

# **Limiting Conditions for Adopting New Variety of Pineapple: A Case Study of Agricultural Development Program in Kediri District**

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## **1. Introduction**

As a tropical fruit producing country, Indonesia has huge potential as a global tropical fruit exporter. Among fruit commodities, pineapple accounts for most of Indonesia's exports. According to Pusdatin (2015), Indonesia exports around 10% of the world's total pineapple production. The largest amount of pineapple exports is in the form of canned pineapple, with the average annual exports of 167,392 tons from 2008 to 2012, compared to average annual exports of 82 tons for fresh pineapple (Pusdatin, 2015).

The global demand for pineapple is increasing. Data from the Food and Agricultural Organization (FAO) (as reported by Pusdatin, 2015) shows that global imports of fresh pineapple have increased significantly, presenting an enormous opportunity for pineapple producers to increase their fresh pineapple exports.

Pineapple production has been increasing over the years in Southeast Asia and now accounts for approximately 23% of total production in the region, offering possibilities for Indonesia to develop pineapple cultivation and expand its presence in the global market. Unfortunately, this opportunity has not been explored extensively, with only limited fresh pineapple exports from Indonesia.

According to Hadiati and Indriyani (2008), although the potential of fresh pineapple as Indonesia's main export commodity is quite large, its current contribution toward exports is insignificant. Pineapple cultivation has not received adequate attention in Indonesia and has been hindered by the lack of improved pineapple varieties and optimal cultivation techniques. Sobir

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and Naibaho (2000) describe three major problems in pineapple development: (1) inadequate supply of and lack of clarification on improved varieties of pineapples in smallholder agriculture, (2) limited supply of seedlings because conventional propagation techniques result in low multiplication rate, and (3) improper application of production techniques. From the literature mentioned, it is evident that pineapple varieties and cultivation techniques need to be improved for pineapple development in Indonesia.

In 2011, the Ministry of Agriculture introduced a new pineapple variety, smooth cayenne, in Kediri District to expand the pineapple market. In addition to free deliveries of seedling, they also assisted with cultivation technique and market expansion assistance, which led to expansion of the local pineapple market. However, the development of this new variety has not worked as expected. Astoko (2014) in his research argued, “The competitiveness of the producers from Kediri District compared with other regions is very weak, especially for the smooth cayenne Variety, due to production discontinuity.”

This discontinuity in the new variety of pineapple production is related to low production levels. Data from local pineapple suppliers show that the demand from urban markets for the new variety of pineapple product, which reaches 25,275 kg per week, cannot be met by the existing supply (Interview, April 2016).<sup>1</sup> The low adoption rate of the new variety by farmers could be the reason behind this problem.

To understand the problem, we must examine the conditions faced by farmers in this area regarding adopting the new variety. Therefore, this study tried to analyze the conditions surrounding adoption of the new variety in Kediri District.

The objectives of this study are as follows: 1) to study the farming households' decisions to adopt the new pineapple variety, 2) to study whether the new pineapple variety brings economic benefits and, 3) to identify the factors determining the adoption of the new variety of pineapple.

## **2. Introduction of the New Variety**

### **2.1 Pineapple Development Potential**

The province of East Java significantly contributes to national production, ranking fifth among all pineapple producers in Indonesia. However, pineapple production in this province is not evenly distributed. The Kediri district is the most significant pineapple producer in East Java. As per the data provided by Pusdatin (2013) from 2011, Kediri is the largest pineapple production center, contributing 88.10% of the total production in East Java. The pineapple farmers in this area can be regarded as experienced farmers. In addition, the suitability of land and the climate provide the greatest opportunities for the development of pineapple farming.

Before the introduction of the new variety, the pineapple varieties in this area had not been diversified. The Queen was the first and most cultivated variety in the region. Moreover, most pineapple produce was sold in traditional markets. Therefore, the government introduced a new variety that has greater potential for a wider market, including the urban and export markets.

