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[All issues](#) ▶ [Volume 444 \(2023\)](#)[◀ Previous issue](#)[Table of Contents](#)[Next issue ▶](#)

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## E3S Web of Conferences

Volume 444 (2023)

### 4<sup>th</sup> International Conference on Agribusiness and Rural Development (IConARD 2023)

Yogyakarta, Indonesia, August 9-10, 2023

Widodo, Triyono, Susanawati, N. Rahmawati, Z. Rozaki, R. Wulandari, M. Senge, M.F. Kamarudin, M.M. Tjale, Y. Witono and J.H. Mulyo (Eds.)

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Statement of Peer review

Published online: 14 November 2023

PDF (130 KB)

▼ Sustainable Agriculture

▼ Agricultural Economic and Business

▼ Rural Environment Development

▼ Agricultural Technology and Smart Farming

 [Open Access](#)

Preface 00001

Widodo, Triyono, Susanawati, Nur Rahmawati, Zuhud Rozaki, Retno Wulandari, Masateru Senge, Modh Fauzi Kamarudin, Malose Moses Tjale, Yuli Witono and Jangkung Handoyo Mulyo

Published online: 14 November 2023

DOI: <https://doi.org/10.1051/e3sconf/202344400001>

PDF (224.2 KB)

#### - Sustainable Agriculture

 [Open Access](#)

Agriculture and International Organization in Indonesia: The Twitter Analysis of FAO Indonesia 01001

Ali Maksum, Sitti Zarina Alimuddin, Ahmad Sahide, Ali Muhammad and Hilman Mahmud Akmal Ma'arif

Published online: 14 November 2023

DOI: <https://doi.org/10.1051/e3sconf/202344401001>PDF (638.3 KB) | [References](#) [Open Access](#)

Urban Farming in Pandemic Covid-19 and How the Economic Impact Analysis for Communities Kauman Village, Malang City 01002

Ni'matul Istiqomah, Wahjoedi, Lutfi Asnan Qodri and Norfaridza bint Mohd Radzi

Published online: 14 November 2023

DOI: <https://doi.org/10.1051/e3sconf/202344401002>PDF (1.597 MB) | [References](#) [Open Access](#)

Sustainable agricultural development through agribusiness approach and provision of location specific technology In North Sulawesi 01003

Jantje G. Kindangen, Agustinus N. Kairupan, Gabriel H. Joseph, Jefni B.M. Rawung and Rita Indrasti

Published online: 14 November 2023

DOI: <https://doi.org/10.1051/e3sconf/202344401003>PDF (1.410 MB) | [References](#)

---

[Open Access](#)

Farmers' Decision to Delay Selling of Coffee in West Lampung, Indonesia 02038

Fembriarti Erry Prasmatiwi, Asyifa Rahmita Zahra, Rusdi Evizal and Tri Novi Astuti

Published online: 14 November 2023

DOI: <https://doi.org/10.1051/e3sconf/202344402038>

PDF (1.565 MB) | [References](#)

---

[Open Access](#)

Feasibility and Risk Analysis of Red Chili Farming With Irrigation Systems on Coastal Sandy Land, Bantul 02039

Francy Risvansuna Fiwintari, Hanifah Salaf Iswara and Tearine Barnabas

Published online: 14 November 2023

DOI: <https://doi.org/10.1051/e3sconf/202344402039>

PDF (1.503 MB) | [References](#)

---

[Open Access](#)

Efficient Production Factors Taking into Account The Risks In Shallot: Case Study in Nawungan Village, Imogiri District, Bantul Regency, DIY 02040

Sriyadi, Nurul Hanifah, Bambang Heri Isnawan, Budiarto and Nik Rahila Wan Ibrahim

Published online: 14 November 2023

DOI: <https://doi.org/10.1051/e3sconf/202344402040>

PDF (1.472 MB) | [References](#)

---

[Open Access](#)

Perceptions Of Farmer Group Members Towards The Implementation Of The Vegetable Alley In Yogyakarta City 02041

Sriyadi, Finka Aulina, Nurul Hanifah and Nor Lailatul Azilah Hamdzah

Published online: 14 November 2023

DOI: <https://doi.org/10.1051/e3sconf/202344402041>

PDF (1.519 MB) | [References](#)

---

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## PREFACE

The 4th International Conference on Agribusiness and Rural Development (IConARD) 2023 was held virtually on 9-10 August 2023. This conference focused on "Global Environment Challenges In Agriculture."

