

# EXPLORING FARMERS' DECISION IN UTILIZING CERTIFIED PALM OIL SEEDS IN RIAU PROVINCE

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## EXPLORING FARMERS' DECISION IN UTILIZING CERTIFIED PALM OIL SEEDS IN RIAU PROVINCE

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**Abstract:** Riau Province is the largest center for smallholder palm oil plantations in Indonesia. The productivity of smallholder palm oil plantations is relatively lower compared to private and state plantations due to the low use of certified seeds. This study aims to describe characteristics of smallholder oil palm businesses and analyze the decisions of smallholders in Riau Province regarding the use of certified oil palm seeds. This research utilized logistic regression analysis. The data used in this study were from the 2014 plantation business household survey conducted by BPS. The number of respondents was 1146 households. The results showed that the variable number of family members significantly negatively affected farmers' decisions to use certified oil seeds. On the other hand, the variables of age, education, capital, farmer groups, and partnership patterns positively influenced farmers' decisions to use certified oil seeds. Meanwhile, the variables of land area, type of land, assistance, and agricultural extension did not affect farmers' decisions to use certified palm oil seeds. Therefore, the decision of smallholders to use certified oil palm seeds is influenced by the number of dependents, age, education, capital, membership of farmer groups, and partnership patterns.

**Keywords:** certificated seed, farmer decision, logistic regression, palm oil, smallholder

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**Abstrak:** Provinsi Riau merupakan sentra perkebunan kelapa sawit rakyat terbesar di Indonesia. Produktivitas perkebunan kelapa sawit rakyat relatif lebih rendah dibandingkan dengan perkebunan milik swasta dan negara karena rendahnya penggunaan bibit bersertifikat. Penelitian ini bertujuan untuk mendeskripsikan karakteristik usaha sawit rakyat dan menganalisis keputusan petani sawit di Provinsi Riau dalam menggunakan bibit sawit bersertifikat. Penelitian ini menggunakan analisis model regresi logistik. Data yang digunakan adalah data survey rumah tangga usaha perkebunan tahun 2014 dari BPS. Jumlah responden sebanyak 1146 rumah tangga perkebunan. Hasil penelitian menunjukkan bahwa variabel jumlah anggota keluarga berpengaruh nyata negatif terhadap keputusan petani menggunakan bibit sawit bersertifikat. Variabel umur, pendidikan, modal, kelompok tani dan pola kemitraan berpengaruh nyata positif terhadap keputusan petani menggunakan bibit sawit bersertifikat. Sedangkan variabel luas lahan, jenis lahan, pendampingan, dan penyuluhan pertanian tidak mempengaruhi keputusan petani dalam menggunakan bibit sawit bersertifikat. Oleh karena itu, keputusan petani rakyat dalam menggunakan bibit sawit bersertifikat dipengaruhi oleh jumlah tanggungan keluarga, umur, pendidikan, modal, keanggotaan kelompok tani dan pola kemitraan.

**Kata kunci:** bibit bersertifikat, kelapa sawit, keputusan petani, petani gurem, regresi logistik

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## INTRODUCTION

7 Palm oil has an important role in the economy of Indonesia. It has increased national income in foreign exchange, encouraged agroindustry development in palm oil derivative products, provided employment, and helped 9 lift people out of poverty. Palm oil is an estate crop that has experienced quite rapid production growth compared to other plantation crops in Indonesia. Indonesia's palm oil production increased from 5.93 million tons in 1998 to 47.12 million tons in 2019, 25 with an average growth of 11.13% annually. However, Indonesia 25 in palm oil's average productivity level is only 16.99 tons per hectare per year in fresh fruit bunches (Direktorat Jenderal Perkebunan, 2020).

More than 14.92 million tons of palm 45 oil are produced by smallholder farmers who own more than 40.79% of the total national palm oil plantation. Smallholder palm oil plantations still need to reach their best potential because their productivity is the lowest compared to large plantations, both state and private plantations (Varina et al. 2020). Riau Province is the 14 largest center of smallholder plantations in Indonesia, with an area of 1.4 million hectares (30.95% of 36 area of national smallholder palm oil plantations) with a total production of 4.2 million tons and a total of 572,737 farmers (24.71%). The average production of smallholder plantations in Riau Province is around 11 tonnes of fresh fruit bunches (FFB) per hectare per year (BPS, 2017), lower than the average private and state-owned plantations, which reached 25-30 tonnes of FFB per hectare per year. Suboptimal allocation of input use and different cultivation techniques among farmers causes low productivity of palm oil farmers (Varina et al. 2020).

33 Many factors cause the low productivity of smallholder plantations, due to the low use of quality seeds, lack of farmers' knowledge of palm oil's technical culture, weak institutional farmers, and limited capital. 10 Smallholder yields, however, are 50% lower than large-scale commercial enterprises. Lack of knowledge of best management practices and limited access to high-quality agricultural inputs are the most significant barriers commonly identified in small-scale farming practices (Saleh et al. 2018). The government has made various efforts to increase palm oil production, including implementing plantation revitalization programs, quality seeds, and various plantation extension programs. The government has also issued

19 Minister of Agriculture Regulation No. 131 Permentan/OT.140/12/2013 concerning good palm oil cultivation guidelines to increase production, productivity, and quality of palm oil yields. Many palm oil farmers do not manage their crops optimally and thus often fail to realize the genetic potential of plants that should be achieved, resulting in gaps between potential and actual yields.