## 2.2 The New Variety

The central government, through the Agriculture Department of Kediri District, provided the budget to develop the new pineapple variety in this area. The budget was significantly increased during its first allocation in 2011 and accounted for projected expenditures until 2016. It was used to deliver free seedlings to farmer groups who proposed it and provide cultivation technique assistance to farmers. The new variety seedling came from Subang District, West Java, where smooth cayenne pineapple production is very popular.

Table 1. The State Budget for Procurement of New Variety of Seedling in Kediri District

Year	Total Area (Ha)	Total State Budget for Seedling Procurement (Million IDR)
2011	3	57
2012	30	570
2013	25	475
2014	20	340
2015	30	510
2016	17	425
<b>TOTAL</b>	<b>125</b>	<b>2,377</b>

Source: Agriculture Department of Kediri District (2015)

The government chose the smooth cayenne variety for its high yield and large fruit size. Grade A of this new variety reaches 2.5 kg per fruit, whereas the old variety only reaches 1.2 kg per fruit. Even though this variety is popular for canned pineapple production in the international market, the fruit is also acceptable in the fresh fruit market (Janick and Paull, 2008). Moreover, according to ACIDI VOCA (2015), the demand for smooth cayenne as a fresh pineapple export commodity from Ghana has increased significantly, implying that the development of this new variety would increase the potential for fresh pineapple exports from Indonesia. This variety also adds value through its suitability for urban consumption. The flat eyes on the fruit's skin and absence of a prickly crown make it convenient to peel and consume.

Since its development in Kediri District, this variety gained popularity in the area. With high demand from communities, the price for this variety is set much higher than for the old variety. However, limited pineapple production and production discontinuity still pose an obstacle.

## 3. Data

### 3.1 Sample Characteristics

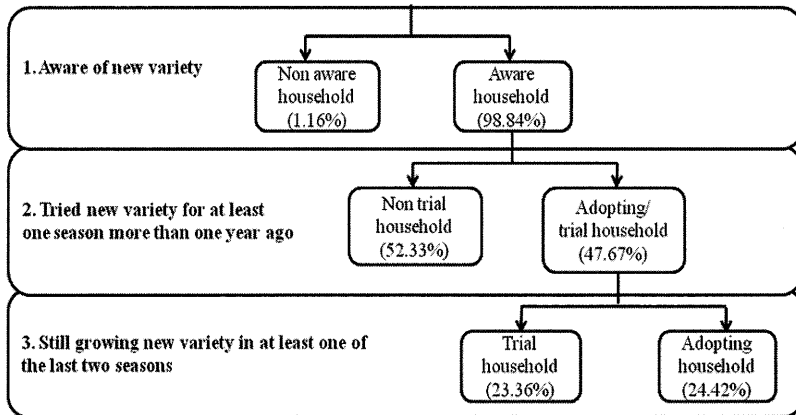
Data used in this study were collected from 86 farming household heads through questionnaires. The survey was conducted in March–April 2016 in two villages of the Ngancar sub-District, namely the villages of Ngancar and Pandantoyo, both known for producing pineapple and the closest villages to the extension center in the Ngancar sub-district.

The data reveals that the level of education of the individuals in the sample was not high, with most of them having only completed elementary school (51.16%). The average experience in pineapple cultivation was 15 years, meaning they possessed significant experience in pineapple farming. The average farm size was only 0.77 ha, with the land ownership ratio being only 44% of the total farm size cultivated.<sup>2</sup>

Most of the individuals in this sample are farmer group members, which enlarges the opportunity for these farmers to be part of the government program and to adopt the new technology delivered through the program. The agricultural development program is delivered to the farmers through farmer groups. Of these farmer group members, only 27.91% are involved in *gapoktan*<sup>3</sup> activities.

### 3.2 Farming Households’ Decisions to Adopt the New Pineapple Variety

The problem of limited supply of the new variety produce may be caused by the low adoption rates of this variety. Therefore, this study tried to analyze the conditions surrounding the adoption of the new variety in Kediri District.