Global climate change that affects global warming has been scientifically proven based on data trends of increasing temperature on earth. The increase in temperature based on trend data per hundred years from 1906-2005 shows that there was an increase in temperature nearly doubling in 1956-2005. This fact makes climate change a necessity as well as an issue of concern to the global community, including Indonesia. The influence of climate change on the agricultural sector in Indonesia is multidimensional, starting from resources, agricultural infrastructure, agricultural production systems, aspects of food security and self-sufficiency, as well as the welfare of farming households in general.

This influence has made changes to the agricultural sector which is very vulnerable to climate change because it affects cropping patterns, planting time, production, and yield quality. In addition, environmental changes will directly affect the supply chain of agricultural products, requiring integration with an environmental perspective into supply chain management including product design, selection and selection of sources of raw materials, manufacturing processes, delivery of final products to consumers and product management after expiration.

Adaptation at the farm household level in dealing with uncertain climatic conditions is determined by how many assets the household owns. Basically every household has adaptive capacity. However, the intensity of the power of adaptive capacity is largely determined by the number of assets controlled, especially agricultural land. The wider the agricultural land and assets controlled, the easier the adaptation efforts will be. This is because adaptation is closely related to the social and economic system it faces. Farm households must make improvements in the use and management of nutrients, pesticides, energy and water, using fewer of these inputs per unit of land. Farmers should make good progress in adopting practices that are more beneficial to the environment, such as conservation tillage, better fertilizer storage, or soil nutrient testing. Considering the importance of this issue, the 4th IConARD 2023 come up with the theme of Global Environment Challenges in Agriculture to provide a scientific forum that facilitate a mutual exchange of insights and discussion as well as prospective collaboration from highly diverse background.

This conference has participated by many researchers from Indonesia, Malaysia, Laos, Philippine, Thailand, Vietnam, Japan, South Korea, South Africa, Russia, and Kazakhstan. The diversity could bring various opinions about this concern issue. To ensure the published papers have high quality, the editorial board and reviewers of IConARD 2023 were experts in their related areas. The publications hope significantly contribute to increase the adaptation in global environment challenge.

We would like to deliver big gratitude to all participants, keynote speakers, committees, and other parties that helped this conference.

Committee of IConARD 2023

# Farmers' Decision to Delay Selling of Coffee in West Lampung, Indonesia

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**Abstract.** Robusta coffee is a leading export commodity in Lampung Province. Coffee farmers face the problem of high coffee price fluctuations. During the harvest season, the price of coffee will decrease, so farmers are advised to adopt a system of delay selling. This study aims to analyze the system of selling coffee by farmers and to analyze the determinants of coffee farmers' decisions to delay selling coffee. The research was conducted in West Lampung Regency in November-December 2022. The sub-districts of Way Tenong, Air Hitam, and Batu Brak were purposively selected as research locations. The number of samples is 190 coffee farmers taken by random sampling. Data were analyzed using binary logistic regression. The results showed that 26.84% of the farmers applied a system of delayed selling. Farmers stored coffee in the form of dry coffee fruit to delay selling between 1-10 months after the coffee fruit has dried. With a delayed selling system, farmers got a higher selling price. The determinants of a farmer's decision to delay selling coffee are farming experience, education level, coffee production, coffee price, household income, and number of family members.

