palm Oil Produced Plants

The type and amount of fertilizer needed is then sent by each company to the Plantation Holding for a recapitulation of all types and needs of PT XYZ and then the supplier selection process is carried out. The selection of suppliers is carried out by an Ad Hoc Committee formed by the Self Estimated Price Adhoc Committee whose task is to determine the technical specifications and own estimated price (HPS) which will be used as a reference in the implementation of the tender. The Procurement Committee is tasked with determining

suppliers based on the tender conducted. The resulting tender product is a Letter of Appointment for Goods and Services Providers (SPPBJ) which will then be sent to the Supplier and to PT. XYZ to be followed up with the issuance of contracts by each company.

Based on the contract, the supplier followed up by dropping/delivering fertilizer to each PT XYZ that needed the fertilizer. Dropping begins with sending fertilizer samples to PT. XYZ which is accompanied by a certificate of fertilizer analysis from an accredited laboratory. If the fertilizer sample sent is declared appropriate by PT. XYZ then the supplier started dropping fertilizer to each unit/garden warehouse at PT. the XYZ. Fertilizers that have been dropped by the supplier before being applied to oil palm plantations are analyzed for proper use. Sampling for usable analysis was carried out by taking samples in one of the plantation units carried out by PT. XYZ, suppliers and officers from accredited laboratories.

The results of this usable analysis are used as a basis by PT. XYZ to determine whether the dropping fertilizer is in accordance with the required quality specifications or not. If the fertilizer specifications are in accordance with the quality requirements that have been determined, then the fertilizer can be applied to the plants and the supplier can continue dropping the fertilizer. Meanwhile, if based on the results of the appropriate use analysis it is stated that the fertilizer is not in accordance with the quality standards that have been set, the supplier can submit a re-analysis where the costs for this re-analysis are the burden of the supplier. The results of this re-analysis are the reference for both PT.XYZ and the supplier. If the results of the re-analysis are suitable for use, the fertilizer is in accordance with the required quality, then the fertilizer can be immediately applied to the plant, but if based on the results of the re-analysis, it is still suitable for use and does not meet the required quality standards, PT. XYZ will refuse delivery and or delivery of fertilizers so that the supplier is obliged to replace all the fertilizers that have been sent with substitute fertilizers in accordance with the required quality standards.

Fertilization of oil palm plantations that are not in accordance with the plan is caused by the risk of the procurement process of goods and services, including delays in dropping fertilizer by fertilizer suppliers, delays in the supplier selection process, delays in recommendations, delays in collecting recapitulation of fertilizer needs from subsidiaries, delays in signing contracts, delays in agreement methods. payments, delays in the results of proper use analysis, fertilizers by an accredited laboratory or by other factors. The main problem in fertilization performance in PT.XYZ is the mismatch between planning and realization. This discrepancy affects the achievement of production targets. The activity that greatly affects the realization of fertilizer is the procurement process. Thus, risk management in the fertilizer procurement process needs to be carried out. The risk management carried out in this study is the FMEA (Failure Modes and Effect Analysis) and AHP (Analytic Hierarchy Process) methods.

According to (Cavique et al., 2019; Zhang et al., 2019) FMEA is a method used to evaluate failures that occur in a system, design, process, or service. Identification of potential failures is done by assigning a score or score for each failure mode based on the occurrence, severity, and detection level. Identification of the failure of the fertilizer procurement process is carried out following the identification method carried out by (Hassan et al., 2020), namely by giving a score of 1-10 on each criterion. The first thing to do in the risk management process is to identify risk events that occur in the fertilizer procurement process. After identifying the risk then conducting a risk analysis. Risk analysis can be done using the Analytic Hierarchy Process (AHP). AHP is a quantitative technique developed for cases that have various levels (hierarchies) of analysis (Herjanto in Winoto and Santoso, 2017). This method is a practical way to deal with various functional relationships in a complex network. This method use comparison in pairs, calculate the weighting factor and analyze it so as to produce a relative priority among the alternatives. AHP is a simple and flexible method that can accommodate creativity for problem solving.

Risk management is carried out from the planning process until the fertilizer supply process is carried out. Good risk management is risk management starting from the planning process. This action can minimize the occurrence of unpredictable risks during project implementation. Risk management in the fertilizer procurement process at the company using the FMEA and AHP methods results in mitigation that can be done to overcome the identified risks. The stages in carrying out risk management are identifying risks, giving priority ratings to risks and determining risk mitigation. This result is a very important recommendation for the improvement of the future fertilizer procurement process at PT.XYZ.

