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The Impact of Palm Oil Plantations on Per Capita Income in Kalimantan and Its Effect on Unemployment

Januar Barkah[1*]
Universitas Borobudur, Indonesia
Email: januarmemangbarkah@gmail.com

Sumaryoto [2]
Universitas Borobudur, Indonesia
Email: sumaryoto2512@yahoo.com

Muhammad Rozali[3]
Universitas Borobudur, Indonesia
Email: m.rozali@borobudur.ac.id

ABSTRACT
Currently, Indonesia's oil palm plantation sector is in a critical phase. While the sector has contributed significantly to national income and created jobs, it is increasingly urged to address a number of social and environmental issues. This study aims to explain the complex relationship between oil palm plantation expansion, per capita income, and unemployment dynamics in the region. Using quantitative methodology and multiple linear regression analysis, this study examines secondary data sourced from the Central Bureau of Statistics (BPS) and the Ministry of Agriculture covering the period 2001-2022. The findings show that the expansion of oil palm plantations significantly increases per capita income through direct and indirect job creation. However, its impact on unemployment is not uniform and depends on the prevailing economic structure and adaptability of the local labor market. While some regions experienced a decline in unemployment due to increased job availability, other regions experienced an increase in structural unemployment caused by the adoption of modern technology that reduced the need for manual labor. These findings underscore the need for regional policies tailored to the local economic context, labor market, and local employment conditions.

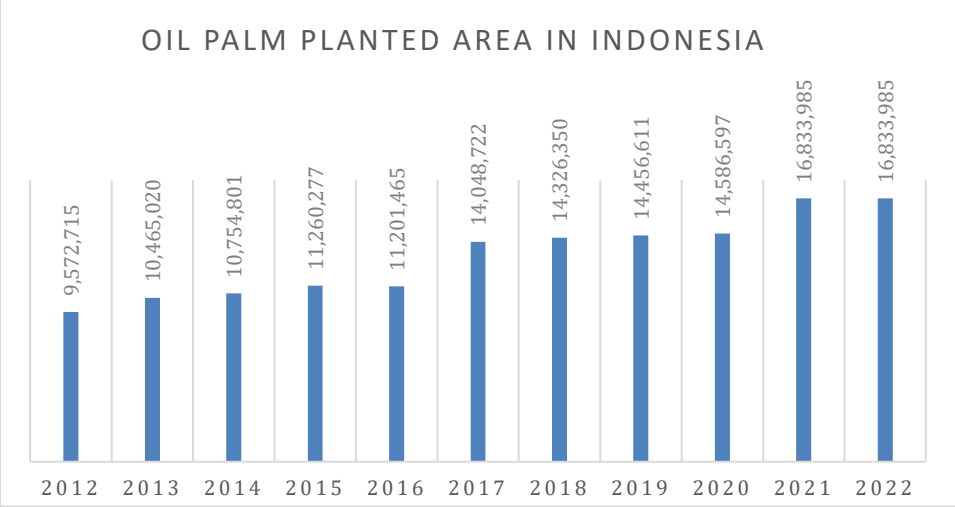
Keywords: palm oil plantations; per capita income; unemployment; Kalimantan; economic policy; labour market.

INTRODUCTION

Oil palm plantations are an important economic sector that substantially contributes to local and national income by creating jobs and increasing Gross Domestic Product (GDP) (Apresian et al., 2020; Pacheco et al., 2017; Sibhatu, 2023). In Indonesia, particularly in tropical regions such as Kalimantan, the sector plays an important role as a key driver of local economic development. However, the impact of oil palm plantations on per capita income is not uniform, as it depends on several important factors,

including plantation ownership structure, wealth distribution patterns, and prevailing economic policies. These factors can significantly shape how the benefits of oil palm plantation expansion are distributed to different segments of society, thereby affecting local and national economies (Dharmawan et al., 2020; Gatto et al., 2015; Xin et al., 2021). The complexity of the sector therefore requires a comprehensive analysis to understand its true socio-economic impacts.

The development of oil palm plantations in Indonesia, particularly in Kalimantan, has been a topic that has received considerable attention in economic and environmental discussions. According to data from the Central Bureau of Statistics (BPS), the total land area for oil palm plantations has drastically increased from 6.7 million hectares in 2000 to more than 14 million hectares in 2022 (BPS, 2023). This development shows great potential for increasing regional income, but also poses serious challenges related to unemployment and environmental damage. Previous research shows that while this sector can create jobs, the adoption of modern technology also has the potential to reduce the demand for manual labor, contributing to an increase in structural unemployment (Kraus et al., 2024; Kubitza et al., 2024; Rambe et al., 2023).

