Comparison of the prosperity of coffee and non-coffee farmers in Central Aceh District based on expenditure, access to food, and ownership of assets

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Abstract. Central Aceh District, Aceh, Indonesia, is well known as a coffee-producing region. However, based on land elevation, not all areas in this district are suitable for producing coffee. Thus, not all farmers can cultivate coffee. This study examines the difference in prosperity between farmers who cultivate coffee and farmers who do not. Prosperity varies based on household members' expenditure per capita, access to food, and assets owned by the two farmers' groups. The study uses the Chi-Square Test of Independence and Independent Samples t-Test. Based on per capita expenditure, access to food, and assets, the results demonstrate no significant difference in the welfare of the two groups of farmers.

1. Introduction

Agriculture is a primary development sector in Central Aceh District. It creates new job positions and business opportunities, increasing economic growth and quality of life. The agricultural industry drives the regional economy. The Central Aceh District Government's flagship program relies on agricultural development, including food agriculture, plantations, animal husbandry, and fisheries.

The central region of Aceh Province holds potential as an agricultural center. Agricultural products, especially coffee and horticulture, supply Aceh, Sumatra, and other regions. These agricultural products have also stimulated the development of industry in the Aceh region. The community depends on the livelihood of farmers who cultivate horticultural crops, such as vegetables, fruits, and annual crops, particularly coffee and sugar cane. The district also raises buffalo, cows, and horses. The cultivated land consists of paddy fields (8,243 hectares), moor (10,873 hectares), arable land (5,605 hectares), and plantations (52,711 hectares). Central Aceh District stands 200-2,600 meters above sea level ideal for cultivating commercial crops such as Arabica coffee [1].

Arabica coffee cultivation in Central Aceh District benefits from suitable climatic conditions and high soil fertility, caused by Andisol soils derived from volcanic rock crumbs. Farmers act as executors at every stage of coffee farming. From land clearing to harvest and post-harvest, coffee farming is a plantation commodity with high economic value. Coffee has become a significant source of regional income in Central Aceh District.

Farmers also cultivate potatoes, tomatoes, chilies, oranges, and avocados. Vegetables continue to increase in demand due to population growth in Central Aceh. Access to food is essential for farming
households. Food access refers to an individual's entry or right to adequate resources to obtain food suitable for the needs of a healthy diet [2]. Fair food access is achieved through a combination of production and stock in the household. At the national level, adequate food access is covered through food imports. At the household level, food achievement is considered sufficient when individuals can consistently obtain food [3]. Farmers’ household accessibility to food depends on several factors, including income, national food access, and food access facilities [4].

According to the World Bank [5], household assets are composed of (a) land, (b) livestock, and (c) other household assets. Rural families still rely on agricultural land assets as a primary source of wealth. Farmland represents opportunities to produce and increase family income. In line with a farming household’s demands, family assets such as household furniture and electronics have become critical to help ease work or support leisure. Many households own electric appliances, such as modern televisions with led screens, refrigerators, cell phones, computers, televisions, rice cookers, irons, blenders, etc. Other assets include motorcycles and cars.

2. Material and method
2.1. Study area and household survey
This research was conducted in Central Aceh District. The research subjects are household farmers who cultivate coffee and those who do not cultivate coffee, planting rice, sugar cane, vegetables, and potatoes instead. In this study, farmers who grow coffee are called coffee farmers, and farmers who do not produce coffee are called non-coffee farmers. This study uses national socio-economic survey data from Statistics Indonesia, 2019. This study compares welfare of the two farming groups based on access to food and assets. Access to food is analyzed through three phenomena: concern about not having enough food, diversity of food types consumed, and prevalence of skipped meals. Meanwhile, assets owned are household items such as refrigerators, air conditioners, cell phones, computers, motorbikes, cars, and televisions greater than 30 inches wide. Furthermore, farmers’ prosperity is also measured by ownership of savings, land used in farming, and per capita expenditure.

2.2. Independent samples t-test
The Independent Samples t-Test compares the means of two separate groups to determine whether there is statistical evidence that the associated population means are significantly different [6]. The Independent Samples t-Test is a parametric test used to determine whether there is a significant difference in income or expenditure per capita between coffee farmers and non-coffee farmers’ households.

