The Awareness of NPK Fertilizer Applications on Oil Palm among Kampung Seri Mendapat Farmers: An Interview

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ABSTRACT

This study investigates the awareness and knowledge level of NPK (Nitrogen, Phosphorus, and Potassium) fertilizer application among oil palm farmers in Kampung Seri Mendapat, Melaka. Using a qualitative approach, in-depth interviews were conducted with farmers from Pembangunan Pertanian Melaka (PPM) to explore fertilizer usage practices, influencing environmental factors, and technical challenges. Data were analyzed using thematic analysis to identify key issues related to fertilizer dosage, weather impact, and sustainable practices. Environmental factors such as excessive rain and nutrient leaching influence fertilizer strategy, prompting the use of lime, single fertilizers, and frond-based application methods. The findings revealed that PPM implements precise fertilizer practices based on laboratory soil and leaf analysis and adheres to guidelines by the Malaysian Palm Oil Board (MPOB). The company applies between 7.5 to 9 kg of NPK per tree annually in split applications, adjusting rates based on soil conditions and rainfall patterns. Nutrient leaching due to frequent flooding was a concern, leading to the adoption of lime spreading and the use of single fertilizers. Fertilizer is strategically applied over fronds to reduce nutrient loss and enhance soil structure. The study concludes that high awareness and strong institutional training result in improved productivity and sustainability. It recommends expanding soil testing access, promoting site-specific nutrient management, and educating smallholders on best practices.

Keywords: Oil palm, NPK fertilizer, Nutrient management, Soil fertility, Nutrient leaching

INTRODUCTION

Malaysia's oil palm is a major commodity crop that boosts both rural employment and the country's GDP. Oil palm has a high nutrient demand, and fertilization is one of the most crucial agronomic activities in oil palm agriculture. Degradation of the soil, higher production costs, and lower yields might result from improper NPK fertilizer use. Many oil palm farms run by smallholders and companies such as Pembangunan Pertanian Melaka (PPM) can be found at Kampung Seri Mendapat in Melaka. However, farmer's knowledge, awareness and actual application techniques all have a significant impact on how efficiently NPK fertilizer is used. Past studies have established the importance of nutrient management in tropical soils, where issues like high rainfall, soil acidity, and poor retention capacity can drastically affect fertilizer effectiveness. According to Mahmud & Chong (2022), liming and soil pH management are key to enhancing nutrient availability in Malaysian soils. Similarly, research by Pratama et al. (2025) emphasizes the importance of tailoring fertilizer dosage to plant developmental stages and local conditions.

The objective of this study is to evaluate the level of awareness among oil palm farmers and plantation workers in Kampung Seri Mendapat regarding NPK fertilizer applications. Specifically, the research aims to determine the level of awareness of the amount of fertilizer that farmers apply to the oil palm tree, To identify the challenges farmers face and the practices they adopt when applying NPK fertilizer to oil palm crops. Further studies showed that excessive or unbalanced fertilization contributes to the deterioration of the biological value and quality of yields (Martins Loução et al., 2022). This is to make sure to maintain high crop yields of oil

palm and many other crops need a lot of fertilizer each year, and frequently there aren't enough nutrients to support plant growth. Sustainable agriculture can be described as a method that improves the environment and the resource base on which agriculture relies over time, meets basic food and nutrients requirements, is economically feasible, socially acceptable, and improves the quality of life for farmers and communities (Mahmud & Chong, 2022). Nutrient leaching is typically minimal in soils with high nutrient availability and water holding capacity but poor water infiltration, such as clay soil. On the other hand, nutrient leaching losses are more common in sandy-textured soils with high soil density, allowing water to flow more freely (Mahmud & Chong, 2022). Resolving this issue is essential to boosting smallholder farmers' livelihoods, guaranteeing environmental sustainability, and increasing agricultural output. The purpose of this study is to investigate the present methods of fertiliser application in oil palm farming, pinpoint the difficulties that farmers have, and offer suggestions to increase knowledge and uptake of accurate fertiliser management strategies.

