

**Politic Ecology and Sustainability of Arabica Coffee (Coffee Arabica L.) in Timor Leste**Lucio M. Gomes^{1,2*}, M. Saleh S. Ali², Darmawan Salman³, M. Tumpu⁴¹Department of Agronomy, Faculty of Agriculture, National University of Timor Leste²East Timor Coffee Institute (ETCI) Timor Leste³Faculty of Agriculture, Hasanuddin University, Makassar, Indonesia⁴Disaster Management Study Program, The Graduate School, Hasanuddin University, Makassar, Indonesia*Corresponding Author Email: lmg_etci@yahoo.com/rectoretci@gmail.com*<https://doi.org/10.18280/ijesca.12345>**ABSTRACT****Received: 18 March 2024****Accepted: 27 March 2024****Keywords:***timor lester, ecological politics, sustainability of arabica coffee*

Between January 2021 and January 2022, research was conducted in Timor Leste's Liquica, Ermera, and Ainaro districts, representing lowland, moderate plains, and highland regions, respectively. The study aimed to identify ecological aspects of Arabica coffee cultivation and assess Timor Leste's sustainability and environmental politics. Using a case study method, the research employed mixed-methods, combining qualitative and quantitative approaches. Purposive sampling selected respondents from a pool of 180 coffee producers. The findings revealed a need for development and support for farmers, especially those aged 51 to 56, where 30% completed only elementary school. The political and ecological study significantly influenced social, community, and product responsibility factors ($p < \alpha 0.01$) and had a considerable impact on environmental factors ($p < \alpha 0.05$). However, labor and economic elements showed minimal impact. This research sheds light on crucial aspects of coffee cultivation sustainability in Timor Leste.

1. INTRODUCTION

One hundred fifty-seven million coffee consumers worldwide may be excited by Arabica coffee's aromatic flavor and caffeine scent (*Coffea arabica* L), a revitalizing beverage (International Coffee Organization, 2016) [1] During the rule of the governor Celestino da Silva in 1860, Arabica coffee was first introduced by the Portuguese conquerors to the inhabitants of Timor Leste as a plantation product in 1815. Timor Leste's inhabitants produce precious coffee economically, and they call it by its most well-known moniker, "The Green Gold (Orro Verde)." The higher class gives coffee to the lower class. It has pushed Arabica coffee as the top agricultural product, ranking behind only oil and natural gas in total export commodities. Arabica coffee is a staple of Timor Leste's agricultural exports, in addition to cocoa, coconut, vanilla, and cloves. A plantation product called coffee is anticipated to boost Timor Leste's export revenue [2].

One of the districts, Ermera, has 56,000 acres of the most extensive coffee plantations in the country, producing over 5,600 tons of coffee annually. The difference is considerable compared to Timor-demand Leste's population's (needs), which totals 10,600 tons annually. Ermera regency has a very high economic potential in terms of regional growth, particularly in the plantation sub-sector. As a result, it is not overstating things to say that the Ermera district's economic growth paradigm is centered on the harmony of agricultural development by depending on the development of local resources. One of the farming subsectors that have the

potential to become one of East Timor's leading producers of premium arabica coffee is people's coffee farms [3].

When measured in terms of production, the arabica coffee grown in Timor Leste seems less productive than the norm for nearby nations like Indonesia. However, the Ermera district has the highest rating for coffee commodity planting areas, and even the area planted with coffee keeps growing, earning it the coffee agro-tourism area. Ninety percent more arabica coffee is grown in Ermera Regency than in any other Timor Leste region. Look at the history of its growth. You will see that the Portuguese colonialists forced Timorese ancestors to work as enslaved people to establish Timor Leste's people's coffee plantation company. The Portuguese considered coffee during the colonial era as one of the agricultural pursuits that offered promising prospects for the people of Timor Leste, who had the potential for suitable, fertile land and very supportive topography for the development of coffee plants in six districts, including Ainaro, Aileu, Bobonaro, Ermera, Manufahi, and liqueur.