Based on the description of the background above, the following problems can be identified: 1) Based on Figure 1.1 Realization of fertilization cannot be carried out according to the plan that has been set by the company, namely the realization of fertilization is lower than the plan., 2) The risks of the fertilizer procurement process starting from planning to receiving fertilizer include delays in recommendations, delays in the supplier

selection process, delays in signing contracts, delays in dropping fertilizers by fertilizer suppliers, or by other factors affecting the realization of fertilization for oil palm plants. This research is structured based on several problems which are formulated as follows; 1) What are the priority risks in fertilizer procurement planning risks?; 2) What are the priority risks in the process of selecting fertilizer suppliers?; 3) What are the priority risks in the risk of dropping/delivery of fertilizer from suppliers to the company?; 4) What are the priority risks in the fertilizer acceptance process in the company?; 5) What is the strategy in the fertilizer procurement process to improve fertilization performance?

2. LITERATURE REVIEW

Oil palm (*Elaeis guineensis* Jacq.) is a tropical plant that produces the world's largest vegetable oil. One hectare of oil palm plantation produces between 10 and 35 tonnes of fresh fruit bunches (FFB) per year. FFB can generally be harvested after 3 years from planting and the optimal amount is 10 years after planting. In its life cycle, the economic age of oil palm is between 20–25 years with the first 11–15 months of seedling. The first harvest usually occurs 32–38 months after planting and maximum yields are 5–10 years after planting. Normally, oil palm grows in tropical lowlands, 15°N–15°S with an even rainfall of 1800–5000 mm/year (Beaudry et al., 2018). The world's need for vegetable oil continues to increase along with the increase in population (Juliansyah & Supijatno, 2018). The area of oil palm plantations in Indonesia in the last 3 (three) years has continued to increase. According to data from the Central Statistics Agency for 2020, the area of large plantation oil palm plantations in 2017 was 6 685.2 thousand hectares, in 2018 it was 8 507.4 thousand hectares and in 2019 it was 8 688.9 thousand hectares (temporary figures). Meanwhile, the area of smallholder oil palm plantations in 2017 was 5 697.90 thousand hectares, in 2018 it was 5 818.90 thousand hectares and in 2019 it was 6 035.70 thousand hectares (temporary figures) (Dirjenbun, 2019).

Oil palm is a monocotyledonous plant with fibrous roots. which can grow in a variety of soil conditions. Oil palm is able to adapt to various types of soil and conditions of low pH and water content (Hambali & Rivai, 2017). Oil palm cultivation is influenced by plant environmental factors such as soil, temperature and climate. In addition, the presence of water and social activities in the plantation environment also affects the growth of oil palm plants (Khatun et al., 2017). Compatibility is the extent to which the innovation is in accordance with the current values of the organization and current needs (Rogers, 1995).

Fertilizer is a very important factor in the process of oil palm cultivation. The application of fertilizer to oil palm plants is very necessary to help the growth of oil palm plants (Sinulingga et al., 2015). The application of fertilizers increases the production of oil palm fresh fruit bunches. The main elements needed by oil palm plants in their growth are the content of nitrogen, phosphorus and potassium in the soil. For this reason, in oil palm planting, fertilizer application, especially NPK is carried out from the nursery to the growth in the garden (Izzati et al., 2015; Ko et al., 2020). It also helps the process of tissue development, the process of reproduction (flowering) and the process of fruit production. As well as increasing plant resistance to pests and diseases (Siallagan et al., 2014; Warsito et al., 2017). According to (K. A. T. Hidayat et al., 2017), fertilizer application can increase plant growth rate which can be seen from plant height and stem diameter in oil palm plants in nurseries.

The application of single fertilizer with a maximum dose of 9 kg urea + 6 kg SP-36 + 9 kg KCl + 50 g Borate + 50 g CuSO₄.5H₂O per plant per year can increase productivity by 260.64% (26.94 tons/ha) compared to control 7.47 tons/ha. The application of compound fertilizer with a dose of 12 kg NPK compound + 50 g Borate + 50 g CuSO₄.5H₂O per plant per year can increase productivity by 237.08% (25.18 tons/ha) compared to control. Giving 6 kg urea + 4 kg SP36 + 6 kg KCl + 100 kg organic fertilizer per plant per year increased productivity to 265.59% (Sukmawan et al., 2016). According to (Panggabean S, 2017), the application of NPK fertilizer and organic fertilizer can increase the rate of plant growth. The optimum dose of organic fertilizer is 40.7 kg of plants and for compound NPK fertilizer is 1.9 kg of plants on immature oil palm plantations of one year. One of the most widely used organic fertilizers in oil palm plantations is empty fruit bunches (Sakiah et al., 2020).

Fertilization is one of the main factors influencing the growth and productivity of oil palm. Fertilization is the provision of nutrients into the soil to maintain the balance of nutrients needed by plants and replace nutrients lost to the harvest (Panggabean S, 2017). Fertilization is carried out throughout the planting period from the nursery to fruit production (Ariyanti et al., 2017; Juliansyah & Supijatno, 2018).

