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Preface

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Preface

First and foremost, it is our great pleasure to welcome all of our distinguished forum guest and invited speakers, presenters, and participants of the 4th International Conference on Agriculture and Life Sciences 2020 (ICALS 2020). The world are now facing the COVID-19 pandemic that threatens human health and disrupting other aspects of human life. A new life order that called as "New Normal" has been introduced to the community in order avoid COVID-19 infection during their life activities. One of the things that is emphasized in implementing the New Normal is having a healthier lifestyle through the consumption of healthy and nutritious food. The industrial crops are thought to have an important role in the provision of healthy food or health supplements. Therefore, the main theme of this conference is "**Retouching Strategy for Exploring Potency of Industrial Crops for Health in Adapting to the New Normal Era**". Due the implementation of Indonesian government regulations to limit the spread of COVID-19 viral infection through the prohibition of gathering activities with many participants, the current ICALS was held in the virtual format instead to be postponed.

This virtual conference was held on 6 – 8 October 2020 in Faculty of Agriculture University of Jember, Indonesia. It is an ongoing effort by the Faculty of Agriculture University of Jember, starting from 1st ICALS as International Seminar and Workshop of Plant Industry (ISWPI) on 2017, the International Seminar and Workshop of Plant Industry (ISWPI) on 2018, 3rd International Conference on Agriculture and Life Sciences (ICALS 2019) on 2019. The ICALS 2020 is co-organized by Faculty of Agriculture University of Jember, Graduate Program University of Jember, Implementation Programs Unit of Islamic Development Bank University of Jember, and Center of Excellence on Crop Industrial Biotechnology (PUI-PT-BioTIn).

The plenary session of the international seminar presented two keynote speakers from the University of Jember and from the Ministry of Agriculture, Republic of Indonesia with 40 minutes for lecture for each. The guest and invited speakers from South Korea, Japan, Belgium, Germany, and Indonesia have been participated in this conference to share their knowledge and expertise on 30 minutes of presentation. The ICALS 2020 was remotely attended by 1262 participants from academician, researchers, students, farmers, private business, and governments from total 8 countries (Indonesia, Malaysia, India, Australia, Japan, Belgium, Germany, South Korea) and 13 provinces in Indonesia (East Java, Central Java, Jogjakarta, West Java, South Sumatra, North

Sumatra, West Sumatra, South Sulawesi, South East Sulawesi, North Sulawesi, Bali, West Nusa Tenggara, and Papua). Among this number, 160 participants disseminated their scientific result related to this conference topic. This virtual conference was successfully delivered using Zoom application and discussion sessions were conducted by means of the presenters answering questions that were raised through the chat menu.

Last but not least, we would like to express blessed gratitude to University of Jember for their support to success of this virtual conference and also, a heartfelt wish to all the committee involved in ICALS 2020.

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Risk preference and choice of sugarcane planting method: are risk-taker farmers more likely to choose bud chip methods?

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Risk preference and choice of sugarcane planting method: are risk-taker farmers more likely to choose bud chip methods?

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Abstract. An effort to increase the productivity of sugarcane is by using the method of bud chips. Bud chip method has proven to improve the productivity of sugarcane and produce more cost-efficient, but still a few farmers who use it. This is due to higher production risk, and sugarcane farmers are still not technically skilled. This research aims to analyze the magnitude of the risk of sugar cane production with bud chip and conventional method and to know the characteristics of sugar cane farmers with bud chip and conventional method in facing production risk. The research was conducted in the working area of PTPN X company (Kediri Regency, East Java Province, Indonesia). The sample was taken incidentally by selecting 60 sugarcane farmers (20 farmers sugarcane with the bud chip method and 40 sugarcane farmers with the conventional method). The results showed that sugar cane farmers with the bud chip method have a higher risk of production than conventional methods; beside that, sugar cane farmers with bud chip method classified as a risk-taker and sugar cane farmers with conventional methods were risk averters. Intensive training and assistance from the sugar factory are needed to improve the application of bud chips at PTPN X company.

1. Introduction

Sugar has been determined as a special commodity (special product) such as rice, corn, and soybean in the World Trade Organization negotiations [1]; [2]; [3]. This particular commodity gives meaning to sugar as a commodity that is very influential in people's lives. National sugar demand has now reached 5.8 million tons. In the next 5 years, it is predicted to increase to 6.6 million tons - 7.0 million tons in line with the increasing population of Indonesia [4]; [5]; [6]. The increasing sugar needs of the people are not balanced with an increase in national sugar production which is only around 2.69 million tons or 45% of the national sugar needs [7].