Source: Author’s field survey in 2016

Figure 1. Farmer Households’ Decisions to Adopt New Variety of Pineapple (n=86)

According to Rogers (2003), “The *innovation-decision process* is the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision.” He conceptualized five main steps in the process: knowledge, persuasion, decision, implementation, and confirmation. These five steps are in line with the following five stages (steps): awareness, interest, evaluation, trial, and adoption. Farmers’ decisions to implement the new variety in Kediri District can be examined in

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terms of these five stages. This study adopts the method of a decision tree by each household, based on Ramaekers *et al.* (2013).

According to the data collected by the author, only half of the sampled households have tried to cultivate the new variety. Meanwhile, almost half of those who tried to cultivate it discontinued adopting the new variety. Rogers (2003) stated “innovations with a high rate of adoption could have a low rate of discontinuance.” On the contrary, in this study, the high rate of discontinuance of the new variety adoption implies that the rate of adoption is low. This condition leads to delay in the development of the new variety.

Table 2. Source of First New Variety Seedling (n=41)

No.	Source of First Seedling	Percentage (%)
1.	Program	83
2.	Given by other farmers	15
3.	Bought from other farmers	2

Source: Author’s field survey in 2016

Most of the trial households of the sample received seedlings of the new variety for the first time from the program. However, 17% of the sampled individuals did not receive the first seedling from the program. This shows that even though they did not get the free seedling from the program, they were interested in adopting the new variety. Regardless of their membership status, the households that did not get the free seedling procured it from other farmers either for a fee or free of charge. There is no local seedling breeder or seedling seller of the new variety in the area, so the farmers do not have access to the new seedling variety from outside the area and are deprived of incentives to procure these seedlings.

In addition to the problem of procuring the new variety seedling, the price of seedlings in this area is almost five times higher than that of the old variety because of its limited availability, which hampers farmers who are trying to cultivate the new variety.

Table 3. Source of New Variety Seedling for Adoption (n=21)

No.	Source of Seedling	Percentage (%)
1.	Previous cultivation	81
2.	Program	4
3.	Program and previous cultivation	5
4.	Previous cultivation and bought from other farmer	5
5.	Program and bought from other farmers	5

Source: Author’s field survey in 2016

Meanwhile, for further cultivation, the farmers use the seed from previous cultivation through the propagation technique, which is commonly used for continuous pineapple cultivation.

According to UNCTAD (2016), “because the pineapple produces few seedlings, it is reproduced, particularly for industrial planting, by sprouting from the plant after fruit bearing.” The farmers in this area usually use sprouts produced from the previous plant and replant it for continuous cultivation.

There is a difference between the old and new variety in terms of the propagation technique. In case of the old variety, a plant can produce 3–4 sprouts from one plant, while for the new variety, the plant can only produce 1–2 sprouts. This means that plant reproduction in the new variety is slower and seedling productivity is lower than the old variety.

Thus, farmers’ availability of the new variety seedling relied only on the sprouts of previous cultivation. Moreover, higher failure risk of cultivation becomes an obstacle to further development of the new variety.

Crop failure happened due to the following external factors:

1. Since the onset of the program, the plantation has been affected by pests and disease that continue to threaten pineapple cultivation. The endemic crops pests in this area are *Lepidiota Stigma F.* and mice, and the disease is the *Pineapple Mealybug Wilt Associated Virus*. According to Janick and Paull (2008), “Queen is more tolerant of pests and diseases than is smooth cayenne.” In fact, in Kediri District, both varieties are affected by pests and disease.
2. The eruption of Mount Kelud in early 2014 destroyed many plantations comprising both old and new pineapple varieties. However, the impact of the eruption on the new variety plantation was greater than on the old variety ones because of the morphological differences between the two varieties. The gravel thrown out during the volcanic eruption affected the new variety plant more than the old variety. Therefore, the old variety plantation affected by the eruption recovered better than the new variety ones.

