



# Arabica Coffee Development Model in Alleviating Poverty in West Sumatra

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## ABSTRACT

Arabica coffee has promising market potential in the world market, which reaches a market share of 85% in the coffee industry. However, the Robusta variety has dominated Indonesian coffee production, which comes 90%, while the Arabica variety contributes only 10%. Given the opportunity of this Arabica coffee market, the West Sumatra government created programs to develop this type of coffee. Solok Regency performed a rapid development area of Arabica Coffee that allowed it to become the second largest production center in the last three years. This commodity's development is expected to reduce the poverty rate in Solok Regency, which currently reaches 8%. The study aims to: (1) Measure the proportion of smallholder farmers whose income is below the poverty line and the severity of the poverty situation; (2) Analyze the influence of economic and non-economic factors on the poverty rate of coffee farmers. This research was conducted in Solok Regency, which is selected purposively due to having a high poverty rate and rapid growth in the Arabica coffee area. The results showed that the poverty rate of Arabica coffee farmers is quite large, with a Head-count index of 0.50, meaning that as many as 50% of farmers have incomes below the poverty line. Arabica coffee farmers who are members of cooperatives have a higher poverty rate compared to non-cooperative farmers based on the Headcount Index, the Poverty Gap Index, and Poverty Severity Index. No other source of income and dependence on coffee farming on a small land might contribute to this condition. Factors affecting the poverty rate of Arabica coffee farmers are assets and being members of cooperatives. The existence of cooperatives will increase opportunities for farmers to gain access to financing sources to encourage farmers to develop their businesses and open new businesses to increase their income. Policies are required to encourage farmers to open other companies to increase their income. Diversification of business becomes very important because it will help farmers escape poverty.

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## 1. INTRODUCTION

Coffee is one of the primary commodities of Indonesian plantations that contribute to foreign exchange and labor absorption. Statista (2021) reported that Indonesia was the world's fourth largest coffee exporting country after Brazil, Vietnam, and Columbia, with an export volume of 664,000 bags (1 bag = 60 kg) in 2020. Global coffee exports increased by 1.9%, from 116.77 million bags in 2019/20 to 118.96 million bags in 2020/21 (ICO, 2021). As the increase in consumption is estimated at 167.26 million bags and the world coffee price continues to increase with

a composite indicator of the average monthly price of 6.2% is an opportunity for Indonesia to gain a more significant role in trade through the development of the coffee industry.

Arabica coffee is an essential coffee produced worldwide, while Robusta ranks second. In Indonesia, Arabica coffee only contributes 10% to national coffee production. Arabica coffee prices are much higher than Robusta. In 2020, arabica coffee prices reached 3.32 USD / kg while Robusta coffee prices were 1.52 USD / kg (Statista, 2021). Indonesia has suitable climate conditions for Arabica

coffee cultivation, allowing the development of Arabica coffee to have promising prospects.

Most coffee commodities in Indonesia are smallholders owned; therefore, the development of this commodity will have an impact on increasing the income of smallholder farmers and have the opportunity to reduce poverty. To support the development of coffee production, the West Sumatra Provincial Plantation Office implemented programs to expand coffee plants, especially Arabica coffee, in West Sumatra. Six regencies that could potentially develop Arabica coffee in West Sumatra are Solok, Tanah Datar, Agam, South Solok, Pasaman, and West Pasaman (Dinas Perkebunan Provinsi Sumatera Barat, 2014). Arabica coffee business in Solok Regency is developing rapidly. In 2015, the area of Arabica coffee cultivation in Solok Regency ranked as the fourth largest area. It became the third largest Arabica coffee area, reaching 1,877.50 ha, in 2020 (BPS-Statistics of Solok Regency, 2021).

The development of the Arabica coffee business was allegedly also driven by the formation of Solok Radjo Cooperative in 2014. Solok Radjo cooperative is home to specialty coffees made by farmers. This cooperative has three main activities: production, processing, and marketing. The cooperative members must sell their yields to the cooperative because all means of production are provided, including seedlings, fertilizers, and chemicals. This partnership aims to obtain the standard quality of coffee desired by the cooperative.