LITERATURE REVIEW

The oil palm tree (Elaeis guineensis) is an important economic tropical plant native to Africa. The oil palm has a significant socioeconomic and cultural impact on the inhabitants of the communities where it is grown. One of the most productive crops is palm oil, figure 2.1 shows the picture oil palm plantation. Today, oil palm is crucial to the economies of many countries, especially Indonesia and Malaysia, from which large quantities of its products are exported in the form of oil, meal and other derivatives (D.J. Murphy & K. Goggin, 2020). Malaysia is the second largest producer and exporter of crude palm oil (CPO). The oil palm industry in Malaysia significantly expanded and has become a major economic sector. The global demand of this precious commodity as food and fuel has caused a significant upsurge in production of oil palm (Ezechi & Muda, 2019). However, despite its increasing cultivation on three widely separated continents, the vast majority of oil palm is still grown in the two adjacent South East (SE) Asian countries of Indonesia and Malaysia that generate about 85% of the entire global production (D.J. Murphy& K. Goggin, 2020).

Table I: Major of global oil palm cultivation in 2020.

RANK	COUNTRY	PALM OIL PRODUCTION	
		MT (metric ton)	%
1	Indonesia	42.5	58.8
2	Malaysia	18.5	25.6
3	Thailand	2.8	3.9
4	Colombia	1.5	2.1
5	Nigeria	1.0	1.4
	Others	5.9	8.2
	Total	72.3	

(Source: D.J. Murphy & K. Goggin, 2020)

Oil palm growers usually straighten natural rivers within plantations to make it easy to plant oil palm trees. The growers do not plant oil palm trees in the areas near the straightened rivers. These unused spaces can be filled by planting indigenous trees to increase biodiversity within the plantation. Aside from enhancing biodiversity, this type of buffer zone planting can yield many benefits such as improving water quality, protecting oil palm from insect pests, providing habitats for insect pollinators and enabling financial incentives (Yamada et al., 2016). The Malaysian oil palm industry experienced an enhanced performance in 2019 as compared to that of in 2018 where significant achievements have been attained in exports, palm oil stocks and prices. All in all, crude palm oil (CPO) production, exports and imports of palm oil recorded an increase while palm oil stocks, crude palm oil prices and total export earnings of oil palm products declined (Kadir, 2020).

The application of NPK fertilizer can cause the soil to become hard due to the accumulation of the residue left on the ground. The productivity of oil palm plantations is currently not been currently maximum, and therefore, various efforts are required to improve the productivity of oil palm, one of which is by using NPK fertilizer (Adileksana et al., 2020). NPK nutrients are n the primary source of nutrients for oil palm. Long-term use of synthetic chemical fertilizers can reduce soil organic matter, harm soil structure, and leave behind

chemical residues that are hard to break down. An environmentally friendly substitute is required because synthetic fertilizer is being used. In order for soil microbes to convert manure, an organic material applied to the soil, into humus, it must go through many stages. All animal waste products that can be utilized to boost nutrients and enhance the physical and biological characteristics of soil are referred to as manure (Adileksana et al., 2020). One may be abundant in your soil while the others may be scarce. Many soils lack enough nitrogen yet have enough potassium and phosphorus for plants. Additionally, plants utilise less phosphorus than they do potassium and nitrogen. Accordingly, selecting the appropriate fertiliser can entail selecting one with a higher initial number or three distinct numbers, such as 16-8-2. Nutrients such as potassium, nitrogen, and phosphorus, which are important for growth, take longer to be broken down by soil microorganisms. Without complete decomposition, these nutrients are not available in sufficient quantities or in a form that is easily accessible to plant roots, so stem diameter growth is not affected (Andika Pratama et al., 2025).