Theoretically, there are three sources of productivity growth (Coelli et al. 1998), called the application of technology, increased technical efficiency, and increased economies of scale. Increasing productivity in palm oil commodities can be done in two ways: increasing technology adoption and using available resources more efficiently. Technology is part of agricultural development to increase farmer productivity and income because technology determines the production process. Technology is one of the absolute conditions for agricultural development (Nicholson, 2012; Dumasari, 2020). One of the determining factors for crop production is a seed. According to Jacquemard et al. (2007), the most important factor affecting palm oil productivity is the 34 quality of palm oil seeds. Although other production factors such as fertilizer, water, sufficient light and climate support, low-quality seeds will still produce low yields.

On the other hand, the higher the quality of the seeds used, the higher the production will be (Pinem & Safrida, 2018). Certified seeds and a good quality control system can guarantee the authenticity of varieties and genetic purity to increase production, productivity, and quality of competitive agricultural products, increasing farmers' 12 income and welfare. According to Papenfus (2005), one of the causes for the low productivity of smallholder's palms is the use of uncertified seeds, and others need to be appropriately spacing, insufficient fertilizers, and mismanagement practices.

The return on farmers' investment using certified seeds is faster than farmers using non-certified seeds (Kariyasa, 2015). Superior palm seeds enormously contribute to increasing palm oil productivity, reaching 58.8% of the total increase in productivity (Ardana & Kariyasa, 2016). Many farmers use uncertified/fake/random seeds, which is one reason for the low productivity of palm oil in Indonesia (Sugiarto & Raisawati, 2021; Sayaka et al. 2006). Many farmers still do not use certified seeds even though the use of these seeds results in relatively higher productivity, which is

an exciting matter for further research. What factors influence the farmer's decision to use seeds? Some of the factors that cause many farmers to use random seeds are (i) inadequate availability of superior seeds at the farmer level, (ii) low understanding of the use of superior seeds, (iii) farmers' lack of access to superior seeds, (iv) relatively high price of superior seeds, (v) relatively easy and cheap distribution of seeds. According to Liwang et al. (2011), the availability of certified high-quality palm seeds is largely determined by several factors, such as; the number of superior palm oil seeds produced, not standardized cultivation techniques applied, limited capital and management knowledge, lack of insight/experience of farmers and lack of awareness of the importance of crop quality and productivity. Since 2009, the availability of certified superior palm seeds has exceeded the demand for palm oil seeds. However, ironically there are still illegal sales transactions of low-quality palm oil seeds.

Most palm oil farmers in Riau Province still use non-certified palm oil seedlings, which also affects the low productivity of smallholder palm oil plantations in Riau Province. In Riau, most farmers (84.21%) do not use certified seed and only 15.79% use certified seed. Many farmers still need to start using certified oil palm seeds even though the availability of certified oil palm seeds is relatively high, which raises the question of how farmers decide to use oil palm seeds. What might influence a farmer's decision to use certified seeds?

Research on farmers' decisions to use palm oil seeds has been carried out by other researchers, such as Utoyo & Yolandika (2018), using logistic regression. The variables used were education, age, farming experience, land area, seed price, external influences, perception, resistance of seedlings to pests and plant diseases, and seed access. Nasution's research (2021) used the conjoint analysis method with six attributes: seed type, size, seed price, promotion, ease of access, and land type, to see farmers' preferences in buying certified seed in Batu Bara Regency. Pinem et al. (2022) used multiple linear regression analysis with the independent variables of education, influence of other parties, length of farming, land area, seed price, seed access, quality, and perception. Damanik & Simanjuntak (2022) used Fishbein's Multi-attribute analysis to determine which attributes farmers consider most important in selecting palm oil seeds. The attributes used are selling price, brand, production potential,

resistance to pests and diseases, promotion, and seed quality. This study used a quantitative approach; the relationship between variables was analyzed using a logistic regression model. The novelty of this study is the analysis of farmers' decisions not only seen from the probability of the influence of age, farmer's education, and land factors. However, it is also seen from the capital, peat, and non-peat soil types, whether there is government assistance, extension services, farmer groups, and partnership patterns. In addition, this study uses census data from BPS, which is more representative and complete so that it can more clearly describe the condition of smallholder oil palm farmers in Riau in real terms.

The use of certified oil palm seeds will increase productivity. Therefore, there is an intensification in the palm oil production process to reduce extensification, reduce deforestation. The existence of smallholder oil palm farmers still using uncertified oil palm seeds is interesting to study. Based on the background of the problem that there are still farmers who use uncertified oil palm seeds, this study aims to analyze farmers' decisions in Riau Province to use certified oil palm seeds. What influences smallholders' decisions to use certified oil palm seeds?