In addition to providing nutrients for plants, fertilizer application can also help improve soil physical and chemical properties, and increase nutrient levels in the soil (Effendy & Jalal, 2019; Warsito et al., 2017). Fertilizer application also affects the development of microbes in the soil that are associated with roots. The

application of different types of fertilizers and fertilizer application techniques affects the growth and activity of soil microbes so that they can increase soil pores and improve soil structure (Murugan et al., 2020). Risk is the possibility of loss that can occur in a management system. Risk events can occur in various fields of work such as education (Aleksandrova and Novikova, 2019), trading business (Oguzhan & Erol, 2016), construction (Chatterjee et al., 2018), health (Pablo et al., 2020) and agriculture (Supriyanto et al., 2019). In general, the agricultural sector is the sector that has the greatest risk. Some of the risks that may occur in agriculture include water factors, energy availability, workers, cultivation factors and plant pests and natural disasters (Zandi et al., 2020). In the palm oil supply chain management process, it is known that there are 5 risk aspects, namely aspects of raw material supply, quality aspects of supply FFB, FFB price aspects, management aspects, and social aspects (Thaheer & Hasibuan, 2019).

To overcome the occurrence of risk events, a risk mitigation strategy is needed that has been determined since the activity planning. So that risk events can be addressed more quickly and reduce waste (Lin et al., 2018). Risk mitigation actions carried out on risk events in activities with a short duration are carried out faster than activities with a long duration. Therefore, for activities with a long duration, different risk mitigation strategies are needed. Implementation of mitigation efforts can prevent companies from losses caused by risks that occur (Aranti & Oktaufanus, 2015). In conducting risk analysis there are methods that can help, including AHP and FMEA. These two methods are widely used to analyze risk in various fields of work (Aranti & Oktaufanus, 2015; Yahman et al., 2020).

Risk analysis is carried out by classifying the identified risk factors into high risk and low risk groups. Priority risk assessment factors may differ in each field of work. Measurement of risk control in a project must be carried out based on risk resilience (Zandi et al., 2020).

Risk Management is a comprehensive set of policies and procedures owned by the organization to manage, monitor and control the organization's exposure to risk. Risk is defined as the uncertainty caused by changes (W. Hidayat, 2019). Many researchers focus on identifying, analyzing, ranking and managing risk. In carrying out this risk management, many methods are available to evaluate the risk of a project or group of the same project (Zandi et al., 2020). Risk management is carried out from the planning process to the implementation process. Risk management carried out in the planning stage can reduce risk events that are not identified at the time of implementation (Kartikasari, 2018; Muriana and Vizzini, 2016). There are 4 basic stages of the risk management process, consisting of (1) risk identification, (2) risk assessment, (3) risk priority and response planning, and (4) risk monitoring (Hartuliyoso et al., 2018).

The application of fertilizer to oil palm plantations affects crop yields. Excessive application of fertilizers can cause damage to plants, have a negative impact on the environment such as air and water pollution and require a lot of costs. So it is necessary to do a soil analysis first before planning fertilization (Khatun, 2017; Sanputawong et al., 2017; Woittiez, 2018). In addition to soil analysis, in planning fertilization it is also necessary to carry out leaf analysis. Leaf analysis is carried out by taking leaf samples and bringing them to the laboratory to undergo a series of analytical tests so that it is known whether the nutrient content that has been absorbed by the plant is in accordance with the standard or not. Fertilization management is carried out in accordance with the SOP set according to the 6T rules (right type, right dose, right time, right method, right place and right tool). The application of the 6T rules is needed to achieve the effectiveness and efficiency of fertilization (Khalida et al., 2019; Pranata & Afrianti, 2020). In the fertilization process, things need to be considered: 1) the type of fertilizer used, 2) the amount of fertilizer dose, 3) the time of application, 4) how it is applied, 5) the quality of the fertilizer to be used (Sanputawong et al., 2017).

Procurement of fertilizer in an oil palm producing company is carried out in the following stages; 1) The company sets its own estimate price for the procurement of fertilizer to the procurement committee who then prepares the procurement document; 2) Procurement is done through the website; 3) Winners announced on the website; 4) Contract signing (Kurniawan and Riyanto, 2019). The supplier selection process is carried out online using the e-procurement method, namely through the website and managed by a procurement team (Ridwan et al., 2019). The selected supplier is the one with the highest score, which is the one that best meets the criteria determined by the procurement team. The higher the score of the supplier, the more appropriate it is needed by the company. The selection process can be done using the AHP method (Rianti, 2018). Several problems in the process of sending fertilizer from vendors to companies often arise. These include the high cost of delivery and the lack of clarity in the delivery contract between the vendor and the company (Msuku et al., 2020). Therefore, the chapter on the delivery of goods must also be included in the contract for the procurement of goods (Khalida et al., 2019).