In fact, the plantation destruction caused by the external factors also destroyed the seedling source for the new cultivation in this area, thereby leading to seedling scarcity and delays in new variety development.

## **4. Economic Impacts of Adopting the New Pineapple Variety**

### **4.1 Differences in Selling Techniques of the Produce between the Old and New Variety**

Both the new and old varieties of pineapple produced in Kediri District are commonly sold through a middleman, who distributes the pineapple produce in either the traditional or the modern market. Through the customary practice of selling in this area, the farmers do not need to harvest and sell their harvested crops by themselves; the middlemen undertake these activities. This leads to a wider price gap between the on-farm price and market price. However, farmers can avoid the market price risk. For each variety of pineapple, the selling technique varies depending on market requirement.

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Table 4. Differences in Selling Techniques of Produce Between the Old and New Varieties

No.	Old Variety	New Variety
1.	“ <i>Bijian</i> ” means the selling price of the pineapple produce is calculated per fruit	“ <i>Kiloan</i> ” means the selling price of the pineapple produce is calculated by the weight (kg) of each fruit
2.	The produce grading and pricing is estimated before harvesting	The produce grading and pricing is estimated after harvesting
3.	Price: Grade A: IDR 2,000–3,500 per fruit Grade B: IDR 1,000–2,000 per fruit Grade C: IDR 500–1,000 per fruit	Price: Grade A: IDR 4,000–6,000 per kg Grade B: IDR 3,000–4,500 per kg Grade C: IDR 2,000–3,000 per kg
4.	Marketing chain: Farmer – Middleman – Traditional market (local or other cities)	Marketing chain: a. Farmer – Middleman – Modern market supplier b. Farmer – Middleman – Modern Market c. Farmer – Cooperative – Modern market supplier

Source: Author’s field survey in 2016

The different selling techniques define the different timings of grading and pricing conducted by the middleman. The “*bijian*” system is applied to the old variety, for which the pricing of the produce value can be conducted by the middleman while the unripe fruits are still attached to the plant. The fixed payment to farmers is decided at the time of pricing; farmers can then avoid risks such as crop failure, natural disaster, or theft, which could occur at the time of pricing and harvesting. For the new variety, the “*kiloan*” system, commonly used for the modern market, is applied. Pricing is conducted by the middlemen after harvesting, since they need to know the exact grade and weight of the produce sold in the modern market. Farmers need to take care of their produce longer than for the old variety and tend to be afraid of the uncertainty during the cultivation period extended prior to harvest.

### 4.2 Pineapple Farming Analysis of the New and Old Variety

The economic analysis of farming new and old pineapple varieties is shown in Table 5. Both varieties are commonly classified into three grades, based on volume or weight. The higher the grade, the higher is the price. Although the population of the old pineapple variety per hectare is almost twice that of the new variety, the entire produce cannot be classified as high grade. The revenue for farmers cannot be maximized without maximizing the output of the produce.

The most significant difference in cultivation cost between the two varieties is that of the seedling. Even though the population of the new variety per hectare is half that of the old variety, the seedling price is much higher. In this area, the farmers in this survey did not buy the new variety seedling, but obtained it from the program. Therefore, the farmers sampled in this study did not incur any seedling cost.

Table 5. Pineapple Farming Analysis by Variety (per Hectare)

	New Variety (n = 11)			Old Variety (n = 73)		
	Volume	Unit	Value (1,000 IDR)	Volume	Unit	Value (1,000 IDR)
Seedling	48,378	Seedling	0 *)	94,677	Seedling	19,063
Organic Fertilizer						
- Petroganik <sup>4</sup>	1,658.47	Kg	829	301.37	kg	153
- Organic	8,863.64	Kg	750	11,493.46	kg	926
Chemical Fertilizer	1,006.33	Kg	2,016	385.90	kg	715
Liquid Fertilizer	207.50	Package	5,603	313.96	package	8,477
Ethrel <sup>5</sup>	31.56	Package	450	87.10	package	1,054
Total Labor	374.86	day*people	9,633	421.47	day*people	11,149
Land rent	1	Hectare	14,545	1	hectare	15,399
<b>Total Cost</b>			33,826			56,936
Output	53,265.77	Kg		44,921.02	kg	
<b>Total Revenue</b>			205,528			118,578
R/C Ratio			6.08			2.08
R/C Ratio of the Seedling Purchased			2.50			2.08

\*) New variety seedling price is set at IDR 1,000 per seedling, in case the seedling is procured from breeder or other farmer. Old variety seedling price is set at IDR 201 per seedling, on average, in case the seedling is procured from another farmer.

