

Cocoa Producers' Decision on Fermenting Beans in Jembrana Regency, Bali Province, Indonesia

I Gusti Agung Ayu Ambarawati

Agribusiness Study Program, Faculty of Agriculture,
Udayana University, Indonesia

Ni Puspa Ayu Esterina

Agribusiness Study Program, Faculty of Agriculture,
Udayana University, Indonesia

ABSTRACT

Cocoa bean has an important role in the agricultural economy of Indonesia for its foreign earnings. Demand for high quality of cocoa beans is increasing fast due to the expansion of global cocoa and chocolate market. Bali Province also plays an important role in Indonesia's cocoa production and export where the main cocoa plantation lies in Jembrana Regency cultivated by small-scale farmers. Chocolate industry requests for high quality cocoa beans from fermented cocoa for high prices, however farmers are still reluctant to do fermentation. This study aims at analyzing probability of farmer's decision to ferment cocoa beans at Jembrana Regency, Bali Province, Indonesia. Logit regression was utilized where the dependent variable is in binary, which is the change in probability of a cocoa producer choosing to ferment their cocoa beans, given the independent variables included farm size, production and other occupation of farmers. The result from the average marginal effect shows that only production variable is significant to increase the probability of the cocoa farmers to ferment their cocoa beans. Result from the analysis indicates that on average for one kilogram increase in cocoa production per month, the probability of observing increases fermentation by approximately 0.26 percentage point. In other words, higher production volume increases the probability of the cocoa producers to ferment their cocoa beans. It is suggested to multi stakeholders in cocoa industry to further improve production through the implementation of good agricultural practices (GAP) and extending training for cocoa farmers.

Keywords: cocoa beans, fermentation, logit, Jembrana, average marginal effect

INTRODUCTION

Demand for cocoa beans in the world market is increasing in line with growing trend of chocolate industries. The global cocoa and chocolate market is projected to grow from \$48.29 billion in 2022 to \$67.88 billion by 2029, at a CAGR of 4.98% in forecast period (Fortune Business Insights, 2022). This implies that cocoa beans are most essential and valuable input for the chocolate industry. In terms of supply and demand, there must be challenges for the chocolate industry to maintain the supply standard products with the availability of standard

raw material coming from cocoa beans. This phenomenon is a promising opportunity for cocoa producing countries like Indonesia to fulfill the growing chocolate demand.

Cocoa bean is one of the important export commodities for Indonesian's foreign earnings. Indonesia has experienced in cocoa export since the last 20 years, resulting from massive growth of cocoa plantation, mainly from smallholder farmers. Indonesia is known as the third largest cocoa producer in the world after Ivory Coast and Ghana. The main cocoa producing area in Indonesian is the island of Sulawesi accounting for 60 percent of the country's total production. Despite of major player in the world market, cocoa production in Indonesia has been facing a decline figure. Several reasons such as aging trees and lack of maintenance. Data from Statistics Indonesia exposed that cocoa production in 2018 achieved 767,400 tons and decreased to 650,612 tons in 2022, a decline of 3.81 percent per year in average (Statistic Indonesia, 2023). In terms of quality, Indonesian cocoa is known for producing inconsistent quality resulting in low price competetiveness in the world market. ICCO noted that only 10 percent of cocoa export from Indonesia in categorized as 'fine' or 'flavoured' (FAO, 2024).

The government of Indonesia (GoI) has implemented several policies to boost farmer's productivity together with private initiatives, including improved seedling, input subsidies and access to financial services. The National Movement for Cocoa Fermentation or GERNAS in 2014 started as a key point to gear Indonesian cocoa production. (Glorya and Nugraha, 2019). Recent commitment was on the program of Transforming the Cocoa Sector in Indonesia through Value Addition for Smallholders (abbreviated as Traction's) to support sustainable cocoa fermentation (Yusuf, 2022). It is expected that farmers will get high price from the improved quality of cocoa beans.

Bali Province is one of Indonesia provinces has an important role in cocoa production and export. Cocoa is one main agricultural export commodity of Bali where main development of cocoa plantation lies in Jembrana Regency. Data from Bali Statistics (2022) showed that Bali total cocoa production was 13,876 tons and 45 percent of it came from Jembrana regency. Cocoa production in Jembrana has increased doubled from 2019 to 2021. Cocoa production in 2019 was only 2,942 tons, while a slightly increase in 2020 up to 3,009 tons and achieved 6.341 tons in 2021. These increase productions came from newly rejuvenated harvest in the previous years. Cocoa production in Jembrana is expected to increase from some more rejuvenated tress, supported by the Jembrana Regent and Ministry of Agriculture.