## METHODS

The location of this study is in Riau Province. This study uses secondary data derived from the 2014 plantation business household survey, which was conducted by Central Statistics Agency (BPS). Census data is more representative of the condition of smallholder oil palm farmers. The last census data conducted by BPS was in 2014; the latest census data has yet to be available. Data regarding the use of certified oil palm seeds by smallholders is still sufficient to represent the current condition of oil palm smallholders. Counterfeit oil palm seeds are more widely circulated because farmers can quickly obtain them, and the prices are lower (BPDKS, 2018). The Palm Oil Research Center (PPKS) survey stated that the reason farmers bought counterfeit seeds was that 37% were deceived, 14% were cheap, 20% did not know how to buy, 12% had complicated requirements for buying legal seeds, 10% of farmers do not know where to buy official seeds, and 4% are far away from the location of the producer's office and do not understand the advantages of certified legal

seeds. The number of respondents was 1146 plantation households. The data used in the analysis were palm oil plant data in the TM phase (yielding plants) for the plant age group: 3–8 years.

This study analyzes logistic regression models to determine the factors influencing farmers' decision-making using the certificated seed. Theoretically, the logit function model is formulated as follows:

$$\ln (P_i / (1 - P_i)) = \alpha + \beta_i X_i + \varepsilon$$

Where:  $P_i$  opportunity for farmers' decision to use certificated seeds ( $P_i = 1$ , if farmers use certificated seeds and  $P_i = 0$  if farmers do not use certificated seeds);  $X_i$  independent variable vector ( $i = 1, 2, 3 \dots n$ );  $\alpha$ ,  $\beta$ ,  $\varepsilon$  intercept, regression coefficient, random error

In logit regression does not assume the relationship between dependent and independent variables linearly, but includes factors that are thought to influence decisions in logistical relationships, built the following test model:

$$\ln (P / (1 - P)) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 D_1 + \beta_7 D_2 + \beta_8 D_3 + \beta_9 D_4 + \beta_{10} D_5 + \varepsilon$$

Where:  $\ln (P / (1 - P))$  opportunity for farmers' decision to use certificated seeds ( $P_i = 1$ , if farmers use certificated seeds and  $P_i = 0$  if farmers do not use certificated seeds);  $X_1$  number of family members (people);  $X_2$  age (years);  $X_3$  education (years);  $X_4$  area (ha);  $X_5$  capital (IDR);  $D_1$  dummy of types soil (1= peatlands, 0= non-peatlands);  $D_2$  dummy of aids (1= available, 0= not available);  $D_3$  dummy of extension services (1= available, 0= not available);  $D_4$  dummy of farmer group (1= available, 0= not available);  $D_5$  dummy of partnership pattern (1= partnership, 0= self-subsistent);  $\alpha$  intercept;  $\beta$  the regression coefficient  $i$  ( $i = 1, 2, 3 \dots 10$ );  $\varepsilon$  random error. In this equation the expected parameter values are positive ( $\beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10} > 0$ ) and negative ( $\beta_1 < 0$ )

Palm oil is a plantation crop that has experienced relatively rapid production growth compared to other plantation crops in Indonesia. More than 41% of palm oil plantations in Indonesia are smallholder plantations. The average production of smallholder plantations is

lower than that of private and state-owned plantations. Many factors, including the low use of superior seeds, cause the low productivity of smallholder palm oil plantations. Seed quality is one of the most critical factors affecting palm oil productivity. Farmers have a huge role in selecting seeds that will be used for farming. The decision-making by farmers in choosing seeds is crucial because it determines productivity. Farmers' decision-making in choosing seeds is influenced by several factors (Utoyo & Yolandika, 2018; Nasution & Tarigan, 2020; Pinem et al. 2022; Damanik & Simanjuntak, 2022).

The factors used in this study are the number of family members, age, education, area, capital, dummy of types soil, dummy of aids, dummy of extension services, dummy of farmer group, and dummy of partnership pattern. The number of family members will add to the farmer's economic burden. This case affects the size of the budget allocation that can be used to manage smallholder palm oil plantations. The farmer's age is considered sufficient to represent the maturity and experience of the farmer in carrying out his farming business. Farmer education also influences the ability of farmers to respond quickly and adopt technological improvements. Land area is a factor that influences farmers' decisions to use certified seeds. The ability of farmers' capital is considered to influence the decision to use seeds. The price of certified seeds, which is relatively more expensive than non-certified seeds, certainly requires a relatively higher cost. As a result, the greater the farmer's capital, the greater the opportunity to use certified seeds. Soil types in the form of peat and non-peat soils are called to have an influence on farmers' decisions in choosing palm oil seeds due to differences in fertility.

Moreover, the assistance obtained by farmers is thought to influence farmers' decision to use seeds. Likewise, counseling given to farmers will increase farmer's understanding of the importance of certified seeds. In addition, farmer group institutions will also contribute to the farmer's decisions making since the existence of farmer groups will accelerate technological transformation. Furthermore, the partnership pattern is also believed to predispose farmers' decisions. Partner farmers will prefer certified seeds compared to independent farmers.