One of the problems in developing arabica coffee and robusta coffee in the Democratic Republic of East Timor (RDTL) is farmers' knowledge in choosing the quality of coffee and picking coffee that is still weak. Due to limited labor in coffee plantations, climate change, and very long weather, farmers' farming business management is still traditional; they need to use adequate technology to increase maximum production. Buyers do not allow farmers to use fertilizers or medicines; they only allow the use of organic materials derived from plant residues in the form of compost and animal waste.

Sustainable coffee plantations emphasize production in the long term and remain profitable and environmentally friendly. This system produces coffee beans and provides environmental services such as soil and water conservation and biodiversity conservation—ecological processes such as nutrient and water cycles, energy flow, and population regulation mechanisms. At least seven kinds of activities are needed to achieve the sustainable agriculture goals, namely: improving economic development; prioritizing food sufficiency; improving the development of human resources; increasing self-esteem; empowering and liberating farmers; maintaining environmental stability (safe, clean, balanced, renewed); and focusing on long-term productivity goals [4].

The objective of this research is to identify the ecological traits of East Timor's arabica coffee growing and to examine this industry's political ecology and long-term viability. The land conservation practices and the arabica coffee growing method are the environmental features mentioned in this research.

2. RESEARCH METHOD

2.1 Place and time

From January 2021 to January 2022, this research was conducted in three districts: Liquica, Ermera, and Ainaro. The locations were chosen with the following factors in mind: Geographically, the Liquica district represents a lowland area with a location altitude of 700-900 m above sea level, and the Ermera district represents a temperate plain area with a location altitude of 1000-1400 m above sea level, and the Ainaro district represents a plateau area with a b) ecology of coffee farming in the Liquica, Ermera, and Ainaro districts under the supervision of the agriculture and plantation department.

2.2 Types and Methods of Research

The type of research used in this study is a case study on farming communities in coffee farming areas in Liquica, Ermera, and Ainaro districts. *Nasir 1998* explains that case studies provide a detailed picture of the background of distinctive traits or characters or the status of the individual, which then makes the above unique characteristics into a general thing. This case study research results in a generalization of typical case patterns of individuals, groups, institutions, etc. Depending on the purpose of the study, the scope may include specific segments or sections or have an individual, group, and so on cycle, either with an emphasis on particular case factors or covering the entirety of factors. In this study, the case analysis unit included farmer households and coffee farming institutions in Liquica, Ermera, and Ainaro districts.

The research method used is mix-methods, which are research approaches that combine or associate qualitative and quantitative forms in the data collection stage [5]. Descriptive qualitative research is focused on answering research questions about who, what, where, and how an event or

experience occurs until it is finally studied in depth to find patterns that arise in the event [6].

Quantitative descriptive research is a type of research used to analyze data by describing or describing data collected to research specific populations or samples, data collection using research instruments, and quantitative data analysis [7].

2.3. Population and Sampling

The study's whole subject (Universum), which may include people, animals, plants, and even air, as well as its symptoms, values, occurrences, and other aspects, makes up the research population. These items may provide information for the study. A "sample," on the other hand, is a process where just a portion of the population is collected and utilized to ascertain the desired qualities and characteristics of a population.

This study used respondents from coffee farmers from 3 (three) districts spread across East Timor. The respondents selected as many as 180 coffee farmers who used the "Purposive Sampling Technique." Purposive sampling is a technique for determining samples with specific considerations [7].

2.4 Types of Data and How it is Collected

The information gathered is both primary and secondary. Direct interviews with predetermined respondents are used to collect primary data. Meanwhile, secondary data is obtained from relevant agencies or institutions, such as the national director of plantations, the national director of agriculture, village offices, and sub-districts. Qualitative research data was collected using triangulation methods, namely in-depth interviews, literature studies, and field observations. Interviews were conducted with respondents, coffee farming ecology actors, local government officials, related agencies, and companies engaged in coffee agricultural ecology.

The results of in-depth interviews with respondents were then recorded in field diaries by researchers. The literature study was carried out to extract information secondarily through data in the form of reports and official letters from government officials' support and strengthen the data from in-depth interviews. Meanwhile, field observations are carried out with thorough observations related to the actual conditions.