Fahrezi (2017) found that the income and benefits of Solok Radjo cooperative members were higher than non-cooperative members. The average income of members per hectare was Rp. 17,168,655 per year, while the average income of non-cooperative coffee farmers per hectare was Rp. 11. 621,820 per year. It indicates that the existence of Solok Rajo Cooperative is expected to increase farmers' incomes and reduce poverty in Solok Regency. BPS - Statistics of Sumatera Barat Province (2020) reported that the poverty rate in Solok Regency is higher than the average poverty rate in West Sumatra. The percentage of poor people in Solok Regency in 2019 was 7.98%, the second highest poverty rate in West Sumatra after Kepulauan Mentawai. The development of the Arabica coffee industry in Solok Regency is expected to contribute to poverty alleviation.

This research aims to: (1) Measure the proportion of smallholder farmers whose income is below the poverty line and the severity of the poverty situation, and (2) Analyze the influence of economic and non-economic factors on the poverty rate of coffee farmers.

## 2. METHOD

### 2.1. Research Site

This research was conducted in Solok Regency, which was selected purposively due to having a high poverty rate and rapid growth in the Arabica coffee area. Another consideration is that the Solok Radjo cooperative is relatively successful in helping farmers market Arabica coffee.

### 2.2. Sampling methods and data collection

Data were collected using the survey method by interviewing Arabica coffee farmers (members and non-members of Solok Radjo Cooperative). This study involved 30 Arabica coffee farmers selected using the Disproportionate Stratified Random Sampling method.

### 2.3. Variables

The variables observed to address the first research objectives are (a) Income per capita on Arabica coffee farming (Rp /month); (b) Income Per capita of other farms (Rp/month); (c) Income per capita from non-agriculture activity (Rp /month); (d) Characteristics of farmers (level of education, age, the experience of arabica coffee farming, number of family dependents, a land area owned)

The variables observed to address the second purpose of the study are: (a) Characteristics of farmers (level of education, age, the experience of arabica coffee farming, number of family dependents, number of labor in the family available for Arabica coffee farming); (b) Agricultural assets owned (land area owned for Arabica coffee, land area for other crops, agricultural equipment owned); (c) Access to economic facilities (distance to nearby markets (inputs and outputs), access to agricultural financing); (d) Access to knowledge (counseling, training, mentoring); (e) Access to information (prices, sources of financing, programs); (f) Cooperative membership (dummy variable); (g) Access to production inputs for Arabica coffee (help or buy your own); (h) Per capita income per month (from Arabica coffee farming, other farming businesses, and from non-agriculture); (i) Ratio of income per capita to the poverty line.

The relationship of all variables to identify factors influencing poverty rates through the role of local institutions in the second research objective is presented in Figure 1.

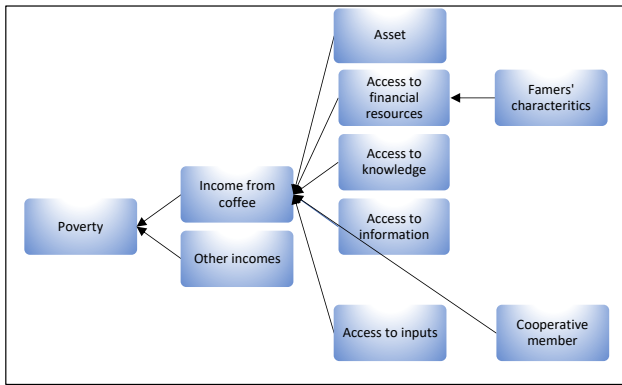


Figure 1. Hypothetical Model of Arabica Coffee Development in Poverty Alleviation in West Sumatra

2.4. Data Analysis Method

The poverty level is analyzed using three measurements: The Head Count Index (HCI-P0) is the percentage of poor people who fall below the Poverty Line; The Poverty Gap Index (P1) measures the spending gap of each poor person against the poverty line. The higher the index value, the further the average population spends from the poverty line; The Poverty Severity Index (P2) provides an index to describe the expenditure distribution among poor people. The higher the index value, the higher the expenditure inequality among the poor.

Foster-Greer-Thorbecke (1984) formulated a measure used to measure poverty rates as follows:

$$P_a = \frac{1}{n} \sum_{i=1}^q \left[ \frac{z - y_i}{z} \right]^a$$

Where:

- a = 0, 1, 2
- z = Rural poverty line in Solok Regency in 2020
- Yi = Average per capita income per capita of farmers who are below the poverty line (i =1,2,...,q), Yi < z
- q = The number of farmers who are below the poverty line
- n = Number of sample farmers
- If a = 0 = Head Count Index (P0)
- If a = 1 = Poverty Gap Index -P1
- If a = 2 = Poverty Severity Index (P2).