Strong commitment to improve quality of cocoa through fermentation has been carried out by the Jembrana Regent and other stakeholders in Jembrana Regency. This appears in Traction's commitment where seven producing cocoa areas in Indonesia decided to commit for sustainable fermented cocoa (Yusuf, 2022). Like many other cocoa producing areas in Indonesia, farmers to some extend are reluctant to ferment their cocoa for several reasons (Arsyad et al., 2013; Soemarno et al., 2015 and Hariyati, 2016). Results study from Soemarno et al. (2015) in Jembrana Regency exposed that unsuitable fermented cocoa price compared to unfermented, the number of village collectors to buy unfermented cocoa and insufficient ability to conduct fermented technology were contributable reasons for not conducting fermentation. Consistent with previous study, Hariyati (2016) indicated that farmers are unwilling to sell fermented cocoa because there are buyers purchasing unfermented cocoa. There are chances

for farmers to sell their cocoa with slight effort of sun drying for two to three days and village collector will buy.

There are numbers of research on reluctance of farmers conducting cocoa fermentation such as Arsyad et al. (2013), Sumarno et al. (2015), Hariyati (2016) and Rifin (2020). This study will provide more information on the probability of farmer decision to ferment cocoa beans in Jembrana Regency, Bali Province, Indonesia.

RESEARCH METHODS

Location of the research was selected purposively in Jembrana Regency, as the main cocoa production in Bali. Further two villages were selected as representatives of areas where farmers conduct fermentation and not. Cocoa farmers in Ekasari village conduct cocoa fermentation while unfermented for cocoa farmers at Blimbingsari village. The number of farmer's respondents in this study was selected based on the numbers of population (cocoa farmers) in these two villages. By using Slovin criteria with the error of 10 percent, the total number of respondents were 78 farmers.

This research used a survey method by visiting respondents on the location of the study. Farmers were selected randomly in both villages and they agreed to be interviewed. Primary data from farmers were collected by using prepared questionnaires while secondary data were obtained from official publication such as Statistics Indonesia. Cocoa data observed from farmers were average production during June 2022 to May 2023.

A logistic regression (logit) model was used in this study to answer the research question on the probability of farmer's decision to ferment their cocoa beans. Primary data collected from farmers include age, farm-size holding, cocoa production, other occupation than cocoa farming, and length of experience cocoa farming.

The model was developed using three explanatory variables, namely farm size, production and other occupation of farmers apart from cocoa farming to the one response variable P (Fermentation = 1). The model is shown below:

$$P(\text{Fermentation} = 1) = \frac{e^{(\beta_0 + \beta_1 \text{Farm Size} + \beta_2 \text{Production} + \beta_3 \text{Other Occ})}}{1 + e^{(\beta_0 + \beta_1 \text{Farm Size} + \beta_2 \text{Production} + \beta_3 \text{Other Occ})}}$$

where:

- $P(\text{Fermentation} = 1 \text{ and } 0 \text{ for not fermenting cocoa})$
- β_0 = constant
- $\beta_1, \dots, \beta_3$ = regression coefficients
- Farm Size = Farm size of cocoa farmers (ha)
- Production = average cocoa beans harvested (kg/month)
- Other Occ = other occupation of farmer ($y = 1$)

Other primary data collected not included in the logit model were used to support results of the study such as age, education, length of cocoa farming experience.

RESULTS AND DISCUSSION

Characteristics of Cocoa Farmers in Jembrana Regency

Table 1 shows the characteristics of cocoa farmers in Jembrana Regency including age, level of education, farm size, cocoa production, other occupation and length of experience in cocoa farming. The characteristics of farmers are separated into two categories, namely farmers conducting fermentation (Ekasari Village) and unfermented (Blimbingsari Village).