Good coordination between suppliers and fertilizer users is one of the risk mitigation measures that can be taken to reduce the impact of risks that arise during the delivery of goods (Ulfah et al., 2018). Preparation of mitigation plan documents such as the Disaster Recovery Plan is one of the important actions before sending fertilizer (Supriyanto et al., 2019). In palm oil companies, the checking of fertilizer specifications is carried out by the plantation technical team together with the procurement team from supplier and consumer companies (Amanah & Tjitropranoto, 2018). The preparation of appropriate storage areas also needs to be considered in the acceptance process. So that the quality and condition of the goods received are maintained well after being received and reduce the impact of losses (Ulfah et al., 2018).

Efforts made by the company in improving fertilization performance are by improving supervision in storage to maintain the availability and quality of fertilizers needed, using fertilizers efficiently and effectively, adding fertilizer employees to speed up the fertilization process and meeting fertilizer needs for oil palm (Kelapa et al., 2018). Fertilizer application needs to meet the 5T principles, namely the right amount of nutrients, the right form of fertilizer, the right application placement, the right time and the right type of nutrition as needed. This principle must be met to avoid damage to crops and losses both in terms of materials and workers (Tyagi et al., 2018). Failure Mode Effect and Analysis (FMEA) is a method to identify the source and root cause of problems. The FMEA method is a structured procedure to identify and prevent as many failure modes as possible with a priority scale. FMEA is usually applied with Gray Theory which begins with looking at the effect of failure (Severity-S), chance of failure (Occurrence-O), failure detection (Detection-D), and the value of RPN (Risk Priority Number) (Zandi et al., 2020). RPN is the final FMEA result obtained from the multiplication of severity, occurrence and detection. The RPN is then sorted from the highest rating and given alternative recommended actions for improvement. In order to determine the most appropriate action, weighting is used with the Analytical Hierarchy Process (AHP) method (Huang et al., 2020; Shi & Fei, 2019).

Failure mode and effects analysis (FMEA) is an appropriate management technique widely used in various industries to ensure the safety and compatibility of systems, services and projects. Several reports indicate that the development of FMEA has increased rapidly in the past 2 decades, especially after 2013. Fuzzy FMEA and Gray Theory are developments from the previous FMEA (Huang et al., 2020). The Analytic Hierarchy Process (AHP) method is the method used for decision making. This method was developed by Thomas L. Saaty with the characteristics of using several variables with a multilevel analysis process. This method is a decision support model that describes a complex multi-factor problem into a hierarchy (Winanto & Santoso, 2017).

According to (saaty, 2016), hierarchy is defined as a representation of a complex problem in a multi-level structure where the first level is a goal or goal, followed by the level of factors, criteria, sub-criteria, and so on down to the last level of alternatives. A complex problem can be broken down into its elements and then arranged into a hierarchy so that the problem is more structured. In order for this problem to be solved, relevant information is needed. The information is collected from sources related to the problem to be decided. Information collection was prepared in the form of filling out a questionnaire by the resource person using the AHP method. In this study, the information needed is the assessment of the informants about the risks they face as actors in the palm oil supply chain.

AHP is a theory of relative measurement of tangible and intangible criteria based on the judgment of knowledgeable and expert people. Measurements and statistics are needed to make decisions using this method. AHP has been widely applied in multi-objective, multi-criteria and multi-party decision making (Kulcsár et al., 2020). Decision making in improving fertilization performance is important to do so as to reduce the impact of risk. Some alternative decision making that can be taken are as follows; 1) Ensure adequate budget

In the risk management model, the concerns are the introduction and analysis of risk, the development and implementation of management decisions to reduce the possibility of an adverse situation, as well as the possibility of reducing material or other losses. Risk management mechanisms and related financing are one way that can be done to help get out of the uncertainty zone with more or less predictable results (Borkovskaya et al., 2018); 2) Add fertilizer suppliers.

The number of fertilizer suppliers in the process of improving fertilizer performance greatly affects the availability and quality of fertilizers. To improve the performance of fertilization, the presence of sufficient suppliers is needed so that fertilizers are available in the amount and time that suits their needs (Rianti, 2018); 3) Increase the frequency of quality inspection of fertilizers received.