Seeing the situation above, the national sugar market balance has always had to be met by importing sugar. That is why, until now Indonesia is one of the world's largest sugar importing countries. When sugar consumption tends to increase and cannot be matched by an increase in national sugar production, the dependence of sugar imports will certainly be higher [4].

Considering that the national sugar industry is concerned with meeting the people's basic food needs, the livelihoods of many people and the stability of the national economy, it is important to immediately deal with it as well as possible. Two important conditions faced by the national sugar industry in the field of on-farm. First, the latent problem on the farm side is the limited availability of sugar cane. Second, the low productivity of sugar cane also has implications for the declining performance of the national sugar industry. The productivity of sugarcane in the last five years ranges from 60.01 tons per hectare to 67.83 tons per hectare. This figure is still far from world sugarcane productivity which reaches 89-90 tons per hectare [8]; [7].

The target of sugarcane productivity in the next 5 years is relatively high at 93 tons/hectare. These targets can be achieved by introducing superior varieties, seed treatment, ratoon care methods, and land management. One effort to increase sugarcane productivity is by conducting seed treatment (bud chip method), where using the bud chip method is expected to increase sugarcane productivity up to 166 tons per hectare (in Colombia). This figure is still far higher than the level of sugarcane productivity in East Java and in Indonesia, which is only around 80 tons per hectare. In East Java, especially PTPN X company, the use of the bud chip method is far more efficient compared to conventional methods, where seeding with conventional methods will require around 48,000 buds per hectare, while the bud chip method only requires 9,000 to 12,000 buds per hectare [8]; [9]. Although it is more efficient in the use of seedlings and can increase sugarcane productivity, only a few farmers use this method in PTPN X company. This can be caused by the risk of loss (production) by using a bud chip is considered greater than conventional methods. Based on this, it is important to study the risk preferences of sugarcane farmers using the bud chip method and the conventional method.

Researches related to farm risk and risk preferences have been conducted, including research by [10]; [11]; [12]; which states that from several sources of risk, the most important risks faced by farm households are production and price risks. The decline in sugarcane productivity continuously needs to be seen from the allocation of inputs used. Theoretically, the behavior of farmers in facing production risk affects the size of the allocation of inputs used [13]. Farmer production risk behavior is divided into three groups, namely (a) farmers who like risk-takers, (b) farmers that are risk-neutral and (c) risk-averse farmers. Like the research conducted by [14]; [15]; [16] which concluded that small-scale farmers are risk-averse.

Research on the risk of sugarcane farming has also been carried out by [17], which shows that the risk of sugarcane farming is relatively large due to the choice of varieties used, availability of fertilizers, availability of irrigation water, the presence of unpredictable weather and climate changes and harvest time and sugarcane farmers most of them behave risk-averse. Research on the bud chip method has also been carried out by [18], [19]and [20]. The results show that sugarcane farming using the bud chip method is more efficient than using conventional methods. The relevance of previous research to this study is that both want to know the magnitude of risk and risk preferences of farmers. However, many previous studies focused on non-sugarcane commodities, in addition, research on bud chips only focused on efficiency. Furthermore, the novelty of this research is to compare the magnitude of risk and risk preferences of sugarcane farming by using bud chip and conventional methods. This study aims to (1) analyze the magnitude of the risk of sugar cane production with bud chips and conventional methods; (2) Identifying the risk preferences of sugarcane farmers with the bud chip method and conventional methods.

2. Materials and Methods

2.1 Data collection methods

This research was carried out in East Java Province, specifically at PT Perkebunan Nusantara X (Kediri Regency, East Java Province, Indonesia). The research location was chosen purposively because the Kediri area is one of the centers of sugar cane production in East Java. This research was conducted from June to August 2018.

The research data used are primary and secondary data. Primary data obtained through interviews with sugarcane farmers who cultivate sugarcane using the bud chip method and conventional methods. Respondents were selected using the incidental method. The respondents chosen were farmers who sold sugar cane at PG Meritjan, PG Pesantren Baru and PG Ngadirejo. The number of respondents was 60 farmers (farmers who used the bud chip method were 20 people and farmers with the conventional method were 40 people).