Oil palm is one of the highest potential yields of any oil crop. Under the best conditions, it can deliver 20 to 30 metric tonnes of fresh fruit bunches (FFB) per hectare annually. This translates to 4 to 6 metric tonnes of crude palm oil (CPO) and 0.5 to 1 metric tonnes of palm kernel oil per hectare per year. Oil is known as the new potential development to enter into the export market, job opportunities, rural livelihood development and national income. Moreover, despite promoting the added value of palm oil for energy security, development and mitigating climate change, its development also accounts for negative impacts, which resulted in reduced food availability (Alam & Begum, H., 2015).

METHODOLOGY

This study employed a qualitative research design to explore the level of awareness and practices related to NPK fertilizer application among oil palm farmers in Kampung Seri Mendapat, Melaka. A case study approach was used to allow for a deeper contextual understanding of how field practices align with or diverge from recommended fertilization standards. This method was selected due to its strength in capturing detailed, experience-based data from real plantation environments. Kampung Seri Mendapat is a village that has many farmers because it has several oil palm plantation organizations, such as FELCRA and PPM. Kampung Seri Mendapat also has many elderly farmers, and the use of bilingualism will help farmers to answer questions during the interview session. This interview is conducted in one company, which is Pembangunan Pertanian Melaka (PPM). Only 5 people will be in this interview and the chosen of this company because they have large oil palm plantations, and it can be said that most of the oil palm plantations in Kampung Seri Mendapat belong to them, apart from organizations like FELCRA. This interview was also conducted as a group interview.

The primary method of data collection was structured face-to-face interviews, conducted with three farmers of Pembangunan Pertanian Melaka (PPM), a government-affiliated plantation management agency. These participants were selected through purposive sampling based on their field roles, decision-making responsibilities, and direct involvement in fertilizer application processes. Their positions within the plantation management structure made them highly relevant informants. The interviews were conducted in a group setting to encourage natural discussion and reflection, while maintaining a structured format to ensure that specific research themes were covered. Bilingual communication, in which Malay and English were used to accommodate language preferences and to ensure accurate and meaningful responses. Interview questions focused on four main thematic, which were awareness and knowledge of NPK fertilizer amount, environmental factors influencing fertilizer application, techniques used in field application, and challenges during applying NPK fertilizer.

Each interview was audio recorded, transcribed, and compiled into a formal interview transcript document. The transcript served as critical supporting data for this study, allowing detailed review, coding, and thematic analysis. The transcript was preserved as part of the appendix and acts as a documented evidence base to support the interpretation of findings. Data analysis was conducted using thematic analysis, a flexible and systematic method for identifying, analyzing, and reporting patterns within the qualitative dataset. Transcripts were carefully read, and initial codes were generated manually based on recurring ideas, language use, and technical insights. These codes were then grouped into broader thematic categories that correspond to the research objectives. Data triangulation was further achieved through cross-comparison with secondary sources, including fertilization guidelines published by the Malaysian Palm Oil Board (MPOB), internal fertilizer

records from PPM, and monthly rainfall statistics from the Melaka Meteorological Department. The purpose of the interviews was to collect information that would provide insight into the perceptions, lived experiences, and adaptive tactics of those engaged in grassroots oil palm farming. Thematic analysis was used to examine this qualitative data. This approach, which is well known for its versatility and efficacy in qualitative research, entails finding, examining, and summarising patterns or themes in the data.

RESULT AND DISCUSSION

This interview involved five employees at Pembangunan Pertanian Melaka, and it was conducted in a group setting. Some of the questions asked were related to the objective of the final year project. The officers interviewed were five people. Mrs. Hasmah and Mr. Khairul Faizi are two important individuals who maintain fertilizer practices in the Pembangunan Pertanian Melaka (PPM) oil palm plantation area. This is because although this interview was conducted in a group, the ones who answered many of the questions were Mr. Khairul Faizi and Mrs. Hasmah who administer the fertilization practices in the PPM oil palm plantation. All the questions asked were answered well by the employees at PPM. Qualitative data are most often collected by researchers through interviews and questionnaires. This fertilization practice is very important on a plantation and it will play an important role in the yield produced by the trees because the nutrients supplied by this NPK fertilizer can increase the yield and quality of trees on oil palm plantations such as in PPM. The questions asked during the interview session with the officers at the site have several aspects that have been researched before being submitted to the officers at the site. There are many qualitative methods which are developed to have an in depth and extensive understanding of the issues by means of their textual interpretation and the most common types are interviewing and observation (Shazia, 2014).