In the process of receiving fertilizer, it is necessary to ensure by both parties, both the supplier and the recipient, that the quality of the fertilizer received is in accordance with what is required. The frequency of inspections needs to be carried out more at each point of receipt so that if there is a decrease in quality due to mishandling in shipping, it can be detected and immediately addressed (Ume et al., 2020); 4) Using information

technology in the estimation process of fertilization and fertilizer distribution. The use of information technology in the process of procurement and delivery of fertilizers can minimize losses caused by inappropriate fertilization estimates. Digitally documented distribution and transportation processes can make it easier to control both from the supplier and the company. Delivery date, control at each point and monitored receiving process can reduce time wasted due to waiting for each other to process (Msuku et al., 2020); 5) Determine the timing of fertilizer application and fertilization planning. Fertilization planning and application time according to the right calculation can improve fertilization performance. Therefore, the application of the right type and on time is one of the criteria that needs to be done (Dawi et al., 2017).; 6) Improve communication between fertilizer providers and fertilizer users. Good communication between fertilizer suppliers and recipients needs to be established both before, during delivery and during fertilizer use. This can reduce the risk of errors in both delivery and use (Ward et al., 2019).

Risk management in the fertilizer procurement process at PT XYZ is carried out using the FMEA method. Primary and secondary data obtained both from interviews and from company data are grouped by entering into the FMEA table as follows:

Table. 1 Table FMEA

Number	Failure Type	Severity	Occurance	Detection	RPN
1	The length of the procurement planning process				
2	The length of the document preparation process				
3	The length of the supplier selection				
4	The length of the contract agreement process				
5	Fertilizer delivery time				

The data is given a score between 1-10 based on the level of conformity with Severity, Occurance and Detection. The scores obtained are then summed to obtain the RPN value that can be used in determining the risk of failure. Decision-making problems can be complex because of the existence of several objectives and criteria. One of the tools that are suitable for candidate selection or priority sequencing is the Analytic Hierarchy Process (AHP) which was developed (saaty, 2016). Specifically, AHP is suitable for candidate selection or priority ordering problems that have the following characteristics (Hassan et al., 2020).

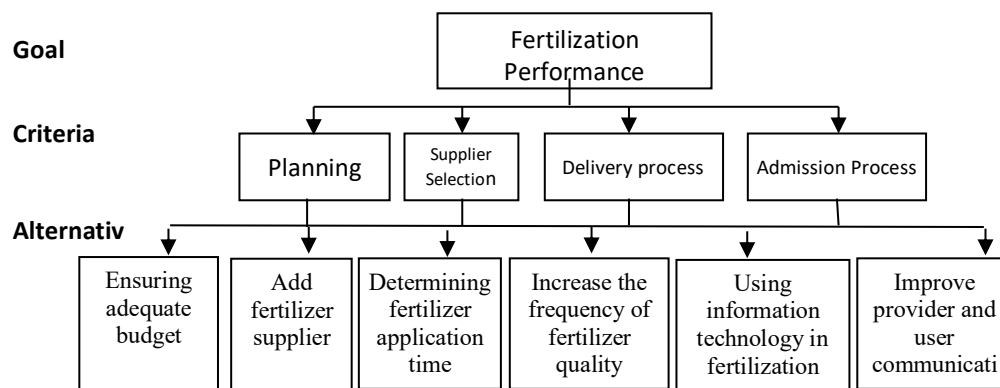


Figure 2. AHP Model of Fertilizer Performance Improvement

3. METHODS

The research design that will be carried out in this study is based on the problems studied using descriptive analysis methods. Measurement of priority risk using FMEA and formulation of mitigation strategies using AHP (Analytic Hierarchy Process) by collecting data through observation, questionnaires with stakeholders who have expertise in their respective fields at the research site.

4. FINDINGS AND DISCUSSION

Respondents in this study are expert employees who have experience and deep insight in the fertilizer procurement process and have positions as leadership employees who have positions at the managerial level. Researchers grouped the respondent's profile based on the function of the work division, gender, and age. The

following are the results of grouping the respondent's profile. The composition of respondents for each division of work is proportional to 33.3 percent respectively. This proportional number of respondents will produce a more objective assessment. The composition of respondents is shown in the following table:

Table 2. Respondent Work Section

Work Section	Amount	Percentage
Plant Division/Section	9	33,3
HPS Ad Hoc Committee	9	33,3
Procurement Ad Hoc Committee	9	33,3
Total	27	100.0

Source: processed data (2022)

Based on table 2. respondents in this study were employees who were directly involved and experienced in the process of procuring goods and services, especially fertilizer procurement, namely the Division/Plant Division for fertilization as many as 9 (nine) people, the HPS Ad Hoc Committee as many as 9 (nine) people and the Ad Hoc Procurement Committee. as many as 9 (nine) people.

The majority of respondents in this study were male respondents. Employees at PT XYZ are dominated by male gender. Although the majority of respondents are male, this will not affect the assessment because there is no assessment regarding aspects of gender. The composition of respondents by gender is shown as follows.