## RESULTS

### 8 Overview of The Development of Palm Oil Plantations in Riau

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Riau Province has the largest palm oil plantation in Indonesia. The area of palm oil plantations in Riau in 2022 reached 3.49 million hectares, or 20.74% of the palm oil area in Indonesia (Table 1). Most (87.6 percent) of palm oil plantations in Riau were in the TM (Productive Plant) condition, with a productivity of about 8.9 million tons (3.75 tons/hectare). The TM area of Riau Province is dominated by community gardens (P.R.). The TM area of Riau Province is dominated by smallholder plantations (P.R.), large State Plantations (PBN), and Private Large Plantations (PBS). T.M. for smallholder plantations (P.R.) Riau in 2022 is estimated at 1.40 million hectares (productivity 3.19 tons/hectare), while PBN and PBS are 71.03 million hectares (productivity 5.6 tons/hectare) and 917.14 million hectares (4.47 tons/hectare), respectively. (Direktorat Jenderal Perkebunan, 2023).

### Respondent Characteristics

#### 1. Respondent Age

The age dimension reflects the maturity level of a person's thinking and the level of rational consideration of a person. Younger farmers are usually more aggressive in making decisions and are more willing to accept innovations and take risks. Generally, older farmers tend to be very conservative and less responsive to changes in technological innovation. The age of smallholder palm oil farmers in Riau ranges from 18–98 years. In general, the average age of farmers is around 44 years (Table 2). The average age of farmers using certified seed with non-certified seed is the same, namely 44 years; however, the age range of certified seed farmers is relatively younger than that of non-certified seed farmers.

#### 2. Level of education

The level of education is the formal education level of the farmers. The average level of education of farmers using certified seeds in Riau Province is relatively higher than that of farmers using non-certified seeds. Based on Table 3, 80% of farmers who do not use

certified seeds have an elementary school education, 17% have a junior high school education level, and only 2.5% have a high school education. Meanwhile, farmers with certified seeds had an elementary education level of 70.7%, junior high school of 25.4%, high school of 3.3%, and 0.6% of farmers with a higher education level. Several studies have established a positive relationship between education and farmers' ability to perceive climate change and the likelihood of adopting strategies (Jha & Gupta, 2021).

### 5 3. Number of Family Members

The number of family members reflects the burden a family must bear. The more family members, the heavier the householder's burden to finance the household. However, many family members are household capital since palm oil cultivation is labor-intensive. Family members substitute the wage labor outside the family to reduce costs paid in cash. The farm-level adaptive response depends on household size as it determines the feasibility of adopting any particular strategy. The number of dependent members can positively and negatively impact their adaptive capacity (Jha & Gupta, 2021).

The number of family members will influence farmers' farming decisions. Arianti et al. (2022) stated that the larger the number of family members, the greater the costs incurred for the need of the farmer's household. Mita et al. (2018) stated that the number of family dependents significantly affected farmer decision-making in implementing innovation because the greater the number of family dependents, the more household expenses. The large or small number of family members will impact the living costs incurred by farmers in fulfilling their family life. In addition, the greater the number of dependents, the higher the consumption expenditure will be. This high consumption expenditure will reduce the opportunity for farmers to use more inputs to be more in line with standard palm oil farming procedures, especially if input prices are not affordable. Ultimately, this condition will affect the efficiency and production of FFB. The average number of family members of palm oil farmers in Riau Province (Table 4), using certified and uncertified seeds, is the same, namely four people belonging to the middle family group.

Table 1. Area and production of palm oil in Riau by concession status

Year	PR		PBN		PBS		Total	
	Area (ha)	Production (ton)	Area (ha)	Production (ton)	Area (ha)	Production (ton)	Area (ha)	Production (ton)
2017	1,386,575	3,677,989	92,714	328,159	1,013,887	4,715,000	2,493,176	8,721,148
2018	1,733,959	4,789,191	70,004	284,513	902,929	3,422,325	2,706,892	8,496,029
2019	1,733,959	4,789,191	79,244	335,175	928,418	4,388,842	2,741,621	9,513,208
2020	1,762,163	4,731,888	75,150	359,212	1,024,819	3,772,832	2,862,132	8,863,931
2021	1,762,163	4,817,725	75,192	393,782	1,020,818	3,750,433	3,494,583	8,961,94
2022	1,762,163	4,474,193	75,083	397,793	1,021,406	4,097,602	3,494,583	8,969,588

Table 2. Age of smallholder palm oil farmers in Riau

Range of Age (year)	Farmers with Non-Certified Seed		Farmers with Certified Seed	
	Amount (people)	Percentage (%)	Amount (people)	Percentage (%)
21-30	420	43.5	76	42
31-40	292	30.3	55	30
41-50	173	17.9	38	21
51-60	64	6.6	10	6
61-70	16	1.7	2	1
Total	965	100	181	100
Average	44.14		44.33	