2.5 The Variables and Measurement Indicators

This study combines qualitative and quantitative methods, and the findings of interviews may be used to gather qualitative information on farmers' ages (in years), educational levels (in years), and agricultural experience (years). In contrast, quantitative information may be gathered from critical respondents in the form of area (ha), production volume (tons), and export volume (tons) based on the findings of field observations and interviews. The primary responders were criminals from Liquica, Ermera, and Ainaro areas, who came from farming families and numerous agricultural organizations. Table 1 lists the observation variables and associated measurement indicators as follows:

Table 1. Variable measurement indicators

| No | Variable | Indicators |
|----|----------|------------|
|----|----------|------------|

| | | | |
|---|---------------------------------------|--|--|
| 1 | Social Aspects | <ul style="list-style-type: none"> a. Follow farmer groups b. Activeness in participating in farmer group activities c. Participate in community activities d. Number of community groups involved e. Activeness in mutual aid activities | |
| 2 | Economic Aspects | <ul style="list-style-type: none"> a. Productivity of coffee farming business b. Ease of obtaining market information in the form of prevailing coffee prices c. Selling price of coffee d. Transparency in the assessment of the quality of coffee produced (moisture content, defects in beans, etc.) e. Ease of coffee marketing | |
| 3 | Environmental Aspects | <ul style="list-style-type: none"> a. Handling wildlife in the garden b. Carrying out conservation steps and actions by planting various intercropping/shade plants c. Pest control, diseases and weeds in the garden | |
| 4 | Aspects of Labour Use and Decent Work | <ul style="list-style-type: none"> a. Employment b. Labor/Management Relations c. Occupational health and safety d. Training and education e. Diversity and employment opportunities | |
| 5 | Aspects of Society | <ul style="list-style-type: none"> a. Community b. Corruption c. Public policy d. Non-competitive behavior e. Compliance | |
| 6 | Product Responsibility Aspects | <ul style="list-style-type: none"> a. Customer Health and Safety b. Label Installation for Products c. Communication and Marketing d. Personal Flexibility of the Customer e. Compliance | |

2.6 Data Analysis

Primary data was collected based on information from the respondents recorded in daily notes and used as a guide in analyzing primary data. The information obtained in the form of statements is then constructed to interpret each statement from the respondents for the descriptively analyzed characteristics of the respondents. Data related to ecological politics on the sustainability of coffee farming management is analyzed using multiple linear regression and continued with the T-test. The multiple linear regression model used is: $Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6$

Information:

Y = Sustainability of coffee farming business

X1 = Social aspect

X2 = Economic aspect

X3 = Environmental aspects

X4 = Labor aspect

X5 = Aspects of society

X6 = Product responsibility aspect

3. RESULT AND DISCUSSION

3.1 Characteristics of respondents

The following are thorough descriptions of the characteristics of farmer responses in the arabica coffee growing in the Liquica, Ermera, and Ainaro areas, including the age category of farmers, education, agricultural experience, and family dependents:

3.1.1 Age of farmers

One element that may influence the amount of effort and ability—both physically and mentally—or the choices made about the operation of an arabica coffee plantation is the age of the farmers. Table 2 provides information on the age of arabica coffee producers.

Table 2. Age classification of respondent farmers

| Regency | Age (Year) | Totals (People) | Percentage (%) |
|---------|------------|-----------------|----------------|
| Liquica | 41-45 | 4 | 6.67 |
| | 46-50 | 6 | 10.00 |
| | 51-55 | 15 | 25.00 |
| | 56-60 | 17 | 28.33 |
| | 61-65 | 12 | 20.00 |
| | >66 | 6 | 10.00 |

| | | | |
|--------|-------|----|-------|
| Ermera | 45-50 | 20 | 33.33 |
| | 51-55 | 18 | 30.00 |
| | 56-60 | 15 | 25.00 |
| | 61-65 | 6 | 10.00 |
| | >66 | 1 | 1.67 |
| Ainaro | 41-45 | 4 | 6.67 |
| | 46-50 | 16 | 26.67 |
| | 51-55 | 18 | 30.00 |
| | 56-60 | 14 | 23.33 |
| | 61-65 | 8 | 13.33 |