Table 3. Gender

Gender	Amount	Percentage
Male	2	7,4
Female	25	92,6
Total	27	100,0

Source: processed data (2022)

From the above, it can be seen that the respondents in this study were 25 (twenty five) men or (92.6%), while the female respondents were 2 (two) or (7.4%). Respondents are in productive age. In general, as leadership employees, they are accepted to work at the age of 24 to 25 years. Thus, respondents are employees who have worked for a long time and have experience related to their field of work.

Tabel 4. Age

Age	Amount	Precetage
20 - < 30 years	1	3,7
30 - < 40 years	10	37,0
40 - < 50 years	16	59,3
Total	27	100,0

Source: processed data (2022)

From table 4, above, it can be seen that respondents aged 20 - < 30 years amounted to 1 (one) person or (3.7%), those aged 30 - < 40 years amounted to 10 (ten people) or (37%) and those aged 40 - < 50 years old totaling 16 (sixteen) people or (59.3%). Based on the results of the study showed that increasing the performance of NPK fertilization is very important and important for PT XYZ. Improved performance of NPK fertilization will increase the productivity of oil palm plants, because NPK fertilizer is the main fertilizer used in oil palm producing plants. The planning criteria for the procurement of NPK fertilizer, the selection of suppliers of NPK fertilizer, the delivery process for NPK fertilizer, and the process for receiving NPK fertilizer are very important and important criteria for improving the performance of oil palm fertilization, because these criteria are a series of a fertilizer procurement process.

Table 5. Criteria

Criteria	Amount	Percentage
Improving Palm Oil NPK Fertilization Performance		
- Very unimportant	0	0,0
- Not Important	0	0,0
- Ordinary	0	0,0
- Important	5	18,5
- Very Important	22	81,5
Total	27	
Planning for Procurement of Palm Oil NPK Fertilizer		
- Very unimportant	0	0,0
- Not Important	0	0,0
- Ordinary	0	0,0
- Important	3	11,1
- Very Important	24	88,9
Total	27	
Selection of NPK Fertilizer Supplier		
- Very unimportant	0	0,0
- Not Important	0	0,0
- Ordinary	0	0,0
- Important	8	29,6
- Very Important	19	70,4
Total	27	

NPK Fertilizer Delivery Process		
- Very unimportant	0	0,0
- Not Important	0	0,0
- Ordinary	0	0,0
- Important	5	18,5
- Very Important	22	81,5
Total		
NPK Fertilizer Acceptance Process		
- Very unimportant	0	0,0
- Not Important	0	0,0
- Ordinary	0	0,0
- Important	10	37,0
- Very Important	17	63,0
Total	27	

Source: processed data (2022)

Based on table 5. the results of the study above show that of the 27 (twenty seven) respondents, the majority of the respondents amounted to 22 (twenty two) people or (81.50%) stated that improving the performance of NPK fertilization has a very important role, while as many as 5 (five) respondents or (18.5%) stated that improving the performance of NPK fertilization has an important role. Furthermore, in the planning criteria for the procurement of NPK fertilizer as many as 24 (twenty four) people or (88.9%) stated it was very important and 3 (three) people or (11.1%) stated it was important. In the selection criteria for NPK fertilizer suppliers, 19 (nineteen) people or (70.4%) stated it was very important and 8 (eight) people or (29.6) stated it was important. On the criteria for sending NPK fertilizer, 22 (twenty two) people or (81.5%) stated it was very important and 5 (five) people or (18.5%) stated it was important. While on the criteria for receiving fertilizer, 17 (seventeen) people or (63%) stated it was very important and 10 (ten) people or (37%) stated it was important.

Risk identification is carried out using the Failure Mode and Effects Analysis (FMEA) method. According to (Alijoyo et al., 2020) when compiling the criteria for parameters Severity (S), Occurrence (O) and Detection

(D) are the criteria for the three parameters having the same scale. Determination of the scale used can be done by consensus and agreed by the team.

In this study, the scale for measuring Severity, Occurrence and Detection asked for opinions from experts, namely the division in charge of corporate risk management and then agreed upon by the team involved in the joint fertilizer procurement process as follows:

Tabel 6. Severity (S), Occurrence (O) and Detection (D) Rating Scale

Scale	Information
Severity (S)	
1	Not severe, NPK fertilizer application >90%
2	Slightly severe, NPK fertilizer application >50% and <90%
3	Severe, application of NPK fertilizer is less than 50%
4	Very bad, no NPK fertilizer application at all
Occurrence (O)	
1	Never happen
2	Very rare (1 time in 1 year)
3	Frequent (<9 times in 1 year)
4	Very common (>9 times in 1 year)
Detection (D)	
1	Very easy to detect (failure does not occur because it has been prevented by the controller)
2	Easy to detect (high probability of controller to detect failure)
3	Difficult to detect (the controller's probability of detecting a failure is very low)
4	Not detected (controller cannot detect failure)

Source: processed data (2022)

Based on the rating scale as table 4.5 above, it can be calculated the Risk Priority Number (RPN) which is the result of the multiplication of Severity (S), Occurrence (O), and Detection (D). The results of the Risk Priority Number (RPN) assessment as contained in table. 6.