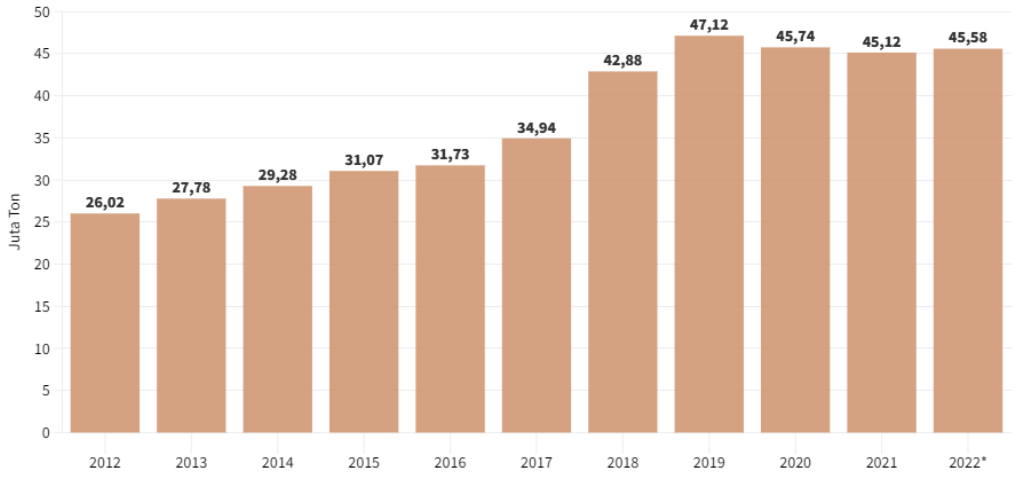


Source: Directorate General of Plantations, Ministry of Agriculture, Republic of Indonesia

According to data from the Ministry of Agriculture, the expansion of Indonesia's palm oil industry is evidenced by increasing cultivation areas, production, and exports over recent decades (Afriyanti et al., 2016; Varkkey et al., 2018). Between 2015 and 2022, the area dedicated to palm oil plantations experienced considerable growth, particularly in 2017 and 2021. This expansion not only underscores the industry's potential for further growth but has also led to improved infrastructure and greater access to public services around plantation areas, thereby enhancing local living standards. Nevertheless, the long-term sustainability of these benefits depends on addressing the accompanying social and environmental challenges that arise from rapid plantation growth.

Despite the economic advantages linked to the palm oil industry, its adverse effects cannot be ignored. Palm oil plantations have often been implicated in land conflicts, especially with indigenous communities, and in environmental degradation due to widespread deforestation (Abram et al., 2017; Andrianto et al., 2019). The resulting deforestation and environmental damage have posed significant threats to Indonesia's biodiversity. Socially, the concentration of wealth among a small number of large plantation owners has further deepened economic and social disparities within communities. As a result, the sector's growth must be carefully managed to balance economic progress with social equity and environmental sustainability.

Palm Oil Production in Indonesia (2012–2022)



Source: Central Bureau of Statistics of Indonesia (BPS)

Data from Indonesia's Central Bureau of Statistics (BPS) reveal a persistent upward trend in palm oil production. In 2022, Indonesia's palm oil production reached 45,58 million tonnes, reflecting a 1,02% increase from the previous year's total of 45,12 million tonnes. The highest production in the last decade was recorded in 2019, amounting to 47,12 million tonnes. Specifically, in 2022, large plantations accounted for 30,06 million tonnes, while smallholder plantations produced 15,52 million tonnes. Palm oil production is dispersed across 26 provinces, with Riau leading at 8,97 million tonnes, followed by Central Kalimantan (7,04 million tonnes) and North Sumatra (5,99 million tonnes). Conversely, the Riau Islands reported the lowest production at 16.100 tonnes, followed by North Maluku (16.300 tonnes) and Maluku (17.000 tonnes). This disparity in production levels underscores the varied contributions of different provinces to Indonesia's overall palm oil output.