## 1 Introduction

Coffee is a commodity that plays an important role in world trade and business [1,2]. Coffee farming is the main livelihood for millions of small farmers in more than 52 countries [3]. In Indonesia, coffee farming is important for the national economy, namely a source of people's income and a source of employment. Coffee is produced in more than 60 countries, but around 70% of the harvest is obtained in four countries, namely Brazil, Vietnam, Colombia and Indonesia. Indonesia is the fourth largest coffee producer and exporter in the world after Brazil Vietnam and Colombia [4].

Columbia, which is a traditional Arabica coffee producing country, is developing robusta coffee plantations, especially in lowland areas [5]. The average Indonesian coffee production from 2014-2018 was 662.75 thousand tons per year and contributed 7.13% to the total world coffee production. The average Indonesian coffee export in 2013-2017 was 462.61 thousand tons per year and provided a 6.40% share of the total world coffee exports [6].

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Coffee is a leading export commodity in Lampung Province. Lampung Province is the second largest contributor of coffee production after South Sumatra. Indonesian coffee production which mostly robusta coffee is also produce in others province including Bengkulu, North Sumatra, East Java, and South Sulawesi [7].

In 2021 the area of coffee plants in Lampung is 156,460 hectares with coffee production of 117,311 tons or contributing 15 percent of Indonesia's total coffee production [6]. Coffee production in Lampung is mainly produced by smallholder coffee plantations [8,9] which are managed in traditional system and labor intensive [10].

Coffee production in Lampung is concentrated in four regencies, namely West Lampung, Tanggamus, North Lampung and Way Kanan with a contribution of 94.35 percent of the total coffee production in Lampung Province. West Lampung Regency contributed the largest coffee production in Lampung Province, namely 52.57 thousand tons or contributed 47.55% of the total robusta coffee production in Lampung Province [11]. Even though it occupies the top position as a coffee center in Lampung, West Lampung Robusta coffee production is considered to be still fluctuating and facing production risks and price risks. Fluctuations in coffee production have an impact on the supply of coffee to the market and will also have an impact on varying coffee prices [12]. The risk of fluctuating coffee production may be caused by climate change [13].

Coffee is an agricultural commodity that has a high price volatility value which is characterized by high price fluctuations [14]. This price volatility causes farmers to face risks [15], namely production risk and also price risk. Price volatility can resulted in an uncertainty about price levels, investment decisions, and the amount of commodity production in the future. For coffee farmers, price volatility has significant consequences, making it difficult for farmers to estimate income and provide funds for coffee farming and household needs [16]. Meanwhile, fluctuations in coffee prices on the international market were caused by increased coffee supplies from various coffee exporting countries such as Brazil, Vietnam, Indonesia, Colombia and India. Price fluctuations and the rupiah exchange rate will have an impact on price conditions in the national market and the selling price of coffee received by farmers.

When the supply of coffee bean is high, which occurs during the harvest season, the selling price of coffee bean will decrease. On contrary, outside the harvest season, the supply of coffee bean will decrease. Farmers' income depends on the quantity sold and the price at sale, both of which vary greatly according to season and market location [3]. This condition can be a consideration for farmers to delay selling activities. Delay selling of coffee can help farmers to obtain high prices so that farmers can enjoy the benefit of their farming. The decision to delay selling is difficult for farmers to make because of the need for cash. So that farmers will sell their products immediately after harvest, even though the selling price received is low. Low prices at the farm level, reducing agricultural productivity and weakening investment in coffee farming [17].

So far, coffee farmers in West Lampung have found it difficult to implement a coffee selling delay system. Farmers are faced with the problem of low coffee production and urgent household needs. Farmers always value their harvest as a cash crop, so they sell their coffee immediately after harvest, even though at a low price. One alternative in preventing a drop in selling prices is to store coffee and postpone sales. Storage of harvested crops not only functions as a stock for consumption but also functions as a system of delaying sales in order to obtain a higher price. The delay in selling will affect farmers' income and coffee stock storage. Having coffee stocks will make it easier for farmers to make money when there is an urgent need, thus minimizing farmers' dependence on financial institutions that lend money at high interest rates. The economic benefit of delaying the sale of coffee is the price difference received by farmers after delaying the sale. This study aims to analyze the system

of selling coffee by farmers and to analyze the determinants of farmers' decisions to delay selling coffee.