Table 1: Characteristics of Cocoa Farmers in Jembrana Regency

No	Description	Fermented (Ekasari Village) N= 38	Unfermented (Blimbingsari Village) N=40
1	Average age (year)	51.68	60.10
2	Level of education -High school -Diploma	25 (65.80%) 6 (15.78%)	19 (47.50%) 18 (45.00%)
3	Farm size	1.39	1.32
4	Average cocoa production (kg/month)	85.89	47.90
5	Other occupation	10 (26.32 %)	19 (47.50%)
6	Cocoa farming experience (years)	10.71	16.15

Cocoa farmers in the study area are old enough, which the average age is more than 50 years. Farmers of unfermented cocoa are much older than that of fermented village (Table 1). Younger farmers are assumed to have a higher probability to ferment their beans since they have more capability to conduct fermentation. The process of fermentation takes some more times and efforts therefore younger farmers have more power to conduct fermentation. A study by Rifin (2020) indicated that age was one significant factor affecting farmers to ferment their cocoa, while it was not a significant variable for farmers in Bali and West Sulawesi. In term of education, about two-third of farmers who fermented cocoa enjoyed their high school, while more educated farmers (enjoying diplomas) were in unfermented cocoa village. There is no such big difference in terms of farm size between the two villages (Table 1). Other interesting things can also be seen from Table 1. Average cocoa production in fermented village is much higher compared to the unfermented area. Almost half of farmers of unfermented cocoa had their other occupation such as driver, trader, and retired civil servants. Farmers in this village perceive that cocoa farming is not their main job. Unfermented cocoa farmers also had longer experience in cocoa farming compared to fermented cocoa farmers. It implies that longer experience in cocoa farming does not guarantee to ferment cocoa beans. In this study, farmers were asked their reasons for not fermenting their cocoa. Farmers were free to talk about their rationale grounds and it came up into three main reasons. Table 2 shows reasons of farmers for not fermenting their cocoa and will be explained descriptively without any statistics test.

Table 2: Reasons of farmers for not fermenting cocoa in Jembrana Regency (N=40)

No	Reason for not fermenting	Percentage (%)
1	Age of farmers (old)	60
2	Not enough production capacity to ferment	30
3	Low price incentive between fermented and unfermented cocoa	15

Majority of farmers were saying that their age made them reluctant to ferment their cocoa. As can be seen from Table 1, the average age of farmers in unfermented cocoa village was 60 years, while almost 52 years at fermented cocoa area. If they are willing to ferment, they have to hire some workers to carry out the job and more cost of production. By the same time, there is market for unfermented cocoa which is very low-price difference between fermented and unfermented cocoa. Farmers can sell their cocoa with 2-3 days of sun-drying with the average price of IDR 31,625/kg while IDR 48,000/kg for fermented cocoa (only 52% above the unfermented cocoa). However, it takes 5 days to proceed wet cocoa to ferment and it needs 3kg of raw cocoa to obtain 1kg fermented cocoa.

Another reason for farmer's unenthusiastic in fermenting cocoa is because of their production capacity. Table 2 reveals that one-third of farmers do not want to ferment their cocoa because they feel their production capacity is still low. Farmers in Jembrana regency carry out fermentation in a collection action with other members under the agreement of farmer's group. It needs 50 kg of wet cocoa to ferment in a box. Farmers at unfermented village feel that their production capacity is inadequate to fulfil one box every time to ferment whereas there is market for unfermented cocoa.

Probability of Farmers to Ferment Cocoa

Matrix correlation among independent variables is presented in Table 3. Average cocoa production per month shows the only independent variable has high correlation with farmer's decision to ferment. It was assumed previously in the model that farm size and other occupation were two variables have high correlation with farmer's choice to ferment, in fact the correlation matrices show a negative sign.

Table 3: Correlation matrix among independent variables

Variables	Fermentation	Farm Size	Production	Other Occupation
Fermentation	1.0000			
Farm Size	0.0294	1.000		
Production (Wet)	0.3221	0.0200	1.000	
Other Occupation	-0.1539	-0.1731	-0.1939	1.000

Results of logistic regression of farmer's decision to ferment their cocoa beans in Jembrana Regency is presented in Table 4. It shows that among three explanatory variables, only average cocoa production per month gives significant sign at 95% of level of confidence. The figure of average marginal effect (AME) was 0,0026057 indicates that an increase by one kilogram of cocoa production, the probability of cocoa to ferment is 0.026%. The figure of AME gives information on the effect on the probability of independent variables when dependent variable increases by one unit. According to Perrignon (2019), marginal effect is a way of presenting results as differences in probabilities, which is more informative than odds ratios. Since a probit is a non-linear model, that effect will differ from one to another.

This study finds that the probability of farmers to ferment their cocoa beans is very low for every one unit increase in cocoa production. It implies that there needs actions or initiatives to boost production and productivity of cocoa beans, resulting in higher figure of probability to cocoa fermented. Result from Rifin' study (2020) observed that cocoa farmers in Bali who participated in fermentation training have 4.38 times of fermenting probability compared to

farmers without any experience in fermentation training. This should be taken into consideration by multi-actors in the cocoa industry including government, private sectors, NGO to further increase cooperation initiatives to take care of production management to enhance livelihood of farmers.