The impact of the palm oil industry on employment is also evident, as it creates jobs while confronting challenges related to unsafe working conditions, low wages, and dependence on global commodity price fluctuations. Unemployment in the sector can also be affected by external variables, such as shifts in global crude palm oil prices and changes in labour policies. These factors highlight the interconnectedness of local employment conditions with broader economic and policy shifts, indicating the need for robust regulation and monitoring mechanisms.

In this context, it is crucial to thoroughly examine the impact of palm oil plantations, not only in terms of their contribution to per capita income but also in relation to unemployment rates and socio-economic dynamics in Kalimantan. This study aims to provide an in-depth understanding of the role of palm oil plantations in the regional economy while assessing their negative consequences, thereby enabling the implementation of more sustainable management practices. Such an approach is essential to ensure that the benefits derived from this sector are shared equitably among local communities and do not come at the cost of long-term socio-economic and environmental stability.

This study focuses on the relationship between oil palm plantation expansion, per capita income increase, and unemployment in Kalimantan, using a quantitative approach that employs multiple linear regression analysis. While many previous studies have examined the economic impact of oil palm, this research adds a new dimension by exploring the complex interactions between these variables in a more contemporary context.

Several studies have shown both positive and negative impacts of oil palm plantations. For example, Riantana and Handoko (2019) found that the expansion of oil palm plantations can increase community income, but with negative environmental and social consequences (Ayompe et al., 2021). This study builds on those studies by providing a more in-depth and up-to-date analysis of the situation in Kalimantan, as well as considering factors that influence labor market dynamics.

The objective of this study is to identify and analyze the impact of oil palm plantation expansion on per capita income and unemployment in Kalimantan. The benefits of this research are expected to provide input for policy makers in formulating more effective strategies to maximize economic benefits while minimizing social and environmental impacts. The implications of this research include the need for policy development that considers the impact of oil palm plantation expansion on per capita income and unemployment in Kalimantan.

Literature Review

The term land area refers to the surface of the earth and encompasses all the physical and biological characteristics existing above and below it, which are vital for sustaining human life. More specifically, land is defined as an area on the earth's surface containing permanent components of the biosphere, including the atmosphere, soil, parent rock, relief, hydrology, vegetation, and animals. This comprehensive definition integrates both physical and biological elements, highlighting the essential role they play in various life systems (Ray et al., 2019). Such a holistic view allows for a better understanding of land not just as a physical space, but as an interconnected system supporting multiple ecological and human functions. Therefore, any discussion on land use must consider this integration of attributes to ensure sustainable management.

Land is frequently conceptualised as soil specifically used for agricultural purposes. However, not all land is considered agricultural, although all agricultural land is regarded as soil. From a systemic perspective, land is composed of both structural components, often termed as land characteristics, and functional components, known as land qualities. These land qualities encompass a range of attributes that collectively determine the land's capability and suitability for different uses. As a dynamic system, land includes well-organised components working together towards achieving certain goals in relation to human activities.

These land components are often classified as resources when examined in the context of human endeavours aimed at meeting basic needs. Key land resources crucial for agricultural development include climate, topographical relief, geological formations, soil, water, vegetation, and artificial elements. The potential of a particular region for agricultural development is fundamentally determined by the compatibility between its physical characteristics, such as climate and hydrology, and the requirements of specific land use or crop growth. Thus, an assessment of regional development potential must take into account these various physical and environmental factors to ensure effective land use.

The alignment between the physical characteristics of an area and its intended use can provide valuable insights into the development potential of that land. When land is used for a designated purpose, with careful consideration of necessary inputs, it is expected to produce desired outcomes. According to researchers, land serves several key functions that are fundamental to supporting human life and development. These functions include providing a foundation for production, supporting environmental sustainability, regulating climate and hydrology, and offering living spaces for various human activities. Understanding these functions is critical to ensuring that land resources are managed effectively for long-term benefits.

According to researchers, land has several key functions, each serving distinct yet interconnected roles. Firstly, the Production Function refers to land's role in sustaining life systems through the production of biomass, which includes food, animal feed, fibre, timber, and other biotic raw materials for humans, either directly or through agricultural activities, including aquaculture. Secondly, the Environmental Function highlights land as a part of terrestrial biodiversity that provides habitats and genetic reservoirs for plants, animals, and microorganisms, both above and below ground. These functions are crucial for maintaining the ecological balance and biodiversity essential for human survival.