Table 3. Education level of smallholder palm oil farmers in Riau

Education (year)	Farmers with Non-Certified Seed		Farmers with Certified Seed	
	Amount (people)	Percentage (%)	Amount (people)	Percentage (%)
Primary school	777	80.5	128	70.7
Junior high school	164	17.0	46	25.4
Senior high school	24	2.5	6	3.3
University	0	0.0	1	0.6
Total	965	100	181	100

Table 4. Number of smallholder palm oil farmer families in Riau

Number of family members (people)	Farmers with Non-Certified Seed		Farmers with Certified Seed	
	Amount (people)	Percentage (%)	Amount (people)	Percentage (%)
≤3	817	84.66	158	87.29
4-5	131	13.58	21	11.60
6-7	16	1.66	2	1.10
>7	1	0.10	0	0.00
Total	965	100	181	100
Average	4,15		4,01	

#### 4. Farmer Group Membership

The farmer group is one of the institutions that support farmers at the village level. Apart from being a place to gather and share information related to agriculture, farmer groups in the research area also function as a forum for development assistance grants provided by

the local government and a forum for farmers to obtain fertilizer subsidies. Government programs delegated management to farmer groups aim to increase the production and quality of FFB. Ideally, farmers gain additional knowledge and skills in running palm oil farming through discussions among them or technology transfer provided by field agricultural extension agents

(PPL). The technology transfer includes such as cultivation techniques, the use of production inputs following recommended usage, and the introduction of seeds. PPL is certified and a standard of good palm oil plantation management. Membership of farmers in farming institutions is thought to influence farmers' mindsets, insight information, and technology absorption rates. Farmers who are members of the farmer groups are considered to be able to apply the information obtained from the farmer groups compared to farmers who are not members (Table 5). The farmer who follows the farmer's group has a higher value of technical efficiency than the farmer who does not follow the farmer group (Cahyaningsih, 2022).

The majority smallholder palm oil farmers in Riau. In fact, both farmers using certified seeds (83.98%) and farmers using non-certified seeds (94.92%) are not members of farmer groups (Table 5). The reason is that most of the smallholder palm oil farmers in Riau are mostly independent smallholders. Usually, partnership farmers require participation in farmer group membership. Meanwhile, independent farmers have no provision to join a farmer group. Palm oil smallholders in Riau do not have a strong smallholder palm oil organization. This implies no uniformity in the selling price of smallholder palm products. Farmers cannot negotiate to get credit and lower input prices (Mariyah, 2018). In addition, it results in low technology transfer through counseling. Survey data on farmers who are

not part of groups indicates that the main reason they did not join farmer groups was the absence of palm oil farmer groups in the area (63.99%). Other reasons are the remote location of the farmer groups (4.91%), farmers' disappointment as group activities are not as expected (5.46%), unsatisfactory services (10.81%), and others (14.83%).

### Characteristics of Smallholder Palm Oil Cultivation

#### 1. Land Area

Land is one of the main production factors for managing the farm and affects the business's scale. Most of the household farmer's land size in Riau, both using certified seeds and non-certified seeds, ranges from 0-2 hectares (96.13% and 98.03%) or falls under the qualifications of smallholders, while the rest are middle farmers (Table 6). The average area owned by smallholders using non-certified seeds is relatively lower than those using certified seeds, with an average area of 1.71 hectares and 2.17 hectares, respectively. The land area controlled illustrates the farmers' financial capital ability in farming. A large area of land will also provide large revenues. Moreover, the cultivated land area can be used as a reflection of the welfare level of farmers. Farmers with large land sizes were found to have a positive and significant relationship with adopting an adaptation strategy (Jha & Gupta, 2021)

Table 5. Membership of smallholder palm oil farmer groups in Riau

Farmers Group	Farmers with Non-Certified Seed		Farmers with Certified Seed	
	Amount (people)	Percentage (%)	Amount (people)	Percentage (%)
Non-member	916	94.92	152	83.98
Member	49	5.08	29	16.02
Total	965	100	181	100

Table 6. Area of smallholder palm oil smallholders in Riau

Land Area	Farmers with Non-Certified Seed		Farmers with Certified Seed	
	Amount (people)	Percentage (%)	Amount (people)	Percentage (%)
0-2 ha	946	98.03	174	96.13
3-15 ha	19	1.97	7	3.87
Total	965	100	181	100
Average		1.71		2.17



## 2. Palm oil Seeds

In obtaining oil palm seeds, farmers carry out two ways: buying and producing them themselves. Generally, farmers buy certified seedlings from officially certified producers, such as the Palm Oil Research Centre (PPKS). Once the plant is 3 or 4 years old, it is easier to tell which one uses certified and non-certified/fake seeds. At that age, the palm oil production per hectare between certified and uncertified seedlings is almost the same. At the fifth/sixth plant age, it is only clear that uncertified seedlings' productivity is only around 40–60% of certified seedlings (Kariyasa, 2015).

The limited availability of palm oil seeds has resulted in an illegal palm oil seed market whose origins need to be clarified and produced without following plant breeding principles and applicable government regulations. The use of illegal seeds is very detrimental to farmers because fruit production is lower. The plants tend to bear fruit more slowly and are susceptible to disease, resulting in a slower return on capital. Although since 2009, the number of palm oil seeds produced has exceeded the demand for seeds, there are still many illegal uses of seeds caused by the lack of information or publications and socialization about the importance of using good and quality certified seeds (Liwang et al. 2011).