Structural equation modeling was used to assess factors affecting poverty. In general, the model can be formulated as follows.

$$Y_i = \sum_{q=1}^K \beta_q X_{qi} + \epsilon_i$$

3. RESULTS AND DISCUSSION

This study began with collecting secondary data and implemented a survey of Arabica coffee farmers. Primary data was collected from interviews with 30 farmers in the Lembah Gumanti Subdistrict.

3.1. Overview of Research Areas

Solok Regency has 3,738 Km<sup>2</sup> consisting of 14 subdistricts, 74 Nagari, and 414 Jorong. The topography of Solok Regency varies greatly between plains, valleys, and hills, with a height between 284 meters to 1,458 meters above sea level.

Solok Regency generally has a tropical climate with temperatures varying between 20 °C to 30 °C. Average rainfall ranges from 2,139.6 mm per year. Rainfall is almost evenly distributed the whole year in the southern and central parts of Solok Regency, including Lembah Gumanti, Hiliran Gumanti, Danau Kembar, Lembang Jaya, and Gunung Talang. While in the northern part of Solok Regency, Kubu IX Koto Sungai Lasi, X Koto Singkarak, Paninggahan dan, and Sulit Air have variations. The northern Solok Regency has lower rainfall than the central and southern regions. The number of rainy days ranges from 127 - 240 per year (BPS Solok Regency, 2018). Uneven rain in the north results in a water shortage for the agricultural sector in the dry months. Solok Regency has natural resources that are suitable for agricultural businesses. Other water sources for farming businesses come from mountains, hills, lakes, and rivers and are channeled through secondary and tertiary irrigations.

Based on data BPS-Statistics of Solok Regency (2020), Arabica coffee production in Solok Regency in 2019 increased from 2018 from 872.15 tons to 888.80 tons. Three main areas of arabica coffee are in Pantai Cermin District, producing 339,5 tons by 1,363 farmers, Lembah Gumanti District with a production of 181.25 tons by 330 farmers; and Danau Kembar with the output of 63.75 tons by 288 farmers. With the potential possessed by this area, making the opportunity to continue to develop quality coffee following the concept of encoding Geographically. All stakeholders, especially farmers, must support the improvement of coffee quality. They must conduct cultivation and post-harvesting well by applying agricultural business management innovations following the Good Agriculture Practice (GAP) concept.

3.2. Profile of Coffee Farmers in Lembah Gumanti

The findings reveal that many farmers in Lembah Gumanti Subdistrict used to grow Arabica coffee but now have switched to seasonal crops, especially vegetables, due to the coffee price decrease since Covid-19. In 2010, the price of coffee continued to decline from the previous one reaching US \$ 4.68 per kg or equivalent to Rp 68,000. Since the pandemic, coffee prices have dropped below US\$ 2.5 per kg or around Rp 36,000 per kg (Katadata, 5 August 2020). The disruption of the supply chain and coffee demand was due to the quarantine policy (lockdown) implemented by various countries. Based on ICO data as of June 2020, the price of Arabica coffee decreased by 7.6%, and the Robusta coffee price decreased by 13.24% compared to June 2019.

Our study found it challenging to obtain farmers who still maintain arabica coffee plants. A total of 30 Arabica coffee farmers who were successfully interviewed in the Lembah Gumanti Sub-District were mainly in Nagari Aie Dingin, consisting of 19 farmers who were cooperatives and 11 people who were not members of the cooperative.

In Table 1, it is seen that 67% of the farmers interviewed are male. Most of the sample farmers (57%) were at a productive age < (50 years), and 27% were farmers at a young age. Most farmers are high school graduates, as much as 40%. In comparison, sample farmers who studied in college were very few (10%).

Table 1. Characteristics of Arabica Coffee Farmers in Lembah Gumanti

Description	Co-operative members (%)	Non-Anggota (%)	Total
Gender			
Man	46.67	20.00	66.67
Woman	16.67	16.67	33.33
Age (years)			
≤ 30	16.67	10.00	26.67
31 - 40	6.67	6.67	13.33
41 - 50	10.00	6.67	16.67
51 - 60	13.33	10.00	23.33
≥ 61	16.67	3.33	20.00
Education			
Not school	10.00	3.33	13.33
Primary	6.67	20.00	26.67
Junior high school	10.00		10.00
Senior High School	26.67	13.33	40.00
University	10.00		10.00

Table 2 describes the area of land size holding. Most farmers (80%) do not have irrigated land. It shows that farmers depend on their livelihoods from dry land. However, the area of dry land owned is relatively small; only 20% of farmers have an area of 2 hectares. Most of them even have a small land of 1 hectare.