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2.2 Data analysis

The analysis used to determine the amount of risk of sugarcane production both with bud chip and conventional methods is to calculate the coefficient variation. The formulations are as follows:

1. Variance

The variance value indicates deviations or production risks faced by sugarcane farmers. Variance values can be written using the following formula:

$$\sigma^2=p_1(Y_1-\hat{Y})^2+p_2(Y_2-\hat{Y})^2+p_3(Y_3-\hat{Y})^2 \quad (1)$$

Explanation:
σ^2 = *Variance* of sugarcane productivity (bud chip method and/or conventional)
p_i = Opportunities farmers to obtain the highest productivity, normal and lows.
Y_i= Sugarcane productivity (Ton/Ha)
$\hat{Y}_i$= Productivity expectation of sugarcane with bud chip method and/ conventional (Ton/Ha)

2. Standard Deviation

Standard deviation can be used to determine the magnitude of the risks faced by sugarcane and conventional method of sugar cane farming. Mathematically can be written as follows:

$$\sigma_i =\sqrt{\sigma^2} \quad (2)$$

Explanation:
σ^2 = Variance from sugarcane productivity with bud chip and/or conventional method
σ_i = Deviation standard of sugarcane productivity with bud chip and/or conventional method

3. Coefficient Variation

The coefficient of variation is used to compare the productivity risks faced with the production of bud chip and conventional sugarcane methods. Mathematically coefficient variation can be written as follows:

$$CV= \sigma i / \hat{Y}_i \quad (3)$$

Explanation:
CV = Coefficient Variation
σ_i = Deviation Standard
$\hat{Y}_i$ = sugarcane productivity expectation with bud chip method and/or conventional

The production function and risk function of sugarcane production, both with the bud chip method and conventional methods, were analyzed using a model developed by Just and Pope. The model already accommodates risks in the production equation by including variances from production. [21] explain that the production function in the Just and Pope model that uses a two-step procedure is the Cobb-Douglas production function in the form of natural logarithms. The Just and Pope model was analyzed using Software Eviews 7. The Just and Pope production function model by including elements of risk is as follows:

Production Function:

$$f(x)= LnY_i = \beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 LnX_5 + \beta_6 LnX_6 + \varepsilon \quad (4)$$

Risk Function:

$$\sigma^2 Y_i = g(x)= (Y_i - \hat{Y}i)^2 \quad (5)$$

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Where the production risk in this study is the residual of the regression model (productivity variance) obtained from the difference between the actual production and the estimated production of the regression results. Production Risk Function:

$$g(x)= Ln\sigma^2 Y_i = \alpha_0 + \alpha_1 LnX_1 + \alpha_2 LnX_2 + \alpha_3 LnX_3 + \alpha_4 LnX_4 + \alpha_5 LnX_5 + \alpha_6 LnX_6 + \alpha_7 Ln\, e^{D1} + \varepsilon \qquad (6)$$

Explanation:
Y = Sugarcane production (ton)
$\hat{Y}$ = Estimated sugar cane production (ton)
β = Parameters estimated in the production function
α = Parameters estimated in the production function risk
X_1 = Land area (Ha)
X_2 = Seed (Ton)
X_3 = ZA fertilizer (00 kg)
X_4 = Ponska fertilizer (00 kg)
X_5 = Pesticide (liter)
X_6 = Labor (HOK)
D_1 = Dummy farming method (0 = conventional method; 1= bud chip method)

The utility approach is used to analyze the risk preferences of sugar cane bud and conventional farmers in the PTPN X Work Area. Sugarcane farmers both the bud chip and conventional methods are assumed to try to maximize utility and utility maximization approached with income maximization, and farmers get production yields y at the price level p, then the maximization of farmer utility is the utility U of profit π [22], then:

Max $U(\pi)$

$$\pi = p.y - r.x - C \qquad (7)$$

Explanation:
π = Profit of sugarcane farming using bud chip and conventional method (Rp)
r = Input price (Rp/input)
x = The number of inputs used
C = Fixed cost sugarcane using bud chip and conventional method (Rp)
p = sugarcane output price using bud chip and conventional method (Rp/Ton)
y = sugarcane production using bud chip and conventional method (Ton)
Sugarcane production is a function of the production equation and risk function as follows:

$$y = f(x) + g(x) \qquad (8)$$

by substituting equation (7) in equation (8) , then obtained:

$$U(\pi) = p.f(x) + p.g(x) - r.x - C \qquad (9)$$

The utility function for sugarcane farmers [U (π)] is:

$$U(\pi_i) = p.f(xi) + p.g(xi) - r_i (x_i) - C \qquad (10)$$

Where:
$U(\pi_i)$ = sugar cane farmer utility
$f(x)$ = sugarcane production function of the bud chip and conventional farming methods
$g(x)$ = Risk function of sugarcane farming method of bud chip and conventional
p = Price of output (rupiah/ton)
r_i = Price of input i (rupiah)

x_i = Amount of input i
C = Fixed costs of farming

From the equation, we will find First Order Condition (FOC) and Second-Order Condition (SOC) for each variable. First Order Condition (FOC) of the utility function:

$$U'(\pi_i) = p.f'(x_i) + p.g'(x_i) - r_i \quad (11)$$

Second-Order Condition (SOC) from the utility function:

$$U''(\pi_i) = p.f''(x_i) + p.g''(x_i) \quad (12)$$

To analyze the farmer's risk preference value by adopting Arrow-Pratt absolute risk-aversion (AR) obtained from the division between SOC and FOC values from the utility function, as follows:

$$AR = -\frac{U''(\pi)}{U'(\pi)} \quad (13)$$

Explanation:
AR = Absolute Risk Averse
U'(π) = First Order Condition of the function utility
U''(π) = Second Order Condition of the utility function
Sugarcane farmer can be said to be: (1) risk-averse if AR> 0, (2) risk-taker if AR <0, and (3) risk-neutral if AR = 0 [23].

3. Results and Discussion

3.1 Production and Risk Function of Sugarcane in PTPN X company

The risk often faced by sugarcane farmers is the risk of production which tends to fluctuate each season. The determination of sugarcane risk function used in this study is the Just and Pope model approach. Just and Pope model is a function model that estimates the production function together with the risk function (based on the value of variance). Furthermore, the preference of sugarcane farmers in facing risks is carried out using input allocation approaches used by farmers such as land area, seeds, ZA fertilizer, ponska fertilizer, pesticides, and the amount of labor used.

The production of sugar cane farmers in the PTPN X work area is planted using the bud chip method and conventional methods. The bud chip method in Colombia has been proven to produce high production (166 tons/hectare), but the bud chip method in Indonesia has not shown the desired results by farmers. This research specifically will compare the risks faced by farmers who use conventional and chip bud methods.

The factors that influence the risk of sugarcane production in PTPN X company can be seen in Table 1. The estimated results of the sugarcane production function in the PTPN X work area show that the land area variable has a significant influence on sugarcane production with a coefficient value of 0.789. The coefficient shows that an increase in the land area of 1 percent (ceteris paribus) can increase sugarcane production by 0.789 percent. Based on the coefficient value, the land variable is the most responsive variable compared to other variables. This implies that to increase sugarcane production in the PTPN X COMPANY region, it is necessary to expand sugarcane land. The results of the study are in line with research by [24], [25], [4] and [26] which show that land area has a positive effect.

Sugarcane seedlings also have a significant effect on sugarcane production of -0,101. This means that for every 1 percent increase of seedlings used assuming ceteris paribus, it will reduce sugarcane production by 0.101 percent. Therefore, efforts to increase sugarcane production in the work area of PTPN X company need to be supported by a reduction in sugarcane seedlings. This research is the opposite of [18]; [27]; [2] and [28] which shows that seedlings have a positive effect on production. The use of seeds per hectare in PT Perkebunan Nusantara X amounted to 48,000 seedlings.

Labor is one of the variables that significantly affect sugarcane production with a coefficient of -0.171. This value indicates that there is excess use of labor in the PTPN X work area where an increase in labor use will reduce sugarcane production. Sugar cane farming is labor-intensive, but the use of labor in PTPN X's work area is already relatively high. In one hectare of sugar cane land in the work area of PTPN X company, a workforce of 157 HOK is used. This amount is higher than the results of [29] research which shows the use of labor in sugarcane farming in Swaziland is 32-32 Man Days / Hectare. The results of this study show the opposite relationship with the research of [30], [27], [2], and [26] which shows that labor has a positive effect on sugarcane production. The implication is that there is a need to reduce the number of workers, especially labor for the harvest to increase sugarcane production in the work area of PTPN X company.