Research findings by Agustira (2018) show that 60% of the plant materials used by smallholder plantations in Indonesia are sourced from illegal plant materials, and 90% of them are independent farmers. Use of plant materials the low quality has an impact on production that could be more optimal. The reason for using these fake seeds is the difficulty of farmers getting superior seeds. The opinion of farmers/planters is that superior seeds/seedlings are difficult to obtain due to administrative requirements, high prices, and the propaganda of spreading fake seeds/seedlings. The fraudulent mode by producers and sellers of fake plant material is carried out through counterfeiting documents and packaging of superior seed producers. In Riau Province, most farmers (84.21%) do not use certified seed, and only 15.79% use certified seed (Table 7). This indicates that the awareness of palm oil farmers about using certified seeds in Riau is still very low. This is because a self-help pattern dominates the composition of the smallholder palm oil plantation management patterns.

## 3. Partnership Pattern

The PIR partnership pattern farmers who use certified seeds (57.14%) are relatively larger than those who do not use certified seeds (42.86%) (Table 8). On the other hand, for independent farmers, the use of certified seeds is relatively low (15.02%); the rest do not use certified seeds (84.98%). This indicates that farmers in PIR partnership schemes are more required to use superior seeds by partner companies than independent farmers. Price considerations and difficulty obtaining them usually cause the common use of certified seedlings in a self-help scheme. Often farmers could not tell the difference between good/certified seeds and bad/fake seeds. So, they are more likely to be deceived by illegal seeds producers/sellers. There are usually differences in managing palm oil plantations using certified and uncertified seedlings. Farmers who use certified seeds usually manage their palm oil plantations more effectively than those who do not (Kariyasa, 2015).

### Analysis of Farmer Decision Making

Maximum likelihood testing to see the independent variable's simultaneous influence on the dependent variable in this study shows a significant simultaneous influence on the independent variable on the dependent variable because the Chi-Square p-value is  $0.000 < \text{Alpha } 0.05$  or the calculated Chi-Square value is  $81.437 > \text{Chi-Square}$ . The Nagelkerke R Square value of 0.118 in this study shows that the independent variable's ability to explain the dependent variable is 11.8%. There are 88.2% other factors outside the model that explain the dependent variable.

To test the significance of the study's model, the Goodness-of-fit test was carried out using the Hosmer-Lemeshow (H-L) method. The results show that the H-L test statistical value is 10,574, and the resulting p-value or significance is 0.227. The resulting p-value is greater than the real level of 5%. These results indicate that the model formed is correct because there is no significant difference between the model and its observation value. This study's logit model is feasible because it can explain farmers' decisions to use palm oil seeds. In the logistic regression interpretation value with SPSS, the overall percentage value is 84.2%, which means that the research model's accuracy is 84.2%.

Table 7. Use of smallholder palm oil seeds in Riau

	Amount (people)	Percentage (%)
Non-Certified Seed	965	84.21
Certified Seed	181	15.79
Total	1146	100.00

Table 8. Use of smallholder palm oil seeds based on management patterns in Riau

Item	Farmers with Non-Certified Seed		Farmers with Certified Seed	
	Amount (people)	Percentage (%)	Amount (people)	Percentage (%)
Partnership Pattern:				
PIR Partnership	9	42.86	12	57.14
Self-Subsistent	956	84.98	169	15.02

### Estimating Parameters

A variable significantly affects if the Sig. or the p-value is less than or equal to the alpha ( $\alpha$ ) value. The alpha value used in this study is 5%. Based on the logistic regression (Table 9), six independent variables significantly affect farmers' decisions to use certified oil seeds in Riau Province. The variables are the number of family members of the farmer, age, education, capital, farmer groups, and partnership patterns.

The variable number of family members in this study significantly negatively affects farmers' decisions to use certified palm oil seeds, with a significance level of 0.035 at 5% alpha. The variable number of family members has an odds ratio of 0.322, which means that the big chance for farmers to use certified palm oil seeds due to the number of farmer family members is 0.322 times. Suppose one person increases the number of farmer family members by one person. In that case, the chances of the farmer's decision to use certified palm oil seeds will be 0.322 times smaller than before, ceteris paribus the number of dependents related to the consumption of household members and expenditure per capita. The more the number of family members, the higher the expenditure household. High per capita household expenditure can reduce the inability of households to carry out rejuvenation independently because the income derived from the oil palm business is more widely used for consumption (Mariah, 2018).

The age variable in this study significantly positively affects the farmers' decision to use certified palm oil seeds with a significance level of 0.030 at 5% alpha. The age variable has an odds ratio of 6,185, which means that the big chance for farmers to use certified

palm oil seeds due to the farmer's age is 6,185 times. If there is an increase in the farmers' age by one year, it will increase the chances of farmers' decisions to use certified palm oil seeds by 6,185 times, ceteris paribus. Age represents the farmer's experience level and is a determining factor in agricultural adaptation. Young farmers are more interested in adopting adaptation strategies.