The amount of fertilizer applied to an oil palm tree must be in accordance with several factors that may affect the yield and quality produced by the oil palm tree. This is said to be so because oil palm trees depend on nutrients to produce quality fruits and bunches. During the interview, Puan Hasmah said that their company determines the amount of NPK fertilizer needed per tree by analyzing the soil and samples in a trusted laboratory. The laboratories that trusted to analyze the soil and samples are such as laboratories at MPOB, IOI Plantation and FELCRA. Analytical and Quality Development Unit provides the latest analytical techniques and methods validation on key quality parameters for palm oil products. The amount of fertilizer needed can be estimated by doing soil and leaf analysis. Single fertilizers are easy to meet the nutrient needs of each tree accurately but require a lot of logistics and labour to spread each type of fertilizer (MPOB, 2025). From what Mrs. Hasmah said, the amount of fertilizer that should be applied to a tree is very important for the PPM because the company will not apply it at will and requires several processes before they knows the amount of fertilizer that should be applied to a tree. The company is very concerned with the amount of fertilizer applied and they are also very careful with the condition of the soil and trees before applying the actual amount of fertilizer.

Table II: Fertilizer application by MPOB

Parameter	Rate
N removed per ha/year	~192 kg
P_2O_5 removed per ha/year	~26 kg
K_2O removed per ha/year	~251 kg
MPOB NPK compound	2.5 kg/palm every 4 months (~7.5 kg/year)
Estimated NPK blend per ha	~1050 kg/ha/year

(Source**:** MPOB F4, 2014)

From the table 4.1, MPOB recommended 2.5 kilogram compound fertilizer every 4 months and the total fertilizer application in one year is 7.5 kilogram. Fertilizer application depends on the age of the tree, the frequency of fertilization is three times a year when the tree is between one and four years old and twice a year after the tree is more than four years old (MPOB, 2025). Referring to the matters presented by Mrs. Hasma and Mr. Khairul, this shows PPM very particular and meticulous about the amount of fertilizer they must apply to one tree in a year. The efforts taken by their company are one of their efforts to ensure that fertilization

practices at the Kampung Seri Mendapat oil palm plantation owned by their company can be carried out properly and managed according to the fertilization guidelines set by MPOB. The awareness from PPM is so high about fertilization application. According to Mrs. Hasma as one of the officers who supervises fertilization practices at PPM, the maximize amount of fertilizer to 9 kilograms per year per tree. The NPK fertilizer application will operate in 3 rounds using a ratio of 3:3:3, where 3 kilograms will be applied in each round. However, according to Mrs. Hasma, the rate of fertilizer application in the oil palm plantation area in Kampung Seri Mendapat owned by Pembanguna Pertanian Melaka also depends on the results of the agronomist that conducted by MPOB on the plantation. Mrs. Hasma also said that if MPOB analyzes the soil condition and has good nutrients, the fertilizer application rate will also change according to the rate set by MPOB.

