

Determinants of Oil Palm Production among FELDA Smallholders: Evidence from FELDA Tun Ghafar Kemendor, Melaka, Malaysia

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DOI Link: <http://dx.doi.org/10.6007/IJARBS/v16-i10/28871>

Published Date: 19 October 2026

Abstract

Oil palm cultivation is a major contributor to Malaysia's agricultural economy and an important source of income for FELDA settlers. However, productivity levels among smallholders vary considerably, highlighting the need to identify the factors influencing production performance. This study examines the determinants of oil palm productivity among FELDA settlers and also identifies the most influential factor affecting the oil palm production in FELDA Tun Ghafar Kemendor, Melaka, Malaysia. A quantitative research design was employed, involving 100 active settlers selected from a population of 134 households. Data were collected through structured face-to-face interviews using a questionnaire. The data were analyzed using descriptive statistics, Spearman's rho correlation, and multiple linear regression in IBM SPSS Statistics. The findings revealed that labour availability, fertilizer and input costs, and government support and extension services were positively and significantly associated with oil palm productivity. Among these factors, government support and extension services emerged as the strongest predictor of production performance, emphasizing the importance of institutional support in enhancing smallholder productivity. In contrast, land area did not have a statistically significant effect on productivity after controlling for other variables. This study concludes that strengthening extension services and institutional support is crucial for improving oil palm productivity among FELDA smallholders. Enhancing access to agricultural inputs and addressing labour constraints are also important for increasing production performance. These findings provide valuable insights for policymakers and plantation stakeholders in developing targeted strategies to improve productivity and promote sustainable oil palm production among smallholders in Malaysia.

Keywords: Oil Palm Productivity, Factors of Production, Felda Smallholders, Extension Services, Labour Availability, Agricultural Inputs, Malaysia.

Introduction

Oil palm (*Elaeis guineensis* Jacq.) is a vegetable oil crop with the highest yield and has a significant contribution in Malaysian agricultural industry (Parveez *et al*, 2025). In spite of the good performance of the oil palm industry, oil palm smallholders usually have low yields of fresh fruit bunch (FFB) than large commercial estates, which is a cause of concern regarding future productivity and competitiveness (MPOB, 2024).

Federal Land Development Authority (FELDA) has been formed to change the social and economic condition of the poverty-stricken rural community, which was established on 1st July, 1957. FELDA settlements are a significant feature of Malaysian smallholder environment, but most of the long-established schemes remain trapped by production bottlenecks, which are associated with labor shortages, increased input prices, small landholdings, and inconsistent performance of extension services (Hassan, 2020).

Even though the earlier research has investigated the determinants of the oil palm productivity, there is still paucity of localized research on the specific FELDA settlements. As such, this paper explores the variables that influence oil palm production in FELDA Tun Ghafar Kemendor in Melaka, Malaysia and to determine the strongest predictor of the productivity of smallholders.

Research Methodology

The research design was a quantitative research design that was used in this study to determine the determinants of oil palm production among FELDA settlers. A total of 134 settlers were targeted as smallholders who were active and 100 of them were chosen through convenience sampling on the basis of their access and desire to respond (Creswell and Cresswell, 2017). Primary data were gathered using structured questionnaires that were administered using face-to-face interviews as a way of enhancing accuracy of the responses. The four independent variables considered in the research were the land area, availability of labor, fertilizer use and the cost of inputs, and government assistance and extension services with the oil palm production being the dependent variable. IBM SPSS was used to analyze the data. At first, reliability analysis for the pilot study was done to confirm the validity of the questionnaires. Then, descriptive statistics were used to outline respondent characteristics whereas the rho correlation using Spearman was used to determine association between variables. This was then followed by the application of multiple linear regression to show how each factor impacts on production relative to the other and also which is the best predictor of production (Hair *et al*, 2010).