Table 2. Land Ownership of Arabica Coffee Farmers in Lembah Gumanti

Description	Co-operative Members (%)	Non-members (%)	Total
Area of irrigation land			
No land	56.67	26.67	83.33
0.5 ha	3.33	6.67	10.00
2 ha	3.33		3.33
4 ha		3.33	3.33
Dry land area			
< 1 ha	30.00	13.33	43.33
1 - 2 ha	23.33	13.33	36.67
> 2 ha	10.00	10.00	20.00

The average price of Arabica coffee at the farmer level is Rp.7,300 per kg. The price received by non-cooperative farmer members is lower than the cooperative member, as they sell to the intermediaries. However, non-cooperative farmers have access to sell their coffee to Solok Radjo Cooperative.

The dependents of arabica coffee farming households range from 2 to 8 (Figure 2). Most farmers have dependents of around 3 to 4 people, cooperative member farmers, and non-cooperative farmers.

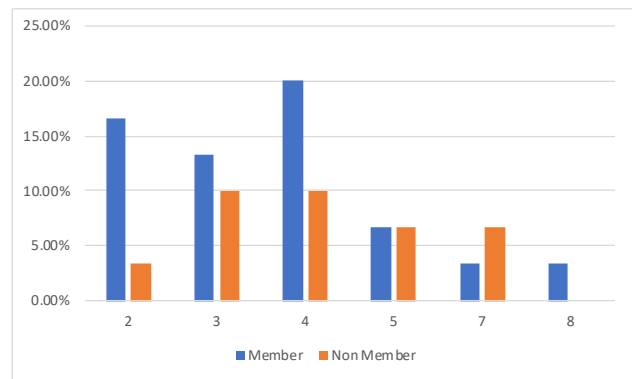


Figure 2. Number of Dependents of Coffee Farmer Families in Lembah Gumanti

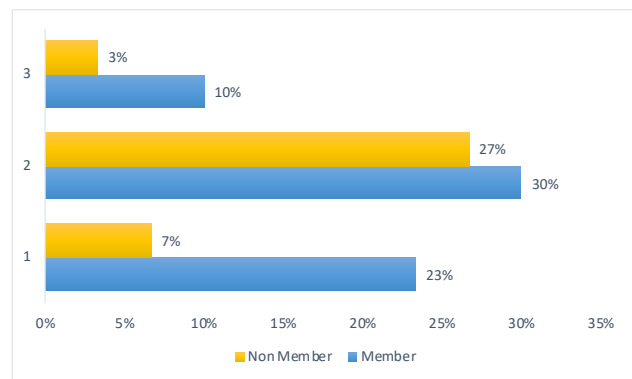


Figure 3. The Number of Workers in the Family

Most Arabica coffee farmers have two workers from their family members (Figure 3). About 23% of farmers' cooperative members are even only the head of the household who work for their coffee farming. It means that a limited amount of labor is available for agricultural activities in the family.

Table 3 describes the average production of arabica coffee as 977 kg/ha per year. The coffee production of cooperatives members (1,030 kg/ha/year) is higher than that of non-cooperative farmers (885 kg/ha/year). It is likely related to members' access to input and knowledge of good agricultural practices.

The landholding size of coffee is relatively small. Most farmers have an area of 0.1 - 0.5 ha, while only a few have an area of land > 2 ha. Most farmers have enough experience in coffee farming (5-10 years), and most farmers also gained knowledge about Arabica coffee cultivation techniques in the last three years. Therefore, farmers may be able to manage the coffee garden optimally. The input used comes from various sources. Some farmers get it from cooperatives and farmer groups. Others buy their inputs.