In contrast, older farmers are emotionally attached to traditional farming practices and may resist adopting new agricultural practices and advanced technologies. This is mainly because young farmers tend to be risk-takers, while old farmers are more risk-averse (Jha & Gupta, 2021). Liwang et al. (2011) show the opposite result, where age does not significantly affect the number of purchases of palm oil seeds. The effect of age is also insignificant on farmers' decisions to use certified superior seeds in Pinem and Safrida's research (2018). The results of this study contrast with Charina's research (2018), where age does not affect farmers' decisions in implementing organic farming SOPs.

The educational variables in this study have a significant positive effect on farmers' decisions to use certified oil seeds, with a significance level of 0.001 at 5% alpha. The educational variable has an odds ratio of 5.304, which means that the big opportunity for farmers to use certified palm oil seeds due to farmer education is 5,304 times. If there is an increase in smallholder farmers by one year, it will increase farmers' chances of using certified palm oil seeds by 5,304 times, ceteris paribus. This study's results are consistent with Ardana and Kariyasa (2016) research, which also found that the level of education had a significant effect on farmers' decisions to adopt superior technology, in this case,

certified palm seeds. Pinem and Safrida's research (2018) shows that the higher the farmers' education, the greater the possibility of farmers using certified palm oil seeds. (Sumarwan, 2003) states that income and education will affect the decision-making process and consumption pattern because education affects the values adopted, one's perspective, and perception. The level of education determines a person's ability to digest the information given and is related to the quality of work in farming. Nkongho (2014) states that the level of education can play an important role in accessing information for better plantation management. Most (60%) respondents view education as a long-term adaptation strategy.

The capital variable in this study significantly positively affects farmers' decisions to use certified oil seeds, with a significance level of 0.000 at 5% alpha. The capital variable has an odds ratio of 2,793, which means that the big chance for farmers to use certified oil seeds due to the farmer's capital is 2,793 times. If a farmer's capital is increased by 1 unit, it will increase farmers' chances of using certified oil seeds by 2,793 times, *teris paribus*. (Pinem and Safrida, 2018) Found that the higher the price of seeds, the greater the possibility of farmers using certified palm oil seeds. Guaranteed quality and productivity of certified seed make farmers not hesitate to continue using it and assume that price increases are a form of improved seed quality. The seed price will determine the capital farmers need for their palm oil business. The more significant the capital they own will affect the farmers' decision to use certified oil seeds. Kosmayanti & Ermia (2017); Suroto

(2022), capital has a positive and significant effect on the income of oil palm farmers. Weak finances are an obstacle causing small farmers' low productivity (Herdiandyah, 2020).

Riau Province has 3.89 million hectares of peatlands, the largest of the total 6.4 million hectares on the island of Sumatra. Around 1,037,020 hectares of peatland are used by farmers for cultivating palm oil, food crops, and horticulture (Carolina, 2022). The cultivation of palm oil is closely related to the land's carrying capacity as a planting medium for this commodity. The suitability of land to support plant growth will directly affect soil fertility, impacting yield productivity (Krisnohadi, 2011). The potential for oil palm on various types of peat is quite high, between 12–27 tons of Fresh Fruit Bunches (FFB) per hectare per year (Winama, 2012). However, the quantity and quality of FFB on mineral lands is relatively better, where the average yield of FFB CPO is about 2% higher compared to FFB produced from peatlands (Winama et al. 2006) in Wigena et al. (2013). The income of oil palm farmers on peatlands is lower than oil palm farmers on mineral soils. The high cost of land management that farmers must incur to increase land productivity is the cause of lower farmer income (Nasrul, 2012). Differences in productivity, income, and management costs in oil palm cultivation on peatlands and dry lands may influence farmers' decisions to use certified oil palm seeds. For this reason, the land type category was added as a dummy variable in this study. The results show that dummy peatlands do not significantly affect farmers' decisions to use certified oil palm seeds.

Table 9. Logistic regression analysis results for factors affecting the use of certified and non-certified palm oil seeds

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Number of family members (people) (X1)	-1.133	.538	4.435	1	.035	.322
Age (years) (X2)	1.822	.841	4.690	1	.030	6.185
Education (years) (X3)	1.668	.491	11.534	1	.001	5.304
Land area (ha) (X4)	.034	.053	.407	1	.523	1.034
Modal (IDR) (X5)	1.027	.264	15.125	1	.000	2.793
Dummy of types soil (1= peatlands, 0= non peatlands) (D1)	-.093	.201	.214	1	.644	.911
Dummy of aids (1= available, 0= not available) (D2)	.343	.327	1.097	1	.295	1.409
Dummy of extension services (1= available, 0= not available) (D3)	.349	.428	.663	1	.415	1.417
Dummy of farmers group (1= available, 0= not available) (D4)	1.011	.286	12.540	1	.000	2.749
Dummy of partnership pattern (1= partnership, 0= self-subsistent) (D5)	1.358	.508	7.146	1	.008	3.889
Constant	-9.637	1.893	25.905	1	.000	.000

Government support provides market information, capital assistance to develop oil palm businesses, and business regulations that impact smallholders. The existence of government support will make it easier for farmers to do the palm oil business. So that it can improve business performance and the welfare of oil palm farmers (Rolesya et al. 2023). Farmers who receive assistance find it relatively easier to run a business than those who do not. So the category of recipients of assistance is essential to study. In this study, assistance has no effect on farmers' decisions to use certified oil palm seeds in Riau province.