In addition to these functions, land plays a vital role in Climate Regulation by acting as both a source and sink for greenhouse gases. It also influences the global energy balance by absorbing, reflecting, and transforming solar radiation, while playing a significant part in regulating the hydrological cycle. The Hydrological Function involves land's role in managing the storage and flow of groundwater and surface water resources, which subsequently impacts water quality. These functions, along with land's capacity to act as a reservoir of raw materials and minerals (Storage Function), underscore the multifaceted nature of land as an essential resource for human activities.

Land also plays a critical role in Waste and Pollution Control, functioning as a receptor, filter, buffer, and transformer of harmful compounds. Furthermore, the Living Space Function refers to land's provision of physical space for human habitation, industries, and social activities, including sports and recreation. Such an understanding of land, encompassing all its characteristics and uses, highlights its multifaceted functions that can be leveraged to enhance human quality of life. Thus, the effective management of land resources is essential for supporting sustainable development and improving human well-being.

The concept of the production function refers to the relationship between production factors and the resulting level of output achieved. These factors are typically regarded as inputs, while the output indicates the quantity of production. Production, in essence, is the relationship between these inputs and the resulting outputs. Given the available inputs, every company, including those in the agricultural sector, aims to maximise output based on the level of technology accessible at the time. A production function can provide a clearer understanding of technically efficient production, where all inputs are utilised optimally to achieve maximum productivity. This perspective underscores the importance of technology and efficiency in driving production outcomes.

According to researchers, each company strives to achieve maximum output by leveraging the highest level of technology available. In the context of agricultural production, technological advancements can play a critical role in enhancing output levels, thus contributing to broader economic growth. Soekartawi, as cited in Mudakir (2007), identifies several strategies for increasing production. These include increasing the quantity of one or more inputs to improve output levels. By carefully adjusting these inputs, companies can achieve optimal results and maximise their productivity within existing technological constraints.

Economic development, according to Sumitro as cited in Ginting (2008), involves efforts to increase per capita income, which serves as a benchmark for gauging economic progress. This is achieved through investments in capital equipment and the enhancement of human skills (Arokiasamy et al., 2023). Consequently, economic development is seen as an endeavour to elevate societal welfare by raising per capita income levels. Such an approach highlights the significance of capital and skill development in driving economic growth and improving overall living standards.

Per capita income can be understood as the average income earned by a population within a specific country or region. More specifically, regional per capita income is calculated as the total regional income divided by the population within that region, resulting in a figure representing the average income per

person. The researchers describe per capita income as a measure used to evaluate the government's success in implementing economic development initiatives. Sadono Sukirno (2004) adds that per capita income represents the average income of a population within a given period, typically one year (Lagerlöf, 2019). National income, which underlies per capita income calculations, reflects the total value of goods and services produced by a country over a specific period, often one year.

RESEARCH METHODS

This study adopts a quantitative approach to analyse the relationship between palm oil plantation area, palm oil production, per capita income, and their impact on unemployment rates in Kalimantan. The research utilises secondary data sourced from the Central Bureau of Statistics (BPS) and the Ministry of Agriculture, covering the period from 2001 to 2022. The primary analytical technique employed is multiple linear regression, which facilitates the simultaneous evaluation of the relationship between multiple independent variables and a single dependent variable. This methodological approach enables a detailed examination of the interdependencies between key economic indicators.

The multiple linear regression analysis in this study is carried out through a series of well-defined steps:

1. Multiple Linear Regression Equation

The multiple linear regression equation used to measure the relationship between the variables in this study is formulated as follows:

- For per capita income (Y):

$$Y = c + \beta 1X1 + \beta 2X2$$

Where:

- *Y* represents per capita income,
- *X1* represents the palm oil plantation area,
- *X2* represents palm oil production,
- *β1* and *β2* are the regression coefficients showing the influence of each independent variable on per capita income, and
- *c* is the constant.

- For unemployment (Z):

$$Z = \alpha + \beta 1X1$$

Where:

- *Z* represents the unemployment rate,
- *X1* represents the palm oil plantation area,
- *α* is the constant, and
- *β1* is the regression coefficient for the plantation area on unemployment.

1. F-Hypothesis Test

The F-test is used to examine whether the independent variables simultaneously have a significant effect on the dependent variable. This test aims to determine whether the regression model is appropriate and relevant for predicting the dependent variable.

2. t-Hypothesis Test

The t-test is performed to examine the influence of each independent variable individually on the dependent variable. This test seeks to determine whether the palm oil plantation area and palm oil production significantly affect per capita income and unemployment, individually.