Source: Author's field survey in 2016

The high seedling price leads to an increase in seedling procurement costs for farmers when they purchase the new variety seedling using their own resources. The farmers that do not receive a free seedling find the seedling exorbitantly priced, and hence refrain from trying the new variety of pineapple.

Table 6. Comparison of Seedling Price and Supply System of Both Varieties

Criteria	New Variety	Old Variety
<b>Seedling Price</b>	IDR 1,000 per seedling	IDR 201 per seedling
<b>Seedling Supply System</b>	<ul style="list-style-type: none"> <li>• Buying from the breeder in Subang District</li> <li>• Buying from new variety farmers in Kediri and Blitar Districts</li> </ul>	Buying from old variety farmers in Kediri District

Source: Author's field survey in 2016

However, whether or not the new seedling variety is purchased, the revenue from this new variety would still be higher than that of the old variety because the price of the new variety produce is set higher than that of the old variety. It can be said that this new variety can be economically promising if developed.



## 5. Determinants of New Variety Adoption

From the data above, we can see that the new variety brings more economic benefits. However, the discontinuance in adopting this new variety is high. Therefore, to understand the farmers' conditions, we analyzed the factors that determine their adoption of the new variety, using a binary probabilistic method with the following equation:

$$\text{Adoption} = \beta_0 + \beta_1 \text{experience} + \beta_2 \text{education} + \beta_3 \text{family labor} + \beta_4 \text{own land ratio} + \beta_5 \text{livestock (dummy)} + \beta_6 \text{sell directly (dummy)} + \beta_7 \text{gapoktan membership (dummy)} + \beta_8 \text{consultation with extension workers (dummy)} + \beta_9 \text{consultation with other parties (dummy)} + \gamma$$

The factors were analyzed with a *probit* regression analysis using Stata IC. 14

Table 7. Descriptive Statistics of the Variables in Equation

Variables	Definitions	Mean (n=86)	Standard Deviation	Min.	Max.
experience	Experience in pineapple farming activities (years)	15.34	10.07	1	37
education	Years of schooling	7.29	3.17	0	12
family labor	Amount of family labor per hectare (days*people)	133.87	190.03	0	940
own land ratio	Ratio of own land and farm size	0.44	0.41	0	1
livestock	Ownership of livestock (Dummy)	0.62	0.49	0	1
sell directly	Selling pineapple produce directly in the market (Dummy)	0.09	0.29	0	1
gapoktan membership	Gapoktan (farmer group federation) membership (Dummy)	0.28	0.45	0	1
consultation with extension workers	Number of consultations with extension workers done by the farmer in the last year (Dummy)	0.35	0.48	0	1
consultation with other parties	Number of initiative consultations with other parties, i.e., agricultural cooperatives, associations, or researchers, done by the farmer in the last year (Dummy)	0.23	0.42	0	1

Source: Author's field survey in 2016

Table 8 shows the estimation results of the determinants for new variety adoption. The results of the *probit* analysis show that livestock is an important factor for determining the adoption of the new variety. The variable family labor amount in a household also influences the decision to adopt the new variety; farmers' probability to adopt the new variety increases when there are more laborers in the family. Moreover, farmers who sell their pineapple produce directly to the market or have secondary jobs as middlemen are more likely to adopt the new variety because they know the real marketability of the new variety, and hence are in a better position to handle market uncertainties.