Hypotheses
The null hypothesis (H₀) and the alternative hypothesis (H₁) of the Independent Samples t-Test can be expressed as follows:

H₀: µ₁ = µ₂ (The mean expenditure of coffee farmers and non-coffee farmers is not different).
H₁: µ₁ ≠ µ₂ (The mean expenditure of coffee farmers and non-coffee farmers is different).

Where µ₁ and µ₂ are the population means for group 1 (coffee farmers) and group 2 (non-coffee farmers), respectively.

The test statistic for the independent samples t-test is computed as:

\[ t = \frac{\bar{x}_1 - \bar{x}_2}{s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \]

\[ s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}} \]
Where
\[ \bar{x}_1 = \text{Mean of expenditure of coffee farmers} \]
\[ \bar{x}_2 = \text{Mean of expenditure of non-coffee farmers} \]
\[ n_1 = \text{Sample size of coffee farmers} \]
\[ n_2 = \text{Sample size non-coffee farmers} \]
\[ s_1 = \text{Standard deviation of expenditure of coffee farmers} \]
\[ s_2 = \text{Standard deviation of expenditure of non-coffee farmers} \]
\[ s_p = \text{Pooled standard deviation} \]

2.3. Chi-square test of independence

The Chi-Square Test of Independence determines whether there is an association between categorical variables (i.e., whether the variables are independent/different or related). It is a nonparametric test which utilizes a contingency table to analyze data. A contingency table (also known as a cross-tabulation, crosstab, or two-way table) is an arrangement in which data is classified according to two categorical variables. The categories for one variable or the first variable appear in the rows, and the classes for the other variable appear in columns. Each variable must have two or more categories. Each cell reflects the total count of cases for a specific pair of types [7]. The first variable is farmers, divided into two classifications: coffee farmers and non-coffee farmers. Other variables include access to food and assets owned by coffee and non-coffee farmer households.

Hypotheses

The null hypothesis (H₀) and the alternative hypothesis (H₁) of the Chi-Square Test of Independence can be expressed as follows:

H₀: There is a difference between coffee farmers and non-coffee farmers.
H₁: There is no difference between coffee farmers and non-coffee farmers.

Test Statistic

The test statistic for the Chi-Square Test of Independence is denoted as \( X^2 \) and computed as:

\[
X^2 = \sum_{i=1}^{R} \sum_{j=1}^{C} \frac{(o_{ij} - e_{ij})^2}{e_{ij}}
\]  

(2)

where

\( o_{ij} \) is the observed cell count in the \( i^{th} \) row and \( j^{th} \) column of the table
\( e_{ij} \) is the expected cell count in the \( i^{th} \) row, and \( j^{th} \) column of the table computed as:

\[
e_{ij} = \frac{\text{row total} \times \text{col total}}{\text{grand total}}
\]  

(3)

One can then compare the calculated \( X^2 \) value to the critical value from the \( X^2 \) distribution table, using degrees of freedom \( df = (R - 1)(C - 1) \) and a selected confidence level. If the calculated \( X^2 \) value is greater than critical \( X^2 \) importance, then the null hypothesis is rejected.

3. Result and discussion

Based on a sample of 298 farmers from 14 sub-districts in Central Aceh District, the farmers were divided into two groups: 273 farmers who cultivated coffee and 25 farmers who grew other plants besides coffee. In general, those who ran agricultural businesses lived in rural areas, and some farmers had only completed an elementary education level. The characteristics of the respondents can be seen in Table 1 below.
Table 1. Respondent characteristics.

| Characteristic | Frequency | Percent |
|----------------|-----------|---------|
| Farmer         |           |         |
| Non-coffee     | 25        | 8.4     |
| Coffee farmers | 273       | 91.6    |
| Gender         |           |         |
| Women          | 44        | 14.8    |
| Men            | 254       | 85.2    |
| Marital        |           |         |
| Single         | 3         | 1.0     |
| Married        | 251       | 82.2    |
| Divorce        | 44        | 14.8    |
| Living         |           |         |
| Urban area     | 25        | 8.4     |
| Rural area     | 273       | 91.6    |
| Education      |           |         |
| Primary school | 149       | 50.0    |
| Junior high    | 75        | 25.2    |
| Senior high    | 63        | 21.1    |
| Bachelor       | 11        | 3.7     |