3. Determination Test (R^2)

The determination test (R^2) is used to measure the extent to which the independent variables explain the variability of the dependent variable. The R^2 value indicates the percentage of influence the independent variables have on the dependent variable. A higher R^2 value suggests a greater influence of the independent variables in explaining the dependent variable.

The analysis is conducted using statistical software to compute the regression equation, perform the F-test, t-test, and determination test. Therefore, this study provides a comprehensive overview of the impact of palm oil plantation area and production on per capita income and unemployment rates in Kalimantan.

RESULTS AND DISCUSSION

Results

Table 1. Results of Data Processing for Per Capita Income

Dependent Variable: Y
Method: Least Squares
Date: 06/16/24 Time: 10:56
Sample: 1 88
Included observations: 70

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-9043427.	12661236	-0.714261	0.4775
X1	205.5171	40.26145	5.104562	0.0000
X2	-39.86612	9.796884	-4.069265	0.0001

R^2	0.335229	Mean dependent var	56762625
Adjusted R^2	0.315385	S.D. dependent var	57312910
S.E. of regression	47421546	Akaike info criterion	38.22896
Sum squared resid	1.51E+17	Schwarz criterion	38.32533
Log likelihood	-1335.014	Hannan-Quinn critter.	38.26724
F-statistic	16.89328	Durbin-Watson stat	0.163437
Prob (F-statistic)	0.000001		

Table 2. Results of Data Processing for Unemployment

Dependent Variable: Z
Method: Least Squares
Date: 06/16/24 Time: 11:01
Sample (adjusted): 5 88
Included observations: 65 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10365.91	15209.01	0.681564	0.4980
Y	5.32E-06	0.000184	0.028965	0.9770

R^2	0.000013	Mean dependent var	10677.39
Adjusted R^2	-0.015859	S.D. dependent var	86029.50

S.E. of regression	86709.01	Akaike info criterion	25.60879
Sum squared resid	4.74E+11	Schwarz criterion	25.67569
Log likelihood	-830.2856	Hannan-Quinn critter.	25.63519
F-statistic	0.000839	Durbin-Watson stat	1.047690
Prob(F-statistic)	0.976984		

1. Regression Equation

Based on the results of the data processing shown in Table 1 and Table 2, the following regression equations were obtained:

- The regression equation for per capita income is as follows:

$$\mathrm{Y} = -9.043.427 + 205.5171\mathrm{X1} - 39.86612\mathrm{X2}$$

- The regression equation for unemployment is as follows:

$$\mathrm{Z}=10.365{,}91+5{,}32\mathrm{X1}$$

2. F-Hypothesis Test

From the results of the data processing in Table 1 and Table 2, the F-statistic test results for per capita income show a Prob (F-statistic) value of 0,000001, indicating that the area of palm oil plantations and palm oil production jointly have a significant effect on per capita income in Kalimantan. In contrast, the F-statistic test result for unemployment shows a Prob (F-statistic) value of 0,976984, which is greater than 0,05. This implies that per capita income does not have a significant effect on unemployment in Kalimantan.

3. t-Hypothesis Test

Based on the results of the data processing in Table 1 and Table 2, the following key findings were obtained:

1. The area of palm oil plantations (X1) has a probability value of 0,0000, indicating that the plantation area significantly influences per capita income in Kalimantan.
2. Palm oil production (X2) has a probability value of 0,0001, demonstrating that palm oil production significantly affects per capita income (Y) in Kalimantan.
3. Per capita income has a probability value of 0,9770, showing that per capita income does not significantly influence unemployment in Kalimantan.

4. Coefficient of Determination (R^2)

The coefficient of determination (R^2) for per capita income is 0,335229, meaning that X1 and X2 contribute 33,5% to the variation in per capita income, while the remaining 66,5% is influenced by other factors. Meanwhile, the coefficient of determination (R^2) for unemployment is 0,000013, indicating that per capita income contributes very little, almost negligible, to unemployment.

Discussion

The regression equation for per capita income $Y = -9.043.427 + 205{,}5171X1 - 39{,}86612X2$ implies that:

1. If X1 (area) and X2 (production), or changes in X1 and X2, are equal to zero, the per capita income is -9.043.427 rupiah.
2. If X1 increases or decreases by 1-unit, per capita income increases or decreases by 205,5171 units.
3. If X2 increases or decreases by 1-unit, per capita income decreases or increases by 39,86612 units.