The challenges involved in managing fertilizations must be resolved right away in order to prevent the issues from affecting the amount of nutrients supplied to the trees. PPM faces a number of challenges when fertilizing oil palm trees. PPM takes this issue very seriously in order to protect the local plantation's resources and tree quality. The state of the oil palm trees on each plantation is impacted by a variety of factors, including deforestation and water pollution, issues with yield and productivity, difficulties with international trading, and market acceptance. The lack of ability of the trees to deliver high-quality fruit will undoubtedly have an impact on the plantation's revenue and production. According to news published by Astro Awani in 2022, Sime Darby is experiencing a challenge where the company is experiencing a situation where there is a shortage of workers which is affecting operations and practices in Sime Darby's oil palm plantations. This has affected the fertilization activities at Sime Darby because it requires a long period of operation to complete the fertilization activities in the oil palm plantation area. However, this problem is not faced by PPM because each plantation has its own problems. The biggest challenge faced by PPM is the weather that has hit the oil palm plantation in Kampung Seri Mendapat. This is said to be because the continuous rainy weather has affected PPM's oil palm plantation. Fertilization activities have also been affected because the continuous rainy conditions have caused PPM's oil palm plantation to experience waterlogging which affects the nutrient levels in the soil and leaching of nutrients when applying fertilizer. Another challenge faced by PPM is to ensure that the amount of fertilizer given to a tree is not too much and not too little. Excessive fertilizer is also not allowed because this affects the stability of nutrients in the soil and can also increase the cost of fertilization in PPM oil palm plantations. Insufficient amount of fertilizer during fertilization also affects the quality of fresh fruit bunches in PPM plantations and yields are also reduced.

In an interview session with PPM officers, questions about weather-affecting fertilization practices were also asked to PPM officers. Mr. Khairul said that the oil palm plantation in Kampung Seri Mendapat owned by their company, has a problem of stagnant water caused by the non-stop rain in the Kampung Seri Mendapat area. This will cause the trees and soil to get excessive water according to Mr. Khairul. Flooding condition or environment for a longer time more than 3 weeks and continuous waterlogging can produce a strong anaerobic condition due to the accumulation of considerable organic matter from decaying root systems. Under such conditions, oil palm performance is affected adversely (Nadaraj et al., 2024). This affects the soil nutrients and also the soil PH. Mr. Khairul also said that the Kampung Seri Mendapat area is a valley and an area that is always flooded when it rains continuously. This causes the nutrients in the soil to leach and causes the nutrients not to be supplied to the trees properly and sufficiently. This factor will affect the systematic fertilization practices in the plantation area. Mr. Khairul also mentioned several alternative measures to properly handle this problem. The measures taken include root fertilization to provide nutrients needed by plant roots for healthy growth and development, spreading lime to stabilize the soil PH level and changing the use of compound fertilizers to single fertilizers to focus on nutrients that are not being absorbed by the tree and soil. Oil palm is generally tolerant of relatively high water tables and is thus most suited to water management techniques such as maintaining water levels in the drains. For example, with proper water management by maintaining water level at 45-60 cm on acid sulfate soils oil palm yields are greatly improved (Nadaraj et al., 2024). The palm requires an average of 150 mm/month, with dry periods not exceeding 2–3 months. Higher monthly values can cause waterlogging in poorly drained soils (Haris & Azzam, 2017). Figure 4.2 below shows the average rainfall monthly in Melaka, from the statically graph Melaka average monthly rainfall was above than 200mm. What Mr. Khairul said was true, that Melaka has a rainfall rate that is not good for the valley area because it will affect the amount of nutrients in the soil due to waterlogging.