Table 1. Production and Risk Function of Sugarcane

Variable	Coefficient	Error Standard	t-test
Production Function			
Constant	2.001	1.43	2.31
Crop Land(ha)	0.789**	0.51	3.67
Seed (ton)	-0.101**	0.14	-3.02
ZA fertilizer (00 Kg)	0.020	0.22	0.76
Ponska fertilizer (00 Kg)	0.129	0.11	0.54
Pesticide (liter)	0.013	0.27	0.71
Labor(HOK)	-0.171*	0.39	2.73
F-test	6.41	Prob. F. (0.000)	
Adj. R^2	0.781		
Risk Function			
Constant	-1.305	1.78	-0.66
Crop Land(ha)	-0.411**	0.32	-3.10
Seed (ton)	0.093*	0.14	2.67
ZA fertilizer (00 Kg)	-0.229	0.03	-1.49
Ponska fertilizer(00 Kg)	-0.147**	0.51	-3.55
Pesticide (liter)	-0.100	0.07	-0.98
Labor(HOK)	0.125*	0.71	2.81
Dummy Bud chip	0.184**	0.36	4.02
F-test	7.763	Prob. F (0.000)	
Adj. R^2	0.818		

Description: ** has a significant effect on the level of $\alpha = 1\%$,
* has a significant effect on the level of $\alpha = 5\%$

Other variables such as the use of ZA fertilizer, ponska fertilizer, and pesticides do not affect the production of sugar cane in the work area of PTPN X company. This is because the availability of fertilizer in PTPN X company is still limited in both subsidized and non-subsidized fertilizers, so most farmers apply fertilizer use with the addition of molasses produced from sugar production.

Table 1 shows the factors that influence the risk of sugarcane production in the work area of PTPN X company. There are five variables that affect production risk, namely land area, seedlings, fertilizer, fertilizers, labor and planting methods. Land area variable has a negative effect on the risk of sugarcane production. This shows that each addition of sugarcane land area will reduce the production risk faced by farmers. These results are in contrast with the studies of [31] and [32] which concluded that land area is a variable that increases production risk.

Seedlings are factors that increase production risk with a coefficient of 0.093. This shows that the increased use of seeds tends to increase production risk. These results contradict research by [32] which shows that seedlings will reduce production risk. The use of seedlings in the PTPN X work area is 48,000 seedlings per hectare. This value is relatively large so that it will affect the distance of sugarcane planting and will have implications for the production to be produced.

Ponska fertilizer is a variable that reduces the risk of sugarcane production. Ponska fertilizer has a negative value which means that every additional use of Ponska fertilizer will reduce the risk of sugarcane production. This is consistent with research by [31]; [32] and [33] which show the use of fertilizers will reduce the risk of production. The use of fertilizers in the work area of PTPN X company has limited availability so that an increase in the amount of fertilizer will reduce the risk of sugarcane production.

The use of labor in the PTPN X work area is a factor that raises production risks. This is indicated by the coefficient that is positive. This study is in accordance with [17] research which shows that the use of labor in the PTPN X company region is relatively high so that it will increase the risk of sugarcane production. Although sugarcane farming is classified as labor-intensive if the use of labor exceeds it will tend to increase the risk. This is not in line with research by [31] and [33] which shows that labor is a variable that will minimize the risk.

In addition to the above factors, sugarcane planting methods also have implications for increased production risk. Where the method of planting with conventional methods tends to increase the risk compared to the bud chip method, where the conventional method requires around 48,000 buds per hectare, while the bud chip method only requires 9,000 to 12,000 buds per hectare.

3.2 The magnitude of Risk of Cane Production in Bud Chip and Conventional Methods

The magnitude of the risk of sugarcane production in PTPN X companyis analyzed by calculating the sugarcane productivity variance. Sugarcane productivity is indicated by the lowest, normal and highest production values. The productivity of sugar cane farming is known as follows:

Table 2. The Magnitude of the Risk of Sugar Cane Production with Bud Chip and Conventional Method

Variable	Conventional Method	Bud chip Method
Lowest productivity (Ton/ha)	71.8	92.1
Normal productivity (Ton/ha)	95.3	117
Highest productivity (Ton/ha)	139	157
Lowest Opportunity	0.23	0.38
Normal Opportunity	0.62	0.19
Highest Opportunity	0.15	0.43
Expectations Productivity (Ton/ha)	96.5	124.7
Variance	413.4	863.7
Deviation Standard	20.3	29.4
Coefficient Variation	0.211	0.236

Table 2. Shows that the productivity of sugarcane using the bud chip method is higher than the productivity of sugarcane using conventional methods. The highest productivity using the bud chip method is 157 tons/hectare, higher than the conventional method (139 tons/hectare). The average sugarcane productivity value with the bud chip method is 124.7 tons/hectare, while the sugarcane farmers using the conventional method have an average productivity of 96.5 tons/hectare).