Table 4: Logistic regression of farmer's decision to ferment their cocoa beans

Variable	Fermentation	Average Marginal Effects
Farm Size (Ha)	0.0151	0.003356
	(0.198)	(0.0439109)
Production (kg/month)	0.0118**	0.0026057**
	(0.00470)	(0.000878)
Other Occupation (yes=1)	-0.407	-0.0901873
	(0.492)	(0.1071841)
Constant	-0.623	
	(0.562)	
Observations	78	
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Other independent variables such farm size and other occupation did not have any effect on the probability of farmer to ferment (Table 4). This is similar to the case study by Soemarno et al. (2015) that number of tresses did not have any impact to farmer's decision to ferment in West Sumatera, while Rifin (2020) remarked that dummy of main occupation in West Sulawesi has a significant effect on farmer to decide fermentation.

Recalling result of this study that the probability of farmers to ferment for every kilogram of wet cocoa to ferment is low, it is suggested that multi-stakeholders will work together to improve cocoa production and its quality to meet the world cocoa demand and increase farmer's income from high price of fermented cocoa. Glorya and Nugraha (2019) reported that local NGO Kalimajari Foundation has developed farmer's training on fermentation and other supervision in Jembrana Regency. It was further reported that farmers applied fermentation technology under the farmer's group coordination (*Subak Abian*, in local name). Together with Rifin's result (2020) that fermentation training gives 4.38 times for farmers to ferment their cocoa, private initiatives should be kept in line with government programs to improve cocoa production and quality in the producing area.

CONCLUSION

This study finds that production of wet cocoa per month is an important factor affecting the probability of farmers to ferment. It denotes that higher production volume increases the probability of the cocoa producers to ferment their cocoa beans. It is suggested to multi stakeholders in cocoa industry to further improve production through the implementation of good agricultural practices (GAP) and extending training for cocoa farmers.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Arsyad, M., Nuddin, A., and S. Yusuf. 2013. Strengthening institutional towards smallholder's welfare: Evidence from existing condition of cocoa smallholders in Sulawesi, Indonesia. *Ryukoku Journal of Economic Studies*. 52(1/2): 71-86.

FAO. 2024. Indonesia Upgrading Bulk Bulk Cocoa into Fine Cocoa. Available from <https://www.fao.org/one-country-one-priority-product/asia-pacific/good-practices/detail/indonesi-upgrading-bulk-cocoa-into-fine-cocoa/en>. Accessed on 1 February 2024.

Forune Business Insight. 2022. Cocoa and Chocolate Market. Available from <https://www.fortunebusinessinsights.com/industry-reports/cocoa-and-chocolate-market-100075>. Accessed on 31 January 2024.

Glorya, M.G. and A. Nugraha. 2019. Private Sectors Initiatives to Boost Productivity of Cocoa, Coffee and Rubber in Indonesia. Discussion Paper No. 9. Center for Indonesia Policy Studies, Jakarta.

Hariyati, J. 2016. The Management Product in the Farmers Level and the Role of Supporting Institutions for Cocoa Fermentation Process. *Agriculture and Agricultural Science Procedia* 9 (2016) 128 – 133.

Perraillon, M.C. 2019. Interpreting Model Estimates: Marginal Effects. Available from <https://clas.ucdenver.edu/marcelo-perraillon/codeand-topics/marginal-effects>. Accessed on 31 January 2024.

Rifin, A. 2020. Which Farmers Ferment Cocoa Beans in Indonesia? *J. ISSAAS* Vol. 26, No. 1: 123-131.

Soemarno, D., Haryati, Y., Abdoellah, S. and D.F.S. Hartatri. 2015. Study on incentive price of fermented cocoa to overcome reluctance of farmers to apply fermentation: Case study in Jembrana Regency. *Pelita Perkebunan*. 31(2): 130-141.

Statistics Indonesia. 2023. Indonesia Cocoa Statistics 2022. Available from <https://bps.go.id/publication/2023>. Accessed on 31 January 2024.

Yusuf, N.F. 2022. Tujuh Pemkab komitmen majukan usaha fermentasi kakao berkelanjutan. *Antara News*. <https://www.antaranews.com/berita/2810373/tujuh-pemkab-komitmen-majukan->