Table 7. Result of Risk Priority Number (RPN) Assessment

No	Risk	Reason	Occurance (O)	Severity (S)	Detection (D)	RPN (OxSxD)
1	Fertilizer Planning					
	Fertilizer recommendation late	Sampling and analysis of old leaves	2	2	3	12
	The type of fertilizer used for a long time is determined	Need consideration from cross section	2	3	2	12
	Availability of funds/budget is not in accordance with fertilizer recommendations	Fertilizer prices according to high recommendations	3	3	3	27
	The volume of fertilizer needed by the garden was received late	The garden is late in calculating needs	3	2	2	12
2	Supplier Selection Process					
	Determination of old HPS	Price surveys are hard to come by	2	2	3	12
	Announcement of the old tender carried out	Procurement packages enter at the same time	3	2	3	18
	Supplier bids on HPS	The price on HPS does not match the price conditions	2	2	3	12

	The supplier does not meet the procurement criteria	Supplier unable to meet tender requirements (other than HPS)	2	2	3	12
3	Delivery process					
	Late contract signed	Company and supplier renegotiation	3	2	3	18
	The supplier is late in producing fertilizer	Supplier internal constraints	2	3	2	12
	Fertilizer delivery late	There is a shortage of fuel	2	2	3	12
	Fertilizer quality is not suitable	The quality of the fertilizer sample does not meet the requirements	2	2	3	12
4	Admission Process					
	Fertilizer quality is not suitable	The quality of the fertilizer does not match the sample sent	2	2	3	12
	The amount of fertilizer received is not appropriate	Fertilizer is reduced during the trip	2	2	3	12
	Fertilizer received past the time period	The supplier's production capability does not match	2	3	3	18
	Incomplete shipping documents	Documents are still incomplete	2	2	3	12
	There is damage to goods or packaging due to transportation	Damaged goods due to improper treatment	2	2	3	12
	Different types of fertilizers accepted	Fertilizers are replaced with other brands with the same ingredients	2	2	3	12
5	Competence					
	Lack of personnel knowledge	The assigned personnel is still new	2	2	3	12
	Lack of personnel skills	Inexperienced personnel	2	2	3	12
	The number of personnel is less	Personnel handling less in number	2	2	3	12
6	Fertilizer Quality					
	Fertilizer quality is reduced due to Storage Conditions	Moist warehouse	2	2	3	12
	Fertilizer packaging is not up to standard	Open packaging due to transportation	2	2	3	12
	The method of sowing fertilizer is not up to standard	Unprepared applicator	2	2	3	12

Source: processed data (2022)

Based on table 7 above, it is known that the risk priority (Risk Priority Number) in the fertilizer procurement planning criteria is the risk of the availability of funds/budget not in accordance with the fertilizer recommendation with an RPN value of 27. Furthermore, the risk priority supplier selection criteria is the announcement of the old tender carried out with an RPN value. 18. Next on the risk priority fertilizer delivery

criteria are late contracts signed with an RPN value of 18. While the risk priority fertilizer acceptance process criteria are fertilizers received past the time period with an RPN value of 18.

Availability of budget is the main thing in a procurement process. The current condition of fertilizer prices is very high due to, among other things, the war between Russia, where one of the main sources of making NPK is element K (potassium) which is obtained from Belarus. While the preparation of the budget for fertilization was carried out in the previous year. The old fertilizer packages were announced/tendered because the current condition was that all fertilizer packages for all commodities were carried out simultaneously, so the NPK fertilizer packages were waiting for the announcement to be made. The old contract was signed due to the length of negotiations between the PT. XYZ in question and the selected fertilizer provider due to the fact that in the procurement document and technical specifications there are things that are still unclear and must be negotiated between the two parties, namely the article on payment and the article on the period of execution of the work. Meanwhile, fertilizer has passed the time period because currently the pawnshop method used for one procurement package is one winner, so if the winner experiences problems, it will disrupt the process of sending fertilizer to PT. XYZ.

Joint procurement is carried out to meet mutual needs for goods and services or production supporting materials of the same type and certain for the parent company and or subsidiaries. Joint procurement is carried out to ensure that the price of goods and services or production supporting materials is more efficient and the availability of goods and services or production supporting materials is guaranteed. One of the goods carried out by joint procurement is fertilizer.

Based on the understanding of the procurement of goods and services where the process starts from planning the needs to the handover of the results of the work in accordance with the results of the study, there are several things that become priority risks. The priority risks of pawning NPK fertilizer according to the results of the study are as follows:

- 1) In the risk priority planning process, the availability of funds/budget is not in accordance with fertilizer recommendations with an RPN value of 27.