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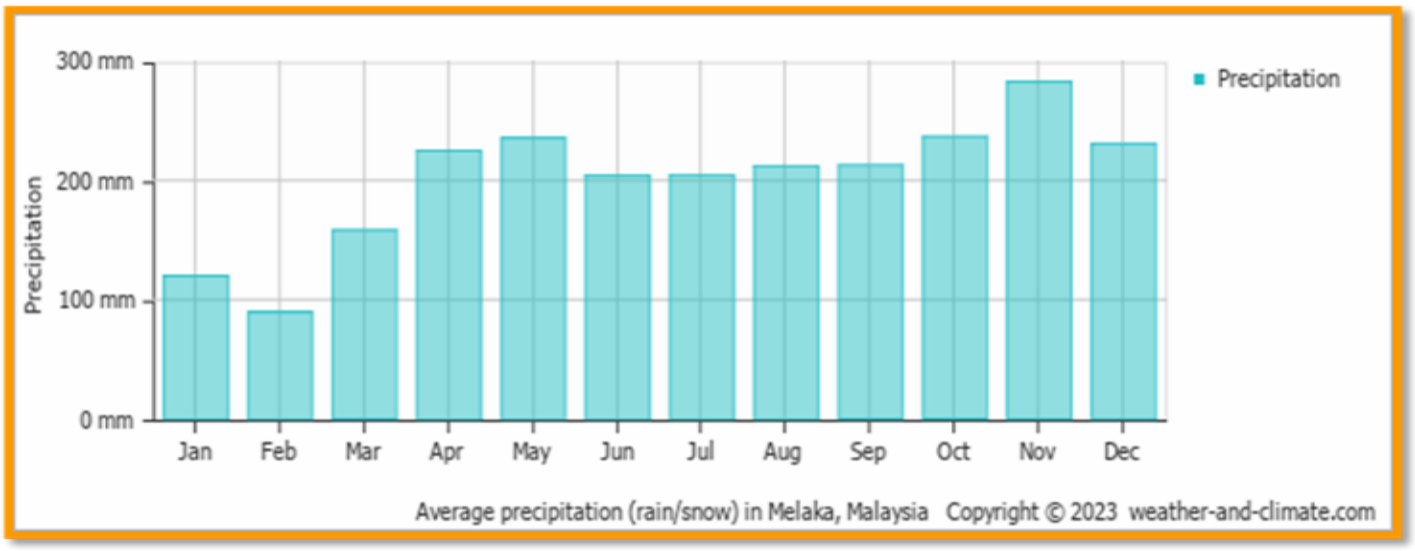

Figure I: Average monthly rainfall in Melaka

Questions regarding the effects of excessive and underuse of fertilizers were also asked to officers working at PPM. Puan Hasma said that they are very concerned about the excessive or underuse of NPK fertilizers because this can affect the fruit and the bunches will also decrease. According to Puan Hasma, excessive use of fertilizer will also increase the cost of fertilizer use, so PPM needs to supervise this properly to prevent an increase in costs on fertilization sector. However, given the ever-increasing cost of fertilizers and the concerns of civil society about sustainable crop management sequences, studies have become necessary to measure the efficiency of fertilization and its impacts on the environment. It was in this spirit that used two long-duration fertilization trials to investigate the effects of the main N, P and K fertilizers on the characteristics of soils after several years of fertilization (Dubos et al., 2016). Table 4.2 shows the optimum range of nitrogen (N), phosphorus (P_2O_5), and potassium (K_2O) application in oil palm cultivation, together with the potential impacts if the guidelines are not followed. For nitrogen, the optimum range is 110–155 kg/ha/year. Levels below 110 kg/ha can lead to nitrogen deficiency, which is expressed through reduced chlorophyll production, weak vegetative growth, and thus lower yields. On the other hand, application of more than 155 kg/ha may result in leaching of nutrients, nitrogenpotassium imbalance, and unwarranted production costs without attendant yield increases.

Table III: Recommended range NPK uses

Nutrient	**Recommended Rang (kg/ha/year)**	**Implication**
N	110 - 155	Too low (<110) = yield reduction; too high (>155) = leaching, N/K imbalance
P_2O_5	64 - 98	Underuse (<64): weak root development; overuse (>98): micronutrient suppression
K_2O	230 - 445	Underuse (<230): reduced yield & stress tolerance; overuse (>445)

(Source: Haifa Group, 2017)

Mr. Khairul explained the used NPK fertilizer by applying it over the fronds of the oil palm. This is a great method of ensuring that the fertilizer applied will not easily leach whenever heavy rains rain on the farm. The method helps the trees absorb more nutrients and also maintain soil fertility. Mrs. Hasma explained that applying fertilizer using the method above also prolongs its effectiveness. This is because the plants have some protection from direct sunlight, reducing over loss by evaporation or sublimation. Fertilizers placed under full exposure to sunlight may suffer from sublimation, where solid particles are immediately changed into vapor, reducing available nutrient content for the oil palm. Therefore, this method is an effective way to preserve nutrient value without sacrificing even release into the soil.