## 2. Method

Data collecting was conducted in November-December 2022 in West Lampung Regency as a center for coffee production in Lampung Province. The sub-districts of Way Tenong, Air Hitam, and Batu Brak were selected purposively as research locations with the consideration that there are coffee farmers (associated in farmer groups) who have implemented coffee storage or delay selling coffee and there are also coffee farmers who do not delay selling. The research method used is a survey method. The number of samples in this study were 190 coffee farmers who were taken by random sampling in several villages, namely Fajar Bulan, Mutar Alam, Puralaksana, and Sukaraja in Way Tenong District, Gunung Terang Village and Sinar Jaya Village in Air Hitam District and Sukabumi Village in Batu Brak District.

The study used a quantitative descriptive analysis which was used to analyze the coffee sales system by farmers. Post-harvest processing of coffee from picking, drying, grinding and ready for sale takes between 2 weeks to 1 month. Coffee selling time varies. Coffee farmers who do not delay selling coffee are farmers who sell their coffee bean less than one month after harvest. Farmers who delay selling coffee, sell their crops more than a month after harvest. To analyze the determinants of farmers implementing a sale delay system, binary logistic regression analysis is used as follows.

$$\ln \frac{P_i}{1-P_i} = Z_i = \alpha + \beta_i X_i \quad (1)$$

$$Z_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots \dots \dots \beta_n X_n \quad (2)$$

$Z_i$  = probability of farmers to make decisions on delaying coffee sales

Where :

Probability P1 = P( $Z_i=0$ ) farmers do not delay selling coffee (sell coffee bean less than one month after harvest)

Probability P2 = P( $Z_i=1$ ) farmers delay selling coffee (sell coffee bean more than one month after harvest)

$X_1$  = farmers' age (year)

$X_2$  = experience in coffee farming (year)

$X_3$  = education (year)

$X_4$  = side job (dummy variable D =1, if farmers have side job, and D=0 if do not have).

$X_5$  = coffee land area (ha)

$X_6$  = coffee production (kg)

$X_7$  = coffee selling price (Rp)

$X_8$  = household income (Rp)

$X_9$  = family member (person)

$X_{10}$  = coffee certification membership (dummy variable D =1, if farmers have membership, and D = 0 if do not have)

To determine the effect of all independent variables together on the dependent variable, the Likelihood Ratio (LR) test is used. To test the effect of each independent variable on the dependent variable, the Wald Test is used.

### 3. Results and Discussion

Coffee farmers in West Lampung Regency are in productive age, which is in the age range of 38-57 years old with an average of 44 years old. The majority of farmers' education level is Elementary School which is in percentage of 45.26%. As much as 55.26% of farmers have family members ranging from 4-6 peoples. Coffee farming is the main occupation of farmers, namely 59.47% of farmers make coffee farming the only source of household income and 40.53% of farmers have side jobs for source of income.

The land tenure of farmers ranges from 1-3 hectares which an average 1.54 hectares is land of coffee cultivation. The majority of farmers cultivate their own farm land or their status are land owner. Most of the farmers have 15-28 years of coffee farming experience with an average of 18 years. Most of the coffee farmers in West Lampung Regency participate in the coffee certification program. Several schemes of coffee certifications that farmers followed are RA (Rainforest Alliance), 4C (Common Code for The Coffee Community) and organic coffee certification. These certification schemes implemented in Lampung has been reported by [18] and [19]. As much as 61.57% of farmers are members of the certification. Each certification member receives guidance from a partner company related to coffee farming in accordance with the certification standards followed by farmers. In addition to coaching, some certification members also receive assistance in the form of agricultural tools and machinery. Mitiku et al [20] reported that the price of coffee at the farm level is quite significantly higher for coffee that has certification than for coffee that is not certified.