The above results are in accordance with Research of [18], [19] and [20] which shows that Bud Chip technology is able to increase sugarcane production between 122.6 Tons/hectare up to 156.67 Tons / Hectare. This value is relatively high compared to the production potential using a conventional system which is only 139.91 tons/hectare. This is because by applying bud chip technology, it can produce 8-12 sugarcane stems with a uniform diameter, whereas the cultivation technique with conventional systems is only able to produce 5-8 sugarcane stems with various diameters.

Despite having high productivity, the bud chip method has a higher production risk than the conventional method. This is indicated by the coefficient of variation produced in sugarcane farmers with a bud chip system (0.236) higher than farmers with a conventional system (0.211) (Table 2). Measurement of the amount of risk in this research can be seen from the values of variance, standard deviation, and coefficient of variation. High variance and coefficient of variation results in high risk.

The coefficient of variation shows that high productivity produced by farmers using the bud chip system can be achieved if farmers apply Good Agriculture Practices (GAP). Sugar cane with a bud chip system requires very intensive management because it requires intensive watering, regular fertilizing and regular picking processes. Therefore, although the bud chip system is capable of producing high productivity, sugarcane farmers do not want to apply the bud chip method because of the high risk.

3.3 Farmer's Risk Preferences with the Bud Chip and Conventional Methods

The preference of sugarcane farmers in taking risks or avoiding production risks depends on the utility received by the farmer from the output produced. The estimated risk preference value is used to calculate the Absolute Risk Averse (ARA) value. Farmers are risk-averse if they have ARA> 0, Neutral Risk if ARA value = 0 and risk-taker If AR value <0. The value of sugarcane farmers' risk preferences both with bud chip and conventional methods is shown in Table 3.

Table 3. Farmer's Risk Preference with the Bud Chip and Conventional Method

Description	AR Value	Risk Preference
Conventional Method	0.0024	Risk-averse
Bud Chip Method	-0.0547	Risk-taker

Table 3 explains that the ARA value of sugarcane farmers with conventional methods is 0.0024. The positive ARA value means that sugar cane farmers using conventional methods are risk-averse. The majority of farmers using conventional methods are risk-averse as many as 34 farmers (85% of the sample of conventional methods farmers). This shows that farmers with conventional methods like to avoid production risks. The farmer will not take the risk by choosing the bud chip method because there are risks and uncertainties in production. This is in accordance with research [13]; Roger and Engler (2008); [15]; [16] and [34] which show that small-scale farmers are generally risk aversion.

Farmer's behavior using the bud chip method has a negative ARA value of -0.0547. The ARA value implies that farmers have the courage to take production risk (risk takers). 18 farmers out of 20 sample farmers who used the bud chip method were risk-takers. The data confirms that farmers who use the bud chip method are more willing to take risks compared to farmers with conventional methods. This is also shown by the behavior of sugarcane farmers with the bud chip method which is more daring in implementing intensive cultivation systems (regular irrigation and regular fertilization), in addition, farmers with the bud chip method are bolder in spending higher costs (for purchases seeds, labor costs, and fertilizer purchases) although the production to be produced is not necessarily high.

Therefore, intensive training and assistance from the sugar factory are needed to improve the application of bud chips at PTPN X company. In addition, seed and capital assistance are also needed Sugarcane cultivation with bud chip technology can also be carried out on the land with technical irrigation because the bud chip system requires intensive irrigation.

4. Conclusions

There are five variables that affect production risk, namely land area, seedlings, fertilizer, fertilizers, labor and planting methods. Sugar cane farmers with the bud chip method have a higher risk of

production than conventional methods; Sugar cane farmers with bud chip method classified as a risk-taker and sugar cane farmers with conventional methods were risk averters
Intensive training and assistance from the sugar factory are needed to improve the application of bud chips at PTPN X company. In addition, seed and capital assistance are also needed sugarcane cultivation with bud chip technology can also be carried out on the land with technical irrigation because the bud chip system requires intensive irrigation.

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