Liquica Regency is a district representing a lowland region with an altitude of 700–900 m above sea level. Table 2 shows that the selected respondent farmers were 60 people with age intervals between 41 and 45 years: many four people with a percentage of 6.67%; those aged 46 to 50 years, as many as six people with a percentage of 10%; those aged 51 to 55 years, as many as 15 people with a percentage of 25%; those aged 56 to 60 years, as many as 17 people with a percentage of 28.33%; the age category of 61 to 65 years, as many as 12 people with a percentage of 20%; and those aged more than 66 years, as many as six people with a percentage of 10%; This shows that arabica coffee farmers in Liquica Regency are aged 56–60 years, namely 28.33%, and only 6.67% have an age range of 41–45 years.

Ermera Regency represents a region at 1400 meters above sea level with a range of respondent farmers' ages. The age category of farmers between the ages of 45 and 50 has the highest number of respondents (20 people, or 33.33%), followed by that of farmers between the ages of 51 and 55, who have 18 people, or 30%. Those between the ages of 56 and 60, who have 15 people, or 25%, and the farmers between the ages of 66 and 70; this demonstrates that Ermera regency's arabica coffee producers are older on average than 45 years old, with just 1.67% being older than 66.

Ainaro Regency is one of the regencies located in the central region. It is at the foot of Mount Ramelau, a mountain with an altitude of 3000 meters above sea level. Ainaro Regency represents a highland area with an altitude of 1600-1800 meters above sea level, with as many as 60 respondent farmers ranging in age from 41 to >66 years, with the highest age range of 51-55 years, namely 18 people or equivalent to 30%, followed by farmers with an age range of 46-50 years,

namely 16 people (26.67%), and for the age category of 56-60 years, as many as 14 people with a percentage of 23.33%. This shows that, in aggregate, the age of farmers involved in the cultivation of arabica coffee is dominated by men, with an age category of more than 51 years.

3.1.2 Education of Respondent Farmers

One of the most important aspects of farm management is education. In general, a person's degree of education may impact their way of thinking and acting while managing a company, boosting business productivity, and raising farmer income. The attitude of the community will be influenced by the educational level of a farmer in a village; the greater a person's education, the higher the quality of his thinking. Table 3 shows the respondents' status according to educational attainment.

According to Table 3, 45 respondents did not attend school in the three districts, or a percentage of 25%; 59 respondents attended elementary school, or a percentage of 32.78%; 55 respondents attended junior high school or a percentage of 30.56%; and 21 respondents who attended high school, or a percentage of 11.67%. Shows that their education level significantly impacts the output and productivity of farmers. This is a result of the parent's lack of desire to take their kids to school and the poor economic status of the country. Low-educated respondent farmers often struggle or lack new knowledge in the world of arabica coffee plantations; in contrast, high-educated respondent farmers rapidly acquire information so they may boost productivity and profit from their crops.

Table 3. Education levels of respondent farmers in three districts

| Regency | Level Education | Total (People) | Percentage (%) |
|---------|--------------------|----------------|----------------|
| Liquica | No School | 24 | 40.00 |
| | Elementary School | 20 | 33.33 |
| | Junior High School | 10 | 16.67 |
| | Senior High School | 6 | 10.00 |
| Ermera | No School | 5 | 8.33 |
| | Elementary School | 15 | 25.00 |
| | Junior High School | 30 | 50.00 |
| Ainaro | Senior High School | 10 | 16.67 |
| | No School | 16 | 26.67 |
| | Elementary School | 24 | 40.00 |
| | Junior High School | 15 | 25.00 |
| | Senior High School | 5 | 8.33 |

Table 4. Respondent's farming experience

| Farming Experience (Years) | Total of Respondents (People) | Percentage (%) |
|----------------------------|-------------------------------|----------------|
|----------------------------|-------------------------------|----------------|

| | | |
|-------|----|-------|
| 0-5 | 10 | 5.56 |
| 5-10 | 30 | 16.67 |
| 10-15 | 40 | 22.22 |
| 15-20 | 60 | 33.33 |
| 20-25 | 20 | 11.11 |
| <25 | 20 | 11.11 |