One of the important tools in post-harvest coffee activities is the drying floor. Only 1.05% of coffee farmers in West Lampung use drying floors to dry their coffee fruit. As much as 98.95% of farmers dry their coffee products on the ground covered with tarpaulin. Drying work is done in the yard of the farmer's house or in the garden. Farmers who have gardens that are far from their homes, during the harvest farmers live in guard huts in the garden. Thus, drying activities are carried out in the garden. All farmers do not have a special room for storing post-harvest processed coffee beans before being sold. During storage, coffee is placed in the kitchen, living room, family room, even on the ceiling.

The coffee production of farmers in West Lampung Regency is 1,154.89 kg per 1.54 hectare or a productivity of 751.45 kg/ha. The farm-gate selling price of coffee is IDR 22,000/kg. Coffee farming income is IDR 29,291,006.55 per farm or IDR 19,020,134.12 per hectare. Coffee farming income is obtained from coffee income and income from intercropping plants. Farm household income comes from two sources, namely income from the agricultural sector (farm) and from non-agricultural sectors or side jobs (non-farm). Coffee farmer household income is IDR 37,056,856.13 per year.

#### 3.1 Coffee Selling Pattern

Coffee post-harvest activities generally take about 2 weeks consisting of pulping (breaking coffee beans using a pulping machine, or alternatives without pulping), drying for about 4 - 7 days (affected by sunlight conditions), hulling to obtain coffee beans, and sorting coffee beans. Farmers' coffee production in West Lampung Regency is 1,154.89 kg. Of this production, 94.47% or 1,091.06 kg was sold, 4.00% was used for hulling wages (from dried coffee cherries to coffee bean), 1.16% was for household consumption, 0.28% was used for social activities. The process of hulling the skin from dried coffee cherries into coffee bean take a cost of 4% or for every 25 kg of coffee bean obtained, farmers pay a cost of 1 kg of coffee bean. The next process after hulling is been sorting. The shrinkage of coffee beans at this sorting stage ranges from 0.09% which means that in 100 kg of coffee beans there will be 99.91 kg of coffee beans ready for sale. This finding is similar to [21] who reported that



coffee harvest and post harvest was high cost. The total cost of harvest and post harvest reached 20% of the kg of the coffee bean production.

**Table 1.** Allocation of use of coffee products by farmers

Allocation (kg)	Sum (kg)	Percentage
Sold	1,091.07	94.47
Hulling cost	46.20	4.00
Consumption	13.38	1.16
Social activities	3.23	0.28
Shrinkage of sortation	1.02	0.09
Coffee production	1,154.89	100

Farmers sell coffee in the form of rice coffee. Generally, farmers (87.36%) sell coffee to village middlemen who then sell coffee to wholesalers at the sub-district level. Furthermore, wholesalers sell coffee to exporters in Bandar Lampung. As much as 12.64 percent of farmers use other marketing channels, namely selling directly to district wholesalers. At the research sites, we found almost no difference in the way of marketing coffee for farmers who participated in the coffee certification program and those who did not participate in the certification program. The certification program does not oblige farmers to sell their crops to partner companies. Interestingly, we found one farmer selling some of his coffee products online.

The selling time of coffee varies from less than 1 month to 10 months after harvest. Farmers who sell their coffee less than 1 month after harvest (including for post-harvest) are categorized as not delaying sales. As previously explained, the post-harvest process of coffee until it is ready for sale takes about 2 weeks. As many as 71.58% of farmers do not delay selling coffee (selling their crops less than one month after harvest), meanwhile 28.42% of farmers postpone selling to wait for higher prices as shown in Table 2.