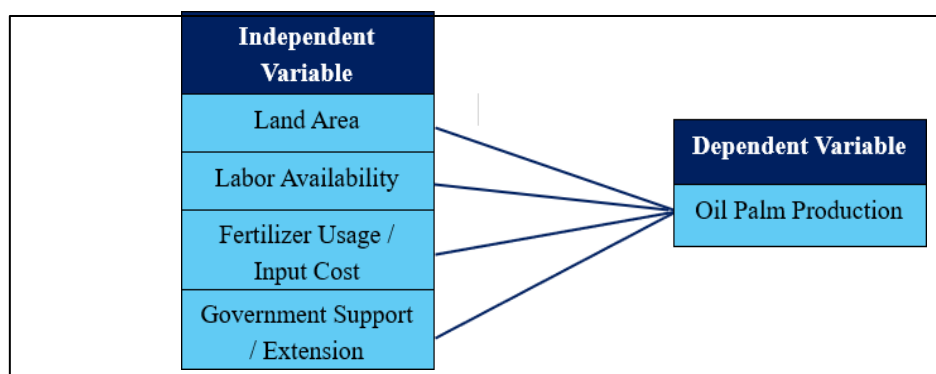


Figure 1 Conceptual Framework of The Study

Figure 1 outlines the study's conceptual framework, which evaluates the impact of key production inputs on overall oil palm yield through the lens of agricultural production economic theory. Grounded in classic production models, the framework posits that overall output is driven by physical land assets, labor allocation, agronomic inputs, and institutional extension support. Cultivated land area serves as the fundamental physical input in crop production economics, where expanding harvestable acreage directly enhances total volumetric yield capacity under constant returns to scale. Furthermore, because oil palm management remains heavily labour-intensive, adequate labor availability is critical for maintaining timely harvesting cycles, proper pruning, and fresh fruit bunch recovery to prevent yield loss. Beyond physical inputs, optimal fertilizer usage / input costs reflect the agronomic and financial commitment required to sustain soil fertility, optimize bunch weight, and maximize per-hectare yield performance. Finally, institutional intervention through government support / extension services bridges technical knowledge gaps by facilitating access to subsidies, capacity building, and Good Agricultural Practices (GAP).

Results and Discussions

Reliability Analysis

Table 1

Results of Reliability Tes

Reliability Statistics	
Cronbach's Alpha	N of Items
0.949	41

From the results of the reliability test, the Cronbach's Alpha value obtained was 0.949 for the 41 items. This value indicates a very high level of internal consistency and reliability among the items, as the value exceeds the commonly accepted threshold of 0.70. Therefore, the questionnaire demonstrates excellent reliability and is considered suitable for further analysis in this study.

Spearman Rho's Correlation Analysis

Table 2

Spearman's Rho Correlation between Independent Variables and Oil Palm Production

Variable	Correlation Coefficient (r)	Significance (p-value)	Strength of Relationship
Land Area with Oil Palm Production	0.808	< 0.001	Strong
Labour Availability with Oil Palm Production	0.853	< 0.001	Strong
Fertilizer Usage and Input Cost with Oil Palm Production	0.835	< 0.001	Strong
Government Support and Extension Services with Oil Palm Production	0.868	< 0.001	Strong

The findings indicated that the all the variables studied, including land area, availability of labor, use of fertilizer and input cost, and the government support/ extension services had a strong relationship with the oil palm production. Table 2 presents the Spearman's rho correlation analysis evaluating the non-parametric relationships between the four independent variables and oil palm production. All four predictors exhibit statistically significant, strong positive correlations with oil palm yield (p value < 0.001). Government support and extension services demonstrate the strongest correlation ($r = 0.868$, p value < 0.001), emphasizing the pivotal role of policy backing, technical assistance, and advisory programs in optimizing smallholder and plantation productivity. This is closely followed by labor availability ($r = 0.853$, p value < 0.001), confirming that sufficient manual workforce is critical for timely harvesting cycles and minimizing fresh fruit bunch (FFB) deterioration. Similarly, fertilizer usage and input cost showed a strong positive relationship with production ($r = 0.835$, p value < 0.001), reinforcing the necessity of sustained soil fertility management and agronomic investments for maximum vegetative growth and fruit development. Enough labor is needed to provide a timely harvesting and to ensure the quality of yield, whereas enough fertilizers will help provide a maximum palm growth and fruit development (Wahid *et al*, 2009). Finally, land area displays a strong positive association ($r = 0.808$, p < 0.001), indicating that physical acreage extension reliably scales volumetric output. Overall, these results confirm that institutional support, human capital, agronomic inputs, and spatial assets synchronously drive yield enhancement in oil palm operations.

Multiple Linear Regression Analysis

Table 3

Summary of Multiple Linear Regression Results

Independent Variable	Standardized Beta (β)	p-value	Significance
Land Area	-0.021	0.829	Not Significant
Labour Availability	0.193	0.047	Significant
Fertilizer Usage and Input Cost	0.314	0.003	Significant
Government Support and Extension Services	0.487	< 0.001	Highly Significant
**Dependent variables: Oil Palm Production			

The empirical findings from the multiple linear regression analysis provide key insights into the drivers of oil palm production. Among the four evaluated predictors, government support and extension services emerged as the most dominant factor, followed by fertilizer usage and

input costs, and labor availability. Conversely, land area demonstrated no statistically significant impact on production within this sample.

Government Support and Extension Services: Government support and extension services exhibited the strongest positive influence on oil palm production ($\beta = 0.487$, $p < 0.001$). This highly significant finding highlights the pivotal role of institutional interventions such as technical training, subsidies, and advisory services in optimizing farm-level productivity. Access to modern agricultural knowledge and resource assistance enables smallholders and estate managers to adopt best management practices, directly boosting yield performance.

Fertilizer Usage and Input Cost: Fertilizer usage and input costs showed a moderate, statistically significant positive effect ($\beta = 0.314$, $p = 0.003$). Oil palm is a nutrient-intensive crop that requires consistent fertilization for optimal fresh fruit bunch (FFB) development. Higher investment in quality inputs and proper soil nutrition correlates directly with improved crop yield, reinforcing the economic reality that resource allocation toward essential inputs remains a critical driver of output.