At this time the price of fertilizer has increased very significantly compared to the previous fertilizer price, so that the fertilizer budget according to the recommendations is no longer sufficient to meet purchases as needed. To be able to proceed to the next process the volume must be reduced or diverted from another budget which is not short.

- 2) In the risk priority supplier selection process, the announcement of the old tender was carried out with an RPN value of 18.

At the time of the joint procurement of fertilizer at Holding Perkebunan Nusantara, it was carried out simultaneously for all commodities in PT XYZ. This causes at a certain time the number of fertilizer procurement packages to enter the Ad Hoc Procurement Committee simultaneously, so that the packages that enter the Ad Hoc Procurement Committee cannot be immediately announced at that time.

- 3) In the fertilizer delivery process, the risk priority is the late contract signing with the RPN value of 18

In the procurement document sourced from technical specifications compiled by the HPS Ad Hoc Committee, there are several points that still do not provide certainty, namely payment points. In the Procurement Document CHAPTER IV letter E Article 1 reads "Payment for Fertilizer is made through Giro, and/or based on an agreement between the selected fertilizer provider and the relevant PT.XYZ. This led to a long negotiation between PT. XYZ and the provider which caused delays in signing the contract.

- 4) In the process of receiving fertilizer, the risk priority is that the fertilizer is received past the time period with an RPN value of 18

At this time for joint fertilizer procurement using a 1 (one) winner for 1 (one) procurement package. With this system, if during the work process there are obstacles, it will cause the fertilizer received by PT.XYZ to pass the time period. At this time the period of work for the procurement of NPK fertilizer is 90 (ninety) calendar days.

Based on the results of the study, there are several alternatives to mitigate these risks which aim to improve the performance of NPK fertilization for Palm Oil, namely:

- 1) Ensure sufficient funds/budget

Adequacy of funds/budget is the main alternative choice for improving the performance of NPK Palm Oil fertilization with a Value of 0.432. Budgeting is carried out a year before the implementation of the work,

so that when preparing the budget the company must take into account the potential for price increases and other things that will affect NPK fertilizer. The majority of NPK fertilizer raw materials are raw materials obtained through imports, such as Phosphate and Potassium elements. At the time of budgeting the Company's Work Budget Plan (RKAP) which was carried out in the year prior to the implementation of procurement, thus requiring more precise pricing accuracy.

2) Adding fertilizer suppliers

The alternative of adding suppliers is the second alternative which has a value of 0.208. At this time the Regulation of the Procurement of Goods and Services Directors of PT Perkebunan Nusantara III (Persero) has adopted the existence of multiple winners in one procurement package, so it is possible in one procurement package there are more than 1 (one) provider. With more than 1 (one) winner, these providers will be more competitive in completing their work in fertilizer procurement.

3) Improve communication between fertilizer providers and users 0.188

The third main alternative in improving the performance of NPK fertilizer procurement is to improve communication between fertilizer providers and users with a value of 0.188. With more intensive communication, it is hoped that negotiations on matters that are not clear will reach an agreement more quickly. In order to reduce negotiations related to the payment of the Procurement Documents, it is necessary to strictly stipulate in what way the payment will be applied so that it will close the door to negotiations regarding payments with the provider.

5. CONCLUSION

Based on data analysis and discussion, the following conclusions can be obtained:

- 1) The priority risk in the fertilizer procurement planning process is the availability of funds/budget that is not in accordance with the fertilizer recommendation with a value of RPN 27, the risk priority in the fertilizer supplier selection process is the announcement of the old tender being carried out with a value of RPN 18, the risk priority in the fertilizer dropping/delivery process is late contract signed with a value of RPN 18, the priority risk in the process of receiving fertilizer is that fertilizer is received past the time period with a value of RPN 18.
- 2) Criteria in improving the performance of the procurement of NPK Palm Oil fertilizer at PT XYZ is the criteria for planning the procurement of fertilizer has the first order with a value of 0.575. The second criterion is the selection of suppliers with a value of 0.214. The third criterion is the delivery of fertilizer with a value of 0.134. The fourth criterion is fertilizer acceptance with a value of 0.077.
- 3) Alternatives in improving the performance of palm oil NPK fertilizer procurement at PT XYZ are alternatives to ensure the adequacy of the budget has the first order with a value of 0.432. The second alternative is to add fertilizer suppliers with a value of 0.208. The third alternative is to improve communication between fertilizer providers and users with a value of 0.188. The fourth alternative is to determine the time of fertilizer application with a value of 0.070. The fifth alternative is to increase the frequency of fertilizer quality inspection with a value of 0.055. The sixth alternative is to use information technology in fertilization with a value of 0.047.

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