**Table 2.** Percentage of farmers implement sale delay system

Delayed selling	Number of farmer	Percentage
Not delayed (<1 month)	136	71.58
Delayed 1-2 month	27	14.21
Delayed 2-3 month	14	7.37
Delayed 3-4 month	7	3.68
Delayed 4-5 month	3	1.58
Delayed 5-6 month	1	0.53
Delayed > 6 month	2	1.05
Sum	190	100.00

Of the entire coffee production sold by each farmer (1091.07 kg), as much as 61.47% (or 670.71 kg) was sold less than 1 month after harvest. The remaining 38.53% is stored and sold in stages over several sales periods as presented in Table 2. Coffee is stored in the form of dry coffee cherries (coffee with skins) which are more resistant to storage than the bean form. During storage, dry coffee cherries are put in sacks and arranged in a certain room. Proper storage still produces good quality coffee beans.

**Table 3.** Weight of coffee sold per sales period

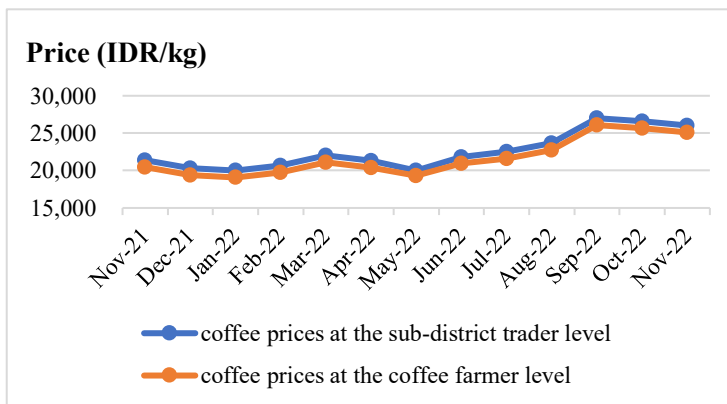
Delayed selling	Weight (kg)	Percentage
Not delayed (<1 month)	670.71	61.47
Delayed 1-2 month	212.54	19.48
Delayed 2-3 month	108.78	9.97
Delayed 3-4 month	66.45	6.09
Delayed 4-5 month	13.17	1.21
Delayed 5-6 month	11.57	1.06
Delayed > 6 month	7.86	0.72
Sum	1091.07	100.00

When the coffee will be sold, the skin of the dried coffee cherries is peeled into coffee beans. Coffee beans are coffee products that are ready to be traded, namely in the form of dry coffee beans that are free from fruit skin, horn skin and epidermis, with a water content ranging from 12-13%.

Coffee farmers do not delay selling because farmers need money to meet family needs which must be met immediately, especially for farmers with small coffee production and farmers who only rely on coffee farming as a source of income. Several farmers immediately sold their coffee production because they borrowed money from collectors and immediately had to pay with the money from the sale of coffee. The least coffee sales occurred at an interval of more than 6 months after harvest, which was 0.72% of the total coffee production owned by farmers. The price of coffee during this time period reached Rp. 25,676.00/kg, much higher than the initial period which only had a coffee price of Rp. 19,320.00/kg [22]. The coffee delay system provides direct benefits to farmers, namely getting a higher selling price. In addition, the sale delay system can also improve the coffee stock and distribution system.

### 3.2 Benefit of Coffee Sale Delay System

The coffee harvest season in West Lampung usually starts in April/May and ends in June/August. The flowers do not come out simultaneously, so the coffee cherries ripen gradually. During the main harvest, coffee supplies are abundant resulting in low coffee selling prices. The price received by farmers at harvest time is IDR 19,320.00/kg which occurred in May. The highest coffee price was in September of IDR 26,076/kg. There is a difference in the price of coffee at the level of farmers and sub-district traders, which ranges between Rp. 700-Rp. 950/kg. This difference occurs because there are transportation costs, depreciation costs, loading and unloading costs, labor costs and profit margins imposed at the sub-district trader level, as shown in Figure 1.