Table 5. Number of dependents of respondent farmer families in 3 districts

| Family Dependents (People) | Total Respondents (person) | Percentage (%) |
|----------------------------|----------------------------|----------------|
| 2 – 4 | 160 | 88.89 |
| 5 – 8 | 20 | 11.11 |

3.1.3 Farming experience

More than just high expertise or agricultural experience is required for a firm to succeed. Both formal and informal education also calls for understanding. The majority of the farmers who provided feedback are long-time farmers. They assumed their parents had passed on their love of farming to them. According to (Alex & Nitisebito, 2004) [8], the longer a person engages in a particular activity, the more information they will have about the industry to help them make decisions about the technological execution of a firm. The following statement on the respondent's degree of agricultural experience can be found in Table 4.

According to Table 4, the farmers who responded to the survey have a wide range of farming experience, including a modest 0–5 year experience of 5.56%, 5–10 year experience of 30 people (16.67%), 10-15 year experience of 40 people (22.22%), followed by 15-20 year experience with the highest number of 60 people (33.33%), and more than 25-year experiences with 20 people each (11.11%). This shows that most arabica coffee farmers have some experience, while only a few have basic knowledge (5.56%).

3.1.4 Number of family dependents

The respondent farmer has family dependents determined by the number of family members responsible for the head of the family or the farmer himself. Children, wives, and relatives live together in one house, and these family members can serve as labourers. For more details on the number of dependents of the respondent, the farmer family can be seen in Table 5. According to Table 5, farmers with 2-4 family dependents are 88.89% off, while only a few with 5-8 are 11.11% off. Based on these data, it can be concluded that family conditions are relatively few because the more dependents there are, the more family members there are.

3.2 Political ecological analysis of the sustainability of coffee farming

According to the measurement indicators (Table 1), the findings of research carried out in the Democratic Republic of Timor Leste (RDTL) to examine ecological politics and their effect on the sustainability of Arabica coffee farming are discussed. The analysis's findings reveal that the coefficient of determination (R²) is used as a gauge to determine the goodness of fit of the multiple regression equation used. If R² is near 1, the multiple regression equation is considered excellent (fit). The importance of the coefficient of determination, or R², is evaluated using the F-count method. *Pratico, 2009* claims that the determined F-value may be used to assess the suitability of the built model since the probability (sig) of the F-count is 0.000 (0.01), allowing the model to be used to calculate the value of the regression coefficient. Data analysis using SPSS version 24 yielded an R² value of 0.265, which suggests that all independent variables in the equation can account for 26.5% of the sustainability of Arabica coffee cultivation. Other factors not examined in this research may account for the remaining 73.5%. With a sig value of 0.000, the computed F-value for the F test was 11.742. The sustainability of Arabica coffee growing is strongly impacted by all independent factors combined, as shown by the sig value of (1%). There have yet to be any studies conducted that have produced findings comparable to this one employing the six independent factors. *Wollni and Brümmer* employed organic fertilizer factors while *Suwarno, Supriyadi, and Ruspindi, and Poudel* used variables related to coffee plant trimming.

As shown in Table 6, the t-test is used to examine the impact of each free variable on the sustainability of arabica coffee farming:

Table 6. The analysis of ecological and political regression on the sustainability of coffee farming produced its findings

| Variable | Coefficient | Standard | t | Sig. |
|-------------------------------------|-------------|----------|--------|------|
| | Regression | Error | | |
| Constanta | 10.404 | 5.752 | 1.809 | .016 |
| Social Aspects (X1) | .345** | .099 | 3.471 | .001 |
| Economic Aspects (X2) | .407 | .879 | .463 | .644 |
| Environmental Aspects (X3) | -2.999* | 1.298 | -2.311 | .022 |
| Labor Aspects (X4) | .885 | .832 | 1.064 | .289 |
| Aspects of Society (X5) | 4.807** | .783 | 6.142 | .000 |
| Product Responsibility Aspects (X6) | 4.409** | 1.409 | 3.128 | .002 |

Information: The * sign indicates that the environmental aspect variable (X3) has a significant impact on the sustainability of arabica coffee farming (Y) at the level of = 0.05%; the ** sign indicates that the variables of social aspects (X1), community aspects (X5), and product responsibility aspects have a genuine effect on the sustainability of arabica coffee farming (Y) at the level of = 0.01%.