Table 8. Determinants of New Variety Adoption

	Coef.	z	P> z	Sig.
_cons	-3.3698	-3.69	0.000	***
experience	0.00054	0.90	0.368	
education	0.0925	1.36	0.174	
family labor	0.0022	2.01	0.044	*
own land ratio	-0.2014	-0.38	0.707	
livestock	1.4803	2.79	0.005	**
sell directly	2.2559	2.93	0.003	**
<i>gapoktan</i> membership	0.9812	2.16	0.031	*
consultation with extension workers	-0.7828	-1.69	0.090	
consultation with other parties	1.0177	2.06	0.040	*

Significant level: \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$

Source: Author's field survey in 2016

Farmers who have livestock, more family labor, and sell produce directly can overcome the risks associated with adopting the new variety. These three variables can somehow contribute to reducing the risks and uncertainties attached to farming and marketing and enable the adopters to cope with crop failure.

Farmers who are more active in an organization, especially in *gapoktan*, are more likely to adopt the new variety. They can obtain additional information about the new variety than those who are not active and cope with uncertainty.

The role of other parties, especially cooperatives, is significant in delivering information about the new variety. In fact, since the onset of the development of the new variety, one agricultural cooperative in this area has played a special role as the market channel for the new variety produce by buying the new variety produce from the farmers and then selling it in the modern market. The farmers who consult with the cooperative can resolve market uncertainties, and simultaneously get market access for selling the new variety produce.

On the contrary, consultation with extension workers has no significant influence on adoption of the new variety, which implies that even though the farmers have initiative to consult with extension workers, this does not influence them to adopt the new variety. The extension workers usually provide information sources for new variety adoption, but their role in this area is still limited. The farmers who consult the extension workers may get more information about the new variety, but still cannot resolve the risk and uncertainties associated with new variety adoption. They may also consult the extension workers about commodities other than the new variety.

## 6. Conclusion

From the data and analysis of this study, we can see that access to and availability of pineapple seedlings limited the number of trial households and resulted in a high rate of discontinuance of the new variety adoption. The conventional dissemination technique could not meet the need of the new variety seedling.

From the analysis, we can see a difference in produce-selling techniques between the new and old variety. Moreover, although the price of the new variety's seedlings is much higher than that of the old variety, it brings greater economic benefits. Therefore, the development of this new variety can prove to be promising.

The determinants of new variety adoption are mostly related to the farmers' behavior in facing the risks and uncertainties attached to farming and marketing. The results also indicate the information channels regarding the new variety's influence on the farmers' decisions to adopt it.

It can be concluded that making sufficient seedlings available in the early stages of diffusion is crucial. The government needs to develop access to cheaper seedling either by developing local breeders or improving stakeholders' (farmers or buyers) roles so that they can fulfill their needs for new variety seedlings. In addition, the role of extension services and other institutions, especially agricultural cooperatives, aimed at reducing the risks and uncertainties of new variety adoption is important to support pineapple development.

## Endnotes

<sup>1</sup> Data on demand for new pineapple variety from the Kediri District was obtained from four main suppliers (middlemen) in this area.

<sup>2</sup> Farmers in this area mostly use the state forestland free of charge or by paying rent, which is managed by Perum Perhutani, a state-owned enterprise. The state forest management involves forestland management by the community. The forestland is utilized for planting hardwood species, and the local community can use the land for planting crops and horticulture, including pineapple.

<sup>3</sup> *Gapoktan* refers to a farmer group federation. *Gapoktan* membership in this area means that the farmer is active both in a farmer group and in *gapoktan*. It also means that they are the most active members of the organization rather than the others.

<sup>4</sup> *Petroganik* is one of the organic fertilizer brands of the fertilizer company, Petrokimia Gresik. It is more expensive than the regular organic fertilizer, which is produced by local producers as it has a different formulation than the regular organic fertilizer.

<sup>5</sup> *Ethrel* is a hormone use to force pineapples to flower. It is usually used by the pineapple farmers to adjust the flowering and harvesting time of pineapple plantations.

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