Table 3. Profile of Arabica Coffee Farming in Lembah Gumanti

Description	Cooperative Members	Non-members	Total
Average production per hectare (kg)	1.030	885	977
Coffee grounds (ha)			
0.1 - 0.5	11	6	17
0.6 - 1.0	4	1	5
1.1 - 2.0	2	1	3
2.1 - 8.0	2	2	4
Business experience			
< 5 years	3	5	8
5 - 10 years	14	4	18
> 10 years	2	1	3
Average price (Rp/kg)	7.447	6.955	7.267
Price level			
Low, because it's sold to a middlemen		3	3
High, because it was sold to Solok Radjo Cooperative	19	8	27
Input source			
Subsidy & buy	3	1	4
Buy yourself	1	6	7
Seedlings of Farmers Group, Fertilizer Itself		1	1
Solok Rajo Seeds, Self-Fertilizer	1	1	2
Seedlings-subsidy, self-buy fertilizer	9	1	10
Solok Radjo Cooperative (seedlings and fertilizers)	3		3
Myself and from the cooperative	2	1	3
Gain knowledge of Arabica coffee cultivation in the last 3 years			
No		1	1
Yes	19	10	29

The average price of Arabica coffee at the farmer level is Rp.7,300 per kg. The price received by non-cooperative members is lower than that of the cooperative member, as they sell to the intermediaries. However, non-cooperative farmers have access to sell their coffee to Solok Radjo Cooperative

Most coffee trees are under ten years old (Figure 4), which means they are still of productive age. Most non-cooperative members have coffee trees under six years old. It indicates that non-cooperative farmers are starting to be interested in cultivating Arabica coffee.

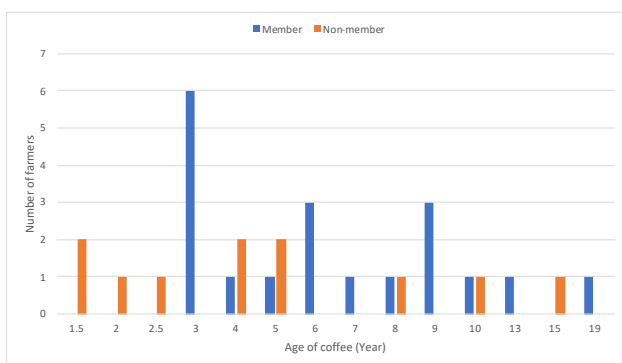


Figure 4. The Age of Tree of Arabica Coffee

### 3.3. Income Level of Coffee Farmers in Lembah Gumanti

The average household income of Arabica farmers per year is Rp. 32,315,842 (Table 4) came from 3 sources: coffee farming, another farm, and non-farm businesses. With an average family of 4 people, the number of farmers per capita per month amounted

to Rp.712,671. This income level is significantly higher than Solok's poverty line in 2020 (Rp.451,906). Nevertheless, the range of per capita income per month is vast between the minimum and maximum values, which means there is a considerable gap.

Table 4. Average Household Income of Arabica Coffee Farmers

Description	Average	Minimum Value	Maximum Value
Income from other farms	19,688,000	1,000,000	128,000,000
non_pertanian income	5,673,333	3,000,000	36,000,000
UT coffee revenue	6,954,509	840,000	16,800,000
Total Revenue	32,315,842	2,400,000	144,560,000
Revenue/kap/th	8,552,053	642,857	33,720,000
Revenue/kap/mo	712,671	53,571	2,810,000
Kab. Solok 2020 poverty line	451,906		

Coffee farming is not the primary source of household income, contributing only 22% (Table 5). The most significant contribution to total household income comes from other agricultural activities at 61%.

Table 5. Household Income Structure of Arabica Coffee Farmers

Description	Average	Contribution to total revenue
Income from other farms	19,688,000	61%
non_pertanian income	5,673,333	18%
UT coffee revenue	6,954,509	22%
Total Revenue	32,315,842	

Our study found that as many as 50% of farmers are below the poverty line (Figure 5). It is a very high poverty rate. Income inequality is also very high, as seen from the minimum income value (Rp. 54,000) and maximum (Rp. 2,810,000).

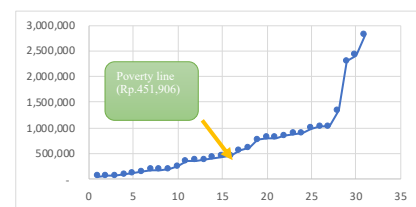


Figure 5. Per capita income distribution per month

The results of the poverty index calculation in Table 6 showed that the poverty rate of cooperative member farmers was higher than that of non-cooperative members for all three poverty indices. About 53% of cooperative member farmers are below the poverty line, while in non-cooperative members, 45%. The poverty gap index shows the increase in the income of cooperative member farmers by 29% from the poverty line or Rp 131,062 per capita per month will get farmers out of poverty. In contrast, non-cooperative farmers only need an increase in income of Rp. 89,584 per capita per month to get out of poverty.