Besides, research has confirmed the effectiveness of this practice. The previous study has shown that stacking palm fronds improved soil macroporosity and was capable of significantly reducing leaching of major nutrients like potassium (K), magnesium (Mg), sodium (Na), phosphorus (P), and aluminum (Al) (Kurniawan et al., 2018). Enhanced macroporosity in the soil introduces aeration and root growth and promotes drainage as well as nutrient retention. This shows that fertilizer overpruned fronds can have a dual advantage beyond being a physical check against leaching, it is an organic amendment that will increase the soil structure in the long term.

Furthermore, Tao et al. (2018) showed that fertilizer was normally broadcast over pruned fronds extending outside palm circles and into the rows. This position also permits the availability of nutrients across the soil in areas best accessible to root zones. Slow-release fertilizers are applied when fertilizers are blended with planting medium and infused into polybags at nursery or seedling levels for a gradual release of nutrients as the growing young plant requires (Md Tauhid, 2021). Additionally, foliar fertilizers can be applied by spraying them over the palm fronds to supplement nutrient intake, especially when quick uptake is needed or where soil uptake is limited. As a rule, application of fertilizer over fronds is a productive and agronomically viable regime which not only prevents loss of nutrients but also encourages healthy plant growth by improving the soil structure as well as the nutrient availability.

CONCLUSIONS

This study has explored the awareness, knowledge, and practice of NPK fertilizer usage among farmers at the Pembangunan Pertanian Melaka (PPM) oil palm plantation in Kampung Seri Mendapat. Through the qualitative approach of in-depth interviews, valuable information was obtained regarding the level of farmers' knowledge, issues faced in the field, and fertilization methods being practiced. The evidence shows that PPM has demonstrated a commendable level of awareness in assuring fertilizer application with precision and sustainability. The organization gives importance to accuracy in fertilizer dose determination by using soil and leaf analyses, employs trained laborers to carry out fertilization operations, and plays an active part in training workshops organized by certification bodies like MSPO.

Based on findings from this study, several recommendations can be laid down to further improve NPK fertilizer use practices among oil palm producers, particularly in Kampung Seri Mendapat. To enhance long-term productivity and environmental sustainability in oil palm cultivation among Kampung Seri Mendapat farmers, a coordinated effort between government agencies, research institutions, and industry stakeholders is crucial. Regular workshops, farmer field schools, and digital learning tools should be organized to strengthen farmers' knowledge of proper NPK fertilizer application, ensuring they understand the correct rates, timing, and techniques. Government agencies can play a vital role by subsidizing soil testing services and deploying mobile soil laboratories to rural areas, making it easier for farmers to monitor soil nutrient status and follow recommendations. Incentives, such as fertilizer discounts, can further encourage participation in soil testing programs. In addition, promoting site-specific nutrient management (SSNM) strategies tailored to local soil conditions will allow farmers to optimize fertilizer use, reduce waste, and minimize environmental harm. The use of precision agriculture tools, simple nutrient calculators, and regular monitoring can improve decision-making and limit nutrient runoff. Collaboration with fertilizer companies and farmer cooperatives can provide better access to inputs, extension services, and shared resources, while also strengthening community-based initiatives for soil health. Finally, raising awareness of the long-term economic and ecological benefits of balanced fertilization and encouraging integrated soil health practices such as using compost or cover crops will help preserve soil fertility and ensure sustainable oil palm production for future generations.

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