The extension can accelerate access to information about innovations in managing smallholder oil palm plantations so that the problems farmers face can resolve (Yulistriani, 2018). The categories of availability of extension services were analyzed in the dummy variable in this study. The results show that the availability of extension service<sup>8</sup> does not affect farmers' decisions to use certified oil palm seeds in Riau province.

The farmer group variable in this study significantly positively affects farmers' decisions to use certified oil seeds with a significance level of 0.000 at 5% alpha. The farmer group variable has an odds ratio of 2,749, which means that the big opportunity for farmers to use certified palm oil seeds due to farmer membership in farmer groups is 2,749 times. If there is an increase in farmer membership in the farmer group by one time, it will increase farmers' chances of using certified oil seeds by 2,749 times, ceteris paribus. Information about the advantages of certified seeds obtained from group members can influence farmers' decisions in selecting seeds (Pinem & Safrida, 2018).

This study's partnership pattern variable significantly positively affects farmers' decisions to use certified oil seeds with a significance level of 0.008 at 5% alpha. The partnership pattern variable has an odds ratio of 3,889, which means that farmers' big opportunity to use certified palm oil seeds due to the farmer's partnership pattern in running the palm oil plantation business is 3,889 times. If there is an increase in farmer partnership patterns by one time, it will increase farmers' chances of using certified oil seeds by 3,889 times, ceteris paribus. The main factor keeping independent smallholder yields low is the use of low-quality seed stocks. The advantage of farmers with a partnership scheme is that they can quickly access

new technologies that can produce high productivity. The partnership has positively impacted the welfare of farmers' plasma. There is an increase in income, production input assistance, cultivation guidance palm oil, ease of market access, ease of credit services, and companies and cooperatives are committed to the welfare of plasma farmers (Munirudin et al. 2020).

### Managerial Implication

The managerial implications of the results of this research for palm oil smallholders in using certified palm oil seeds are by formally and informally increasing education. The implementation can be done by joining and utilizing farmer groups and partnership patterns to increase knowledge regarding the importance of using certified seeds to increase palm oil production. The government needs to support farmers, especially smallholder farmers, in terms of ease of access to capital and availability of certified seeds.

The forms of support that the government can provide can be in the form 1) The government can expand the funding and development program for self-help oil palm plantations through Village-Owned Enterprises (BUMDes) and Non-Governmental Organizations (NGOs). 2) Provision of Financing Assistance, The government can provide financial assistance through banks that have programs extending credit to the plantation sector, especially for independent oil palm smallholders. This will help farmers obtain capital in cultivating, processing, and marketing palm oil products. 3) The government can ensure the availability of superior seeds, and 4) training/counseling to independent oil palm smallholders on how to cultivate good oil palm.

## CONCLUSIONS AND RECOMMENDATIONS

### Conclusions

The number of dependents, age, education, capital, membership of farmer groups, and partnership patterns influence the decision of smallholders to use certified oil palm seeds. The variable number of family members significantly negatively affects farmers' decisions to use certified palm oil seeds. The variables of age, education, capital, farmer group, and partnership patterns in this study significantly positively affected farmers' decisions to use certified palm oil seeds. Meanwhile,

the variables of land area, type of land, assistance, and agricultural extension did not affect farmers' decisions to use certified palm oil seeds.

### Recommendations

Several recommendations can be formulated as follows: First, the availability of certified seeds, which are widely available at seed-breeding companies, should be accessible to farmers. A price subsidy is needed for farmers to make it easier to access these seeds. The government must be pro towards smallholder oil palm farmers regarding land legality, seeds, and FFB price certainty [8] support the success of ISPO certification. In facing the implementation of Indonesian Sustainable Palm Oil (ISPO) standardization, independent smallholders must prepare legal (certified) seeds, but if they prepare independently, they are not ready for capital. For this reason, it is recommended that farmers form farmer groups/cooperatives/plasma with companies that can partner well. Second, assistance is needed to independent smallholders intensively in obtaining certified superior seeds. Because the factor of education for independent smallholders is still relatively low; Third, the palm oil rejuvenation for Smallholder Program (PSR) through the Palm Oil Plantation Fund Management Agency (BPDPKS) can be used by independent smallholders to obtain superior (certified) seeds. However, smallholder farmer still has land legality issue that prevents them from participating in this program; Fourth, stakeholders related to palm oil plantations must assist independent smallholders, especially in obtaining certified seeds; and Fifth, by using certified seedlings, FFB productivity is expected to increase. As a result, the land expansion program can be controlled, and the problem of land use in forest areas (deforestation) can no longer occur.

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