Labour Availability: Labour availability exerted a positive and statistically significant impact on production ($\beta = 0.193$, $p = 0.047$). Given that harvesting, pruning, and field collection in oil palm cultivation remain highly labour-intensive and minimally automated, adequate workforce availability ensures timely operations, minimizing fruit loss due to over-ripening or delayed harvesting.

Land Area: Interestingly, land area showed a negligible negative coefficient that was not statistically significant ($\beta = -0.021$, $p = 0.829$). This implies that simply increasing acreage does not guarantee higher yield efficiency without proportional inputs and proper management. In modern palm oil production, yield intensification (increasing productivity per hectare) plays a far more decisive role than spatial expansion (extensification).

Multiple Linear Regression Equation

$$Y = 0.487 X_1 + 0.314 X_2 + 0.193 X_3 - 0.021 X_4$$

Where:

- Y = Oil Palm Production (Dependent Variable)
- X_1 = Government Support and Extension Services ($\beta = 0.487$, $p < 0.001$)
- X_2 = Fertilizer Usage and Input Cost ($\beta = 0.314$, $p = 0.003$)
- X_3 = Labour Availability ($\beta = 0.193$, $p = 0.047$)
- X_4 = Land Area ($\beta = -0.021$, $p = 0.829$, *not statistically significant*)

The empirical findings from the multiple linear regression analysis provide key insights into the operational and institutional drivers of oil palm production (Y). The standardized multiple linear regression model derived from the analysis is expressed as above. Where X_1 represents Government Support and Extension Services, X_2 represents Fertilizer Usage and Input Cost, X_3 represents Labour Availability, and X_4 represents Land Area. Among these four factors, institutional assistance emerged as the primary determinant of production, followed by direct agronomic inputs and labor availability, whereas land area demonstrated no statistically significant direct impact.

Institutional Support as the Primary Yield Driver: Government support and extension services, X_1 exerted the strongest positive influence on production ($\beta = 0.487$, $p < 0.001$). Controlling for other variables, a one-standard-deviation increase in institutional support yields a 0.487 standard deviation increase in oil palm output. This finding underscores that technical capacity building, agricultural extension contact, and advisory services are critical for closing productivity gaps. Access to institutional advisory networks facilitates knowledge transfer regarding optimal harvesting intervals, pest control, and proper agronomic management, directly translating into higher technical efficiency and crop performance. Modern agricultural economic literature consistently emphasizes that human capital development and access to technical information often outweigh physical resource accumulation in driving smallholder performance (Gultom *et al*, 2021).

Agronomic Inputs and Labor Dynamics: Fertilizer usage and input costs, X_2 represented the second most influential driver in the model ($\beta = 0.314$, $p = 0.003$). Oil palm (*Elaeis guineensis*) is a highly nutrient-demanding perennial crop; macro-nutrients such as Nitrogen, Phosphorus, and Potassium (N, P, K) are vital for continuous fresh fruit bunch (FFB) synthesis and canopy health. Investment in essential inputs yields direct, positive returns in terms of output volume, reinforcing empirical findings that financial allocation toward high-quality fertilizers and crop maintenance remains an indispensable prerequisite for achieving potential yields (Rahman *et al*, 2022).

Labour availability, X_3 also demonstrated a positive, statistically significant effect ($\beta = 0.193$, $p = 0.047$). Because field operations such as harvesting ripe FFB, frond pruning, and crop collection remain heavily manual and minimally automated, workforce availability directly prevents crop loss caused by delayed harvests or over-ripe fruit degradation (Utama *et al*, 2021).

Shift from Land Expansion to Yield Intensification: In contrast to classical land-dependent growth models, land area, X_4 exhibited a negligible and statistically non-significant coefficient ($\beta = -0.021$, $p = 0.829$). This implies that simply expanding total acreage without corresponding allocations of managerial guidance, X_1 and material inputs, X_2 yields diminishing marginal returns. Rather than spatial expansion (extensification), modern sustainable oil palm production relies primarily on yield intensification, maximizing output per hectare through superior management practices and optimized resource deployment.

Conclusions and Recommendations

The findings demonstrate that while labor availability, fertilizer application, and government support are critical drivers of oil palm productivity at FELDA Tun Ghafar Kemendor, Melaka, Malaysia, extension services serve as the primary catalyst for yield optimization. To bridge existing yield gaps and achieve long-term self-sufficiency across Malaysian smallholder systems, strategic interventions must prioritize the expansion of agricultural advisory and training programs alongside targeted strategies for input access and labor stabilization. Furthermore, expanding future analytical frameworks to incorporate technological adoption and climatic variability will offer a more holistic understanding of production fluctuations, enabling better policy formulation without the need for additional proxy variables.

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