3.2.1. Social aspects

The phrase "social aspect" refers to interactions and human nature between people, farmer groups, and community groups

that coexist in the same communal context. The application of ecological politics in the farming system is consistent with the Timor Leste government's efforts to promote an increase in premium prices through certification of ecologically based coffee, as shown in Table 6 by the very significant influence ($p < 0.01$) of the social aspect on the sustainability of coffee farming in this study. People may create the laws, institutions, and systems they want to live by engaging with one another. Because coffee is one of the primary commodities that has contributed to farmers' incomes by 60–70% and the country's foreign exchange by 45%, this has the effect of increasing the spirit of cooperation and cooperation between individuals or groups to increase each farmer's income and Timor-foreign Leste's exchange [9]. This is possible due to farmers' and families' social sustainability initiatives centred on coffee plantation enterprises that may boost their revenue. Farmers

must take part in the following activities: Take part in farmer groups, farmer group activities, community activities (several community organizations are listed below), and cooperative activities. Table 7 illustrates the contribution of coffee growing in the research area to the area planted and coffee output for (five) years.

Both the sustainability of coffee cultivation as Timor-Leste's industry and the involvement of social groups in agricultural activities vary and are quite dynamic, with contribution values ranging from 73.09% to 77.89% (planting area) and 74.90% to 84.56% (total area) (for production). The social component of stakeholders, particularly social responsibility implementation and reporting, may improve cooperative farmer welfare and loyalty, resulting in higher business productivity [10].

Table 7. Total area of coffee planting and production in 2016–2020

| Regency | Total Acreage (ha) | | | | | Number of tons of production /ha | | | | |
|--------------|--------------------|--------|--------|--------|--------|----------------------------------|--------|-------|--------|--------|
| | 2016 | 2017 | 2018 | 2019 | 2020 | 2016 | 2017 | 2018 | 2019 | 2020 |
| National | 58,745 | 58,805 | 58,895 | 58,898 | 59,216 | 10,468 | 10,448 | 9,966 | 10,609 | 10,448 |
| Liquica | 11,964 | 11,969 | 11,970 | 11,966 | 11,969 | 1,959 | 1,254 | 1,254 | 1,959 | 1,254 |
| Ermera | 32,000 | 32,025 | 32,141 | 32,142 | 32,252 | 4,360 | 5,102 | 5,020 | 4,336 | 5,102 |
| Ainaro | 5,695 | 5,698 | 5,698 | 5,697 | 5,698 | 1,540 | 1,489 | 1,489 | 1,540 | 1,489 |
| Total | 49,659 | 49,692 | 44,111 | 49,805 | 49,919 | 7,859 | 7,845 | 7,763 | 7,835 | 7,845 |
| Contribution | 84.53 | 84.50 | 74.90 | 84.56 | 84.30 | 75.08 | 75.09 | 77.89 | 73.85 | 75.09 |

Table 8. The state of timor-foreign leste's exchange and farmers' take-home pay as a result of coffee output from 2011 to 2019

| No | Years | Number of Farmers | Total Acreage (ha) | Total Production (tons) | Export Amount (tons) | Value (Million Dollars (US\$)) |
|----|------------|-------------------|--------------------|-------------------------|----------------------|--------------------------------|
| 1 | 2012 | 54,317 | 53,844 | 8,461 | 6,636 | 11,917,000 |
| 2 | 2013 | 54,396 | 54,267 | 8,204 | 6,417 | 9,817,000 |
| 3 | 2014 | 54,525 | 54,538 | 8,034 | 8,034 | 9,342,000 |
| 4 | 2015 | 54,666 | 55,082 | 8,019 | 7,157 | 11,919,000 |
| 5 | 2016 | 54,875 | 58,745 | 10,468 | 8,898 | 10,814,000 |
| 6 | 2017 | 55,676 | 58,805 | 10,448 | 9,848 | 12,781,000 |
| 7 | 2018 | 55,755 | 58,921 | 9,966 | 6,543 | 13,771,000 |
| 8 | 2019 | 55,825 | 58,894 | 10,605 | 8,898 | 9,731,000 |
| 9 | 2020 | 55,847 | 59,216 | 10,448 | 7,718 | 12,962,000 |
| | Total | 495,882 | 512,308 | 84,653 | 70,149 | 103,054,000 |
| | Flattening | 55,098 | 56,924 | 9,406 | 7,794 | 11,450,444 |
| | Stdev | 664 | 2,388 | 1,183 | 1,221 | 1,595,016 |