Table 6. Poverty Index

Description	Head Count Index - P0	Poverty Gap Index-P1	Poverty Severity Index-P2
Co-operative members	0.53	0.29	0.21
Non-cooperative members	0.45	0.20	0.12
Total	0.50	0.26	0.17

The poverty severity index of cooperative member farmers is higher than non-cooperative farmers, meaning that the poorest cooperative member farmers need even greater assistance to get out of poverty.



Table 8. Estimation Results of Arabica Coffee Farmers Poverty Model

Endogenous variables	Exogenous variables	Coefficient- $\beta$	Value Z
Poverty	Assets	0.33*	1.90
	Access to economic facilities	-0.10	-0.45
	Co-operative members	-0.36*	1.75
	Access to inputs	0.23	1.09
Access to economic facilities	Konstan	-0.42	-0.51
	Access to knowledge	0.53*	4.99
	Access to information	0.47*	4.54
	Co-operative members	0.20*	1.72
Access to knowledge	Age	0.06	0.44
	Education	0.05	0.35
	Constant	0.25	0.27
	Age	0.33	1.63
Access to information	Education	0.55*	3.01
	Constant	-2.39	-2.42
	Age	0.30	1.39
Access to information	Education	0.40*	1.95
	Constant	-1.93	-1.79

\*Significant at  $\alpha = 0.10$

Access to knowledge, access to information, and being a member of cooperatives proved to have a significant effect on farmers' access to economic facilities. Being a cooperative member opens up opportunities for farmers to access financial facilities.

The level of education provides a significant increase in opportunities for farmers to gain access to knowledge and information. It can occur at different age levels.

Farmers' capacity is an essential factor in the development of coffee. Farmers are one of the production factors determining the success of coffee agribusiness. Currently, the use of technology by coffee farmers is relatively low. This condition impacts the slow transfer of science and technology from coffee experts, research institutions, or extensionists to farmers (Nalurita et al., 2014). Vegro & de Almeida (2020) reveals diffusion of innovations for coffee production needs to be done. Especially for using superior seed varieties susceptible to disease attacks, mechanization during harvesting (at the time of harvest) requires extra work that is usually done by hand.

Studies on poverty conditions in coffee farmers conducted by (Sriastuti, 2017) show that conventional coffee farmers are more likely to be poor than farmers who produce certified coffee, but the difference is minimal. The intensity of poverty experienced by poor farmers with certified and conventional coffee does not differ significantly. The initial idea of certification was the benefits for farmers through market mechanisms, but it does not seem to apply to coffee farmers in Indonesia. Farmers remain vulnerable at the bottom of the value chain, and their profits do not increase significantly. Certification does not increase farmers' profit, which brings no increase in farmers' consumption expenditures, making poverty alleviation would be impossible.

It indicates that improvements in non-monetary aspects are expected to positively impact people's well-being rather than advances in monetary elements such as income, prices, and profits. One of them is through the empowerment of local institutions. CRIEC and World Bank (2002) found that in Indonesia, the poor are usually farmers who do not have assets such as land, equipment, and information (e.g., markets, technology, capital, and business opportunities). Access to

information is the main factor determining the gap between the poor and the rich.

#### 4. CONCLUSIONS

The poverty rate of Arabica coffee farmers is quite large, with a Head-count index of 0.50, meaning that as many as 50% of farmers have incomes below the poverty line. Arabica coffee farmers who are members of cooperatives have a higher poverty rate than non-cooperative farmers from the Headcount Index and the Poverty Gap Index, and Poverty Severity Index. It is because cooperative member farmers have no other source of income and are very dependent on coffee farming on a narrow land.

Factors that affect the poverty rate of Arabica coffee farmers are assets and being members of cooperatives. The existence of cooperatives will increase opportunities for farmers to gain access to economic facilities, one of which is access to financing sources to enable farmers to develop their businesses and open new businesses to increase their income. A policy is required to encourage farmers to have other sources of income to increase their income. Diversification of business becomes very important because it will help farmers escape poverty.

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