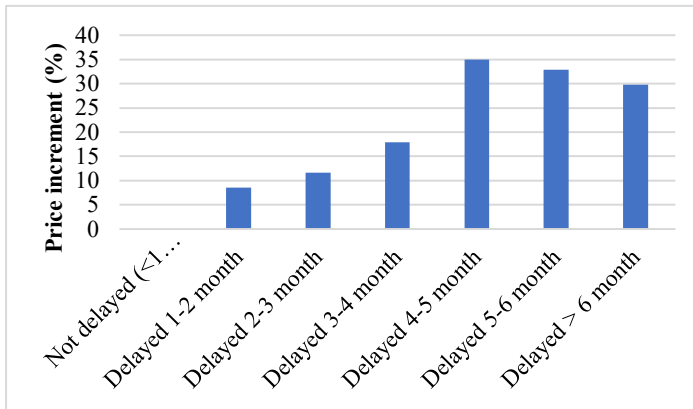


- Coffee prices at sub-district trader level (Source: [22])
- Coffee prices at the farm level (primary data)

**Fig. 1.** Dinamic of coffee prices from November 2021-November 2022

There is a price difference in each sales period after harvest. If farmers sell coffee at the beginning of May, farmers get a coffee price of IDR 19,320.00/kg. However, if the farmer stores the coffee for one month before selling it, the farmer will get a coffee price of IDR 20,976.00/kg. The difference in price received is IDR 1,656.00/kg or an increase of 8.57% when storing coffee for 1 month after harvest. Even if farmers are willing to store coffee until

the end of September with a coffee price of IDR 26,076.00/kg, farmers will get a price difference of IDR 6,756.00/kg or 34.96% above the harvest price (Figure 2).



**Fig. 2.** Coffee price increment of delay selling system.

The difference in coffee prices over several time periods can be seen in Table 4. The longer the time interval between farmers in delaying sales, the higher the price difference received by farmers. This is in line with research by [23] that a delay selling system is more profitable than no delay sales system. [14] also said that the income of coffee farmers who delay sales is greater than farmers who do not delay sales. Implementation of a delay selling system will provide more proportional benefits to farmers in the form of increased margins and profits. The sale delay mechanism can help in controlling coffee price fluctuations in the market.

**Table 4.** Economic benefit of coffee sale delay system

Description	Coffee sold (kg)	Selling price Rp/kg	Price gap with harvest price (Rp/kg)	Profit (Rp)
<b>A. Revenue</b>				
Not delayed (<1 month)	670.71	19,320.00	0	0
Delayed 1-2 month	212.54	20,976.00	1,656.00	351,966.24
Delayed 2-3 month	108.78	21,576.00	2,256.00	245,407.68
Delayed 3-4 month	66.45	22,776.00	3,456.00	229,651.20
Delayed 4-5 month	13.17	26,076.00	6,756.00	88,976.52
Delayed 5-6 month	11.57	25,676.00	6,356.00	73,538.92
Delayed > 6 month	7.86	25,076.00	5,756.00	45,242.16
Total Revenue	1091.07			1,034,782.72
<b>B. Cost</b>				
- Bag	20		2,500	50,000.00
- Depreciation				46,239.60
<b>Total cost</b>				96,239.60
<b>C. Profit of delay selling</b>				938,543.12

The farmer's benefit in delaying selling is the difference in price received by farmers if farmers sell during the main harvest with the price received when delaying selling. For coffee storage, farmers only pay for the purchase of sacks used for coffee packing at a price of IDR 2,500/unit. All workers use family labor so they are not paid. Coffee is stored indoors in the house and does not incur costs for room rent. Besides that, another cost that must be calculated is the depreciation cost which is the multiplication of the amount of coffee that is

lost by the price of coffee that occurs at the time of sale. The profit of delaying the sale is IDR 938,543.12 (7,99% higher than no delay selling system).

### 3.3 Determinants of Farmer's Decision to Implement Delay Selling

The determinants of farmers' decisions in implementing the coffee delay system were analyzed using binary logistic regression analysis. The results of the analysis are presented in Table 3.