3.2.2. Economic aspects

According to Table 6 above, this study's economic component had no discernible impact ($p > 0.05$). This suggests that initiatives to raise premium prices through the certification of environmentally friendly coffee should be coordinated with initiatives to introduce a financial system in coffee farming. In other words, labelled coffee farming will be a compelling incentive for farmers if they desire premium prices for coffee beans at the farm level to offset a significant increase in production. Farmers' income and foreign exchange are unaffected by economic factors or interconnected production and consuming activities that determine natural resources (the environment). The indicators listed in the table above, namely: Productivity of coffee farming; ease of obtaining market information in the form of current coffee prices; selling price of coffee; and transparency in evaluating the quality of the coffee produced (moisture content, bean defects) as a consideration for the selling price, can be

followed by coffee business actors in Timor-Leste's arabica coffee farming in the three districts that have been designated explicitly as coffee research locations.

Several parts of the economy need to be addressed to improve production, distribution, trade, and consumption capabilities. Economic growth based on environmental exploitation exacerbates social justice. Therefore, enhancing financial aspects must synergize with ecological improvements. An extreme and poorly managed environment will reduce coffee production, and its participation causes farmers' incomes and state foreign exchange to decrease. The contribution of economic aspects to coffee production, farmers' incomes, and foreign exchange can be seen in Table 8.

According to Table 8, the contribution of the arabica coffee plantation subsector to the income of farmers in East Timor who manage coffee crops is still traditional and has not been impacted by technology. This includes the correct application

of farming business, such as upkeep, weeding, fertilizing, pest and disease control, harvesting, and post-harvest, to produce quality and good quality coffee.

3.2.3. Environmental aspects

The environment is a branch of science that examines the interdependence of living things and their surroundings. It involves a variety of physical conditions, including the state of natural resources like soil, water, solar energy, minerals, and flora and fauna that grow on land and in the ocean, as well as institutions that are the result of human creation, such as choices about how to use the physical environment.

Table 6 above shows that environmental aspects have a significant effect ($p < \alpha 0.05$) on the sustainability of coffee farming in this study, indicating that the macro environment supports the coffee growth and production process. Research on the relationship between ecological aspects of protective trees and coffee production in the state of Chiapas-Mexico found that coffee cultivars, plant age, species enrichment, protective tree populations, and land slope showed an insignificant influence on coffee production. Meanwhile, removing protective tree canopies above 50% can reduce coffee production [11]. The term "environment" may also refer to everything that surrounds people and impacts how they live their lives. All living creatures, including people, animals, plants, fungi, and other living things, are included in the biotic component of the living environment. The ground, water, fire, stone, air, and other inanimate materials are examples of abiotic components that are helpful for the survival of living beings in an environment. Both natural occurrences and human ignorance do damage to the atmosphere. Humans sometimes need to be reminded of the value of a healthy living environment since neglecting it may harm the ecosystem and life.

Several things harm the ecosystem, including the following: a) Natural factors, or natural phenomena, are biological activities, such as natural catastrophes and rough weather, that occur without human involvement. These physical activities are the sources of environmental degradation. b) Artificial aspects such as human behavior will continue to advance from a primitive way of existence to contemporary life as we evolve into intelligent beings with great capacities compared to other species. Their requirements will also dramatically change as life progresses, including the need for excessive exploitation of natural resources.