The regression equation for unemployment $Z = 10.365{,}91 + 5{,}32X1$ implies that:

1. If economic growth is zero, or changes in economic growth are zero, unemployment equals 10.365,91 people.
2. If economic growth increases or decreases by 1 unit, unemployment increases or decreases by 5,32 units.

F-Hypothesis Test

The F-statistic test result for per capita income shows a Prob (F-statistic) value of 0,000001, which is less than 0,05. This indicates that the area and production of palm oil plantations together significantly influence per capita income in Kalimantan. Meanwhile, the F-statistic test result for unemployment is 0,976984, which is greater than 0,05, indicating that per capita income does not influence unemployment in Kalimantan.

t-Hypothesis Test

The area of palm oil plantations (X1) has a probability value of 0,0000, meaning that the plantation area significantly influences per capita income in Kalimantan. Similarly, palm oil production (X2) has a probability value of 0,0001, which indicates that palm oil production significantly affects per capita income (Y) in Kalimantan. However, per capita income has a probability value of 0,9770, showing that per capita income does not significantly influence unemployment.

Coefficient of Determination (R^2)

The R^2 for per capita income is 0,335229, meaning that X1 and X2 contribute 33,5% to the variation in per capita income, while the remaining 66,5% is influenced by other factors. The R^2 for unemployment is 0,000013, indicating that the contribution of per capita income to unemployment is negligible.

The results of the analysis show that the expansion of oil palm plantations in Kalimantan has a significant impact on per capita income, but its effect on the unemployment rate is uneven. Through multiple regression analysis, it was found that plantation land area (X1) contributed positively to the increase in per capita income (Y), with a coefficient of 205.5171. This means that every one unit increase in the area of oil palm plantation can increase per capita income by 205.5171 rupiah. Conversely, oil palm production (X2) has a negative influence on per capita income, with a coefficient of -39.86612, which indicates that an increase in production can reduce per capita income if not managed properly.

The strong correlation between plantation expansion and per capita income reflects that the growth of this sector is able to create jobs and improve infrastructure in rural areas. However, the analysis also shows that although the sector creates employment, the adoption of modern technology in the production process leads to a reduced demand for manual labor. The F-test results show that plantation land area and production together have a significant effect on per capita income, while their effect on unemployment is not significant. With a low coefficient of determination (R^2) of 0.000013, the study concludes that factors other than per capita income play a bigger role in determining the unemployment rate in Kalimantan. These findings highlight the need for more targeted policies to ensure that the economic benefits of oil palm plantations can be equally felt by all levels of society, while maintaining social and environmental sustainability**.**

CONCLUSION

This study underscores the substantial potential of palm oil plantations in Kalimantan to enhance per capita income, primarily through the creation of both direct and indirect employment opportunities within the plantation sector. The expansion of plantation areas and increased palm oil production contribute significantly to improving the local population's per capita income. However, the benefits are not uniformly experienced across all socio-economic dimensions, highlighting disparities in the

distribution of these gains. While palm oil plantations generate employment, the introduction of modern technology in some areas has led to a reduced demand for manual labour, resulting in increased structural unemployment. This finding indicates that despite the expansion of plantation areas, mechanisation and automation processes can exacerbate unemployment by reducing reliance on physical labour. The study also identifies that external factors, including labour market dynamics, wealth distribution, and economic policies, play critical roles in shaping these outcomes. The low coefficient of determination suggests that various other factors, beyond the scope of this study, influence unemployment levels in the region. From an environmental perspective, the expansion of palm oil plantations has led to considerable negative consequences, such as deforestation and habitat destruction, which threaten local biodiversity. Therefore, it is essential that prudent management and environmental sustainability are prioritised to mitigate these adverse effects and maintain ecological balance in Kalimantan. Such an approach is necessary to reconcile economic development with the preservation of vital ecological systems. In conclusion, while the palm oil plantation industry offers significant economic advantages, it is crucial to consider its long-term implications for both the workforce and the environment. A more comprehensive approach to managing this sector is essential, one that integrates environmental sustainability, worker welfare, and economic policies aimed at fostering more equitable wealth distribution. By addressing these interconnected issues, stakeholders can ensure that the benefits of palm oil plantations are maximised while minimising their negative impacts.

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