Income shows household welfare from an economic perspective [8]. Calculation of household income or income per capita of a farming household depends on per capita expenditure. Statistically, there is no difference in per capita expenditure of coffee farmer groups and farmers who do not cultivate coffee, as shown in Table 2. In this study, the average per capita expenditure of coffee farmer household members is Rp. 216,290,0341. While this is greater than the per capita expenditure of non-coffee farmer household members, the difference is small enough that it does not suggest significant difference in welfare between the two groups of farmers. In other words, the average expenditure of the two farmer groups is the same.

Table 2. The Independent t-test for expenditure per capita per month.

| Variable            | t    | p-Value | Alpha | Mean difference |
|---------------------|------|---------|-------|-----------------|
| Monthly expenditure | 0.138| 0.074   | 0.05  | 216290.0341     |

This similarity in expenditure impacts access to food for these two groups of farmers. Access to food is measured in three ways: concern about not having enough food; food quantity and diversity, and prevalence of skipped meals within a day. The results in Table 3 show that there is no difference between the two groups of farmers.

Table 3. Chi-Square test of independence for access to food.

| Variable        | Pearson chi-square | p-Value | Alpha |
|-----------------|--------------------|---------|-------|
| Having enough   | 0.138              | 0.710   |       |
| Food diversity  | 2.697              | 0.101   | 0.05  |
| Skipping one    | 0.948              | 0.330   |       |

Likewise, regarding household asset ownership, the Chi-Square test of independence shows no difference or association between farmer groups in terms of bank accounts, refrigerators, air conditioners, computers, cars, televisions, and agricultural land, except for motorcycle ownership. The assets mentioned are everyday goods owned by farmer households in Central Aceh District.

The data demonstrates few differences in prosperity between farmers who cultivate coffee and those who do not. The average difference in income between coffee farmers and non-coffee farmers is estimated at IDR 200,000. Coffee farmers do not merely grow coffee, but also vegetables which generate income. Similarly, farmers who do not grow coffee generate income from multiple sources. They work other jobs in their spare time, such as working as a coffee or sugar harvester.
Table 4. Chi-Square test of independence for household assets

| Variable                  | Pearson Chi-Square | p-Value | Alpha |
|---------------------------|--------------------|---------|-------|
| Bank account              | 2.512              | 0.113   |       |
| Land ownership            | 0.691              | 0.406   |       |
| Refrigerator              | 0.435              | 0.510   |       |
| Air Conditioner           | 0.184              | 0.668   | 0.05  |
| Computer                  | 1.981              | 0.159   |       |
| Motorcycle                | 4.359              | 0.037   |       |
| Car                       | 2.296              | 0.130   |       |
| Television 30 inches or greater | 0.101 | 0.751   |       |

Furthermore, since knowledge of coffee farming has been passed down over generations, coffee farmers are assisted by their families, which reduces labor costs. In addition, farmers of both groups were able to subsistence farm. Coffee farmers saved money by growing vegetables between periods of coffee cultivation. Neither coffee farmers nor non-coffee farmers profoundly influenced food diversity in their community, since there was demand for a variety of vegetables. Nearly all vegetables can be grown in Central Aceh District, with the support of natural resources and appropriate agroecosystems. Thus, there was little difference between farmers’ access to food [9]. Farmers who need to purchase food at the market find prices affordable because the food is supplied from the Central Aceh District.

Moreover, both groups of farmers had similar access to agricultural knowledge via technology. Family ownership of electronics has become a vital necessity to ease work and support leisure at home. Farmers own household items that use electricity, such as refrigerators, rice cookers, blenders, gas stoves, LED colour televisions, and mobile phones. With internet network available in remote areas, farmers can access more information about agricultural cultivation and track the price of agricultural commodities more easily.

4. Conclusion

This study concludes there is no difference in prosperity between coffee farmers and non-coffee farmers. Prosperity is measured by expenditure, land area owned, household assets, and access to food. Farmers accumulate wealth over time using appropriate natural resources and agroecosystems. Thus, when farmers select high-value plants that are suitable for local weather and soil conditions, they have equal opportunity to prosper.

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