Analysis of environmental factors identifies direct and indirect positive and negative influences. Finding remedies and mitigating the effects of these environmental factors are other goals of ecological research. Environmental impacts include physical, chemical, biological, and social changes to an environment from its initial state. Ecological changes will harm the current order for people, animals, and plants if they are not foreseen. To increase welfare via growth in all spheres, emerging nations must pay more attention to the issue of sustaining environmental sustainability. Ecological sustainability in this context refers to a dynamic ecosystem that can yet maintain a better level of life, which means that the surrounding environment's carrying capacity can effectively absorb the effects of development. All environmental changes are the result of activities, both good and bad, that have an impact on growth. Therefore, all decisions must be made with an ecological perspective, maximizing sound effects and reducing negative ones.

3.2.4. Labor aspects

According to Table 6 above, there is no discernible impact of labor on the sustainability of Arabica coffee farming. Each person works as part of the workforce to earn daily, monthly, and yearly salaries. Because it is challenging to assess labor when considering coffee is a yearly plant, the labor element has little impact. As a result, it simply needs to invest little labor. In this situation, farmers only need to look for a small amount of outside employment. Getting their family involved in coffee cultivation would suffice [12]. The government develops policies and workforce plans that address two aspects of workforce development: Planning for both the macro and micro workforces is step one. The government must be guided by workforce planning as described in the workforce planning document and prepared based on workforce information, including, among others: Population and workforce; employment Opportunities; job Training, including Job Competence; labor Productivity; industrial Relations; environmental Conditions; and g). Labor Wages and Benefits [13].

It is mandatory to improve the workforce's ability through the following training. Job training is organized and directed to equip, improve, and develop work competencies to increase capabilities, productivity, and welfare. Every workforce has the right to obtain, improve, and develop work competencies through their talents, interests and abilities through job training; job training for workers with disabilities is carried out by considering the type, degree of disability, and ability of the workers with disabilities concerned; job training can be organized with an apprenticeship system; organizing job training can be carried out by the government or the private sector, or in collaboration with one another; and training institutions held by the private sector can be in the form of legal entities or individuals; however, in conducting them, they must obtain a permit and register with the agency responsible for workforce affairs.

3.2.5. Aspects of society

The analysis's findings in Table 6 above demonstrate how community involvement in coffee growing operations significantly impacts the industry's sustainability. As the central Arabica coffee-producing regions in the State of Timor Leste, the districts of Liquica, Ermera, and Ainaro, community access to agricultural operations, notably coffee planting, is sensitive. As a result, coffee farming operations are accessible in the general community. Because each family member may participate in coffee farming that has been practised for a long time and is still practised now, family involvement in coffee farming is rather significant. In addition, family engagement in coffee farming is an attempt to lower production costs. The general population sees coffee cultivation as a lucrative economic opportunity that will help the region raise the quality of its coffee. It is anticipated that encouraging producers would enable the neighbourhood to produce high-quality coffee. So far, on average, residents in the districts of Liquica, Ermera, and Ainaro have successfully sold their coffee both locally and abroad (exports).

3.2.6. Products of responsibility aspects

According to the analysis's findings in Table 6 above, cultivation of Arabica coffee in the Liquica, Ermera, and Ainaro areas is severely impacted by the issue of product

responsibility. Given that the generated coffee goods are export commodities, this is understandable (penetrating foreign markets). Customer health and safety, product labelling, communication and marketing, customer privacy, and compliance are some measurement indicators for product responsibility. Because coffee may be marketed in various forms, from freshly harvested coffee to dry-processed coffee, maintaining product quality will have a twofold impact, raising both the selling price of the product and public interest in coffee cultivation. Or wet. Coffee harvests enable farmers to provide for their families. Therefore, in the future, the community and the government may assess the development of community coffee cultivation and continue to support it via economic dimensions and aspects.

4. CONCLUSION

From the description of the results of the above research can be concluded as follows:

- 1) Given that the age of farmers is dominated by the age group between 51 and 56 years (30%) and that formal education is still relatively low at only elementary school by 40%, the ecological politics towards the sustainability of coffee farming in Liquica, Ermera, and Ainaro districts still require improvement.
- 2) The ecological and political study of coffee farming's sustainability findings shows that social, community, and product responsibility factors have a significant impact (p 0.01), and environmental factors have a considerable impact (p 0.05). The impact on the labor market and the economy is negligible.

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