**Table 3.** Results of the analysis of the determinants that influence coffee farmers in implementing selling delay system in West Lampung Regency

Variable	Coefficient	Std. Error	Z	Sig.	Odds Ratio
Constanta	-8.2227	2.1838	-3.7653	0.0002	0.0003
Farmer's age (X1)	-0.0405	0.0279	-1.4532	0.1462	0.9603
Farming experience (X2)	0.0953***	0.0291	3.2709	0.0011	1.1000
Education (X3)	0.1539**	0.0666	2.3113	0.0208	1.1664
Side job (X4)	0.3806	0.3974	0.9575	0.3383	1.4631
Land area (X5)	-0.0404	0.1969	-0.2054	0.8372	0.9604
Production (X6)	0.0007*	0.0004	1.8247	0.0681	1.0007
Farm-gate price of coffee (X7)	0.0002**	0.0001	2.1032	0.0354	1.0002
Household income (X8)	0.0000*	0.0000	-1.6355	0.1009	1.0000
Family number (X9)	0.6282***	0.1908	3.2923	0.0010	1.8743
Certification membership (X10)	-0.2993	0.4101	-0.7297	0.4656	0.7414

Note:

\*\*\* : significant at  $\alpha$  1%

\*\* : significant at  $\alpha$  5%

\* : significant at  $\alpha$  10%

Based on the statistical Z value or Wald test, there are six determining factor variables that have a significant effect on the decision to implement a delay selling coffee system, namely coffee farming experience, level of education, coffee production, selling price of coffee, household income, and number of family members. Factors that have no significant effect are the farmer's age, side job, land area, and farmer's membership in coffee certification. Coffee farming experience has a positive effect on the decision to postpone coffee sales at the 99% level of confidence. The longer the experience a farmer has in farming coffee, the higher the probability of delaying selling. This is because experienced farmers believe that coffee prices will rise after the main harvest is over. Thus, farmers will delay selling coffee while waiting for prices to rise. The number of family members also has a positive effect on farmers' decisions to delay selling coffee at the 99% level of confidence. The fewer the number of family members, the less the financial needs of farmers. Therefore, farmers who have a small number of family members have a greater probability of delaying the sale of coffee.

Coffee production has a positive effect on farmers' decisions to delay coffee sales at the 90% confidence level. The higher the coffee production, the higher the probability of farmers delaying selling. This is in line with the results of research by [14].

The education level of farmers also has a positive effect with a 95% confidence level on the farmer's decision to postpone the sale of coffee. The higher the farmer's education, the higher the probability of the farmer in implementing the delay selling system. The level of education will affect the knowledge and skills of farmers in accepting or adopting technology, innovation and information.

The selling price of coffee has a significant positive effect on farmers' decisions to delay coffee sales at the 95% level of confidence. The main goal of the farmers in delaying the sale of coffee is to get a high price. In Lampung, the sale delay system aims not only to obtain a high selling price but also as a savings and solution to address various urgent needs. Coffee household income has a positive effect on farmers' decisions to postpone coffee sales at the 90% confidence level. The greater the income of the farmer's household, the greater the probability of the farmer to postpone the sale of coffee.

## 4. Conclusions

The majority of farmers (71.58%) do not implement a delayed-sale system, namely selling their coffee yields in less than one month after harvest. Meanwhile, rest (26.84%) implemented a delayed selling system, namely selling their crops more than 1 month after harvest while waiting for a higher price. As much as 87.36% of farmers sell coffee beans to middlemen, the remaining 12.64% of farmers sell through other marketing channels, such as markets, online sales and wholesalers.

Factors that have a significant positive effect on the implementing farmer's decision to delay selling are coffee farming experience, number of family members, education level, coffee production, coffee price, and household income. The coffee selling delay system will provide more proportional benefits to farmers, namely increasing prices and farmers' income.

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